FIFTEEN-YEAR SURVIVAL OF ROOT CANAL TREATED TEETH IN ENGLAND AND WALES

by

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Abstract

Title

Fifteen-year Survival of Root Canal treated Teeth in England and Wales

Objective

Investigate the fifteen-year survival curve for root treated teeth in adult patients treated within the National Health Service General Dental Services (NHS GDS) in England and Wales by General Dental Practitioners (GDPs).

Methods

The data source was the age-stratified random sample of NHS GDS patients and the treatments they received over the period from 1990 to 2006 (SN7024 from https://ukdataservice.ac.uk). The survival was measured to reintervention which was categorised as re-root canal treatment, root-end surgery (apicectomy) or extraction after root canal treatment (RCT). Analysis was carried out using modified Kaplan-Meier methodology to establish survival curves extending to fifteen years and investigation of factors that can affect survival.

Results

The 15 years survival of root canal treated teeth by GDPs was 77% based on reintervention for 791,375 RCT teeth from over 2.5 million patients, whilst based on extraction the 15-year survival was 83%. The investigation of factors that affect survival were carried out and indicated that there were some dentist, patient and tooth

factors of significance. The dentists in their 30s had the best survival outcome whilst the opposite was evident for dentists aged 60 and above, also dentists working in South Central England had markedly better results than those in Wales. The age of the patient and the full charge paying status of the patient were also significant factors.

The tooth factors investigated revealed better survival among posterior teeth, lower teeth, and those restored after RCT with a crown, bridge abutment and pin/screw. A previous history of RCT, post, crown and bridge abutment decreased the survival of the RCT teeth. Occlusal restorations also decreased the survival both before and after RCT.

Conclusion

The 15 years survival of root canal treated teeth carried out on 791,375 teeth by GDPs in England and Wales was 77% based on reintervention and 83% based on extraction. These findings are encouraging and appear to support the provision of RCT by GDPs working in the NHS GDS to save teeth. Two dentist factors, two patient factors plus tooth factors including the tooth position and nine types of restorations were found to be significant.

Dedications

I would like to dedicate this work to my family and all my teachers (past and present) who have inspired me to believe I can make a difference.

I am grateful to my husband Omid whose endless love and support over these years, made my dream become a reality.

My Ariana and Ryan, who allowed me not be mummy when I was ‘working on my PhD’.

My mum Pari and brother Michael Mehrdad, who stepped up, and Linda who made me truly believe that I can get it over the finish line.

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Their belief, patience and vision in this project from its infancy in 2014, has been extraordinary and I am forever grateful for their insight. I have learned so much from them, which I hope to pass on to my students.

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List of Abbreviations

3D	Three-dimensional
AAE	American Association of Endodontists
ADHS	Adult Dental Health Survey
AOHS	Adult Oral Health Survey
BDA	British Dental Association
CBCT	Cone Beam Computed Tomography
COS	Core Outcome Sets
DO	Distal Occlusal
DoH	Department of Health
DPB	Dental Practice Board
ESE	European Society of Endodontology
GDPs	General Dental Practitioners
GDS	General Dental Services
KM	Kaplan-Meier
IBM	International Business Machines Corporation
MO	Mesial Occlusal
MOD	Mesial Occlusal Distal
NHS	National Health Service
NHSBSA	National Health Service Business Services Authority
OH	Oral Hygiene
PAI	Periapical Index
PCT	Percent
PG	Postgraduate
PROM	Patient Related Outcome Measures
RCF	Root canal filling
RCT	Root canal treatment
ReRCT	Re-Root Canal Treatment
RF	Root Filled
RES	Root End Surgery or apicectomy
RoB2	Risk of Bias 2
ROBINS-I	Risk of Bias in Non-Randomised Studies – of Interventions
SPSS	Statistical Package for Social Sciences
UDA	Unit of Dental Activity
UG	Undergraduate
UK	United Kingdom
USA	United States of America
vs	Versus
WHO	World Health Organisation
XLA	Extraction

Chapter 1 Literature Review

1.1 Introduction

1.1.1 Tooth Loss

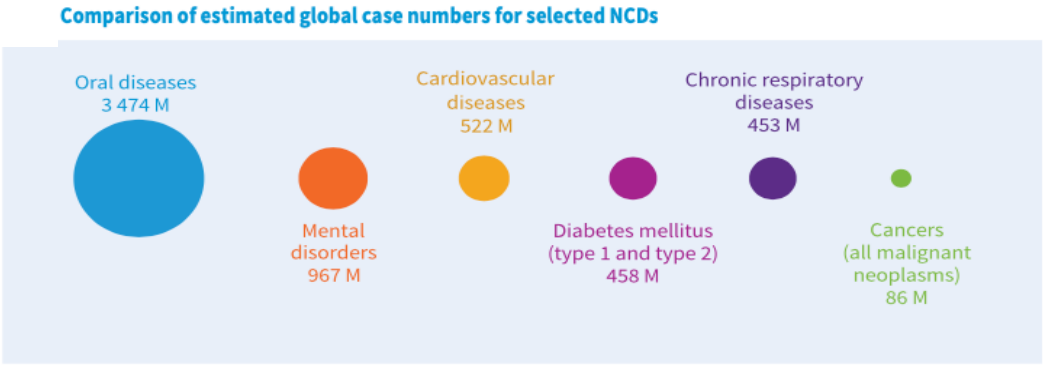
Tooth loss can be due to dental caries and its sequelae as well as periodontal disease and dental trauma. It is widely accepted that untreated dental caries can lead to pain, infection and tooth loss (WHO, 2016). Loss of teeth can be psychologically traumatic, socially damaging and functionally limiting for patients. Teeth are important for well-being, and root canal treatment can help retain teeth so that patients can continue to smile, talk and eat, while with proper care, most root canal treated teeth can last a lifetime (ESE, 2024).

1.1.2 Epidemiology

The World Health Organisation (WHO) reports that oral diseases are the most common of the non-communicable diseases and affect people throughout their lifetime, causing pain, discomfort, disfigurement and unfortunately even death. They

report that the most prevalent condition is dental caries in permanent teeth, affecting half of the world's population (WHO, 2016). They report that the oral health conditions which are preventable and treatable in their early stages, are dental caries, periodontal disease, tooth loss and oral cancers. The provision of root canal treatment (RCT) can be considered necessary in prevention of tooth loss due to caries and subsequent pain, considered the most common cause of tooth loss (Duncan *et al*., 2023).

Furthermore, the WHO Global Oral Health Status Report (2022) estimated that oral diseases are the most widespread conditions among more than 300 diseases and conditions that affect humanity, affecting close to 3.5 billion people (Figure 1) worldwide with 3 out of 4 people affected who live in middle-income countries. Dental caries of permanent teeth is estimated to affect 2 billion people globally and 514 million children suffer from caries of primary teeth (WHO, 2022).



Note. Data are for all ages and both sexes from GBD 2019; oral diseases do not include lip and oral cavity cancer *(4)*. A standard method has been applied to incorporate the latest UN population estimates.

Figure 1 Estimated global case numbers of non-communicable diseases (WHO, 2022)

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Unfortunately, oral diseases continue to be ranked first as the most prevalent disease around the world irrespective of the country income level and are reported to be increasing around the world, as shown in figure 2. The multi-factorial process involved in this increase has complex components, but some are simple, such as poor access to fluoride and oral health care services in the community (WHO, 2022).

Ranking of most prevalent conditions per WB country income level

Higher rank — Lower rank

	Global	World Bank low income	World Bank lower-middle income	World Bank upper-middle income	World Bank high income
Oral diseases	1	1	1	1	1
Neurological disorders	2	5	2	3	2
Digestive diseases	3	7	4	2	6
Respiratory infections & TB	4	4	3	4	9
Skin diseases	5	3	5	6	5
Sense organ diseases	6	9	8	5	7
Musculoskeletal disorders	7	11	9	7	3
NTDs & malaria	8	2	7	12	19
HIV/AIDS & STIs	9	8	10	8	10
Nutritional deficiencies	10	6	6	13	15
Unintentional injury	11	13	13	9	4
Diabetes & CKD	12	14	12	10	8
Mental disorders	13	10	11	11	11
Cardiovascular diseases	14	16	14	14	13
Neoplasms	15	17	18	15	12
Chronic respiratory	16	15	15	17	14
Self-harm & violence	17	12	17	16	18
Transport injuries	18	19	16	18	17
Substance use	19	22	22	19	16
Maternal & neonatal	20	18	19	20	20
Enteric infections	21	21	21	21	21
Other infectious	22	20	20	22	22

Note. Data are for all ages and both sexes from GBD 2019 *(4)*.

Figure 2 Ranking of most prevalent conditions based on world bank income level (WHO, 2022) Permission from https://creativecommons.org/licenses/by-nc-sa/4.0/deed.enCC BY-NC-SA 4.0 DEED Attribution-NonCommercial-ShareAlike 4.0 International

The elderly have been reported as needing more interventions on their restorations, possibly due to multi-factorial issues such as change in diet, reduced salivary flow (due to systemic health and /or medication) as well as poor Oral Hygiene (OH) measures due to manual dexterity hinderances and failing restorations, including tooth fractures (Burke *et al*., 2005a).

The WHO report that half of the adult population have at least one tooth that has suffered from root canal infection, which signifies a hidden burden of the endodontic disease in society (Dawson *et al.,* 2017, 2021; Fransson & Dawson, 2023). This highlights the need for provision of root canal treatment by general dental practitioners (GDPs) and those in community services around the world.

1.1.3 Adult Dental and Oral Health Surveys

The UK carries out a regular survey to investigate the dental health status of the nation. In England the most recent was the Adult Oral Health Survey of 2021 (AOHS, 2024): this encountered challenges as it was carried out without face-to-face examination due to the pandemic and was based on patients' self-reporting. The results indicated that 31% reported needing treatment or advice due to toothache or mouth pain (AOHS, 2024). Previous surveys highlighted that people are living longer, retaining their teeth into their older years, and with an increase in tooth wear, where moderate tooth wear has increased from 11 per cent in 1998 to 15 per cent in 2009, although severe wear remains rare, while the reporting of pain and discomfort

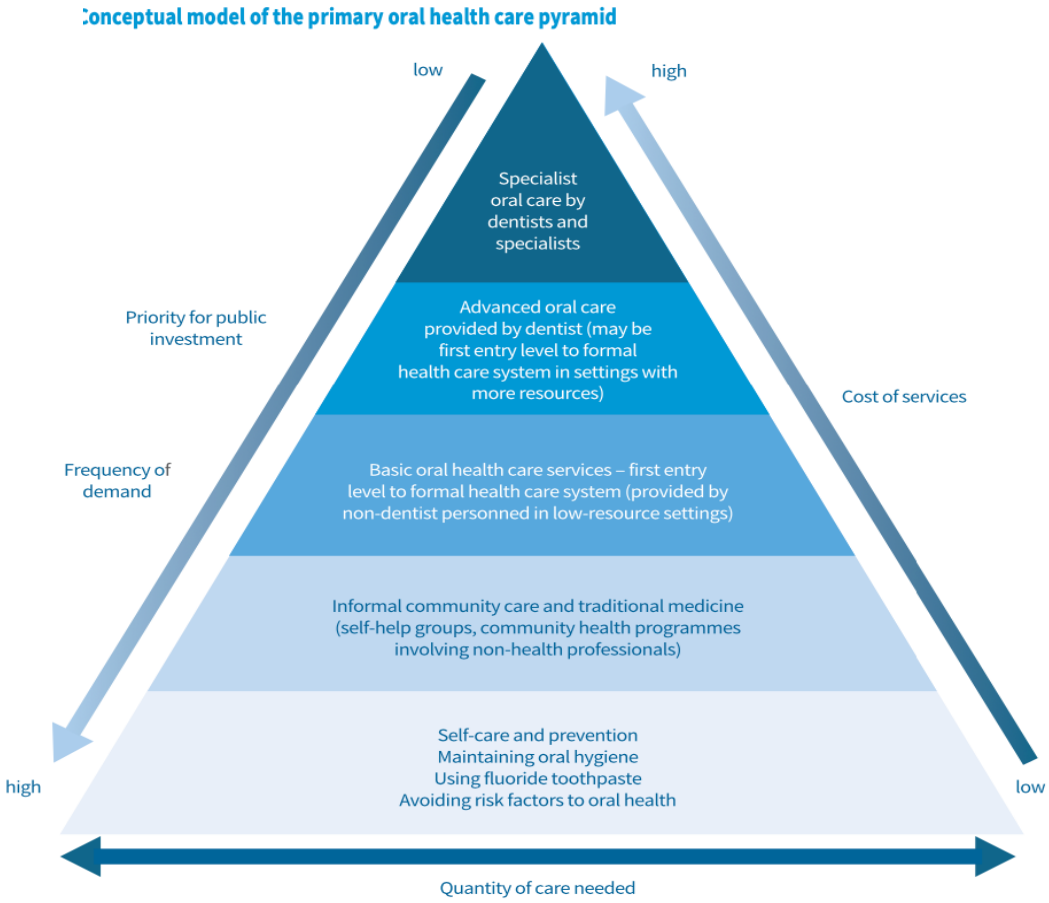
indicates a concern for the population (ADHS, 2011; Murray, 2011). In that regard, it has been reported that pain and discomfort from teeth can lead to days off work, which can affect the national workforce. Furthermore, pain from dental causes has been investigated, finding that 9%-27% absence from work may be due to dental pain with 28%-50% due to toothache and temporomandibular joint pain. (Lima & Buarque, 2019).

The prevalence of root canal treatment worldwide shows that more than half of patients have had at least one RCT tooth, thereby reporting RCT as a common procedure (León-López *et al*., 2022). Specialists in Endodontics and those with further training working in practices limited to Endodontics provide secondary and tertiary care, including emergency hospital clinics often for treatment of more complex cases. Endodontic treatment has often been associated with emergency care and relief of pain, most often within the provision of services in primary dental care provided by the GDPs.

1.2 Primary Oral Health Care

Primary oral health care remains the cornerstone of public services in most countries. In the UK this is provided by the National Health Service (NHS). The principle of the pyramid in the diagram in Figure 3 is based on the notion that need and demand are highest at the lower levels and decrease at the higher levels of provision of oral care. The cost of services shows an inverse relation: the most expensive care is provided

at the top of the pyramid and the least expensive towards the bottom. Priority for public investment thus should focus on aspects that have higher needs and demand and lower costs (WHO, 2022).



Source. Adapted from The challenge of oral disease – a call for global action. Geneva: FDI World Dental Federation, 2015 *(211)*.

Figure 3 Conceptual model of the primary oral health care pyramid (WHO, 2022)

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1.2.1 National Health Service

The NHS General Dental Services (GDS) has been able to offer primary care dentistry for the population since 1948 (Brockelhurst *et al.*, 2016). The NHS also provides secondary and tertiary care via community and hospital services. The NHS GDS services in the UK have been divided into each devolved nation and, over the years, differences have evolved between the services in the four nations. The GDS has had three major developments since 1948, initially there was introduction of charges in 1951, followed by a revision of contract between dentists and Department of Health in 1990 with greater emphasis on continuing care and prevention, then in 2006 the new GDS contract between dentists and Primary Care Trusts was launched in response to the problems facing dentistry which included access to care, minimise over treatment, and simplify the system for patients (https://publications.parliament.uk/pa/cm200708/cmselect/cmhealth/289/28905.htm).

From 1948 to 2006 the Dental Practice Board (DPB) in Eastbourne, oversaw the administration of NHS general dental services for England and Wales, including renumeration of dentists on a fee per item basis, and for probity purposes, a small proportion of patients were examined annually by dentists from the Reference Dental Officer service. In the UK, no recent figures are readily available: however, £50.5 million was spent in the NHS GDS in England and Wales in 2004 for RCT, the stakeholders include patients, third-party funders, governments, clinicians, managers of dental services, taxpayers, as well as educators in RCT (Lumley *et al*., 2008).

1.2.2 Dental Practice Board 15-year Database

The data from 25 million courses of treatment in the NHS GDS, carried out by GDPs on 25 million adult patients, is available from the UKDataService.ac.uk, study number 7024, whereby the data are anonymised (Lucarotti & Burke, 2009, 2018a). The data source was the age-stratified random sample of GDS patients and the treatments they received over a 15-year period, from 1/10/1990 to 31/3/2006, when this system of remuneration ceased. Landmark studies by Burke & Lucarotti whom have published on this database regarding longevity of restorations in the NHS GDS for many years, were recently published in an extensive ten-part series of papers in 2018 in the *British Dental Journal,* (Burke & Lucarotti, 2018a-e; Lucarotti & Burke, 2018a-e).

1.3 Root Canal Treatment

1.3.1 Definition

Root canal treatment (RCT) is described by the American Association of Endodontists (AAE) for patients as *a dental procedure to remove inflamed or infected pulp on the inside of the tooth, which is then carefully cleaned and disinfected, then filled and sealed. Root canal treatment is designed to eliminate bacteria from the infected root canal, prevent reinfection of the tooth and save the natural tooth. Saving the natural tooth with root canal treatment has many advantages:*

- *Efficient chewing*
- *Normal biting force and sensation*
- *Natural appearance*
- *Protects other teeth from excessive wear or strain.*

(AAE, 2023).

Others define RCT as the management of pulpal or periapical infected wounds through the application of age-old surgical principles of wound management, debridement and dressing (obturation) to allow healing (Gulabivala & Ng, 2023).

Apical periodontitis is a highly prevalent dental disease among the adult population in most countries (Kirkevang, 2023). The treatment of choice for apical periodontitis is RCT, which aims at eliminating infection and pain in order to create an environment favourable for healing (ESE, 2023).

1.3.2 Tooth Mortality

The role of RCT is ultimately to save teeth once there has been a breach in the health of the pulp and peri-radicular tissues with ingress of micro-organisms, mainly bacteria, and their by-products into the complex root canal system. The latter can cause a range of presentations for patients from no symptoms to mild symptoms such as discomfort, to more severe acute pain and swelling. In rare occasions, it can be life threatening if the infection spreads to the airway spaces, potentially causing obstruction and patient is unable to breathe. The value of saving a tooth has been reported by the WHO and the AAE “save a tooth” campaign in recent times. The provision of RCT treatment is fundamental as a last step in saving a tooth and preventing its extraction (Lumley *et al*., 2008).

1.4 Outcome of Root Canal Treatment

Over the decades, despite advances in technology for the provision of RCT, it appears that there has not been a dramatic change in the success of RCT over time (Gulabivala & Ng, 2023). In that regard, there is an interplay of technical and biological elements, and it has been considered that this interplay can be hindered by operators focusing on the technical aspects, thereby losing sight of the biology (Noyes, 1922; Naidorf, 1972): this appears true to this day (Gulabivala & Ng, 2023), even with attempts by academics to change it (Bergenholtz & Spanberg, 2004; Naidorf, 1972; Noyes, 1922).

One of the large differences in success rates in root canal treatment has been reported to be a difference of success rates between those that delivering the care (Gulabivala & Ng, 2023; Smith *et al.,* 2024a, 2024b). The literature has reported (Ng *et al*., 2007) that GDPs are less skilled than specialists and therefore may provide a poorer outcome, even though most of the treatment is carried out by GDPs. Other factors specific to the pathology, treatment steps, and post-RCT restorations have been investigated, identifying common factors from various studies, including presence of a periapical lesion, size of the lesion, standard of the root canal filling (RCF), restorations placed in root canal filled tooth, and possible surrogate measures for remaining tooth structure (Gulabivala, 2018; Gulabivala & Ng, 2019; Tibúrcio-Machado *et al.,* 2021).

Unfortunately, in society there remains an element of doubt regarding the evidence for validity and predictability of RCT (Meinig, 1996; “Root cause” documentary film, 2019). Nevertheless, the highest levels of data and evidence can be utilised to recommend best practice (Sanz *et al*., 2021; Schölmerich, 2000). Population based summary

outcome data can be utilised for the GDP (Chambers, 2001) and, at the same time, evidence can aid the development of expertise, with the goal of providing a predictable outcome (Ericsson, 2009; Ericsson *et al*., 2018).

The modality of success of RCT has been debated on many occasions, whilst definition of success has varied among authors. Recent publications no longer use the term 'success' but prefer the terminology of 'outcome of treatment'. Whereby treatment results in complete clinical healing, publications consider it a success, as accepted by a strict criterion, while others define success by a less strict criteria, whereby a tooth may not have complete clinical healing and instead just remained in the mouth (Ng *et al.,* 2011a; Fransson *et al.,* 2016).

Complete clinical success has been suggested to be teeth that, after treatment, are asymptomatic and demonstrate complete healing on an image, e.g. radiograph or cone beam computed tomography (CBCT). Comparisons to other treatment options, including extraction and replacement with an implant, has prompted the question of 'survival' for RCT teeth, so that comparisons can be made between the two options. The research on survival of RCT has had new focus in the Endodontic discipline in the past two decades due to the successful establishment of single implants as an alternative (Alberktsson & Wennerberg, 2005; Fransson *et al*., 2021). More recently, several publications from around the world reported survival of root canal filled teeth in their country, based on either an insurance database or a government health care system (Caplan *et al*., 2002; Lazarski *et al*., 2001; Lumley *et al*., 2008; Salehrabi & Rotstein, 2004; Stoll *et al*., 2005). There are numerous stakeholders involved in provision of root canal treatment, including insurance companies and governments.

The findings of these types of studies should aid understanding of the ultimate objective, the provision of optimum patient care. (Friedman & Mor, 2004; Raedel *et al.,* 2016; Salehrabi & Rotstein, 2004).

1.4.1 Prospective and Retrospective Studies

Prospective studies are limited in number and may also have small patient numbers: they may also be clinical studies associated with examining outcome of clinical intervention/s. (de Chevigny *et al*., 2008; Farzana *et al*., 2010; Makanjuola *et al*., 2018; Oginni & Udoye, 2004; Oliet, 1983; Ørstavik *et al*., 1987; Prashanth *et al*., 2011; Ricucci *et al*., 2011; Salas *et al*., 2020; Sigurdsson *et al*., 2016; Strindberg, 1956; Wong, 2016). They can range from examining a few factors and how those affect outcome to those that try to examine many including patient and tooth specific factors (Farzana *et al*., 2010; Ng *et al*., 2011a, 2011b; Pirani *et al.,* 2018; Ricucci *et al*., 2011; Sigurdsson *et al*., 2016; Vieira *et al.,* 2024).

The studies that investigate larger patient numbers often utilise retrospective cohorts from dental hospital / schools to public sector clinics and, on rare occasions, high street dental practices (Barbakow *et al*., 1980; Grahnen, 1961; Heling & Tamshe, 1970; Heling & Kischinovsky, 1979; Hoskinson *et al*., 2002; Jokinen *et al*., 1978; Nelson, 1982; Peak, 1994; Peak *et al.,* 2001; Pirani, 2018; Sjögren *et al*., 1990; Smith *et al*., 1993; Smith *et al.,* 2024b).

1.4.2 Follow up Period

A range of follow up times have been reported in the literature, with the majority examining 2 to 10 years follow up (Alley *et al*., 2004; Aquilino & Caplan, 2002; Lazarski *et al*., 2001; Lee *et al*., 2012; Lynch *et al*., 2004). Due to the ESE guidelines recommending 4-year follow ups, some studies do not investigate beyond that. It is commonly accepted that most periapical lesions heal in the first 12 months (Azim *et al*., 2015; ESE, 2006; Ng *et al*., 2011a, 2011b), while some take up to 4 years (Strindberg, 1956), and others have investigated cases up to 10 years and reported healing that, in some cases takes longer than 4 years (Halse & Molven, 2004). More recently a group has reported on follow up period of 40 years (Frankenberger *et al.,* 2024) and another reported most failures occurred in the first two years (Mota de Almeida *et al.,* 2023).

1.4.3 Success and Failure Studies

The success of root canal treatment has been reported to be anything from 30% to 98% (Friedman 2002; Friedman *et al.,* 2003; Friedman & Mor, 2004). Reported success is often associated with the clinical success whereby there is no longer any evidence of disease and healing has occurred (Sjögren *et al*., 1991). Authors have often alluded to various parameters as their measuring criteria (Friedman & Mor, 2004; Gutmann, 1992; Ng *et al*., 2007). Comparison of success in studies has proved to be challenging due to the heterogenicity of criteria used in the literature. Simply put, the

definition of success varies, and over the last few decades with more publications highlighting this aspect, there has been a general move towards understanding various criteria for success (Table 1) which a publication has used (Friedman & Mor, 2004; Gulabivala & Ng, 2023).

Criteria for determination of periapical status.

Strindberg (1956)	**Bender et al. (1966a, 1966b)**	**Friedman and Mor (2004)**
Success: *Clinical*: No symptoms *Radiographic*: The contours, width and structure of the periodontal margin were normal, or The periodontal contours were widened mainly around the excess filling.	Success: *Clinical*: Absence of pain/swelling Disappearance of fistula No loss of function No evidence of tissue destruction *Radiographic*: An eliminated or arrested area of rarefaction after a post-treatment interval of 6 months to 2 years	Healed: *Clinical*: Normal presentation *Radiographic*: Normal presentation
Failure: *Clinical*: Presence of symptoms *Radiographic*: A decrease in the periradicular rarefaction, or Unchanged periradicular rarefaction, or An appearance of new rarefaction or an increase in the initial rarefaction.		Diseased: Radiolucency has emerged or persisted without change, even when the clinical presentation is normal, or Clinical signs or symptoms are present, even if the radiographic presentation is normal.
Uncertain: *Radiographic*: There were ambiguous or technically unsatisfactory control radiographs which could not for some reason be repeated; or The tooth was extracted prior to the 3-year follow-up owing to the unsuccessful treatment of another root of the tooth.		Healing: *Clinical*: Normal presentation *Radiographic*: Reduced radiolucency.

Table 1 Criteria for determination of periapical status (Gulabivala & Ng, 2023)

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There has been a range of different clinical protocols, recall rates and observation periods as well as the definition of success itself (Salehrabi & Rotstein, 2004). Success was considered ‘healed’ with the historic work of Strindberg (1956), while Bender *et al*. (1966a, 1966b) defined ‘healing’ cases as success in their research. Friedman and

Mor (2004) suggested the use of the terms; ‘healed, healing and disease’ to avoid confusion for patients. It is considered that the term ‘strict criteria’, as used by Ng *et al.* (2007), had the highest standard of clinical outcome. “Loose criteria” associated with that publication includes cases which may be healing as opposed to those fully healed. In that regard, the rate of healing has been considered variable, and larger lesions have been reported to show faster healing (Esfahani, 2016).

Clinical success relies on a review of the patient, checking of signs and symptoms and employing imaging techniques to check for healing. The older studies utilised radiographs (Ng *et al*., 2011a, 2011b; Saunders *et al*., 1997; Sjögren *et al*., 1991) and some new novel studies have exposed patients to follow up three-dimensional (3D) imaging with cone beam computed tomography (CBCT) images to check for healing (Fernández *et al*., 2017; Liang *et al*., 2011). Standardisation of radiographic interpretation has been introduced with the periapical index (PAI) (Ørstavik, 1966; Ørstavik & Horsted-Bindslev, 1993) but proved challenging with multi-rooted teeth (Huumonen *et al*., 2003). CBCT improves sensitivity and addresses the challenge of multi-rooted teeth (de Paula-Silva *et al*., 2009; Kanagasingam *et al*., 2017; Patel *et al*., 2009; Petersson *et al*., 2012; Sogur *et al*., 2009; Stavropoulos & Wenzel, 2007).

The ESE guidelines (2006) have described success as absence of pain, swelling, other symptoms and sinus tract, as well as radiographic evidence of normal periodontal ligament (PDL) space around the root.

1.4.4 Functional Retention

The term functional retention was coined by Friedman & Mor (2004), as they felt the term success was misleading for patients when comparing RCT to implants. They stated that the endodontic outcome can be defined as tooth retention, more favourably functional retention, where clinical presentation is normal with or without a radiolucency which may be new or persisting. They were attempting to bring endodontic outcome in line to be easily compared to dental implants, as they have been considered the alternative best option to RCT for most patients (Friedman & Mor, 2004; White *et al.,* 2007). They then investigated survival of RCT as part of the Toronto series of studies (de Chevigny *et al*., 2008a, 2008b; Farzaneh *et al*., 2004a, 2004b; Marquis *et al*., 2006) and reported that functional retention was 95% for 132 teeth in a 4 to 6 year follow up period, compared to ten percent less, at 85% when defined by healing (Marquis *et al*., 2006).

1.4.5 Outcome Studies

There are various levels of evidence available as been shown by the pyramid hierarchy of evidence (Figure 4) by Gulabivala and Ng (2023). The new methodologies developed such as Risk of Bias 2 (RoB2) and Risk of Bias in Non-Randomised Studies – of Interventions (ROBINS-I) and Newcastle Ottawa Scale for observational studies, allow grading of evidence when making recommendations in clinical guidelines (http://www.ohri.ca/programs/clinical_epidemiology/ oxford.sp).

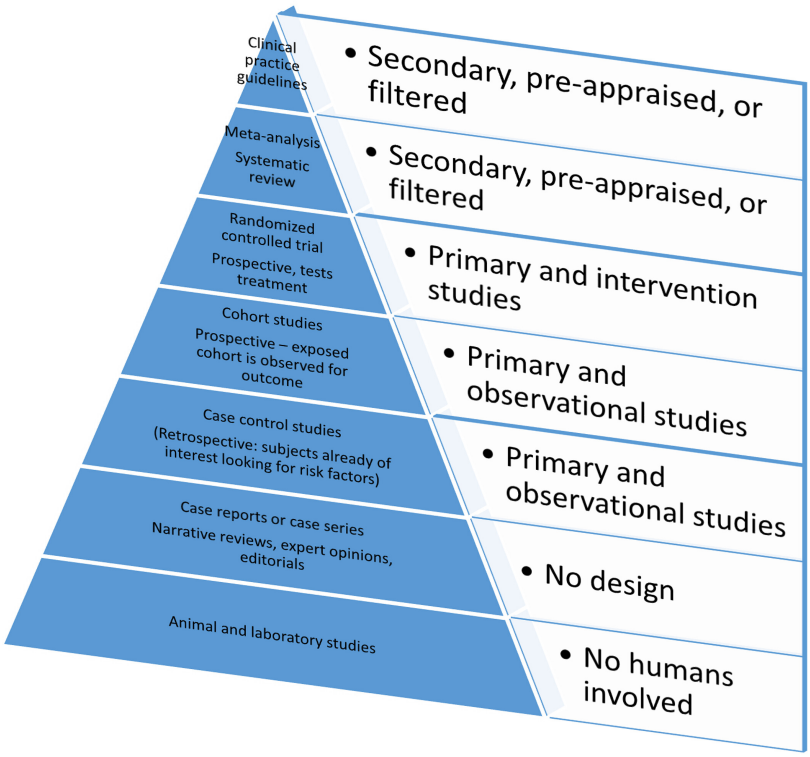

Figure 4 The pyramid hierarchy of evidence (Gulabivala & Ng, 2023)

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The term ‘outcome’ has become a commonly accepted terminology for discussion of the resultant outcome of RCT as it can encompass various outcome measures, most commonly clinical outcomes, but it can also include patient related outcome measures (PROM), survival of the tooth and other related outcome factors. PROM of ‘tooth survival’ has been reported to be the ‘most critical measure’ in the recent development of S3-level clinical practice guidelines by the ESE (Duncan *et al*., 2021). Patients appear to wish for resolution of their symptoms (Bender *et al*., 1966a, 1966b), maintaining a tooth for function (Friedman & Mor, 2004) and improved quality of life (Dugas *et al*., 2002). The latter investigation has reported that 97% of patients reported

improved quality of life and satisfaction with their decision to opt for RCT and not have an extraction (Dugas *et al*., 2002).

Clinical outcome often investigates the prognostic factors and assesses resolution of the clinical signs and symptoms of endodontic disease using clinical examination and imaging (Ng *et al*., 2007). The stakeholders such as health care system providers or insurance companies, are interested in a favourable outcome, namely survival of teeth, and treatment to make sure their financial investment has been worthwhile and successful (Cheung *et al*., 2002; Cheung & Chang, 2003; Lazarski *et al*., 2001; Lumley *et al*., 2008; Salehrabi & Rotstein, 2004; Tickle *et al*., 2008). Whilst core outcome sets (COS) enhance the relevance of research by ensuring it is measured routinely (Kirkham *et al.,* 2016) in endodontics the final COS common to all endodontic modalities have been identified by the academic community and include tooth survival as one (El Karim *et al.,* 2021, 2024)

1.4.6 Survival of Root Canal Treatment

Survival studies for outcome of root canal treatment (Table 2) are lower in the hierarchy of evidence than prospective clinical studies. However, it is important to understand the value and role of these studies within the endodontic outcome literature. Most patients are interested in how long a given tooth can survive, as reported by lack of PROM (Duncan *et al*., 2021) and survival studies can address these queries. Other stakeholders have been represented by bodies which provide funding for dental care;

for example a government body for the provision of national care, an insurance company in private health care sector, a dental school teaching root canal treatment to undergraduates also providing care to the hospital patients, or a national dental registry body that may be controlling the syllabus of what to teach in the dental schools it regulates (e.g. General Dental Council – the GDC in the UK). Table 2 by Fransson & Dawson (2023), is based on the original from twelve years earlier by Ng *et al*. (2010) showing a range of 82-95% chance of tooth survival with a range of 4 year follow up to 10 years after RCT.

Data on tooth survival (no extraction) after root canal treatment from a systematic review (Ng et al., 2010) and a selection of studies published thereafter

	Individuals and/or teeth/ treatments (*n*)	**Source of data**	**Follow-up (years)**	**Tooth survival (%)**
Ng et al., 2010		Systematic review	2–10	86–93
Ng et al., 2011b	572 individuals, 759 teeth and 642 individuals, 858 teeth	Selected population. Prospective. Primary RCT and retreatments performed by endodontic postgraduate students, UK	4	95
Lin et al., 2014	517 234 teeth	Nationwide population based, Taiwan	3	94
Landys Borén et al., 2015	330 individuals, 420 teeth	Sample from referrals to endodontic specialist clinic, Sweden	10	82
Raedel et al., 2015b	556 067 treatments	Insurance company, registry, Germany	3	89
Fransson et al., 2016	217 047 individuals, 248 299 teeth	Nationwide population based, registry, Sweden	5–6	90
Pratt et al., 2016	880 individuals, 882 teeth	Retrospective, posterior teeth treated by postgraduate students, USA	8	88
Ramey et al., 2017	1960 treatments	Sample from an Air Force Dental Service, posterior teeth treated by GDPs and endodontists. Retrospective, USA	4	94
Khalighinejad et al., 2017	315 teeth	Sample from patients with molars treated at specialty education programme in endodontics, USA	9	94
Fernández et al., 2017	132 teeth	Sample from patients treated at postgraduate programme, retrospective, USA	10	92
Pirani et al., 2018	94 individuals, 213 teeth	Retrospective, treatments performed by post-graduate students, Italy	4–6	88
Kwak et al., 2019	2.5 million individuals, >3 million teeth	Nationwide population based, registry, Korea	5	91
Kebke et al., 2021	280 individuals/teeth	Historical cohort of patients treated by GDPs, Sweden	10	82

Table 2 Data on tooth survival (Fransson & Dawson, 2023)

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It is evident that from their investigation that only four studies used large databases, ranging from Fransson *et al*. (2016) who cited just over 248,000 teeth in Sweden, to Lin *et al*. (2014) in Taiwan who examined 517,000 teeth, Raedel *et al*. (2015a) with 556,000 teeth in Germany, and the largest being Kwak *et al*. (2019) with over 3 million teeth in the Republic of Korea. Two of these studies (Lin *et al*., 2014; Raedel *et al*., 2015a) have a three-year follow up, indicating survival of 94% and 89%, while the other two (Fransson *et al*., 2016; Kwak *et al*., 2019) report the survival at six-year follow up to be similar, 90% and 91% respectively. The table shows the range of operators, notably the large cohorts being related to GDPs, since the large database were usually provided by an insurance or national healthcare service provider.

A publication based on large cohort of patients in the USA from an insurance database whereby 1,462,936 teeth were root canal treated across in the USA, found that 97% of these teeth were still in place after 8 years (Salehrabi & Rotstein, 2004). Raedel *et al*. (2015a) followed in similar manner by examining data from a German insurance company for a three-year period of follow up, with reintervention, either by retreatment (reRCT), apicectomy (Root end surgery – RES) or extraction (XLA). They noted that survival was 84% at three years, with a sub-classification for nonvital teeth at 83% and vital teeth at 86%. They also examined number of roots, hence anterior teeth with single roots performed worse at 83%, while multi-rooted, posterior teeth survived better with 86%. It appeared that in two studies when encountering failure of RCT, most teeth were extracted instead of having Re-RCT or apicectomy carried out (Lazarski *et al*., 2001; Salehrabi & Rotstein, 2004).

Investigators trying to answer a particular question may sometimes answer another in their investigation, an example being a publication assessing the effect of rubber dam use on the survival of teeth (Lin *et al*., 2014). They researched *circa* 517,000 teeth and identified that rubber dam was a statistically significant factor for better survival, but they also reported that, over a 3 year follow up, 88% compared to 90% of teeth survived, and as rubber dam was used more with molars, they reported that posterior teeth performed slightly better than anterior teeth. In another study in Sweden, Fransson *et al*. (2016) found that in 2009, over 248,000 teeth received RCT, with a survival of 90% at 5 to 6 years follow up.

The systematic review by Ng *et al*., in 2010 found that 86% to 93% was the survival rate over 2 to 10-year period. The same group performed a prospective study, with the results indicating that the 4-year cumulative tooth survival was 95% for both RCT and Re-RCT (Ng *et al*., 2011b). The latter study reported that they would have preferred a larger sample size or longer follow up, which would have improved their statistical power, although the latter might have faced larger drop-out rate at recall.

Statistical methods examining the survival intervals when the database has been large can help overcome problem of drop-out with small studies. These have been tried and tested with the UK NHS GDS database, initially investigating the survival of direct restorations in restorative dentistry; replacement of glass ionomer restorations, amalgams and composites (Burke & Lucarotti, 2009a, 2009d, 2018b, 2018c, Lucarotti *et al.,* 2005a). Comparisons of RCT teeth and their counterparts have been made (Caplan *et al*., 2005) and survival scrutinised. These workers investigated posterior

teeth and found that after an eight year follow up, the root filled teeth did not survive as well as the non-root filled counterparts.

The literature published in Europe includes several studies focusing on the prevalence of periapical disease after RCT (De Cleen *et al*., 1993; Dutta *et al*., 2014; Eckerbom *et al*., 1991; Eriksen *et al*., 1988; Eriksen *et al*., 2002; Imfield, 1991; Petersson *et al*., 1989) while in the USA the three studies which are often referred to by some researchers (Buckley & Spanberg, 1995; Lazarski *et al*., 2001; Salehrabi & Rotstein, 2004) indicated similar results to the European studies in correlation to standard of treatment and absence of disease at follow up.

Two studies have investigated a very long follow up period for survival of teeth with RCT, examining small cohorts and reported the tooth survival of 65% and 71% over 20 years (Eckerbom *et al*., 2007; Petersson *et al*., 2016).

1.4.7 Large Database Studies

Exceptionally large cohorts have been investigated more frequently in recent decades due to the advances in technology for gathering data, storage technology and database access (Burry *et al*. 2016; Fransson *et al.,* 2016; Kwak *et al*., 2019; Lazarski *et al.,* 2001; Lin *et al.,* 2014; Lumley *et al*., 2008; Raedel *et al.,* 2015b; Salehrabi & Rotstein, 2004; Wigsten *et al.,* 2024). They are usually investigated retrospectively via large databases of treatment using private insurance systems or national public health system databases. In the USA, Lazarski *et al*. (2001) found that 94% of teeth were

retained after RCT among 44,613 patients in an insurance system in Washington State. Salehrabi & Rotstein (2004) have examined an insurance database to assess tooth retention over an 8-year period covering 50 states in the USA: these workers included 1,462,936 teeth, with 21% being anterior, 27% premolars and 52% molar teeth, with a retention rate (survival) of 97% at the end of the 8-year observation period. Another group from USA investigated 487,476 RCT teeth up to 10 years and reported a survival rate of 86% (Burry *et al*. 2016).

In southeast Asia, two large national health database studies have utilised data retrospectively for investigation of survival of RCT teeth. Kwak *et al*. (2019) found, in the Republic of Korea (South Korea) that, of 2,866,749 teeth which had RCT, at 5-year follow up, 91% had survived during 2010, using the entire Korean population national health database. Lin *et al*. (2014) investigated the role of rubber dam in RCT outcome and inadvertently provided data on survival of RCT teeth using the Taiwan National health insurance that cares for 99% of the population. They investigated 517,234 teeth and found a survival rate of 90% at follow up of 3.43 years when rubber dam was used compared to 89% without its use and considered it to be statistically significant.

In the UK, a publication by Lumley *et al*. (2008) involving a large database of NHS GDS treatment in England and Wales, 30,843 RCT teeth were investigated and observation over a 10-year period reported a survival of 74%. Although the NHS GDS database could not pass on clinical information in relation to assessment of quality and standard of RCT, it had been previously scrutinised as part of a NHS GDS evaluation by Dummer (1998) who found, in his investigation of 851 RCF teeth that

under 40% were filled to satisfactory clinical standard as per ESE guidelines, yet Lumley *et al.* (2008) found, at 10 year follow up, that 74% had survived.

These figures from various studies are further scrutinised by patients, GDPs, specialist, educators, all of whom may be keen to know what factors affect better outcome for treatment and clinical studies try to address these questions.

Lucarotti & Burke (2018a) reported that given the size and robustness of the potential analysis of the NHS GDS database, it will provide very precise information regarding the factors influencing survival of restorations of all types. This had eliminated the need for use of confidence interval, or *p* values used to test null hypothesis, which are not applicable to large number studies.

1.5 Factors Affecting Outcome

1.5.1 Surrogate Measures

There are numerous surrogate measures utilised for assessing endodontic outcomes. The ESE recommends that RCT should be assessed at least after one year and subsequently as required. They reported that their criteria for success have been absence of pain, swelling and other symptoms, no sinus tract, no loss of function, and radiographic evidence of a normal periodontal ligament space around the root (ESE, 1994). If there is radiographic healing of a lesion and the patient is asymptomatic one might assume that there has been complete healing even though histology has not been carried out to confirm this at a cellular level, and for obvious reasons that would not be considered appropriate. However, it has been widely accepted that the absence of clinical signs and symptoms with a good technical result of the RCT, this can be considered the outcome measure at the completion of the RCT (Bender *et al*.,1966a, 1966b; Duncan *et al*., 2021; Fransson & Dawson, 2023).

In the survival studies of RCT teeth in large databases, failure has been considered to be the point when a tooth is extracted, therefore no longer in function. However, the difficulty lies in the fact that normally the researchers cannot identify the reason for the extraction or tooth loss with these large cohorts. It may be due to a failed restoration, caries, periodontal disease or trauma, and not necessarily a failed RCT. However, in these large database studies as numbers are so large that it is assumed that they are potentially able to represent the real-life scenario. Interventions such as further RCT

and RES have been associated with failed root canal treatment, hence as surrogate measures, these two, along with extraction can be considered the points when intervention has taken place and can be considered the end point of survival of the RCT tooth and its restorations. These may be considered to be a strict criterion for survival, as opposed to a loose criterion, when only based on XLA as the only type of intervention, as opposed to the strict criteria whereby any of XLA or RES or ReRCT apply. The success rate for RCT carried out for the first time, has a range of 68%-85% from pooling of data in a systematic review by Ng *et al*. (2007), while for retreatment cases it was 70% to 86% (Ng *et al*., 2008).

The pooling of data and its assessment can allow investigators to compare data sets for examining strict criteria for RCT of teeth with and without peri-radicular lesions. The updated meta-analysis by Gulabivala and Ng (2023), based on their original work in 2007 and 2008, has carried out exactly that. They examined twenty-nine studies and, based on a 95% confidence interval, they reported that vital pulpectomy leads to absence of apical periodontitis in 84% of cases (Figure 5) for teeth that did not have a periapical lesion present which has been usually confirmed radiographically. On the other hand, for teeth that had an established periapical lesion and were diagnosed with apical periodontitis, 75% of these cases gained healthy periapical health after RCT (Figure 6).

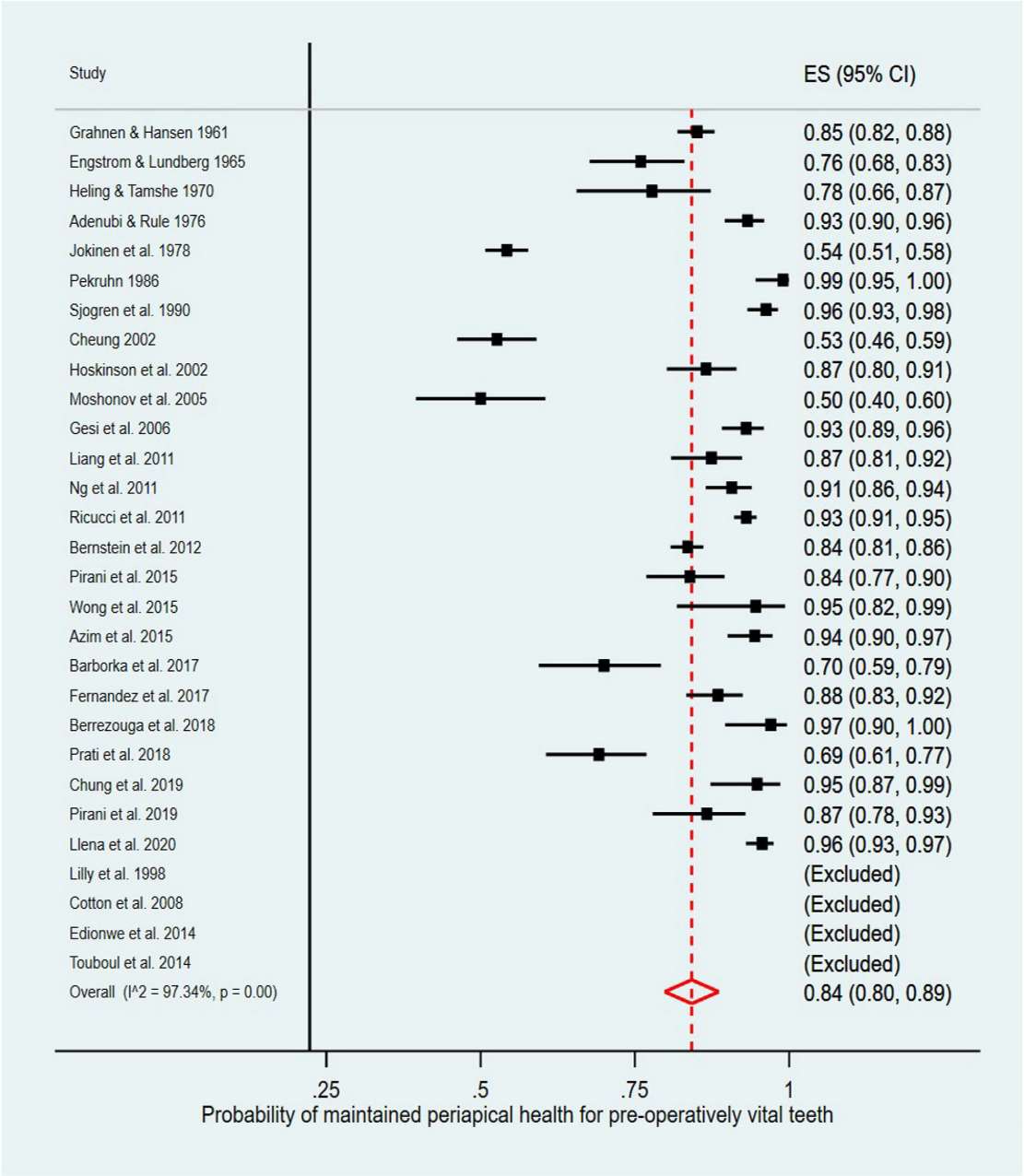

Figure 5 Forest plot for vital teeth using strict criteria (Gulabivala and Ng, 2023)

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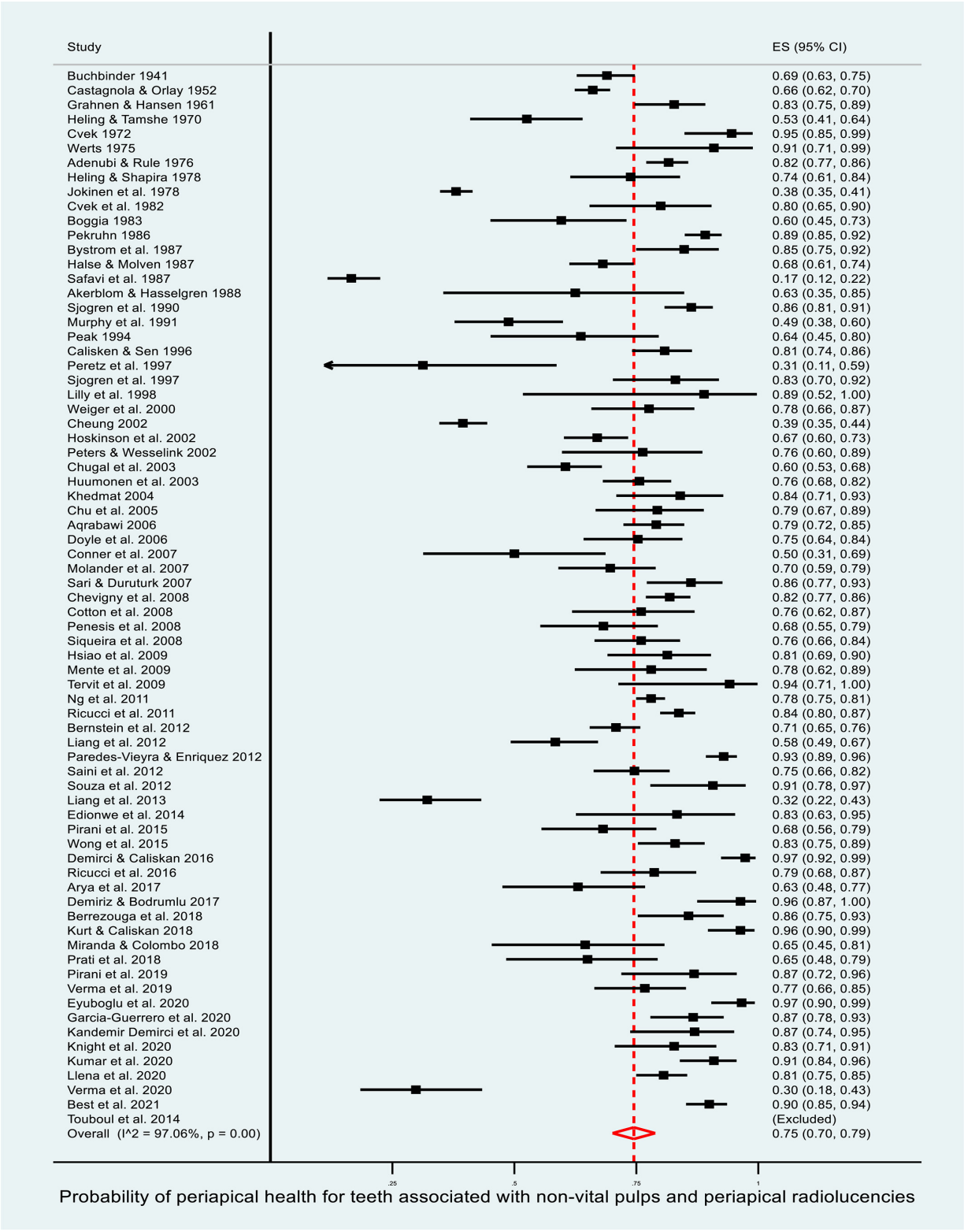

Figure 6 Forest plot for vital teeth using strict criteria (Gulabivala and Ng, 2023)

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1.5.2 Dentist Factors

1.5.2.1 General Dental Practitioner Studies

Studies carried out in which treatment was carried out by GDPs are valuable as they reflect “real world” dentistry, especially if they are based on large cohorts of patients (Hancocks, 2008; Wilson, 2009). It has been reported that RCT teeth may be lost due to post-treatment endodontic disease, unrestorable carious lesions, restorative failure, irretrievable cusp or crown fractures, vertical root fracture or periodontal disease (Mannocci *et al*., 2021). Failure analysis of RCT teeth in survival studies indicate biological (endodontic) and structural (restorative) causes (Landys Borén *et al*., 2015; Salehrabi & Rotstein, 2004), with the main factors influencing the survival of RCT teeth being the quantity of residual sound tooth structure (Al-Nuaimi *et al*., 2017; Nagasiri & Chitmongkolsuk, 2005) and the choice of restoration (Aquilino & Caplan, 2002; Pratt *et al*., 2016).

The value of evidence based clinical practice has been highlighted by Cochrane (1979), a pioneer on this concept in medicine, and the emergence of evidence based clinical practice became more established with time (Sackett *et al*., 1996). In dentistry the same principles apply and aim to improve quality of evidence, given that RCT by GDPs needs evidence. Data collated from systematic reviews have tried to address questions regarding the factors which affect outcome of RCT (Basmadjian-Charles *et al*., 2002; Del Fabbro *et al*., 2007; Figini *et al*., 2007; Hepworth & Friedman, 1997;

Kojima *et al*., 2004; Lewsey *et al*., 2001; Ng *et al*., 2007, 2008a,b; Paik *et al*., 2004; Peng *et al*., 2007; Sathorn *et al*., 2005; Schäfer *et al*., 2005; Stavropoulou & Koidis, 2007; Torabinejad *et al*., 2005, 2007). These studies examined factors in order to advise operators and educators about important factors and whether they can be influenced in any way. If students can be trained in certain theoretical and practical components of RCT in order to gain the highest standards of ability, it may be considered that that should enhance the result of their treatment outcome, thereby also fundamentally improving patient care (Qualtrough, 2014; Qualtrough & Dummer, 1997).

Optimum clinical care can be facilitated with clinically appropriate case selection, attention to various steps in delivery of care and improving those that are crucial for better success, while using technology appropriately, this having been shown, with most advances in dentistry, to benefit some patients more than others (Gulabivala & Ng, 2023). The provision of training at undergraduate (UG) and postgraduate (PG) level generally teaches similar principals. However, with PG training in which more time has been dedicated to focus and teach RCT, a more detailed look at factors is relative and techniques can be mastered, like preparing and filling the root canals to an accurate length (Yee, 2019). The restorative outcomes for RCT teeth have been considered another way of assessing outcomes. In that regard, a publication from USA (Spielman *et al*., 2012), investigated over a thousand patients from 64 practices, followed up for just under 4 years, finding that RCT in molars performed better, as did Raedel *et al*. (2015a) in the endodontic literature. In addition, in another study, those RCT teeth that had full cuspal coverage restorations alongside good periodontal

health, intact proximal margins, non-Latino ethnicity, and who had the RCT carried out by a specialist in endodontics, delivered the best outcomes (Spielman *et al*., 2012).

The three main factors that were identified from systematic reviews for strict criteria of clinically healed cases were presence of a periapical lesion, apical extent (of the RCF) and quality of the RCT and adequate coronal restoration (Ng *et al*., 2008). In studies examining the favourable survival of RCT teeth, four factors were identified; placement of a crown after RCT, presence of both mesial and distal contacts (i.e., the tooth is supported by adjacent teeth), tooth not being used as an abutment for a fixed or removable prosthesis and tooth type, whereby premolar teeth not as favourable as molar teeth (Kebke *et al*., 2021; Kwak *et al*., 2019; Landys Borén *et al*., 2015; Ng *et al*., 2007, 2008, 2010, 2011b; Pirani *et al*., 2018).

1.5.2.2 Dentist Gender

The gender of the dentist has not been investigated extensively in relation to the provision of endodontic treatment in the past. Research of the NHS GDS found that gender of the dentist did not make a difference on survival of directly placed restorations (Lucarotti *et al*., 2005b) but the effect on RCT was not investigated.

1.5.2.3 Dentist Age

The age of the dentist carrying out treatment has not been widely investigated in endodontic literature. However, in the NHS GDS investigation (Lucarotti *et al*., 2005b), it was found that younger dentists in salaried positions had better outcome for directly placed restorations but the effect on RCT was not investigated.

1.5.2.4 Dentist Postcode

The need for dental treatment may be higher in certain postcodes than others due to the socio-economic background of the area and the population demography including patient to dentist ratio. The loyalty of patients to the dentist in this database has been examined and appears to be multi-factorial (Lucarotti & Burke, 2015). They found that survival of porcelain laminate veneers was affected by the postcode of the dentist whereby those in central England outperformed others (Burke & Lucarotti, 2009a).

1.5.2.5 Operator

The operator may be an undergraduate in dental training, on occasion a dentist with further training in Endodontics, and the outcome has been shown to be related to the level of training (Ng *et al*., 2007). The decision-making process has its own array of complexities and is therefore challenging to measure (Ericsson *et al*., 2018).

Endodontic training can vary from a short course entailing days to weeks to more advanced postgraduate degree-type training that can be one-year full time to three years full-time or equivalent part-time. The operating dentist would therefore attain a range of skills to perform RCT. The range encountered with GDPs is vast: a GDP may have gained a lot of experience by encountering many cases that needed RCT, thus would be considered higher skilled that one that has only recently graduated and may have only completed very few RCTs. It is considered that root canal system complexity and clinician expertise may be confounding factors for the health care system that provides the care for the population it serves (Chambers *et al*., 2009; Yee, 2019). On the other hand, a meta-analysis by Ng, Mann & Gulabivala in 2010, revealed that when comparing endodontists to GDPs from pooling data from three studies, (Alley *et al*., 2004; Lazarski *et al*., 2001; Tilashalski *et al*., 2004) there was no significant difference based on the operator.

The skill and knowledge of the clinician have been stipulated to be key when examining RCT survival data of operators and its relationship with complexity of the case (Gulabivala & Ng, 2023). In outcome studies RCT has been provided by a range of experienced and trained operators: some studies have included GDPs, undergraduates, postgraduates and specialists as the sole dentist while other studies had a mixture of providers performing RCT (Ng *et al*., 2007; Gulabivala & Ng, 2023). The most proficient operators have used magnification and illumination, and the research is now available to indicate that one of the main challenges in endodontics is visibility. This can now easily be addressed with availability of loupes, microscopes and additional lighting (McLean & Qualtrough, 2024) but the effect on survival should

ideally be carried out with a randomised control trial, and to date this has not been investigated.

1.5.3 Patient Factors

Patient factors are often related to the patient as a whole entity, some of these having previously been examined in relation to the NHS GDS survival of directly placed restorations (Burke *et al*., 2005a; 2005b; Burke & Lucarotti, 2018a-c) and root canal filled teeth (Lumley *et al*., 2008).

1.5.3.1 Gender

The effect of gender of patients on RCT outcome has been unequivocal in some studies (Caplan *et al*., 2002; Lazarski *et al*., 2001; Tan *et al*., 2006) although in other studies in which attendance of patients had been investigated the ratio was in favour of females, given that they have been consistently reported as the gender that attends the dentist more frequently (Fransson *et al*., 2021; Kwak *et al*., 2019; Ng *et al*., 2010).

1.5.3.2 Age

The age of patients has been investigated in epidemiological studies in relation to the incidence and prevalence of endodontic disease. In outcome studies, it has been

found that the older population appears to have an increase in number of failed cases and survival was not as favourable (Aquilino & Caplan, 2002; Caplan & Weintraub, 1997; Dammaschke *et al*., 2003; Fransson *et al*., 2021; Kwak *et al*., 2019; Landys Borén *et al*., 2015; Lazarski *et al*., 2001; Lumley *et al*., 2008; Nagasiri & Chitmongkolsuk, 2005). This has been related to the various factors such as increased retention of teeth into older age (Qualtrough & Mannocci, 2011), as a longer time present in the mouth equates to increased exposure to occlusal loads, loss of tooth structure, but also, possibly, an acceptance of extraction option more freely among older patients than in younger patients.

Immunity of patients in relation to age has been reported as a factor involved in host response and indicated slower healing of peri-radicular lesions (Ginaldi *et al*., 2016). Fransson *et al*. (2016) found, in a Swedish population, that younger patients demonstrated better survival of their teeth and that extractions were more common with elderly patients. In the same study, they found that the age group 20-29 years had the highest survival rate of RCT teeth at 93%, compared to the lowest, at 90% for the 65–74-year-olds (Fransson *et al*., 2016). On the other hand, a systematic review by Shakiba *et al*. (2017), found that on radiographic evaluation, the longitudinal outcome was not affected by age of the patient.

1.5.3.3 Systemic Health

The medical history of patients has been critically investigated in periodontal research as the host response has been considered important in relation to treatment outcome (Doyle *et al*., 2006; Fouad & Burleson, 2003; Marending *et al*., 2005). The same

concepts may be considered with endodontic research as a positive host response has been a necessity for healing (Ng *et al*., 2011a, 2011b; Yee, 2019). Historically it has been reported that, once the aetiology is removed (mainly bacteria and their by-products), healing can occur. Research has indicated the dampening effect on inflammation, which will allow for healing to occur since the complete elimination of bacteria cannot aways be possible (Gulabivala & Ng, 2023; Matsumiya & Kitamura, 1960).

The patients' systemic state has been investigated within endodontic publications, and a lower tooth survival has been observed in patients with diabetes mellitus (Doyle *et al*., 2006; Cabanillas-Balsera *et al*., 2019; Marending *et al*., 2005; Mindiola, 2006; Ng *et al*., 2011b; Wang *et al*., 2011) and also to be associated with coronary artery disease (Wang *et al*., 2011). Survival was influenced by diabetes or in patients who were receiving systemic steroid therapy, insofar as they had more extractions but not lower healing (Ng *et al*., 2011b). Ng *et al*. (2011b) identified that majority were associated with pain and hypothesised that neuropathy (Edwards *et al*., 2008), may play a role with patients that suffered from diabetes. The relationship of diabetes with reduced healing in dentistry, as in periodontal disease (Genco & Loe, 1993) and periapical healing (Fouad & Burleson, 2003) have been reported. It has also been considered that variation in host responses may affect periapical healing (Ng *et al*., 2011a, 2011b; Yee, 2019). More recently, investigations into gene polymorphisms have suggested they may influence periapical healing and outcome (Farmani, 2018; Mazzi-Chaves *et al*., 2018; Silva-Sousa *et al*., 2020; Siqueira *et al*., 2009, 2011).

1.5.4 Tooth Factors

1.5.4.1 Pre-operative

Pre-operative factors are often related to the tooth itself and, as a result, will need clinical examination and imaging, while some information may be available from dental history.

1.5.4.1.1 Pulp and Peri-radicular Status

The root canal contents, and pulp status can vary from vital to inflamed, necrotic, infected, previously initiated for treatment and root canals filled. The infection status of the pulp has been considered to be significant factor by some investigators (Kojima *et al*., 2004; Lewsey *et al*., 2001). In some studies, vital pulps have fared better compared to non-vital pulps that have had RCT (Dammaschke *et al*., 2003; Raedel *et al*., 2015b; Stoll *et al*., 2005). On the other hand, other studies have not observed any difference between them, unless associated with periapical infection (Rossi-Fedele & Ng, 2022). The results of the landmark investigation by Möller *et al*. (1981) indicated that necrotic pulps did not cause apical pathosis, which could explain why some necrotic cases and vital cases perform similarly in terms of survival and outcome.

1.5.4.1.2 Presence of Lesion

The presence of a periapical lesion has been commonly found to be a factor related to less than favourable clinical outcome of RCT, a factor which is beyond the control of the operator (Basmadijan-Charles *et al*., 2002; Dammaschke *et al*., 2003; Fonzar *et al*., 2009; Ng *et al*., 2008, 2011a, 2011b; Raedel *et al*., 2015b; Stoll *et al*., 2005). It was also noted to be a predictive factor for tooth extraction in a study from Denmark (Kirkevang *et al*., 2017). The complexity of apical infection may also be of relevance, (Nair *et al*., 2005; Vera *et al*., 2012) given that this has been reported with larger lesions, with those containing a more diverse infection, including an increased number of bacterial species and load (Sundqvist, 1976).

Interestingly, in a prospective study and meta-analysis examining the of survival of RCT teeth, the presence of a periapical lesion has not been significant (Ng *et al*., 2010, 2011b). This may be related to variation in parameters (e.g. strict *vs* loose criteria) which can report different factors that affect endodontic treatment outcome. Therefore, reinforcing the significance of outcome measures (Duncan *et al*., 2021).

1.5.4.1.3 Size of Lesion

Apical lesions larger than 1cm on radiographs were considered to be a radicular cyst with oral surgeons often purporting that they would not heal with root canal treatment (Bhaskar, 1966; Nair *et al*., 1996; Simon, 1980; Strindberg, 1956). It has been reported that larger lesions have the greater infection diversity (Sundqvist, 1976) and therefore

its eradication may be considered to be challenging (Byström & Sundqvist, 1981). The size of the lesion has been investigated and has been an important factor for the outcome of treatment (Ng *et al*., 2011a, 2011b). On the other hand, some report that large periapical lesions purely take longer to heal and hence size of the lesion is not a true factor, because if the cases were followed up longer, healing would eventually occur (Esfahani, 2016; Friedman *et al*., 1995; Nair *et al*., 2005; Nair, 2006; Sundqvist, 1976). Thus, size of the lesion is not considered a factor for predicting failure (Gulabivala & Ng, 2023).

Penetration of the bacteria into the dentinal tubules and the accessory anatomy (Shovelton, 1964) plus cyst transformation (Nair, 2006) as well as residual bacteria post treatment (Nair *et al*., 2005) can potentially negatively influence bony healing in larger lesions. The amount of healing increases as time progresses and some lesions may take a long time to heal, as has been reported in studies, including a 27 years' follow up (Fristad *et al*., 2004; Molven *et al*., 2002; Molven & Hasle, 1998; Ørstavik, 1996; Strindberg, 1956; Weiger *et al*., 2000).

1.5.4.1.4 Previous RCT

The previously RCT tooth has been considered to be an adverse factor for better outcome of treatment by some investigators (Nair *et al*., 2005; Peters *et al*., 1995; Ricucci *et al*., 2009; Ricucci & Siqueira, 2010; Siqueira *et al*., 2014; Tibúrico-Machado *et al*., 2021; Vieira *et al*., 2012). Although in some situations it is debated to be the same as first time treatment, especially for those cases that were not treated to a

satisfactory technical standard in the initial treatment, thereby not achieving the critical objectives, it therefore follows that a re-treatment could result the same outcome as a first time RCT by achieving the objectives (Ng *et al*., 2011b; Kwak *et al*., 2019).

1.5.4.1.5 Tooth Type

Survival studies have categorised teeth in various ways and, because of the heterogenicity of the data comparisons cannot be made easily. However, some studies have identified lower survival with second molar teeth (Aquilino & Caplan, 2002; Caplan *et al*., 2002), molars (Caplan *et al*., 2005; Imura *et al.,* 2007;) and posterior teeth (Lazarski *et al*., 2001). The opposite was reported by other investigators (Caplan & Weintraub, 1997; Dammaschke *et al*., 2003; Tan *et al*., 2006). None reported a variation between anterior and posterior teeth. In a meta-analysis pooling 5 studies out of 8 utilised for the investigation, anterior and posterior teeth were identified, and no significant difference was reported when comparing tooth type (Ng, Mann & Gulabivala, 2010). However, when pooling the groups, examining molar *versus* non-molar types, the latter was associated with significantly higher survival of RCT teeth (Dawson *et al*., 2024; Gulabivala & Ng, 2023; Laukkanen *et al.,* 2021).

The external anatomy of the tooth usually dictates the anatomy of the internal root canal system for a particular tooth type, which can be very complex (Hess & Zurcher, 1925). Complexity of the internal anatomy has been normally considered a hindering factor for achieving the goal of root canal disinfection and shaping and it may be associated with a difference between various tooth types (Jang *et al.*, 2024; Nair *et*

al., 2005; Peters *et al*., 1995; Vieira *et al*., 2012). It is reported that the apical canal complexity (and its possible interaction with any infection present) may indicate a lack of difference between anterior teeth and posterior teeth as both are considered to be complex in the apical portion (Azim *et al*., 2015). Commonly, one of the reasons for GDPs to refer to an Endodontist is that the tooth has complex anatomy, as they are considered to be more skilled for these cases due to their further training, when compared to their GDP counterparts (Alley *et al*., 2004).

The outcome for various tooth types is considered to be different due to the experience of caries and complex anatomy as surrogate measures for inadequate chemo-mechanical preparation (Gulabivala & Ng, 2023). Ng *et al*., 2010 found that RCTs in molar teeth did not survive as well as in non-molar teeth, as did Fransson *et al*. (2021) and Kwak *et al*. (2019). Other researchers have found that outcome of treatment of molars was similar to other teeth (Raedel *et al*., 2015b; Salehrabi & Rotstein, 2004). The latter two studies are based on a large-scale data from an insurance company, facilitating the investigation of a large cohort of data. In Sweden, they found with survival of RCT teeth that mandibular premolars had performed best (93%) at 5-6 years, whilst mandibular molars performed worse at 88% (Fransson *et al*., 2016). Root canal anatomy with extra canal morphology in lower molars has been considered as the principal reason for their poorer performance in RCFs. While the caries research hypothesis that the first molar tooth is the tooth most commonly affected by caries and restored tooth most likely to be heavily restored (due to the fact it is the first erupted permanent molar tooth in the mouth), therefore it has the longest exposure in the mouth to dietary sugar that causes dental caries, which predisposes to pulpal and periapical disease and the subsequent need for RCT (Duncan *et al.,* 2019; British

Endodontic Society's A Guide to Good Endodontic Practice, 2022). Tooth type has been investigated due to the range of morphology and investigations into susceptibility to tooth fracture (Eakle *et al*., 1986; Lagouvardos *et al*., 1989). The terminal tooth has been reported to be extracted most frequently (68%) due to fracture compared with only half for those which were non-terminal teeth (38%) (Ng *et al*., 2010, 2011b; Tan *et al*., 2006). It may be extraction is more acceptable for terminal teeth because they did not contribute as much to the occlusion, or that Re-RCT was offered as an option less frequently due to access problems (Ng *et al*., 2011b).

1.5.4.1.6 Tooth Integrity

The amount of tooth structure remaining is important for the strength of the tooth and its subsequent survival (Al-Nuaimi *et al*., 2018; Sim *et al*., 2016; Tan *et al*., 2006). The various cavity sizes and surfaces to which restorations are extended can be interpreted as the extent of the cavity. In RCT teeth the depth of the restoration in the centre of the tooth is necessarily deep, due to the nature of the treatment, as access to the centre of the tooth is required in order to gain entry in to the root canal system, including the root canals and network of ramifications, while, at the same time minimising errors, saving tooth structure, attempting to maintain strength and aesthetics (Mannan *et al*., 2001; Plotino *et al*., 2017; Stock, 1988).

Recently, there has been an advent of new designs for access cavities and 3D guides using CBCT. These aim to reduce weakening of the tooth structure by minimising removal of tooth structure and providing minimal access the root canal system, but

some debate that this may hinder the efficient reduction of bacterial load (Özyürek *et al*., 2018; Sabeti *et al*., 2018; Wang *et al*., 2020).

1.5.4.1.7 Other Clinical Signs and Symptoms

The presence of pre-operative pain (Friedman *et al*., 1995), swelling, sinus tract (Ng *et al*., 2011a, 2011b), and apical resorption (Strindberg, 1956) has been considered as factors reducing favourable outcome. Pain presenting post-RCT has been linked to pre-operative pain and one of the considerations for extraction after provision of RCT (Albashaireh & Alnegrish, 1988; List *et al*., 2008; Polycarpou *et al*., 2005; Yesilsoy *et al*., 1988). Most post-RCT interventions occur in the first few years, and it may be related to pain post-RCT (Ng *et al*., 2011b; Nobuhara & Del Rio, 1993; Salehrabi & Rotstein, 2004).

The decision of the dentist and patient on which intervention to opt for is complex (Reit, 2002). In that regard, reinterventions in the NHS GDS after failure of RCT has not been frequently carried out by another RCT but mainly by extraction (Lumley *et al*., 2008). In provision of advanced dentistry such as crowns, in this cohort it was found that if a crown had been placed previously, the option of reintervention with extraction was more often carried out than if the crown was more recently placed (Burke & Lucarotti, 2009b). The same authors also reported that 3% of teeth that were crowned needed RCT in the first ten years, compared with 12% of the crowned teeth that needed reintervention. This is a lower figure than others have found (Dutta *et al*., 2014; Saunders *et al*., 1997; Saunders & Saunders, 1998) but it may be that these

reinterventions were led by symptoms rather than incidental radiographic findings (Burke & Lucarotti, 2009c).

1.5.4.2 Peri-op / Treatment Factors

The factors that may affect the treatment due to the treatment itself can be numerous as there are various components involved in the delivery of care.

1.5.4.2.1 Dental Dam

Dental dam, frequently referred to as rubber dam, has been around for more than 150 years in dentistry and yet its uptake has been a source of contention among dentists (Ahmad, 2009; Elderton, 1971; Lin *et al*., 2011). There have been many surveys (Al-Omari, 2004; Bjørndal & Reit, 2005; British Endodontic Society, 1983; Going & Sawinski, 1967; Koch *et al*., 2009; Koshy & Chandler, 2002; Lynch & McConnell, 2007; Mala *et al.,* 2009; Palmer *et al.,* 2009; Silversin *et al*., 1975; Stewardson, 2002; Tidmarsh, 1980) examining barriers to its use: some found that poor training and technique is fundamentally what has allowed its use to decline post-qualification. Dental dam use is commonly taught in dental schools, indeed, RCT should not be provided without it and yet, when dentists leave dental schools, it appears this is one of the first things they underutilise. A comparison to cotton-roll isolation has been made in an observational study and the value of rubber dam noted as a significant factor for better outcome of root canal retreatment (van Nieuwenhuysen *et al*., 1994). It has also

been shown that post placement with dental dam has decreased the incidence of failures (Goldfein *et al*., 2013).

Outcome studies with large databases from Taiwan and Republic of Korea (South Korea) explored the use of dental dam and found, at 5-year survival, its use was significant in the outcome of treatment (Kwak *et al*., 2019; Lin *et al*., 2014). In Republic of Korea (South Korea) it they found a difference of 11% and in Taiwan 17% of the RCTs were performed with dental dam, with their uptake of dental dam use being similar to others, Ahmed *et al*. (2014) reported a range from 10% to 89% in rubber dam use among dentists around the world. The reduction of micro-organisms, the key aetiology of endodontic disease, with use of dam and gaining increased survival is fundamental in improving outcomes (Lin *et al*., 2014; Cochran *et al*., 1989). The study in Taiwan utilised a database whereby there was renumeration for use of dental dam: this is not the case with other remuneration systems.

1.5.4.2.2 Root Canal Negotiation to Canal Terminus

Chemo-mechanical preparation of the root canal system has an important consideration, which is to instrument the canal(s) mechanically and introduce chemicals to an appropriate length. In that regard, the debate about what the length should be and how it is measured is one that has been discussed during recent decades. The ability to work to a satisfactory working length has been investigated and particularly with prospective studies, patency has been explored as a factor (Ng *et al*., 2011a). Complex root canal anatomy, in particular the apical anatomy, when

infected, has been accepted as a challenging anatomical and clinical entity (Nair *et al*., 2005, 1997). A significant prognostic factor related to mechanical preparation has been identified as patency at the canal terminus and apical extent of instrumentation (Ng *et al*., 2011a, 2011b). This may be hindered by a variety factors (Seltzer *et al*., 2004) including curves, debris, calcifications, poor instrument control or lack of irrigation.

The concept of apical enlargement was discussed by Crane (1921) and later coined by Grossman (1970) to target three sizes larger than what is naturally discovered. Serial enlargement and tapers were deployed (Schilder, 1974) and laboratory and clinical studies examined them further (Kock *et al*., 2014; Hülsmann *et al*., 2005; Ng *et al*., 2011a, 2011b; Pettitte *et al*., 2001). There is a paradigm shift on this subject, and it is now widely accepted the enlargement should only be to allow irrigation, placement of medicament and thus RCT and filling to the working length (Gulabivala *et al*., 2005), based on investigations of apical preparation sizes (Hoskinson *et al*., 2002; Kerekes & Tronstad, 1979; Ng *et al*., 2011a, 2011b; Saini *et al*., 2012; Souza *et al*., 2012; Strindberg, 1956). Tapers were assessed in the work of Smith *et al*. (1993) whereby flared preparations showed more favourable healing outcomes of RCT than conical ones. A retrospective study (Hoskinson *et al*., 2002) examining tapers of 0.05 and 0,10 with stainless steel hand preparations versus 0.06 and 0.08 with nickel-titanium instruments were investigated, finding that they did not influence the prognosis. It is currently accepted an ISO size 30 with 0.05 taper is more than sufficient provided that there is adequate irrigation (Gulabivala *et al*., 2010; Lee *et al*., 2004).

1.5.4.2.3 Root Canal Irrigation

The various types of irrigant and their concentrations have been assessed in laboratory studies in detail, and, while clinical studies have not been able to show as much detail, there is some evidence that supports the laboratory studies, namely use of sodium hypochlorite to be the gold standard which other irrigants are compared, while others considered adjuncts, for example, chelating agents (Gulabivala *et al*., 2010; Hülsmann *et al*., 2005; Ng *et al*., 2011a, 2011b; Pettitte *et al*., 2001). Sodium hypochlorite has been considered the irrigation of choice and its concentration and volume of use investigated (Hand *et al*.,1978; Huang *et al*., 2008; Lee *et al*., 2004). The choice of irrigant and use of rubber dam have been further analysed (Whitworth *et al*., 2000), with the results indicating that majority of UK NHS dentists never use rubber dam and the choice of irrigant is linked closely to the use of rubber dam.

The vapour lock effect (Gu *et al.,* 2009), whereby gas bubbles occur ahead of the advancing front of the irrigant, can affect the apical contact of the irrigant to the canal contents, thus becoming ineffective in an area which is anatomically complex. It can also cause stagnation of fluid in the apically infected anatomy, referred to as the 'apical stagnation zone', with the potency being challenged by the neutralising of the buffer of this fluid and by infection (Gulabivala *et al*., 2010; Nair, 2000; Nair *et al*., 2005; Vera *et al*., 2012).

1.5.4.2.4 Number of Visits and Interappointment Medicaments

The dilemma of treating RCT cases in one visit or more has challenged dentists for several decades (Figini *et al*., 2007; Sathorn *et al*., 2005). The advent of Nickel Titanium instruments has allowed increased efficiency in provision of care, thus more dentists have the ability to complete root canal treatments in one visit. As a result, there has been an increased focus in investigating the value of an inter-appointment dressing and its effect on outcome. The majority of recent publications which assessed a longer term follow up on cases have been able to ascertain that most do not benefit from an inter-appointment dressing, except for those that are not suitable for obturation due to the tooth being highly inflamed or infected. A culture test that was once in favour, especially during the focal infection era, is no longer considered necessary as there is better acceptance by patients in having RCT in one visit as well as the added cost for this additional step (Molander *et al*., 1996a, 1996b). Nair *et al*. (2005) pioneers in reporting endodontic biofilm in the root canals, showed that the adherent biofilm can be challenging to remove with conventional treatment in infected cases in line with work that showed residual bacteria can multiply and recolonize in the root canal system (Byström, 1986; Byström and Sundqvist, 1985). The latter groups examined the role of the inter-appointment medicament calcium hydroxide, and it has been confirmed to be the ideal material serving the purpose of a dressing that will address cases that cannot be dried due to apical exudate and or pus. (Best *et al*., 2021; Kandemir Demirci *et al*., 2020; Ng *et al*., 2011a, 2011b). Mixing it with other chemicals such as chlorhexidine and comparing it to other pastes has indicated no difference in its efficacy within clinical trials, so calcium hydroxide is proposed as the inter-

appointment root canal dressing of choice (Arruda *et al*., 2018; Basrani *et al*., 2003; Gomes *et al*., 2003; Manzur *et al*., 2007; Shafer & Bossmann, 2005).

The single visit concept is one that has been debated for the past two decades, having initially been favoured more by American endodontists with considerations of cost-effectiveness, practicality, business edge, and post-operative pain. Subsequently randomised controlled trials added support for the European endodontists to follow suit, although there is some that debate the evidence from these studies as not being statistically strong and/or related to bias in the protocols utilised (Fonzar *et al*., 2017; Gesi *et al*., 2006; Manfredi *et al*., 2016; Molander *et al*., 2007; Nunes *et al*., 2021; Peters & Wesselink, 2002; Schwendicke & Gostemeyer, 2017; Spangberg, 2001; Trope *et al*., 1999). In this regard, the large database from the Korean study did not reveal a difference in one visit *versus* multi-visit RCT (Kwak *et al*., 2019). The recommendation for a large randomised controlled trial has been advocated by experts to minimise bias on operator skill, case complexity, patient compliance and recruitment (Gulabivala & Ng, 2023).

1.5.4.2.5 Control of Infection

The focal infection era (Buchbinder & Wald, 1939; Frostell, 1963; Morse & Yates, 1941) introduced quality checking pre-obturation (Molander *et al*., 1996a, 1996b) which has subsequently allowed researchers to investigate each chemo-mechanical stage of treatment, and ascertain their value (Akpata, 1976; Auerbach, 1953; Bence

et al., 1973; Byström *et al*., 1985; Byström & Sundqvist, 1981, 1983, 1985; Card *et al*., 2002; Chu *et al*., 2006; Cvek *et al*., 1976; Dalton *et al*., 1998; Engström, 1964; Gomes *et al*., 1996; Grahnen & Krasse, 1963; Ingle & Zeldow, 1958; Koontongkaew *et al*., 1988; Kvist *et al*., 2004; Lana *et al*., 2001; Markvart *et al*., 2013; Molander *et al*., 1990; Nicholls, 1962; Ørstavik *et al*., 1991; Paquette *et al*., 2007; Peciuliene *et al*., 2000, 2001; Peters *et al*., 2002; Reit *et al*., 1999; Reit & Dahlen, 1988; Shuping *et al*., 2000; Siqueira, Guimaraes- Pinto & Rôças, 2007; Siqueira, Magalhaes & Rôças, 2007; Sjögren *et al*., 1990, 1991, 1997; Sjögren & Sundqvist, 1987; Stewart *et al*., 1961; Vianna *et al*., 2007; Wang *et al*., 2007; Xavier *et al*., 2013; Yared & Dagher, 1994).

Certain bacteria taxa have been identified from cultures prior to obturation and include *Enterococcus*, *Streptococcus*, *Staphylococcus*, *Lactobacillus*, *Veillonella*, *Pseudomonas*, *Fusobacterium* species and yeasts and the *Enterococcus* species (Gulabivala & Ng, 2023). The latter have attracted research in which one group found, that, if present, there was a 55% failure compared to an overall 31% (Frostell, 1963) while in another study 66% *versus* 33% overall (Sundqvist *et al*., 1998) indicating that some bacterial may cause less favourable outcome with RCT. As *Enterococcus* species has not been found in conventional infections and has been considered to be a contaminant in the root canal (Portenier *et al*., 2004), it has placed further focus on asepsis, with evidence emerging that aseptic handling as well as an aseptic field of work with the aid of dental dam could be highly beneficial (Patel *et al*., 2022).

1.5.4.2.6 Acute Exacerbations

An acute exacerbation, often called a flare up, has been investigated as a factor that may affect outcome of RCT. The range of definition varies from slight discomfort from RCT, to one severe pain that required an unplanned visit to the dentist (Nixdorf *et al*., 2010, 2015; Nosrat *et al*., 2020; Seltzer & Naidorf, 1985a, 1985b; Torabinejad *et al*., 1994). There is a difference of opinion, with results of two studies indicating that a true flare up does not make a difference to periapical healing (Kerekes & Tronstad, 1979; Sjögren *et al*., 1990), while, on the other hand, one study has noted that it made a 15% difference for a worse outcome (Ng *et al*., 2011a, 2011b). It has been considered the flare up may be due to the presence of intra-radicular infection whereby obturation entombment has not been sufficient and or extra-radicular infection or foreign body reaction during the treatment (Siqueira, 2003).

1.5.4.2.7 Length of Root Canal Filling

The root canal filling (RCF) material itself has not been identified to be a major factor in the outcome (Gulabivala & Ng, 2023) other than its length and the quality judged on radiographs, but, on the other hand, the length of the RCF has been a widely accepted technical factor in provision of RCT, with numerous researchers finding it to be the single most important factor (Dammaschke *et al*., 2003; Kojima *et al*., 2004; Ng *et al*., 2008, 2011a, 2011b; Shafer *et al*., 2005). However, others report that it may not apply to teeth which do not have apical periodontitis (Byström, 1986; Chugal *et al*., 2003; Cvek, 1976; Seltzer *et al.,* 1969, 2004).

The length of the RCF has been considered a surrogate measure of the penetration of irrigation and medicaments with their associated anti-microbial effects, but effective irrigation and medication have also been shown to have an impact on the apical dynamic status of infection (Vera *et al*., 2012). In this regard, retrospective and prospective studies have found length to be a crucial factor (Ng *et al*., 2011a; Sjögren *et al*., 1990). It is often accepted that if the chemo-mechanical preparation has been carried out well, then a RCF will follow it to the same length, while poor length of the RCF is a proxy for poor length control of the chemo-mechanical preparation. The ESE quality guidelines for endodontic treatment (2006) state that RCF may be 0.5-2mm from the radiographic apex and other terms such as apical constriction, cemento-dentinal junction may be utilised. It is clearly accepted that extrusion should be avoided in order to gain a good healing outcome (Gulabivala & Ng, 2023). Some late failures with extrusion have been considered to be due to possible excess force used during obturation, with this resulting in minor cracks in the root (Kishen, 2005) which, with time, can result in root fractures and re-infection (Ng *et al*., 2011b).

1.5.4.2.8 Quality of Root Canal Filling

The quality of the RCF has been considered an indirect measure of the standard of preparation and filling and has been considered to have a powerful impact on the outcome of root canal treatment. In this regard, the density of the RCF has been considered to be related to the taper of the preparation. Poor quality RCF was found to be associated with increased incidence of extraction (Kirkevang *et al*., 2014) and a good RCF associated with better survival (Goransson *et al*., 2021). The unsatisfactory

RCF was associated with worse outcome while judged by either radiograph (as two-dimensional (measure) and more recently with CBCT (a three-dimensional measure): thus, irrespective of the imaging technique, a satisfactory RCF relates to a better outcome (Ng *et al*., 2008; Fernández *et al*., 2017; Liang *et al*., 2011).

Obturation techniques comparing cold to heat have been investigated in a meta-analysis, with no difference being found between the two in respect to favourable outcome of treatment (Peng *et al*., 2007). The quality of RCF and the presence of a coronal seal have also been shown to be important factors (Saunders & Saunders, 1994).

1.5.4.3 Post-operative Factors

The effect of the post-operative coronal restoration placed following the RCF in relation to the health of the periapical tissues and tooth survival have been investigated (Ng *et al*., 2008, 2011a, 2011b). These workers found that satisfactory quality of a coronal restoration placed after RCF provided three times better peri-apical healing than those that had an unsatisfactory coronal restoration. In this regard, the satisfactory restorations varied from very good seal to adequate, but in most cases where judgement is based on visible margins and radiographs, it was found that it does not confirm the status of the inner core, whereby it may be inadequately adapted to the root canals, and contain voids (Hoskinson *et al*., 2002; Ricucci *et al*., 2011). The prospective studies by Ng *et al*. (2011a, b) adopted a strict definition for unsatisfactory restorations which included obvious signs of exposed RCF and potential leakage by marginal defects and history of de-cementation: they found this factor to be significant

for probability of healing. This was further confirmed with a recent study by Jurič *et al.* (2024).

Restorations can vary by the surfaces they occupy, this often being dictated by the remaining tooth structure, and restoration quality can vary based on the material used as well as the design of the restoration, for example, whether it was a cuspal coverage restoration, or not. The time after placement of the RCF has also been investigated (Mannocci *et al*., 2021) in relation to placement of a cuspal coverage restoration. This may be a consideration due to costs involved and a wait period for stakeholders to ascertain if the RCT has been uneventful (Landys Borén *et al*., 2015; Mannocci *et al*., 2021; Sorenson & Martinoff, 1984). Studies which have assessed fracture as mode of failure post RCT have identified the initial months after RCT to be high risk, so a risk benefit analysis is required for decision making (Aquilino & Caplan, 2002; Pratt *et al*., 2016).

1.5.4.3.1 Quality of the Restorations

Investigation of quality of the RCT and the quality of coronal restoration has found that the quality of the coronal restoration may be more significant than the quality of the RCT (Hommez *et al.,* 2002; Ng *et al*., 2008; Ray & Trope, 1995; Saunders & Saunders, 1997; Siqueira *et al*., 2005). The ideal scenario has been reported as the best of both, namely a good RCF and a good coronal seal, these being factors which are highlighted to dentists by all educators. Therefore, while the RCF which may be considered to be more challenging and performed blindly as opposed to placement of coronal

restorations which will be more clearly visible, it has been shown that it is imperative to minimise coronal leakage as a cause of future failure (Saunders & Saunders, 1994).

1.5.4.3.2 Type of Restoration

It has been reported that a permanent restoration should ideally be placed in the first 90 days following the RCF (Mindiola *et al*., 2006). The non-permanent/provisional restoration has been identified as a significant factor for failure (Caplan *et al*., 2002; Dammaschke *et al*., 2003; Lazarski *et al*., 2001; Lynch *et al*., 2004; Salehrabi & Rotstein, 2004). The types vary from a plastic restoration placed to seal the access cavity (for example, an amalgam filling) to those that restore the loss of remaining tooth structure, for example a large cusp-replacement restoration or a crown. There are cases when the plastic restoration is placed as core material for cuspal coverage, or complete coverage, restoration. There may also be teeth that have so little remaining tooth structure so that they require a post and core to restore the tooth with a cuspal coverage restoration. Of course, it goes without saying that the “restorability” of a given tooth should be assessed prior to commencement (or not) of RCT.

The worst survival of RCT teeth has been associated with teeth that have not had a permanent coronal restoration after the RCF was placed (de Chevigny *et al*., 2008a, 2008b; Fransson *et al*., 2021; Friedman *et al*., 1995; Mindiola, 2016; Ng *et al*., 2011b; Pratt *et al*., 2016). On the other hand, other workers found that the type of permanent

restoration did not affect the periapical healing in outcome studies (de Chevigny *et al*., 2008a, 2008b; Friedman *et al*., 1995; Ng *et al*., 2011a, 2011b; Sjögren *et al*., 1990).

Gulabivala (2004) has reported that tooth survival is likely to be influenced by distribution, amount, strength and integrity of the remaining tooth tissue, the occlusal and functional loading of the tooth and the way the load is distributed within the remaining tooth structure, supported by Fedorowicz *et al* (2012).

1.5.4.3.3 Direct vs Indirect Coronal Restorations

Direct restorations are plastic restorations, while indirect restorations require an impression (physical or digital) of the cavity or preparation to be sent to a laboratory for production of the restoration. With the evolution of technology, scanners are starting to take the place of impression taking in some situations and milling machines allow for fabrication of the coronal restoration chairside. Comparisons have been made between plastic restorations and crowns and a majority found that crowns result in a better outcome (Dammaschke *et al.,* 2013; Dawson *et al*., 2017; de Chevigny *et al*., 2008a, 2008b; Fransson *et al*., 2021; Friedman *et al*., 1995; Landys Borén *et al*., 2015; Ng *et al*., 2010, 2011a, 2011b; Wigsten *et al*., 2018, 2024). In Sweden, researchers found that teeth which had been restored in the first 6 months after RCT with an indirect restoration performed better, at 93%, than those that had a direct filling,

at 90% (Fransson *et al*., 2016). This agrees with a systematic review indicating ten-year survival of 81% with indirect restorations compared to 63% for direct restorations (Stavropoulou & Koidis, 2007).

A comparison of direct *vs* indirect restorations was not significant for periapical health (Ng *et al*., 2011a) but it was significant when it was assessed by tooth survival (Fransson *et al*., 2021; Landys Borén *et al*., 2015; Ng *et al*., 2010, 2011b; Pratt *et al*., 2016; Suskaphar *et al*., 2018; Stavropoulou & Koidis, 2007). Other studies have demonstrated that placement of a crown increased the survival of the RCT-treated tooth by nearly 4 times (3.92) more than those for which a crown was not placed (Alley *et al*., 2004; Aquiliono & Caplan, 2002; Lazarski *et al*., 2001; Lynch *et al*., 2004; Ng *et al*., 2010). It has also been considered that indirect restorations provide heightened protection for fractures and improved the coronal seal (Sequeira-Byron *et al.,* 2015, 2015). Some teeth may need a crown yet are restored with a direct restoration (Dawson *et al*., 2021) because of costs: however, some clinicians have been known to place cusp coverage restorations (historically amalgam overlays), and more recently in resin composite.

One insurance database study found that among extracted teeth, 85% did not have full coronal coverage, and noted that for teeth without a crown, RCT teeth had a 4.8 times higher risk for extraction in anterior teeth, 5.8 times in premolar teeth and 6.2 times in molar teeth, compared to those that did not have a crown (Salehrabi & Rotstein, 2004): this is in agreement with the findings of others (Aquilino & Caplan, 2002, Zadik *et al.,* 2008).

One group had reported that 59% of failures occur due to failure of the coronal restoration or fracture of tooth structure (Vire *et al*., 1991) further supported by a 20-year follow up by Prati *et al* (2018). Another reported that RCT teeth had more unfavourable subgingival fractures (Fennis *et al*., 2002) and another study found that 84% of fractures occurred at crestal level or below, thus resulting in poor prognosis of the RCF tooth that had fractured (Lagouvardos *et al*., 1989). Large amalgam restorations were found to perform worse than cuspal coverage restorations (Hansen *et al*., 1990), this further being confirmed by work of Reeh *et al*. (1989) who showed that an endodontic access cavity only decreased stiffness by 5% while a mesial occlusal distal (MOD) decreased stiffness by 60%, contributing to a multifactorial basis for failure.

In the NHS GDS database, small restorations were associated with better survival of restorations than large MOD restorations or those in need of a pin and RCT (Lucarotti *et al*., 2005a). These workers also investigated general survival of restorations for teeth restored with indirect restorations and found they performed well, given that, at 10 years the survival of crowns was best with metal crowns at 68%, while 53% of laminate veneers had 53% survival at 10 years (Burke & Lucarotti, 2009c, 2009e, 2012).

Salehrabi & Rotstein (2004) found that with RCT teeth, those that needed reintervention, either by reRCT, RES or XLA, occurred mainly in the first 3 years after RCT and, of those that were extracted, 85% had no full coronal coverage restoration. Other groups investigating comparison between plastic restorations showed a similar

outcome between the different types (Dammaschke *et al*., 2003; Mannocci *et al*., 2005; Petersson *et al*., 2016).

1.5.4.3.4 Remaining Tooth Structure

The amount of tooth structure has been examined by investigators with different parameters, with two studies investigating a restorability index for deciding on the prognosis and advising the need for cuspal coverage restorations (Dawood & Patel, 2017; McDonald & Setchell, 2005). Remaining tooth structure has been considered important for healthy periapical tissues (Al-Nuaimi *et al*., 2017). One researcher has reported that most teeth that require root canal treatment have been already restored (83.5%), mainly with direct composite restorations (Wigsten *et al*., 2019). An association with the amount of loss of tooth structure has been identified, with two studies (Al-Nuaimi *et al*., 2020; Nagasiri & Chitmongkolsuk, 2005), indicating that that teeth with the smallest amount of tooth structure loss performed markedly better than those that had 30% or less tooth structure remaining. It has been accepted that the latter group may also be more challenging to isolate with dental dam and restore, therefore the increased risk of microleakage and its effects on the surrounding tooth structures cannot be ignored (Creugers *et al*., 2005; Fokkinga *et al*., 2007). There is lack of research on the type of operator in management and the outcome of the severely broken-down tooth, and there was no significant difference between the different operator types from two studies which were identified; one study compared decision making of postgraduates to GDPs based on the tooth restorability index

(Murphy *et al*., 2009), while another has investigated GDPs and Prosthodontists (Eckerbom & Magnusson, 2001).

1.5.4.3.5 Tooth Surfaces

Posterior and anterior teeth are investigated in slightly different ways because their anatomical morphology is different, hence the surfaces are different for each tooth type, with differing functions. In the majority of patients, the posterior teeth have the function of mastication by grinding/chewing and hence dealing with heavier forces, whereby the anterior teeth have a more shearing and gliding movement. There are exceptions to these, for example for patients with anterior open bites or a reverse overjet, where there is therefore a completely different distribution of occlusal forces (Mannocci *et al*., 2021). Posterior teeth with compromised marginal ridges and heavy occlusal loading have been identified as groups that would benefit from cast cuspal coverage restorations (Reeh *et al*., 1989; Nagasiri & Chitmongkolsuk, 2005). In that regard, it has been advised that once three surfaces or more have been lost from a RCF tooth, it should have a cuspal coverage restoration (Salehrabi & Rotstein, 2004).

1.5.4.3.6 Abutment Tooth for Prosthesis

The role of an abutment for a fixed and removal prosthesis allows the tooth to continue to function as a tooth but also support a pontic, which could mean a change in the long-term prognosis of that tooth, due to increased loading upon the abutment tooth

(Gulabivala & Ng, 2023). In that respect, the RCT tooth used as an abutment has been associated with reduced survival of the tooth (Alley *et al*., 2004; Lazaraski *et al*., 2001; Mindiola, 2006; Ng *et al*., 2010; Pratt *et al*., 2016; Salvi *et al*., 2007). Abutment teeth range from those that are under an overdenture to those that are part of a long span fixed conventional bridge. Comparisons have been made with RCT teeth as non-abutment *versus* abutment teeth (Ng *et al*., 2011a, 2011b; Sjögren *et al*., 1990) with results indicating that they do not perform as well. Two studies investigating results with the RCT tooth used as an abutment for removal prosthesis when compared to a fixed prosthesis have been inconclusive (Alley *et al*., 2004; Wegner *et al*., 2006).

1.5.4.3.7 Presence of Post

The role of a core has been reported to be more important than the placement of the post (Sorenson & Martinoff, 1984). The post retained core and cuspal coverage restoration is considered one of the last restorative steps in saving a tooth, given that, in such cases, there was likely to be limited tooth structure necessitating the placement of a post to retain the core: hence, a cuspal coverage restoration, generally a crown, could be placed to bring the tooth into function. Comparisons have been made with presence and absence of a post *versus* absence of posts (Friedman *et al*., 1995; Ng *et al*., 2011a, 2011b). A meta-analysis by Ng *et al*. (2010) found that there was no statistically significant correlation between the post core and survival of RCT teeth. The same group found, in their prospective study, that there was a 2.6-fold increase in chance of extraction if a cast post core restoration was used (Ng *et al*., 2011a).

Posts have been investigated by Pratt *et al*. (2016) in a retrospective investigation: this found that posts did not make a difference on survival. Other workers have not been able to identify a significant difference with the use of posts, and not using them, in survival of RCT teeth (Aquilino & Caplan, 2002; Caplan *et al*., 2002; Caplan & Weintraub, 1997; Fransson *et al*., 2021; Naumann *et al.,* 2018; Salehrabi & Rotstein, 2004). Fibre posts performed well when compared to other posts by two groups (Schmitter *et al*., 2011; Wang *et al*., 2019).

1.5.4.3.8 Time post RCT

The literature indicates that coronal leakage can penetrate the root canal system once it has been filled, and that this can occur in less than 30 days (Khayat *et al.,* 1993). It also confirms that those teeth that had placement of cuspal coverage restorations soon after the placement of RCF appear to survive better than those with a delay (Khayat *et al.,* 1993; Pratt *et al*., 2016). Teeth with temporary restorations have a larger risk of microleakage (Balto, 2002) and catastrophic fractures (Pratt *et al*., 2016), and comparison being made by researchers (de Chevigny *et al*., 2008a, 2008b; Friedman, 1995; Ng *et al*., 2011a, 2011b) indicates that some dentists may wait on teeth with AP to heal before providing a crown (Chugal *et al*., 2007).

The type of crown has been investigated, with results indicating that that various types are associated with better RCT survival (Goransson *et al*., 2021; Studer *et al*., 2000; Walton, 2013). Research indicates that those teeth that have not been permanently restored within 90 days after RCT had a higher failure rate (Mindiola, 2006) and those

in which the interval following RCT and coronal restoration is more than 4 months also have a 3-fold increased risk of being extracted (Pratt *et al*., 2016). Fransson *et al*. (2016) also found that those still unrestored after 6 months had the lowest survival rates in their investigation of 86% at 5-6 year follow up.

The wait time before the final restoration has been placed has not been easy to investigate; to minimise coronal leakage, the operator may place a plastic restoration or core on the tooth immediately after placing the RCF. The final restoration may be a cuspal coverage restoration, but this may be only placed once the patient can afford to do so, this being due to finances or time or both (Pratt *et al*., 2016).

1.5.4.3.9 Proximal Contacts

The presence of proximal contacts means that there is a tooth on either side of the RCT tooth and potentially during chewing the load is distributed. The loss of contacts has been identified by a number of investigators as a factor that reduces survival of the RCT tooth (Alley *et al*., 2004; Al-Nuaimi *et al*., 2020; Aquilino & Caplan, 2002; Ng *et al*., 2010, 2011a). On the other hand, another investigator did not find it to be a significant factor (Goransson *et al*., 2021). Regarding position of the tooth in the dental arch, the most terminal tooth has been reported to experience a heightened risk for extraction (Ng *et al*., 2011b), which may be related to development of cracks and fractures due to fatigue (Walton, 2002, 2003).

1.5.4.3.10 Tooth Location

The location of the tooth may be a prognostic factor, as it can play a role in risk benefit discussions when deciding to treat or extract a tooth. Location can be divided into maxillary (upper) or mandibular (lower) teeth, anterior or posterior teeth, or tooth notation specific which then depicts exactly the tooth type (Aquilino & Caplan, 2002; Ng *et al*., 2011b; Tan *et al*., 2006). One group investigated if restorations and tooth type had any impact as well as age, with the results indicating that there were associations (Fransson *et al*., 2016, 2021).

1.5.4.3.11 Presence of Cracks

Cracked teeth have been discussed frequently in dentistry: various types of cracks exist, and cracked teeth can be challenging to diagnose. The AAE classification which appears commonly utilised was approved in 2016 and was included in the 2020 Glossary of terms. They use the following terms: abfraction, infraction (Craze line), cracked tooth, longitudinal fracture, vertical root fracture and split tooth. (McClanahan, 2020).

The history of cracked teeth and cuspal fractures may be considered a surrogate to the presence of heavy occlusal forces. The ESE describes a cracked tooth as an incomplete fracture involving dentine, which extends from the crown of the tooth in an apical direction. Cracks most commonly present in the mesio-distal plane in posterior teeth and may extend to variable depth within the crown and/or root (Mannocci *et al*.,

2021). The one-year survival of RCT teeth with cracks has been estimated to be 88% (Olivieri *et al*., 2020), and two-year survival to be 85.5%-100% (Davis & Shariff, 2019; Kang *et al*., 2016; Tan *et al*., 2006) with a range of 5-year survivals reported to be 68%-97% (Nguyen & Jansson, 2021; Sim *et al*., 2016).

Long-term survival of RCT teeth with cracks has not been widely reported in systematic reviews. One group reported 84.1% at 5 years (Leong *et al*., 2020) and another on 10-year survival of 54% (Nguyen & Jansson, 2021). The latter group also compared crowned teeth to composite restorations and found a difference of 95% to 37% respectively after 10 years. A systematic review by Leong *et al*. (2020) also found that multiple cracks, pre-operative presence of a periodontal pocket associated with the crack, crack extending into the root and the terminal tooth, all had a detrimental effect on the prognosis.

1.5.4.3.12 Occlusal Stresses

Occlusal forces for the “average” patient have been considered to be mainly due to mastication, but comparisons between anterior and posterior teeth with direct and indirect restorations have not been carried out (Kumagai *et al*., 1999). The occlusal loads and stresses can be further complicated with extra forces other than mastication, due to parafunctional habits. Other habitual excessive bite forces may be present because of an unfavourable occlusion which may be naturally inherited or due to dental interventions. The effect of the opposing dentition has not been widely assessed, although results of one study (Pratt *et al*., 2016) indicated that it does not

have a significant influence on survival of the RCT tooth, whether it is present or not, and if present, a natural tooth or fixed prosthesis.

Patients may exhibit parafunction, with clinical signs being large masseters, signs of tooth wear, and soft tissue markings such as *linea alba*, and/or cheek biting (Demjaha *et al*., 2019). Excessive occlusal forces due to poor design of restorations can be investigated for premature contacts using articulating papers, and or study models mounted on appropriate articulators (Goldstein & Clark, 2017). In this regard, poorly designed restorations leading to unfavourable loads can fail, and may often be related to failure due to cracks and fractures caused by fatigue (Masumoto & Goto, 1970; Walton, 2002, 2003). Some researchers report that if occlusal loads are favourable, high survival rates may be achieved with teeth used as abutments (Lazarski *et al*., 2001; Salvi *et al*., 2007).

1.6 Improved Health

Oral health care interventions and improving technologies have facilitated potential for improving outcomes of dental care. However, regarding survival/success of RCT unfortunately there has not been any marked improvement with time, despite the significant advancement of technology (Gulabivala & Ng, 2023).

In many countries a mismatch has been noted between the oral health needs of the community and the availability of oral health services. It is widely accepted that not many countries have a strong public oral health care service, while in most countries

the demand and the delivery of care are mismatched and the provision of care by the private sector leads the service, leaving some unable to afford the necessary care (Gulabivala, 2018). The WHO reports that the promotion of oral health and clinical management of oral diseases requires an oral health workforce that needs the ability to implement better care. Unfortunately, there are reports of challenges for access to care in rural and disadvantaged populations (WHO, 2022). In the UK, like other high-income countries, the dentist–population ratio is better and reported to be 6.85:10,000 (although this is variable throughout the country), while low-income countries report a dentist–population ratio of only 0.57:10,000, which is more than 12 times lower, yet reports abound of difficulties facing access to dental care in the UK too. The Department of Health and Social Care report and the annual accounts of 2022/23 have shown that £2.899bn was spent on NHS dentistry, while the British Dental Association (BDA) reported that this figure can be translated into savage cuts, with the budget for NHS dentistry falling by over a third in real terms since 2010 – which translates to a reported real cut of £1bn (BDA, 2024). Investment into NHS dentistry requires evidence to support the need for treatment and beneficial outcome of the treatment.

1.6.1 Outcome Measures and Gaps in Our Knowledge

Various outcome measures assessing the effectiveness of treatment and value for the stakeholders have been reported (Dawson *et al*., 2024; Kwak *et al*., 2019; Lin *et al*., 2014; Raedel *et al*., 2015b; Salehrabi & Rotstein, 2004). Investigators have recently examined the evidence available in endodontics and provision of care as part of the ESE S3 level clinical practice guidelines (Duncan *et al.,* 2023). They have highlighted

that ideally there should be evidence from around the globe. In that regard, clinical trials and multi-centred outcome studies that could fill in the gaps present in current knowledge and recommendations for research into these has been considered (Rossi-Fedele & Rodig, 2022). Some reports found that there is less evidence of RCT on benefits to patients and society, especially when compared to technical and biological outcomes (Duncan *et al*., 2021; Kirkevang, 2023; Wrangstål *et al*., 2024).

The currently available literature indicates there is scope for all types of outcome measures in order to paint a picture of what may be occurring with teeth that require RCT. A narrative review by Fransson and Dawson (2022), on tooth survival after RCT, concluded that it was obvious that studies on prognostic factors regarding the survival of RCT teeth are largely missing, but that the prognosis is likely to be dependent on tooth-related conditions such as restorability, and the impact of using different restorations such as posts. Gulabivala and Ng (2023) stated that prognosis discussions should "take account of the feasibility of both biological (periapical lesion size and symptoms) and technical (root canal system complexity and operator competency) control of the root canal infection, as well as the prospect of sustaining any root-canal-treatment-induced microbial control through tooth and restorative interface integrity. The endodontist must therefore have insight about factors influencing tooth restoration and survival".

Healthcare is considered to be an expensive endeavour, including costs for endodontic treatment, therefore comparisons to other options as part of health economic research has been highlighted and a call to further investigations made (Schwendicke & Herbst, 2023). The RCT provided by GDPs in the NHS is an option

to retain teeth, however, it is imperative that under current financial pressures with stakeholders the evidence from the NHS GDS is examined for the analysis of survival of RCT teeth and prognostic factors. Also, it is important to have an understanding that other factors that may affect outcome include patient factors, dentist factors as well as specific tooth factors including the type of restoration that may be best suited after RCT.

The opportunity is available in this project to utilise evidence from the NHS GDS healthcare in England and Wales for the provision of RCT, based on their regulations, and general practice parameters, by accessing a large sample of patients thus examining a very large number of teeth RCT teeth, observed over a long period; this should allow the stakeholders to examine the results and compare these with other scientific evidence, such as has been identified in this review. Furthermore, it is imperative to state that consideration is given to real-world data from primary dental care, the arena in which majority dental treatment for the general population is provided, worldwide.

The ESE identified that tooth survival was the most critical of all outcome measures in its 4 working groups examining endodontic treatments (Duncan *et al.,* 2023). The literature suggests that survival is now considered a recognised outcome measure for examining success of RCT when investigating a large patient database. The tooth-level data available based on the data records allows for the various factors to be examined in England and Wales: unfortunately the system has evolved away from the collection of tooth-level data and changed to the Unit of Dental Activity (UDA) system,

hence it can no longer allow access to as much detail as previously available based on tooth level items of service renumeration claims (Lucarotti & Burke, 2018a).

GDPs may be disheartened when discussing outcome of RCT as they compare their results to specialists, yet it is important that in the UK there are data available to provide evidence that supports the steps they take in saving teeth for the nation and that their hard work under NHS GDS pressures are valued.

There are gaps in the literature: some may be addressed with this study. Information on the history of a dental restoration placed for a given tooth prior to RCT is potentially significant as a surrogate for amount of tooth structure: however, this appears lacking, and more so in the large database survival analysis of RCT teeth. The literature also suggests that RCT teeth restored with a crown appear to have a better outcome than other types of restorations, while the types of crowns by GDPs have not been widely investigated.

The shortage of dentists and NHS cuts are challenges facing NHS GDPs in addition to their belief that their treatment is not as successful as a specialist in Endodontics. The current outcome measures accept that survival of RCT teeth is a reasonable measure in analysis of large databases, hence it is imperative to support NHS dentistry with data utilising the same source and try to address the questions raised in the literature. This includes identification of prognostic factors for survival of RCT teeth as well those that influence placement of an ideal restoration for better longevity of the RCT tooth. As discussed, the current UDA system in the NHS will not allow for this work to be carried out in the same detail as previously, hence it is imperative that the

data from the fee-per-item system, as described in this study, is utilised in this study to answer these questions.

Therefore, the aim of this project was to investigate the survival of root canal treated teeth in the NHS GDS in England and Wales and identify any associated factors to better survival.

The objectives were to investigate;

1. The overall survival of root canal treated teeth.
2. The general dentist factors including gender, age and region of the dental practice.
3. The general patient factors including gender, age, socio-economic status.
4. The role of restorations before and after RCT in survival of the root canal treated teeth.

Chapter 2 Materials and Methods

2.1 Introduction

One of the most common dental treatment options to save teeth, is root canal treatment (RCT) and this is most often provided by General Dental Practitioners (GDPs) in the National Health Services General Dental Services (NHS GDS). This research project investigated outcomes for RCT teeth in England and Wales by GDPs in a unique opportunity using a database that could shed light on survival rates and evaluate any factors associated with survival, as the newer system does not contain as much detail on the provision of dental care.

2.2 Materials

2.2.1 Database

The source of the data was the database produced by the Dental Practice Board (DPB) from claims for payment made by GDPs providing care for patients in the GDS, as part of their service level agreement with the Department of Health (DoH), for the provision of NHS dental treatment in the England and Wales. The DPB held administrative data for dental treatments from *circa* 35 million courses of dental treatment per year including information about the patient, dentist and the tooth they

had treated. The *Longitudinal Dental Treatment* dataset is available for download from UK Data Service. It traces the NHS primary care dental treatments for a c5% cohort of patients treated in England and Wales between 1990 and 2006. The dataset is intended to be used primarily as a resource for academic research, it was originally developed by NHS Dental Services, now part of the NHS Business Services Authority (NHSBSA), but has since been transferred to the Information Centre for Health and Social Care (HSCIC). The data collection ceased in 2006 with the introduction of the 2006 NHS Dental Contract and there is currently no ongoing data collection for the original cohort of this study, nor any current plans for a similar exercise.

This dataset was downloaded as a SPSS data file under study number 7024 (SN7024), available since August 2012 from UK Data Service (https://ukdataservice.ac.uk/), which allows access to the UK's largest collection of economic, population and social research data for teaching, learning and public benefit. The patient data included more than three million different patients and over 26 million courses of treatment. The dataset used for this study was the age-stratified randomised sample of anonymised patients and their treatments over a 15-year period, (1/10/1990 to 31/3/2006), when this system of remuneration for GDPs ceased. (Lucarotti & Burke, 2018a).

2.2.2 Statistical analysis

The statistical analysis was carried out using IBM® (International Business Machines, Armonk, NY, USA) SPSS, (version 29) to calculate and develop the survival curves for each type of prognostic factor affecting survival of an RCT tooth.

2.3 Methods

2.3.1 Survival analysis

Kaplan and Meier (1958) developed a method for analysis of incomplete survival data between time periods, e.g. ‘life’ and ‘death’. The Kaplan-Meier (KM) estimator is the most used method and considered the bedrock of survival analysis (Collett, 1994). The KM curve uses a dataset, although it is not strictly a curve but made of many steps, like a staircase, with many steps joined together to resemble a curve. The curve is smooth when the sample is large, and the time has been measured in small increments and does not rely on any parameters. Therefore, a KM survival curve is considered to be a bespoke survival curve reflecting the underlying data itself.

Survival analysis measures the time to an event e.g. death or in this study reintervention (Re-RCT or Root End Surgery/Apicectomy or Extraction), from a relevant exposure e.g. RCT of a tooth. When the exact time to an event is unknown for an observation, censoring is applied so that the available data can be used for the survival analysis. The KM method allows for censored data so all cases with the exposure to the risk (e.g. reintervention) can be included.

The interval between time periods used for this research project were RCT as the starting point, with reintervention as the end point. Reintervention was defined as the

need for re-root canal treatment, apicectomy (root end surgery/RES) or extraction of the RCT tooth. The overall survival for all the programs was calculated based on these reinterventions as used in two other very large database studies (Raedel *et al.,* 2015a; Salehrabi & Rotstein, 2004).

An additional analysis was carried out with extraction as the endpoint (excluding Re-RCT or apicectomy/RES), so that survival based on extraction only could be compared to three large database studies, as they had used extraction as their only outcome measure (Fransson *et* al., 2019; Kwak *et al.,* 2019; Lin *et al.*, 2014).

The analysis was carried out using a modified KM methodology to establish the survival curves, up to fifteen years. The unmodified or classical method is used in prospective clinical trials, by meticulously recording loss of cases in drop-outs due to various reasons. Retrospective studies have the limitation that the attendance record cannot be scrutinised in the same way. Two parameters need to be considered, one being that patient is no longer in the system because they have left the population and secondly if they have left, when did this occur. As the observation period in this study was relatively long (15 years), when compared to the other large database studies (Burry *et al.,* 2016; Fransson *et* al., 2019; Kwak *et al.,* 2019; Lin *et al.*, 2014; Raedel *et al.,* 2015a; Salehrabi & Rotstein, 2004) and it was accepted that the latter helped to address this problem. The dataset also has the details of last attendance by the patient, which can help estimation of re-attendance, therefore the KM method was modified, to take follow up time into account.

The modified KM methodology used on this dataset was initially reported and used by Lucarotti *et al.* (2005a; 2005b; 2005c; 2014). It was later shown to be beneficial to use the follow up time for the modification for this dataset (Burke & Lucarotti, 2018a-e; Lucarotti & Burke, 2018a-e).

The modified KM methodology was used to produce survival curves extending to fifteen years (calculated in days). The programs were set up to analyse survival of RCT teeth in number of days to reintervention, but the x-axis of the graphs was set to five-year intervals instead of number of days to allow for easier interpretation.

The process of writing the SPSS analysis programs for each area of investigation involved meticulous program writing, including appropriate name, date, and version number (Appendix 8). The latter was required to allow an audit of activity throughout the writing and development of the program, to minimise errors. All programs were also checked for plausibility, by double checking the output and the files produced as part of the outcome, and each program took many hours to write and underwent various versions until a successful program was produced. Once a program was able to answer the question it was being asked, and had functioned without any error and signs, it was accepted as the final valid version of the program. These versions of each program are presented in Appendix 8, and their outputs (result) are presented in Appendix 9, which includes tables and survival graphs in their raw state.

2.3.2 Foundation programs

The 42 SPSS ‘foundation programs’ developed and used in this research project, are summarised in the following sections. The inclusion criteria for this study were that the patient had to be over the age of 18 and had a tooth which had RCT. It was decided to limit the age to 99 years, as there would not be many follow ups for patients beyond this age, and also patients born around the millennium could be erroneously entered as being over 100. The foundation programs were restricted to adult patients and those that had RCT teeth included GDS claims, teeth treated and reattendance probability.

Three programs were used to filter RCT teeth from other teeth as shown below:

Program 1 - Teeth treated

Program 2 - Root filled all teeth intervals

Program 3 - Root filled all teeth preparation.

A mind map of the programs and how some programs fed into others was produced to allow ease of understanding in a schematic way (Fig. 7).

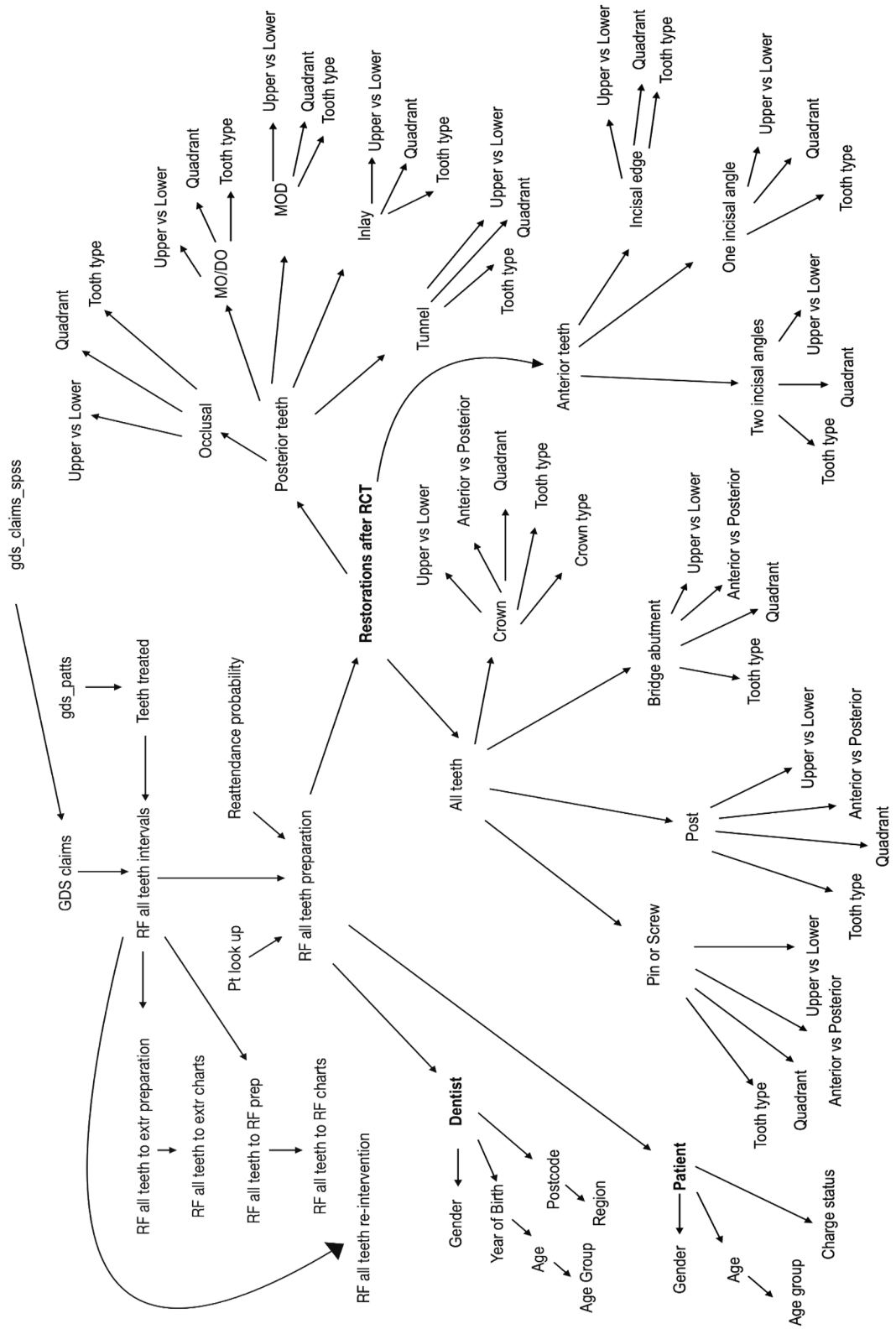


Figure 7 Mind map of the IBM SPSS Programs

2.3.3 Root Canal Treated Teeth

These programs were written to investigate the potential factors affecting the survival of RCT teeth, based on two broad categories: dentist factors and patient factors, and then a specific factor of the tooth itself.

2.3.3.1 Dentist Factors

The general dentist factors investigated were:

1. Gender (male or female)
2. Age (by year)
3. Age group (by decade)
4. Postcode of the practice (nine regions).

The year of birth of the dentist was in the dataset as an entry and the year they carried out the RCT was also provided in the dataset, and these were used to identify the age of the dentist, by subtracting them from each other, and then further grouped into decades, starting from those in their 20s, and ending with those in their 70s.

The postal codes of each practice were allocated to eight recognised geographical regions in England and the postcodes in Wales were pooled together in one group, resulting in a total of 9 regions. The relevant programs and corresponding results for the three dentist factors are summarised in table 3.

Dentist Factors:	**Program:**	**Results:**
Gender	*Appendix 8.2.1*	*Appendix 9.2.1*
Age (year, decade)	*Appendix 8.2.2*	*Appendix 9.2.2*
Region (postcode of the practice)	*Appendix 8.2.3*	*Appendix 9.2.3*

Table 3 Programs investigating Dentist factors

2.3.3.2 Patient Factors

The general patient information investigated were:

1. Gender (male or female)
2. Age (by year)
3. Age group (by decade)
4. Financial status for the treatment (fee paying or not).

Patient's ages were investigated individually and then by decade in order to compare to other epidemiologic studies. The patient's age group was based on the following decades; 18-19, 20-29…70-79, 80 or older, therefore a patient was reported to being in their 20s or 30s or 40s and so on.

The charge status of the patient was categorised in the database; as full charge, exempt or remission. The charge status indicated patients who had not paid the full patient charge and was used as a surrogate measure for their socio-economic status. It is important to note that some patients were not paying the charges as they were from low-income households (remission), while others may have been pregnant or

had a baby under 12 months old (exempt). The relevant programs and corresponding results for the four patient factors are summarised in table 4.

Patient Factors:	**Program:**	**Results:**
Gender	*Appendix 8.3.1*	*Appendix 9.3.1*
Age (year, decade)	*Appendix 8.3.2* *Appendix 8.3.3*	*Appendix 9.3.2* *Appendix 9.3.3*
Financial status for the treatment (Fee paying status).	*Appendix 8.3.4*	*Appendix 9.3.4*

Table 4 Programs investigating Patient factors

2.3.3.3 Dental Factors

The third category was a detailed exploration of tooth factors. The various comparisons were made based on location of the tooth, initially comparing upper to lower teeth, using codes of upper and lower as filters in the program. The comparisons of anterior teeth (incisors and canines), to posterior teeth (premolars and molars) were carried out. There was also assessment of the four quadrants, comparing each corner of the mouth to each other, this was followed by assessing tooth types based on dental anatomy. The anatomy of upper right and upper left tooth types are similar therefore upper teeth were made of eight tooth types; the lower teeth followed the same principle, coded U for upper and L for lower teeth, plus 1 to 8 numerical value to reflect the tooth codes; the program in appendix 8.4 and result output in appendix 9.4.

All teeth investigated by:	**Location of RCT Tooth and its survival based on Reintervention investigated by:**
Survival to reintervention	*Upper vs Lower*
Survival to extraction	*Anterior vs Posterior*
	Quadrant
	Tooth type

Table 5 Programs investigating Tooth factors

Further analysis was carried out based on the restorations placed after RCT, for each restoration, the location of the RCT tooth was based on the previously mentioned tooth types (as shown in Table 6). This was a surrogate measure for the amount of remaining tooth structure based on the type of restoration.

All teeth:	**Anterior teeth:**	**Posterior teeth:**
Crown	*Incisal edge restoration*	*Occlusal restoration*
Bridge Abutment	*One incisal angle*	*MO/DO restoration*
Post	*Two Incisal angles*	*MOD restoration*
Pin or Screw		*Inlay*
		Tunnel

Table 6 Programs investigating Restorations placed after RCT

There were four types of restorations that were generic to all teeth, three restoration types were specific to anterior and five to posterior teeth, therefore a total of twelve types of restorations were investigated. The four types of restorations that were

provided on all tooth types were crown (Table 7), bridge abutment (Table 8), post (Table 9) and pin or screw (Table 10). The programs analysed each of these restorations after RCT, reporting on the survival function, with each table representing the survival graphs made from the analysis. The crowns had various types, so this was also captured in the analysis.

Crown program: **Appendix 8.4.1.1**	**Survival graphs:** **Appendix 9.4.1.1**
	Crown vs all other RCT teeth
	Upper vs Lower
	Anterior vs Posterior
	Quadrants
	Tooth types
	Crown types

Table 7 Programs investigating Crowns placed after RCT

Bridge abutment program: **Appendix 8.4.1.2**	**Survival graphs:** **Appendix 9.4.1.2**
	Bridge abutment vs all other RCT teeth
	Upper vs Lower
	Anterior vs Posterior
	Quadrants
	Tooth types

Table 8 Programs investigating Bridges placed after RCT

Post program: **Appendix 8.4.1.3**	**Survival graphs:** **Appendix 9.4.1.3**
	Post vs all other RCT teeth
	Upper vs Lower
	Anterior vs Posterior
	Quadrants
	Tooth types

Table 9 Programs investigating Posts placed after RCT

Pin or Screw program: **Appendix 8.4.1.4**	**Survival graphs:** **Appendix 9.4.1.4**
	Pin or Screw vs all other RCT teeth
	Upper vs Lower
	Anterior vs Posterior
	Quadrants
	Tooth types

Table 10 Programs investigating Pin or Screw placed after RCT

Restorations specific to anterior teeth included incisal edge restoration (Table 11), restoration of just one angle of the tooth (Table 12), and restoration of two angles (Table 13) with analysis of upper versus lower jaw, quadrants and tooth type.

Incisal edge program: **Appendix 8.4.2.1**	**Survival graphs:** **Appendix 9.4.2.1**
	Incisal edge vs all other RCT teeth
	Upper vs Lower
	Quadrants
	Tooth types

Table 11 Programs investigating Incisal edge restoration placed after RCT

One incisal angle program: **Appendix 8.4.2.2**	**Survival graphs:** **Appendix 9.4.2.2**
	One incisal angle vs all other RCT teeth
	Upper vs Lower
	Quadrants
	Tooth types

Table 12 Programs investigating One Incisal angle restoration placed after RCT

Two incisal angles program: **Appendix 8.4.2.3**	**Survival graphs:** **Appendix 9.4.2.3**
	Two incisal angle vs all other RCT teeth
	Upper vs Lower
	Quadrants
	Tooth types

Table 13 Programs investigating Two Incisal angle restoration placed after RCT

The posterior teeth had five different types of restorations including; occlusal restorations (Table 14), restorations that involved one proximal ridge; Mesio-Occlusal (MO) or Disto-Occlusal (DO) (Table 15), restorations with two proximal ridges (Table 16); referred to as Mesio-Occlusal-Distal (MOD), and the remainder were inlay (Table 17) and tunnel restorations (Table 18).

Occlusal program: **Appendix 8.4.3.1**	**Survival graphs:** **Appendix 9.4.3.1**
	Occlusal vs all other RCT teeth
	Upper vs Lower
	Quadrants
	Tooth types

Table 14 Programs investigating Occlusal restoration placed after RCT

MO/DO program: **Appendix 8.4.3.2**	**Survival graphs:** **Appendix 9.4.3.2**
	MO/DO vs all other RCT teeth
	Upper vs Lower
	Quadrants
	Tooth types

Table 15 Programs investigating MO or DO restoration placed after RCT

MOD program: **Appendix 8.4.3.3**	**Survival graphs:** **Appendix 9.4.3.3**
	MO/DO vs all other RCT teeth
	Upper vs Lower
	Quadrants
	Tooth types

Table 16 Programs investigating MOD restoration placed after RCT

Inlay program: **Appendix 8.4.3.4**	**Survival graphs:** **Appendix 9.4.3.4**
	Inlay vs all other RCT teeth
	Upper vs Lower
	Quadrants
	Tooth types

Table 17 Programs investigating Inlay restoration placed after RCT

Tunnel program: **Appendix 8.4.3.5**	**Survival graphs:** **Appendix 9.4.3.5**
	Tunnel vs all other RCT teeth
	Upper vs Lower
	Quadrants
	Tooth types

Table 18 Programs investigating Tunnel restoration placed after RCT

2.3.3.4 Programs of Restorations Placed Before the RCT

Once the survival graphs were produced the results raised some interesting questions, further searches into the literature revealed gaps regarding restorations placed before the RCT. Therefore, the research project was discussed with the supervisors and further developed by examining historical restorations i.e. restorations placed before RCT. The data was explored using programs to identify the restorations placed before RCT on the same tooth and then survival function for the teeth were applied. The programs produced analysis of the various types of restorations before the RCT. This was the same as the previously discussed total of twelve types of restorations, but with an additional two: previous RCT and RES/Apicectomy, a total of fourteen different types of treatments before RCT. A mind map represents the programs used and how they fed into each other (Figure 8).

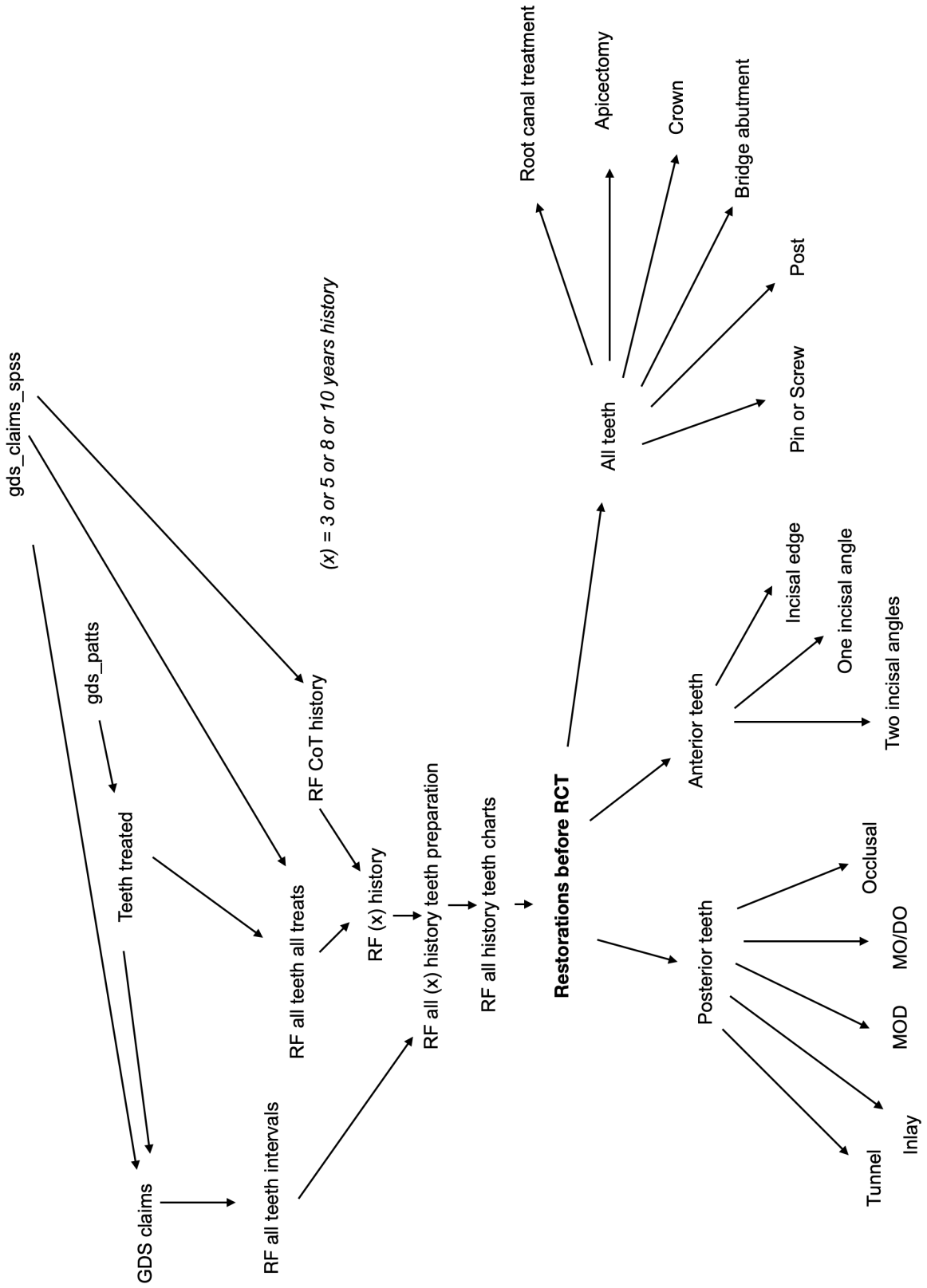


Figure 8 Mind map of the IBM SPSS Programs looking at History of restorations

Each type of restoration before RCT was investigated in relation to the survival of the RCT tooth. The database had 15 years of data therefore one could investigate different time points and obtain a corresponding number of years of history, then deduct that from 15, to identify the number of follow up years. It was decided to look at 4 groups spread within the 15-year database (Table 19).

Group:	**Years of history:**	**Years of follow up:**
1	*3*	*12*
2	*5*	*10*
3	*8*	*7*
4	*10*	*5*

Table 19 Groupings of historical calculations

The first group was those that had a 3-year history of restorations, and a 12-year follow up, so the survival was analysed based on a twelve-year period (Table 20). Each historic group had 14 survival graphs produced based on various treatments before RCT on the tooth.

Group 1 *3 years of history* *12 years of follow up*	**Survival graphs:** **Appendix 8.4.4.1 and 9.4.4.1**
All teeth:	
	Root canal treatment
	Apicectomy/RES
	Crown
	Bridge Abutment
	Post
	Pin or Screw
Anterior teeth:	
	Incisal edge restoration
	One incisal angle
	Two Incisal angles
Posterior teeth:	
	Occlusal Restoration
	MO/DO restoration
	MOD restoration
	Inlay
	Tunnel

Table 20 Programs investigating Group 1 historic restoration placed before RCT

The second group was those with a 5-year history and 10-year survival follow up (Table 21), subsequently 8-year history and 7-year survival follow up (Table 22), and the final group were those with 10-year history and 5-year survival follow up (Table 23).

Group 2 *5 years of history* *10 years of follow up*	**Survival graphs:** **Appendix 8.4.4.2 and 9.4.4.2**
All teeth:	
	Root canal treatment
	Apicectomy/RES
	Crown
	Bridge Abutment
	Post
	Pin or Screw
Anterior teeth:	
	Incisal edge restoration
	One incisal angle
	Two Incisal angles
Posterior teeth:	
	Occlusal Restoration
	MO/DO restoration
	MOD restoration
	Inlay
	Tunnel

Table 21 Programs investigating Group 2 historic restoration placed before RCT

Group 3 *8 years of history* *7 years of follow up*	**Survival graphs:** **Appendix 8.4.4.3 and 9.4.4.3**
All teeth:	
	Root canal treatment
	Apicectomy/RES
	Crown
	Bridge Abutment
	Post
	Pin or Screw
Anterior teeth:	
	Incisal edge restoration
	One incisal angle
	Two Incisal angles
Posterior teeth:	
	Occlusal Restoration
	MO/DO restoration
	MOD restoration
	Inlay
	Tunnel

Table 22 Programs investigating Group 3 historic restoration placed before RCT

Group 4 *10 years of history* *5 years of follow up*	**Survival graphs:** **Appendix 8.4.4.3 and 9.4.4.3**
All teeth:	
	Root canal treatment
	Apicectomy/RES
	Crown
	Bridge Abutment
	Post
	Pin or Screw
Anterior teeth:	
	Incisal edge restoration
	One incisal angle
	Two Incisal angles
Posterior teeth:	
	Occlusal Restoration
	MO/DO restoration
	MOD restoration
	Inlay
	Tunnel

Table 23 Programs investigating Group 4 historic restoration placed before RCT

The survival graphs from the four historical groups, and for every restoration were plotted in a bar chart dedicated to that restoration, whilst comparing to the whole sample of 15-year survival of RCT teeth.

The results will be presented as percentage (%) of teeth that have survived and the difference between various survival percentages will be presented as percentage point (PCT) difference when making comparisons. It is important to note that if the number of cases were not fully represented at 15-years, then the previous year was used, for example 14-years.

Chapter 3 Results

3.1 Overall Survival of Root Canal Treated Teeth

The full output result from this program can be found in appendix 9.4.1.1, which was produced by the program in appendix 8.4.1.1. The results indicated that the program had identified a total of number of 792,261 RCT teeth, and the number of those that could be utilised for the calculation was 791,375 teeth (whole sample). The graph represents the survival of all RCT teeth based on reintervention (Fig. 9), with the x-axis presenting survival in five-year intervals. The 5-year survival was 89%, 10-year survival was 83%, and 15-year survival of RCT teeth was 77%, and all were based on reintervention (Re-RCT, RES/Apicectomy, Extraction).

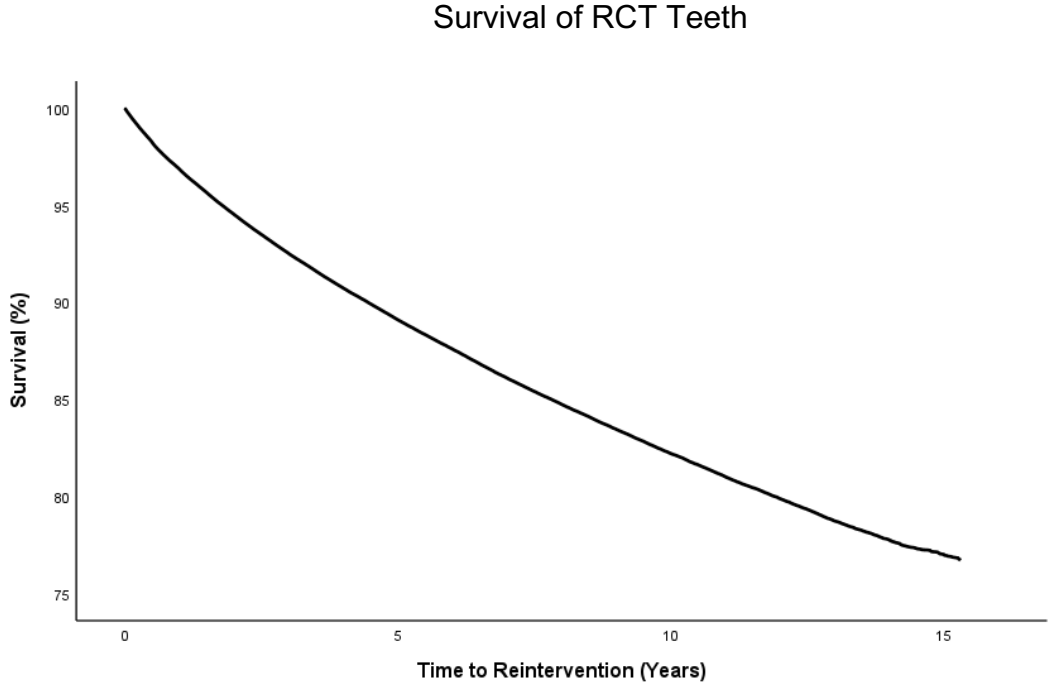


Figure 9 Overall survival of RCT Teeth based on Reintervention

The survival of RCT teeth over 15 years was also analysed based on extraction only (Fig. 10), so that the dataset could be compared to studies that reported survival based on extraction as the end point outcome measure. The full output result of this program can be found in appendix 9.4.1.2, which was produced by the program in appendix 8.4.1.2. The 5-year survival based on extraction only was 93%, 10-year survival was 87%, and 15-year survival of RCT teeth was 83%, the latter being 6 percentage points (PCT) different to reintervention as the survival outcome measure end point.

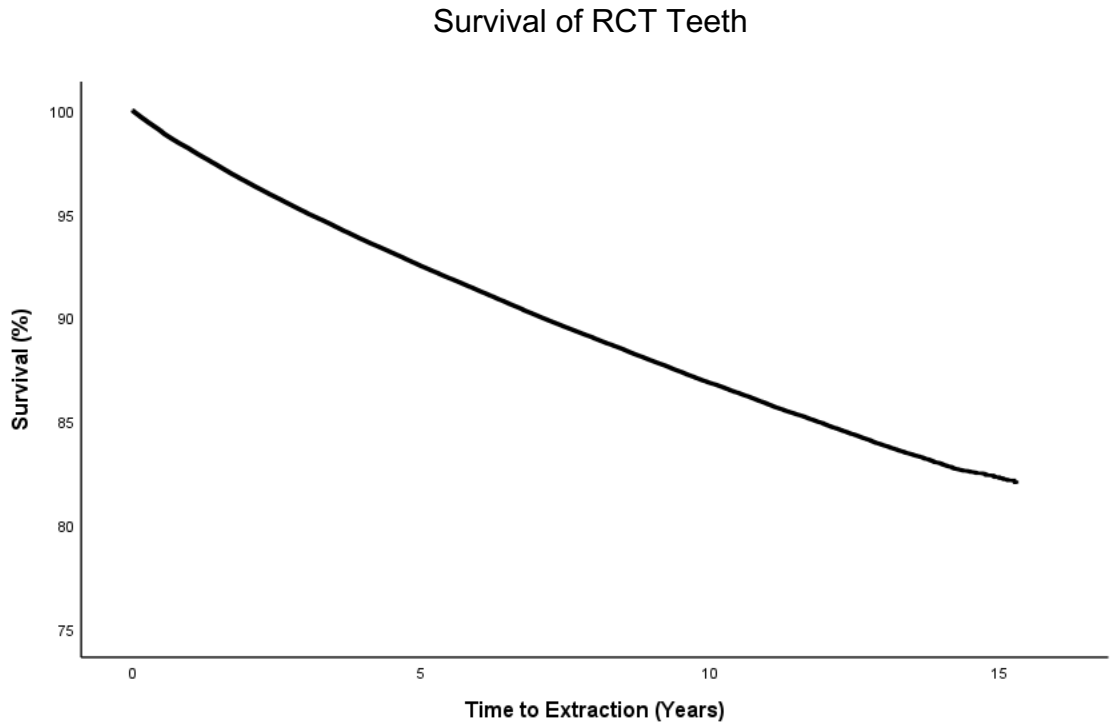


Figure 10 Overall survival of RCT Teeth based on Extraction

The figure 11 illustrates the comparison between the two types of survival and shows that initially there was a 3 PCT difference between survival based on extraction and reintervention (ReRCT, RES/Apicectomy, Extraction) at 5-year survival, increasing to

4 PCT at ten-year survival and increasing even more, hence at the 15-year survival the difference was 6 PCT.

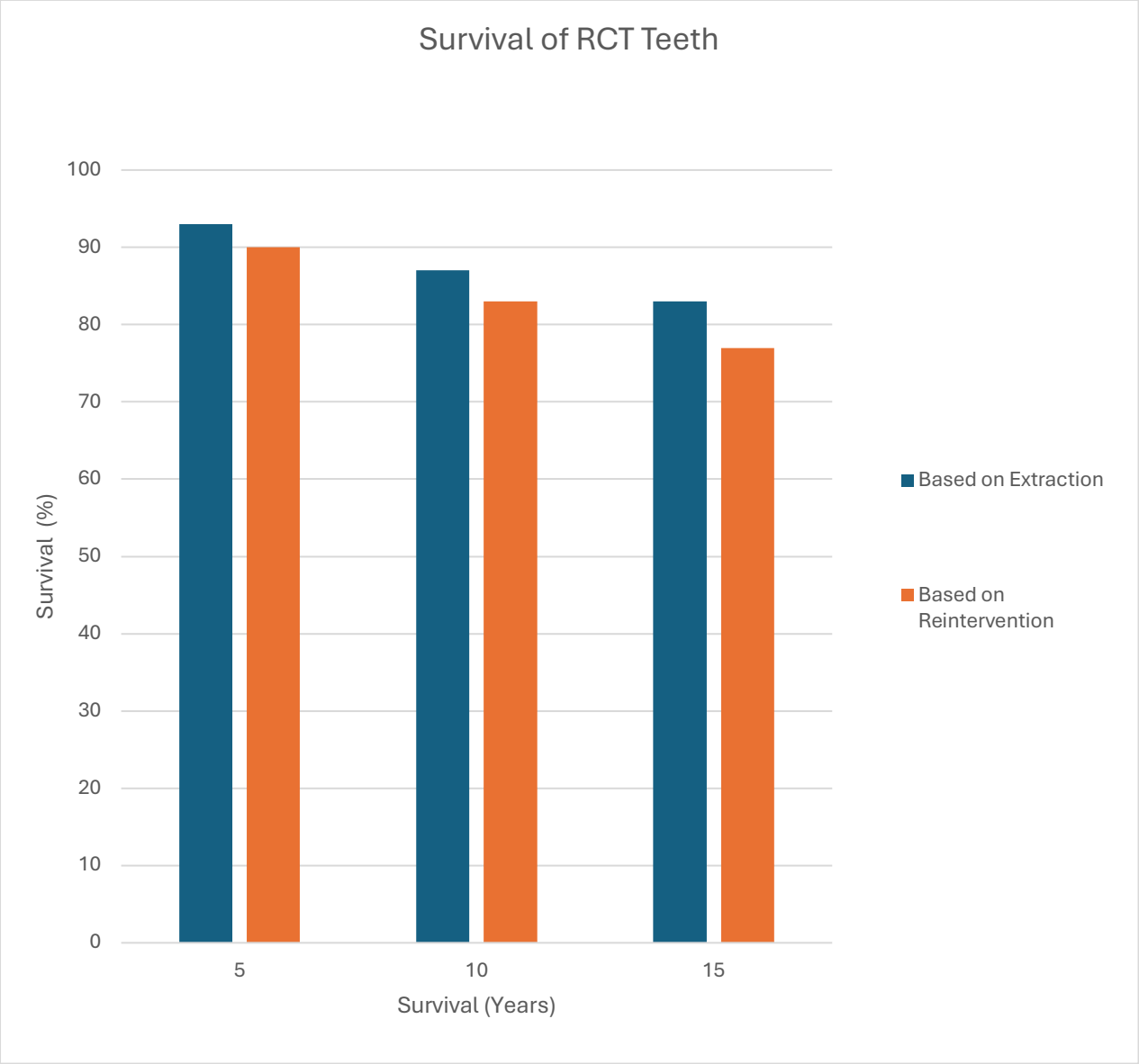


Figure 11 Comparison of overall survival of RCT Teeth

3.2 General Dentist Factors

3.2.1 Gender of the Dentist

The program in appendix 8.2.1, produced the result output in appendix 9.2.1. The total number of RCT teeth by female dentists was 157,063, while male dentists carried out RCT on 634,312 teeth, four times more than their female counterparts. The survival graph for gender of dentists (Fig.12) showed very similar results for both male and female dentists performing the treatment, therefore the gender of the dentist did not make a significant difference in survival of the RCT teeth.

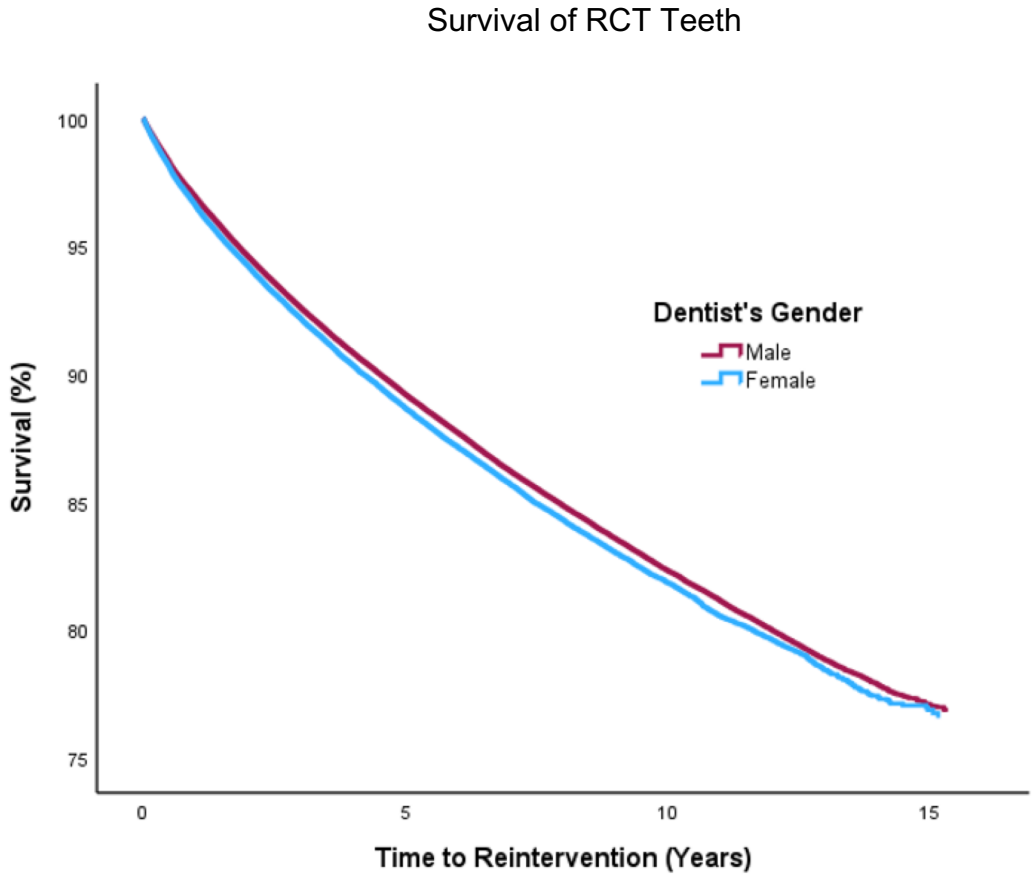


Figure 12 Survival of RCT Teeth based on Gender of the Dentist

3.2.2 Year of Birth of Dentist

The full output result of this program can be found in appendix 9.2.2, produced by the program in appendix 8.2.2. The results from the output table were processed into an excel graph (Fig. 13) and showed that the highest number of dentists were born between the mid-1950s to late 1960s.

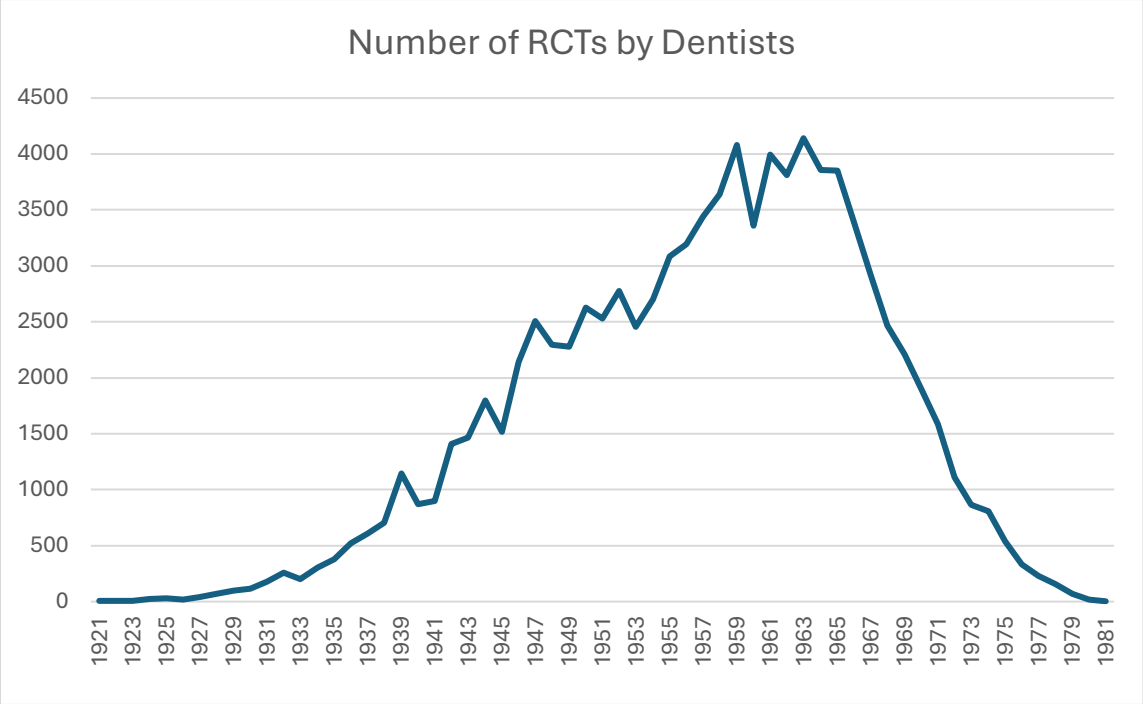


Figure 13 Number of RCTs provided by Dentist based on their Year of Birth

The age of the dentist at the time of RCT was calculated and the figure 14 represents the age of the dentist when grouped into decades. There were no dentists older than 77 years of age, this oldest decade group had the smallest number of dentists and performed the fewest number of root canal treatments. The bulk of dentists demonstrated a similar pattern of performance, with those in their 30s having the best

survival outcome from their RCT, while those in their 60s performing 3 PCT worse at the 12-year survival.

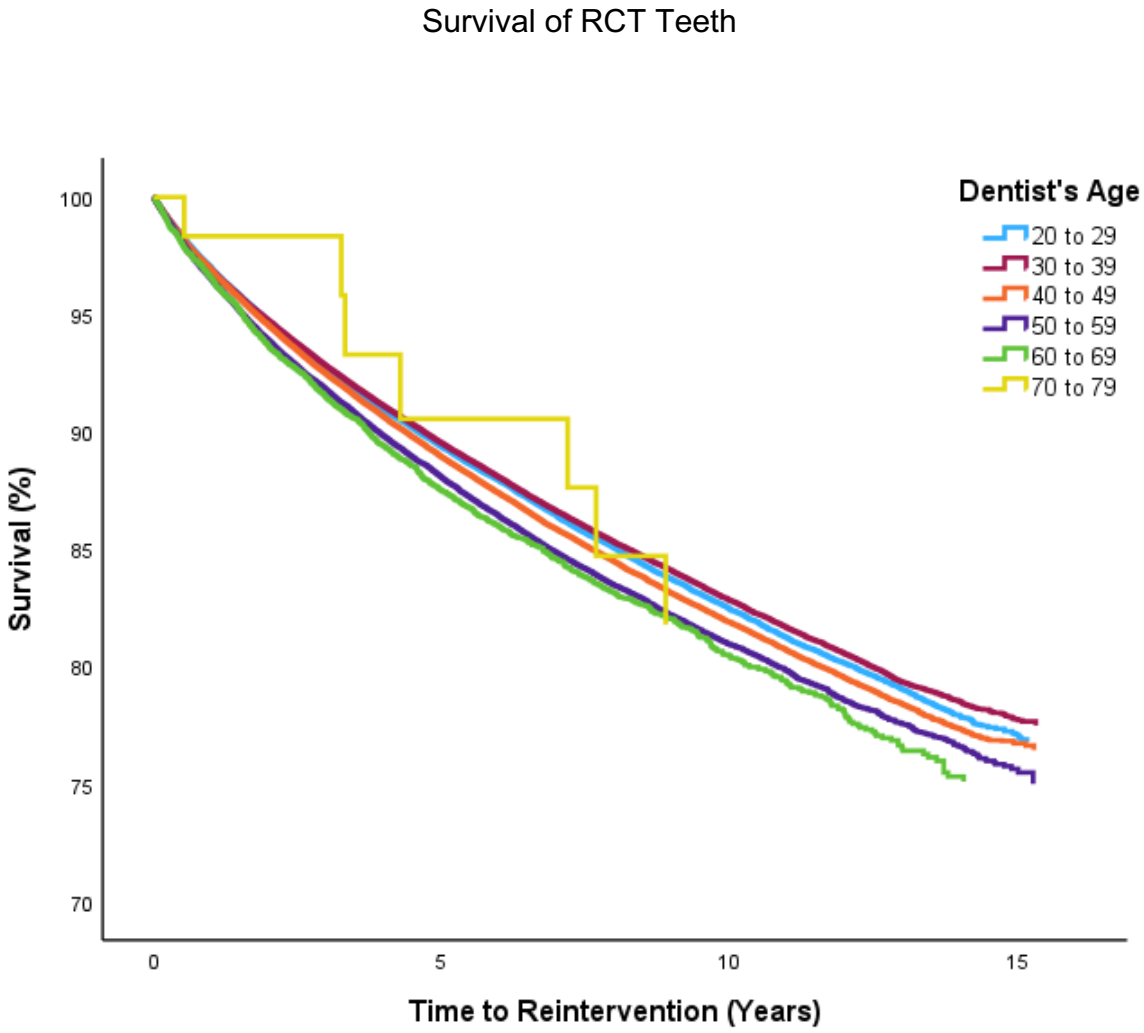


Figure 14 Survival of RCT Teeth based on Age group of the Dentist

3.2.3 Postcode of the Dental Practice

The full output result of this program can be found in appendix 9.2.3, which was produced by the program in appendix 8.2.3. The postcodes were categorised into 8

geographic regions in England and the postcodes of Wales were gathered into one group. The number of RCT teeth was then tabulated and is presented in the bar chart (Fig. 15). The lowest number of RCTs was in Wales while the highest was in London and North of England.

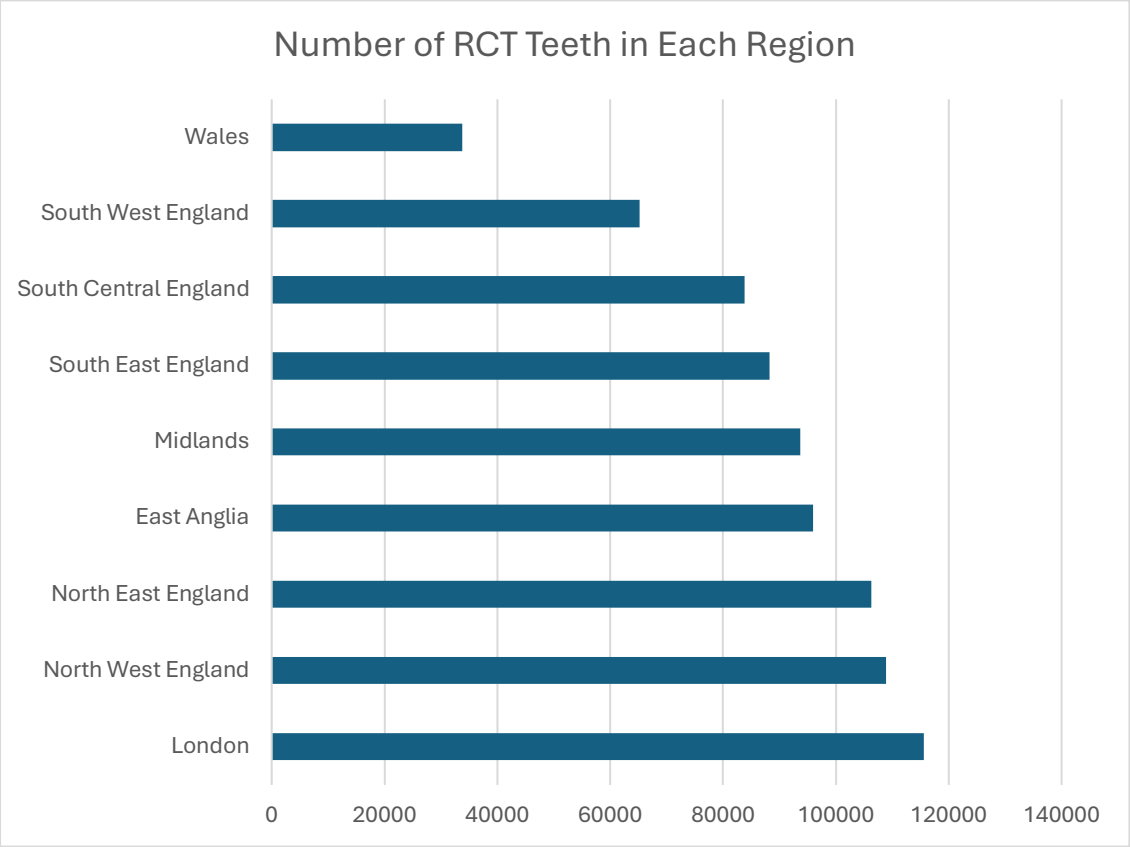


Figure 15 Number of RCTs by Region

The survival of RCT teeth varied among the regions, with the best survival in South Central England and worst survival in Wales (Fig. 16), with a difference of 9 PCT between them. The other areas that performed better in terms of RCT survival were South East England, East Anglia and London. The regions of North East England, North West England and Midlands were among the lowest performers in England.

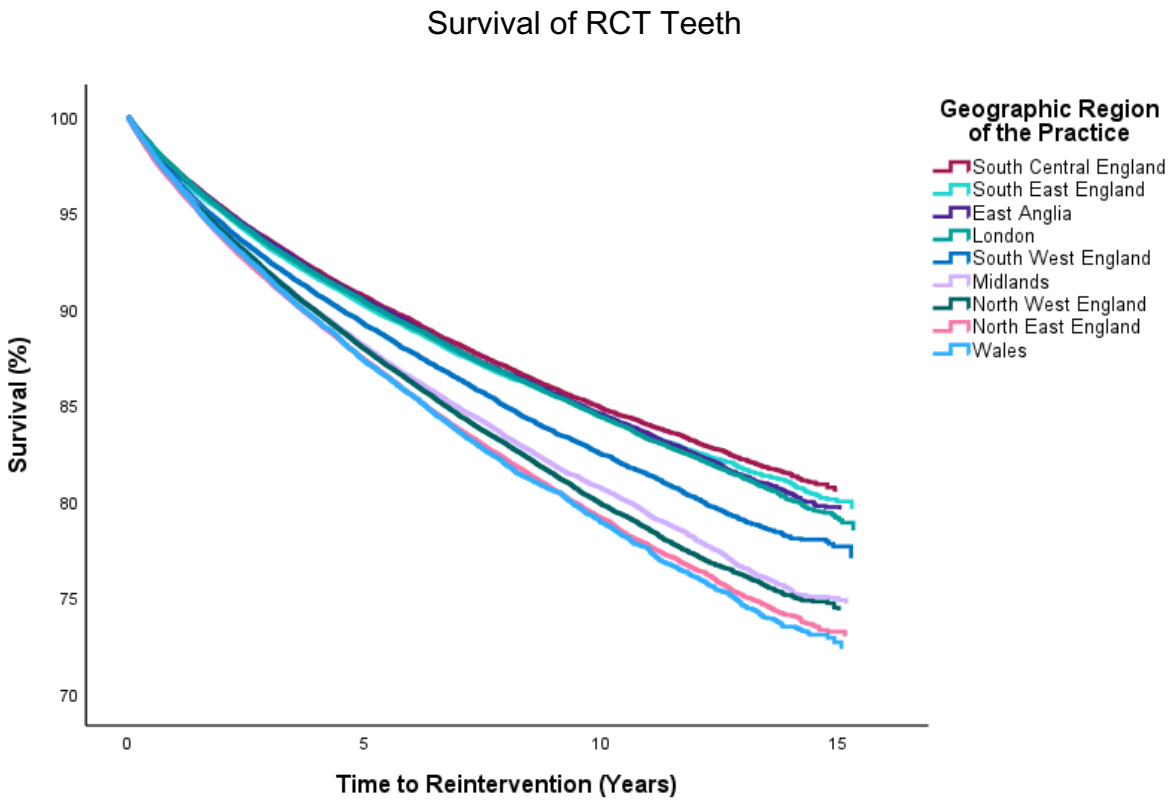


Figure 16 Survival of RCT Teeth by Region

3.3 General Patient Factors

3.3.1 Gender of the Patient

The program in appendix 8.3.1 produced the result output in appendix 9.3.1. The total number of RCT teeth in female patients was 409,297, while male patients had RCT in 382,078 teeth, which was 27,000 fewer. A similar survival rate of RCT teeth was noted among male and female patients (Fig. 17).

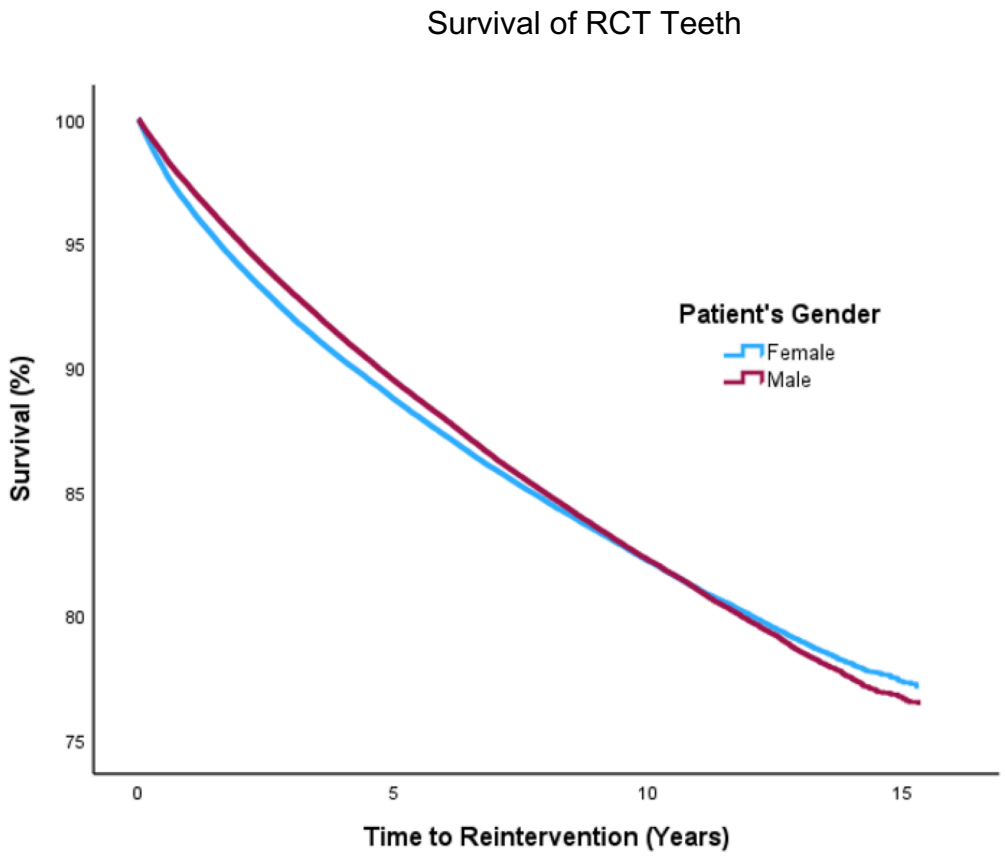


Figure 17 Survival of RCT Teeth by Gender of the Patient

3.3.2 Age of the Patient

The program in appendix 8.3.2 produced the result output in appendix 9.3.2. The result indicated the highest number of root fillings was among 34-year-olds (23,266 patients) and the lowest was four RCT teeth among 95-year-old patients (Fig. 18). The pattern of survival with age had the variation in ages being as much as 7 PCT, therefore age was further analysed by decades.

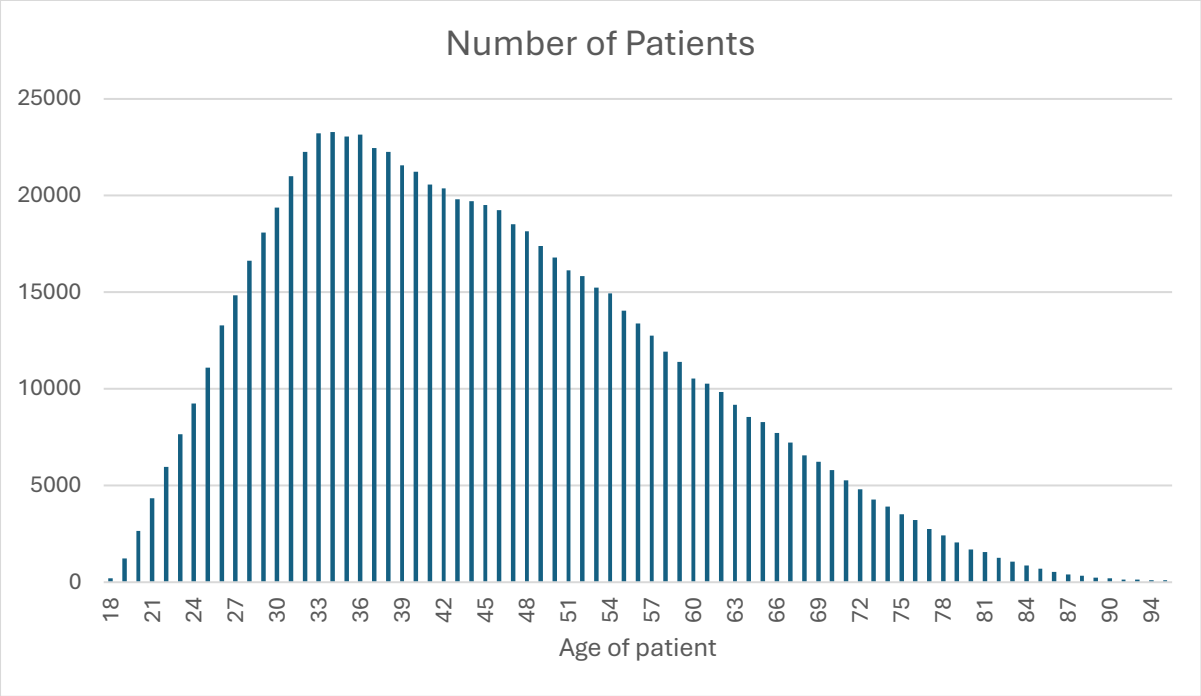


Figure 18 Number of RCTs as per Patient's age

3.3.3 Age of Patients Grouped by Decade

The program in appendix 8.3.3 produced the result output in appendix 9.3.3 and it is represented in the bar chart below (Fig. 19).

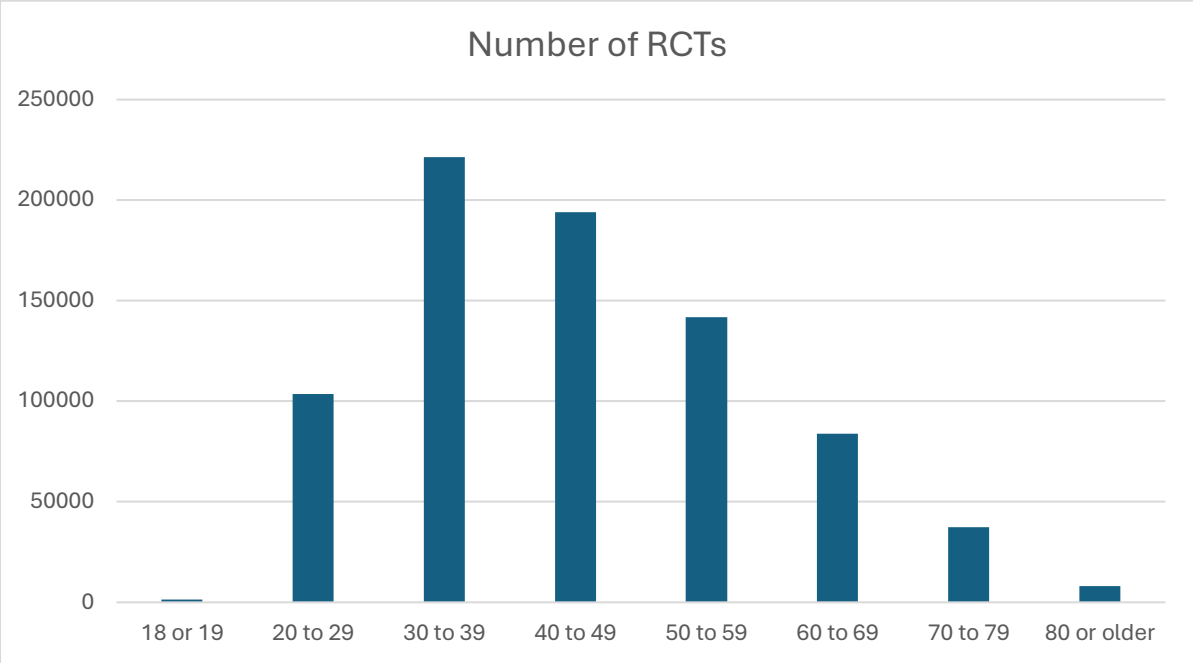


Figure 19 Number of RCTs for each Patient Age Group

The greatest number of RCT was provided to patients in their thirties, followed by those in their forties and fifties. The survival of RCT teeth was highest in patients in their twenties and worst in those in their seventies a difference of around 7 PCT at 14-year survival (Fig. 20).

Survival of RCT Teeth

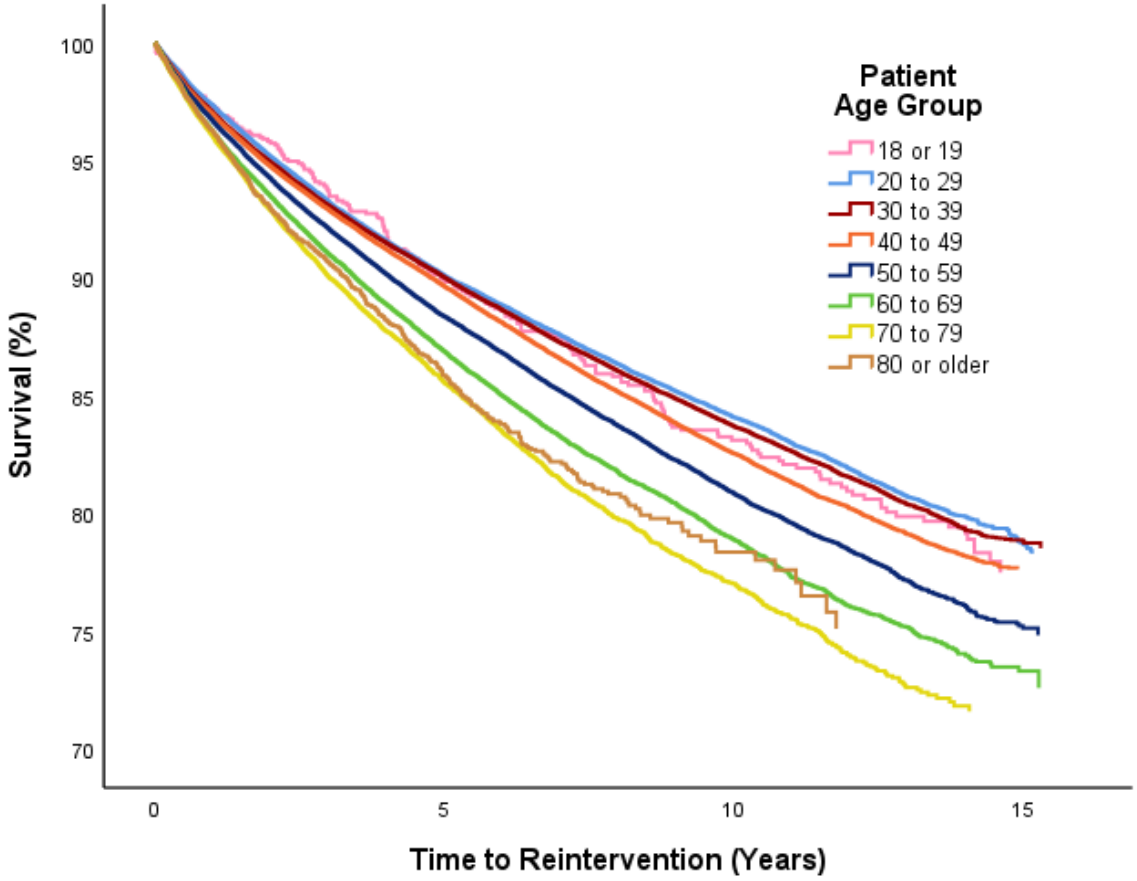


Figure 20 Survival of RCT Teeth based on Age Group of the Patient

3.3.4 Charge Paying Status of the Patient

The program in appendix 8.3.4 produced the result output in appendix 9.3.4. The number of full charge paying patients was 520,872, while the number of non-full charge paying patients was 270,503, which meant that there were was nearly twice as many as non-full charge paying patients. There was a 78% RCT survival rate for full charge paying patients at 15-years as opposed to 74% for those that were non-full charge paying patients (Fig. 21), a difference of 4 PCT.

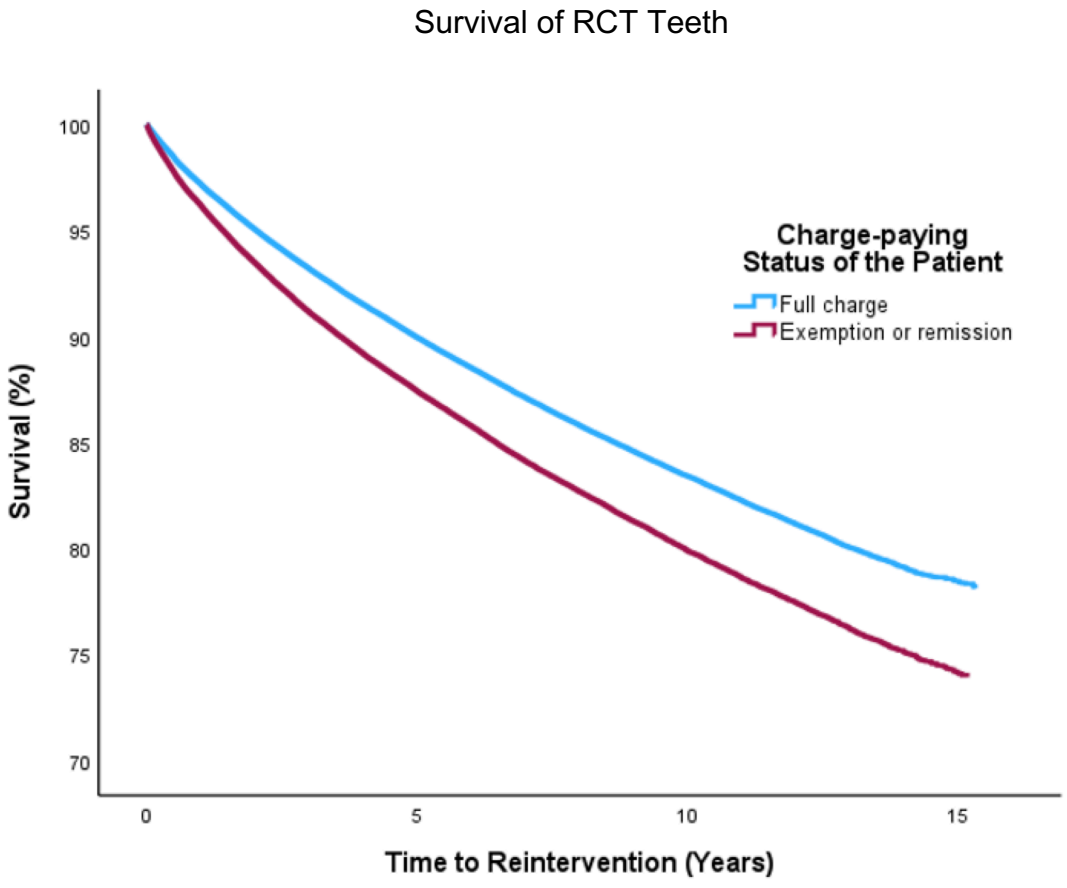


Figure 21 Survival of RCT Teeth based on Charge Paying Status of the Patient

3.4 Survival of Root Canal Treated Teeth

The overall survival of all teeth has been reported (Fig. 8). Further analysis of the teeth revealed the ratio of anterior to posterior teeth was *circa* 2:5, resulting in 334,123 fewer anterior teeth with RCT than posterior teeth. The survival rate of RCT anterior teeth was 74% as opposed to 79% for posterior teeth, a difference of 5 PCT, as shown in the survival curve of RCT Anterior versus (vs) Posterior Teeth (Fig. 22).

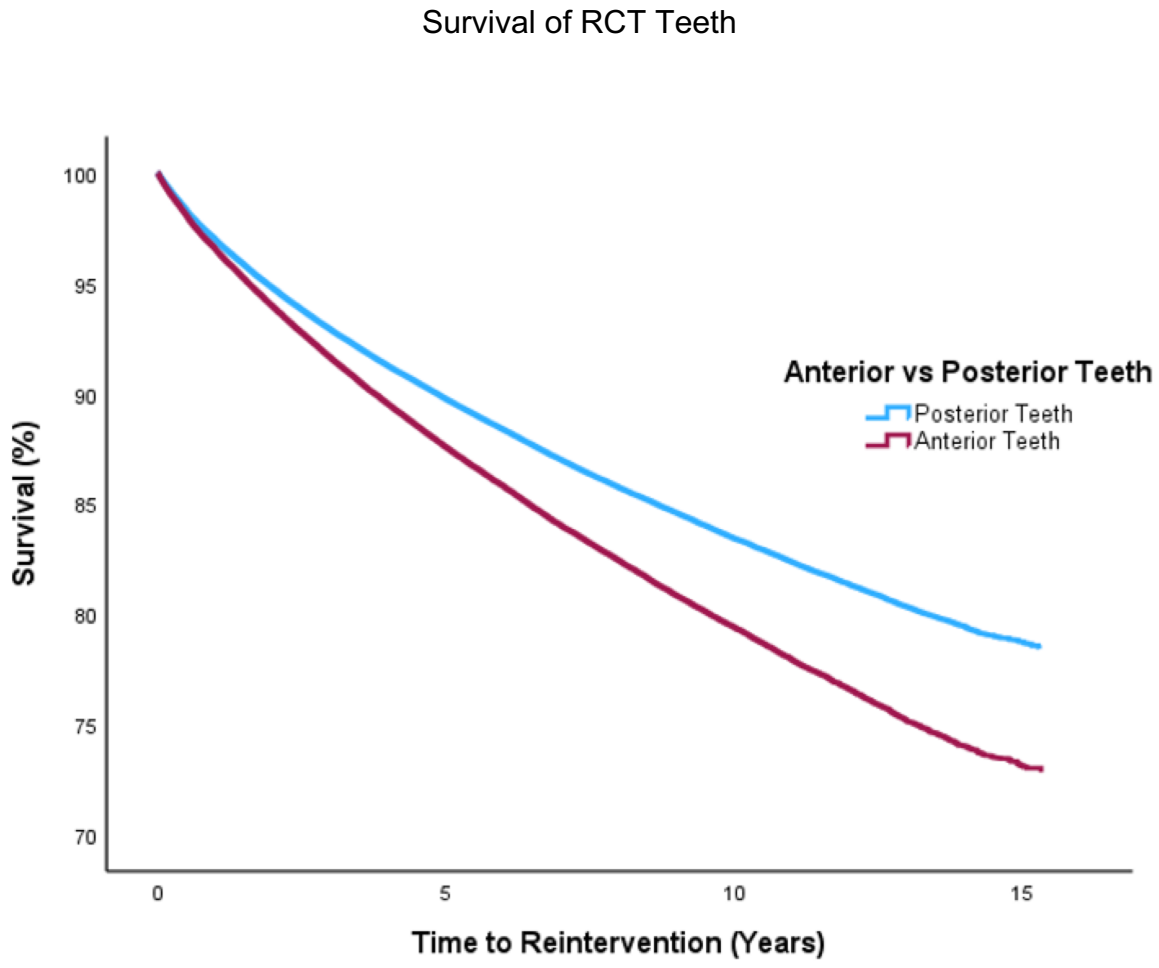


Figure 22 Survival of Anterior vs Posterior RCT Teeth

Ratio of teeth RCT treated was compared between different jaws, and the result indicated that ratio of upper to lower teeth was approximately 3:2, with 185,191 fewer lower teeth having RCT than upper teeth. The survival curve comparing upper teeth to lower teeth had a 2 PCT difference between them, 76% for upper teeth, and lower teeth had a 78% survival of RCT teeth at 15 years (Fig. 23).

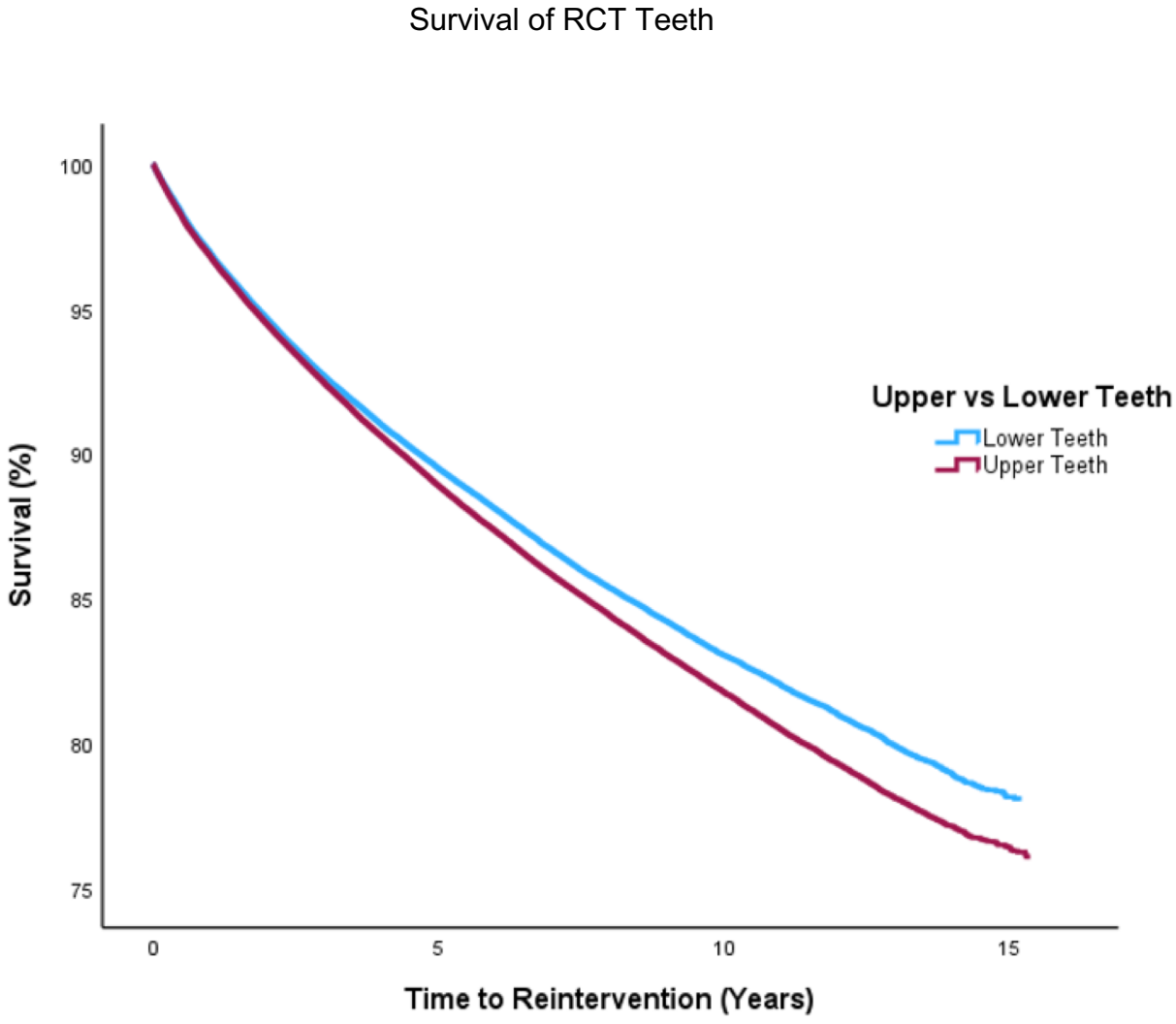


Figure 23 Survival of Upper vs Lower RCT Teeth

The investigation of quadrants of the mouth indicated the same indifferent jaws, the left or right side in the mouth were not significant (Fig. 24), and that that there was better performance with lower teeth than upper teeth.

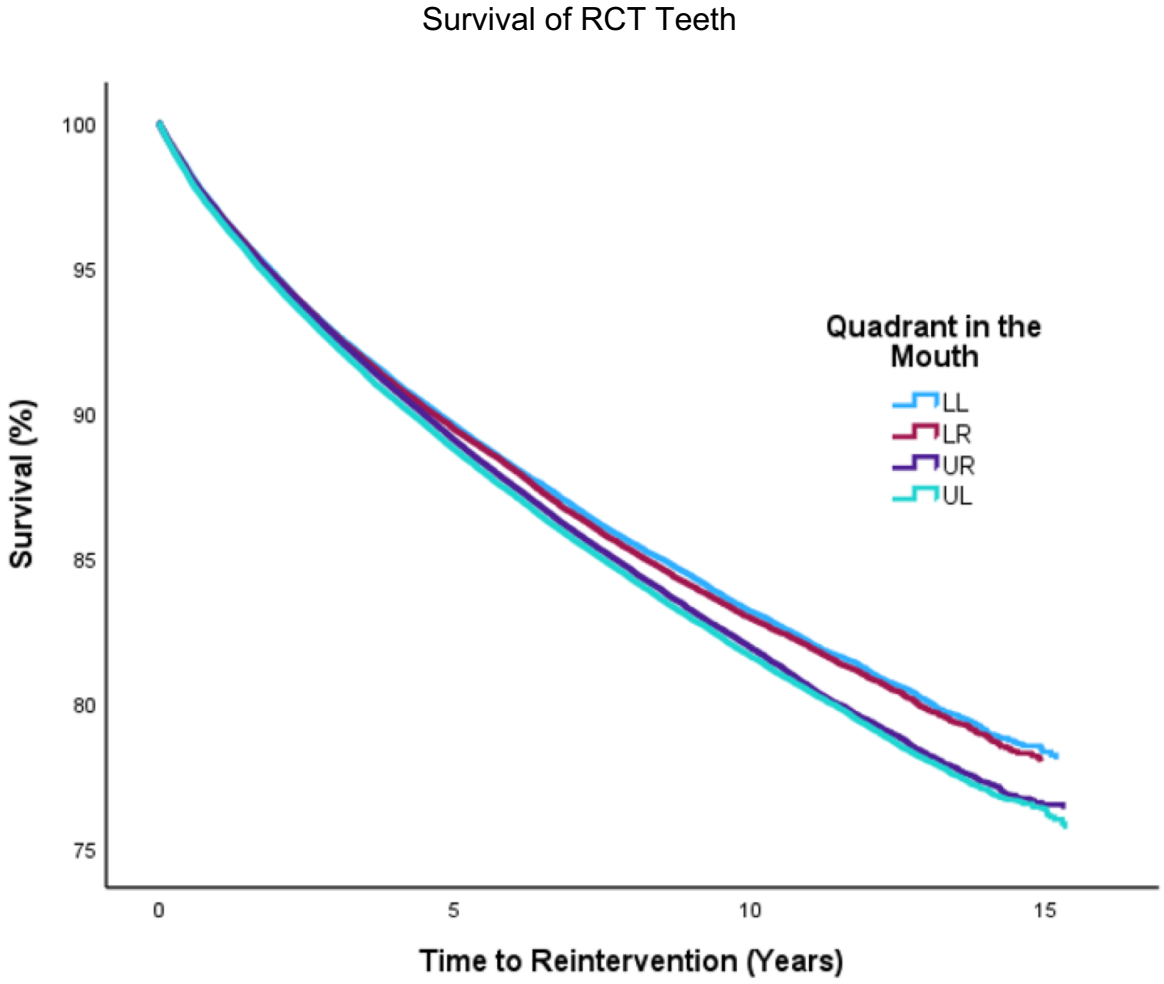


Figure 24 Survival of RCT Teeth in Each Quadrant

The teeth that most frequently had RCT were the upper second premolars (U5) followed by lower first molars (L6) and upper first molars (U6) as shown in figure 25. The Third molars were the least frequently root canal filled tooth type, followed by lower lateral incisors and central incisors.

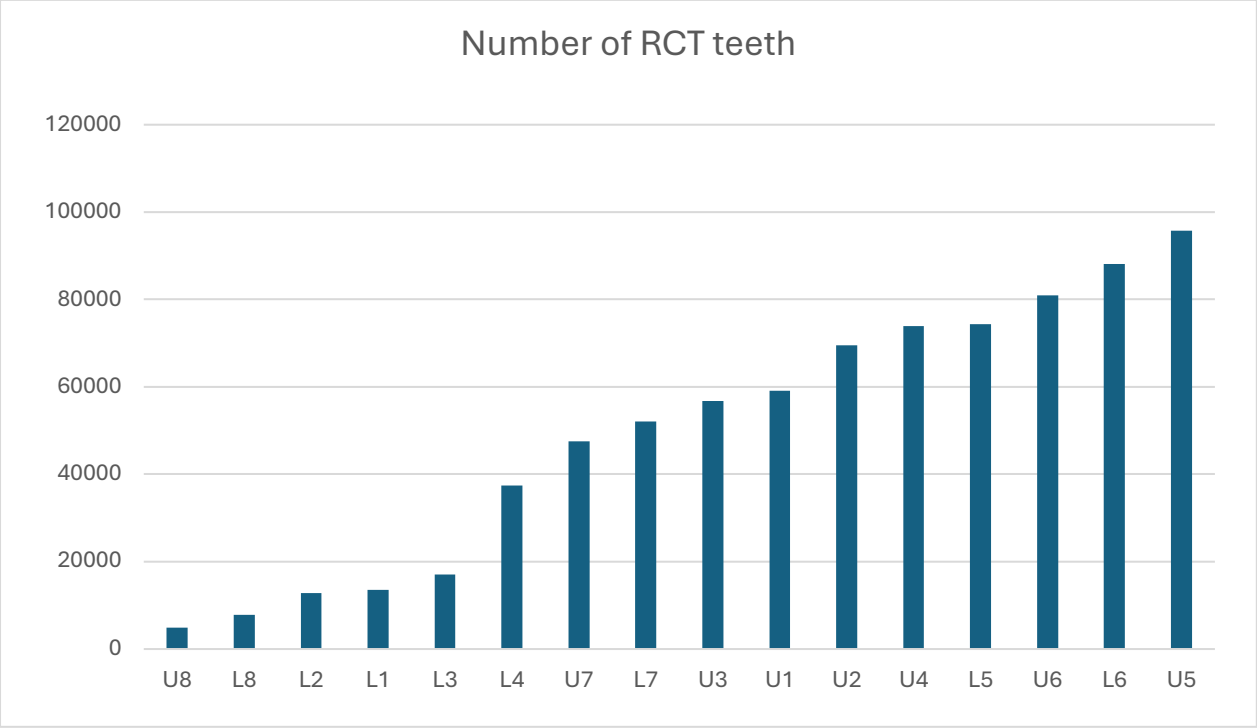
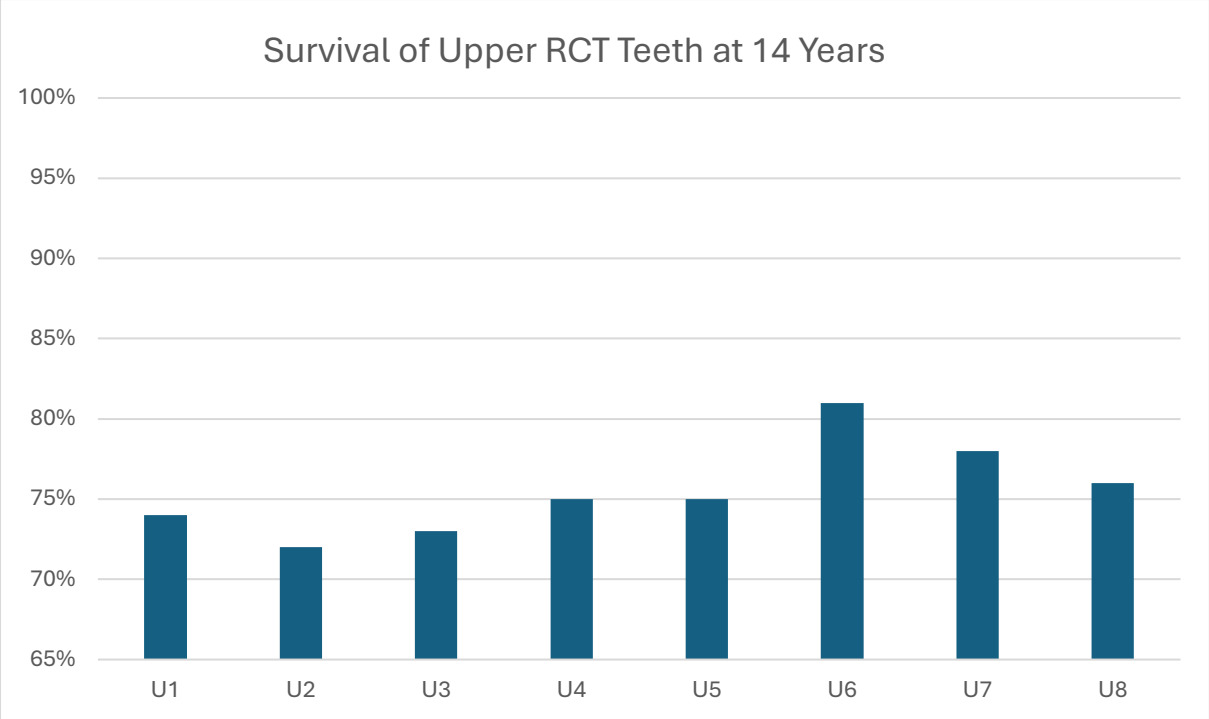


Figure 25 Number of RCTs by Tooth Type

Results analysing survival by tooth type indicated that upper first molars and lower third molars performed best at 14-year with a survival rate of 82% and the worst were upper and lower lateral incisors with a 70% survival rate, a 12 PCT difference (Fig. 26). In order to have enough RCT teeth for all tooth types, the 14-year survival was chosen, rather than 15 years, as used in the majority of analysis.



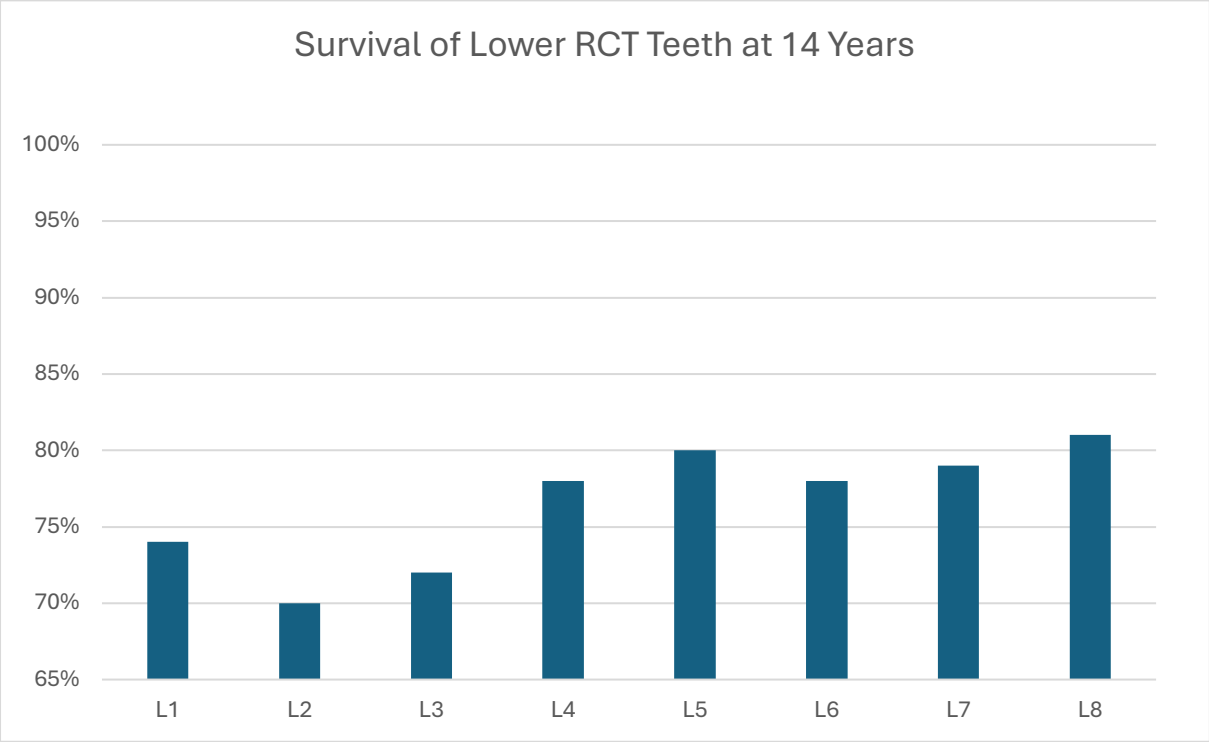


Figure 26 Survival of RCT Teeth by Tooth Type at 14 Years

3.5 Role of Restorations Placed After the RCT

3.5.1 All teeth

Some restorations can be placed on all tooth types while others are limited to the anatomical shape of the tooth, therefore, restorations were subdivided into anterior and posterior teeth The restorations that can be placed on all tooth types are reported first.

3.5.1.1 Crown

The full output result of this program can be found in appendix 9.4.1.1 produced by the program in appendix 8.4.1.1. The results indicated that the program had used a total of number of 792,261 RCT teeth, and of those 178,158 teeth were crowned, namely, 22% of the total of 792,261 RCT teeth. The graph represents the survival of RCT teeth that were crowned compared to those that were not, the x-axis presents survival in five-year intervals. The 15-year survival of RCT crowned teeth was 79%, which was slightly higher than those that were not crowned (77%), with the difference reaching a maximum at 5 PCT at 7-year survival (Fig. 27).

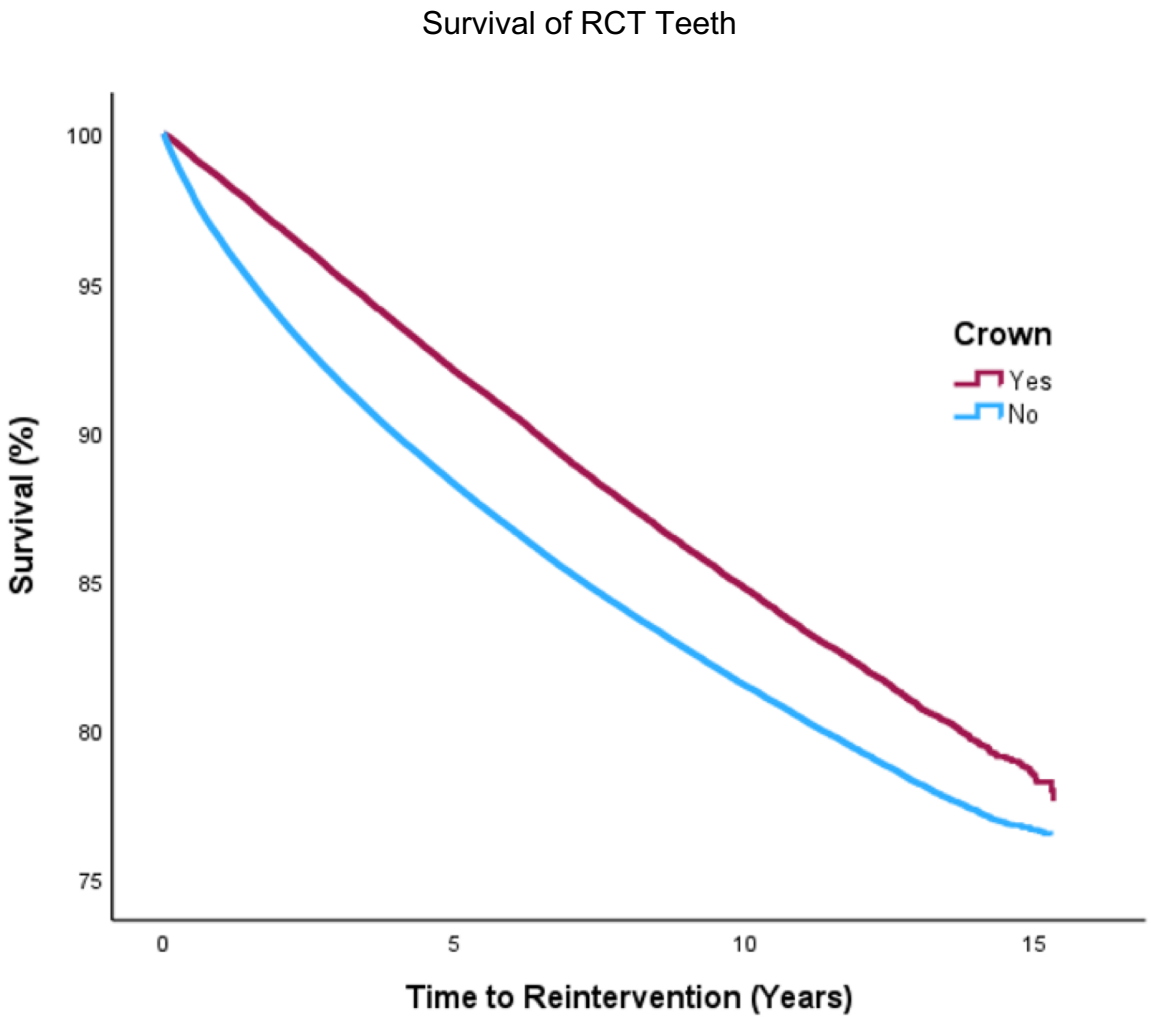


Figure 27 Survival of RCT Teeth Restored with a Crown

The lower RCT crowned teeth appear to survive better than upper teeth. There were 56,846 RCT crowned lower teeth with a 15-year survival of 82% (Fig. 28) compared to 121,312 RCT crowned upper teeth with a survival of 76%. The number of RCT crowned upper teeth was more than double the number of RCT crowned lower teeth, with a 6 PCT difference in survival.

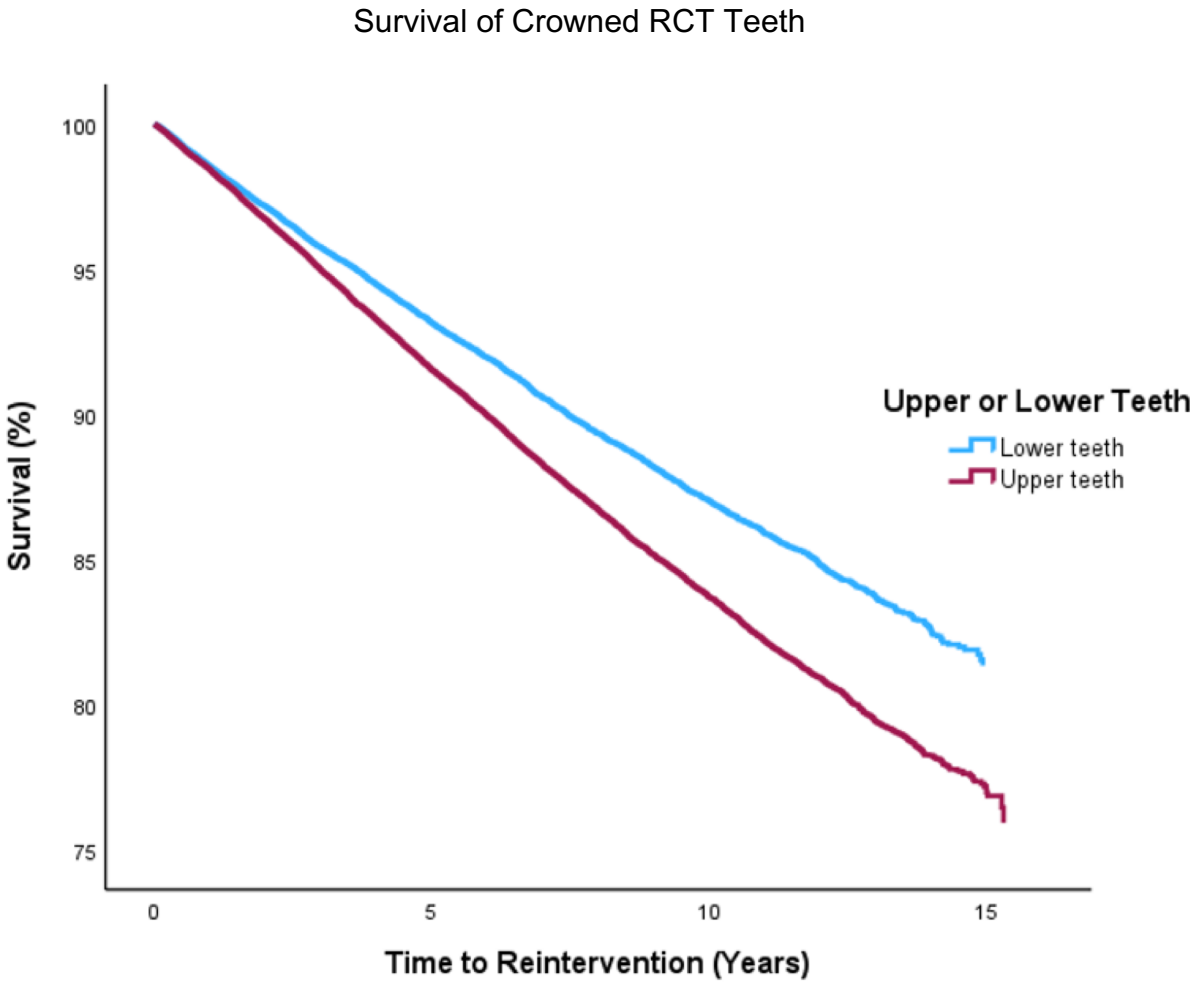


Figure 28 Survival of Upper vs Lower Crowned RCT Teeth

The anterior teeth have been categorised as central incisor, lateral incisor, and canine teeth, while the posterior teeth are categorised as the two premolars and three molar teeth. The total number of RCT crowned anterior teeth was 68,989, and the number of RCT crowned posterior teeth was 109,148 RCT. The 15-year survival for the posterior teeth was 82% and for the anterior teeth was 72%, which was markedly 10 PCT lower (Fig. 29).

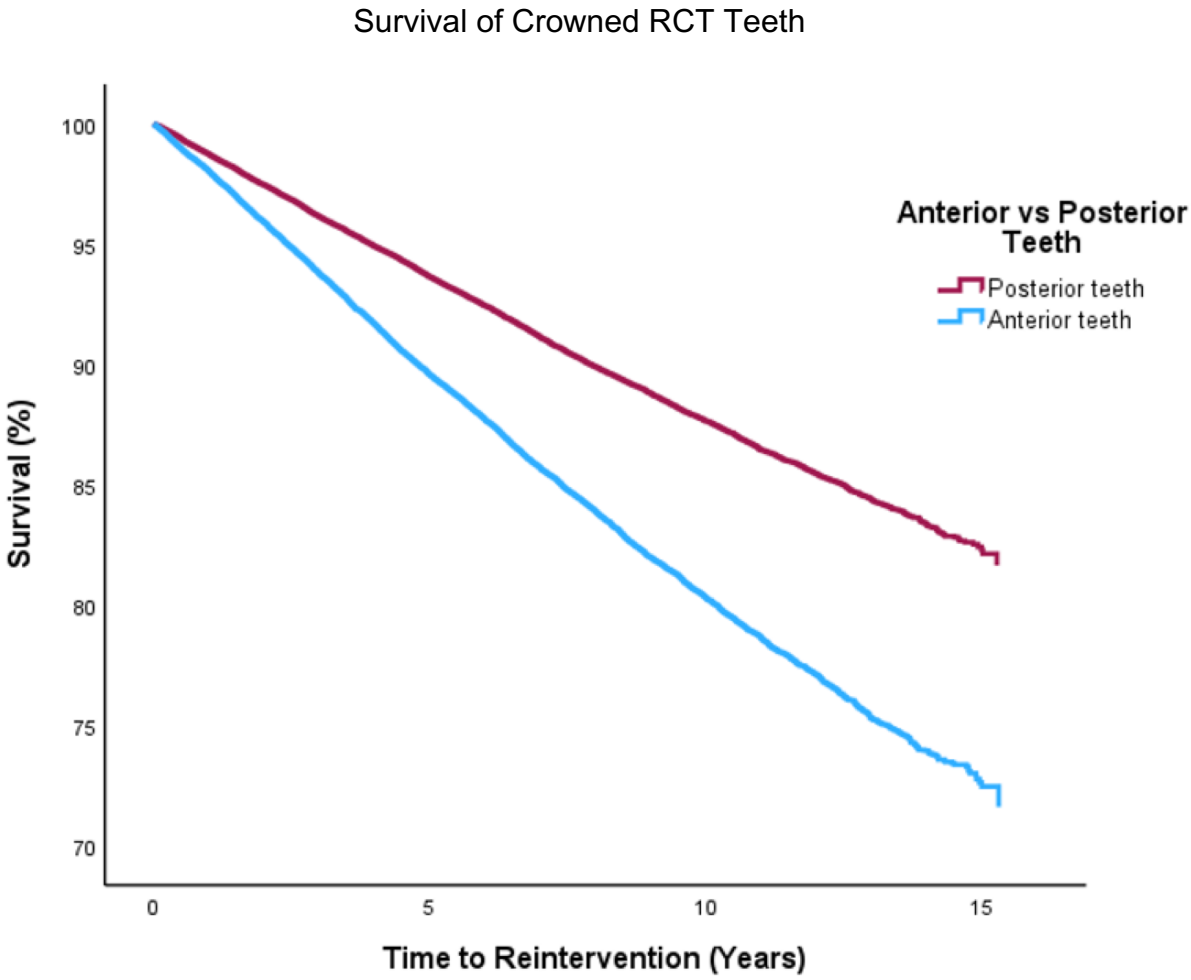


Figure 29 Survival of Anterior vs Posterior Crowned RCT Teeth

The different sides of the mouth were investigated by examining the effect of quadrants. The lower left and lower right quadrants were similar to each other, as were the upper left and upper right, depicting not much difference between right or left sides of the mouth with a picture similar to upper and lower teeth (Fig. 30).

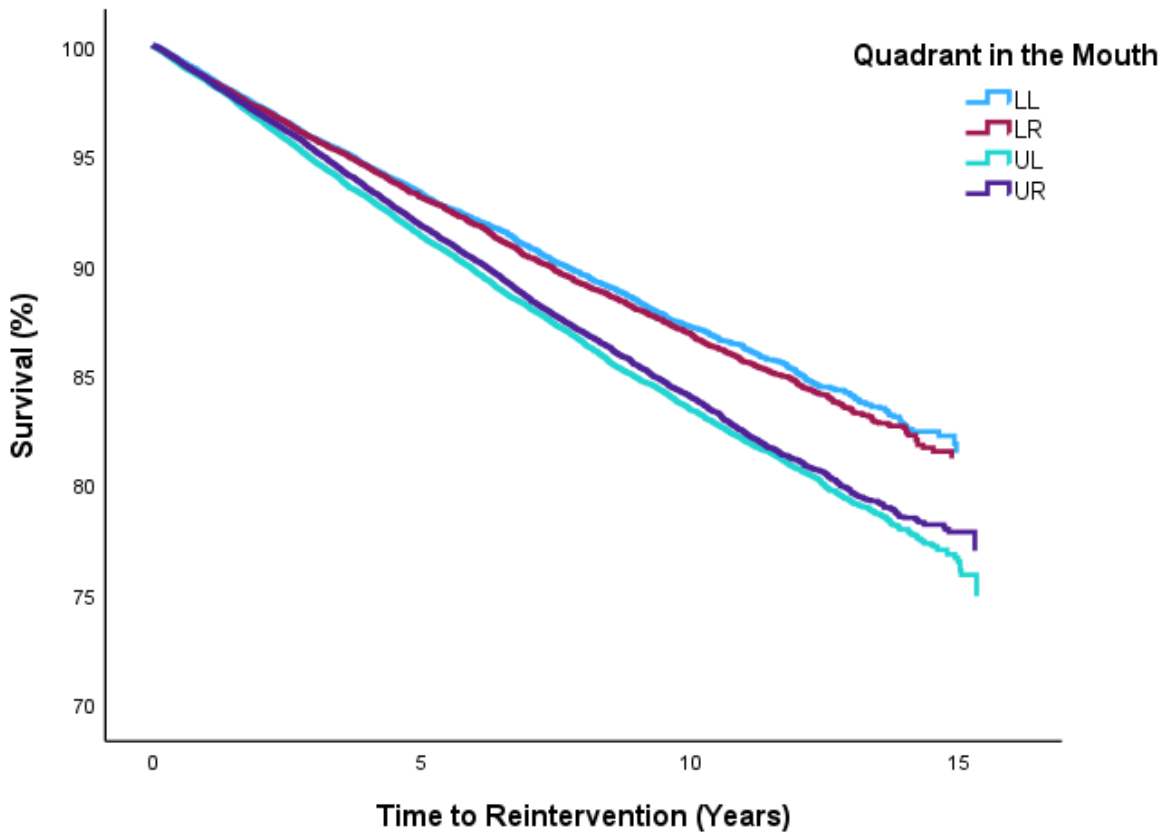


Figure 30 Survival of Crowned RCT Teeth in Each Quadrant

The survival graph for each tooth type indicates that the 12-year survival for upper first molars (U6) was over 15 PCT better than upper lateral incisors (U2) (Fig. 31).

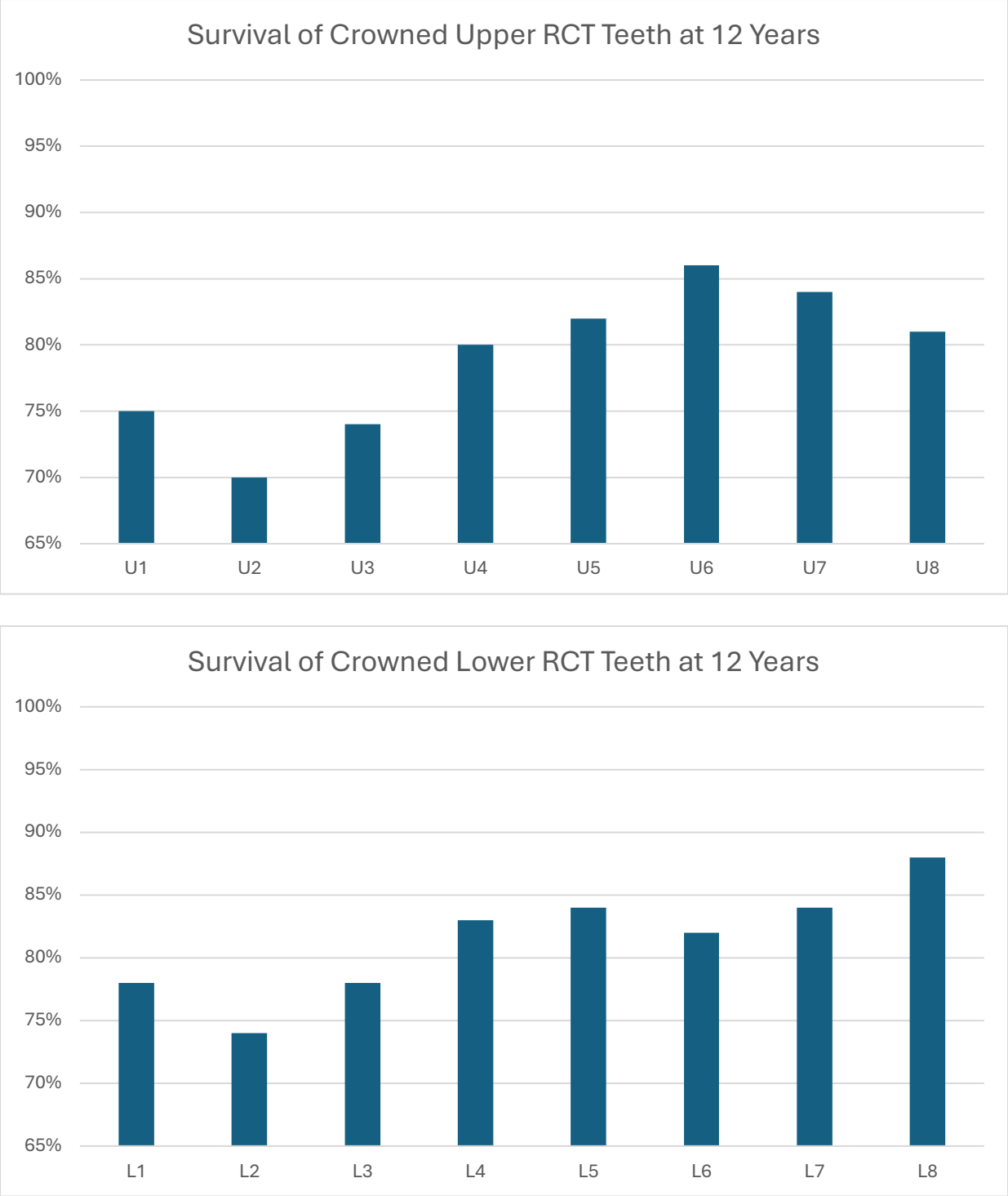


Figure 31 Survival of Crowned RCT Teeth by Tooth Type at 12 Years

The various crown types (which were available within the NHS Regulations) were investigated in order to identify if some facilitated better survival of root canal treated teeth than others. The full output result of the program can be found in appendix

9.4.1.1.1, which was produced by the program in appendix 8.4.1.1.1. The summary displayed (Fig. 32) that gold crowns survive 85% which was *circa* 10 PCT better than PJC crowns, and 5 PCT better than bonded and other types of metal crowns at 13 years.

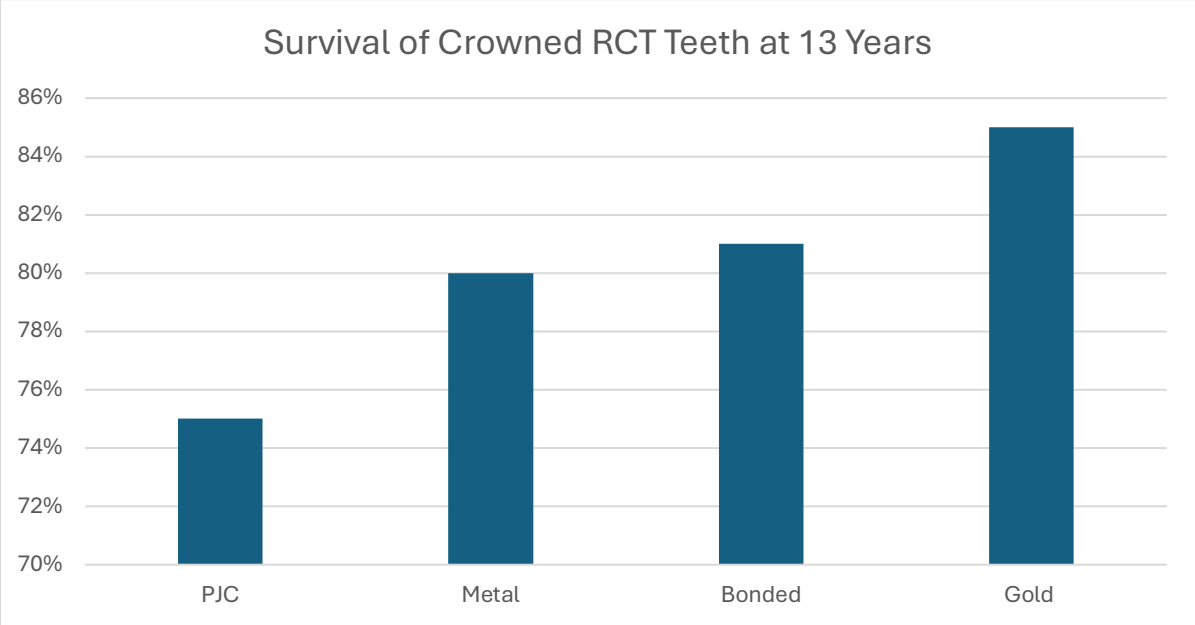


Figure 32 Survival of Crowned RCT Teeth by Crown Type at 13 Years

Bonded metal/ceramic crowns comprised 83% of RCT crowned teeth, with 10% being metal crowns and 5% gold crowns. The remainder were porcelain jacket crowns, and a very small proportion of laboratory made temporary crowns (Fig. 33).

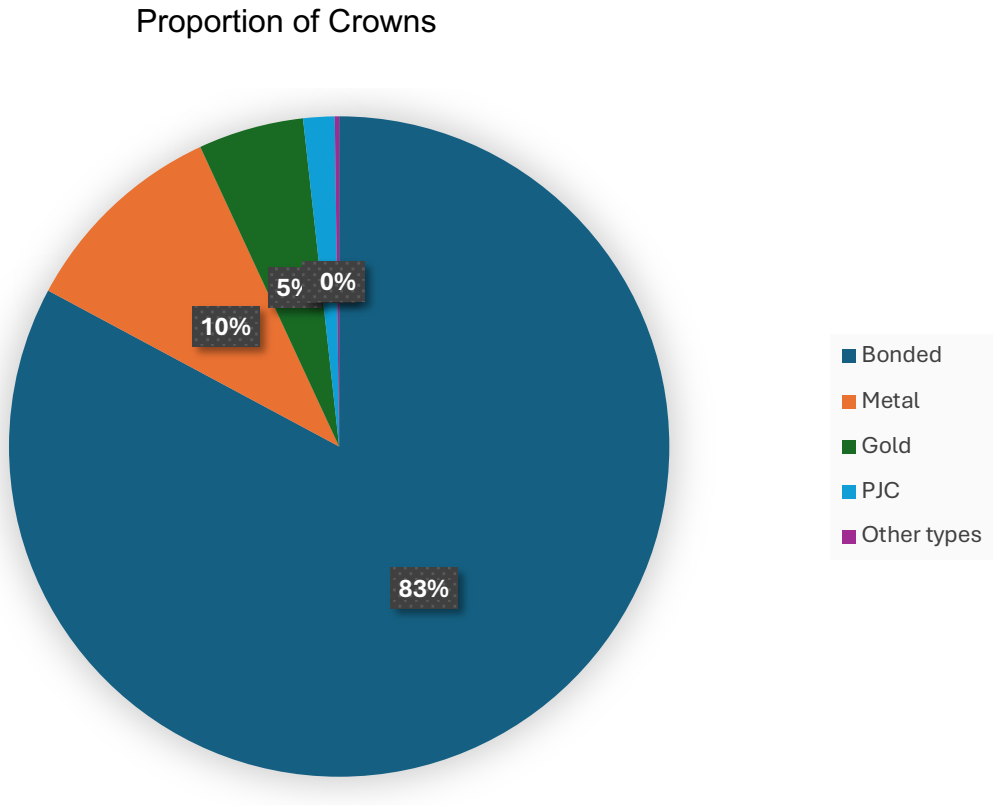


Figure 33 Proportion of Crowns Placed on RCT Teeth

3.5.1.2 Bridge Abutments

The full output result of this program can be found in appendix 9.4.1.2, which was produced by the program in appendix 8.4.1.2. RCT teeth that were used as bridge abutments comprised of 12,046 teeth, which was *circa* 2% of the total of 792,261 RCT teeth. The 14-year survival of RCT bridge abutment teeth was 80% which was slightly higher than those that were not abutments (78%) (Fig. 34).

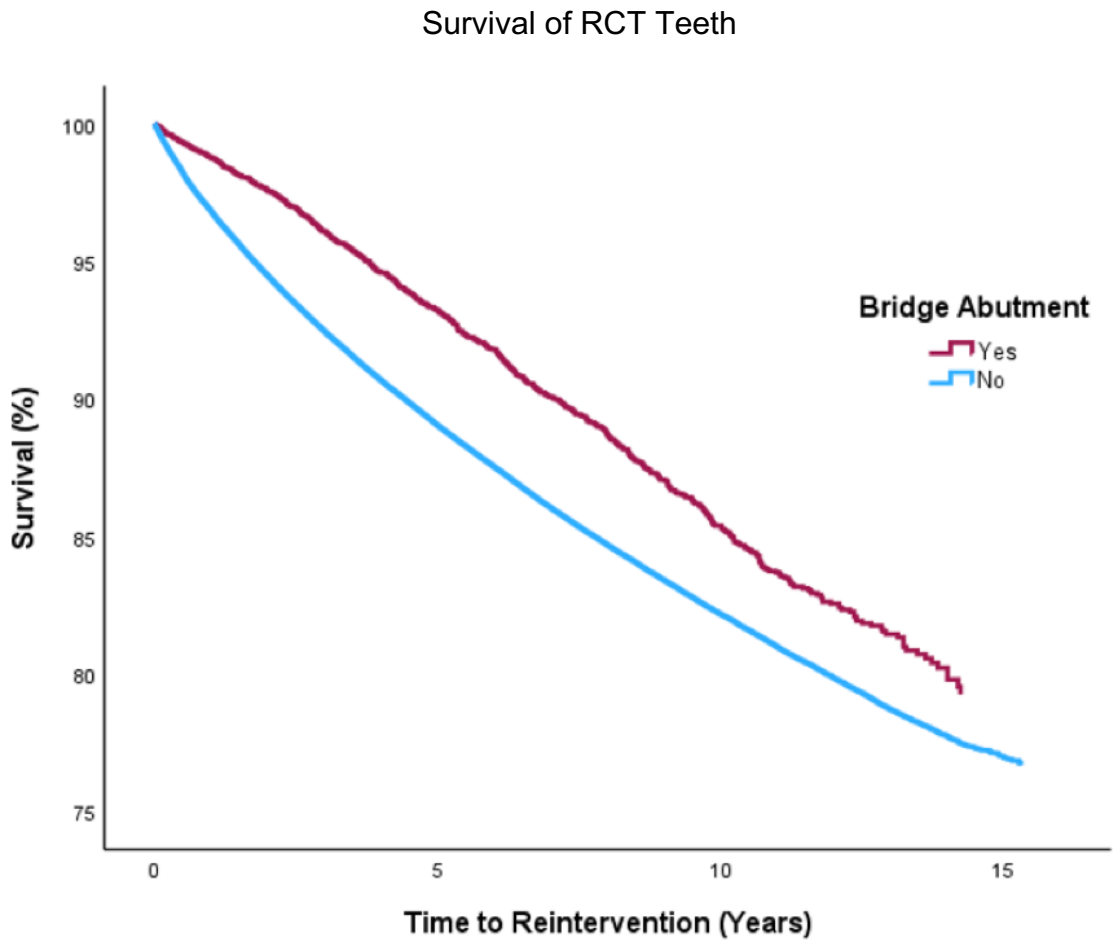


Figure 34 Survival of RCT Teeth Restored as a Bridge Abutment

The position of the RCT bridge abutment tooth in the mouth in relation to the arch, i.e. upper or lower jaw was investigated. Figure 34 indicates that lower teeth survive better than upper teeth. There were 2,365 RCT lower abutment teeth with a 14-year survival of 83% (Fig. 35), compared to 9,679 RCT abutment upper teeth with a survival of 80%. The number of RCT abutment upper teeth was more than three times the number of RCT abutment lower teeth, with a 3 PCT difference in survival.

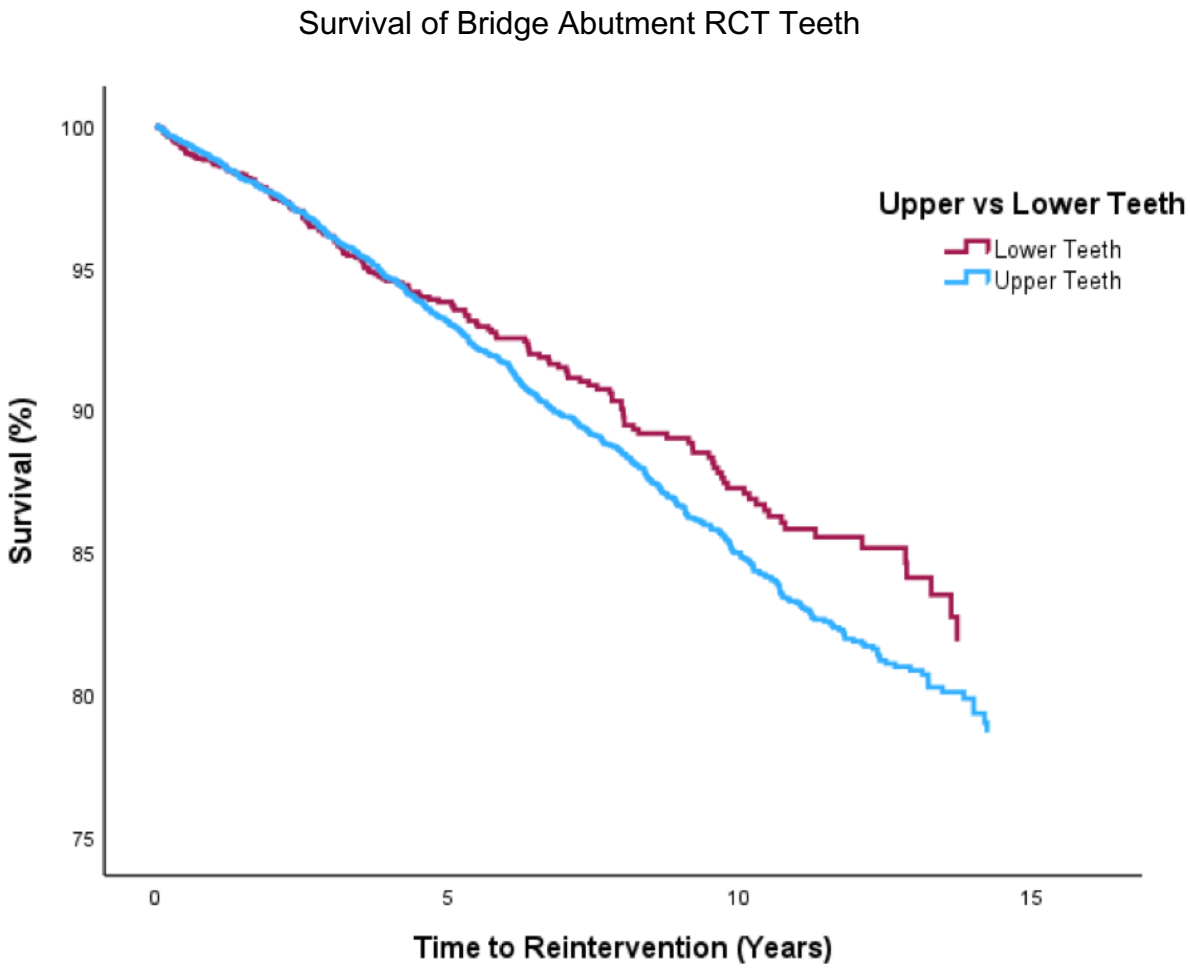


Figure 35 Survival of Upper vs Lower Bridge Abutment RCT Teeth

The total number of RCT abutment anterior teeth was 6,471, and there were 5,570 RCT abutment posterior teeth. The 14-year survival for the posterior teeth was 81% and for the anterior teeth was three PCT less at 78% (Fig. 36).

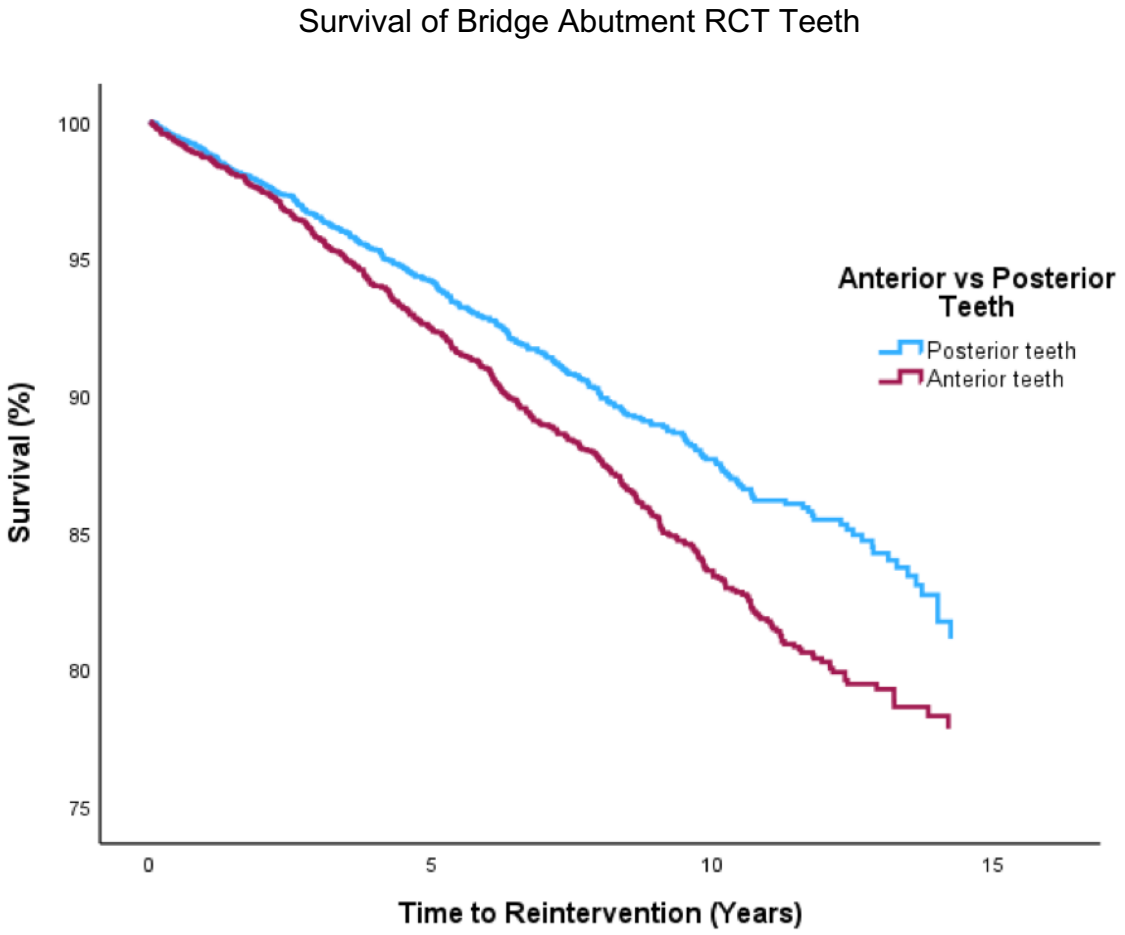


Figure 36 Survival of Anterior vs Posterior Bridge Abutment RCT Teeth

The different sides of the mouth were investigated by investigating the quadrants. The upper right quadrant performed about 5 PCT worse than the other three quadrants which were similar at 14 years survival (Fig. 37). The best survival of a bridge abutment was 86% for upper first molars (U6) and worst, by over 10 PCT, for upper lateral incisor (U2) teeth at 75%.

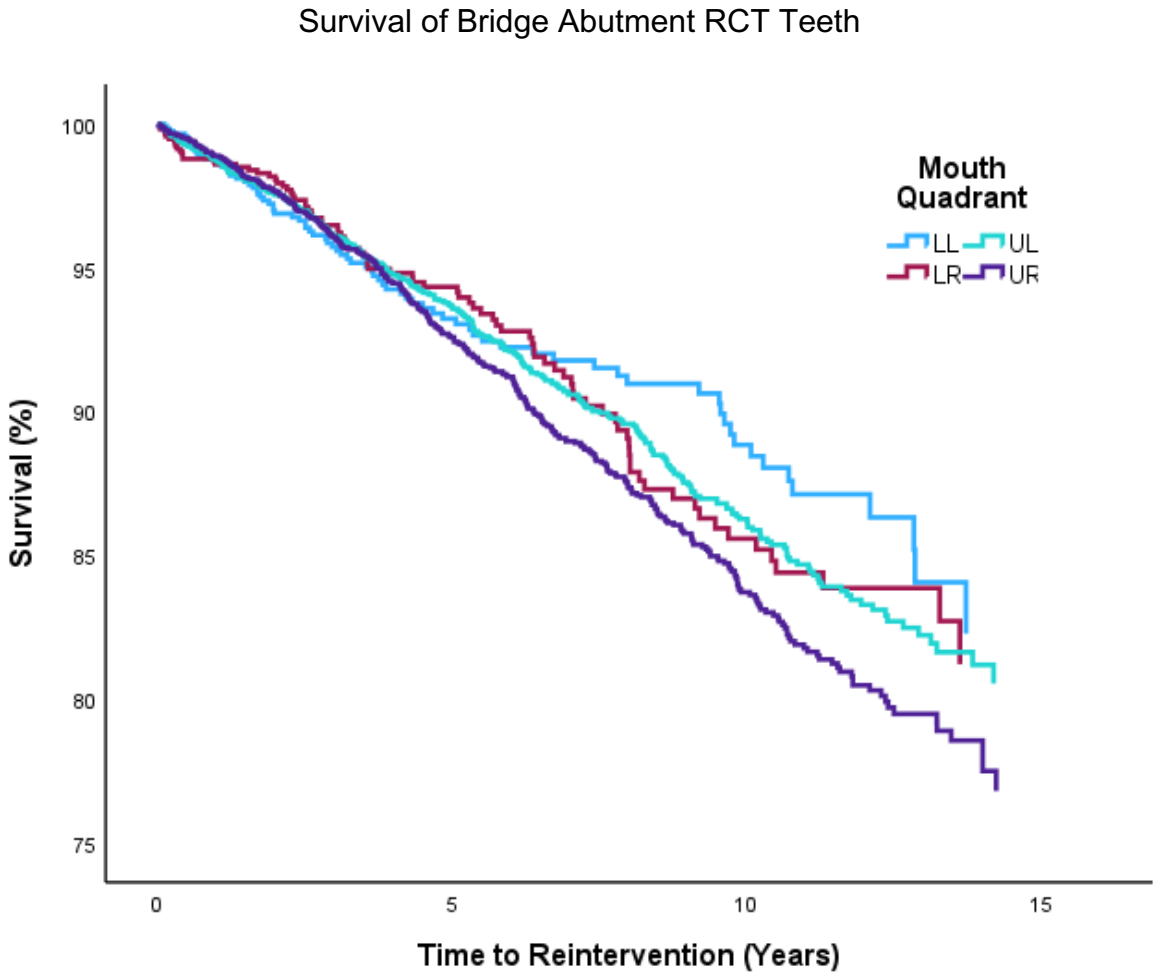


Figure 37 Survival of Bridge Abutment RCT Teeth in Each Quadrant

3.5.1.3 Post

The full output result of this program can be found in appendix 9.4.1.3, which was produced by the program in appendix 8.4.1.3. The number of RCT teeth that had a post placed was 114,618, which was just over 14% of the total of 792,261 RCT teeth. Fifteen-year survival of teeth without a post was 77%, which was slightly higher than those that did not have a post (76%). This was the opposite to the data at the first ten years, in which teeth with a post performed better than those which did not have a

post. The ten-year mark was when teeth with a post started to perform worse than those without one (Fig. 38).

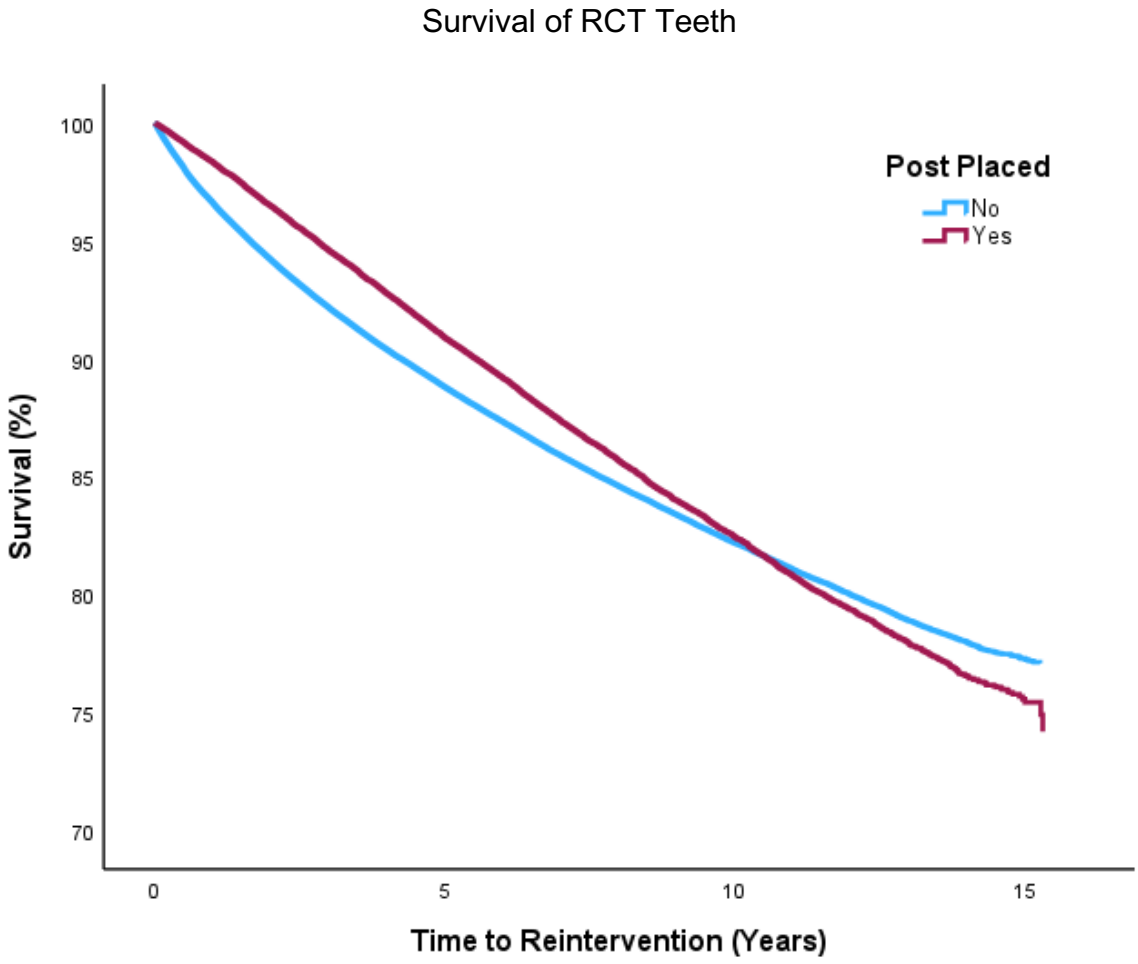


Figure 38 Survival of RCT Teeth Restored with a Post

Figure 38 shows that, for teeth with a post, the 27,626 lower teeth survive better than the 86,982 upper teeth, by just over 5 PCT (Fig. 39).

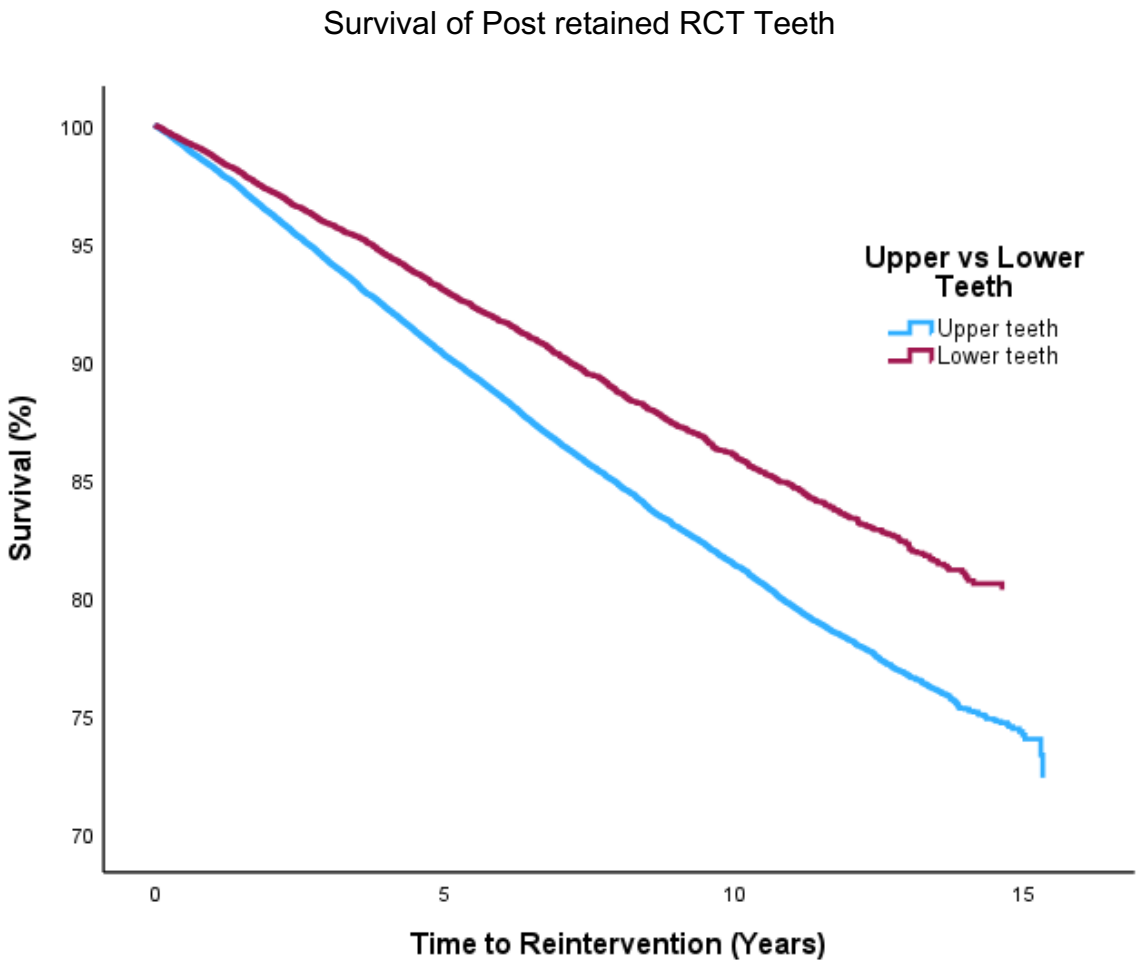


Figure 39 Survival of Upper vs Lower RCT Teeth Restored with a Post

The total number of RCT teeth with a post was 63,177 for the anterior teeth, while the number was 51,420 for posterior teeth with a post. The 15-year survival of posterior RCT teeth with a post was 81%, which was ten PCT better than for anterior RCT teeth with a post (Fig. 40).

Survival of Post Retained RCT Teeth

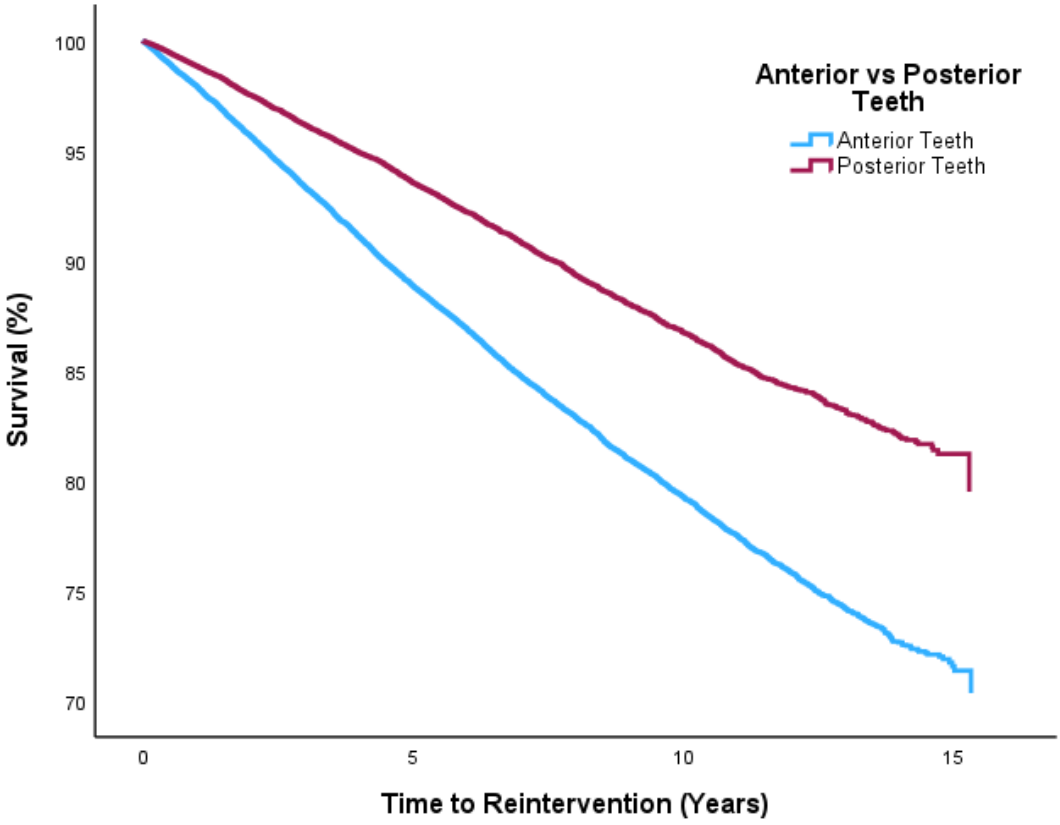


Figure 40 Survival of Anterior vs Posterior RCT Teeth Restored with a Post

The different sides of the mouth were investigated by investigating the quadrants, with the results indicating that the lower quadrants survived 5 PCT better than the upper quadrants; this was a similar pattern to figure 38.

3.5.1.4 Pin or Screw

The full output result of this program can be found in appendix 9.4.1.4, which was produced by the program in appendix 8.4.1.4. The number of RCT teeth that had a pin or screw placed to retain a core was 135,615, which was just over 17% of the total number of 792,261 RCT teeth. The 15-year survival rate of teeth with a pin or screw was 80% compared to 76% for those RCT teeth without a pin or screw, a 4 PCT difference for the better (Fig. 41).

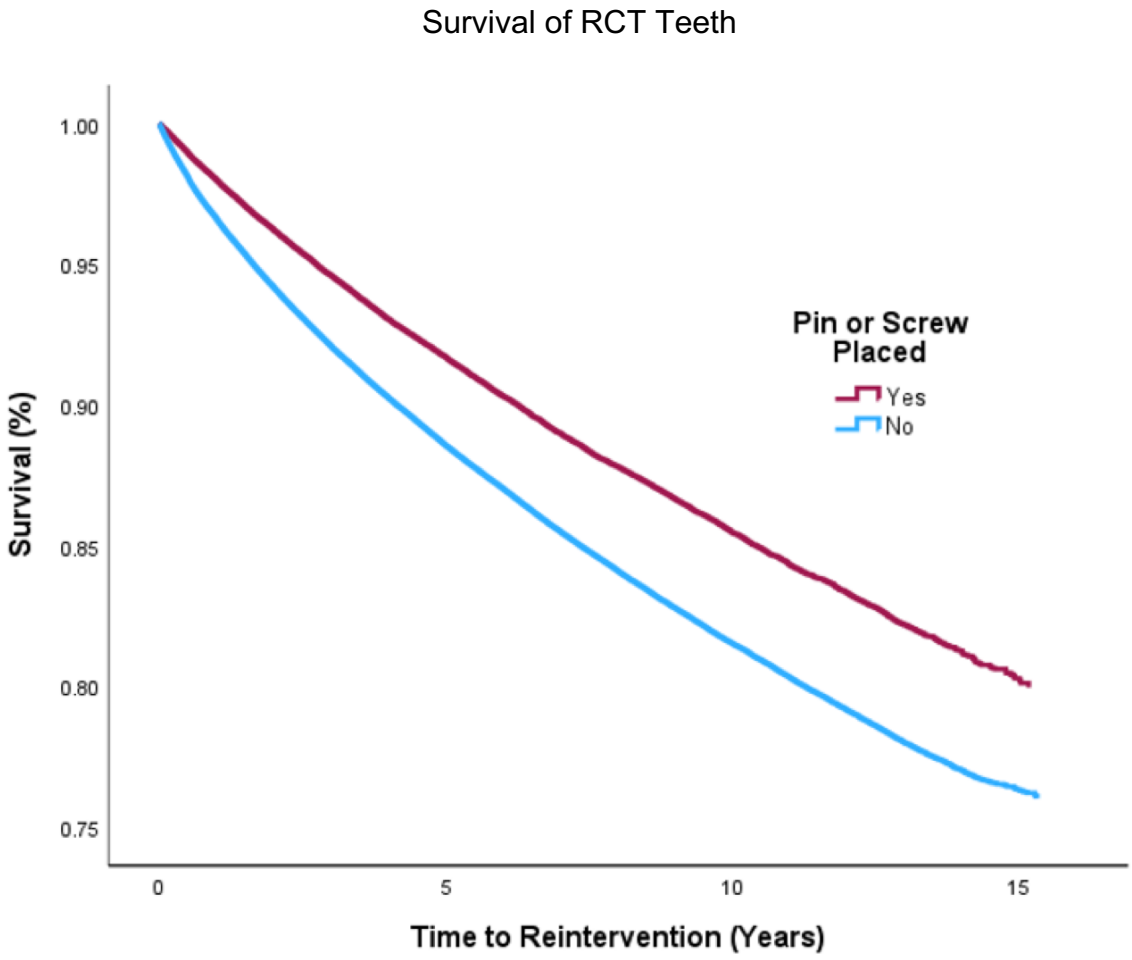


Figure 41 Survival of RCT Teeth Restored with a Pin or Screw

The results indicated that, for teeth with a pin or screw, lower teeth survive better than upper teeth, a 15-year survival of 81% compared to 79% respectively. The total number of RCT anterior teeth with a pin or screw was 14,861, and 120,751 RCT posterior teeth, nearly eight times more with the 15-year survival of 81%, a marked ten PCT higher than RCT anterior teeth (Fig. 42).

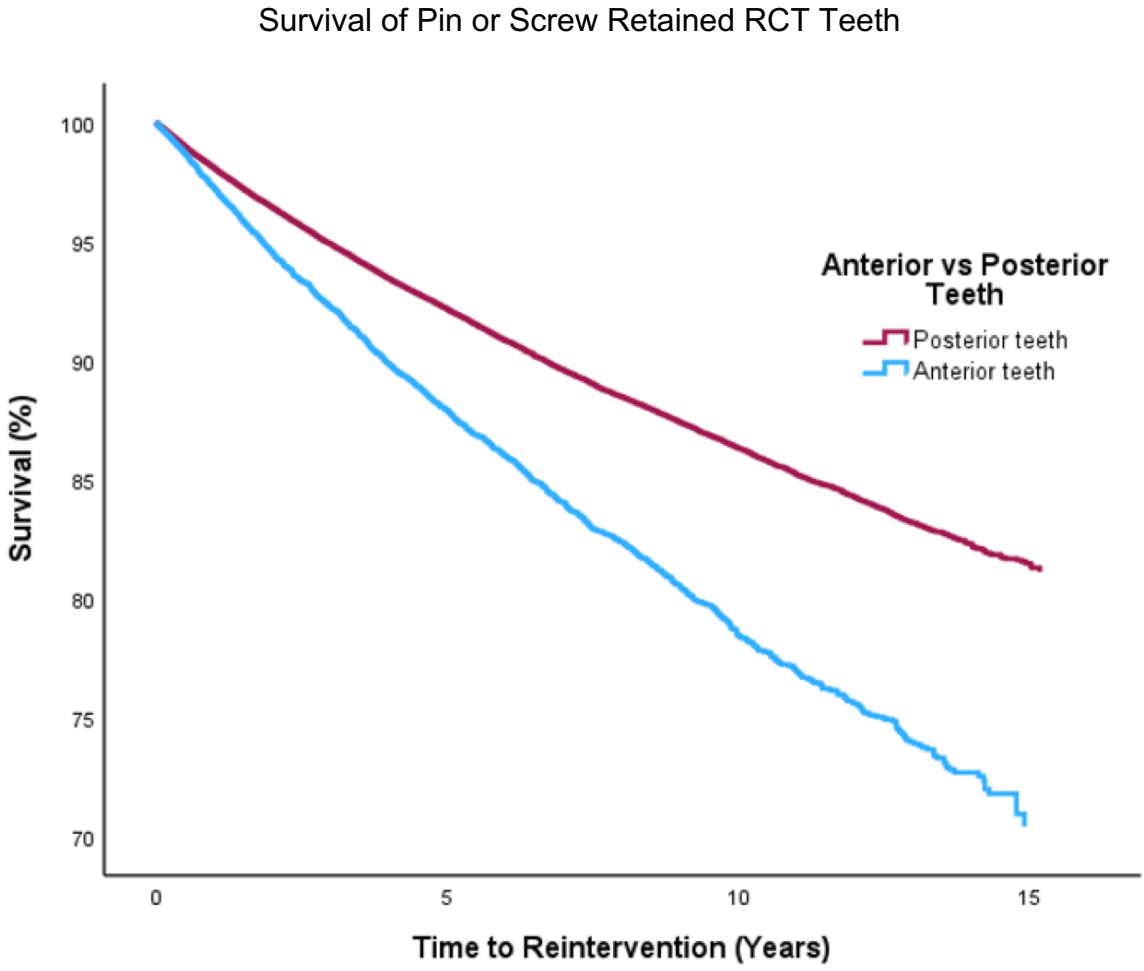


Figure 42 Survival of Anterior vs Posterior RCT Teeth Restored with a Pin or Screw

Survival of RCT teeth with a pin or screw in different sides of the mouth was examined by investigating the quadrants: this did not reveal a significant difference between left

and right. The survival graph for each tooth type revealed a marked difference of 15 PCT between the best surviving tooth type (U6: upper first molars) at 85%, and worst for U2 (upper lateral incisor) teeth at 68%.

3.5.2 Anterior Teeth

It is generally necessary for anterior teeth to have a palatal access cavity through which the RCT can be carried out, but there are also certain restorations that are specific to anterior teeth which are reported in this section.

3.5.2.1 Incisal Edge Restoration

The full output result of this program can be found in appendix 9.4.2.1, which was produced by the program in appendix 8.4.2.1. The total number of RCT teeth which had an incisal edge restoration was 2,132, which was 0.3% of the total of the total of 792,261 RCT teeth. The number of teeth for this group of restoration was low and the survival figures should be noted with this consideration. The 12.5-year survival of RCT anterior teeth with an incisal edge restoration was 75%, the same as those that did not have this restoration. The position of the RCT anterior tooth with an incisal restoration in relation to the arch, i.e. upper or lower jaw was investigated, as was the quadrants, and it was not significant.

3.5.2.2 One Incisal Angle Restoration

The full output result of this program can be found in appendix 9.4.2.2, which was produced by the program in appendix 8.2.2.2. The total number of RCT teeth that had one incisal angle restoration was 11,144, the highest of the three types of the anterior restorations investigated, which was 1% of the total of 792,261 RCT teeth. The number of teeth for this group of restoration was low and the survival figures should be noted with this consideration. The 14-year survival of RCT anterior teeth with an incisal angle restoration was 73%, only 1 PCT lower than those that did not have the same restoration, the quadrants did not show much difference between them either.

3.5.2.3 Two Incisal Angle Restoration

The full output result of this program can be found in appendix 9.4.2.3, which was produced by the program in appendix 8.4.2.3. The total number of RCT teeth that had two incisal angle restorations was 1,529, the number of teeth for this group of restoration was low and the survival figures should be noted with this consideration. The 14-year survival of RCT anterior teeth with two incisal angle restorations was 74%, similar to those that did not have the same restoration.

3.5.3 Posterior Teeth

Five restoration types were investigated for posterior teeth.

3.5.3.1 Occlusal Restoration

The full output result of this program can be found in appendix 9.4.3.1, which was produced by the program in appendix 8.4.3.1. The total number of RCT teeth that had an occlusal restoration was 84,450, this being 11% of the total of 792,261 RCT teeth. The 15-year survival of RCT posterior teeth with occlusal restoration was 78%, at 2 PCT lower than those that had other types of restoration and not solely occlusal (Fig. 43).

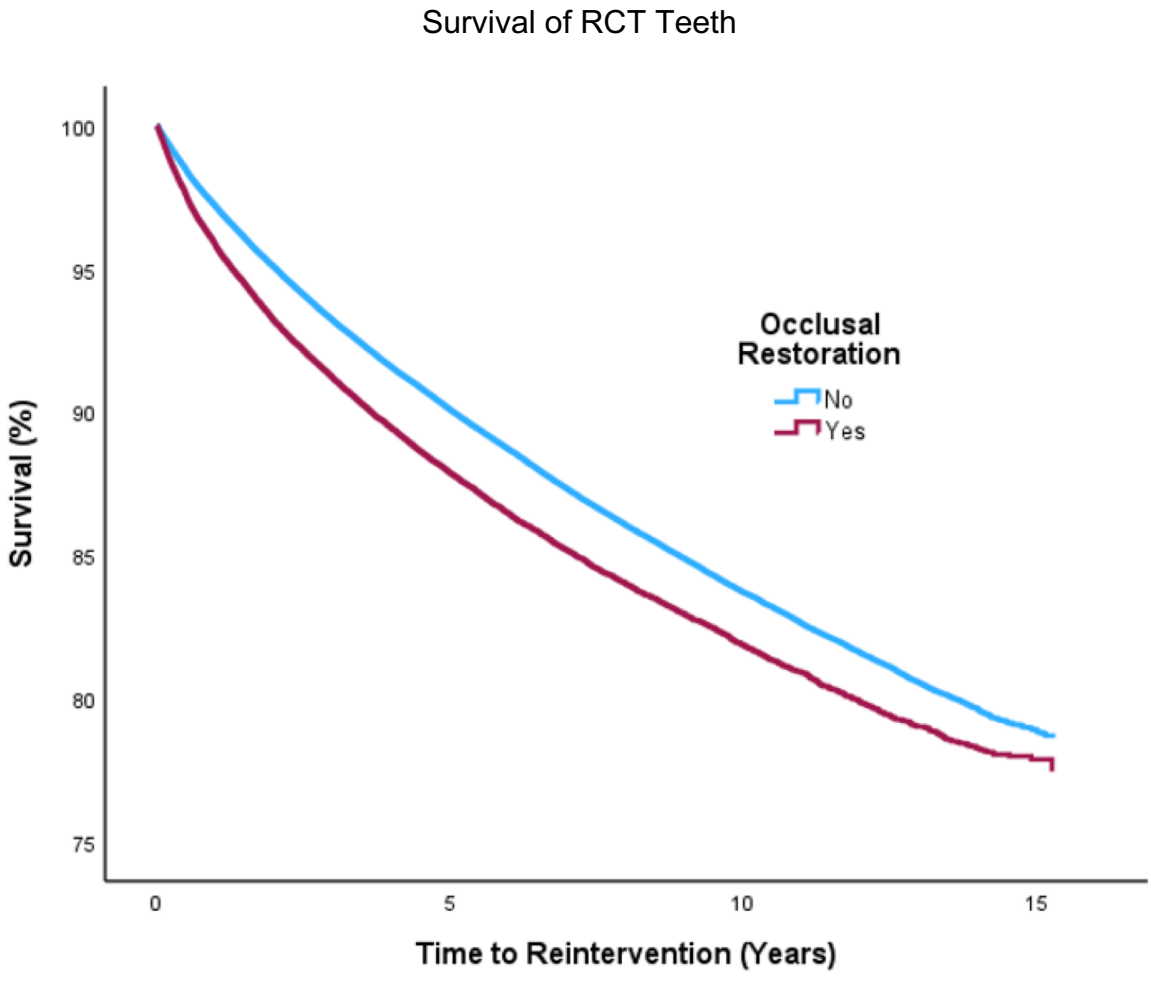


Figure 43 Survival of RCT Teeth Restored with an Occlusal Restoration

The RCT posterior teeth with an occlusal restoration performed similarly among upper and lower teeth and also in the different quadrants, as well as tooth types.

3.5.3.2 MO or DO Restoration

The full output result of this program can be found in appendix 9.4.3.2, which was produced by the program in appendix 8.4.3.2. The total number of RCT teeth that had one marginal ridge (MO or DO) restoration was 154,485, which was 19% of the total of 792,261 RCT teeth. The 15-year survival of RCT posterior teeth with one marginal ridge restoration was 78%, very similar to those that did not have the same restoration (Fig. 44).

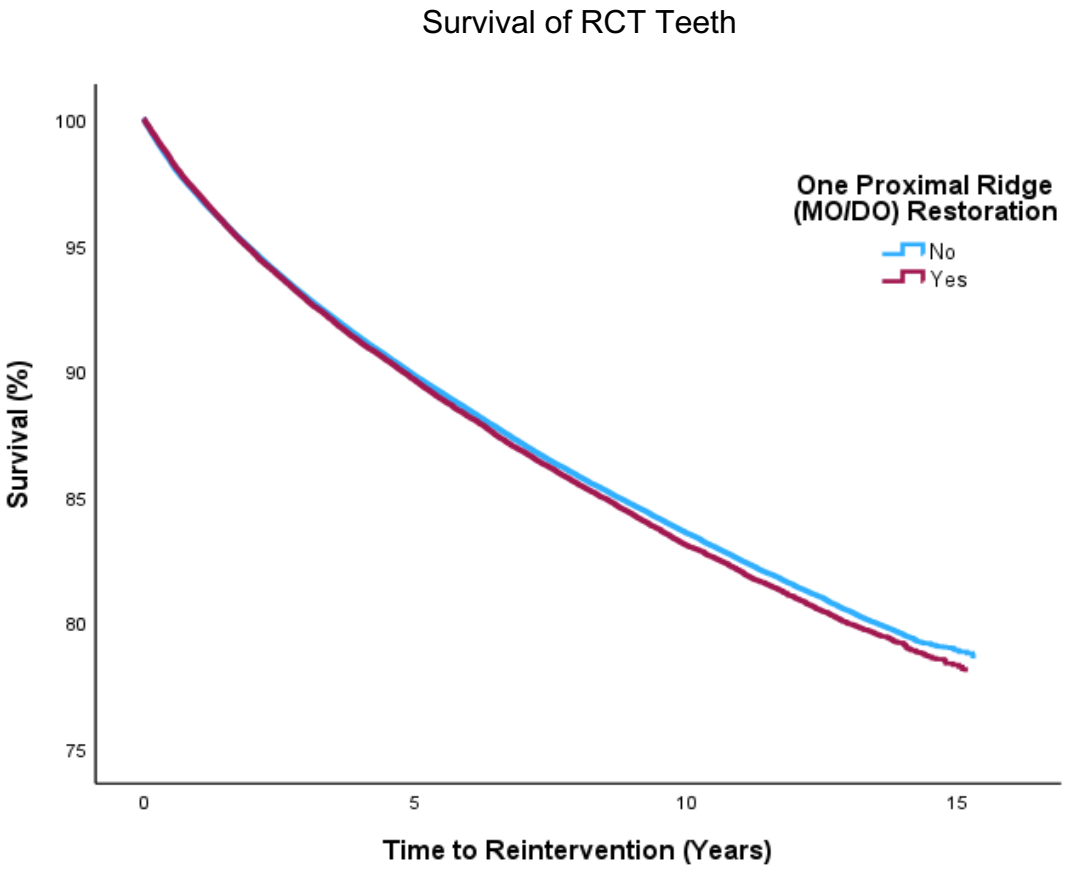


Figure 44 Survival of RCT Teeth Restored with a MO/DO Restoration

The position of the RCT posterior tooth with one marginal ridge restoration in relation to the arch, i.e. upper or lower jaw was investigated and there was no significant difference. The different sides of the mouth were considered by investigating the quadrants. The lower left quadrant performed best at 15 years at 79% and the worst was the upper left quadrant, which was 2 PCT less at 77%, while the right side, made of the other two quadrants, was similar throughout the 15 years (Fig. 45).

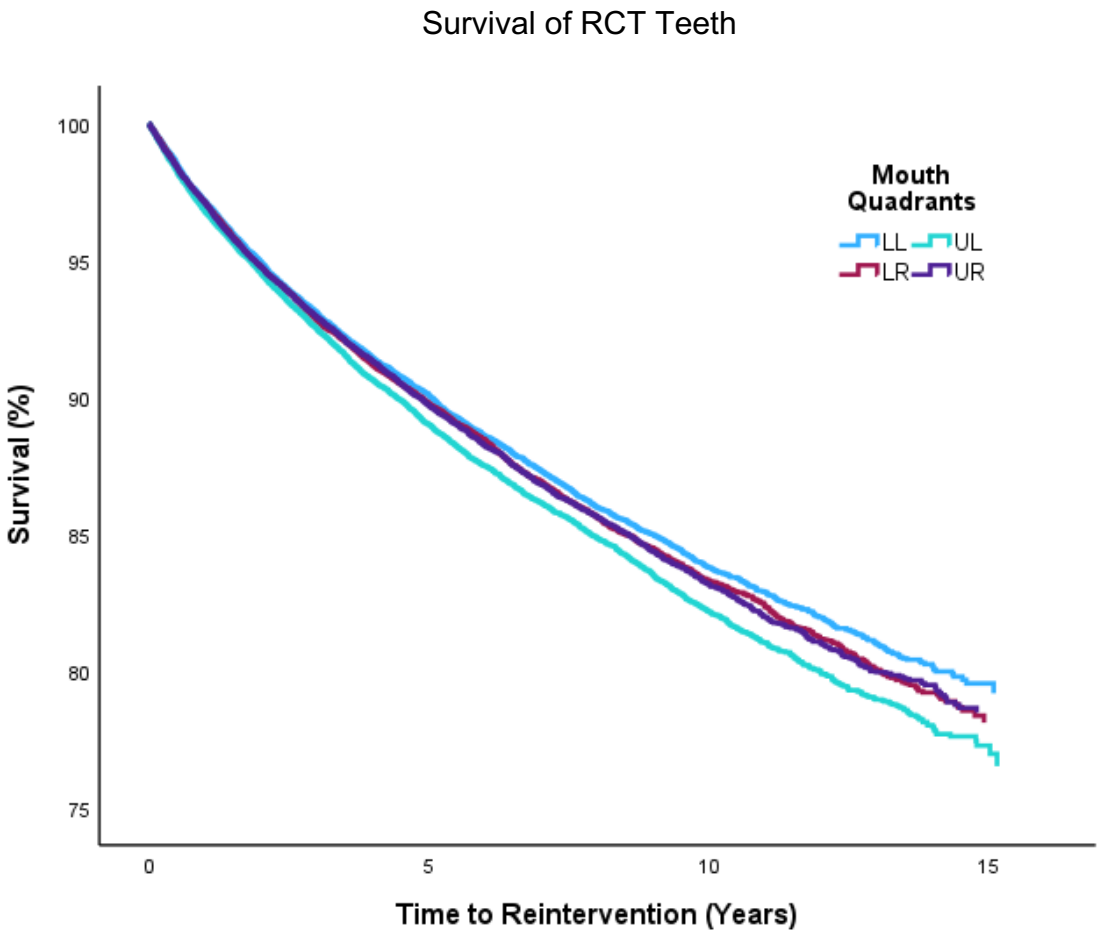


Figure 45 Survival of RCT Teeth Restored with a MO/DO Restoration in Each Quadrant

3.5.3.3 MOD Restoration

The full output result of this program can be found in appendix 9.4.3.3, which was produced by the program in appendix 8.4.3.3. The total number of RCT teeth that had an MOD restoration was 111,911, which was 14% of the total of 792,261 RCT teeth, with a 15-year survival of 78%, very similar to those that did not have the same restoration (Fig. 46).

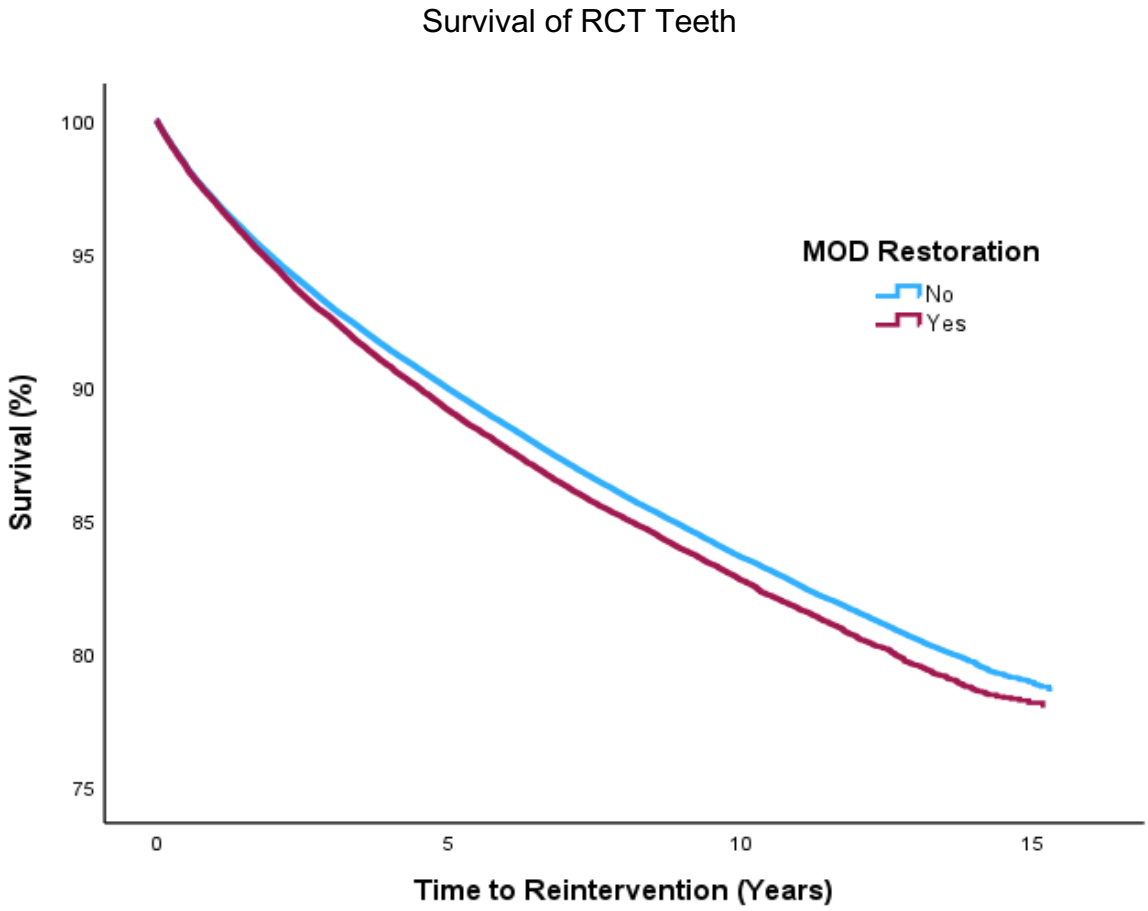


Figure 46 Survival of RCT Teeth Restored with a MOD Restoration

The position of the RCT posterior tooth with MOD restoration in relation to the arch, i.e. upper or lower jaw was investigated as well as quadrants and there was no

significant difference. However, whilst the 15-year survival was similar for most teeth, there was a 5 PCT difference among the L4 (lower first premolar) and L8 (lower third molar) which performed best at 81% while upper premolars, U4 (upper first premolar) and U5 (upper second premolar), performed worse at 76%.

3.5.3.4 Inlay Restoration

The full output result of this program can be found in appendix 9.4.3.4, which was produced by the program in appendix 8.4.3.4. The total number of RCT teeth that had an inlay restoration was 7,575, which was 1% of the total of 792,261 RCT teeth. The 13-year survival of RCT posterior teeth with an inlay restoration was 77%, about 3 PCT fewer than those that did not have the same restoration. However, until 8-years, there was no difference in survival (Fig. 47).

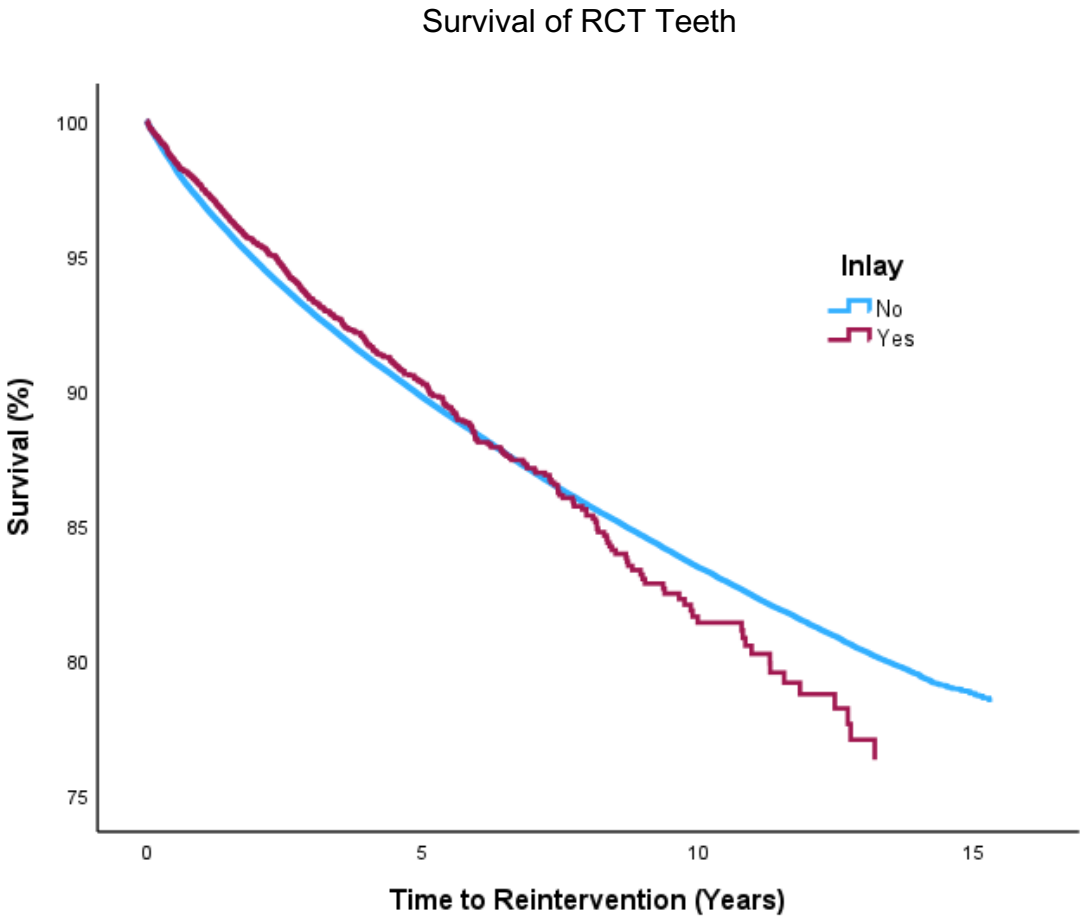


Figure 47 Survival of RCT Teeth Restored with an Inlay Restoration

3.5.3.5 Tunnel Restoration

The full output result of this program can be found in appendix 9.4.3.5, which was produced by the program in appendix 8.4.3.5. The total number of RCT teeth that had a tunnel restoration was 130, which was very small and therefore not considered to be worthy of further investigation.

3.6 Role of Restorations Placed Before the RCT

3.6.1 All Teeth

Historic restorations were categorised into four groups by the length of history and follow up, being variable as reported in the method. The program in appendix 8.4.4.1. produced the output in appendix 9.4.4.1. The program had used a total of number of 431,945 RCT teeth and it found those that could be utilised for the calculation comprised of 431,190 teeth. The 12-year survival rate of RCT teeth with a restorative history of 3 years was 80%.

The program in appendix 8.4.4.2. produced the output in appendix 9.4.4.2. The program had used a total of 324,326 RCT teeth and it found those that could be utilised for the calculation comprised of 323,595 teeth. The 10-year survival rate of RCT teeth with a restorative history of 5 years was 83%.

The program in appendix 8.4.4.3. produced the output in appendix 9.4.4.3. The program had used a total of number of 191,477 RCT teeth and it found those that could be utilised for the calculation comprised of 190,793 teeth. The overall 7-year survival rate of teeth with a restorative history of 8 years was 86%.

The program in appendix 8.4.4.4. produced the output in appendix 9.4.4.4. The program had used a total of number of 116,528 RCT teeth and it found those that could be utilised for the calculation comprised of 115,897 teeth. The overall 5-year survival rate of teeth with a restorative history of 10 years was 90%. The four cohorts were

pooled together and are represented in the chart, including the whole sample (Fig. 48).

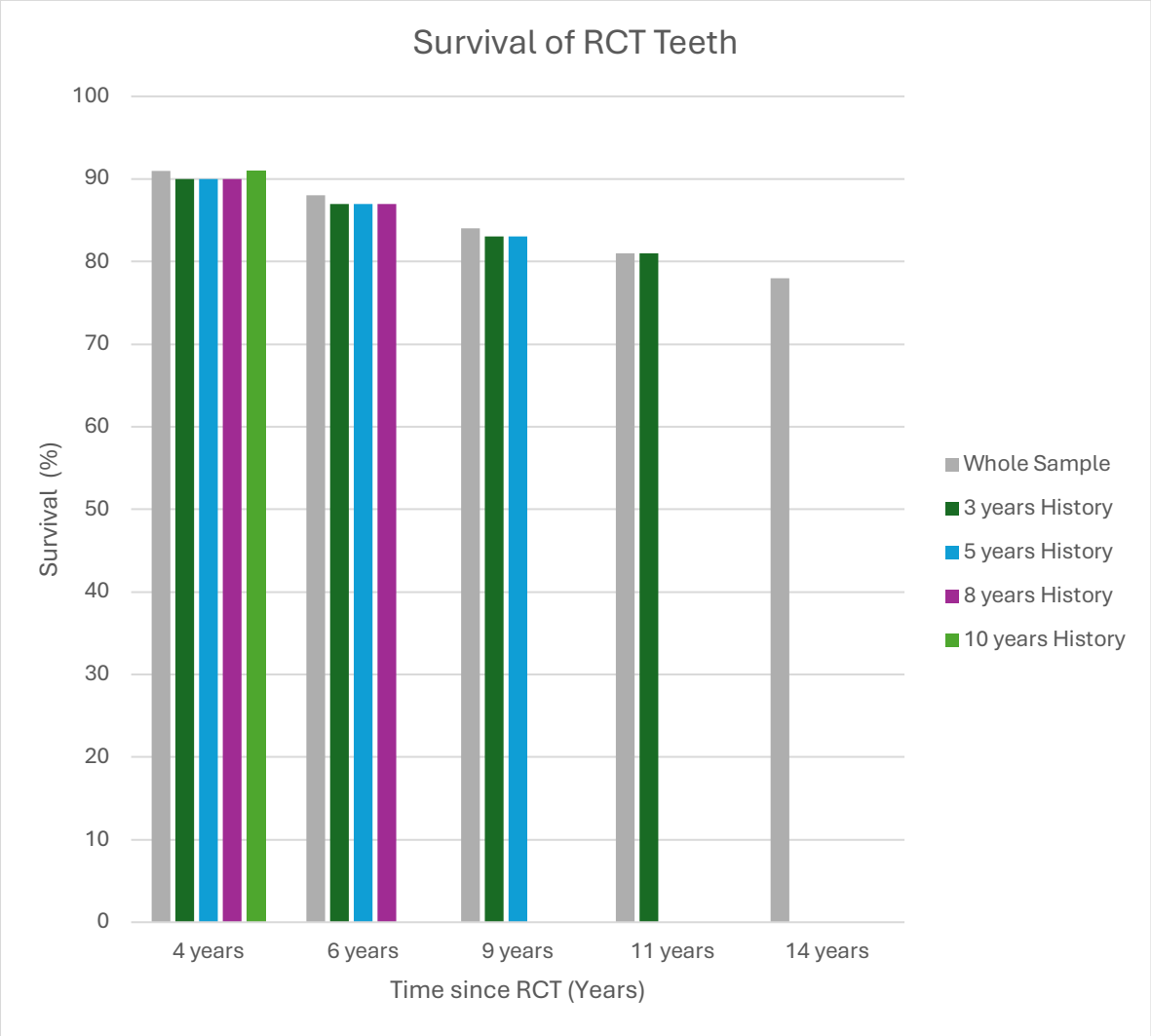


Figure 48 Comparison of Survival of Teeth with Various Time Periods

The four programs in appendix 8.4.4.1-4 produced the four outputs in appendix 9.4.4.1-4 for various restorations which had been reported.

3.6.1.1 RCT

The total number of RCT teeth with a 3-year history that previously have had RCT at least once was 11,586, which was 3% of the total number of 431,190 RCT teeth. The total number of RCT teeth with a 5-year history that previously have had RCT at least once, was 11,936, which was 4% of the total number of 323,595 RCT teeth. The total number of RCT teeth with an 8-year history that previously have had RCT at least once, was 8,900, which was 5% of the total number of 190,793 RCT teeth. The total number of RCT teeth with a 10-year history that previously have had RCT at least once, was6,012, which was 5% of the total number of 115,897 RCT teeth. The number of RCT teeth that previously have had a RCT at least once, ranged from 6,012 to 11,936, and were pooled together and the four historic cohorts represented in the chart (Fig. 49). The survival of these teeth was on average 5 PCT fewer than those that were not had RCT previously.

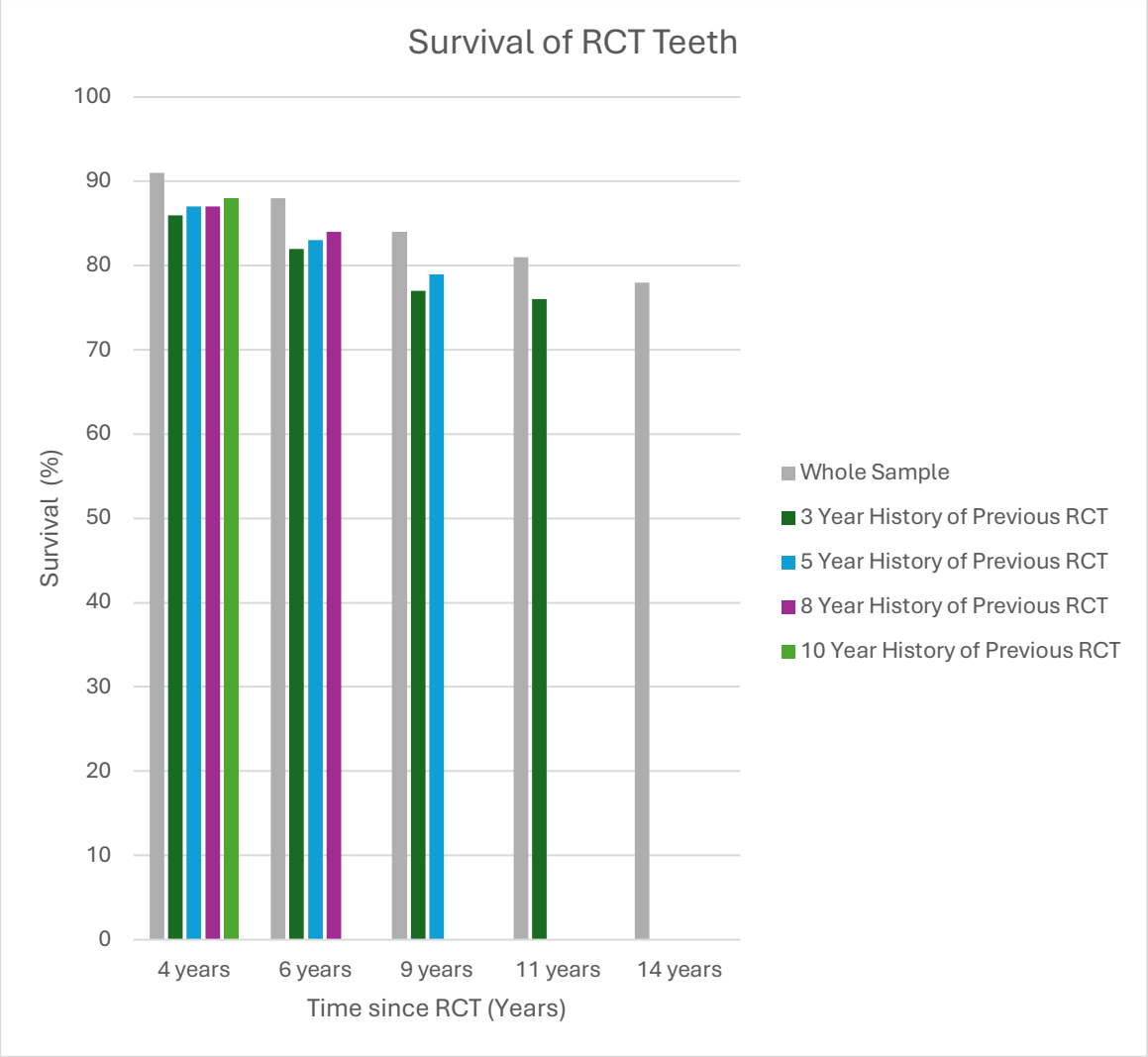


Figure 49 Survival of RCT Teeth with History of Previous RCT

3.6.1.2 Apicectomy

The total number of teeth that previously had an apicectomy at least once ranged from 59 to 131 teeth, in the four historic cohorts, therefore the results were not considered to be sufficient for investigation.

3.6.1.3 Crown

The total number of teeth that previously had a crown at least once ranged from 8,682 to 14,555 teeth among these four historic cohorts. The survival of the RCT teeth with a history of a previous crown was 5 PCT worse than those that did not have a crown (Fig. 50). The latter concept is applied the graphs from here on as a point of comparison to the whole sample and the placement of that type of restoration before and after RCT.

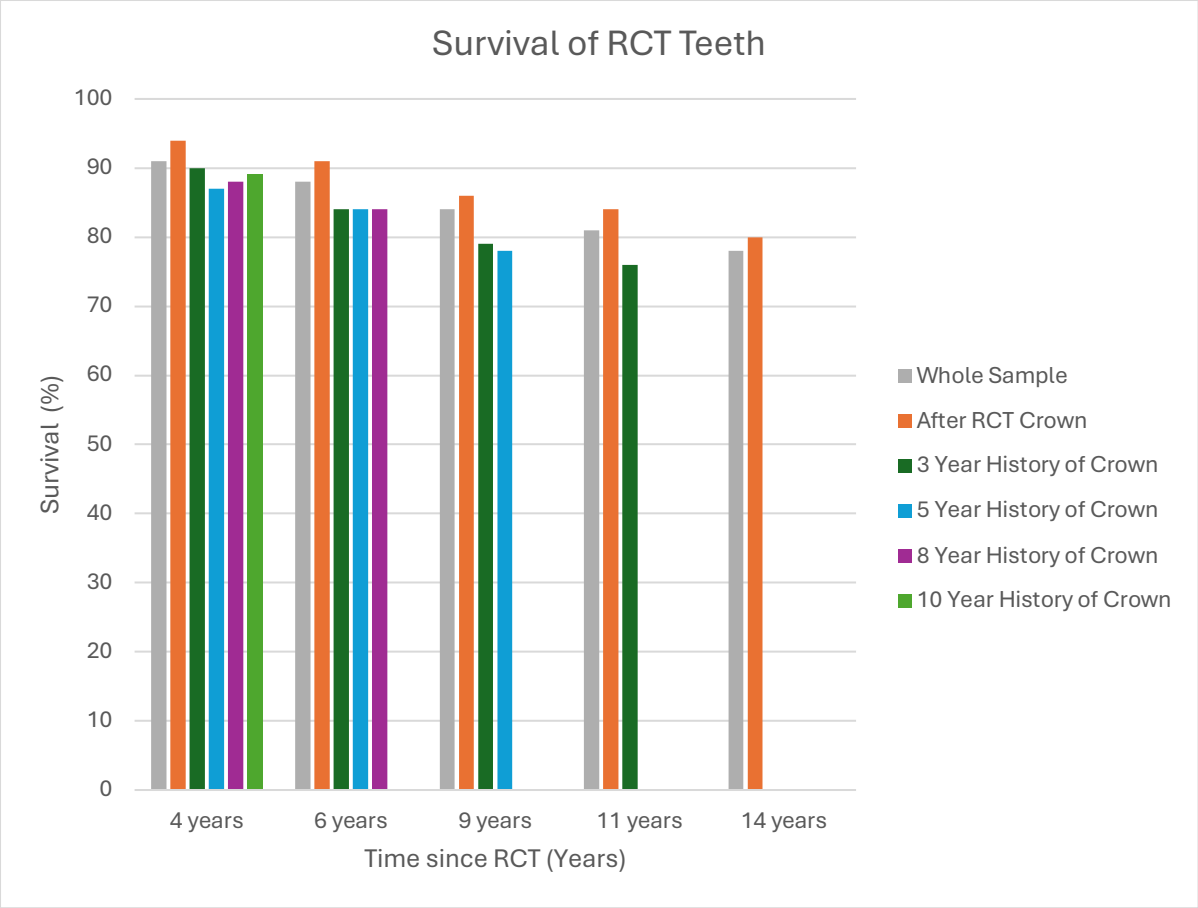


Figure 50 Survival of RCT Teeth with History of Previous Crown

3.6.1.4 Bridge Abutment

The total number of teeth that previously had been a bridge abutment restoration at least once ranged from 1,828 to 2,524 teeth among these four cohorts. The survival of the RCT teeth that previously had been a bridge abutment restoration was on average 3 PCT worse than those that had not been a bridge abutment (Fig. 51).

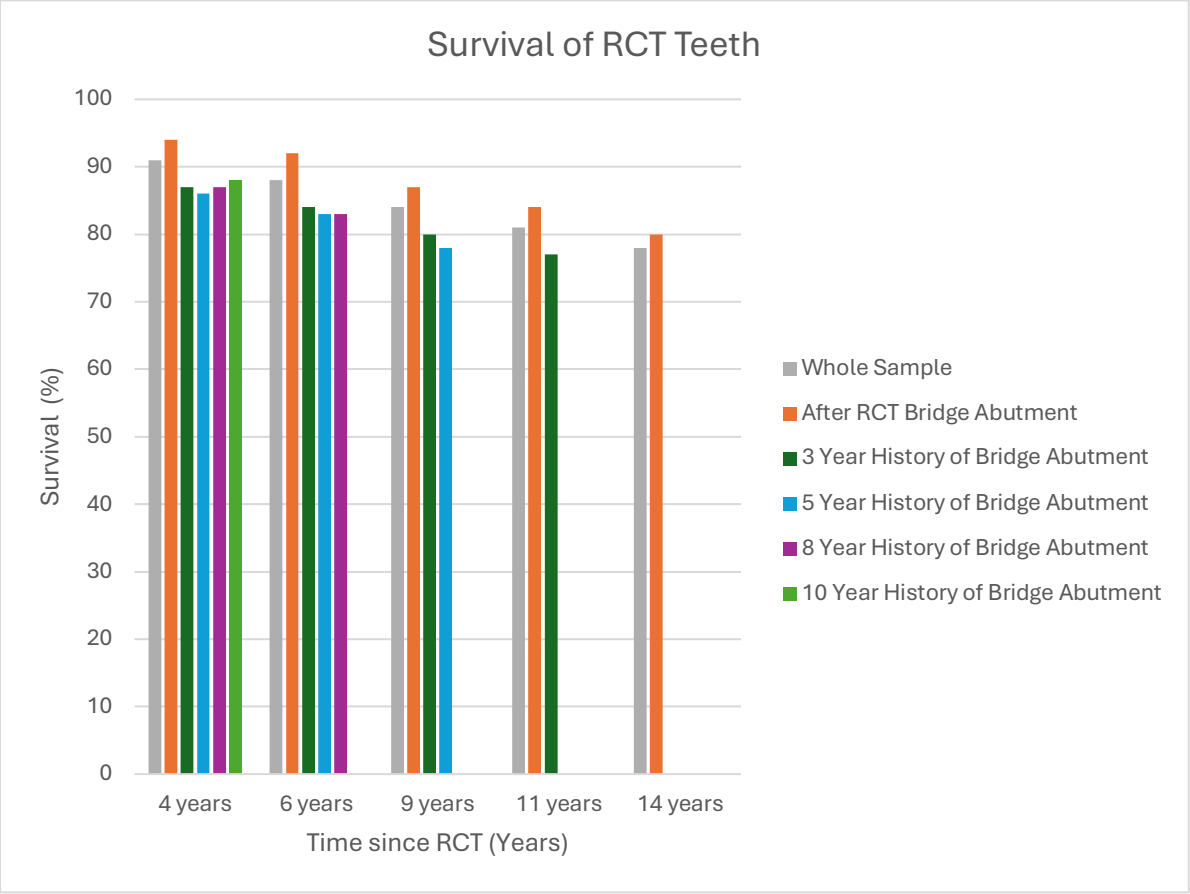


Figure 51 Survival of RCT Teeth with History of Previous Bridge Abutment

3.6.1.5 Post

The total number of teeth that previously had had a post placed at least once ranged from 1,140 to 1,980 teeth among these four cohorts. The survival of these teeth was on average 5 PCT worse than those that did not have a historic post (Fig. 52).

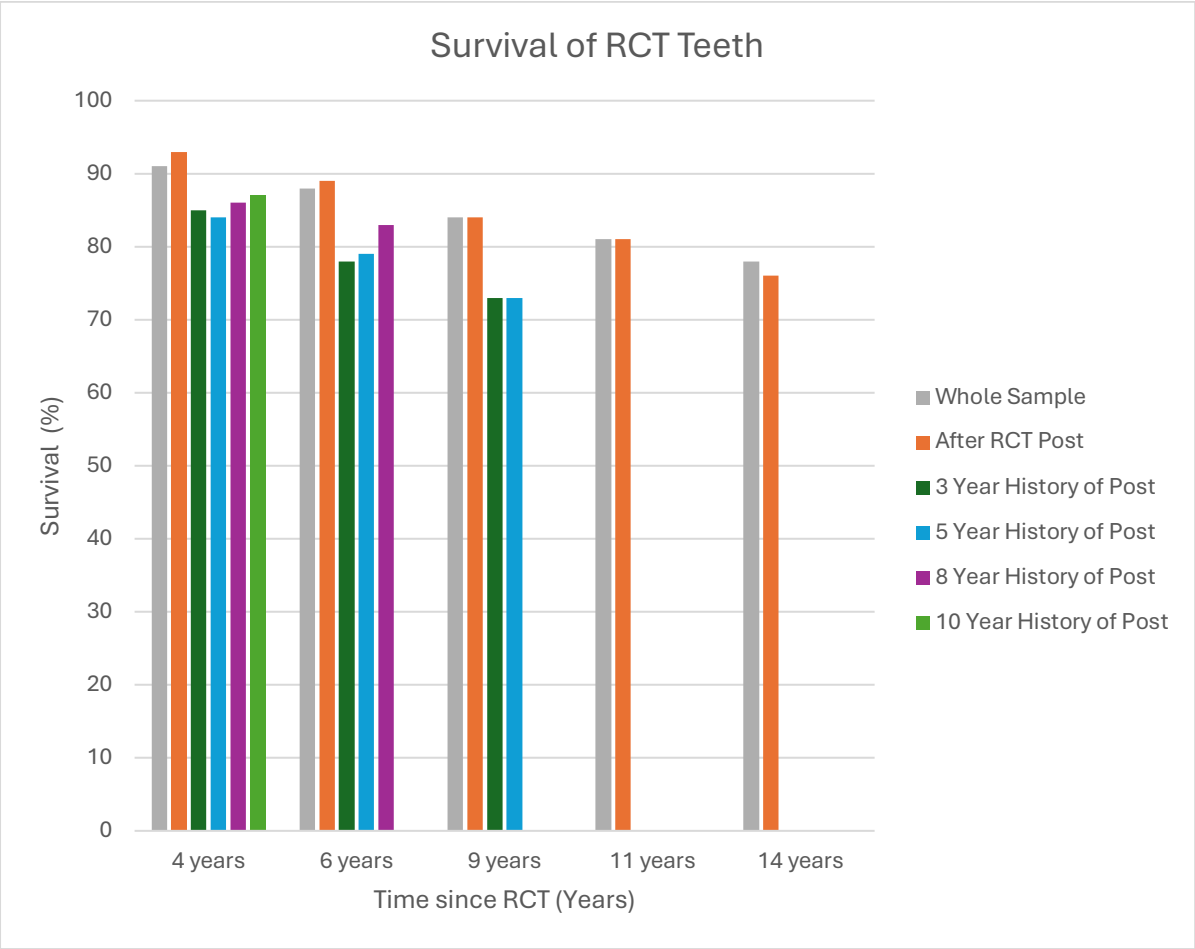


Figure 52 Survival of RCT Teeth with History of Previous Post

3.6.1.6 Pin or Screw

The total number of teeth that previously had had a pin or screw placed (for the restoration) at least once ranged from 10,876 to 20,764 teeth, in the four historic cohorts from the output. The results were not considered to be worthy of further investigation as they were very similar (Fig. 53).

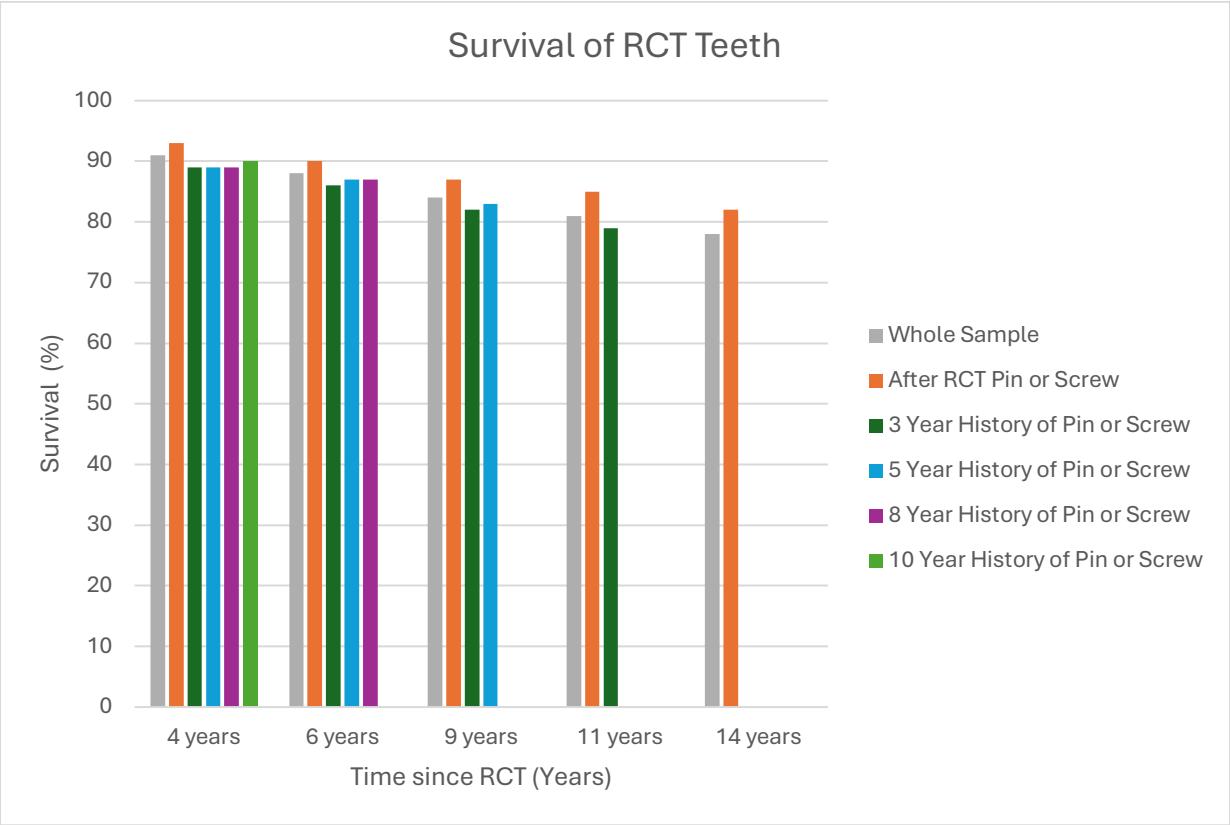


Figure 53 Survival of RCT Teeth with History of Previous Pin or Screw

3.6.2 Anterior Teeth

The four programs in appendix 8.4.4.1-4 produced the output in appendix 9.4.4.1-4.

3.6.2.1 Incisal Edge Restoration

The total number of teeth that previously had an incisal edge restoration at least once ranged from 607 to 1,016 teeth in the four historic cohorts therefore the results were not considered to be significant.

3.6.2.2 One Incisal Angle Restoration

The total number of teeth that previously had one incisal angle restoration at least once ranged from 3,424 to 6,565 teeth among these four cohorts, the results were similar, and this restoration type placed historically considered not a significant factor (Fig. 54).

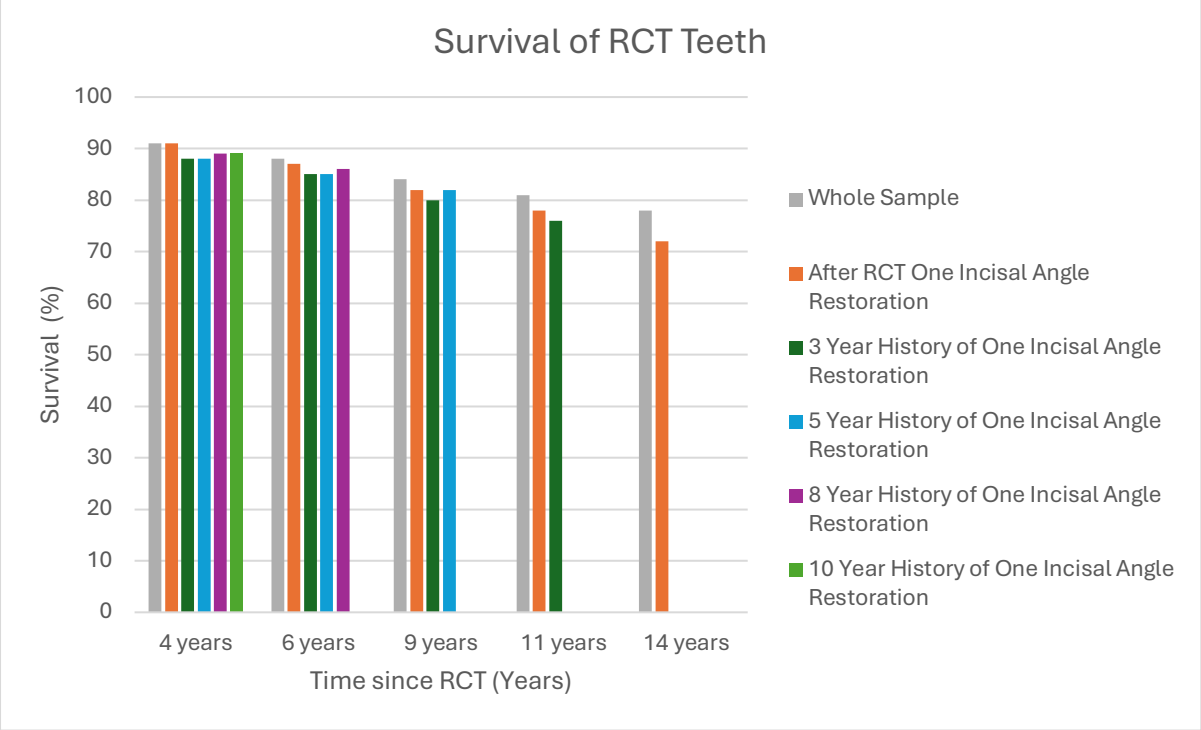


Figure 54 Survival of RCT Teeth with History of Previous One Incisal Angle Restoration

3.6.2.3 Two incisal angle restoration

The total number of teeth that previously had a restoration involving two incisal angles at least once ranged from 380 to 676 teeth in the four historic cohorts therefore the results were not considered to be worthy of further investigation as they were very similar.

3.6.3 Posterior Teeth

The programs in appendix 8.4.4.1-4 produced the output in appendix 9.4.4.1-4.

3.6.3.1 Occlusal Restoration

The total number of teeth that previously had an occlusal restoration at least once ranged from 6,746 to 10,652 teeth among these four cohorts, the survival of the RCT teeth was 2 PCT fewer than those that did not have an occlusal restoration placed previously (Fig. 55).

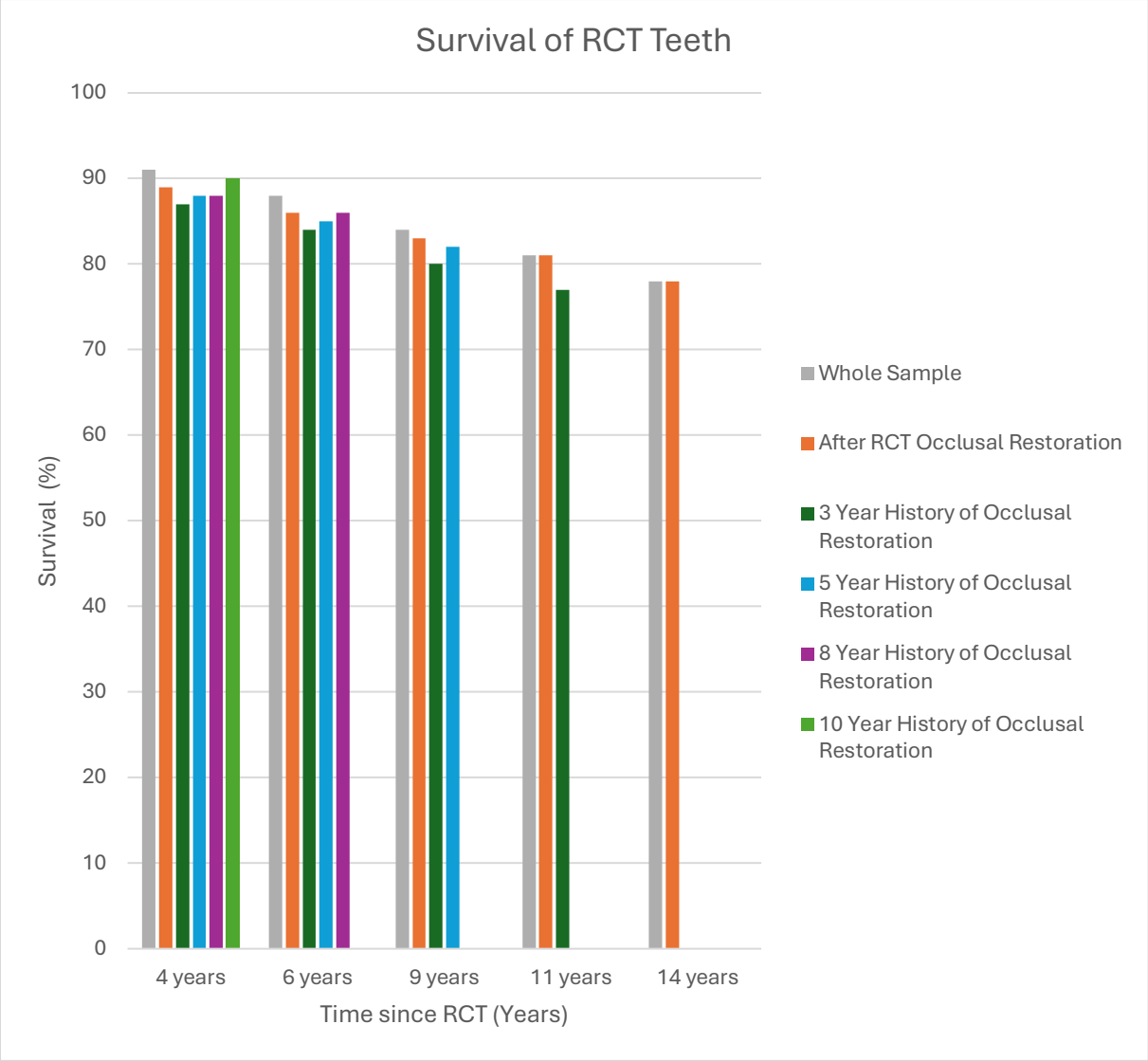


Figure 55 Survival of RCT Teeth with History of Previous Occlusal Restoration

3.6.3.2 MO or DO Restoration

The total number of teeth that previously had an MO or DO restoration at least once ranged from 24,937 to 47,789 teeth among these four cohorts, the results were not considered worthy of further investigation as they were very similar (Fig. 56).

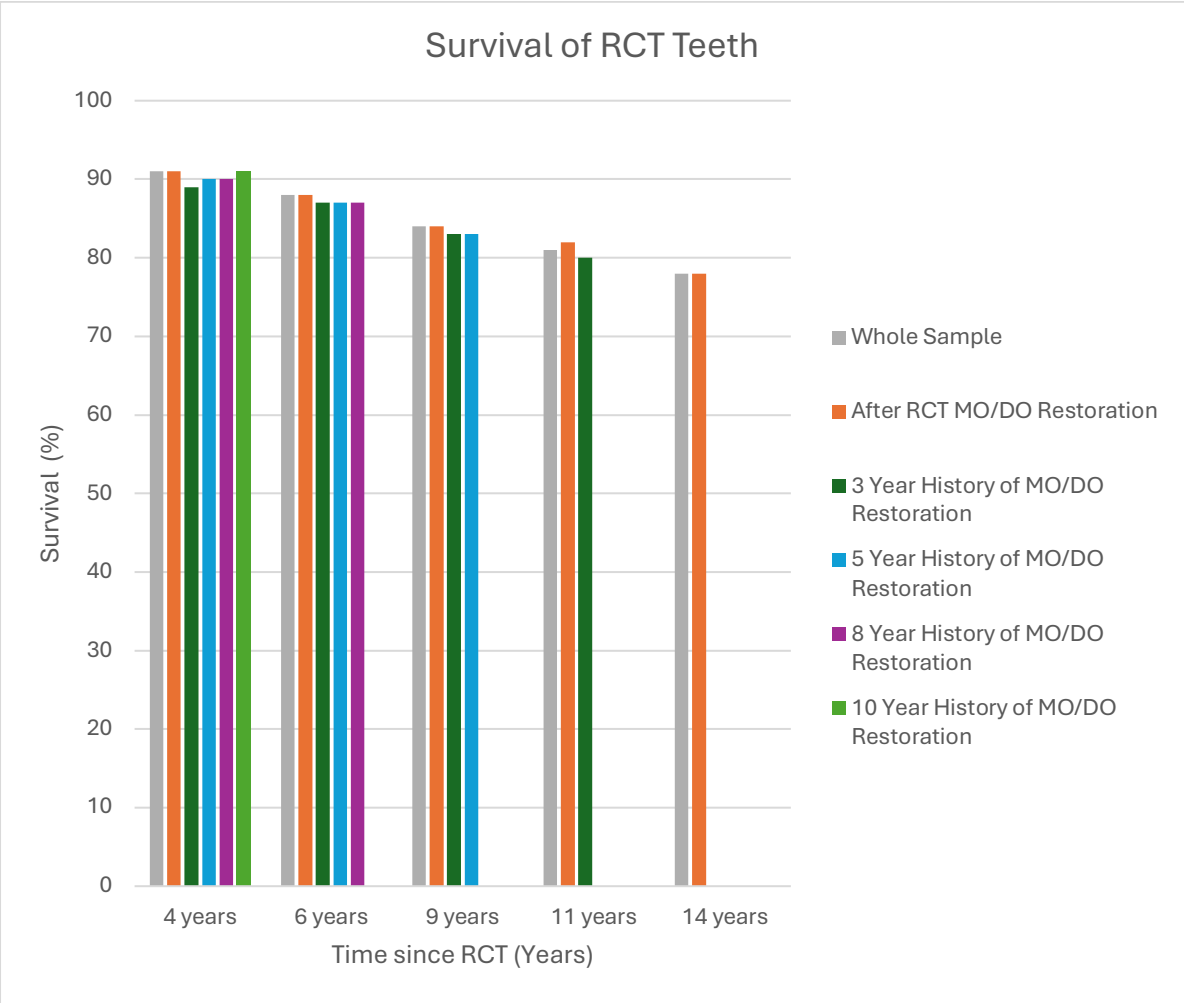


Figure 56 Survival of RCT Teeth with History of Previous MO/DO Restoration

3.6.3.3 MOD Restoration

The total number of teeth that previously had an MOD restoration at least once ranged from 15,061 to 28,882 teeth among these four cohorts, the results were not considered worthy of further investigation as they were very similar (Fig. 57).

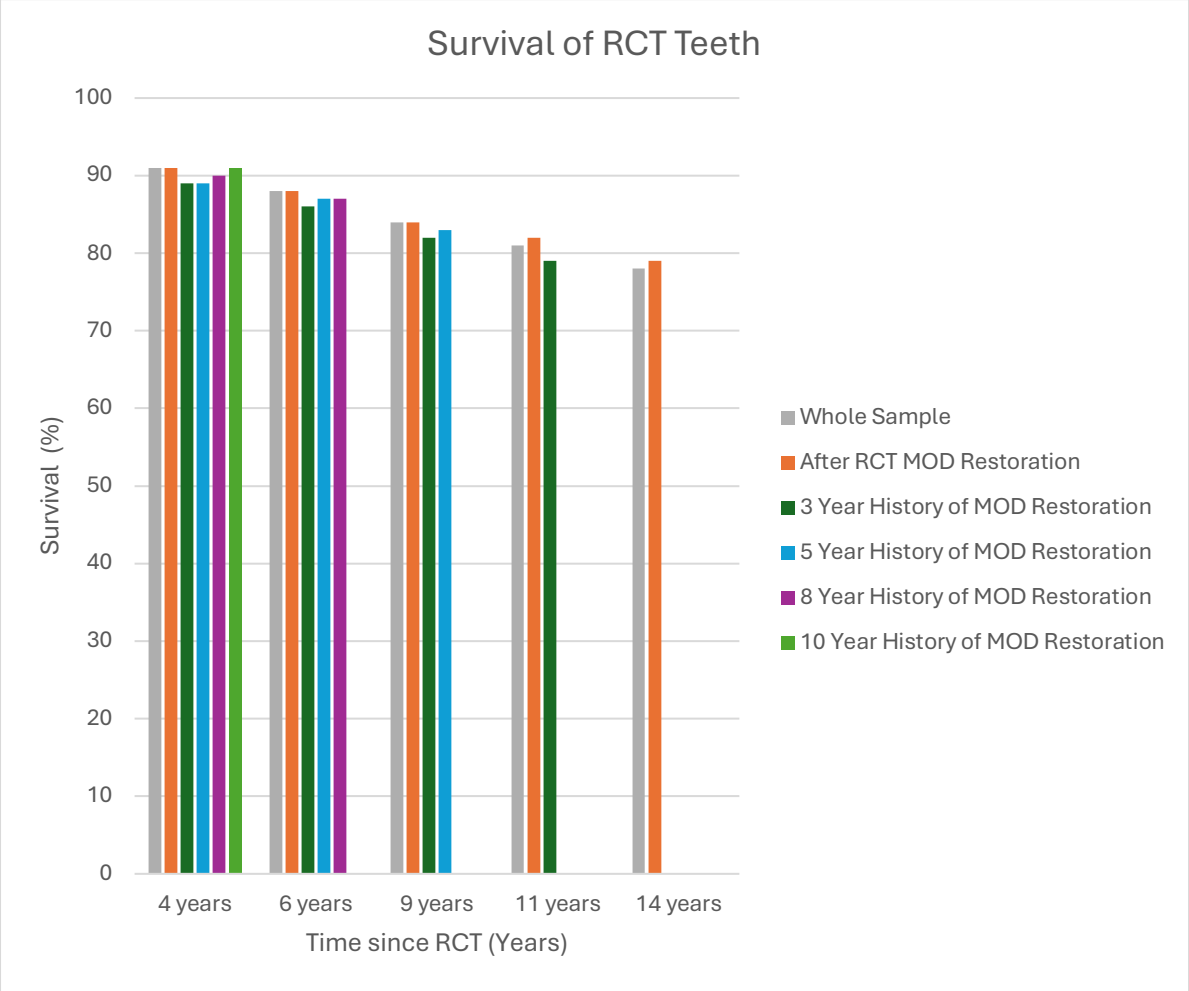


Figure 57 Survival of RCT Teeth with History of Previous MOD Restoration

3.6.3.4 Inlay Restoration

The total number of teeth that previously had an inlay restoration at least once ranged from 880 to 1,378 teeth among these four cohorts, therefore the results were not considered worthy of further investigation as they were very similar.

3.6.3.5 Tunnel Restoration

The total number of teeth that previously had a tunnel restoration at least once ranged from 48 to 91 teeth among these four cohorts, therefore the results were not considered worthy of further investigation as they were very similar.

Chapter 4 Discussion

4.1 Overall Survival of Root Canal Treated Teeth

The 15-year survival of root canal treatment carried out on 791,375 teeth by GDPs in England and Wales was 77%, based on reintervention (RE-RCT, RES/Apicectomy, Extraction), and 83% based on extraction alone. These findings are encouraging and appear to support the provision of RCT by GDPs working in the NHS GDS in order to restore teeth. The strength of the data, due to the large numbers and the long duration of follow up, adds value to these findings.

A limitation of this study was lack of access to clinical findings, including radiographs. For example, the clinical studies set in practice (Hoskinson *et al*., 2002) or hospital (Ng *et al*., 2011a) have investigated factors such as presence of an apical lesion, treatment protocols, quality of the RCT including length of root filling and the quality and type of restoration after the RCT. These factors cannot be applied to this study, as the database used was derived from remuneration claims, therefore it contained general dentist information, patient information and claims for the dental treatment. The latter provided information about the tooth, including the type of restoration that was placed either before or after the RCT in the 15-year period (01/10/1990 to 31/03/2006). However, the present author considers that the vast amount of data more than compensates for the absence of factors such as those mentioned above.

The DPB in its previous format is no longer in existence and the NHS Business Services Authority (NHSBSA) Dental Services Division has taken over the role of the

DPB. Unfortunately, their current UDA claim system does not allow for continuation of this type of research to be undertaken since this level of detail is no longer recorded in the current system, despite calls for tooth-level data to be re-instated, reported by an independent review of the NHS dental services in England led by Professor Jimmy Steele, frequently referred to as the “Steele Report” which had been commissioned by the Government (Steele *et al.,* 2009).

Worldwide, there have been six other very large database studies published (using more than 100 thousand RCT teeth), utilising either insurance databases from a government health system or from the private sector (Burry *et al.,* 2016*;* Chen *et al*., 2007; Fransson *et al*., 2019; Kwak *et al.,* 2019; Raedel *et al.,* 2015a; Salehrabi & Rotstein, 2004). These studies reported a follow up period ranging from 3 to 10 years, whereas this study was able to report on 15 years. They had a variety of outcome measures; in two studies (Fransson *et al*., 2019; Kwak *et al.,* 2019) extraction was used as the end point, and four studies used a stricter criterion of reintervention either by ReRCT, RES/Apicectomy and extraction as the end point (Burry *et al.,* 2016*;* Chen *et al*., 2007; Raedel *et al.,* 2015a; Salehrabi & Rotstein, 2004). In this study all but one calculation was based on reintervention (ReRCT, RES/Apicectomy, extraction) as the end point outcome measure. One calculation was undertaken using extraction only, for the purpose of comparison to Fransson *et al*., 2019 and Kwak *et al.,* 2019. This study has shown that when the outcome measure was extraction only, the survival rate was higher. It also permitted comparison of the trend when comparing extraction to reintervention (Re-RCT, RES/Apicectomy, Extraction). These two types of survival (extraction and reintervention) were plotted in five-year intervals and compared (Fig. 58). It appears that as time goes on; the outcome based on extraction shows a uniform

trend. The difference between the two bars indicates that the number of teeth that had ReRCT or RES/Apicectomy, appears to be increasing slightly with time. This may be because if a tooth is not extracted after RCT, a patient and/or dentist may be more likely explore the option of ReRCT and RES/Apicectomy, with the complexities of the decision-making process in endodontics having been reported (Kvist 2012). The reason for failure cannot be explored as part of this study as the dataset does not contain such information, but the literature has reported it is more associated with restoration failure rather than the RCT (Aquilino & Caplan, 2002; Pratt *et al.*, 2016; Vire *et al.*, 1991).

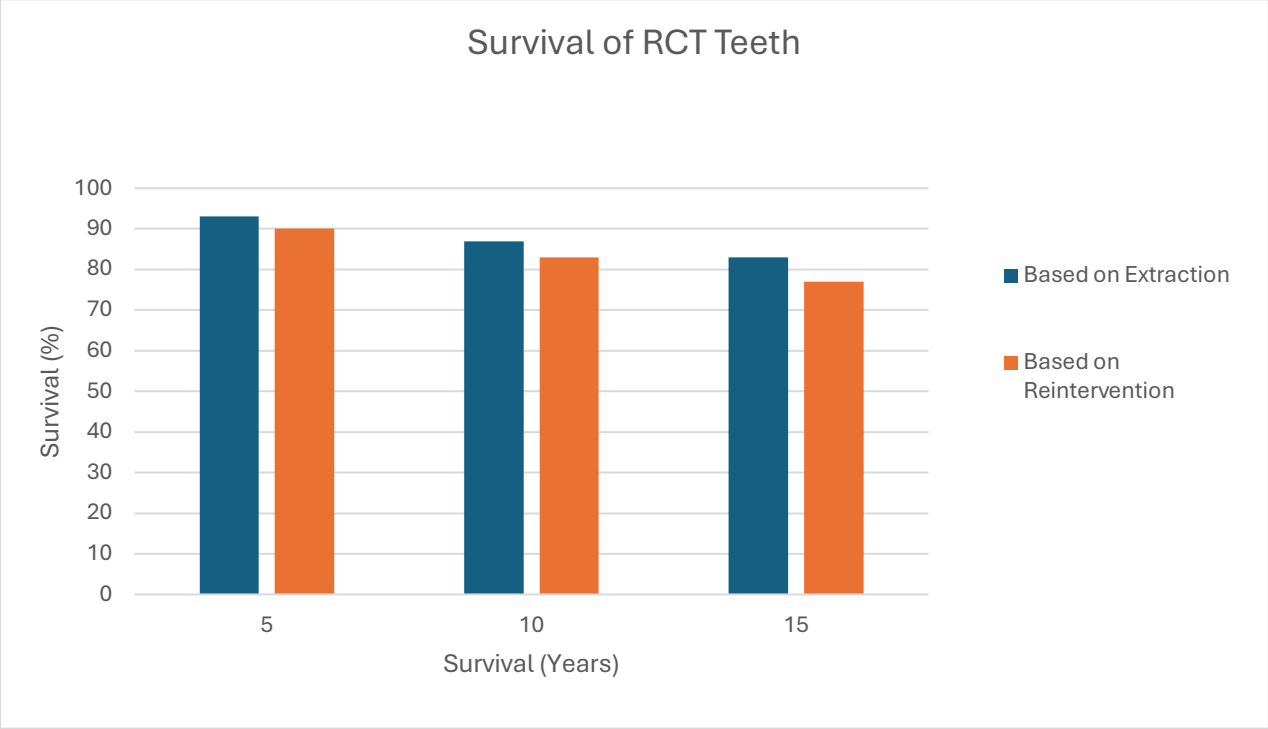


Figure 58 Survival of RCT Teeth based on different Success Criteria

The comparison of this study to others with those with exceptionally large databases is presented in Table 3. The present study has the longest follow up period of the seven studies. The last column indicates comparisons of studies with various follow up and

survival outcome measures to this study. The comparison has been based on readings taken from the two different survival graphs, one based on extraction and the other on reintervention (ReRCT, RES/Apicectomy, Extraction). Only two studies have a better survival result than this study, both from USA, based on private practice with a mix of GDPs and Endodontists. This may be considered to suggest that the dentists in England and Wales have been providing excellence in treatment as compared with international colleagues. Unfortunately, cost-effectiveness calculations are not possible with the data available from this and the other studies, but is something which should be considered in future work.

Study	*Year*	*Country*	*Source of the Database*	*Outcome Measure for Survival*	*Number of teeth*	*Follow up Period*	*Overall Survival*	*How does this study compare?*
This study	**2024**	England & Wales	National Health Service	Reintervention	791,375	15 years	77%	X
Burry et al.	**2016**	USA	Delta Dental of Wisconsin	Reintervention	487,476	10 years	86%	83%
Chen et al.	**2007**	Taiwan	Taiwan National Health Insurance	Reintervention	1,557,547	5 years	93%	89%
Fransson et al.	**2016**	Sweden	Swedish Social Insurance Agency	Extraction	248,299	5 years	90%	93%
Kwak et al.	**2019**	Republic of Korea	Korean National Health Insurance	Extraction	3,040,178	5 years	91%	93%
Raedel et al.	**2015**	Germany	German National Health Insurance Company	Reintervention	556,067	3 years	84%	92%
Salehrabi & Rotstein	**2004**	USA	Delta Dental Insurance	Reintervention	1,462,936	8 years	97%	84%

Table 24 Comparison of this study and other exceptionally large database studies

The six studies were plotted on survival graphs; the first graph (Fig. 59) showed that based on extraction as the outcome measure, the present study performed very well and lies above five out of six studies. The comparison with two studies (Fransson *et al*., 2016; Kwak *et al*., 2019) plotted in orange is applicable as they used extraction as their outcome measure for survival of RCT teeth. This study (in black) has performed better than both of those two studies, representing the health systems in Sweden and Republic of Korea (South Korea). The latter had the largest database of all studies, reporting on over 3 million RCT teeth.

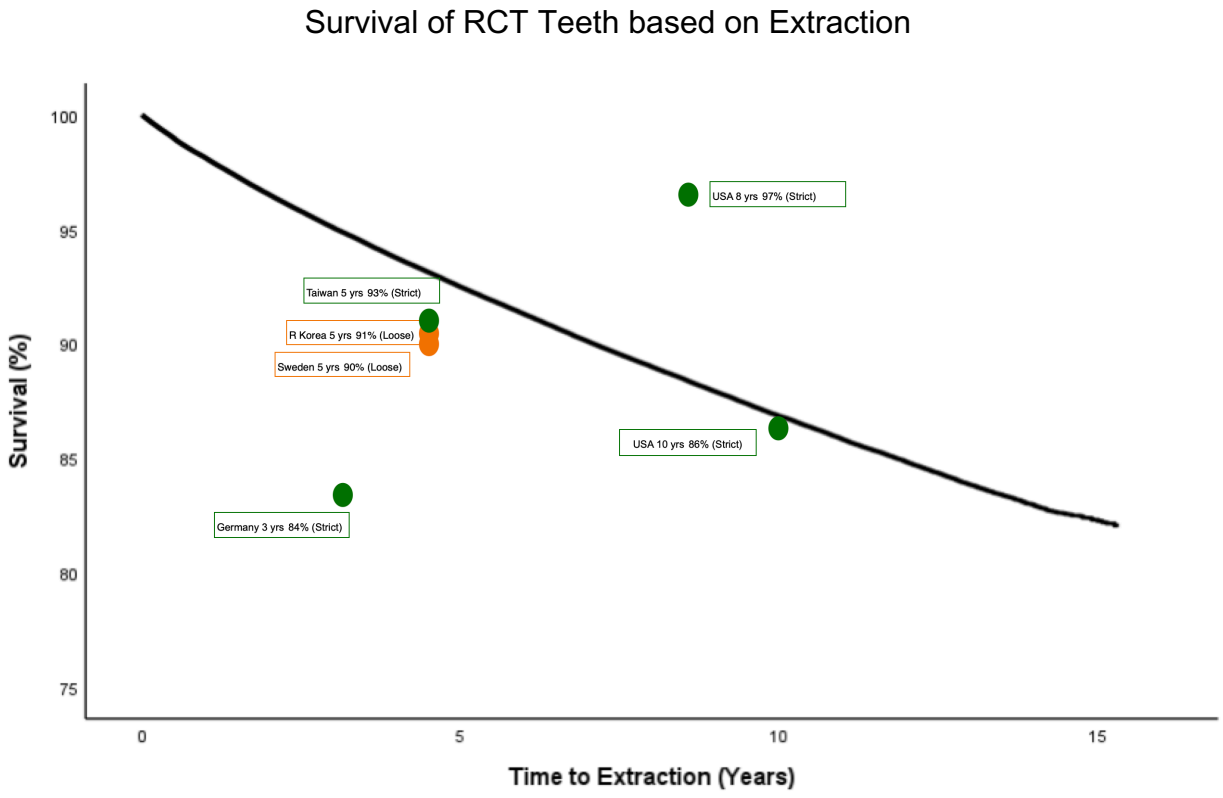


Figure 59 Survival of RCT Teeth based on Extraction compared to other Studies

A comparison to the four studies examining a more strict criterion of end point outcome measure, based on reintervention (ReRCT, RES/Apicectomy, Extraction) was made (Fig. 60). The survival data in the study from Germany (Raedel *et al*., 2015a) did not perform as well as the present study, whilst the other three indicated better performance than this study. The two studies from the USA were from private health insurance systems and included operators that specialised in Endodontics, whilst the other studies were based on their nation's health system. It could be argued that specialists (who might be considered to spend much of their time on RCT) should produce more robust survival figures, while on the other hand, they may be referred the more challenging root canal treatments and/or retreatments.

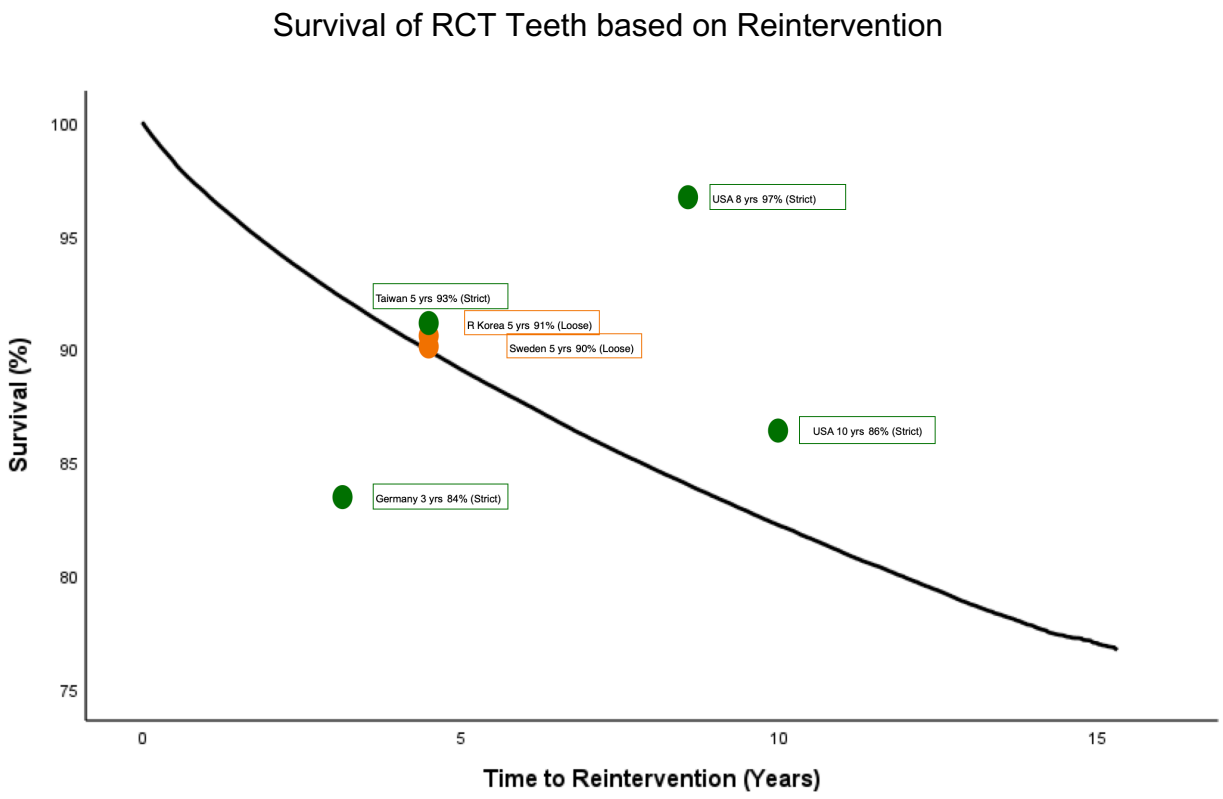


Figure 60 Survival of RCT Teeth based on Reintervention compared to other studies

It has been reported by Salehrabi & Rotstein (2004) that, in the first 3 years of their 8 years follow up, most endodontic clinical failures occurred requiring reintervention in the form of ReRCT, RES/Apicectomy or Extraction. Another study examined records and radiographs of RCT cases in the NHS GDS and reported that the majority of failed RCT teeth failed in the first two years (Tickle *et al*., 2008).

There are few studies on RCT teeth that have followed up a large cohort, although the Swedish group (Dawson *et al.,* 2024) are in the process of publishing their data based on 10-11 year follow up with 76% survival based on reintervention, which is less than the findings in this study of 83% at 10 years.

4.1.1 Summary

In summary, using reintervention (ReRCT, RES/Apicectomy, Extraction) as the end point outcome measure, the overall survival of root canal treated teeth based on the 15 years survival of root canal treated teeth was 77% in England and Wales. These findings are encouraging and appear to support the provision of RCT to restore and save teeth by GDPs in the NHS GDS. Additionally, using extraction only as the end point outcome measure for survival of root canal treated teeth, which is considered by some patients a more relevant measure, the 15-year survival was 6 PCT better at 83%.

4.2 Dentist factors

4.2.1 Gender of the Dentist

Analysis of the gender of dentists indicated very similar survival results for RCT teeth for both male and female dentists. The gender of the dentist did not make a difference in survival of the RCT teeth, although there were four times more RCT on teeth carried out by male dentists compared to female dentists, which has not been previously investigated in the literature. At the time of collection of the data used in the present study, male dentists predominated the GDS: however, the ratio of male to female dentists has changed in the workforce with more female dentists graduating from dental schools in recent decades (Fleming *et al.*, 2023). In this regard, the WHO confirmed that 70% of the world's health and social care workforce is now female, and it appears the dental profession has also followed this trend, as 63% of dental students and 49% of registered dentists were female in the EU/EEA in 2013, whilst in USA, 51% of dental graduates in 2019 were female (Versaci 2021). Furthermore, more recently, the NHS dental statistics for England (2022-2023) reported that the ratio of female to male dentists has changed, with a trend for increasing numbers of female dentists working in the NHS GDS (https://digital.nhs.uk/data-and-information/publications/statistical/nhs-dentalstatistics/2022-23-annual-report). A further breakdown of the data from 2022/2023, indicated that that a larger proportion of female dentists were under the age of 35 years, with a smallest proportion being 55 years or over. (Fig. 61).

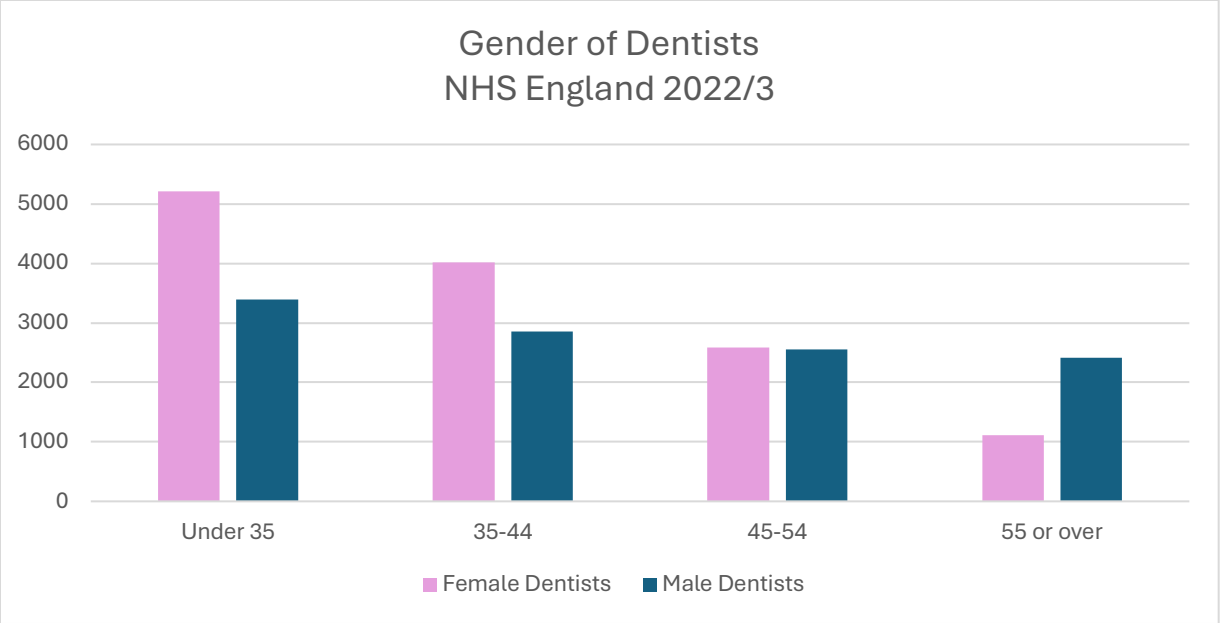


Figure 61 Gender of Dentists in NHS England 2022/3

There are reports that female dentists often work as associates of a dental practice rather than owning their own practice, working fewer hours per week and having a lower salary than their male counterparts (Adams 2005; Fleming *et al.*, 2023, Versaci 2021). These may be factors in clinical decision making for provision of RCT, especially as it is a time-consuming procedure, needing longer appointments compared to other procedures that also may need more than one appointment, all of which could challenge the diary of a female part-time dentist compared to a full-time male colleague.

4.2.2 Age of the Dentist

Newly qualified dentists in their 20s and 30s had the best 15-year RCT survival rates whilst older dentists in their 50s and 60s had a 3 PCT lower 15-year survival of RCT teeth. This may be because younger dentists have had a more contemporary clinical training and embrace the nuances of RCT. It has been reported that younger dentists usually keep up with CPD and technology better than their older counterparts (Mühlemann *et al*., 2019). Furthermore, older dentists may have less experience in the latest developments in RCT instrumentation, or be "winding down" towards retirement, with an inevitable effect on treatment outcome.

Whilst the age of dentists and the outcome of RCT has not been widely reported in the literature, the use of dental (rubber) dam in younger dentist age group has been investigated and compared to its use by older dentists. A lower uptake of dental dam was reported by older dentists, who also reported a major disincentive to its use was the time taken to apply, limiting its use within the context of an already time-pressured procedure in the confines of the NHS (Whitworth *et al.,* 2000). The fees for RCT within the NHS GDS are also considered inadequate (McColl *et al*., 1999). The younger dentist may not feel as pressurised for their time, given that they will have graduated more recently, being allowed more time for RCT in their undergraduate training and thereby appreciating that it is not a speedy process. The older dentists may have more financial pressures and need to be as efficient as possible in their clinical timings thus they might be shortcutting some clinical steps. The role of Foundation Dentist (previously called Vocational

Trainees) and their educational supervisors (Vocational Trainers) in the NHS GDS has been important for the service but may act as a double edged sword whereby bad habits such as foregoing use of dental dam for RCT could be passed on from the older dentist to the younger qualified dentist, who may have had some better habits from their recent contemporary teachings.

4.2.3 Geographical Region of the Dental Practice

The survival outcome in the dataset was investigated based on eight regions in England and one for Wales. The best survival was in South Central England, and a significant difference of 9 PCT to Wales. The regions of London, Southeast England and East Anglia were also closely affiliated with the highest survival. It appears that higher success was linked to regions that were more affluent, rather than fluoridation of the water supply, as the pattern did not follow the pattern of water fluoridation, or number of RCT in the region, as did Burke *et al.* (2005b). The number of RCTs carried out was lowest in Wales with under 40,000 and the most RCT carried out in London, at just under 120,000 RCT teeth. On the other hand, there were fewer dentists in Wales than in London and, given that there are three dental schools in London and that students tend to practice close to where they graduated, the finding of improved RCT survival in London may be linked to dentists' age, with younger dentists producing better survival rates than older dentists, as discussed in Section 4.2.2.

The North of England and Wales had lower survival rates: these areas were also considered to be more deprived regions as reported by Public Health England (Inequalities in oral health in England, Public Health England, 2021; www.gov.uk/phe). Affluent regions were linked to better health status and educational levels based on their report and areas of deprivation were linked to lower socio-economic status, lower educational levels, decreased understanding of the role of sugar, health related issues and therefore may not look after their teeth as well as areas where dental health was a higher priority. Comparing that to the more affluent regions where there was the opposite of this socio-economic status including education and dental health prioritisation, it may be that the patients value their teeth and look after their RCT teeth better. Inequality was reported to have four main dimensions: socio-economic position, protected characteristics, vulnerable groups and geography. Previous research on longevity of restorations using a smaller version of same database as this study (Burke & Lucarotti, 2009a) also found that geographical area was a factor that influenced outcomes. The other studies (Chen *et al*., 2007; Fransson *et al*., 2019; Kwak *et al.,* 2019; Raedel *et al.,* 2015a; Salehrabi & Rotstein, 2004) examined wide geographical areas and did not report regional variation, whilst one study was limited to one state in the USA (Burry *et al*. 2016).

This study examined GDPs working in the NHS GDS system, a comparison to other operators in the private sector or hospitals or dental schools was not made, similar to one other study (Raedel *et al*., 2015a). However, Lumley *et al*., (2008) did not identify a link to the status of the dentist in the NHS GDS practice from this database. Table 25 summaries the dentist factors compared to other exceptionally large database studied.

Study	*Dentist Factors*			
	Gender	**Age**	**Region**	**Operator**
This study	NS	30s - better, (60s - 3PCT worse)	Affluent regions - better (9 PCT)	GDPs
Burry et al.	X	X	Wisconsin only	GDPs, Endodontists (Molars 5 PCT better with Endodontist) (Endodontist did 32% of all RCT)
Chen et al.	X	X	X	GDPs, Endodontists
Fransson et al.	X	X	X	GDPs, Endodontists (0.6% of operators) (School, Private, Public)
Kwak et al.	X	X	X	Local Clinic, Dental Hospital (Dental Hospital 2 PCT better)
Raedel et al.	X	X	X	GDPs
Salehrabi & Rotstein	X	X	X	GDPs, Endodontists

Table 25 Comparison of this study and others based on Dentist factors

4.2.4 Summary

The gender of the dentist did not make any difference to the survival rates for RCT teeth, however the age of the dentist and the region in which they worked affected the survival outcome of RCT teeth. This has not been examined by previous studies and therefore a direct comparison cannot be made with other studies.

4.3 Patient General Factors

4.3.1 Gender of the Patient

The patient general factors examined did not reveal any difference when examining the patient's gender. The proportion of male and female patients were similar, whilst the survival of the male patients fluctuated about 0.5-1 PCT throughout the survival period and was not considered to be statistically significant, as they found in Sweden (Fransson *et al*., 2016; Fransson *et al*., 2021). These findings were supported by other studies (Dammaschke *et al*., 2003; Fernández *et al*., 2017; Gulabivala & Ng, 2023; Kebke *et al*., 2021; Laajala *et al*., 2024; Lazarski *et al.*, 2001; Ng *et al*., 2010), although female patients were found to have better RCT survival in one study (Kwak *et al.*, 2019).

4.3.2 Age of the Patient

The survival of RCT teeth was best in those in their 20s and worst in those in their 70s, a difference of 7 PCT being observed between them at 15-year survival. The inferior outcome for the elderly has been shown by many researchers (Fransson *et al.* 2021; Kwak *et al.* 2019, Landys Borén *et al.* 2015; Lumley *et al.* 2008), with this trend applying also to survival of restorations other than RCT (Burke & Lucarotti, 2018e). Among the large database studies, Kwak *et al.* (2019) found that patients above the age of 65 years

had about 10 PCT lower survival of RCT teeth. In Sweden it was 4 PCT for those 65 years and above when compared to the best age groups which were those in their twenties (Fransson *et al*. 2016; Fransson *et al*., 2021). Yoshino *et al*. (2015) hypothesised that younger patients have teeth that were more resilient to masticatory forces and therefore fractured and cracked less than those in older patients. Another group (Ginaldi *et al.* 2016) reported it may be the possible effects of the host response and change in immunity in the elderly, whilst another group reported that it may also be that the elderly may have a larger need for RCT than the rest of the adult general population (Hamedy *et al*., 2016). Some believe it is not age that is a factor, but the longer period teeth have been in function in the mouth, potentially with less tooth structure remaining and exposure to other oral conditions e.g. marginal periodontitis (Khalighinejad *et al*., 2017; Nazir *et al*., 2020). Lazarski *et al.* (2001) found the survival plateaued from the age of 60, this being in agreement with Lumley *et al*. (2008) based on a smaller part of the database used in the present study. However, this study did not find a plateau effect as all the age groups appeared to progress at a similar rate. A systematic review by Shakiba *et al*., (2017) found that that older age did not influence healing and survival of RCT teeth, a finding that was also agreed by Gulabivala & Ng (2023).

In the present study, the most number of RCT teeth was carried out in patients in their thirties, followed by those in their forties and then fifties: this has seldom been reported, although in Sweden (Fransson *et al*., 2021) they found that most RCT were carried out among 50-64 age group and most extractions of RCT teeth were among those aged 65 and above.

4.3.3 Charge Status of the Patient / Socio-economic Status

The survival of RCT teeth for full fee-paying patients at 15-years was 78%, as compared with 74% for those that were non-full fee-paying patients, a substantial difference of 4 PCT being recorded. The finding is also highly significant statistically ($p<0.001$). The charge status of the patient was considered a possible reflection of the patients' socioeconomic status as those paying full charges of their dental treatment are less likely to have been in the low socio-economic sector. This is in keeping with oral health research (Steele *et al.,* 2012) comparing the 1968 to 2009 Adult Dental Health Surveys (ADHS), in which it was found that dental status was less good for those in lower socio-economic status with routine and manual occupation households, opposite to those from more affluent households with managerial and professional occupations. Implications for social equity has been raised from the ADHS (Bradnock *et al.,* 2001), with more deprived households lagging behind in terms of oral health attitudes. The most important indicator must be the increase in people who prefer their painful back tooth to be restored rather than extracted. This latter comment relates to RCT and provision of this treatment to restore/save posterior teeth, especially among those with dental pain. Furthermore, it has been reported that dental anxiety is a key barrier for many dental patients as well as cost of treatment (Hill *et al*., 2013; Nuttall *et al.,* 2001), which should not be ignored as a key factor when undergoing RCT.

A report on the 2009 ADHS revealed that the frequency of oral impacts including pain, caries and periodontal disease were higher amongst those with lower socio-economic

status (White *et al*., 2012). The cost and anxiety were considered barriers to seeking dental care and the type of restoration chosen (Hill *et al*., 2013). These barriers could potentially mean that those with a need for RCT in low socio-economic sectors with less disposable income, could contribute an underestimation of demand because cost and anxiety barriers prevent patients seeking help from a dentist. The most recent Adult Oral Health Survey (AOHS) carried out during the COVID 19 pandemic was based on self-reporting of patients and found the most common problems were broken/decayed teeth and toothache/mouth pain, with deprived neighbourhoods suffering more than those who lived in the least deprived neighbourhoods (www.gov.uk/government/statistics/the-impact-of-covid-19-on-access-to-dental-care/adult-oral-health-survey-2021-technical-report). Most patients living in deprived neighbourhoods and among households with the lowest income avoided contacting a dentist due to costs (https://www.healthwatchbrightonandhove.co.uk/news/2022-12-21/national-survey-highlights-dental-health-inequalities).

However, in a Swedish investigation, no association was found between the patient's disposable income and education level when evaluating risk of extraction of RCT teeth (Fransson *et al*. 2021). Table 26 summaries the patient factors compared to the other large databases studied.

Study	*Patient Factors*		
	Gender	**Age**	**Socio-economic Status**
This study	NS	20 s - better, (70s - 7 PCT worse)	Full fee-paying - better, (non-full fee paying - 4 PCT worse)
Burry et al.	X	X	X
Chen et al.	Not allowed access	X (Investigated but not reported)	X
Fransson et al.	Male (slightly)	20-29 - better, (65 and over - 4 PCT worse)	X
Kwak et al.	Female (3-4 PCT)	Less than 20 - better, (65 or over - 11 PCT worse)	X
Raedel et al.	X	X	X
Salehrabi & Rotstein	X	X	X

Table 26 Comparison of this study and others based on Patient factors

4.3.4 Summary

The gender of the patients did not make a difference in 15-year survival of RCT teeth, however patient age seemed to be factor with a 7 PCT difference between the very young and old patients. This variation may be multifactorial and further research is required to identify the role of each factor. The difference of 4 PCT among fee status of the patients also highlighted the findings of the wider surveys of oral health in the UK and socio-economic status is related to areas of deprivation and oral health inequality.

4.4 Patient Tooth Factors

4.4.1 Survival of Root Canal Treated Teeth

It was evident in the present study that different types of teeth had variable survival rates after RCT. The different groupings revealed that posterior teeth had a 5 PCT better survival than anterior teeth, which agrees with another large database study (Raedel *et al.,* 2015a) that investigated 556,067 RCT teeth with a three year follow up. These two studies are the only two of the large database studies that have found that posterior teeth perform better: this may be due to the rules and regulations in place in their health systems for providing restorations. In Germany clinicians have to justify the rationale for saving the molar tooth and not opt for shortened dental arch. This may be an extra step in the clinical decision-making process for these GDPs to save teeth that are not hopeless and have a strategic role, reinforcing principles of good treatment planning.

Smaller studies have supported the same findings. A clinical study (Riccuci *et al*. 2011) investigated 816 teeth with a 5 year follow up found that multi-rooted teeth, which they categorised as upper first premolars and all molars, had better survival rates by 2 PCT than single rooted teeth. Van Nieuwenhuysen *et al*., 2023 also found in their 25-year cohort study of 2500 RCT teeth in Belgium, that molar teeth performed better than anterior teeth.

RCTs in teeth other than molars were reported to survive better than molars by others (Benenati & Khajotia, 2002; Fransson *et al*., 2021; Field *et al*., 2004; Ng *et al*., 2010) while Salehrabi & Rotstein (2004) did not find a difference among tooth category types (anterior, premolar and molar) in survival. Kwak *et al.* (2019) also found that anterior RCT teeth survived slightly better than posterior teeth. On the other hand, in Sweden (Fransson *et al*., 2021) it was found that most extractions of RCT teeth were among molars, followed in terms of prevalence by lower canines, upper canines, upper premolars and then lower premolars. It has been reported that a perception exists that anterior teeth are simpler for conducting RCT than posterior teeth (Laukkanen *et al*., 2021). However, Gulabivala & Ng (2023) stated there was not much difference, with the anatomical complexity of the apex acting as an aetiological factor that can affect outcome of RCT, rather than the broader canal system complexity which is reported relative to tooth position (Azim *et al*., 2015).

When comparing RCT in upper *versus* lower teeth, the lower teeth were found to be slightly better performers by 2 PCT, in agreement with Kwak *et al.* (2019) but not with others (Lumley *et al*., 2008; Vire *et al*., 1991). The findings may be explained by the fact that lower teeth were usually surrounded by more saliva, and its protective function may put these teeth at an advantage. Also, lower teeth may permit an easier direct view of the pulp chamber, whereas sometimes with upper teeth, visualisation through the mouth mirror can be challenging for dentists especially if they're drilling, as water and debris can fall onto their dental mouth mirror affecting their visibility, plus poorer illumination compared to the advantage of easier use of the dental light positioning on lower teeth. Hypothetically if direct vision and illumination on lower teeth contribute to the slightly

better outcome compared to upper teeth, it is encouraging to note that a recent position statements from the British Endodontic Society Teachers of Endodontology Group highlighted visualisation and recommended the use of dental loupes to be integrated into endodontic clinical skills training and provision of treatment (McClean & Qualtrough, 2024).

Examining quadrants of the mouth and the 15-year survival of RCT teeth, there were no significant difference between upper left and right quadrants as well as lower left and right quadrants. It replicated the pattern of upper and lower teeth, so there was a 2 PCT difference between upper and lower teeth in each quadrant. This has not been examined to the same extent from other studies and one found there was little difference associated with survival and quadrants (Lumley *et al*., 2008).

In the present study the 14-year RCT survival included all tooth types, and the worst survival rate (of 70%) was among both upper and lower lateral incisors and upper canines (Fig. 62) whilst the best performance was found in upper first molars and lower third molars (at 82%), a very large difference of 12 PCT, among tooth types.

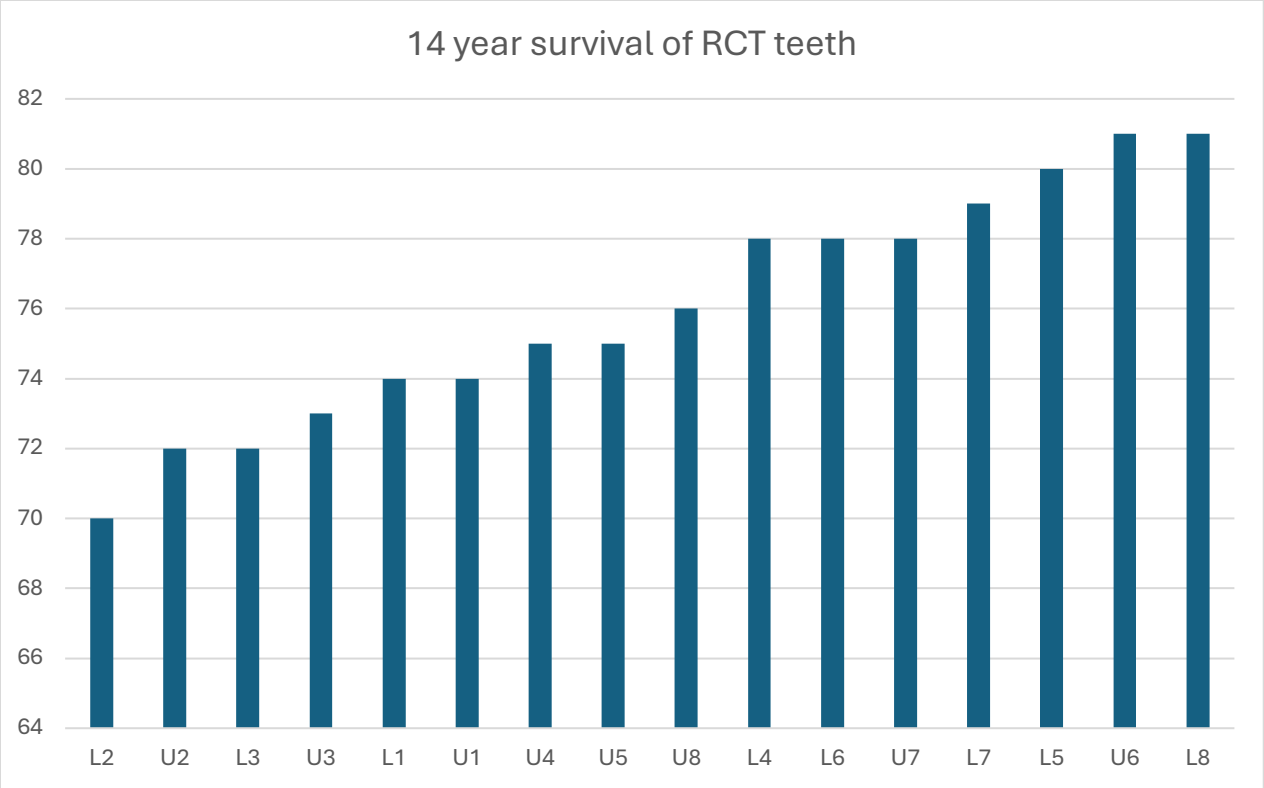


Figure 62 Survival of RCT Teeth at 14 Years

Lateral incisors as a tooth type performed the worst of all teeth: these teeth have been associated with lower performance previously and associated with the complex apical anatomy (Lumley *et al*., 2008). The upper laterals have an apical curvature which sometimes cannot be chemo-mechanically addressed easily, therefore this may harbour microorganisms that can result in RCT failure. They also have been associated with being a commonly fractured tooth, thereby proving challenging to restore easily: hence, dentists may opt for extraction of these teeth as opposed to carrying out RCT. Lower laterals have been associated with having a second root canal that could not be easily detected, and it has been reported often a narrow canal can be another challenge to chemo-mechanical preparation (Gulabivala *et al*., 2010).

Canine teeth have also been associated with their own anatomical challenges for RCT. They have long roots and some dentists may therefore not be able to chemo-mechanically debride them to full length and obturate. Dental trauma of anterior teeth is a common indication for RCT, therefore the complications may also affect the lower survival (Van Nieuwenhuysen *et al*., 2023).

In the present study RCT in posterior teeth performed better, possibly due to the complex root canal anatomy that has many communications, and which may allow for a more effective communications enhanced access of chemical agents. This could be considered to be “a silver lining” in response to the chemo-mechanical objectives of RCT, but also allow for entombing of remaining micro-organisms in these communication channels (isthmus) with obturation, thus achieving the biological objectives better than anterior teeth. Although anterior teeth were perceived to have a simpler root canal anatomy, they often have a larger root canal space, which may cause challenges in chemo-mechanical preparation, including removal of collagenous pulp tissue, with potentially larger microbial infection due to larger space plus the challenges of homogenous dense obturation. The anatomical challenges of apical deltas, extra anatomy (root canals) and ramifications generally vary from tooth to tooth but often present in roots that have two canals or more (Vertucci *et al*. 1984).

Molars performed well, even second molars which often dentists do not attempt due to difficulty in accessing these teeth in the mouth, plus the challenges of second molar root canal anatomy. In that regard, upper second molars were the most frequently extracted

teeth in one study (Caplan *et al*., 2002). All molars have been researched widely in the literature in relation to a fourth root canal, referred to as MB2 in upper molars and a second distal root canal in lower molars. It may be that the anastomosis of communication between these root canal systems within the same root allows favourable response to the chemo-mechanical preparation. Molar teeth seemed to perform better than premolars in the present study: this may also be linked to the acceptance of a cuspal coverage restorations in molars more readily by dentists and patients. Furthermore, premolars are often more visible than molars and this may act as a barrier for acceptance of a crown more anteriorly as often patients can be concerned about the visibility of the crown margins.

The frequency of RCT on tooth types was also analysed, with the results indicating that the most RCT tooth in the mouth was the upper second premolar (Fig. 63) followed by lower first molars. This was an unexpected finding, as one expects first molars to be more frequently treated as they have been in the mouth the longest of all posterior teeth and may have had more exposure to the risk factors of dental caries. The third molars as expected were the least frequently treated teeth followed by lower lateral and central incisor teeth. The ratio of RCT teeth was compared among different jaws, and the results indicated that upper to lower teeth ratio was about 3:2, resulting in 185,191 fewer lower RCT teeth than upper teeth, and yet their survival was better. Investigations on this have not been carried out extensively by others therefore direct comparison could not easily be made.

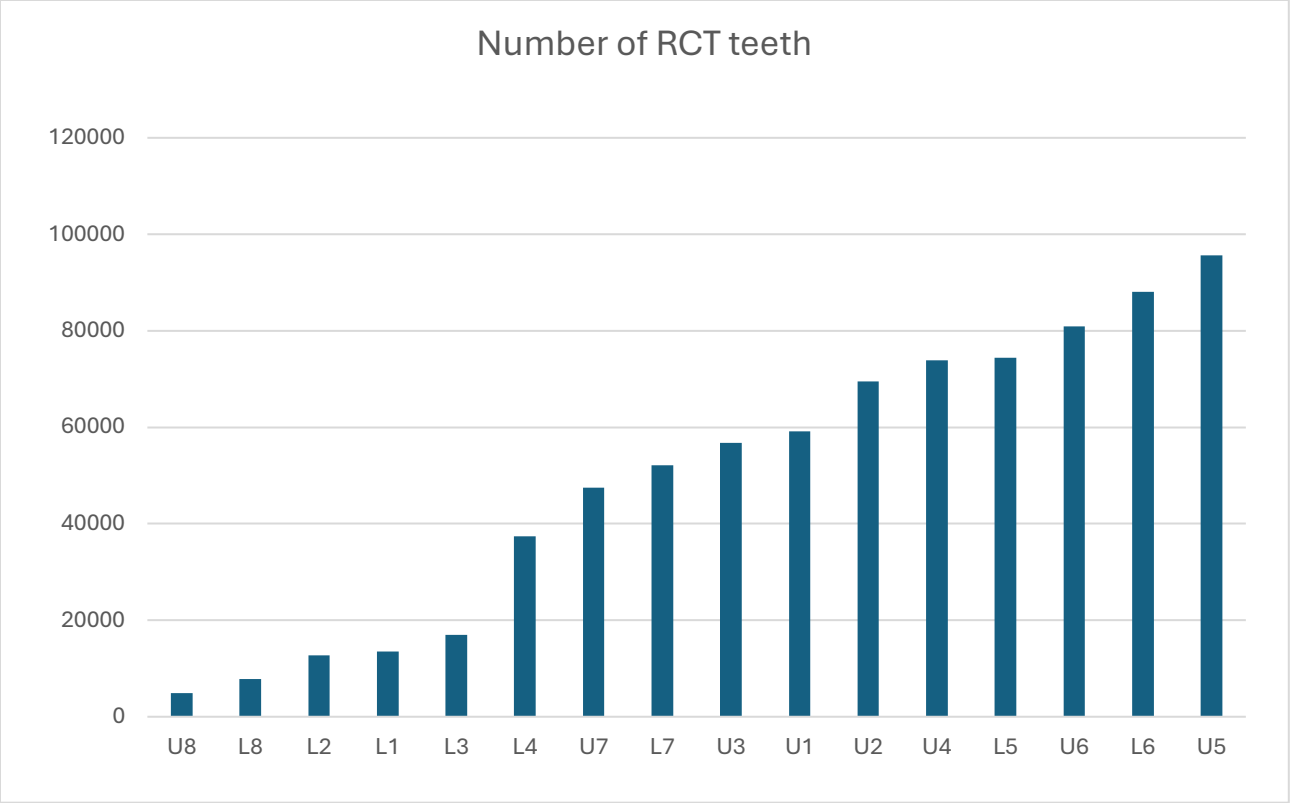


Figure 63 Number of RCT Teeth Investigated

The table 27 summarises the general tooth factors in other studies similar to this.

Study	*Tooth Factors*			
	Anterior vs Posterior	**Maxillary vs Mandibular**	**Quadrants**	**Tooth Type**
This study	Posterior (Better by 5 PCT)	Mandibular - better (by 2 PCT)	Quadrant - LL and LR (better by 2 PCT)	Upper 1st molar & Lower 3rd molar (Lower lateral incisors worse by 12 PCT)
Burry et al.	Anterior then premolars then molars	X	X	X
Chen et al.	Anterior then premolars then molars (4 PCT between best and worst)	X	X	X
Fransson et al.	Anterior then premolars then molars	X - IBNR		Best lower premolars 93% (worse lower molars by 5 PCT)
Kwak et al.	Anterior (Better by 1-5 PCT)	Mandibular - better	X	X
Raedel et al.	Multi-rooted (Molars plus Maxillary 1st Premolar) (Better by 2 PCT)	X	X	X
Salehrabi & Rotstein	Anterior then premolars then molars (1 PCT between best and worst)	X	X	X

Table 27 Comparison of this study and others based on General tooth factors

4.4.2 Restorations Placed After the RCT on All Teeth

In this study twelve different types of restorations after root canal treatment were identified from the NHS GDS, and while some were applicable to be placed on all tooth types, eight were specific to either anterior (3) or posterior teeth (5) only. The restorations and the amount of remaining tooth structure has been investigated in clinical studies, whilst in large cohort studies like this, investigating the restoration type may also be considered to be a surrogate measure of remaining tooth structure.

The variety in types of restorations on RCT teeth has not been widely reported and as there was twelve variations of restorations investigated, they are represented in the bar chart (Fig. 64). The colour scheme is representative of the those that were statistically significant. There were three types of restorations (dark blue) that were associated with improved survival and one (orange) with lower survival at 15 years, whilst the others (light blue) did not represent a statistically significant difference.

The large numbers of each restoration types are evident in Figure 64 and supports statistical significance of the study.

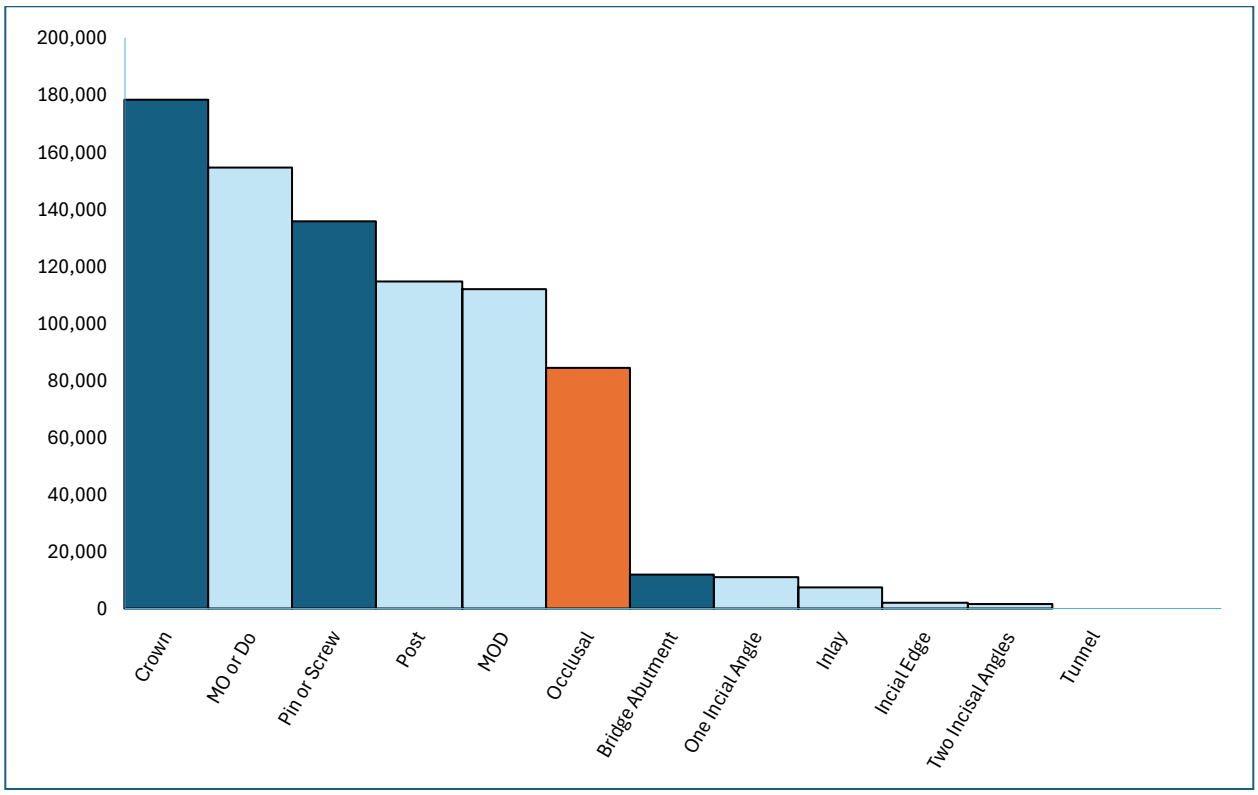


Figure 64 Number of Teeth Investigated with Various Restorations after RCT

Permanent restorations may be considered essential for better survival, by minimising leakage and forces fracturing the RCT tooth (Fransson 2021; Mindola 2006; Ng 2008; 2011a, 2011b; Pratt 2016). The debate about placement of an indirect restoration or a cuspal coverage restoration has been longstanding. In that regard, Lazarski *et al.* (2001) found that single full coverage restorations had the best long term survival, followed by multi-unit full coverage restorations, compared to amalgam and resin composite restorations. This is supported by the present study and by Kumagai *et al.*, (1999), whose results indicated that indirect restorations had better survival for posterior teeth than anterior teeth.

Vire *et al.* (1991) and Fransson *et al*. (2021) both reported that extraction of RCT teeth was strongly related to the type of restoration, with the former finding that the reason for extraction of 59% of RCT teeth was prosthodontic/restorative failure, not the endodontic treatment. Satisfactory and unsatisfactory restorations had a 3-fold difference when investigated by Ng *et al*. (2008). This has been linked to microleakage. Prevention by subseals has been advocated as a clinical step to mitigate the effects of coronal leakage (Saunders & Saunders, 1994) and with the benefits being investigated by Kumar *et al*. 2020 and Ng *et al.*, (2011a, 2011b). It has also been reported that extensive tooth tissue loss could challenge rubber dam isolation, and that further microleakage post-treatment may hinder the longevity of the restoration (Creugers *et al*., 2005; Fokkinga *et al*., 2007).

The long term examination of survival can be enlightening. An example of this is from Nguyen & Jansson (2021) who reported that, in comparing restoration types for cracked teeth at five years, they observed a 2 PCT difference between crowns and composites, and at 10-year follow up the difference had increased to 20 PCT. These examples support the need for further research of long term follow up studies (Fransson & Dawson, 2023).

4.4.2.1 Crown

In the present study, the survival graph indicated that the 15-year survival of RCT crowned teeth was 79%, this being slightly higher than those teeth that were not crowned (77%):

this is in line with findings of other researchers (Alley *et al*., 2004; Aquilino & Caplan, 2002; Lazarski *et al*., 2001, Lynch *et al*., 2004, Valderhaug *et al*., 1997).

The analysis of crowns placed after RCT indicated that there was always an advantage in having a crown after RCT, as opposed to not having one. The largest difference between having a crown or not was at 7 years post- RCT where a 5 PCT difference was evident, with the difference decreasing to a 2 PCT difference at 15-year survival, in which crowns performed better than the RCT teeth without a crown. Two large database studies also concluded that crowns improved survival of RCT teeth (Fransson *et al.,* 2016; Salehrabi & Roststein, 2004).

Potential challenges have been reported in the literature regarding the clinical decision-making process for placing a crown on RCT tooth. In that regard, there appears to be confidence in placing a crown when the RCT has been carried out to a good standard (Goransson *et al*., 2021), or if the tooth has no visible apical lesion on a radiograph (Chugal *et al*., 2007) when compared to other reasons (Dawson *et al.*, 2021). However, factors such as these could not be investigated in this study due to lack of access to clinical records and radiographs.

Results from the present study indicated better survival for indirect restorations in the form of a crown and/or bridge abutment. In studies an onlay formed part of the indirect restorations which were studied, however, in the present study, it was not possible to identify onlays (or cuspal coverage) as opposed to inlays, as there was not a category for

this in the database. In that regard, it could be argued that, if an additional fee had been provided for cuspal coverage, more cusps would have been covered and fewer cusps may have fractured post-RCT. The placement of a direct versus indirect restoration has been investigated, with improved survival of RCT teeth being apparent when indirect restorations were provided (Fransson *et al.,* 2021; Landys Borén *et al.,* 2015; Ng *et al.,* 2010; Ng *et al.,* 2011b; Pratt *et al*., 2016; Suksaphar *et al.*, 2018). Ng *et al.* (2010) reported that RCT teeth with a crown had 3.92 times higher survival than those that did not. Sequeira-Byron *et al*. (2015) reported that indirect restorations like a crown were believed to offer improved protection against cracks and fractures, as well as microleakage but the scientific evidence has been insufficient due to bias and they highlighted the need for randomised clinical trials to investigate this further.

Crowns were significantly more successful in certain tooth types in the present study. There was a significant advantage when comparing lower teeth when compared with upper teeth, with a 6 PCT better survival at 15-years among the lower teeth. Whilst placement of a crown after RCT on anterior *versus* posterior teeth, revealed that posterior teeth had a significant 10 PCT better survival with posterior teeth, which is in agreement with many other studies (Dawson *et al*., 2017; de Chevigny *et al*., 2008a, 2008b; Fransson *et al*., 2021; Friedman *et al*., 1995; Landys Borén *et al*., 2015; Ng *et al*., 2010, 2011a, 2011b; Wigsten *et al*., 2018, Wigsten *et al.*, 2024).

Restorative dentistry has evolved with time, paying attention not only to the amount of remaining tooth structure and/or presence of a ferrule, but also that occlusal loads from

the occlusion and bite forces via chewing play a part in survival of the restored tooth, with food texture and parafunction also playing a part (Manhart *et al*., 2004; Mannocci *et al*., 2021, Santos *et al*., 2024). One investigation of 47,563 teeth with crowns (7,639 had root canal fillings) in the NHS GDS, found that the survival of the crowned teeth (based on any form of reintervention) at 10 years among anterior teeth was 17 PCT better if the crowned tooth did not have an RCT, and a 10 PCT with posterior teeth. In that regard, Lucarotti *et al.* (2014) concluded that crowns have decreased survival based on any reintervention, if they had RCT.

The type of crown associated with the long-term survival of RCT teeth has not been widely reported: in this study this was further investigated, and four main types of crowns were identified. The 13-year follow up revealed adequate numbers for comparison and found that gold crowns had an 85% survival, with a 10 PCT lower survival with porcelain jacket crowns. Of crown types, bonded (porcelain to metal) crowns were provided most frequently in the dataset, however they did not perform as well as gold crowns. In that regard, it has been reported that gold crowns have a better survival rate that other types, due to a variety of reasons, including removal of less amount of tooth structure, adaption to tooth wear, polish-ability, and minimal plaque retention, even though the aesthetics is not considered pleasing by all. The gold crown wear rate is more compatible to tooth structure as opposed to other types of crowns, as other types may cause tooth wear to the opposing tooth/teeth, especially if they are not adequately polished after adjustment (Manhart *et al*., 2004, Santos *et al*., 2024; Tennert *et al*., 2022).

The lower left and lower right quadrants were similar to each other as were the upper left and right, suggesting no difference between right or left sides of the mouth. The main difference was the comparison of upper and lower teeth, as noted previously with a 4 PCT difference between them at 15 years, the lower quadrants performing better at 81%.

The number of RCT teeth for each tooth type was plotted in order of the least common to the most common and compared to the number of RCT teeth that were crowned after RCT for each tooth type (Fig. 65). The ratio is variable depending on the tooth type, therefore the decision made by the dentists to crown a tooth that had RCT is not directly proportional to the number of teeth that had RCT.

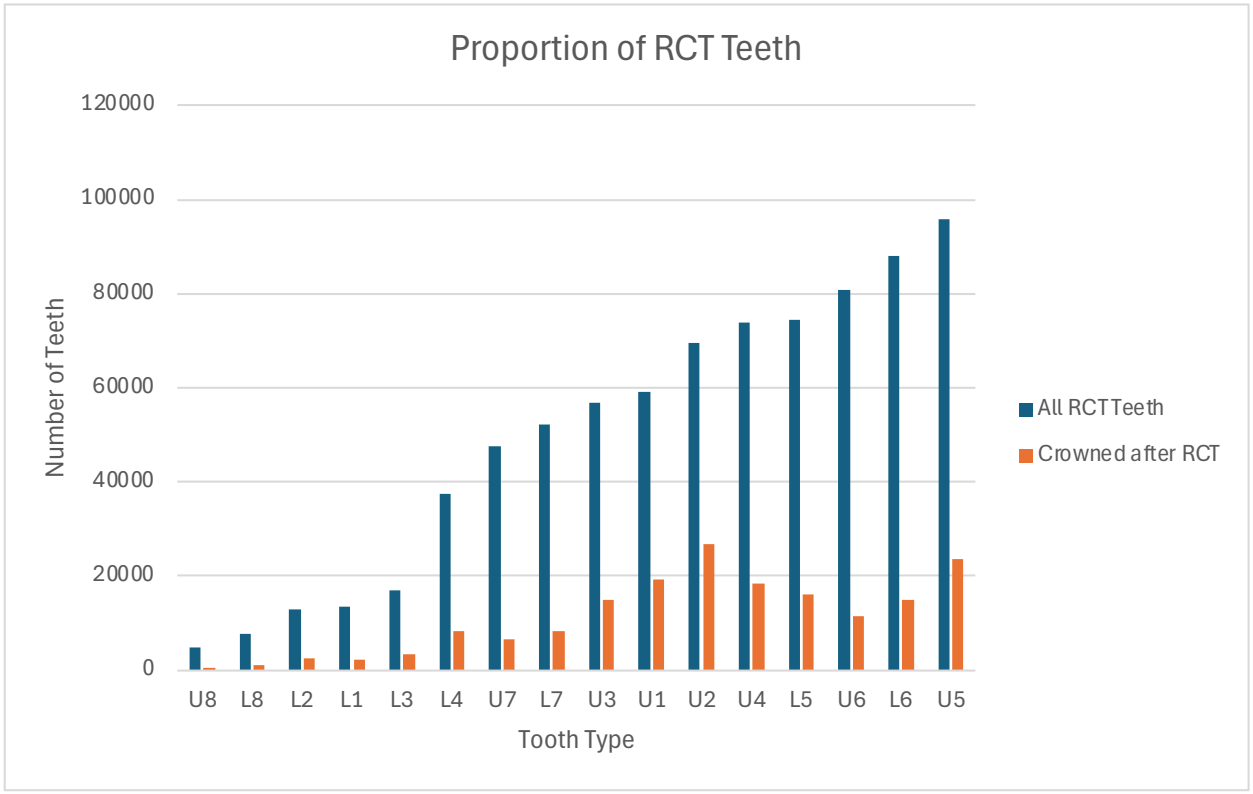


Figure 65 Number of RCT Teeth and Crowned RCT Teeth Investigated

The decision-making process by dentists has been accepted to be complex and clearly more frequently made to crown certain teeth than others. In that regard, 38% of RCT upper lateral incisors were crowned, while only 14% RCT upper first and second molars were crowned. It is therefore clear that proportionally some tooth types received the decision to have a crown more than other teeth, with aesthetics of anterior teeth potentially playing a part, given that this study found that, among upper teeth anterior teeth had 25-38% of teeth crowned compared with 25% for upper premolars and upper molars (9-14%). Among lower teeth 17-19% of anterior teeth received crowns, while for lower premolars the equivalent figure was 21-22%, with 13-17% of lower molars being crowned after RCT. These findings would suggest that upper anterior teeth were most likely to have crowns after RCT: this may be due to an increased demand for improvement of the aesthetics in comparison to posterior teeth, but it may also be related to issues with discolouration as a result of one or more of the following, namely, dental trauma, caries, loss of vitality and after RCT due to inappropriate use of RCT obturation materials.

The survival of almost all types of RCT teeth was better with placement of a crown except for one, that being the upper lateral incisor teeth which was 2 PCT less good. As previously discussed, this may be related to the anatomical and biological complexities encountered with this tooth type. As reported by Van Nieuwenhuysen *et al*. (2023) the decision-making process of placing a crown is a complex, involving not only objective criteria, but also other aspects, such as the implications of treatment costs or patient preferences (Kvist, 2018, Rotstein *et al.,* 2006), which were not recorded within the limitation of this study. The decision-making process about placing a crown on a tooth

with RCT seems to be linked to the role of apical periodontitis (Chugal *et al*., 2007) and quality of the root filling, with the latter potentially causing selection bias (Goransson *et al*., 2021).

4.4.2.2 Bridge Abutment

The bridge abutment is similar to a tooth that has had a cuspal coverage restoration after RCT, i.e. a type of indirect restoration. The number of RCT teeth for this restoration type were less than those available for crowns and therefore the survival rate up to 14 years was calculated. The 14-year survival of bridge abutments was 80% slightly higher than those that teeth which were not bridge abutments, and interestingly the pattern among tooth types was very similar to a crown. Therefore, it may be assumed that the pattern is similar because it is the type of restoration allowing for better cuspal protection and longevity of the tooth, as with any indirect restoration. Although bridges have been widely accepted to be avoided mainly because of the presence of a pontic tooth leads to increased occlusal loads when compared to a single tooth crown. The literature supports this recommendation and advises avoiding using RCT teeth as bridge abutments (Mannocci *et al*., 2021; Ng *et al*., 2010), as they do not survive as well as other teeth. A periodontal study (Nymand & Lindhe, 1979), that used controversial large span bridges on periodontally compromised teeth, was criticised due to lack of support from the teeth and alveolar bone, but it was accepted that these bridges performed well due to the maintenance regime highlighting role of case selection and clinical management. If we

consider case selection for the NHS GDS bridges, permission to place bridges was not easily given by the DPB with a pre-approval system being applied as this was an expensive procedure. In many such cases, a treatment plan involving a bridge would have been scrutinised by a dentist employed by the DPB when an application for approval of the provision of the bridge was made: It could be argued that this could improve case selection and the element of control implied by the DPB could enhance survival rates of teeth which were bridge abutments.

In this study bridge abutments followed the same pattern of tooth location with upper *versus* lower, anterior *versus* posterior, as was reported with crowns. The 14-year survival of RCT bridge abutment teeth was 80%, which was 2 PCT higher than those that were not abutments (78%), this being the same as the difference seen in the crowned teeth.

The literature is clear that RCT teeth were not favoured as bridge abutments and have been associated with increased failure (Alley *et al*., 2004; Lazarski *et al*., 2001; Ng *et al.*, 2010; Salvi *et al*., 2007) due to increased unfavourable occlusal loads (Masumoto & Goto, 1970) leading to cracks and fractures due to fatigue (Walton *et al*., 2002; Walton *et al.,* 2003). Investigators have reported that numbers have been small in their studies and no significant difference was found between RCT bridge abutments and crowns (Goransson *et al*., 2021; Ng *et al*., 2011a). On the other hand, others have reported that, if the occlusal loads were favourable then high survival rates can be achieved (Lazarski *et al*., 2001; Salvi *et al*., 2007). The latter may be the case in the present study, given that, as

previously mentioned the DPB of the NHS GDS had strict rules in granting permission for provision of bridges.

4.4.2.3 Provision of a Post

Interestingly, the present research did not reveal that placement of a post made a significant difference in survival or RCT teeth. However, a significant difference between upper and lower teeth was noted, with the lower teeth surviving better, with a 5 PCT difference compared to upper teeth, and for anterior *versus* posterior teeth, there was a 7 PCT difference whereby posterior teeth performed better. This mirrors the pattern seen with crowns, therefore it may be considered that this highlights that the survival pattern follows a crown, and the post itself may not make much difference to the final outcome. It may be that with significant numbers as in this study, and placement of a cuspal coverage restoration, e.g. a crown after the post, the advantage of the crown overrides the placement of the post. The landscape is not as simple as this, as there were various types of post designs and nuances that make a difference on the tooth structure and its longevity. The placement of a post is often associated with retention of the core material underneath the cuspal coverage restoration (Mannocci & Cowie, 2014, Mannocci *et al*., 2021) but also signifies the lack of tooth structure requiring the tooth to be built up with a post to retain the core in the first place.

Results from work by Salehrabi & Rotstein (2004) indicated that posts did not influence survival of RCT teeth, whilst, on the other hand, Lazarski *et al*. (2001) found that cast posts and cores were associated with more failures than prefabricated post/cores and both indicated a decreased survival than RCT teeth without a post. Fransson *et al*. (2021) compared post types and found this did not make a difference in survival of RCT teeth but both types (direct and indirect) were associated with a slightly lower survival. Pratt *et al*. (2016) reported that fibre posts did not influence survival of RCT teeth, while Vire *et al.* (1991) found there were more failures in RCT premolar teeth restored with a post, but reported that this was more likely to prosthodontic failures than endodontic failures. The meta-analysis by Ng *et al*. (2010) using five studies (Alley *et al*., 2004; Aquilino & Caplan, 2002; Dammaschke *et al*., 2003, Lazarski *et al*., 2001; Salvi *et al*., 2007) found that tooth survival was not affected by the post/core restoration. A recent systematic review also found there was no difference with a post (Naumann *et al*., 2018) but noted the importance of a ferrule. However, in a prospective study (Ng *et al*., 2011a) reported 2.6 times increase in extraction rate for teeth restored with a post.

This unexpected finding that posts in such a large cohort did not make a difference also helped prompt the investigation of the restorations placed on a tooth before RCT was required.

4.4.2.4 Pin or Screw Placement

The survival of RCT teeth with a pin, or a screw compared to those that did not, at 15-year survival was 80%, compared to 76% for those RCT teeth without a pin or screw, a 4 PCT difference. The placement of a pin or a screw is to retain a core under a cuspal coverage restoration or a retain a large filling. In this study there was a 4 PCT difference for improved survival when a pin or screw was used. Placement of a pin or a screw could not be differentiated from one another in the claims for patients. Screws utilise the pulp space whilst pins use dentine to increase retention. There was a significant 10 PCT difference between posterior and anterior teeth, whilst only 2 PCT was recorded between upper and lower teeth. The different tooth types showed the largest difference between any of the restorations in this study, a 17 PCT was found when comparing upper first molars (85%) to upper lateral incisors (68%).

Restoration type has not been previously investigated to this extent and it is important to consider this in the context of large amalgam restorations for posterior teeth and large composite restorations for anterior teeth. The advantage in the use of pins has been to aid the retention of the core, and potentially future proof indirect restorations, in teeth where the core may be lost due to lack of retention from the surrounding tooth structure. Their use was relatively common, being the third most placed restoration on RCT teeth, with a total of 135,615 pins being claimed in RCT teeth. The retention of the core and hence further prevention of the loss of the core and potentially subsequent de-

cementation of the cuspal coverage restoration e.g. crown, may be considered fundamental in achieving better survival.

Fransson *et al*. (2021) found that placement of direct restorations with a post but without an indirect restoration had three times higher failure rate when compared to teeth with an indirect restoration and a post. Screw posts were reported to be the most common prefabricated post system used by dentists in Germany (Naumann *et al*., 2006). The screw post is not in the post category of this study and can complicate the interpretation of studies: however, it has been interesting to find that post compared to pin/screw have different effects on the survival of RCT tooth, potentially being due to the increased volume of tooth tissues lost when a post is indicated.

4.4.3 Restoration Placed After the RCT on Anterior Teeth

Restorations on anterior teeth after RCT were an incisal edge composite or a composite restoration which included one or two incisal angles. There was no statistical significance between these restorations, therefore none of these restorations may be considered to make a difference to survival of RCT teeth over 15 years. The access cavity for the RCT teeth would have been positioned palatal or lingual and present on all three types of restorations compared here. Although results of the work by Fransson *et al*. (2021) indicated that most extractions were on teeth with composite restorations with or without a post, it may be important to consider that, in Sweden (where this study was based),

composite was used for all tooth types, and there was no detail on composites in anterior *versus* posterior teeth. However, in the present study, most of the anterior plastic restorations were composite, while for posterior teeth, restorations were mainly formed in amalgam due to the regulations in the NHS GDS.

4.4.4 Restoration Placed After the RCT on Posterior Teeth

Among posterior teeth, five different types of restorations specific to posterior teeth were investigated; occlusal amalgam, MO/DO amalgam, MOD amalgam, gold inlay and tunnel restorations. The only restoration type that significantly affected the survival of RCT teeth, was the occlusal restoration whilst the others did not impact survival of RCT teeth.

Occlusal teeth restored with an amalgam restoration had a 2 PCT lower survival than other RCT teeth: this was a difference that was established early on in the survival graph and remained the same until 15 years. This may represent an increased risk at the outset of an occlusal restoration and not one that developed with time. Occlusal restorations are the smallest type of cavity associated with posterior RCT teeth as they only involve loss of one tooth surface, especially when compared to an MOD where there is loss of tooth structure in three surfaces. Occlusal cavities can be relatively small in RCT teeth, especially as in recent times, due to minimally invasive endodontics (Al-Helou *et al*., 2023; Gluskin *et al.*, 2014; Plotino *et al.,* 2017*)*. However, these cavities can also be very wide, especially if caries has invaded the pulp space, leaving a thin shell of tooth to retain the

occlusal filling. On occasion, some dentists cut an access cavity into an existing large restoration, e.g. MOD, and on this database an occlusal restoration claim would have appeared as the restoration placed after RCT, even though the tooth could have been more heavily restored. There have not been many reports on RCT teeth and occlusal restorations. One group that has investigated it (Nagisiri & Chitmongkolsuk, 2005) only had 27 teeth in the occlusal restoration category, and they had an inclusion criteria requirement of a minimum of 2mm thickness of the wall. They found that these teeth survived well and did not identify a difference between amalgam and composite restorations, but their findings may not be as applicable for comparison to this study due to the case selection and limited numbers.

The prosthodontic literature in preservation of tooth structure has, if possible, favoured the isthmus size to be less than 1/3 of the width of the tooth, and this has also been investigated in the endodontic literature examining restorations placed after RCT (Gulabivala & Ng, 2023; Ng *et al*., 2011a). It has been accepted that occlusal restorations can be conservative or large, especially if more than a 1/3 of the isthmus of the tooth has been lost. As stated previously, the decision on how to restore the RCT tooth can be challenging for dentists, with these nuances potentially being complex for simple situations (Mannocci & Cowie, 2014; Mannocci *et al*., 2021).

The literature has always emphasised the significant role of loss of marginal ridges (Gulabivala & Ng, 2023; Mannocci *et al*., 2021). The loss of the marginal ridge has often been considered a factor in survival and success of RCT teeth. Posterior restorations that

involved loss of one marginal ridge, e.g. MO or DO, were considered to be stronger than teeth that have lost both marginal ridges, i.e. MOD restoration. Surprisingly, the results from the present study indicated that there were no significant differences between teeth restored with MO, DO or MOD restorations, and those that did not have this type of restoration. This was an unexpected finding, especially as occlusal restorations had 2 PCT lower performance. The number of teeth that had an occlusal, MO/DO (154,485) and MOD (111,911) restoration were significant therefore the statistical power of the analysis is strong.

Studies have discussed the cumulative loss of tooth structure from caries and restorative and endodontic procedures, and how MOD restorations can be best supported in a posterior tooth with a cuspal coverage restoration (Reeh *et al*., 1989; Sorenson & Martinoff, 1984). Hansen *et al*. (1990) also recommended that provision of amalgam restorations with cuspal coverage was critical for good long-term prognosis. Tooth fracture has been associated with three or more restored surfaces, often below crestal level in 83% of fractured RCT teeth with Lagouvardous *et al*. (1989) and Fennis *et al*. (2002) recommending cuspal coverage restorations to avoid catastrophic fractures in these teeth.

It has been well documented that RCT teeth can break at the cervical margin and the break can be catastrophic resulting in extraction. Fractures were the most common reason for extraction of root filled teeth in a recent study (Van Nieuwenhuysen *et al*., 2023).

Whilst the inlay restoration may be similar to the MO/DO or MOD, they were not significantly better or worse than teeth which did not have this type of restoration. These findings sparked the interest to delve into investigation of the historic placement of restorations before the RCT, in order to identify the role of marginal ridges. It may be worth stating that the intention started that way, but out of curiosity also expanded into all historic types of restorations before the RCT to see how they may affect survival of RCT teeth.

The pattern of upper teeth and lower teeth was the same as all RCT teeth, irrelevant of the type of restoration after RCT. The different sides of the mouth were investigated by investigating different quadrants. These also followed the pattern of the lower teeth performing better except in one situation. In relation to MO or DO restorations; there was a difference noted that the lower left performed better than all quadrants, whilst the upper left the worst of the four quadrants. The right side had the same survival if upper or lower. The explanation for this is not clear, and there has not been any previous study examining this detail, therefore no comparison can be made. Nevertheless, the survival graphs on each tooth type generally followed the pattern of the RCT teeth.

Tunnel restorations, where the aim was to preserve the marginal ridge, were interesting to investigate. Unfortunately, the numbers were very low in this category, but it was interesting to identify the tooth types that had this type of restorations. Over half of the

tunnel restorations were placed on second premolars, a tooth type that had the greatest number of RCT of any other tooth.

The table summarise the very large database studies and their findings on these tooth factors (Table 28).

Study	*Restorations after RCT*				*Other*
	Crown	**Bridge**	**Pin/Screw**	**Occlusal Restoration**	
This study	Crown (Better by 2 PCT)	Bridge (Better by 2 PCT)	Pin/Screw (Better by 4 PCT)	Occlusal (Worse by 2 PCT)	
Burry et al.	X	X	X	X	
Chen et al.	Cannot provide prosthodontic work on their health system				
Fransson et al.	Indirect 93% unrestored 86% (7 PCT) then comps all types plus or minus post	Direct vs Indirect (3 PCT indirect better)	X	Composite Restorations	Most RCT 50-64 and lower molars, Married or Registered Partner (better), Restore within 6m better, Not allowed on 8s
Kwak et al.	Cannot provide prosthodontic work on their health system	X	X	X	Dental Dam (Better by 2PCT)
Raedel et al.	X	X	X	X	Vital vs Non-Vital (Better by 3 PCT)
Salehrabi & Rotstein	Crown				85% of extracted teeth had no crown, and not many with posts

Table 28 Comparison of this study and others based on Restorations after RCT

4.4.5 Historic Restoration Placed Before RCT

Once the results after RCT restorations were evaluated, it was puzzling to find placement of a post and loss of marginal ridges did not make a significant difference as expected. This led to further analysis investigating the historic restorations before RCT of the tooth and examining the subsequent survival of the restored tooth. In that regard, there is a paucity of information are in the literature in relation to restorations placed prior to RCT and how this affected tooth survival. Therefore, in the present study, 14 different restoration types before RCT were identified and evaluated using programs on 4 various historic periods. Each of the 14 restoration types were investigated using a history of 3 years' worth of restorations and 12 years of follow up and then the other three periods; each made of history of 5 years, 8 years and 10 years' worth of restorations.

Results indicated that the history of previous RCT, presence of a crown, bridge abutment, post and occlusal restoration from the historic restorations was significant for the survival of RCT teeth. The history of RCT made a 5 PCT difference in survival outcome and of all the historic restorative procedures, therefore having a previous RCT made the largest difference. In another large database study, a tooth that has previously had RCT was reported to have a slightly lower survival compared to a tooth that has not had RCT in the past (Kwak *et al.,* 2019). Previously RCT teeth in need of ReRCT were generally accepted to have a lower survival rate but reported more frequently in clinical studies with strict healing criteria (Fransson & Dawson, 2023; Gulabivala & Ng, 2023; Ng *et al*., 2011b, Sabeti *et al.,* 2024).

In historic restorations post placement appeared to decrease survival as had been expected, but after RCT it was not the case. It may be that the latter was counteracted by the improvement of having an indirect restoration e.g. a crown, thus overall impact of post after RCT for survival of RCT teeth was not significant.

An occlusal restoration pre-RCT and after RCT caused a 2 PCT decrease in survival, and again the loss of marginal ridges were not significant. The reasons for these findings have been previously discussed and may be applicable again. The size of the restoration can be large, and yet because the marginal ridges were intact the dentist might not consider cuspal coverage restoration necessary for the tooth. It may also be that some dentists accessed through the restorations: this could be indicative of a different result on pre-RCT to after RCT, but nevertheless no difference was noted with marginal ridges. The loss of marginal ridge/s associated with large fillings may be associated with the dentist deciding on crown placement more frequently, so the cases that were remaining might have not had the very large fillings, and possibly the isthmus width with was 1/3 or less, in contrast to the large occlusal fillings that may be more than 1/3 isthmus width and leave only a shell of enamel and dentine retaining it. The filling materials in posterior teeth were mainly amalgam as that was allowed under the GDS regulations. Amalgams have been associated with cracks (Hansen *et al*.,1990) and this may also be another factor that can be considered. It has also been reported that extractions were three times more likely if less than 30% of the tooth structure remained (Al-Nuaimi *et al*., 2017; Al-Nuaimi *et al*.,

2020), therefore in this study that would apply to the large restorations like an MOB or MOD with/without cusp replacement but also possibly to very large occlusal restorations.

The loss of tooth structure historically before RCT is carried out has been considered to be an important factor, especially if a crown has not been placed (Al-Nuaimi *et al.,* 2020; Nagisiri & Chitmongkolsuk, 2005). Loss of tooth structure is considered to dictate the type of restorations placed in teeth, and majority of teeth that need RCT have been previously restored, as confirmed by Wigsten *et al*. (2019) who reported that in Sweden 83.5% of teeth that had RCT had been previously restored. They reported also that they were mostly restored with a composite, further reporting that there was over 12% difference in survival if the loss of tooth structure was more than a third of the coronal tooth structure.

The table 29 summarises the findings of the exceptionally large database studies and how they compared in relation to this study.

Study	*Restorations before RCT*				
	RCT	**Crown**	**Bridge**	**Post**	**Occlusal Restoration**
This study	RCT (Worse by 5 PCT)	Crown (Worse by 5 PCT)	Bridge (Worse by 3 PCT)	Post (Worse by 5 PCT)	Occlusal (Worse by 2 PCT)
Burry et al.	X	X	X	X	X
Chen et al.	X	X	X	X	X
Fransson et al.	X	X	X	X	X
Kwak et al.	RCT (Worse by 3 PCT)	X	X	X	X
Raedel et al.	X	X	X	X	X
Salehrabi & Rotstein	X	X	X	X	X

Table 29 Comparison of this study and others based on Restorations before RCT

4.4.6 Summary

There was clear evidence that RCT on lower teeth and posterior teeth have a better survival than their counterparts in upper teeth and anterior teeth). The restorations placed after RCT which appeared to increase the survival of RCT teeth were crowns, bridge abutments and pins/screws, whilst occlusal restorations were associated with lower survival rates.

The previous history of RCT, post, crown, use as bridge abutment and occlusal restorations decreased the survival of the RCT teeth. Comparisons cannot easily be made to other studies as they did not investigate in detail the types of restorations, tooth position and tooth types.

4.5 National Health Service General Dental Services

The result of this research is encouraging as it has highlighted the worthwhile option of RCT in the NHS GDS to save teeth. Although there has been criticism on the quality of the RCT in this system (Dummer 1998), there have only been two publications reporting on the quality of RCT in the NHS GDS based on clinical radiographs related to the ESE quality guidelines. Dummer (1998) found that only 10% of cases were satisfactory, while Tickle *et al.* (2008), reported that from 174 RF teeth in their study, 26.6% were root filled to an optimal standard, whilst 38.2% were sub-optimal, with the remainder having unreadable radiographs. They found the failure rate was similar among the three groups ranging from 8.7% (optimal RF), 9.1% (sub-optimal RF) and 9.8% for those without a radiograph or unreadable radiograph. Their study further evaluated the cases and reported that survival analysis showed there was no significant difference in probability of failure among the optimal and sub-optimal cases. However, interestingly, the teeth that were restored with a crown had not failed in the eight year period of this study.

These studies were also conducted when dentists were still under the fee per item contract. The research stated that at the time there was concern regarding remuneration being insufficient to adequately reimburse dentists for the time taken to provide this complex form of therapy to a high standard. However, Tickle *et al*. (2008) believed this was unwarranted as their study showed the quality of the RF had little

impact on their outcomes and debated the need for further radiographic evaluation. Their publication was considered controversial as they stated, “These findings indicate that endodontic treatment may not be as technique sensitive as previously thought and the coronal restoration of root filled teeth is more important than the perceived quality of the root filling.” They found that the role of a crown on first molar teeth had a favourable outcome, and was significant as they found no reintervention during their five years follow up period, and seemed to perform well among those with optimal and sub-optimal RCT. Their survival rate of 87-93% at 5 years was comparable to the present study’s overall survival of 90%. They also reported that patient related outcome measures (Kay, 2001; Marshall *et al*., 2006, Sullivan, 2003) were considerations for this type of treatment which has not been dealt with adequately in the literature (Wong *et al*., 2023). They recommended PROM and the NHS GDS clinical research needs to be considered when considering restoring/saving teeth with RCT by GDPs.

A recent report by the Nuffield trust reported that there were inequalities in access to NHS dentistry across different regions and the unequal distribution of dentists mirrors the variation in access, with poorer access in areas of fewer dentists per head of the population. The Health and Social Care Committee’s report on NHS dentistry, published in July 2023, said the following groups were affected by unequal access to oral health:

- people who were entitled to free treatment on the NHS, including children and young people, pregnant women, and those in receipt of low-income benefits

- people from ethnic minority backgrounds
- people with additional or complex needs including those with SEND and autism
- people from vulnerable groups including refugees and asylum seekers
- people who were homeless.

Ten years earlier, Watt *et al*. (2013) recommended that future oral health policy needs to address oral health inequalities, encourage skill mix and promote and facilitate the dental profession to deliver appropriate and high-quality care relevant to the needs of their local population. Also highlighted from the ADHS 2009, was the consideration that cost and anxiety were important barriers to care. Twenty-six percent of adults said the type of treatment they had opted for in the past had been affected by the cost and 19% said they had delayed dental treatment for the same reason. The 2009 survey data demonstrated a relationship between dental anxiety and dental attendance. Adults with extreme dental anxiety were more likely to attend the dentist only when they had trouble with their teeth (22%) than for a regular check-up (Hill *et al*., 2013).

The current UDA system introduced in 2006 has been considered by some to have been developed rapidly and was initially intended to be temporary. It encouraged volume of activity over need and service quality, unfortunately postulating a scenario where patients with high levels of need were avoided. The system had been considered bureaucratic to operate, unpopular with dentists and has also been criticised for not improving access or quality. It has also been reported (Colonio Salazar

et al., 2019; Gallagher *et al*., 2021) that dentists' health and wellbeing is affected by multiple contemporary influences, that dentists are unhappy with the current NHS primary care systems, perceived as being primarily business centred with pressures to meet practice contracts and targets. Despite the challenges, dentists achieve great satisfaction from 'making a difference to patients' especially for those in high need, and it is reported this contributed to their sense of professional wellbeing, which could easily arise from seeing patients that were in pain and have a swelling often requiring RCT. There were reports of a move back towards the ethos and historical values of an NHS to build a future with collaboration (NHS long term plan 2019). The results from this type of study should be encouraging to dentists, patients and governing bodies, knowing that good success for RCT can be achieved by GDPs in the NHS GDS in England and Wales.

Holmes *et al.,* (2020) has reported concern regarding NHS primary care settings incorporating skill-mix to meet the changing needs of patients and populations in the future. He reported that the dental services were changing in the clinical, social and political climate in the UK, and the ageing population have complex oral health needs. These have been previously reported in relation to endodontics and the elderly, plus the challenges of provision of RCT in heavily restored or broken-down teeth as well as complexities of RCT itself including narrower root canals (Qualtrough & Mannocci, 2011). The report on the future of the dental workforce for England (Gallagher *et al.,* 2019) highlighted that the NHS is seeking to build a sustainable future that embraces many facets including delivery of quality care in support of public health which will require innovation and local flexibility. The increasing importance on the health

workforce, as evidenced by the human resources for health 2030 strategy from the WHO (2016), aims to progress towards equitable access to health workers within strengthened health systems. There may be a role for the specialist endodontist and dentists with enhanced endodontic skills in this landscape may be to allow for upskilling of dentists through education and access to care with various community projects.

The House of Commons research briefing on NHS Dentistry in England (2024) reported that the current NHS dental contract has been criticised by professionals, unions, and the Government. Stakeholders have argued it is inflexible and does not fairly reward dentists for seeing more complex and time-consuming patients (Garrett & Harker, 2024). The current contract had remained largely unchanged until the (minor) reforms announced on 19 July 2022 and further changes introduced by the Government's recovery plan for NHS dentistry. Stakeholders and the Commons Health and Social Care Committee have said these changes don't go far enough and the NHS contract needs fundamental reform, including moving away from the UDA system. They also reported that real-terms funding for dental services (accounting for inflation) has fallen by 19% (in 2022/23 prices) since 2010/11, from £3.56 billion in 2010/11 to £2.90 billion in 2022/23.

The Health and Social Care Committee's report on its inquiry into NHS dentistry said that fundamental reform and a move away from the UDA system is required. While the

British Dental Association (BDA) has said the fundamental issues with the UDA system remain, RCT on molar teeth were changed so that more recently rewarded with seven UDAs, as opposed to three UDAs for many years, as a result of BDA lobbying. However, they warn that the move is unlikely to be a game changer, given the nature of the challenging and time-consuming treatments - which can take up to three hours on a single tooth.

Oral and dental care in England is largely provided in primary dental care settings which involve 80-90% of dental professionals (Gallagher *et al*., 2019). The landscape of dentistry has changed and will continue to do so (Hemmings 2023). Whilst in the current climate of increased medico-legal challenges in endodontics, has led to excessive referrals and fostering a culture of “defensive dentistry” (Al-Yaseen *et al*., 2024). Technology is advancing fast, especially in endodontics, and dentists find it easier to provide high quality dentistry than they did 50 years ago, and this study should encourage provision of RCT by GDPs.

In recent times the dental services have had to deal with the COVID-19 pandemic, and the latest financial year estimates for 2022/23 reveal 15% less activity than the 2019/20 figures of 38.9 million courses of treatment, the latter being defined as assessment and examination of a patient and the provision of any planned treatment. The NHS dental statistics for England (2022-3) reported that 18.1 million adults were seen by an NHS dentist in the 24-month preceding 30 June 2023, with 32.5 million courses of treatment, reflecting an increase of 23.2%, with 24,151 dentists performing an NHS

activity in 2022-2023, a decrease of 121 on the previous year on delivering dental care for England. The low socio-economic background of some of those surveyed as part of the AOHS 2021(AOHS 2024) revealed that they were more likely to have painful, broken and decayed teeth, least likely to contact their dentist when they needed treatment, and the impact of cost of living caused these patients as much to avoid dental treatment based on costs. This is concerning as it is not much different to the barriers reported from the 2009 ADHS before the pandemic.

The dental press shows concern that the NHS dentistry is at a tipping point and has real risks of collapsing unless urgent action is taken, reporting that an estimated ten million people waiting for routine dental treatment in the UK. Moreover, 85% of dental practices have been reported to be closed to new NHS patients, with 60% of patients feeling that it is harder to access an NHS dentist now than it was ten years ago. Based on the AOHS 2021 report (AOHS 2024) in the last year, 53% of the population saw a dentist for a routine check-up, and even though oral health has improved in the last thirty years, oral health inequalities have widened. In 2008, the proportion of children with dental decay was 2.9x higher in the most deprived than the least deprived areas. In 2019, this is now 3.8x higher. Access to dentistry is at its lowest levels in years and has been exacerbated by the pandemic.

In summary, Public Health England have stated the following (Inequalities in oral health in England, Public Health England, 2021; www.gov.uk/phe):

“Good oral health is essential for good general health and wellbeing. Poor oral health can have a negative impact throughout life and can cause pain, infection and lead to difficulties with eating, sleeping, socialising and wellbeing. In England oral diseases place significant costs on society and the NHS for what are essentially preventable diseases. Good oral health is not enjoyed equally across the population in England. The impacts of poor oral health disproportionally affect the vulnerable and socially disadvantaged individuals and groups in society. Oral health inequalities can be defined as differences in levels of oral health that are avoidable and deemed to be unfair, unacceptable and unjust. There are upstream, midstream and downstream causes of oral health inequalities. Reducing oral health inequalities is a matter of social justice and ethical imperative. Public bodies across the health sector in England have legal duties and responsibilities to address inequalities.”

The present research should be utilised to support the recommendations of Public Health England and the British Dental Association to support dentists working in the NHS GDS to overcome barriers for patients to receive care and to break down inequalities in oral health. We should be proud and encouraged that compared to other countries, our dentists are able to provide RCT to restore/save teeth, with a good survival rate for RCT at 15 years, arguably at fee rates to the Exchequer which are lower than most others in the developed world.

Chapter 5 Conclusion

In conclusion the 15 years survival of root canal treated teeth was 77% by GDPs based on reintervention for *circa* 800,000 RCT teeth in the NHS GDS in England and Wales. These findings are encouraging and appear to support the provision of RCT to save teeth by GDPs working in the NHS GDS, additionally, when based on extraction, the 15-year survival was also promising at 83%.

The investigation into factors that affect survival was carried out and indicated that there were some dentist, patient and tooth factors of importance. It was revealed that the age of the dentist and the region they worked had some implication on the survival outcome of RCT teeth. These have not been examined in the same way by previous studies, therefore a direct comparison cannot be made with other studies. The dentists in their 30s had the best RCT survival outcome whilst the opposite was evident among dentists 60 and above. The dentists working in South Central England had markedly better results than those in Wales, with a 9 PCT difference.

The age of the patient seemed to be a relevant factor in survival of RCT teeth, with a 7 PCT difference at 14-year survival among the young, in their twenties (80%), and older patients, aged 70 and above (73%). Variation in survival may be multifactorial and further research would be required to identify the role of each factor. The survival among those that were charge-paying patient was 78% exhibiting a difference of 4 PCT in comparison to non-full charge-paying patients (74%), potentially reflecting the

challenges of socio-economic status and its relationship to areas of deprivation and oral health inequality.

The tooth factors indicated that the position of the tooth, and the type of restoration before and after the RCT were relevant. The posterior teeth (79%) survived 5 PCT better than anterior teeth (74%), and lower (mandibular) teeth (78%), a 2 PCT better survival than upper (maxillary) teeth (76%) at 15 years. The treatments that had decreased the survival of the RCT teeth were the previous history of RCT (5 PCT), post (5 PCT), crown (5 PCT), bridge abutment (3 PCT) and occlusal restorations (2 PCT). The restorations that were placed after RCT with improved survival of RCT teeth were crowns and bridge abutments by 2 PCT, while pins/screws by 4 PCT, but provision of occlusal restorations deteriorated it by 2 PCT.

This study cannot easily be compared to other studies in the literature as some of these factors have not been investigated to this detail and longevity. The research from this work should be utilised to support the recommendations of Public Health England and British Dental Association in lobbying the Government to support dentists working in the NHS GDS to overcome barriers for patients to receive care and to break down inequalities in oral health. We should be proud that compared to all other countries our dentists are able to provide RCT to save teeth and we should be encouraged by their good survival rates at 15 years at fee rates which are lower than most others in the developed world.

Chapter 6 List of References

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Chapter 7 Summary of Appendix

The following two chapters contain the computer programs used in SPSS presented in chapter 8 and the output they produced including tables and graphs presented in chapter 9.

The methods and materials (chapter 2) contain the mind maps of the programs, tables and referencing for each of the programs. They have been reproduced here for ease of use.

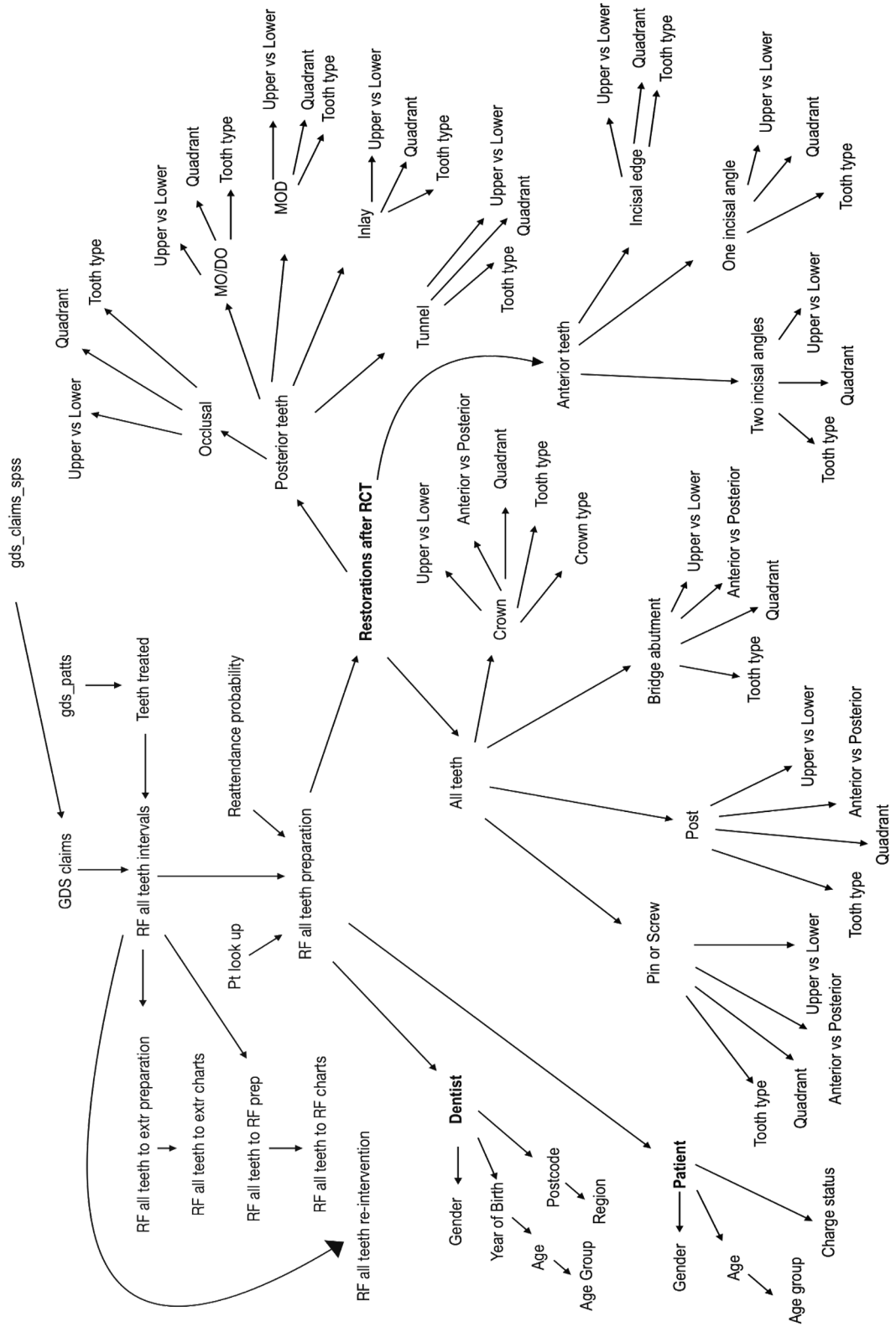

Figure 7 Mind map of the IBM SPSS Programs

Dentist Factors:	**Program:**	**Results:**
Gender	*Appendix 8.2.1*	*Appendix 9.2.1*
Age (year, decade)	*Appendix 8.2.2*	*Appendix 9.2.2*
Region (postcode of the practice)	*Appendix 8.2.3*	*Appendix 9.2.3*

Table 3 Programs investigating Dentist factors

Patient Factors:	**Program:**	**Results:**
Gender	*Appendix 8.3.1*	*Appendix 9.3.1*
Age (year, decade)	*Appendix 8.3.2* *Appendix 8.3.3*	*Appendix 9.3.2* *Appendix 9.3.3*
Financial status for the treatment (Fee paying status).	*Appendix 8.3.4*	*Appendix 9.3.4*

Table 4 Programs investigating Patient factors

All teeth investigated by:	**Location of RCT Tooth and its survival based on Reintervention investigated by:**
Survival to reintervention	*Upper vs Lower*
Survival to extraction	*Anterior vs Posterior*
	Quadrant
	Tooth type

Table 5 Programs investigating Tooth factors

All teeth:	**Anterior teeth:**	**Posterior teeth:**
Crown	*Incisal edge restoration*	*Occlusal restoration*
Bridge Abutment	*One incisal angle*	*MO/DO restoration*
Post	*Two Incisal angles*	*MOD restoration*
Pin or Screw		*Inlay*
		Tunnel

Table 6 Programs investigating Restorations placed after RCT

Crown program: **Appendix 8.4.1.1**	**Survival graphs:** **Appendix 9.4.1.1**
	Crown vs all other RCT teeth
	Upper vs Lower
	Anterior vs Posterior
	Quadrants
	Tooth types
	Crown types

Table 7 Programs investigating Crowns placed after RCT

Bridge abutment program: **Appendix 8.4.1.2**	**Survival graphs:** **Appendix 9.4.1.2**
	Bridge abutment vs all other RCT teeth
	Upper vs Lower
	Anterior vs Posterior
	Quadrants
	Tooth types

Table 8 Programs investigating Bridges placed after RCT

Post program: **Appendix 8.4.1.3**	**Survival graphs:** **Appendix 9.4.1.3**
	Post vs all other RCT teeth
	Upper vs Lower
	Anterior vs Posterior
	Quadrants
	Tooth types

Table 9 Programs investigating Posts placed after RCT

Pin or Screw program: **Appendix 8.4.1.4**	**Survival graphs:** **Appendix 9.4.1.4**
	Pin or Screw vs all other RCT teeth
	Upper vs Lower
	Anterior vs Posterior
	Quadrants
	Tooth types

Table 10 Programs investigating Pin or Screw placed after RCT

Incisal edge program: **Appendix 8.4.2.1**	**Survival graphs:** **Appendix 9.4.2.1**
	Incisal edge vs all other RCT teeth
	Upper vs Lower
	Quadrants
	Tooth types

Table 11 Programs investigating Incisal edge restoration placed after RCT

One incisal angle program: **Appendix 8.4.2.2**	**Survival graphs:** **Appendix 9.4.2.2**
	One incisal angle vs all other RCT teeth
	Upper vs Lower
	Quadrants
	Tooth types

Table 12 Programs investigating One Incisal angle restoration placed after RCT

Two incisal angles program: **Appendix 8.4.2.3**	**Survival graphs:** **Appendix 9.4.2.3**
	Two incisal angle vs all other RCT teeth
	Upper vs Lower
	Quadrants
	Tooth types

Table 13 Programs investigating Two Incisal angle restoration placed after RCT

Occlusal program: **Appendix 8.4.3.1**	**Survival graphs:** **Appendix 9.4.3.1**
	Occlusal vs all other RCT teeth
	Upper vs Lower
	Quadrants
	Tooth types

Table 14 Programs investigating Occlusal restoration placed after RCT

MO/DO program: **Appendix 8.4.3.2**	**Survival graphs:** **Appendix 9.4.3.2**
	MO/DO vs all other RCT teeth
	Upper vs Lower
	Quadrants
	Tooth types

Table 15 Programs investigating MO or DO restoration placed after RCT

MOD program: **Appendix 8.4.3.3**	**Survival graphs:** **Appendix 9.4.3.3**
	MO/DO vs all other RCT teeth
	Upper vs Lower
	Quadrants
	Tooth types

Table 16 Programs investigating MOD restoration placed after RCT

Inlay program: **Appendix 8.4.3.4**	**Survival graphs:** **Appendix 9.4.3.4**
	Inlay vs all other RCT teeth
	Upper vs Lower
	Quadrants
	Tooth types

Table 17 Programs investigating Inlay restoration placed after RCT

Tunnel program: **Appendix 8.4.3.5**	**Survival graphs:** **Appendix 9.4.3.5**
	Tunnel vs all other RCT teeth
	Upper vs Lower
	Quadrants
	Tooth types

Table 18 Programs investigating Tunnel restoration placed after RCT

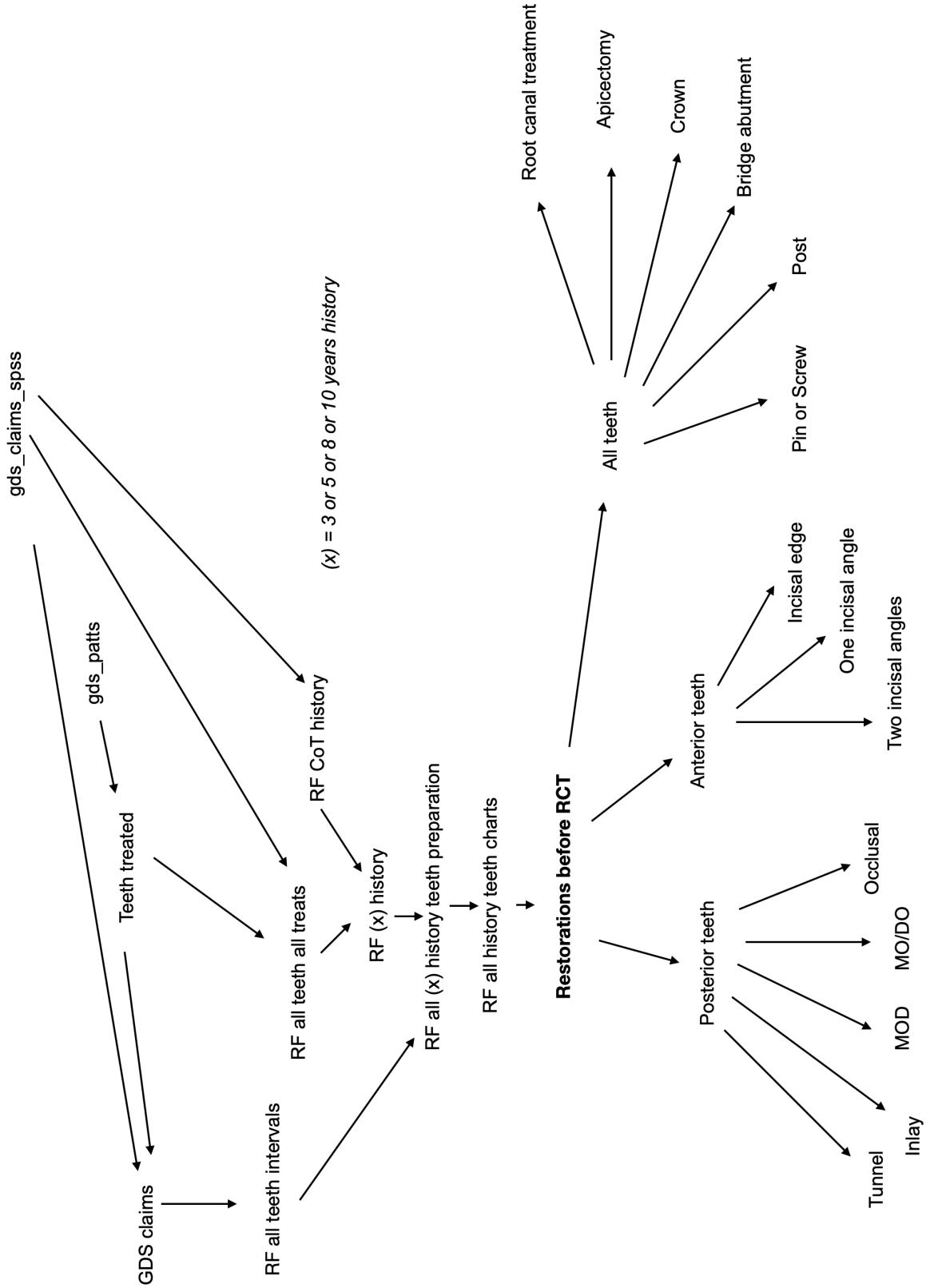

Figure 8 Mind map of the IBM SPSS Programs looking at History of restorations

Group:	Years of history:	Years of follow up:
1	*3*	*12*
2	*5*	*10*
3	*8*	*7*
4	*10*	*5*

Table 19 Groupings of historical calculations

Group 1 *3 years of history* *12 years of follow up*	**Survival graphs:** **Appendix 8.4.4.1 and 9.4.4.1**
All teeth:	
	Root canal treatment
	Apicectomy/RES
	Crown
	Bridge Abutment
	Post
	Pin or Screw
Anterior teeth:	
	Incisal edge restoration
	One incisal angle
	Two Incisal angles
Posterior teeth:	
	Occlusal Restoration
	MO/DO restoration
	MOD restoration
	Inlay
	Tunnel

Table 20 Programs investigating Group 1 historic restoration placed before RCT

Group 2 *5 years of history* *10 years of follow up*	**Survival graphs:** **Appendix 8.4.4.2 and 9.4.4.2**
All teeth:	
	Root canal treatment
	Apicectomy/RES
	Crown
	Bridge Abutment
	Post
	Pin or Screw
Anterior teeth:	
	Incisal edge restoration
	One incisal angle
	Two Incisal angles
Posterior teeth:	
	Occlusal Restoration
	MO/DO restoration
	MOD restoration
	Inlay
	Tunnel

Table 21 Programs investigating Group 2 historic restoration placed before RCT

Group 3 *8 years of history* *7 years of follow up*	**Survival graphs:** **Appendix 8.4.4.3 and 9.4.4.3**
All teeth:	
	Root canal treatment
	Apicectomy/RES
	Crown
	Bridge Abutment
	Post
	Pin or Screw
Anterior teeth:	
	Incisal edge restoration
	One incisal angle
	Two Incisal angles
Posterior teeth:	
	Occlusal Restoration
	MO/DO restoration
	MOD restoration
	Inlay
	Tunnel

Table 22 Programs investigating Group 3 historic restoration placed before RCT

Group 4 *10 years of history* *5 years of follow up*	**Survival graphs:** **Appendix 8.4.4.3 and 9.4.4.3**
All teeth:	
	Root canal treatment
	Apicectomy/RES
	Crown
	Bridge Abutment
	Post
	Pin or Screw
Anterior teeth:	
	Incisal edge restoration
	One incisal angle
	Two Incisal angles
Posterior teeth:	
	Occlusal Restoration
	MO/DO restoration
	MOD restoration
	Inlay
	Tunnel

Table 23 Programs investigating Group 4 historic restoration placed before RCT

Chapter 8 Appendix of Programs

8.1 Programs for SPSS

8.1.1 Programs to Prepare the Data

8.1.1.1 GDS Claims

```
* Encoding: UTF-8.
* GDS Claims 03.sps.

* Written by PSKL on 9/10/2011. Modified by ML 26/4/2015. Remodified 30/4/2023.
Remodified 27/05/2023.

* Read and store the file of GDS claims data.

GET DATA
  /TYPE=TXT
  /FILE="C:\Users\maria\OneDrive\Documents\PhD Results\SPSS
Sav\gds_claims_spss.sav"
  /DELCASE=LINE
  /DELIMITERS="\t"
  /ARRANGEMENT=DELIMITED
  /FIRSTCASE=2
  /IMPORTCASE=ALL
  /VARIABLES=
  randclaimID F3.0
  randpatID F7.0
  randdentID F5.0
  Patgender A1
  patyob F4.0
  freqgrp F1.0
  Chargestatus F1.0
  doaccn F6.0
  doexamn F6.0
  docompn F6.0
  ScaleFees F6.2
  postarea A2
  DentistGender A1
  Dentistyob F4.0.
CACHE.
EXECUTE.
DATASET NAME DataSet1 WINDOW=FRONT.
```

```
VARIABLE LABELS
 randclaimID 'Claim ID'
 randpatID 'Patient ID'
 randdentID 'Dentist ID'
 Patgender 'Patient Gender'
 patyob 'Patient Year of Birth'
 freqgrp 'Surname Frequency Group'
 Chargestatus 'Charge-paying Status'
 doaccn 'Date of Acceptance (days)'
 doexamn 'Date of Examination (days)'
 docompn 'Date of Completion (days)'
 ScaleFees 'Scale Fees'
 postarea 'Postcode Area of Surgery'
 DentistGender 'Dentist Gender'
 Dentistyob 'Dentist Year of Birth'.

Value Labels Patgender DentistGender
'M' 'Male'
'F' 'Female'
/ freqgrp
 1 '      Once'
 2       ' 2 to 10'
 3       '11 to 100'
 4       '101 to 1,000'
 5       '1,001 to 10,000'
 6       '10,001 or more'
 / Chargestatus
 1       'Full charge'
 2       'Exemption or remission'.

SAVE OUTFILE='C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\GDS
claims.sav'
  /COMPRESSED.
```

8.1.1.2 Teeth treated

```
* Encoding: UTF-8.
* Teeth treated 02.sps.
* Include all teeth including deciduous (A to E) and supernum (S).

* Written by ML on 30/9/2015.  Modified 27/05/2023.

* N.B. As currently written, this captures only the first tooth record for any quadrant. If
the full detail is needed, the full pattern needs revisiting.

Get file = 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS
sav\gds_patts.sav'
```

```
* Translate tooth pattern data to quadrants.

STRING TOOTHPAQ(A9) Quadrant (A2) Tooth (A1).

* Expand file into quadrant records.

Temporary.
Select IF
(ANY("#",SUBSTR(TOOTHPAT,1,1),SUBSTR(TOOTHPAT,11,1),SUBSTR(TOOTHPA
T, 21,1),
SUBSTR(TOOTHPAT,31,1))).
compute TOOTHPAQ=SUBSTR(TOOTHPAT,INDEX(TOOTHPAT,"#")+1,9).
compute quadrant='UR'.
Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

Temporary.
Select IF
(ANY("£",SUBSTR(TOOTHPAT,1,1),SUBSTR(TOOTHPAT,11,1),SUBSTR(TOOTHPA
T, 21,1),
SUBSTR(TOOTHPAT,31,1))).
compute TOOTHPAQ=SUBSTR(TOOTHPAT,INDEX(TOOTHPAT,"£")+1,9).
compute quadrant='UR'.
Save outfile='C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp1A.sav'.


Temporary.
Select IF
(ANY("%",SUBSTR(TOOTHPAT,1,1),SUBSTR(TOOTHPAT,11,1),SUBSTR(TOOTHP
AT, 21,1),
SUBSTR(TOOTHPAT,31,1))).
compute TOOTHPAQ=SUBSTR(TOOTHPAT,INDEX(TOOTHPAT,"%")+1,9).
compute quadrant='UL'.
Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

Temporary.
Select IF
(ANY("&",SUBSTR(TOOTHPAT,1,1),SUBSTR(TOOTHPAT,11,1),SUBSTR(TOOTHPA
T, 21,1),
SUBSTR(TOOTHPAT,31,1))).
compute TOOTHPAQ=SUBSTR(TOOTHPAT,INDEX(TOOTHPAT,"&")+1,9).
compute quadrant='LR'.
Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.

Temporary.
```

```
Select IF
(ANY("",SUBSTR(TOOTHPAT,1,1),SUBSTR(TOOTHPAT,11,1),SUBSTR(TOOTHPAT
, 21,1),
SUBSTR(TOOTHPAT,31,1))).
compute TOOTHPAQ=SUBSTR(TOOTHPAT,INDEX(TOOTHPAT,"")+1,9).
compute quadrant='LL'.
Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.

Add files file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'
 /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1A.sav'
 /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'
 /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'
 /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'
 /BY randclaimid.

* Resort by new quadrant label.

sort cases by randclaimid quadrant trtcode.

* Count number of instances on each tooth.

Compute toothA=0.
Compute toothB=0.
Compute toothC=0.
Compute toothD=0.
Compute toothE=0.

Compute toothS=0.

Compute tooth1=0.
Compute tooth2=0.
Compute tooth3=0.
Compute tooth4=0.
Compute tooth5=0.
Compute tooth6=0.
Compute tooth7=0.
Compute tooth8=0.

LOOP #I=1 TO 9.

IF (ANY('A',SUBSTR(toothpaq,#I,1))) toothA=toothA+1.
IF (ANY('B',SUBSTR(toothpaq,#I,1))) toothB=toothB+1.
IF (ANY('C',SUBSTR(toothpaq,#I,1))) toothC=toothC+1.
IF (ANY('D',SUBSTR(toothpaq,#I,1))) toothD=toothD+1.
IF (ANY('E',SUBSTR(toothpaq,#I,1))) toothE=toothE+1.

IF (ANY('S',SUBSTR(toothpaq,#I,1))) toothS=toothS+1.
```

```
IF (ANY('1',SUBSTR(toothpaq,#I,1))) tooth1=tooth1+1.
IF (ANY('2',SUBSTR(toothpaq,#I,1))) tooth2=tooth2+1.
IF (ANY('3',SUBSTR(toothpaq,#I,1))) tooth3=tooth3+1.
IF (ANY('4',SUBSTR(toothpaq,#I,1))) tooth4=tooth4+1.
IF (ANY('5',SUBSTR(toothpaq,#I,1))) tooth5=tooth5+1.
IF (ANY('6',SUBSTR(toothpaq,#I,1))) tooth6=tooth6+1.
IF (ANY('7',SUBSTR(toothpaq,#I,1))) tooth7=tooth7+1.
IF (ANY('8',SUBSTR(toothpaq,#I,1))) tooth8=tooth8+1.

END LOOP.

Temporary.
Select if toothA>0.
compute ntreats = toothA.
compute tooth='A'.
Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\tempA.sav'.

Temporary.
Select if toothB>0.
compute ntreats = toothB.
compute tooth='B'.
Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\tempB.sav'.

Temporary.
Select if toothC>0.
compute ntreats = toothC.
compute tooth='C'.
Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\tempC.sav'.

Temporary.
Select if toothD>0.
compute ntreats = toothD.
compute tooth='D'.
Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\tempD.sav'.

Temporary.
Select if toothE>0.
compute ntreats = toothE.
compute tooth='E'.
Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\tempE.sav'.


Temporary.
Select if toothS>0.
compute ntreats = toothS.
compute tooth='S'.
Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\tempS.sav'.
```

```
Temporary.
Select if tooth1>0.
compute ntreats = tooth1.
compute tooth='1'.
Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

Temporary.
Select if tooth2>0.
compute ntreats = tooth2.
compute tooth='2'.
Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

Temporary.
Select if tooth3>0.
compute ntreats = tooth3.
compute tooth='3'.
Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.

Temporary.
Select if tooth4>0.
compute ntreats = tooth4.
compute tooth='4'.
Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.

Temporary.
Select if tooth5>0.
compute ntreats = tooth5.
compute tooth='5'.
Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav'.

Temporary.
Select if tooth6>0.
compute ntreats = tooth6.
compute tooth='6'.
Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav'.

Temporary.
Select if tooth7>0.
compute ntreats = tooth7.
compute tooth='7'.
Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp7.sav'.

Temporary.
Select if tooth8>0.
compute ntreats = tooth8.
compute tooth='8'.
Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp8.sav'.
```

```
Add files file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\tempA.sav'
 /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\tempB.sav'
 /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\tempC.sav'
 /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\tempD.sav'
 /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\tempE.sav'
 /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\tempS.sav'
 /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'
 /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'
 /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'
 /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'
 /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav'
 /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav'
 /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp7.sav'
 /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp8.sav'
 /by  randclaimid quadrant trtcode.


sort cases by randclaimid quadrant tooth trtcode.

* N.B. If count>4 the records are incomplete - applies to 12 cases with trmt 1421 and
3 with 1426.

Save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\Teeth
Treated.sav'
 /drop toothA to tooth8.
```

8.1.1.3 Reattendance probability

```
* Reattendance probability.sps.
* Written by PSKL on 09/06/12.

Get file='C:\Users\lucarops\Documents\SPSS sav\GDS claims.sav'.

* Create year/month variable and schednum to number of months.
* Calculate observation interval in days to next acceptance date if revisit or 31/3/2006
if not.

Compute lstdsn=MAX(doaccn, doexamn, docompn).

sort cases by randpatid (a) lstdsn (d).

compute revisit = 0.
if (randpatid=lag(randpatid)) revisit = 1.
```

```
compute  interval = yrmoda(2006,3,31) - lstdsn.
if (randpatid=lag(randpatid))interval = lag(doaccn) - lstdsn.

* If two courses overlap, set interval to zero.

if (interval<0) interval=0.

formats randpatid randclaimid (F10) lstdsn interval (F6) revisit (F1).

save outfile= 'c:\pskltemp\temp1.sav'.


**************************************************************************************************
.

sort cases by claimidn.

match files file=*
 /table='D:\Longitudinal Data\All filling claims 1991 to 2001.sav'
 /by claimidn
 /keep patidn claimidn lstmsn schednum interval revisit patage.

recode patage
 (lo thru 19  = 1)
 (20 thru 29 = 2)
 (30 thru 39 = 3)
 (40 thru 49 = 4)
 (50 thru 59 = 5)
 (60 thru 69 = 6)
 (70 thru 79 = 7)
 (80 thru hi  = 8)
 into patagegr.

Value labels patagegr
 1 '18 or 19'
 2 '20 to 29'
 3 '30 to 39'
 4 '40 to 49'
 5 '50 to 59'
 6 '60 to 69'
 7 '70 to 79'
 8 '80 or older'.


CROSSTABS
  /TABLES=interval  BY revisit By patagegr
  /FORMAT= AVALUE TABLES
  /CELLS= COUNT .
```

```
Aggregate outfile=*
 /break interval revisit patagegr
 /n=n.

sort cases by patagegr (a) interval revisit (d).
compute cases=n.
if (revisit=0 and lag(patagegr)=patagegr and lag(interval)=interval) cases=n+lag(n).
execute.
select if revisit=0.
compute reattend=cases-n.

save outfile='c:\temp2.sav'.
get file='c:\temp2.sav'.

* Initialise counts to values at 134 months in each age group.
* Cumexpre is the expected cumulative re-attendance.

compute cumcases=cases.
compute cumreatt=reattend.
compute cumexpre=reattend.


* Recursive loop for each age group.

do if ($casenum > 1 and Lag (patagegr) = patagegr).
compute cumcases= lag(cumcases) + cumcases.
compute cumreatt= lag(cumreatt) + cumreatt.
compute cumexpre=lag(cumexpre) + reattend + (cases-reattend) * lag(cumexpre) /
lag(cumcases).
end if.

compute prreatt=cumexpre/cumcases.
sort cases by patagegr interval.

save outfile='D:\Longitudinal Data\Revised reattendance probability patagegr.sav'
  /DROP=revisit n cases reattend cumcases cumreatt cumexpre/COMPRESSED.

GRAPH
  /LINE(MULTIPLE)MEAN(prreatt) BY interval BY patagegr
  /MISSING=REPORT.
```

8.1.1.4 Patient look up

```
* Patient Lookup.sps.

* Written by PSKL on 30/10/2011.
```

```
* Create reference file for patients.

get file ='C:\Users\lucarops\Documents\SPSS sav\GDS claims.sav'.

sort cases by  randpatID.

Aggregate outfile=*
 /BREAK  randpatID
 / Patgender patyob freqgrp
= first (Patgender patyob freqgrp).

SAVE OUTFILE='C:\Users\lucarops\Documents\SPSS sav\Patient Lookup.sav'
  /COMPRESSED.
```

8.1.2 Programs to extrapolate RCT teeth

8.1.2.1 Root Canal Treated all teeth intervals

```
* Encoding: windows-1252.
* RF All Teeth intervals 21.sps.

* Written by ML on 6/6/2021. Amended 3/7/2022. Modified 13/04/2024.
* This produces a file of intervals between root-filling of teeth and re-root filling,
apicectomy or extraction.

*************** Add course of treatment details including patient year of birth.

Match files file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\Teeth
Treated.sav'
/Table = 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS sav\GDS
claims.sav'
/By  randclaimID.

execute.

* Restrict to adults on date of acceptance.

Compute patage=XDATE.YEAR( doaccn*24*60*60) - patyob.
FREQUENCIES VARIABLES = patage.
select if (range(patyob,1906,1972)).
FREQUENCIES VARIABLES = patage.

SORT CASES by  randpatID  randclaimID.


*************** Restrict to patients of interest.
```

```
Select if
(Range(TRTCODE,1401,1401,1403,1404,1411,1411,1422,1424,1431,1431,1501,150
1,1521,1521,1531,1531,1701,1706,1711,1712,1716,1716,1721,1723,1726,1727,173
1,1734,1741,1743,1751,1751,1801,1808,1811,1814,1818,1818,1831,1832,1841,184
1,1851,1852,1897,1897,2101,2101,2205,2205,5101,5103,5201,5201,5215,5215,581
1,5811,5813,5814,5822,5824,5831,5831,5841,5841)).

Execute.
Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
Get file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

********** Define treatments which start or end intervals.
Compute Root=0.
Compute Occlusal=0.
Compute oneproximalridge=0.
Compute MOD=0.
Compute tunnel=0.
Compute pinorscrew=0.
Compute post=0.
Compute incisaledge=0.
Compute oneangle=0.
Compute twoangles=0.
Compute Inlay=0.
Compute Crown=0.
Compute Abutment=0.
Compute Extract=0.
Compute Apicect=0.

If (Any(TRTCODE,1501,5841)) Root=1.
If (Any(TRTCODE,1401,5811)) Occlusal=1.
If (Any(TRTCODE,1403,5813)) oneproximalridge=1.
If (Any(TRTCODE,1404,5814)) MOD=1.
If (Any(TRTCODE,1411))Tunnel=1.
If (Any(TRTCODE,1431,5831,1734,1814)) pinorscrew=1.
If (Any(TRTCODE,1727,1731,1732,1733,1743,1811,1812,1813,1818,5103)) post=1.
If (Any(TRTCODE,1422,5822)) oneangle=1.
If (Any(TRTCODE,1423,5823)) incisaledge=1.
If (Any(TRTCODE,1424,5824)) twoangles=1.
If (Any(TRTCODE,1701,1702,1703,1704)) Inlay=1.
If
(Any(TRTCODE,1705,1706,1711,1712,1716,1721,1722,1723,1726,1741,1742,1751,
5101,5102))Crown=1.
If
(Any(TRTCODE,1801,1802,1803,1804,1805,1806,1807,1808,1831,1832,1841,1851,
1852,1897)) Abutment=1.
If (Range(TRTCODE,2101,2205,5201,5215)) Extract=1.
If (Range(TRTCODE,1521,1531)) Apicect = 1.
```

```
compute Start=0.
Compute End = 0.
If (Root=1) Start=1.
If (Any(1,Root,Apicect,Extract)) End = 1.

********** Reduce to one record per tooth per course of treatment.


sort cases by randpatID quadrant tooth doaccn.

aggregate outfile=*
 /presorted
 /break  randpatID quadrant tooth doaccn
 /ntoothtreats=n
 /  randclaimID  doexamn docompn  Patgender patyob freqgrp Chargestatus
ScaleFees postarea DentistGender Dentistyob
 = first(randclaimID  doexamn docompn Patgender patyob freqgrp Chargestatus
ScaleFees postarea DentistGender Dentistyob)
 /mintrt=min(trtcode)
 /maxtrt Root Occlusal oneproximalridge MOD tunnel pinorscrew post incisaledge
 oneangle twoangles Inlay Crown Abutment Extract Apicect Start End =
max(TRTCODE Root Occlusal oneproximalridge MOD tunnel pinorscrew post
incisaledge oneangle twoangles Inlay Crown Abutment Extract Apicect Start End ).

Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
Get file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

********** Restrict to start courses and next courses of interest - those which
conclude the interval.

Select if (Start=1 or End=1).

* Calculate time lag for starter courses, both to next root treatment, if any, and to
extraction.

sort cases by  randpatID quadrant tooth (a) doaccn (d) start (a).

Do if (randpatid=lag(randpatid) and quadrant=lag(quadrant) and tooth=lag(tooth)
      and (start=1 or apicect=1)).
Compute time=lag(doaccn)-max(doaccn, doexamn, docompn).
Compute nextmintreat=lag(mintrt).
Compute nextmaxtreat=lag(maxtrt).
Compute nextextract=lag(extract).
Compute nextroot=lag(root).
Compute nextapicect=lag(apicect).
Compute nexclaim=lag(randclaimid).

End if.
```

```
Execute.

* time to extraction.

If (nextextract=1) timetoext = time.
If (randpatid=lag(randpatid) and quadrant=lag(quadrant) and tooth=lag(tooth) and
nextextract=0) timetoext = lag(timetoext)+time.

Execute.

* Restrict to starts.

Select if (Start=1).

Save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All
Teeth Intervals.sav'.
```

8.1.2 Programs to extrapolate RCT teeth

8.1.2.1 Root Canal Treated all teeth intervals

```
* Encoding: windows-1252.
* RF All Teeth intervals 21.sps.

* Written by ML on 6/6/2021. Amended 3/7/2022. Modified 13/04/2024.
* This produces a file of intervals between root-filling of teeth and re-root filling,
apicectomy or extraction.

********** Add course of treatment details including patient year of birth.

Match files file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\Teeth
Treated.sav'
/Table = 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS sav\GDS
claims.sav'
/By  randclaimID.

execute.

* Restrict to adults on date of acceptance.

Compute patage=XDATE.YEAR( doaccn*24*60*60) - patyob.
FREQUENCIES VARIABLES = patage.
select if (range(patyob,1906,1972)).
FREQUENCIES VARIABLES = patage.

SORT CASES by  randpatID  randclaimID.
```

********** Restrict to patients of interest.

```
Select if
(Range(TRTCODE,1401,1401,1403,1404,1411,1411,1422,1424,1431,1431,1501,150
1,1521,1521,1531,1531,1701,1706,1711,1712,1716,1716,1721,1723,1726,1727,173
1,1734,1741,1743,1751,1751,1801,1808,1811,1814,1818,1818,1831,1832,1841,184
1,1851,1852,1897,1897,2101,2101,2205,2205,5101,5103,5201,5201,5215,5215,581
1,5811,5813,5814,5822,5824,5831,5831,5841,5841)).

Execute.
Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
Get file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
```

********** Define treatments which start or end intervals.

```
Compute Root=0.
Compute Occlusal=0.
Compute oneproximalridge=0.
Compute MOD=0.
Compute tunnel=0.
Compute pinorscrew=0.
Compute post=0.
Compute incisaledge=0.
Compute oneangle=0.
Compute twoangles=0.
Compute Inlay=0.
Compute Crown=0.
Compute Abutment=0.
Compute Extract=0.
Compute Apicect=0.

If (Any(TRTCODE,1501,5841)) Root=1.
If (Any(TRTCODE,1401,5811)) Occlusal=1.
If (Any(TRTCODE,1403,5813)) oneproximalridge=1.
If (Any(TRTCODE,1404,5814)) MOD=1.
If (Any(TRTCODE,1411))Tunnel=1.
If (Any(TRTCODE,1431,5831,1734,1814)) pinorscrew=1.
If (Any(TRTCODE,1727,1731,1732,1733,1743,1811,1812,1813,1818,5103)) post=1.
If (Any(TRTCODE,1422,5822)) oneangle=1.
If (Any(TRTCODE,1423,5823)) incisaledge=1.
If (Any(TRTCODE,1424,5824)) twoangles=1.
If (Any(TRTCODE,1701,1702,1703,1704)) Inlay=1.
If
(Any(TRTCODE,1705,1706,1711,1712,1716,1721,1722,1723,1726,1741,1742,1751,
5101,5102))Crown=1.
```

```
If
(Any(TRTCODE,1801,1802,1803,1804,1805,1806,1807,1808,1831,1832,1841,1851,
1852,1897)) Abutment=1.
If (Range(TRTCODE,2101,2205,5201,5215)) Extract=1.
If (Range(TRTCODE,1521,1531)) Apicect = 1.

compute Start=0.
Compute End = 0.
If (Root=1) Start=1.
If (Any(1,Root,Apicect,Extract)) End = 1.

*************** Reduce to one record per tooth per course of treatment.


sort cases by randpatID quadrant tooth doaccn.

aggregate outfile=*
 /presorted
 /break  randpatID quadrant tooth doaccn
 /ntoothtreats=n
 /  randclaimID  doexamn docompn  Patgender patyob freqgrp Chargestatus
ScaleFees postarea DentistGender Dentistyob
 = first(randclaimID  doexamn docompn Patgender patyob freqgrp Chargestatus
ScaleFees postarea DentistGender Dentistyob)
 /mintrt=min(trtcode)
 /maxtrt Root Occlusal oneproximalridge MOD tunnel pinorscrew post incisaledge
 oneangle twoangles Inlay Crown Abutment Extract Apicect Start End =
max(TRTCODE Root Occlusal oneproximalridge MOD tunnel pinorscrew post
incisaledge oneangle twoangles Inlay Crown Abutment Extract Apicect Start End ).

Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
Get file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

*************** Restrict to start courses and next courses of interest - those which
conclude the interval.

Select if (Start=1 or End=1).

* Calculate time lag for starter courses, both to next root treatment, if any, and to
extraction.

sort cases by  randpatID quadrant tooth (a) doaccn (d) start (a).

Do if (randpatid=lag(randpatid) and quadrant=lag(quadrant) and tooth=lag(tooth)
      and (start=1 or apicect=1)).
Compute time=lag(doaccn)-max(doaccn, doexamn, docompn).
Compute nextmintreat=lag(mintrt).
Compute nextmaxtreat=lag(maxtrt).
```

```
Compute nextextract=lag(extract).
Compute nextroot=lag(root).
Compute nextapicect=lag(apicect).
Compute nexclaim=lag(randclaimid).

End if.

Execute.

* time to extraction.

If (nextextract=1) timetoext = time.
If (randpatid=lag(randpatid) and quadrant=lag(quadrant) and tooth=lag(tooth) and
nextextract=0) timetoext = lag(timetoext)+time.

Execute.

* Restrict to starts.

Select if (Start=1).

Save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All
Teeth Intervals.sav'.
```

8.1.2.2 Root Canal Treated all teeth preparation

```
* Encoding: windows-1252.
* RF All Teeth Preparation 16.sps
* Written by PKSL on 06/06/2021. Revised by ML and Modified by ML 13/04/2024.

* This program prepares adult restoration intervals for KM survival analysis.
* by adding wights and assitional cases to allow for time-dependent censoring.

Get file = 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS sav\RF All Teeth
Intervals.sav'.

* Check whether time is in acceptable range, and set reint flag.

compute doplacn = max( doaccn, doexamn, docompn).

compute reint=0.
if not (missing(time)) reint=1.
if (time le 0) reint=0.

sort cases by randclaimID.


* Create weights to adjust for time dependent censoring.
```

```
* Double up the cases with no re-intervention and weight by probability of re-intervention.

* First calculate patient age at start of year of acceptance in years.

compute patage=XDATE.YEAR( doaccn*24*60*60) - patyob.

* Remove children and very old patients (most of whom are miscodings of children).

SELECT IF (Range (patage, 18, 99)).

recode patage
(18 thru 19 = 1)
(20 thru 29 = 2)
(30 thru 39 = 3)
(40 thru 49 = 4)
(50 thru 59 = 5)
(60 thru 69 = 6)
(70 thru 79 = 7)
(80 thru hi = 8)
into patagegr.

Value labels patagegr
1 '18 or 19'
2 '20 to 29'
3 '30 to 39'
4 '40 to 49'
5 '50 to 59'
6 '60 to 69'
7 '70 to 79'
8 '80 or older'.

compute caseid=$casenum.
execute.

* Look up probability of reattendance after last visit.
* Interval is the number of days from treating the tooth until the end of the data on 31st March
2006.
* N.B. on rare occasions, docplcn is after 2006/3/31.

compute interval = max((yrmoda(2006,03,31)-doplacn),0).
sort cases by patagegr interval.
match files file=*
/table='C:\Users\maria\OneDrive\Documents\PhD Results\SPSS sav\reattendance
probability.sav'
/by patagegr interval.
compute recid=1.
sort cases by caseid.
save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (reint=0).
compute recid=2.
save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
```

```
add files file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'
/file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'
/by caseid .

Compute weight = 1000.
Do if (reint=0).
if (recid=1) weight=1000-trunc(1000*prreatt+0.5).
if (recid=2) weight = trunc(1000*prreatt+0.5).
end if.

save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.

* Look up date of last visit by patient.

Sort cases by randpatID.
Match files file=*
/table='C:\Users\maria\OneDrive\Documents\PhD Results\SPSS sav\Patient Lookup.sav'
/by randpatID.

execute.

* Assume censored cases are lost at one year (365 days) after last visit.

* recalculate time if reint=0.
* Impute effective time of censoring.
Do if (reint=0).
If (recid=1) time=max((min(lastvn+365,yrmoda(2006,03,31))-doplacn),0).

if (recid=2) time=max((yrmoda(2006,03,31)-doplacn),0).
end if.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'


**************************************************************************************************
* Document variables.

get file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'


Variable Labels
  randpatid 'Patient ID No'
  quadrant 'Mouth quadrant'
  tooth 'Tooth position'
  randclaimid 'Claim ID No'
  lastvn 'last date of visit by patient (days)'
  doplacn 'Date of placement (days)'
  interval 'Interval from last visit to 31 March 06 (days)'
  mintrt 'Min Treatment Code'
  maxtrt 'Max Treatment Code'
  start 'start of tooth treatment of interest?'
  time 'Time to reRCT apicect or extract'
  nexclaim 'Claim ID for next treatment on tooth'
```

```
  dentistgender 'Gender of Dentist'
  dentistyob 'Year of Birth of Dentist'
  postarea 'Postcode Area of Surgery'
  chargestatus 'Charge-paying Status of patient'
  patage 'Patient age'
  patagegr 'Patient Age Group'
  reint 'reintervention flag'
  caseid 'Case ID (for time-dependent censor adjustment)'
  prreatt 'Estimated probability of re-attendance'
  recid 'record ID (for time-dependent censor adjustment)'
  weight 'weighting (for time-dependent censor adjustment)'.

value labels Root Occlusal oneproximalridge tunnel MOD pinorscrew post incisaledge
oneangle twoangles Inlay Crown Abutment Extract Apicect Start End 1 'Yes' 0 'No'.



Save outfile = 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.
```

8.2 Dentist’s General Factors

8.2.1 Gender of the Dentist

```
* Encoding: windows-1252.
* RF All Teeth x dentist gender 02.sps.

* Written by ML on 24/04/2020. Modified 27/05/2023.

* This uses random censoring to calculate survival statistics using the CoxR procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel plotting.
* Used for assessment of individual teeth types and crown placement.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).


* What happens if the dentist is female?.

COXREG time
  /STATUS=reint(1)
  /strata = DentistGender
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survdentfem).
```

8.2.2 Dentist Year of Birth

```
* Encoding: windows-1252.
* RF All Teeth x dentist's year of birth 02.sps.

* Written by ML on 24/04/2020. Modified on 27/05/2023.

* This uses random censoring to calculate survival statistics using the CoxR procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel plotting.
* Used for assessment of individual teeth types and crown placement.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).


* What happens in relation to dentist year of birth /age?.

COXREG time
  /STATUS=reint(1)
  /strata = Dentistyob
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survdentyob).
```

8.2.3 Postcode of the Dental Practice

```
* Encoding: windows-1252.
* RF All Teeth x postcode area of the surgery 02.sps.

* Written by ML on 25/04/2020. Modified on 27/05/2023.

* This uses random censoring to calculate survival statistics using the CoxR procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel plotting.
* Used for assessment of individual teeth types and crown placement.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.


compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).


* What happens if the patient has a dentist in a particular area?.

COXREG time
  /STATUS=reint(1)
  /strata = postarea
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survpostarea).
```

8.3 Patient's General Factors

8.3.1 Gender of the Patient

```
* Encoding: windows-1252.
* RF All Teeth x patient gender 04.sps.

* Written by ML on 25/04/2020. Modified 27/05/2023.

* This uses random censoring to calculate survival statistics using the CoxR procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel plotting.
* Used for assessment of individual teeth types and crown placement.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).


* What happens if the patient is female or male?.

COXREG time
  /STATUS=reint(1)
  /strata = Patgender
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survpatgender).
```

8.3.2 Age of the Patient

```
* Encoding: windows-1252.
* RF All Teeth x patient age 02.sps.

* Written by ML on 25/04/2020. Modified 27/05/2023.

* This uses random censoring to calculate survival statistics using the CoxR procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel plotting.
* Used for assessment of individual teeth types and crown placement.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).


* What happens if the patient young or old?.

COXREG time
  /STATUS=reint(1)
  /strata = patage
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survpatage).
```

8.3.3 Age of Patients Grouped by Decade

```
* Encoding: windows-1252.
* RF All Teeth x patient age groups 04.sps.

* Written by ML on 25/04/2020. Modified on 27/05/2023.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and crown placement.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.
* Encoding: windows-1252.
* RF All Teeth x patient gender 04.sps.

* Written by ML on 25/04/2020. Modified 27/05/2023.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and crown placement.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.
```

```
compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).

* What happens if the patient is older than younger?.

COXREG time
  /STATUS=reint(1)
  /strata = patagegr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survpatagegroup).
```

8.3.4 Charge Status of the Patient

```
* Encoding: windows-1252.
* RF All Teeth x charge status 02.sps.

* Written by ML on 24/04/2020 modified 23/05/2023.

* This uses random censoring to calculate survival statistics using the CoxR procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel plotting.
* Used for assessment of individual teeth types and crown placement.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).


* What happens if the patient is exempt from paying?.

COXREG time
  /STATUS=reint(1)
  /strata = Chargestatus
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survchargestatus).
```

8.4 Patient Tooth Factors

8.4.1 Restoration Placed After the RCT on All T=eeth

```
* Encoding: windows-1252.
* RF All Teeth survival 01.sps.

* Written by ML on 27/07/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).

**************************************************.


**************************************************.

*What happens to upper or lower teeth ?


* Create descriptive variables.
```

```
String upplow (a1).

If (Any(quadrant,'UR','UL')) upplow= '1'.
If (Any(quadrant,'LR','LL')) upplow= '2'.

Execute.

value labels
/upplow
'1' 'Upper teeth'
'2' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.


COXREG time
  /STATUS=reint(1)
  /strata = upplow
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survUL).

**************************************************.

*What happens to anterior vs posterior teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

* Create descriptive variables.

String antpost (a1).

If (Any(tooth,'1','2','3')) antpost= '1'.
If (Any(tooth,'4','5','6','7','8')) antpost= '2'.

Execute.


value labels
/antpost
'1' 'Anterior teeth'
'2' 'Posterior teeth'.


save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
```

```
COXREG time
  /STATUS=reint(1)
  /strata = antpost
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootAP).

**************************************************.

*What happens to quadrant?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.


COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootQ).

**************************************************.

*What happens to tooth position of teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.


COXREG time
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootTP).

**************************************************.
```

8.4.1.1 Crown

```
* Encoding: windows-1252.
* RF All Teeth survival with a Crown 11.sps.

* Written by ML on 09/08/2020. Modified 04/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).

**************************************************.

* What happens if there is a Crown?.

COXREG time
  /STATUS=reint(1)
  /strata = Crown
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survcrown).
```

```
*****************************************************.

*What happens to upper or lower teeth that are crowned ?


* Create descriptive variables.

String upplow (a1).

If (Any(quadrant,'UR','UL')) upplow= '1'.
If (Any(quadrant,'LR','LL')) upplow= '2'.

Execute.

value labels
/upplow
'1' 'Upper teeth'
'2' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.


select if (crown = 1).

COXREG time
  /STATUS=reint(1)
  /strata = upplow
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survCUL).

*****************************************************.

*What happens to anterior vs posterior of crowned teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

* Create descriptive variables.

String antpost (a1).

If (Any(tooth,'1','2','3')) antpost= '1'.
If (Any(tooth,'4','5','6','7','8')) antpost= '2'.

Execute.
```

```
value labels
/antpost
'1' 'Anterior teeth'
'2' 'Posterior teeth'.


save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

select if (crown = 1).
COXREG time
  /STATUS=reint(1)
  /strata = antpost
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootCAP).

**************************************************.

*What happens to quadrant to crowned teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (crown = 1).
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootCQ).

**************************************************.

*What happens to tooth position to crowned teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.
```

```
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.

select if (crown = 1).
COXREG time
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootCTP).

**************************************************.
```

8.4.1.2 Bridge

```
* Encoding: windows-1252.
* RF All Teeth survival with being a bridge abutment 06.sps.

* Written by ML on 22/05/2022. Modified 13/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).

*******************************************************.

* What happens if there is a bridge abutment?.

COXREG time
  /STATUS=reint(1)
  /strata = Abutment
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survabut).

*******************************************************.

*What happens to upper or lower teeth that are bridge abuted ?
```

```
* Create descriptive variables.

String upplow (a1).

If (Any(quadrant,'UR','UL')) upplow= '1'.
If (Any(quadrant,'LR','LL')) upplow= '2'.

Execute.

value labels
/upplow
'1' 'Upper teeth'
'2' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.


select if (Abutment = 1).

COXREG time
  /STATUS=reint(1)
  /strata = upplow
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survAUL).

*****************************************************.

*What happens to anterior vs posterior of abutment teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

* Create descriptive variables.

String antpost (a1).

If (Any(tooth,'1','2','3')) antpost= '1'.
If (Any(tooth,'4','5','6','7','8')) antpost= '2'.

Execute.


value labels
/antpost
'1' 'Anterior teeth'
```

```
'2' 'Posterior teeth'.


save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

select if (Abutment = 1).
COXREG time
  /STATUS=reint(1)
  /strata = antpost
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootAAP).

**************************************************.

*What happens to quadrant to abutment teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (Abutment = 1).
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootAQ).

**************************************************.

*What happens to tooth position to abutment teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.

select if (Abutment = 1).
COXREG time
```

```
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootATP).

*************************************************************************************.
```

8.4.1.3 Post

```
* Encoding: windows-1252.
* RF All Teeth survival with a post 01.sps.

* Written by ML on 13/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).

**************************************************.

* What happens if there is a post placed?.

COXREG time
  /STATUS=reint(1)
  /strata = post
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survpost).

**************************************************.

*What happens to upper or lower teeth that have a post ?
```

```
* Create descriptive variables.

String upplow (a1).

If (Any(quadrant,'UR','UL')) upplow= '1'.
If (Any(quadrant,'LR','LL')) upplow= '2'.

Execute.

value labels
/upplow
'1' 'Upper teeth'
'2' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.


select if (post = 1).

COXREG time
  /STATUS=reint(1)
  /strata = upplow
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survPOUL).

**************************************************.

*What happens to anterior vs posterior of a post in teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

* Create descriptive variables.

String antpost (a1).

If (Any(tooth,'1','2','3')) antpost= '1'.
If (Any(tooth,'4','5','6','7','8')) antpost= '2'.

Execute.

value labels
/antpost
'1' 'Anterior teeth'
'2' 'Posterior teeth'.
```

```
save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

select if (post = 1).
COXREG time
  /STATUS=reint(1)
  /strata = antpost
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootPOAP).

**************************************************.

*What happens to quadrant to post in teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (post = 1).
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootPOQ).

**************************************************.

*What happens to tooth position to post in teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.

select if (Post = 1).
COXREG time
  /STATUS=reint(1)
```

```
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootPOTP).

*****************************************************************************************.
```

8.4.1.4 Pin or Screw

```
* Encoding: windows-1252.
* RF All Teeth survival with pin and screws 08.sps.

* Written by ML on 09/08/2020. Modified 13/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).

*****************************************************.

* What happens if there is a pin or screw placed?.

COXREG time
  /STATUS=reint(1)
  /strata = pinorscrew
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survpin).

*****************************************************.
```

*What happens to upper or lower teeth that have a pin or screw ?

* Create descriptive variables.

String upplow (a1).

If (Any(quadrant,'UR','UL')) upplow= '1'.
If (Any(quadrant,'LR','LL')) upplow= '2'.

Execute.

value labels
/upplow
'1' 'Upper teeth'
'2' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (pinorscrew = 1).

COXREG time
  /STATUS=reint(1)
  /strata = upplow
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survPUL).

**********.

*What happens to anterior vs posterior of pin or screw in teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

* Create descriptive variables.

String antpost (a1).

If (Any(tooth,'1','2','3')) antpost= '1'.
If (Any(tooth,'4','5','6','7','8')) antpost= '2'.

Execute.

value labels
/antpost
'1' 'Anterior teeth'

```
'2' 'Posterior teeth'.


save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

select if (pinorscrew = 1).
COXREG time
  /STATUS=reint(1)
  /strata = antpost
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootPAP).

*****************************************************.

*What happens to quadrant to pin or screw in teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (pinorscrew = 1).
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootPQ).

*****************************************************.

*What happens to tooth position to pin or screw in teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.

select if (Pinorscrew = 1).
COXREG time
```

```
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootPTP).

*****************************************************************************************.
```

8.4.2 Restoration Placed After the RCT on Anterior Teeth

8.4.2.1 Incisal Edge

```
* Encoding: windows-1252.
* RF Incisor Teeth survival with incisal edge restoration 03.sps.

* Written by ML on 09/08/2020.  Modified 12/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).

**************************************************.

* Restrict to anterior teeth.
* What happens if there is an incisal edge  filling?.

select if (Range (Tooth,'1', '3')).
COXREG time
  /STATUS=reint(1)
  /strata = Incisaledge
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
```

```
  /Save survival (surviedg).

**************************************************.

*What happens to upper or lower teeth that are filled ?


* Create descriptive variables.

String upplow (a1).

If (any(quadrant,'UR','UL')) upplow= '0'.
If (any(quadrant,'LR','LL')) upplow= '1'.

Execute.

value labels
/upplow
'0' 'Upper teeth'
'1' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.




select if (Incisaledge= 1).
COXREG time
  /STATUS=reint(1)
  /strata = upplow
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (suriedgUL).

**************************************************.

*What happens to quadrant to filled teeth?

get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (Incisaledge = 1).
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (suriedgQ).
```

```
**************************************************.

*What happens to tooth position to filled teeth?

* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

select if (Incisaledge = 1).
COXREG time
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (suriedgTP).

**************************************************.
```

8.4.2.2 One Incisal Angle

```
* Encoding: windows-1252.
* RF Incisor Teeth survival with one incisalangle restoration 04.sps.

* Written by ML on 09/08/2020. Modified 12/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).

**************************************************.

* Restrict to anterior teeth.
* What happens if there is one incisal angle  filling?.

select if (Range (Tooth,'1', '3')).
COXREG time
  /STATUS=reint(1)
  /strata = oneangle
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survangle).

**************************************************.
```

*What happens to upper or lower teeth that are filled ?

* Create descriptive variables.

String upplow (a1).

If (any(quadrant,'UR','UL')) upplow= '0'.
If (any(quadrant,'LR','LL')) upplow= '1'.

Execute.

value labels
/upplow
'0' 'Upper teeth'
'1' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (oneangle= 1).
COXREG time
  /STATUS=reint(1)
  /strata = upplow
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (surangleUL).

**********.

*What happens to quadrant to filled teeth?

get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (oneangle = 1).
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (surangleQ).

**********.

*What happens to tooth position to filled teeth?

```
* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

select if (oneangle = 1).
COXREG time
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (surangleTP).

**************************************************.
```

8.4.2.3 Two Incisal Angles

```
* Encoding: windows-1252.
* RF Incisor Teeth survival with two incisal angle restorations 04.sps.

* Written by ML on 09/08/2020.   Modified 12/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).

**************************************************.

* Restrict to anterior teeth.
* What happens if there is two incisal angle fillings?.

select if (Range (Tooth,'1', '3')).
COXREG time
  /STATUS=reint(1)
  /strata = twoangles
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
```

```
  /Save survival (survangles).

**************************************************.

*What happens to upper or lower teeth that are filled ?


* Create descriptive variables.

String upplow (a1).

If (any(quadrant,'UR','UL')) upplow= '0'.
If (any(quadrant,'LR','LL')) upplow= '1'.

Execute.

value labels
/upplow
'0' 'Upper teeth'
'1' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.


select if (twoangles= 1).
COXREG time
  /STATUS=reint(1)
  /strata = upplow
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (suranglesUL).

**************************************************.

*What happens to quadrant to filled teeth?

get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (twoangles = 1).
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
```

```
  /Save survival (suranglesQ).

*****************************************************.

*What happens to tooth position to filled teeth?

* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

select if (twoangles = 1).
COXREG time
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (suranglesTP).

*****************************************************.
```

8.4.3 Restoration Placed After the RCT on Posterior Teeth

8.4.3.1 Occlusal

```
* Encoding: windows-1252.
* RF Posterior Teeth survival with Occlusal 05.sps.

* Written by ML on 09/08/2020.  Modified 12/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).

**************************************************.

* Restrict to posterior teeth.
* What happens if there is an Occlusal filling?.

select if (Range (Tooth,'4', '8')).
COXREG time
  /STATUS=reint(1)
  /strata = Occlusal
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
```

```
  /Save survival (survo).

**************************************************.

*What happens to upper or lower teeth that are filled ?


* Create descriptive variables.

String upplow (a1).

If (any(quadrant,'UR','UL')) upplow= '0'.
If (any(quadrant,'LR','LL')) upplow= '1'.

Execute.

value labels
/upplow
'0' 'Upper teeth'
'1' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.


select if (Occlusal = 1).

COXREG time
  /STATUS=reint(1)
  /strata = upplow
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (surOUL).

**************************************************.

*What happens to quadrant to filled teeth?

get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (Occlusal = 1).
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootOQ).
```

```
**************************************************.

*What happens to tooth position to filled teeth?

* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

select if (Occlusal = 1).
COXREG time
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootOTP).

**************************************************.
```

8.4.3.2 MO or DO

```
* Encoding: windows-1252.
* RF Posterior Teeth survival with one proximal ridge loss ( marginal ridge i.e. MO or DO) =oneproximalridge 07.sps.

* Written by ML on 07/08/2020.  Modified 12/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).

**************************************************.

* Restrict to posterior teeth.
* What happens if there is an MO or DO  filling?.

select if (Range (Tooth,'4', '8')).
COXREG time
  /STATUS=reint(1)
  /strata = oneproximalridge
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survmodo).
```

**********.

*What happens to upper or lower teeth that are filled ?

* Create descriptive variables.

String upplow (a1).

If (any(quadrant,'UR','UL')) upplow= '0'.
If (any(quadrant,'LR','LL')) upplow= '1'.

Execute.

value labels
/upplow
'0' 'Upper teeth'
'1' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (oneproximalridge = 1).
COXREG time
  /STATUS=reint(1)
  /strata = upplow
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (surmodoUL).

**********.

*What happens to quadrant to filled teeth?

get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (oneproximalridge = 1).
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survmodoQ).

**********.

*What happens to tooth position to filled teeth?

```
* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

select if (oneproximalridge = 1).
COXREG time
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survmodoTP).

**************************************************.
```

8.4.3.3 MOD

```
* Encoding: windows-1252.
* RF Posterior Teeth survival with a MOD 07.sps.

* Written by ML on 18/6/2021.  Modified 12/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).

*****************************************************.

* Restrict to posterior teeth.
* What happens if there is an MOD  filling?.

select if (Range (Tooth,'4', '8')).
COXREG time
  /STATUS=reint(1)
  /strata = MOD
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survMOD).

*****************************************************.
```

*What happens to upper or lower teeth that are filled ?

* Create descriptive variables.

String upplow (a1).

If (any(quadrant,'UR','UL')) upplow= '0'.
If (any(quadrant,'LR','LL')) upplow= '1'.

Execute.

value labels
/upplow
'0' 'Upper teeth'
'1' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (MOD = 1).
COXREG time
  /STATUS=reint(1)
  /strata = upplow
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (surmodUL).

**********.

*What happens to quadrant to filled teeth?

get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (MOD = 1).
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survmodQ).

**********.

*What happens to tooth position to filled teeth?

```
* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

select if (MOD = 1).
COXREG time
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survmodTP).

**************************************************.
```

8.4.3.4 Inlay

```
* Encoding: windows-1252.
* RF Posterior Teeth survival with an Inlay 04.sps.

* Written by ML on 09/08/2020.  Modified 12/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).

*****************************************************.

* Restrict to posterior teeth.
* What happens if there is an inlay?.

select if (Range (Tooth,'4', '8')).
COXREG time
  /STATUS=reint(1)
  /strata = Inlay
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survInlay).

*****************************************************.
```

*What happens to upper or lower teeth that are filled ?

* Create descriptive variables.

String upplow (a1).

If (any(quadrant,'UR','UL')) upplow= '0'.
If (any(quadrant,'LR','LL')) upplow= '1'.

Execute.

value labels
/upplow
'0' 'Upper teeth'
'1' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (Inlay = 1).
COXREG time
  /STATUS=reint(1)
  /strata = upplow
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (surInlayUL).

**********.

*What happens to quadrant to filled teeth?

get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (Inlay = 1).
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survInlayQ).

**********.

*What happens to tooth position to filled teeth?

```
* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

select if (Inlay = 1).
COXREG time
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survInlayTP).

**************************************************.
```

8.4.3.5 Tunnel

```
* Encoding: windows-1252.
* RF Posterior Teeth survival with tunnel restoration 03.sps.

* Written by ML on 22/5/2022.  Modified 12/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).

*****************************************************.

* Restrict to posterior teeth.
* What happens if there is an Tunnel  filling?.

select if (Range (Tooth,'4', '8')).
COXREG time
  /STATUS=reint(1)
  /strata = tunnel
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
```

```
  /Save survival (survtun).

**************************************************.

*What happens to upper or lower teeth that are filled ?


* Create descriptive variables.

String upplow (a1).

If (any(quadrant,'UR','UL')) upplow= '0'.
If (any(quadrant,'LR','LL')) upplow= '1'.

Execute.

value labels
/upplow
'0' 'Upper teeth'
'1' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.


select if (tunnel = 1).
COXREG time
  /STATUS=reint(1)
  /strata = upplow
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (surtunUL).

**************************************************.

*What happens to quadrant to filled teeth?

get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (tunnel = 1).
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
```

```
  /Save survival (survtunQ).

**************************************************.

*What happens to tooth position to filled teeth?

* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

select if (tunnel = 1).
COXREG time
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtunTP).

**************************************************.
```

8.4.4 Historic Restoration Placed Before RCT

8.4.4.1 Based on 3 years of Treatment History

History Program
* Encoding: windows-1252.

* RF 3 year History 02.sps

* Written by ML on 16/2/2024. Modified 03/04/2024.

* Create a file totalling previous treatments over 3 years for RF courses for adult patients with at least 3 years history.

* Aggregate a set of files for the first, second, etc root filling on each tooth, but only for cases 3 year history, and only up to 3 years.

* Look up first Course of Treatment for each patient.

```
Match files  file ='C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF all teeth all treats.sav'
  /table = 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF CoT history.sav'
  /by  randpatID.

Execute.

* For each CoT, flag whether it has 3 years history (interval since first CoT greater than 1096 days).

Compute history3=0.

If ( doaccn -  firstcourseaccn gt 1096) history3=1.

Sort cases by  randpatID  Quadrant Tooth (A)  doaccn (D) root (A).

* Remove duplicate treatment records.

Compute dup=0.

If ( randclaimID = lag(randclaimID) and  TRTCODE = lag(TRTCODE) and Quadrant = lag(Quadrant) and Tooth =lag(Tooth)) dup=1.

Execute.

select if dup=0.
```

```
Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

* Create 3 year running totals for all RF treatments with 3 years history.

* Note that first record does not have 3 years history.

* First identify each root filling and its previous treatments - note that the root filling is
the last treatment within the date of acceptance for each tooth (in this sorted order).

If  (randpatID = 3) RFontooth =0.
If (randpatID = lag(randPatID) and Quadrant = lag(Quadrant) and Tooth = lag(Tooth))
RFontooth=lag(RFontooth).
If (root=1) RFontooth=lag(RFontooth) + 1.
If (not(randpatID = lag(randPatID) and Quadrant = lag(Quadrant) and Tooth =
lag(Tooth)) and not( root=1)) RFontooth = 0.
If (not(randpatID = lag(randPatID) and Quadrant = lag(Quadrant) and Tooth =
lag(Tooth)) and root=1) RFontooth = 1.

Save outfile='C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp1A.sav'.

**********************************************************************************************
**************************************.

* Latest root filling on tooth (RFontooth =1).

* Create running totals for each root filling.
If (RFontooth=0) Run1=0.
If not(RFontooth ge 1 and lag(RFontooth) ge 1 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run1=0.
If (RFontooth ge 1 and lag(RFontooth) ge 1 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run1=lag(run1)+lag(doaccn)-
doaccn.

Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.


* Filter down to the treatments preceding each RF which are within 3 years.


Select if (RFontooth ge 1 and run1 le 1096).

* Aggregate treatment flags.

Aggregate outfile = *
    /Break randpatID  Quadrant Tooth
```

```
    / randclaimID doaccn history3 RFontooth = first(randclaimID doaccn history3
RFontooth)
    / Rootplus1 hOcclusal honeproximalridge hMOD htunnel hpinorscrew hpost
hincisaledge honeangle htwoangles hInlay hCrown
    habutment hApicect = sum ( Root Occlusal oneproximalridge MOD tunnel
pinorscrew post incisaledge oneangle twoangles Inlay Crown
    abutment Apicect).

* Remove the first root filling from the aggregate totals.

Compute hroot=rootplus1-1.

* restrict to CoTs with complete 3 year history.

Select if history3 = 1.

save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2a.sav'
    /DROP Rootplus1.

**********************************************************************************************
**************************************.

* Previous root filling on tooth (RFontooth=2).

Get File='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1A.sav'.

* Create running totals for each root filling.
If (RFontooth=0) Run2=0.
If not(RFontooth ge 2 and lag(RFontooth) ge 2 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run2=0.
If (RFontooth ge 2 and lag(RFontooth) ge 2 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run2=lag(run2)+lag(doaccn)-
doaccn.

Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.


* Filter down to the treatments preceding each RF which are within 3 years.

Select if (RFontooth ge 2 and run2 le 1096).

* Aggregate treatment flags.

Aggregate outfile = *
    /Break randpatID  Quadrant Tooth
    / randclaimID doaccn history3 RFontooth = first(randclaimID doaccn history3
RFontooth)
```

```
    / Rootplus1 hOcclusal honeproximalridge hMOD htunnel hpinorscrew hpost
hincisaledge honeangle htwoangles hInlay hCrown
    habutment hApicect = sum ( Root Occlusal oneproximalridge MOD tunnel
pinorscrew post incisaledge oneangle twoangles Inlay Crown
    abutment Apicect).

* Remove the first root filling from the aggregate totals.

Compute hroot=rootplus1-1.

* restrict to CoTs with complete 3 year history.

Select if history3 = 1.

save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3a.sav'
    /DROP Rootplus1.

**********************************************************************************************
**************************************.

* Previous root filling on tooth (RFontooth=3).

Get File='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1A.sav'.

* Create running totals for each root filling.
If (RFontooth=0) Run3=0.
If not(RFontooth ge 3 and lag(RFontooth) ge 3 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run3=0.
If (RFontooth ge 3 and lag(RFontooth) ge 3 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run3=lag(run3)+lag(doaccn)-
doaccn.

Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.


* Filter down to the treatments preceding each RF which are within 3 years.

Select if (RFontooth ge 3 and run3 le 1096).

* Aggregate treatment flags.

Aggregate outfile = *
    /Break randpatID  Quadrant Tooth
    / randclaimID doaccn history3 RFontooth = first(randclaimID doaccn history3
RFontooth)
    / Rootplus1 hOcclusal honeproximalridge hMOD htunnel hpinorscrew hpost
hincisaledge honeangle htwoangles hInlay hCrown
```

```
    habutment hApicect = sum ( Root Occlusal oneproximalridge MOD tunnel
pinorscrew post incisaledge oneangle twoangles Inlay Crown
    abutment Apicect).

* Remove the first root filling from the aggregate totals.

Compute hroot=rootplus1-1.

* restrict to CoTs with complete 3 year history.

Select if history3 = 1.

save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4a.sav'
    /DROP Rootplus1.

*****************************************************************************************************
*************************************.

* Previous root filling on tooth (RFontooth=4).

Get File='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1A.sav'.

* Create running totals for each root filling.
If (RFontooth=0) Run4=0.
If not(RFontooth ge 4 and lag(RFontooth) ge 4 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run4=0.
If (RFontooth ge 4 and lag(RFontooth) ge 4 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run4=lag(run4)+lag(doaccn)-
doaccn.

Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav'.


* Filter down to the treatments preceding each RF which are within 3 years.

Select if (RFontooth ge 4 and run4 le 1096).

* Aggregate treatment flags.

Aggregate outfile = *
    /Break randpatID  Quadrant Tooth
    / randclaimID doaccn history3 RFontooth = first(randclaimID doaccn history3
RFontooth)
    / Rootplus1 hOcclusal honeproximalridge hMOD htunnel hpinorscrew hpost
hincisaledge honeangle htwoangles hInlay hCrown
    habutment hApicect = sum ( Root Occlusal oneproximalridge MOD tunnel
pinorscrew post incisaledge oneangle twoangles Inlay Crown
    abutment Apicect).
```

```
* Remove the first root filling from the aggregate totals.

Compute hroot=rootplus1-1.

* restrict to CoTs with complete 3 year history.

Select if history3 = 1.

save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5a.sav'
   /DROP Rootplus1.

**********************************************************************************************
**************************************.

* Previous root filling on tooth (RFontooth=5).

Get File='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1A.sav'.

* Create running totals for each root filling.
If (RFontooth=0) Run5=0.
If not(RFontooth ge 5 and lag(RFontooth) ge 5 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run5=0.
If (RFontooth ge 5 and lag(RFontooth) ge 5 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run5=lag(run5)+lag(doaccn)-
doaccn.

Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav'.


* Filter down to the treatments preceding each RF which are within 3 years.

Select if (RFontooth ge 5 and run5 le 1096).

* Aggregate treatment flags.

Aggregate outfile = *
   /Break randpatID  Quadrant Tooth
   / randclaimID doaccn history3 RFontooth = first(randclaimID doaccn history3
RFontooth)
   / Rootplus1 hOcclusal honeproximalridge hMOD htunnel hpinorscrew hpost
hincisaledge honeangle htwoangles hInlay hCrown
   habutment hApicect = sum ( Root Occlusal oneproximalridge MOD tunnel
pinorscrew post incisaledge oneangle twoangles Inlay Crown
   abutment Apicect).

* Remove the first root filling from the aggregate totals.
```

```
Compute hroot=rootplus1-1.

* restrict to CoTs with complete 3 year history.

Select if history3 = 1.

save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6a.sav'
   /DROP Rootplus1.

*****************************************************************************************************
*************************************.

* There are no cases with RF on tooth 3 year history, so collect all the aggregate files
together.

Add files file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2a.sav'
   /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3a.sav'
   /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4a.sav'
   /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5a.sav'
   /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6a.sav'
   /by randpatID Quadrant Tooth.

sort cases by  randpatID Quadrant Tooth randclaimID.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF 3
year history.sav'.
```

Preparation Program
* Encoding: windows-1252.
* RF All History Teeth Preparation 02 3y.sps
* Written by ML on 21/03/2023. Modified 17/02/2024.

* This program prepares adult restoration intervals for KM survival analysis.
* by adding weights and additional cases to allow for time-dependent censoring.
* This file is restricted to root filled teeth with a three year treatment history.

Get file = 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Intervals.sav'.

* Check whether time is in acceptable range, and set reint flag.

compute doplacn = max(doaccn, doexamn, docompn).

compute reint=0.
if not (missing(time)) reint=1.
if (time le 0) reint=0.

sort cases by randpatID Quadrant Tooth randclaimID.

Match Files File=*
    /Table = 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF 3 year history.sav'
    /By randpatID Quadrant Tooth randclaimID.

Execute.

* Restrict to patients with at least three years treatment history.

Select if history3 =1.

Execute.

* Create weights to adjust for time dependent censoring.

* Double up the cases with no re-intervention and weight by probability of re-intervention.

* First calculate patient age at start of year of acceptance in years.

compute patage=XDATE.YEAR(doaccn*24*60*60) - patyob.

* Remove children and very old patients (most of whom are miscodings of children).

SELECT IF (Range (patage, 18, 99)).

```
recode patage
(18 thru 19 = 1)
(20 thru 29 = 2)
(30 thru 39 = 3)
(40 thru 49 = 4)
(50 thru 59 = 5)
(60 thru 69 = 6)
(70 thru 79 = 7)
(80 thru hi = 8)
into patagegr.

Value labels patagegr
1 '18 or 19'
2 '20 to 29'
3 '30 to 39'
4 '40 to 49'
5 '50 to 59'
6 '60 to 69'
7 '70 to 79'
8 '80 or older'.

compute caseid=$casenum.
execute.

* Look up probability of reattendance after last visit.
* Interval is the number of days from treating the tooth until the end of the data on
31st March 2006.
* N.B. on rare occasions, docplcn is after 2006/3/31.

compute interval = max((yrmoda(2006,03,31)-doplacn),0).
sort cases by patagegr interval.
match files file=*
 /table='C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\reattendance
probability.sav'
 /by patagegr interval.
compute recid=1.
sort cases by caseid.
save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (reint=0).
compute recid=2.
save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

add files file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'
 /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'
 /by caseid .

Compute weight = 1000.
```

```
Do if (reint=0).
if (recid=1) weight=1000-trunc(1000*prreatt+0.5).
if (recid=2) weight = trunc(1000*prreatt+0.5).
end if.

save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.

* Look up date of last visit by patient.

Sort cases by randpatID.
Match files file=*
 /table='C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\Patient
Lookup.sav'
 /by randpatID.

execute.

* Assume censored cases are lost at one year (365 days) after last visit.

* recalculate time if reint=0.
* Impute effective time of censoring.
Do if (reint=0).
If (recid=1) time=max((min(lastvn+365,yrmoda(2006,03,31))-doplacn),0).

if (recid=2) time=max((yrmoda(2006,03,31)-doplacn),0).
end if.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.


**************************************************************************************************
*
* Document variables.

get file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.

Variable Labels
  randpatid 'Patient ID No'
  quadrant 'Mouth quadrant'
  tooth 'Tooth position'
  randclaimid 'Claim ID No'
  lastvn 'last date of visit by patient (days)'
  doplacn 'Date of placement (days)'
  interval 'Interval from last visit to 31 March 06 (days)'
  mintrt 'Min Treatment Code'
  maxtrt 'Max Treatment Code'
  start 'start of tooth treatment of interest?'
  time 'Time to reRCT apicect or extract'
```

```
  nexclaim 'Claim ID for next treatment on tooth'
  dentistgender 'Gender of Dentist'
  dentistyob 'Year of Birth of Dentist'
  postarea 'Postcode Area of Surgery'
  chargestatus 'Charge-paying Status of patient'
  patage 'Patient age'
  patagegr 'Patient Age Group'
  reint 'reintervention flag'
  caseid 'Case ID (for time-dependent censor adjustment)'
  prreatt 'Estimated probability of re-attendance'
  recid 'record ID (for time-dependent censor adjustment)'
  weight 'weighting (for time-dependent censor adjustment)'.

value labels Root Occlusal oneproximalridge tunnel MOD pinorscrew post
incisaledge oneangle twoangles Inlay Crown abutment Extract Apicect Start End
      1 'Yes' 0 'No'.



Save outfile = 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All
History Teeth Preparation 3y.sav'.
```

```
Chart Program
* Encoding: windows-1252.
* RF All History Teeth charts 02 3y.sps.

* Written by ML on 17/2/2024. Modified on 14/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All
History Teeth Preparation 3y.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160429.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).



**************************************************************************************************
*

* What happens if there is a root filling history?.

* Create descriptive variables.

RECODE hroot
(0 =1)
(1 thru 9=2)
into hrootgr.

value labels
/hrootgr
1 'No previous Root Filling'
```

```
2 'Previous Root Filling'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.


COXREG time
  /STATUS=reint(1)
  /strata = hrootgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.


* What happens if there is a history of apicectomy?.

* Create descriptive variables.

RECODE hApicect
(0 =1)
(1 thru 9=2)
into hApicectgr.

value labels
/hApicectgr
1 'No previous Apicectomy'
2 'Previous Apicectomy'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.


COXREG time
  /STATUS=reint(1)
  /strata =         hApicectgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

**********************************************************************************************
********************

*Restoration in all teeth.
```

```
* What happens if there is a history of pin or screw?.

* Create descriptive variables.

RECODE hpinorscrew
(0 =1)
(1 thru 9=2)
into hpinorscrewgr.

value labels
/hpinorscrewgr
1 'No previous Pin or Screw'
2 'Previous Pin or Screw'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      hpinorscrewgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

* What happens if there is a history of post?.

* Create descriptive variables.

RECODE hpost
(0 =1)
(1 thru 9=2)
into hpostgr.

value labels
/hpostgr
1 'No previous Post'
2 'Previous Post'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.

COXREG time
  /STATUS=reint(1)
```

```
  /strata =      hpostgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT =  SURVIVAL.

* What happens if there is a crown history?.

* Create descriptive variables.

RECODE hCrown
(0 =1)
(1 thru 9=2)
into hcrowngr.

value labels
/hcrowngr
1 'No previous Crown'
2 'Previous Crown'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav'.

COXREG time
  /STATUS=reint(1)
  /strata = hcrowngr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.


* What happens if there is a history of bridge abutment?.

* Create descriptive variables.

RECODE hAbutment
(0 =1)
(1 thru 9=2)
into hAbutmentgr.

value labels
/hAbutmentgr
1 'No previous Bridge Abutment'
2 'Previous Bridge Abutment'.

compute caseid=$casenum.
execute.
```

```
save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =        habutmentgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

*****************************************************************************************************
********************

*Restoration in anterior teeth.

* What happens if there is a history of incisal edge?.

* Create descriptive variables.

RECODE hincisaledge
(0 =1)
(1 thru 9=2)
into hincisaledgegr.

value labels
/hincisaledgegr
1 'No previous Incisal edge'
2 'Previous Incisal edge'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp7.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp7.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      hincisaledgegr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

* What happens if there is a history of an incisal angle?.

* Create descriptive variables.

RECODE honeangle
(0 =1)
(1 thru 9=2)
into honeanglegr.
```

```
value labels
/honeanglegr
1 'No previous one Angle'
2 'Previous one Angle'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp8.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp8.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      honeanglegr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

* What happens if there is a history of two incisal angles?.

* Create descriptive variables.

RECODE htwoangles
(0 =1)
(1 thru 9=2)
into htwoanglesgr.

value labels
/htwoanglesgr
1 'No previous two angles'
2 'Previous two angles'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp9.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp9.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      htwoanglesgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

**************************************************************************************************
********************
*Restoration in posterior teeth.
```

```
* What happens if there is an occlusal history?.

* Create descriptive variables.

RECODE hOcclusal
(0 =1)
(1 thru 9=2)
into hOcclusalgr.

value labels
/ hOcclusalgr
1 'No previous Occlusal'
2 'Previous Occlusal'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp10.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp10.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =  hOcclusalgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

* What happens if there is a history of one proximal ridge (MO or DO)?.

* Create descriptive variables.

RECODE honeproximalridge
(0 =1)
(1 thru 9=2)
into honeproximalridgegr.

value labels
/honeproximalridgegr
1 'No previous MO/DO'
2 'Previous MO/DO'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp11.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp11.sav'.
```

```
COXREG time
  /STATUS=reint(1)
  /strata =   honeproximalridgegr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

* What happens if there is a history of MOD?.

* Create descriptive variables.

RECODE hMOD
(0 =1)
(1 thru 9=2)
into hMODgr.

value labels
/hMODgr
1 'No previous MOD'
2 'Previous MOD'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp12.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp12.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =    hMODgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

* What happens if there is a history of tunnel restoration?.

* Create descriptive variables.

RECODE  htunnel
(0 =1)
(1 thru 9=2)
into  htunnelgr.

value labels
/htunnelgr
1 'No previous Tunnel'
2 'Previous Tunnel'.

compute caseid=$casenum.
```

```
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp13.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp13.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =     htunnelgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.


* What happens if there is a history of inlay?.

* Create descriptive variables.

RECODE hInlay
(0 =1)
(1 thru 9=2)
into hInlaygr.

value labels
/hInlaygr
1 'No previous Inlay'
2 'Previous Inlay'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp14.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp14.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =       hInlaygr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.


**********************************************************************************************
**********
```

8.4.4.2 Based on 5 years of Treatment History

History Program
* Encoding: windows-1252.

* RF 5 year History 06.sps

* Written by ML on 23/3/2023. Modified 03/04/2024.

* Create a file totalling previous treatments over 5 years for RF courses for adult patients with at least 5 years history.

* Aggregate a set of files for the first, second, etc root filling on each tooth, but only for cases 5 year history, and only up to 5 years.

* Look up first Course of Treatment for each patient.

```
Match files  file ='C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF all teeth all treats.sav'
  /table = 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF CoT history.sav'
  /by  randpatID.

Execute.

* For each CoT, flag whether it has 5 years history (interval since first CoT greater than 1826 days).

Compute history5=0.

If ( doaccn -  firstcourseaccn gt 1826) history5=1.

Sort cases by  randpatID  Quadrant Tooth (A)  doaccn (D) root (A).

* Remove duplicate treatment records.

Compute dup=0.

If ( randclaimID = lag(randclaimID) and  TRTCODE = lag(TRTCODE) and Quadrant = lag(Quadrant) and Tooth =lag(Tooth)) dup=1.

Execute.

select if dup=0.


Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
```

```
* Create 5 year running totals for all RF treatments with 5 years history.

* Note that first record does not have 5 years history.

* First identify each root filling and its previous treatments - note that the root filling is
the last treatment within the date of acceptance for each tooth (in this sorted order).

If  (randpatID = 5) RFontooth =0.
If (randpatID = lag(randPatID) and Quadrant = lag(Quadrant) and Tooth = lag(Tooth))
RFontooth=lag(RFontooth).
If (root=1) RFontooth=lag(RFontooth) + 1.
If (not(randpatID = lag(randPatID) and Quadrant = lag(Quadrant) and Tooth =
lag(Tooth)) and not( root=1)) RFontooth = 0.
If (not(randpatID = lag(randPatID) and Quadrant = lag(Quadrant) and Tooth =
lag(Tooth)) and root=1) RFontooth = 1.

Save outfile='C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp1A.sav'.

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* Latest root filling on tooth (RFontooth =1).

* Create running totals for each root filling.
If (RFontooth=0) Run1=0.
If not(RFontooth ge 1 and lag(RFontooth) ge 1 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run1=0.
If (RFontooth ge 1 and lag(RFontooth) ge 1 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run1=lag(run1)+lag(doaccn)-
doaccn.

Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.


* Filter down to the treatments preceding each RF which are within 5 years.


Select if (RFontooth ge 1 and run1 le 1826).

* Aggregate treatment flags.

Aggregate outfile = *
    /Break randpatID  Quadrant Tooth
    / randclaimID doaccn history5 RFontooth = first(randclaimID doaccn history5
RFontooth)
    / Rootplus1 hOcclusal honeproximalridge hMOD htunnel hpinorscrew hpost
hincisaledge honeangle htwoangles hInlay hCrown
```

```
    hAbutment hApicect = sum ( Root Occlusal oneproximalridge MOD tunnel
pinorscrew post incisaledge oneangle twoangles Inlay Crown
    Abutment Apicect).

* Remove the first root filling from the aggregate totals.

Compute hroot=rootplus1-1.

* restrict to CoTs with complete 5 year history.

Select if history5 = 1.

save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2a.sav'
    /DROP Rootplus1.

*****************************************************************************************************
*************************************.

* Previous root filling on tooth (RFontooth=2).

Get File='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1A.sav'.

* Create running totals for each root filling.
If (RFontooth=0) Run2=0.
If not(RFontooth ge 2 and lag(RFontooth) ge 2 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run2=0.
If (RFontooth ge 2 and lag(RFontooth) ge 2 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run2=lag(run2)+lag(doaccn)-
doaccn.

Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.


* Filter down to the treatments preceding each RF which are within 5 years.

Select if (RFontooth ge 2 and run2 le 1826).

* Aggregate treatment flags.

Aggregate outfile = *
    /Break randpatID  Quadrant Tooth
    / randclaimID doaccn history5 RFontooth = first(randclaimID doaccn history5
RFontooth)
    / Rootplus1 hOcclusal honeproximalridge hMOD htunnel hpinorscrew hpost
hincisaledge honeangle htwoangles hInlay hCrown
    hAbutment hApicect = sum ( Root Occlusal oneproximalridge MOD tunnel
pinorscrew post incisaledge oneangle twoangles Inlay Crown
    Abutment Apicect).
```

```
* Remove the first root filling from the aggregate totals.

Compute hroot=rootplus1-1.

* restrict to CoTs with complete 5 year history.

Select if history5 = 1.

save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3a.sav'
    /DROP Rootplus1.

*****************************************************************************************************
*************************************.

* Previous root filling on tooth (RFontooth=3).

Get File='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1A.sav'.

* Create running totals for each root filling.
If (RFontooth=0) Run3=0.
If not(RFontooth ge 3 and lag(RFontooth) ge 3 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run3=0.
If (RFontooth ge 3 and lag(RFontooth) ge 3 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run3=lag(run3)+lag(doaccn)-
doaccn.

Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.


* Filter down to the treatments preceding each RF which are within 5 years.

Select if (RFontooth ge 3 and run3 le 1826).

* Aggregate treatment flags.

Aggregate outfile = *
    /Break randpatID  Quadrant Tooth
    / randclaimID doaccn history5 RFontooth = first(randclaimID doaccn history5
RFontooth)
    / Rootplus1 hOcclusal honeproximalridge hMOD htunnel hpinorscrew hpost
hincisaledge honeangle htwoangles hInlay hCrown
    hAbutment hApicect = sum ( Root Occlusal oneproximalridge MOD tunnel
pinorscrew post incisaledge oneangle twoangles Inlay Crown
    Abutment Apicect).

* Remove the first root filling from the aggregate totals.
```

```
Compute hroot=rootplus1-1.

* restrict to CoTs with complete 5 year history.

Select if history5 = 1.

save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4a.sav'
   /DROP Rootplus1.

*****************************************************************************************************
*************************************.

* Previous root filling on tooth (RFontooth=4).

Get File='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1A.sav'.

* Create running totals for each root filling.
If (RFontooth=0) Run4=0.
If not(RFontooth ge 4 and lag(RFontooth) ge 4 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run4=0.
If (RFontooth ge 4 and lag(RFontooth) ge 4 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run4=lag(run4)+lag(doaccn)-
doaccn.

Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav'.


* Filter down to the treatments preceding each RF which are within 5 years.

Select if (RFontooth ge 4 and run4 le 1826).

* Aggregate treatment flags.

Aggregate outfile = *
   /Break randpatID  Quadrant Tooth
   / randclaimID doaccn history5 RFontooth = first(randclaimID doaccn history5
RFontooth)
   / Rootplus1 hOcclusal honeproximalridge hMOD htunnel hpinorscrew hpost
hincisaledge honeangle htwoangles hInlay hCrown
   hAbutment hApicect = sum ( Root Occlusal oneproximalridge MOD tunnel
pinorscrew post incisaledge oneangle twoangles Inlay Crown
   Abutment Apicect).

* Remove the first root filling from the aggregate totals.

Compute hroot=rootplus1-1.

* restrict to CoTs with complete 5 year history.
```

```
Select if history5 = 1.

save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5a.sav'
   /DROP Rootplus1.

*****************************************************************************************************
****************************************.

* Previous root filling on tooth (RFontooth=5).

Get File='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1A.sav'.

* Create running totals for each root filling.
If (RFontooth=0) Run5=0.
If not(RFontooth ge 5 and lag(RFontooth) ge 5 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run5=0.
If (RFontooth ge 5 and lag(RFontooth) ge 5 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run5=lag(run5)+lag(doaccn)-
doaccn.

Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav'.


* Filter down to the treatments preceding each RF which are within 5 years.

Select if (RFontooth ge 5 and run5 le 1826).

* Aggregate treatment flags.

Aggregate outfile = *
   /Break randpatID  Quadrant Tooth
   / randclaimID doaccn history5 RFontooth = first(randclaimID doaccn history5
RFontooth)
   / Rootplus1 hOcclusal honeproximalridge hMOD htunnel hpinorscrew hpost
hincisaledge honeangle htwoangles hInlay hCrown
   hAbutment hApicect = sum ( Root Occlusal oneproximalridge MOD tunnel
pinorscrew post incisaledge oneangle twoangles Inlay Crown
   Abutment Apicect).

* Remove the first root filling from the aggregate totals.

Compute hroot=rootplus1-1.

* restrict to CoTs with complete 5 year history.

Select if history5 = 1.
```

```
save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6a.sav'
    /DROP Rootplus1.

*************************************************************************************************
*************************************.

* There are no cases with RFontooth ge 6 and a 5 year history, so collect all the
aggregate files together.

Add files file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2a.sav'
    /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3a.sav'
    /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4a.sav'
    /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5a.sav'
    /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6a.sav'
    /by randpatID Quadrant Tooth.

sort cases by  randpatID Quadrant Tooth randclaimID.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF 5
year history.sav'.
```

Preparation Program
* Encoding: windows-1252.
* RF All History Teeth Preparation 05 5y.sps
* Written by ML on 21/03/2023. Modified 03/04/2024.

* This program prepares adult restoration intervals for KM survival analysis.
* by adding weights and additional cases to allow for time-dependent censoring.
* This file is restricted to root filled teeth with a five year treatment history.

Get file = 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Intervals.sav'.

* Check whether time is in acceptable range, and set reint flag.

compute doplacn = max(doaccn, doexamn, docompn).

compute reint=0.
if not (missing(time)) reint=1.
if (time le 0) reint=0.

sort cases by randpatID Quadrant Tooth randclaimID.

Match Files File=*
    /Table = 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF 5 year history.sav'
    /By randpatID Quadrant Tooth randclaimID.

Execute.

* Restrict to patients with at least five years treatment history.

Select if history5 =1.

Execute.

* Create weights to adjust for time dependent censoring.

* Double up the cases with no re-intervention and weight by probability of re-intervention.

* First calculate patient age at start of year of acceptance in years.

compute patage=XDATE.YEAR(doaccn*24*60*60) - patyob.

* Remove children and very old patients (most of whom are miscodings of children).

SELECT IF (Range (patage, 18, 99)).

```
recode patage
(18 thru 19 = 1)
(20 thru 29 = 2)
(30 thru 39 = 3)
(40 thru 49 = 4)
(50 thru 59 = 5)
(60 thru 69 = 6)
(70 thru 79 = 7)
(80 thru hi = 8)
into patagegr.

Value labels patagegr
1 '18 or 19'
2 '20 to 29'
3 '30 to 39'
4 '40 to 49'
5 '50 to 59'
6 '60 to 69'
7 '70 to 79'
8 '80 or older'.

compute caseid=$casenum.
execute.

* Look up probability of reattendance after last visit.
* Interval is the number of days from treating the tooth until the end of the data on
31st March 2006.
* N.B. on rare occasions, docplcn is after 2006/3/31.

compute interval = max((yrmoda(2006,03,31)-doplacn),0).
sort cases by patagegr interval.
match files file=*
 /table='C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\reattendance
probability.sav'
 /by patagegr interval.
compute recid=1.
sort cases by caseid.
save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (reint=0).
compute recid=2.
save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

add files file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'
 /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'
 /by caseid .

Compute weight = 1000.
```

```
Do if (reint=0).
if (recid=1) weight=1000-trunc(1000*prreatt+0.5).
if (recid=2) weight = trunc(1000*prreatt+0.5).
end if.

save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.

* Look up date of last visit by patient.

Sort cases by randpatID.
Match files file=*
 /table='C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\Patient
Lookup.sav'
 /by randpatID.

execute.

* Assume censored cases are lost at one year (365 days) after last visit.

* recalculate time if reint=0.
* Impute effective time of censoring.
Do if (reint=0).
If (recid=1) time=max((min(lastvn+365,yrmoda(2006,03,31))-doplacn),0).

if (recid=2) time=max((yrmoda(2006,03,31)-doplacn),0).
end if.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.


**********************************************************************************************
*
* Document variables.

get file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.

Variable Labels
  randpatid 'Patient ID No'
  quadrant 'Mouth quadrant'
  tooth 'Tooth position'
  randclaimid 'Claim ID No'
  lastvn 'last date of visit by patient (days)'
  doplacn 'Date of placement (days)'
  interval 'Interval from last visit to 31 March 06 (days)'
  mintrt 'Min Treatment Code'
  maxtrt 'Max Treatment Code'
  start 'start of tooth treatment of interest?'
  time 'Time to reRCT apicect or extract'
```

```
  nexclaim 'Claim ID for next treatment on tooth'
  dentistgender 'Gender of Dentist'
  dentistyob 'Year of Birth of Dentist'
  postarea 'Postcode Area of Surgery'
  chargestatus 'Charge-paying Status of patient'
  patage 'Patient age'
  patagegr 'Patient Age Group'
  reint 'reintervention flag'
  caseid 'Case ID (for time-dependent censor adjustment)'
  prreatt 'Estimated probability of re-attendance'
  recid 'record ID (for time-dependent censor adjustment)'
  weight 'weighting (for time-dependent censor adjustment)'.

value labels Root Occlusal oneproximalridge tunnel MOD pinorscrew post
incisaledge oneangle twoangles Inlay Crown abutment Extract Apicect Start End
      1 'Yes' 0 'No'.



Save outfile = 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All
History Teeth Preparation 5y.sav'.
```

```
Chart Program
* Encoding: windows-1252.
* RF All History Teeth charts 09 5y.sps.

* Written by ML on 24/03/2023. Modified on 14/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All
History Teeth Preparation 5y.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160429.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).

**************************************************************************************************
*

* What happens if there is a root filling history?.

* Create descriptive variables.

RECODE hroot
(0 =1)
(1 thru 9=2)
into hrootgr.

value labels
/hrootgr
1 'No previous Root Filling'
2 'Previous Root Filling'.
```

```
compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.


COXREG time
  /STATUS=reint(1)
  /strata = hrootgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.


* What happens if there is a history of apicectomy?.

* Create descriptive variables.

RECODE hApicect
(0 =1)
(1 thru 9=2)
into hApicectgr.

value labels
/hApicectgr
1 'No previous Apicectomy'
2 'Previous Apicectomy'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.


COXREG time
  /STATUS=reint(1)
  /strata =         hApicectgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

**************************************************************************************************
********************

*Restoration in all teeth.

* What happens if there is a history of pin or screw?.
```

```
* Create descriptive variables.

RECODE hpinorscrew
(0 =1)
(1 thru 9=2)
into hpinorscrewgr.

value labels
/hpinorscrewgr
1 'No previous Pin or Screw'
2 'Previous Pin or Screw'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      hpinorscrewgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

* What happens if there is a history of post?.

* Create descriptive variables.

RECODE hpost
(0 =1)
(1 thru 9=2)
into hpostgr.

value labels
/hpostgr
1 'No previous Post'
2 'Previous Post'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      hpostgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
```

```
  /PLOT =  SURVIVAL.

* What happens if there is a crown history?.

* Create descriptive variables.

RECODE hCrown
(0 =1)
(1 thru 9=2)
into hcrowngr.

value labels
/hcrowngr
1 'No previous Crown'
2 'Previous Crown'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav'.

COXREG time
  /STATUS=reint(1)
  /strata = hcrowngr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.


* What happens if there is a history of bridge abutment?.

* Create descriptive variables.

RECODE hAbutment
(0 =1)
(1 thru 9=2)
into hAbutmentgr.

value labels
/hAbutmentgr
1 'No previous Bridge Abutment'
2 'Previous Bridge Abutment'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav'.
```

```
COXREG time
  /STATUS=reint(1)
  /strata =       habutmentgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

************************************************************************************************
********************

*Restoration in anterior teeth.

* What happens if there is a history of incisal edge?.

* Create descriptive variables.

RECODE hincisaledge
(0 =1)
(1 thru 9=2)
into hincisaledgegr.

value labels
/hincisaledgegr
1 'No previous Incisal edge'
2 'Previous Incisal edge'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp7.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp7.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      hincisaledgegr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

* What happens if there is a history of an incisal angle?.

* Create descriptive variables.

RECODE honeangle
(0 =1)
(1 thru 9=2)
into honeanglegr.

value labels
```

```
/honeanglegr
1 'No previous one Angle'
2 'Previous one Angle'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp8.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp8.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      honeanglegr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

* What happens if there is a history of two incisal angles?.

* Create descriptive variables.

RECODE htwoangles
(0 =1)
(1 thru 9=2)
into htwoanglesgr.

value labels
/htwoanglesgr
1 'No previous two angles'
2 'Previous two angles'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp9.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp9.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      htwoanglesgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

*************************************************************************************************
**********
*Restoration in posterior teeth.

* What happens if there is an occlusal history?.
```

```
* Create descriptive variables.

RECODE hOcclusal
(0 =1)
(1 thru 9=2)
into hOcclusalgr.

value labels
/ hOcclusalgr
1 'No previous Occlusal'
2 'Previous Occlusal'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp10.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp10.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =  hOcclusalgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

* What happens if there is a history of one proximal ridge (MO or DO)?.

* Create descriptive variables.

RECODE honeproximalridge
(0 =1)
(1 thru 9=2)
into honeproximalridgegr.

value labels
/honeproximalridgegr
1 'No previous MO/DO'
2 'Previous MO/DO'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp11.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp11.sav'.

COXREG time
  /STATUS=reint(1)
```

```
  /strata =   honeproximalridgegr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

* What happens if there is a history of MOD?.

* Create descriptive variables.

RECODE hMOD
(0 =1)
(1 thru 9=2)
into hMODgr.

value labels
/hMODgr
1 'No previous MOD'
2 'Previous MOD'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp12.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp12.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =    hMODgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

* What happens if there is a history of tunnel restoration?.

* Create descriptive variables.

RECODE  htunnel
(0 =1)
(1 thru 9=2)
into  htunnelgr.

value labels
/htunnelgr
1 'No previous Tunnel'
2 'Previous Tunnel'.

compute caseid=$casenum.
execute.
```

```
save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp13.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp13.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =     htunnelgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.


* What happens if there is a history of inlay?.

* Create descriptive variables.

RECODE hInlay
(0 =1)
(1 thru 9=2)
into hInlaygr.

value labels
/hInlaygr
1 'No previous Inlay'
2 'Previous Inlay'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp14.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp14.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =       hInlaygr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.


**********************************************************************************************
********************
```

8.4.4.3 Based on 8 years of Treatment History

History Program
* Encoding: windows-1252.

* RF 8 year History 02 8y.sps

* Written by ML on 17/2/2024. Modified 03/04/2024.

* Create a file totalling previous treatments over 8 years for RF courses for adult patients with at least 8 years history.

* Aggregate a set of files for the first, second, etc root filling on each tooth, but only for cases 8 year history, and only up to 8 years.

* Look up first Course of Treatment for each patient.

```
Match files  file ='C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF all teeth all treats.sav'
   /table = 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF CoT history.sav'
   /by  randpatID.

Execute.

* For each CoT, flag whether it has 8 years history (interval since first CoT greater than 2921 days).

Compute history8=0.

If ( doaccn -  firstcourseaccn gt 2921) history8=1.

Sort cases by  randpatID  Quadrant Tooth (A)  doaccn (D) root (A).

* Remove duplicate treatment records.

Compute dup=0.

If ( randclaimID = lag(randclaimID) and  TRTCODE = lag(TRTCODE) and Quadrant = lag(Quadrant) and Tooth =lag(Tooth)) dup=1.

Execute.

select if dup=0.


Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
```

```
* Create 8 year running totals for all RF treatments with 8 years history.

* Note that first record does not have 8 years history.

* First identify each root filling and its previous treatments - note that the root filling is
the last treatment within the date of acceptance for each tooth (in this sorted order).

If  (randpatID = 8) RFontooth =0.
If (randpatID = lag(randPatID) and Quadrant = lag(Quadrant) and Tooth = lag(Tooth))
RFontooth=lag(RFontooth).
If (root=1) RFontooth=lag(RFontooth) + 1.
If (not(randpatID = lag(randPatID) and Quadrant = lag(Quadrant) and Tooth =
lag(Tooth)) and not( root=1)) RFontooth = 0.
If (not(randpatID = lag(randPatID) and Quadrant = lag(Quadrant) and Tooth =
lag(Tooth)) and root=1) RFontooth = 1.

Save outfile='C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp1A.sav'.

**********************************************************************************************
**************************************.

* Latest root filling on tooth (RFontooth =1).

* Create running totals for each root filling.
If (RFontooth=0) Run1=0.
If not(RFontooth ge 1 and lag(RFontooth) ge 1 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run1=0.
If (RFontooth ge 1 and lag(RFontooth) ge 1 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run1=lag(run1)+lag(doaccn)-
doaccn.

Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.


* Filter down to the treatments preceding each RF which are within 8 years.


Select if (RFontooth ge 1 and run1 le 2921).

* Aggregate treatment flags.

Aggregate outfile = *
    /Break randpatID  Quadrant Tooth
    / randclaimID doaccn history8 RFontooth = first(randclaimID doaccn history8
RFontooth)
    / Rootplus1 hOcclusal honeproximalridge hMOD htunnel hpinorscrew hpost
hincisaledge honeangle htwoangles hInlay hCrown
```

```
    habutment hApicect = sum ( Root Occlusal oneproximalridge MOD tunnel
pinorscrew post incisaledge oneangle twoangles Inlay Crown
    abutment Apicect).

* Remove the first root filling from the aggregate totals.

Compute hroot=rootplus1-1.

* restrict to CoTs with complete 8 year history.

Select if history8 = 1.

save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2a.sav'
    /DROP Rootplus1.

*****************************************************************************************************
*************************************.

* Previous root filling on tooth (RFontooth=2).

Get File='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1A.sav'.

* Create running totals for each root filling.
If (RFontooth=0) Run2=0.
If not(RFontooth ge 2 and lag(RFontooth) ge 2 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run2=0.
If (RFontooth ge 2 and lag(RFontooth) ge 2 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run2=lag(run2)+lag(doaccn)-
doaccn.

Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.


* Filter down to the treatments preceding each RF which are within 8 years.

Select if (RFontooth ge 2 and run2 le 2921).

* Aggregate treatment flags.

Aggregate outfile = *
    /Break randpatID  Quadrant Tooth
    / randclaimID doaccn history8 RFontooth = first(randclaimID doaccn history8
RFontooth)
    / Rootplus1 hOcclusal honeproximalridge hMOD htunnel hpinorscrew hpost
hincisaledge honeangle htwoangles hInlay hCrown
    habutment hApicect = sum ( Root Occlusal oneproximalridge MOD tunnel
pinorscrew post incisaledge oneangle twoangles Inlay Crown
    abutment Apicect).
```

```
* Remove the first root filling from the aggregate totals.

Compute hroot=rootplus1-1.

* restrict to CoTs with complete 8 year history.

Select if history8 = 1.

save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3a.sav'
   /DROP Rootplus1.

*****************************************************************************************************
*************************************.

* Previous root filling on tooth (RFontooth=3).

Get File='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1A.sav'.

* Create running totals for each root filling.
If (RFontooth=0) Run3=0.
If not(RFontooth ge 3 and lag(RFontooth) ge 3 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run3=0.
If (RFontooth ge 3 and lag(RFontooth) ge 3 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run3=lag(run3)+lag(doaccn)-
doaccn.

Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.


* Filter down to the treatments preceding each RF which are within 8 years.

Select if (RFontooth ge 3 and run3 le 2921).

* Aggregate treatment flags.

Aggregate outfile = *
   /Break randpatID  Quadrant Tooth
   / randclaimID doaccn history8 RFontooth = first(randclaimID doaccn history8
RFontooth)
   / Rootplus1 hOcclusal honeproximalridge hMOD htunnel hpinorscrew hpost
hincisaledge honeangle htwoangles hInlay hCrown
   habutment hApicect = sum ( Root Occlusal oneproximalridge MOD tunnel
pinorscrew post incisaledge oneangle twoangles Inlay Crown
   abutment Apicect).

* Remove the first root filling from the aggregate totals.
```

```
Compute hroot=rootplus1-1.

* restrict to CoTs with complete 8 year history.

Select if history8 = 1.

save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4a.sav'
   /DROP Rootplus1.

*****************************************************************************************************
*************************************.

* Previous root filling on tooth (RFontooth=4).

Get File='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1A.sav'.

* Create running totals for each root filling.
If (RFontooth=0) Run4=0.
If not(RFontooth ge 4 and lag(RFontooth) ge 4 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run4=0.
If (RFontooth ge 4 and lag(RFontooth) ge 4 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run4=lag(run4)+lag(doaccn)-
doaccn.

Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav'.


* Filter down to the treatments preceding each RF which are within 8 years.

Select if (RFontooth ge 4 and run4 le 2921).

* Aggregate treatment flags.

Aggregate outfile = *
   /Break randpatID  Quadrant Tooth
   / randclaimID doaccn history8 RFontooth = first(randclaimID doaccn history8
RFontooth)
   / Rootplus1 hOcclusal honeproximalridge hMOD htunnel hpinorscrew hpost
hincisaledge honeangle htwoangles hInlay hCrown
   habutment hApicect = sum ( Root Occlusal oneproximalridge MOD tunnel
pinorscrew post incisaledge oneangle twoangles Inlay Crown
   abutment Apicect).

* Remove the first root filling from the aggregate totals.

Compute hroot=rootplus1-1.

* restrict to CoTs with complete 8 year history.
```

```
Select if history8 = 1.

save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5a.sav'
   /DROP Rootplus1.

*****************************************************************************************************
****************************************.

* Previous root filling on tooth (RFontooth=5).

Get File='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1A.sav'.

* Create running totals for each root filling.
If (RFontooth=0) Run5=0.
If not(RFontooth ge 5 and lag(RFontooth) ge 5 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run5=0.
If (RFontooth ge 5 and lag(RFontooth) ge 5 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run5=lag(run5)+lag(doaccn)-
doaccn.

Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav'.


* Filter down to the treatments preceding each RF which are within 8 years.

Select if (RFontooth ge 5 and run5 le 2921).

* Aggregate treatment flags.

Aggregate outfile = *
   /Break randpatID  Quadrant Tooth
   / randclaimID doaccn history8 RFontooth = first(randclaimID doaccn history8
RFontooth)
   / Rootplus1 hOcclusal honeproximalridge hMOD htunnel hpinorscrew hpost
hincisaledge honeangle htwoangles hInlay hCrown
   habutment hApicect = sum ( Root Occlusal oneproximalridge MOD tunnel
pinorscrew post incisaledge oneangle twoangles Inlay Crown
   abutment Apicect).

* Remove the first root filling from the aggregate totals.

Compute hroot=rootplus1-1.

* restrict to CoTs with complete 8 year history.

Select if history8 = 1.
```

```
save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6a.sav'
   /DROP Rootplus1.

*************************************************************************************************
**************************************.

* There are no cases with RFontooth ge 6 and a 8 year history, so collect all the
aggregate files together.

Add files file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2a.sav'
   /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3a.sav'
   /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4a.sav'
   /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5a.sav'
   /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6a.sav'
   /by randpatID Quadrant Tooth.

sort cases by  randpatID Quadrant Tooth randclaimID.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF 8
year history.sav'.
```

Preparation Program
* Encoding: windows-1252.
* RF All History Teeth Preparation 02 8y.sps
* Written by ML on 17/2/2024. Modified 03/04/2024.

* This program prepares adult restoration intervals for KM survival analysis.
* by adding weights and additional cases to allow for time-dependent censoring.
* This file is restricted to root filled teeth with an eight year treatment history.

Get file = 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Intervals.sav'.

* Check whether time is in acceptable range, and set reint flag.

compute doplacn = max(doaccn, doexamn, docompn).

compute reint=0.
if not (missing(time)) reint=1.
if (time le 0) reint=0.

sort cases by randpatID Quadrant Tooth randclaimID.

Match Files File=*
    /Table = 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF 8 year history.sav'
    /By randpatID Quadrant Tooth randclaimID.

Execute.

* Restrict to patients with at least eight years treatment history.

Select if history8 =1.

Execute.

* Create weights to adjust for time dependent censoring.

* Double up the cases with no re-intervention and weight by probability of re-intervention.

* First calculate patient age at start of year of acceptance in years.

compute patage=XDATE.YEAR(doaccn*24*60*60) - patyob.

* Remove children and very old patients (most of whom are miscodings of children).

SELECT IF (Range (patage, 18, 99)).

```
recode patage
(18 thru 19 = 1)
(20 thru 29 = 2)
(30 thru 39 = 3)
(40 thru 49 = 4)
(50 thru 59 = 5)
(60 thru 69 = 6)
(70 thru 79 = 7)
(80 thru hi = 8)
into patagegr.

Value labels patagegr
1 '18 or 19'
2 '20 to 29'
3 '30 to 39'
4 '40 to 49'
5 '50 to 59'
6 '60 to 69'
7 '70 to 79'
8 '80 or older'.

compute caseid=$casenum.
execute.

* Look up probability of reattendance after last visit.
* Interval is the number of days from treating the tooth until the end of the data on
31st March 2006.
* N.B. on rare occasions, docplcn is after 2006/3/31.

compute interval = max((yrmoda(2006,03,31)-doplacn),0).
sort cases by patagegr interval.
match files file=*
 /table='C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\reattendance
probability.sav'
 /by patagegr interval.
compute recid=1.
sort cases by caseid.
save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (reint=0).
compute recid=2.
save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

add files file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'
 /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'
 /by caseid .

Compute weight = 1000.
```

```
Do if (reint=0).
if (recid=1) weight=1000-trunc(1000*prreatt+0.5).
if (recid=2) weight = trunc(1000*prreatt+0.5).
end if.

save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.

* Look up date of last visit by patient.

Sort cases by randpatID.
Match files file=*
 /table='C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\Patient
Lookup.sav'
 /by randpatID.

execute.

* Assume censored cases are lost at one year (365 days) after last visit.

* recalculate time if reint=0.
* Impute effective time of censoring.
Do if (reint=0).
If (recid=1) time=max((min(lastvn+365,yrmoda(2006,03,31))-doplacn),0).

if (recid=2) time=max((yrmoda(2006,03,31)-doplacn),0).
end if.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.


*************************************************************************************************
*
* Document variables.

get file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.

Variable Labels
  randpatid 'Patient ID No'
  quadrant 'Mouth quadrant'
  tooth 'Tooth position'
  randclaimid 'Claim ID No'
  lastvn 'last date of visit by patient (days)'
  doplacn 'Date of placement (days)'
  interval 'Interval from last visit to 31 March 06 (days)'
  mintrt 'Min Treatment Code'
  maxtrt 'Max Treatment Code'
  start 'start of tooth treatment of interest?'
  time 'Time to reRCT apicect or extract'
```

```
  nexclaim 'Claim ID for next treatment on tooth'
  dentistgender 'Gender of Dentist'
  dentistyob 'Year of Birth of Dentist'
  postarea 'Postcode Area of Surgery'
  chargestatus 'Charge-paying Status of patient'
  patage 'Patient age'
  patagegr 'Patient Age Group'
  reint 'reintervention flag'
  caseid 'Case ID (for time-dependent censor adjustment)'
  prreatt 'Estimated probability of re-attendance'
  recid 'record ID (for time-dependent censor adjustment)'
  weight 'weighting (for time-dependent censor adjustment)'.

value labels Root Occlusal oneproximalridge tunnel MOD pinorscrew post
incisaledge oneangle twoangles Inlay Crown abutment Extract Apicect Start End
      1 'Yes' 0 'No'.



Save outfile = 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All
History Teeth Preparation 8y.sav'.
```

Chart Program
* Encoding: windows-1252.
* RF All History Teeth charts 02 8y.sps.

* Written by ML on 17/2/2024. Modified on 14/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR procedure.
* Produce survival curves for some values of descriptive variables.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All History Teeth Preparation 8y.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation period (instead of earlier).

Set seed = 20160429.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).

****
*

* What happens if there is a root filling history?.

* Create descriptive variables.

RECODE hroot
(0 =1)
(1 thru 9=2)
into hrootgr.

value labels
/hrootgr

```
1 'No previous Root Filling'
2 'Previous Root Filling'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.


COXREG time
  /STATUS=reint(1)
  /strata = hrootgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.


* What happens if there is a history of apicectomy?.

* Create descriptive variables.

RECODE hApicect
(0 =1)
(1 thru 9=2)
into hApicectgr.

value labels
/hApicectgr
1 'No previous Apicectomy'
2 'Previous Apicectomy'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.


COXREG time
  /STATUS=reint(1)
  /strata =         hApicectgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

**********************************************************************************************
********************

*Restoration in all teeth.
```

```
* What happens if there is a history of pin or screw?.

* Create descriptive variables.

RECODE hpinorscrew
(0 =1)
(1 thru 9=2)
into hpinorscrewgr.

value labels
/hpinorscrewgr
1 'No previous Pin or Screw'
2 'Previous Pin or Screw'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      hpinorscrewgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

* What happens if there is a history of post?.

* Create descriptive variables.

RECODE hpost
(0 =1)
(1 thru 9=2)
into hpostgr.

value labels
/hpostgr
1 'No previous Post'
2 'Previous Post'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.

COXREG time
```

```
  /STATUS=reint(1)
  /strata =      hpostgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT =  SURVIVAL.

* What happens if there is a crown history?.

* Create descriptive variables.

RECODE hCrown
(0 =1)
(1 thru 9=2)
into hcrowngr.

value labels
/hcrowngr
1 'No previous Crown'
2 'Previous Crown'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav'.

COXREG time
  /STATUS=reint(1)
  /strata = hcrowngr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.


* What happens if there is a history of bridge abutment?.

* Create descriptive variables.

RECODE hAbutment
(0 =1)
(1 thru 9=2)
into hAbutmentgr.

value labels
/hAbutmentgr
1 'No previous Bridge Abutment'
2 'Previous Bridge Abutment'.

compute caseid=$casenum.
execute.
```

```
save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =        habutmentgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

************************************************************************************************
********************

*Restoration in anterior teeth.

* What happens if there is a history of incisal edge?.

* Create descriptive variables.

RECODE hincisaledge
(0 =1)
(1 thru 9=2)
into hincisaledgegr.

value labels
/hincisaledgegr
1 'No previous Incisal edge'
2 'Previous Incisal edge'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp7.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp7.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      hincisaledgegr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

* What happens if there is a history of an incisal angle?.

* Create descriptive variables.

RECODE honeangle
(0 =1)
(1 thru 9=2)
```

```
into honeanglegr.

value labels
/honeanglegr
1 'No previous one Angle'
2 'Previous one Angle'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp8.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp8.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      honeanglegr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

* What happens if there is a history of two incisal angles?.

* Create descriptive variables.

RECODE htwoangles
(0 =1)
(1 thru 9=2)
into htwoanglesgr.

value labels
/htwoanglesgr
1 'No previous two angles'
2 'Previous two angles'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp9.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp9.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      htwoanglesgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

*************************************************************************************************
********************
*Restoration in posterior teeth.
```

```
* What happens if there is an occlusal history?.

* Create descriptive variables.

RECODE hOcclusal
(0 =1)
(1 thru 9=2)
into hOcclusalgr.

value labels
/ hOcclusalgr
1 'No previous Occlusal'
2 'Previous Occlusal'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp10.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp10.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =  hOcclusalgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

* What happens if there is a history of one proximal ridge (MO or DO)?.

* Create descriptive variables.

RECODE honeproximalridge
(0 =1)
(1 thru 9=2)
into honeproximalridgegr.

value labels
/honeproximalridgegr
1 'No previous MO/DO'
2 'Previous MO/DO'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp11.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp11.sav'.
```

```
COXREG time
  /STATUS=reint(1)
  /strata =   honeproximalridgegr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

* What happens if there is a history of MOD?.

* Create descriptive variables.

RECODE hMOD
(0 =1)
(1 thru 9=2)
into hMODgr.

value labels
/hMODgr
1 'No previous MOD'
2 'Previous MOD'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp12.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp12.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =    hMODgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

* What happens if there is a history of tunnel restoration?.

* Create descriptive variables.

RECODE  htunnel
(0 =1)
(1 thru 9=2)
into  htunnelgr.

value labels
/htunnelgr
1 'No previous Tunnel'
2 'Previous Tunnel'.
```

```
compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp13.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp13.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =     htunnelgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.


* What happens if there is a history of inlay?.

* Create descriptive variables.

RECODE hInlay
(0 =1)
(1 thru 9=2)
into hInlaygr.

value labels
/hInlaygr
1 'No previous Inlay'
2 'Previous Inlay'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp14.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp14.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =       hInlaygr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.


**********************************************************************************************
********************
```

8.4.4.4 Based on 10 years of Treatment History

History Program

* Encoding: windows-1252.

* RF 10 year History 02.sps

* Written by ML on 17/2/2024. Modified 02/04/2024.

* Create a file totalling previous treatments over 10 years for RF courses for adult patients with at least 10 years history.

* Aggregate a set of files for the first, second, etc root filling on each tooth, but only for cases 10 year history, and only up to 10 years.

* Look up first Course of Treatment for each patient.

Match files file ='C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF all teeth all treats.sav'

  /table = 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF CoT history.sav'

  /by randpatID.

Execute.

* For each CoT, flag whether it has 10 years history (interval since first CoT greater than 3652 days).

Compute history10=0.

If (doaccn - firstcourseaccn gt 3652) history10=1.

Sort cases by randpatID Quadrant Tooth (A) doaccn (D) root (A).

* Remove duplicate treatment records.

Compute dup=0.

If (randclaimID = lag(randclaimID) and TRTCODE = lag(TRTCODE) and Quadrant = lag(Quadrant) and Tooth =lag(Tooth)) dup=1.

Execute.

select if dup=0.

Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

* Create 10 year running totals for all RF treatments with 10 years history.

* Note that first record does not have 10 years history.

* First identify each root filling and its previous treatments - note that the root filling is the last treatment within the date of acceptance for each tooth (in this sorted order).

```
If  (randpatID = 10) RFontooth =0.
If (randpatID = lag(randPatID) and Quadrant = lag(Quadrant) and Tooth = lag(Tooth)) RFontooth=lag(RFontooth).
If (root=1) RFontooth=lag(RFontooth) + 1.
If (not(randpatID = lag(randPatID) and Quadrant = lag(Quadrant) and Tooth = lag(Tooth)) and not( root=1)) RFontooth = 0.
If (not(randpatID = lag(randPatID) and Quadrant = lag(Quadrant) and Tooth = lag(Tooth)) and root=1) RFontooth = 1.

Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1A.sav'.

**********************************************************************************************************************************.
```

* Latest root filling on tooth (RFontooth =1).

* Create running totals for each root filling.

```
If (RFontooth=0) Run1=0.
If not(RFontooth ge 1 and lag(RFontooth) ge 1 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run1=0.
If (RFontooth ge 1 and lag(RFontooth) ge 1 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run1=lag(run1)+lag(doaccn)-
doaccn.

Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.


* Filter down to the treatments preceding each RF which are within 10 years.


Select if (RFontooth ge 1 and run1 le 3652).

* Aggregate treatment flags.

Aggregate outfile = *
   /Break randpatID  Quadrant Tooth
   / randclaimID doaccn history10 RFontooth = first(randclaimID doaccn history10
RFontooth)
   / Rootplus1 hOcclusal honeproximalridge hMOD htunnel hpinorscrew hpost
hincisaledge honeangle htwoangles hInlay hCrown
```

habutment hApicect = sum (Root Occlusal oneproximalridge MOD tunnel pinorscrew post incisaledge oneangle twoangles Inlay Crown

abutment Apicect).

* Remove the first root filling from the aggregate totals.

Compute hroot=rootplus1-1.

* restrict to CoTs with complete 10 year history.

Select if history10 = 1.

save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2a.sav'

/DROP Rootplus1.

**********.

* Previous root filling on tooth (RFontooth=2).

Get File='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1A.sav'.

* Create running totals for each root filling.

If (RFontooth=0) Run2=0.

```
If not(RFontooth ge 2 and lag(RFontooth) ge 2 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run2=0.
If (RFontooth ge 2 and lag(RFontooth) ge 2 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run2=lag(run2)+lag(doaccn)-
doaccn.

Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.


* Filter down to the treatments preceding each RF which are within 10 years.

Select if (RFontooth ge 2 and run2 le 3652).

* Aggregate treatment flags.

Aggregate outfile = *
   /Break randpatID  Quadrant Tooth
   / randclaimID doaccn history10 RFontooth = first(randclaimID doaccn history10
RFontooth)
   / Rootplus1 hOcclusal honeproximalridge hMOD htunnel hpinorscrew hpost
hincisaledge honeangle htwoangles hInlay hCrown
   habutment hApicect = sum ( Root Occlusal oneproximalridge MOD tunnel
pinorscrew post incisaledge oneangle twoangles Inlay Crown
   abutment Apicect).
```

```
* Remove the first root filling from the aggregate totals.

Compute hroot=rootplus1-1.

* restrict to CoTs with complete 10 year history.

Select if history10 = 1.

save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3a.sav'
    /DROP Rootplus1.

*****************************************************************************************
*************************************.

* Previous root filling on tooth (RFontooth=3).

Get File='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1A.sav'.

* Create running totals for each root filling.
If (RFontooth=0) Run3=0.
If not(RFontooth ge 3 and lag(RFontooth) ge 3 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run3=0.
```

If (RFontooth ge 3 and lag(RFontooth) ge 3 and (randpatID = lag(randPatID) and Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run3=lag(run3)+lag(doaccn)-doaccn.

Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.

* Filter down to the treatments preceding each RF which are within 10 years.

Select if (RFontooth ge 3 and run3 le 3652).

* Aggregate treatment flags.

Aggregate outfile = *

/Break randpatID Quadrant Tooth

/ randclaimID doaccn history10 RFontooth = first(randclaimID doaccn history10 RFontooth)

/ Rootplus1 hOcclusal honeproximalridge hMOD htunnel hpinorscrew hpost hincisaledge honeangle htwoangles hInlay hCrown

habutment hApicect = sum (Root Occlusal oneproximalridge MOD tunnel pinorscrew post incisaledge oneangle twoangles Inlay Crown

abutment Apicect).

* Remove the first root filling from the aggregate totals.

```
Compute hroot=rootplus1-1.

* restrict to CoTs with complete 10 year history.

Select if history10 = 1.

save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4a.sav'
    /DROP Rootplus1.

*****************************************************************************************************
*************************************.

* Previous root filling on tooth (RFontooth=4).

Get File='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1A.sav'.

* Create running totals for each root filling.
If (RFontooth=0) Run4=0.
If not(RFontooth ge 4 and lag(RFontooth) ge 4 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run4=0.
If (RFontooth ge 4 and lag(RFontooth) ge 4 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run4=lag(run4)+lag(doaccn)-
doaccn.
```

```
Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav'.

* Filter down to the treatments preceding each RF which are within 10 years.

Select if (RFontooth ge 4 and run4 le 3652).

* Aggregate treatment flags.

Aggregate outfile = *
    /Break randpatID  Quadrant Tooth
    / randclaimID doaccn history10 RFontooth = first(randclaimID doaccn history10 RFontooth)
    / Rootplus1 hOcclusal honeproximalridge hMOD htunnel hpinorscrew hpost hincisaledge honeangle htwoangles hInlay hCrown
    habutment hApicect = sum ( Root Occlusal oneproximalridge MOD tunnel pinorscrew post incisaledge oneangle twoangles Inlay Crown
    abutment Apicect).

* Remove the first root filling from the aggregate totals.

Compute hroot=rootplus1-1.
```

```
* restrict to CoTs with complete 10 year history.

Select if history10 = 1.

save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5a.sav'
    /DROP Rootplus1.

*****************************************************************************************
*************************************.

* Previous root filling on tooth (RFontooth=5).

Get File='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1A.sav'.

* Create running totals for each root filling.
If (RFontooth=0) Run5=0.
If not(RFontooth ge 5 and lag(RFontooth) ge 5 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run5=0.
If (RFontooth ge 5 and lag(RFontooth) ge 5 and (randpatID = lag(randPatID) and
Quadrant = lag(Quadrant) and Tooth = lag(Tooth))) Run5=lag(run5)+lag(doaccn)-
doaccn.

Save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav'.
```

* Filter down to the treatments preceding each RF which are within 10 years.

Select if (RFontooth ge 5 and run5 le 3652).

* Aggregate treatment flags.

Aggregate outfile = *

/Break randpatID Quadrant Tooth

/ randclaimID doaccn history10 RFontooth = first(randclaimID doaccn history10 RFontooth)

/ Rootplus1 hOcclusal honeproximalridge hMOD htunnel hpinorscrew hpost hincisaledge honeangle htwoangles hInlay hCrown

habutment hApicect = sum (Root Occlusal oneproximalridge MOD tunnel pinorscrew post incisaledge oneangle twoangles Inlay Crown

abutment Apicect).

* Remove the first root filling from the aggregate totals.

Compute hroot=rootplus1-1.

* restrict to CoTs with complete 10 year history.

Select if history10 = 1.

```
save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6a.sav'
    /DROP Rootplus1.

*************************************************************************************************
*************************************.

* There are no cases with RF on tooth 10 year history, so collect all the aggregate files
together.

Add files file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2a.sav'
    /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3a.sav'
    /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4a.sav'
    /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5a.sav'
    /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6a.sav'
    /by randpatID Quadrant Tooth.

sort cases by  randpatID Quadrant Tooth randclaimID.

save  outfile=  'C:\Users\maria\OneDrive\Documents\PhD  Results\SPSS  Sav\RF  10
year history.sav'.
```

Preparation Program

```
* Encoding: windows-1252.
* RF All History Teeth Preparation 02 10y.sps
* Written by ML on 17/2/2024 . Modified 03/04/2024.

* This program prepares adult restoration intervals for KM survival analysis.
* by adding weights and additional cases to allow for time-dependent censoring.
* This file is restricted to root filled teeth with an ten year treatment history.

Get file = 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Intervals.sav'.

* Check whether time is in acceptable range, and set reint flag.

compute doplacn = max( doaccn, doexamn, docompn).

compute reint=0.
if not (missing(time)) reint=1.
if (time le 0) reint=0.

sort cases by  randpatID Quadrant Tooth randclaimID.

Match Files File=*
```

```
    /Table =  'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF 10 year
history.sav'
    /By randpatID Quadrant Tooth randclaimID.

Execute.

* Restrict to patients with at least ten years treatment history.

Select if  history10 =1.

Execute.

* Create weights to adjust for time dependent censoring.

* Double up the cases with no re-intervention and weight by probability of re-
intervention.

* First calculate patient age at start of year of acceptance in years.

compute patage=XDATE.YEAR( doaccn*24*60*60) - patyob.

* Remove children and very old patients (most of whom are miscodings of children).

SELECT IF (Range (patage, 18, 99)).
```

```
recode patage
(18 thru 19 = 1)
(20 thru 29 = 2)
(30 thru 39 = 3)
(40 thru 49 = 4)
(50 thru 59 = 5)
(60 thru 69 = 6)
(70 thru 79 = 7)
(80 thru hi = 8)
into patagegr.

Value labels patagegr
1 '18 or 19'
2 '20 to 29'
3 '30 to 39'
4 '40 to 49'
5 '50 to 59'
6 '60 to 69'
7 '70 to 79'
8 '80 or older'.

compute caseid=$casenum.
execute.
```

```
* Look up probability of reattendance after last visit.
* Interval is the number of days from treating the tooth until the end of the data on 31st
March 2006.
* N.B. on rare occasions, docplcn is after 2006/3/31.

compute interval = max((yrmoda(2006,03,31)-doplacn),0).
sort cases by patagegr interval.
match files file=*
 /table='C:\Users\maria\OneDrive\Documents\PhD  Results\SPSS  Sav\reattendance
probability.sav'
 /by patagegr interval.
compute recid=1.
sort cases by caseid.
save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (reint=0).
compute recid=2.
save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

add files file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'
 /file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'
 /by caseid .
```

```
Compute weight = 1000.
Do if (reint=0).
if (recid=1) weight=1000-trunc(1000*prreatt+0.5).
if (recid=2) weight = trunc(1000*prreatt+0.5).
end if.

save outfile='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.

* Look up date of last visit by patient.

Sort cases by randpatID.
Match files file=*
 /table='C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\Patient
Lookup.sav'
 /by randpatID.

execute.

* Assume censored cases are lost at one year (365 days) after last visit.

* recalculate time if reint=0.
* Impute effective time of censoring.
Do if (reint=0).
If (recid=1) time=max((min(lastvn+365,yrmoda(2006,03,31))-doplacn),0).
```

```
if (recid=2) time=max((yrmoda(2006,03,31)-doplacn),0).
end if.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.

*****************************************************************************************
*
* Document variables.

get file='C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.

Variable Labels
  randpatid 'Patient ID No'
  quadrant 'Mouth quadrant'
  tooth 'Tooth position'
  randclaimid 'Claim ID No'
  lastvn 'last date of visit by patient (days)'
  doplacn 'Date of placement (days)'
  interval 'Interval from last visit to 31 March 06 (days)'
  mintrt 'Min Treatment Code'
  maxtrt 'Max Treatment Code'
  start 'start of tooth treatment of interest?'
```

```
  time 'Time to reRCT apicect or extract'
  nexclaim 'Claim ID for next treatment on tooth'
  dentistgender 'Gender of Dentist'
  dentistyob 'Year of Birth of Dentist'
  postarea 'Postcode Area of Surgery'
  chargestatus 'Charge-paying Status of patient'
  patage 'Patient age'
  patagegr 'Patient Age Group'
  reint 'reintervention flag'
  caseid 'Case ID (for time-dependent censor adjustment)'
  prreatt 'Estimated probability of re-attendance'
  recid 'record ID (for time-dependent censor adjustment)'
  weight 'weighting (for time-dependent censor adjustment)'.

value labels Root Occlusal oneproximalridge tunnel MOD pinorscrew post incisaledge
oneangle twoangles Inlay Crown abutment Extract Apicect Start End
    1 'Yes' 0 'No'.

Save outfile = 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All
History Teeth Preparation 10y.sav'.
```

Chart Program

* Encoding: windows-1252.

* RF anterior History Teeth charts 02 10y.sps.

* Written by ML on 17/2/2024. Modified 30/03/2024.

* This uses random censoring to calculate survival statistics using the CoxR procedure.

* Produce survival curves for some values of descriptive variables.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All History Teeth Preparation 10y.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation period (instead of earlier).

Set seed = 20160429.

select if (recid=1).

compute random=uniform(1).

If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

```
COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

*For all teeth examining various restorations before RF.

*For anterior teeth examining various restorations before RF.

```
* Restrict to anterior teeth.

select if (Range (Tooth,'1', '3')).

* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).
```

```
Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

COXREG time
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtoot).

**************************************************.

* What happens if there is a root filling history?.

COXREG time
  /STATUS=reint(1)
  /strata = hroot
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

* What happens if there is a history of apicectomy?.
```

```
COXREG time
  /STATUS=reint(1)
  /strata =        hApicect
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

* What happens if there is a history of incisal edge?.

```
COXREG time
  /STATUS=reint(1)
  /strata =      hincisaledge
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

* What happens if there is a history of an incisal angle?.

```
COXREG time
  /STATUS=reint(1)
  /strata =      honeangle
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

* What happens if there is a history of two incisal angles?.

```
COXREG time
  /STATUS=reint(1)
  /strata =      htwoangles
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

* What happens if there is a history of pin or screw?.

```
COXREG time
  /STATUS=reint(1)
  /strata =      hpinorscrew
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

* What happens if there is a crown history?.

```
COXREG time
  /STATUS=reint(1)
  /strata = hcrown
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
```

```
  /Save survival (survcrown).



* What happens if there is a history of bridge abutment?.


COXREG time
  /STATUS=reint(1)
  /strata =        habutment
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

*************************************************************************************************

*******************
```

Chapter 9 Appendix of Results

9.1 Outputs of the Programs by SPSS

9.1.1 Output of Programs to Prepare the Data

The output for these programs produced data files which programs from Appendix 8.2 onwards can utilise and produce outputs in the shape and form of tables and graphs, presented in Appendix 9 as output, distilled in Chapter 3 Results, and further discussed in Chapter 4 Discussion.

9.1.2 Output of Programs to Extrapolate RCF teeth

The output for these programs produced data files which programs from Appendix 8.2 onwards can utilise and produce outputs in the shape and form of tables and graphs, presented in Appendix 9 as output, distilled in Chapter 3 Results, and further discussed in Chapter 4 Discussion.

9.2 Dentist's General Factors

9.2.1 Gender of the Dentist

```
* Encoding: windows-1252.
* RF All Teeth x dentist gender 02.sps.

* Written by ML on 24/04/2020. Modified 27/05/2023.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
```

```
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and crown placement.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created		25-APR-2024 22:08:35
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.

Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:01:10.17
	Elapsed Time	00:01:38.75
Variables Created or Modified	survall	Survival function evaluate at the current case

Case Processing Summary

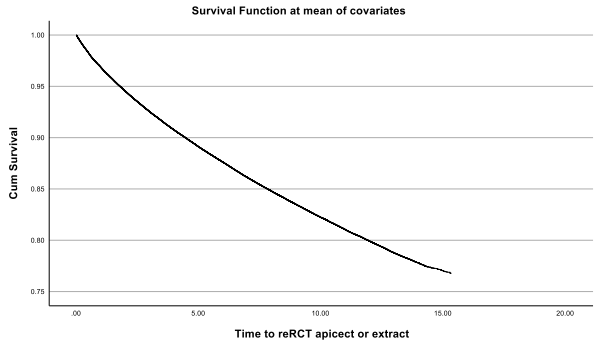
		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2452517.472



* What happens if the dentist is female?.

```
COXREG time
  /STATUS=reint(1)
  /strata = DentistGender
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survdentfem).
```

Cox Regression

Notes

Output Created		25-APR-2024 22:10:14
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>

	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = DentistGender /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survdentfem).
Resources	Processor Time	00:01:35.91
	Elapsed Time	00:02:26.68
Variables Created or Modified	survdentfem	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

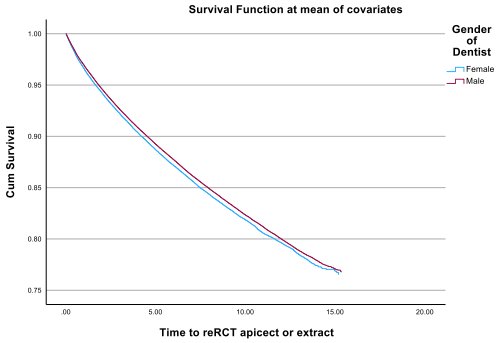
Stratum Status[a]

Stratum	Strata label	Event	Censored	Censored Percent
F	Female	18474	138589	88.2%
M	Male	75563	558749	88.1%
Total		94037	697338	88.1%

a. The strata variable is : Gender of Dentist

Block 0: Beginning Block

Omnibus Tests of Model Coefficients
-2 Log Likelihood
2359405.445



9.2.2 Dentist Year of Birth

```
* Encoding: windows-1252.
* RF All Teeth x dentist's year of birth 02.sps.

* Written by ML on 24/04/2020. Modified on 27/05/2023.

* This uses random censoring to calculate survival statistics using the CoxR procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel plotting.
* Used for assessment of individual teeth types and crown placement.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav'.


* Censor the proportion prreatt of all non-returners at the end of the observation period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created		25-APR-2024 22:17:11
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD

		Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:01:12.44
	Elapsed Time	00:01:37.91
Variables Created or Modified	survall	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

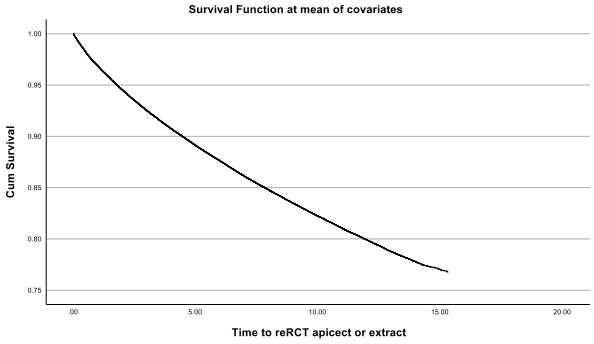
a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model

Coefficients

-2 Log Likelihood
2452517.472



* What happens in relation to dentist year of birth /age?.

```
COXREG time
  /STATUS=reint(1)
  /strata = Dentistyob
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survdentyob).
```

Cox Regression

Notes

Output Created	25-APR-2024 22:18:49
Comments	

Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = Dentistyob /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survdentyob).
Resources	Processor Time	00:01:48.64
	Elapsed Time	00:02:26.09
Variables Created or Modified	survdentyob	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697184	88.0%
	Total	791221	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	1040	0.1%
	Total	1040	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Event	Censored	Censored Percent
1921	8	30	78.9%

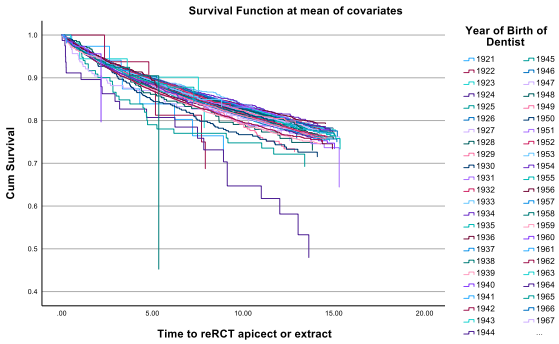
1922	5	11	68.8%
1923	6	48	88.9%
1924	23	56	70.9%
1925	32	110	77.5%
1926	19	97	83.6%
1927	40	167	80.7%
1928	67	321	82.7%
1929	96	435	81.9%
1930	115	461	80.0%
1931	179	876	83.0%
1932	257	1559	85.8%
1933	204	1242	85.9%
1934	304	1907	86.3%
1935	381	2152	85.0%
1936	519	2885	84.8%
1937	609	3455	85.0%
1938	705	4183	85.6%
1939	1143	5900	83.8%
1940	872	4848	84.8%
1941	898	5269	85.4%
1942	1408	7682	84.5%
1943	1464	8582	85.4%
1944	1800	10753	85.7%
1945	1516	9561	86.3%
1946	2138	13174	86.0%
1947	2508	15410	86.0%
1948	2296	14915	86.7%
1949	2277	14770	86.6%
1950	2626	19266	88.0%
1951	2528	17160	87.2%
1952	2775	18759	87.1%
1953	2453	17202	87.5%
1954	2702	19579	87.9%
1955	3086	21510	87.5%
1956	3194	24667	88.5%
1957	3440	25362	88.1%
1958	3637	27981	88.5%
1959	4083	29124	87.7%
1960	3361	25815	88.5%
1961	3992	28557	87.7%
1962	3813	28134	88.1%
1963	4141	31124	88.3%
1964	3857	28915	88.2%
1965	3852	28380	88.0%

1966	3388	26041	88.5%
1967	2920	22553	88.5%
1968	2469	20294	89.2%
1969	2211	18831	89.5%
1970	1898	16756	89.8%
1971	1583	15647	90.8%
1972	1112	12114	91.6%
1973	866	10134	92.1%
1974	809	9335	92.0%
1975	540	7116	92.9%
1976	334	5821	94.6%
1977	228	4235	94.9%
1978	157	3210	95.3%
1979	71	1755	96.1%
1980	19	750	97.5%
1981	3	198	98.5%
Total	94037	697184	88.1%

a. The strata variable is : Year of Birth of Dentist

Block 0: Beginning Block

Omnibus Tests of Model Coefficients
-2 Log Likelihood
1767930.543


Survival Function at mean of covariates
Cum Survival
1.0
0.9
0.8
0.7
0.6
0.5
0.4
.00
5.00
10.00
15.00
20.00
Time to reRCT apicect or extract
Year of Birth of Dentist
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939
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1957
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967

9.2.3 Postcode of the Dental Practice

```
* Encoding: windows-1252.
* RF All Teeth x postcode area of the surgery 02.sps.

* Written by ML on 25/04/2020. Modified on 27/05/2023.

* This uses random censoring to calculate survival statistics using the CoxR procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel plotting.
* Used for assessment of individual tooth types and crown placement.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav'.


* Censor the proportion prreatt of all non-returners at the end of the observation period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.


compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created		25-APR-2024 22:29:50
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD

		Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:01:09.92
	Elapsed Time	00:01:38.74
Variables Created or Modified	survall	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

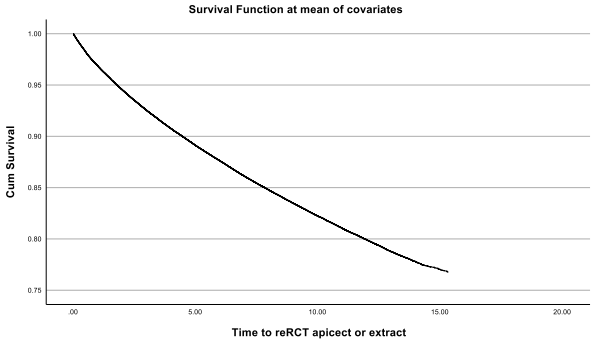
a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model

Coefficients

-2 Log Likelihood
2452517.472



* What happens if the patient has a dentist in a particular area?.

```
COXREG time
  /STATUS=reint(1)
  /strata = postarea
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survpostarea).
```

Cox Regression

Notes

Output Created	25-APR-2024 22:31:28
Comments	

Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = postarea /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survpostarea).
Resources	Processor Time	00:01:49.77
	Elapsed Time	00:02:25.88
Variables Created or Modified	survpostarea	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697237	88.0%
	Total	791274	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	987	0.1%
	Total	987	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Event	Censored	Censored Percent
B	2993	19819	86.9%

E	1746	16540	90.5%
L	1827	10863	85.6%
M	2752	18013	86.7%
N	1948	16265	89.3%
S	2065	14159	87.3%
W	1233	12621	91.1%
BA	593	4433	88.2%
CA	504	2920	85.3%
DA	633	5495	89.7%
HA	969	8166	89.4%
LA	564	4038	87.7%
SA	1298	7695	85.6%
TA	532	3724	87.5%
WA	1128	6603	85.4%
BB	730	5012	87.3%
CB	488	4792	90.8%
UB	625	6998	91.8%
EC	71	822	92.0%
WC	112	996	89.9%
BD	1108	6442	85.3%
HD	565	3442	85.9%
LD	90	478	84.2%
TD	36	216	85.7%
WD	396	4246	91.5%
DE	859	5800	87.1%
LE	1364	9955	87.9%
ME	988	7559	88.4%
NE	2248	13029	85.3%
PE	1053	7245	87.3%
SE	2142	18009	89.4%
CF	1672	9898	85.5%
TF	196	1288	86.8%
WF	915	5602	86.0%
HG	381	2648	87.4%
IG	700	6690	90.5%
NG	2150	13616	86.4%
RG	969	9258	90.5%
SG	782	6325	89.0%
BH	935	7550	89.0%
CH	936	6286	87.0%
DH	530	2819	84.2%
RH	924	7336	88.8%
MK	629	5740	90.1%
SK	1202	8102	87.1%

AL	360	3715	91.2%
BL	734	4843	86.8%
DL	656	3345	83.6%
GL	619	5081	89.1%
LL	853	5792	87.2%
OL	1192	6983	85.4%
PL	700	5192	88.1%
SL	470	4961	91.3%
CM	1169	9882	89.4%
RM	775	7790	91.0%
SM	459	4286	90.3%
BN	1526	12705	89.3%
DN	1175	6490	84.7%
EN	608	5700	90.4%
LN	316	2033	86.5%
NN	963	5884	85.9%
SN	440	3831	89.7%
TN	1108	8889	88.9%
WN	621	3473	84.8%
CO	802	6023	88.2%
PO	1211	9923	89.1%
SO	1062	7907	88.2%
YO	771	4999	86.6%
HP	589	6479	91.7%
IP	951	6985	88.0%
NP	911	5043	84.7%
SP	356	2430	87.2%
TQ	537	3569	86.9%
BR	287	3433	92.3%
CR	803	7084	89.8%
HR	334	1964	85.5%
NR	1311	9281	87.6%
PR	938	5913	86.3%
SR	585	2847	83.0%
TR	428	3127	88.0%
WR	373	2712	87.9%
BS	1417	11311	88.9%
LS	1669	9862	85.5%
SS	814	7833	90.6%
TS	1279	6995	84.5%
WS	823	4466	84.4%
CT	734	6226	89.5%
DT	375	2727	87.9%
KT	825	7336	89.9%

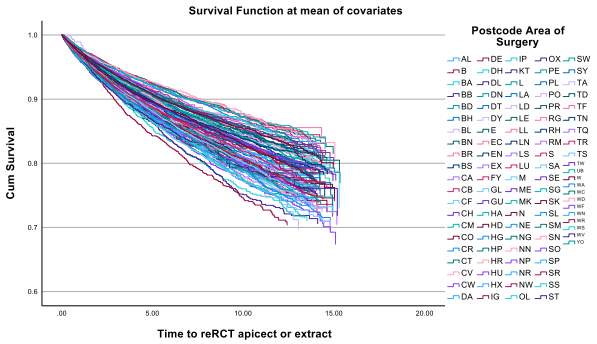
ST	840	5357	86.4%
GU	1121	10340	90.2%
HU	555	3645	86.8%
LU	528	6030	91.9%
CV	1130	8975	88.8%
WV	562	3473	86.1%
CW	408	2744	87.1%
NW	1117	10781	90.6%
SW	1727	15698	90.1%
TW	910	8691	90.5%
EX	849	6075	87.7%
HX	391	2503	86.5%
OX	628	5098	89.0%
DY	664	3930	85.5%
FY	695	4006	85.2%
SY	402	2988	88.1%
Total	94037	697237	88.1%

a. The strata variable is : Postcode Area of Surgery

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1606723.173


Survival Function at mean of covariates
Cum Survival
1.0
0.9
0.8
0.7
0.6
.00
5.00
10.00
15.00
20.00
Time to reRCT apicect or extract
Postcode Area of Surgery
AL DE IP OX SW
B DH KT PE SY
BA DL L PL TA
BB DN LA PO TD
BD DT LD PR TF
BH DY LE RG TN
BL E LL RH TQ
BN EC LN RM TR
BR EN LS S TS
BS EX LU SA TW
CA FY M SE UB
CB GL ME SG WA
CF GU MK SK WC
CH HA N SL WD
CM HD NE SM WF
CO HG NG SN WN
CR HP NN SO WR
CT HR NP SP WS
CV HU NR SR WV
CW HX NW SS YO
DA IG OL ST

9.3 Patient's General Factors

9.3.1 Gender of the Patient

```
* Encoding: windows-1252.
* RF All Teeth x patient gender 04.sps.

* Written by ML on 25/04/2020. Modified 27/05/2023.

* This uses random censoring to calculate survival statistics using the CoxR procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel plotting.
* Used for assessment of individual teeth types and crown placement.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created	25-APR-2024 20:45:20
Comments	

Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:01:05.97
	Elapsed Time	00:01:39.69
Variables Created or Modified	survall	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav

Case Processing Summary

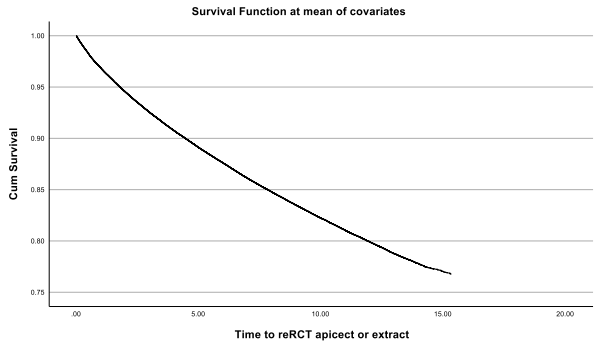
		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2452517.472



* What happens if the patient is female or male?.

```
COXREG time
  /STATUS=reint(1)
  /strata = Patgender
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survpatgender).
```

Cox Regression

Notes

Output Created		25-APR-2024 20:47:00
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = Patgender /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survpatgender).
Resources	Processor Time	00:01:45.34
	Elapsed Time	00:02:25.73
Variables Created or Modified	survpatgender	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%

Total	886	0.1%
Total	792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

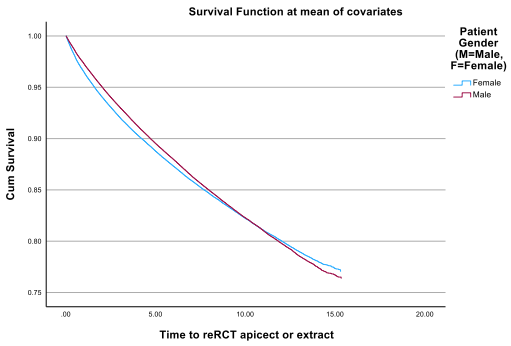
Stratum	Strata label	Event	Censored	Censored Percent
F	Female	49711	359586	87.9%
M	Male	44326	337752	88.4%
Total		94037	697338	88.1%

a. The strata variable is : Patient Gender (M=Male, F=Female)

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2322408.129



9.3.1 Age of the Patient

```
* Encoding: windows-1252.
* RF All Teeth x patient age 02.sps.

* Written by ML on 25/04/2020. Modified 27/05/2023.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and crown placement.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created		25-APR-2024 21:58:06
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD

		Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:01:17.45
	Elapsed Time	00:01:39.56
Variables Created or Modified	survall	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav

Case Processing Summary

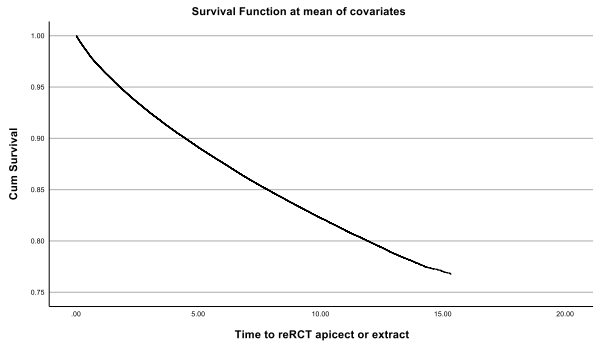
		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2452517.472



* What happens if the patient young or old?.

```
COXREG time
  /STATUS=reint(1)
  /strata = patage
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survpatage).
```

Cox Regression

Notes

Output Created		25-APR-2024 21:59:45
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = patage /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survpatage).
Resources	Processor Time	00:01:54.08
	Elapsed Time	00:02:26.41
Variables Created or Modified	survpatage	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697200	88.0%
	Total	791237	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	1024	0.1%

Total	1024	0.1%
Total	792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Event	Censored	Censored Percent
18.00	24	174	87.9%
19.00	183	1034	85.0%
20.00	355	2268	86.5%
21.00	553	3752	87.2%
22.00	745	5207	87.5%
23.00	970	6657	87.3%
24.00	1169	8054	87.3%
25.00	1423	9644	87.1%
26.00	1613	11652	87.8%
27.00	1877	12948	87.3%
28.00	2011	14581	87.9%
29.00	2144	15902	88.1%
30.00	2243	17119	88.4%
31.00	2322	18634	88.9%
32.00	2421	19819	89.1%
33.00	2500	20687	89.2%
34.00	2496	20770	89.3%
35.00	2369	20638	89.7%
36.00	2496	20606	89.2%
37.00	2377	20043	89.4%
38.00	2356	19860	89.4%
39.00	2332	19183	89.2%
40.00	2302	18877	89.1%
41.00	2231	18308	89.1%
42.00	2276	18058	88.8%
43.00	2196	17554	88.9%
44.00	2264	17393	88.5%
45.00	2257	17220	88.4%
46.00	2240	16961	88.3%
47.00	2170	16310	88.3%
48.00	2177	15919	88.0%
49.00	2048	15310	88.2%
50.00	2019	14727	87.9%
51.00	1888	14198	88.3%
52.00	1944	13836	87.7%
53.00	1877	13293	87.6%
54.00	1791	13083	88.0%

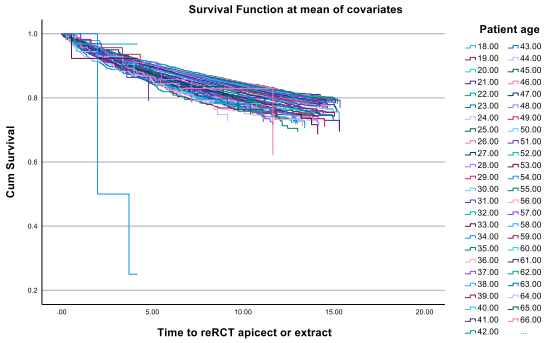
55.00	1778	12207	87.3%
56.00	1749	11588	86.9%
57.00	1620	11093	87.3%
58.00	1512	10370	87.3%
59.00	1466	9863	87.1%
60.00	1418	9064	86.5%
61.00	1391	8832	86.4%
62.00	1317	8466	86.5%
63.00	1228	7900	86.5%
64.00	1202	7268	85.8%
65.00	1086	7121	86.8%
66.00	1070	6580	86.0%
67.00	923	6233	87.1%
68.00	879	5629	86.5%
69.00	833	5337	86.5%
70.00	778	4953	86.4%
71.00	744	4446	85.7%
72.00	675	4069	85.8%
73.00	571	3641	86.4%
74.00	511	3328	86.7%
75.00	450	2983	86.9%
76.00	430	2711	86.3%
77.00	338	2349	87.4%
78.00	289	2039	87.6%
79.00	262	1717	86.8%
80.00	190	1437	88.3%
81.00	160	1304	89.1%
82.00	151	1033	87.2%
83.00	112	869	88.6%
84.00	94	674	87.8%
85.00	51	560	91.7%
86.00	41	401	90.7%
87.00	16	296	94.9%
88.00	16	215	93.1%
89.00	7	147	95.5%
90.00	9	105	92.1%
91.00	6	50	89.3%
92.00	1	30	96.8%
94.00	1	12	92.3%
95.00	3	1	25.0%
Total	94037	697200	88.1%

a. The strata variable is : Patient age

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1696554.497



9.3.3 Age of Patients Grouped by Decade

```
* Encoding: windows-1252.
* RF All Teeth x patient age groups 04.sps.

* Written by ML on 25/04/2020. Modified on 27/05/2023.

* This uses random censoring to calculate survival statistics using the CoxR procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel plotting.
* Used for assessment of individual teeth types and crown placement.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.
* Encoding: windows-1252.
* RF All Teeth x patient gender 04.sps.

* Written by ML on 25/04/2020. Modified 27/05/2023.

* This uses random censoring to calculate survival statistics using the CoxR procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel plotting.
* Used for assessment of individual teeth types and crown placement.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).
```

```
* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created		25-APR-2024 21:42:45
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:01:09.05
	Elapsed Time	00:01:38.56
Variables Created or Modified	survall	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth

Preparation.sav

Case Processing Summary

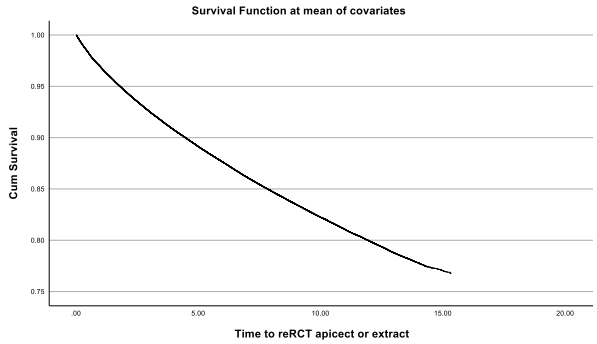
		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2452517.472



* What happens if the patient is older than younger?.

```
COXREG time
  /STATUS=reint(1)
  /strata = patagegr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survpatagegroup).
```

Cox Regression

Notes

Output Created		25-APR-2024 21:44:24
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>

	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = patagegr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survpatagegroup).
Resources	Processor Time	00:01:45.16
	Elapsed Time	00:02:25.13
Variables Created or Modified	survpatagegroup	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Strata label	Event	Censored	Censored Percent
1.00	18 or 19	207	1208	85.4%
2.00	20 to 29	12860	90665	87.6%
3.00	30 to 39	23912	197362	89.2%
4.00	40 to 49	22161	171915	88.6%
5.00	50 to 59	17644	124258	87.6%
6.00	60 to 69	11347	72443	86.5%
7.00	70 to 79	5048	32250	86.5%

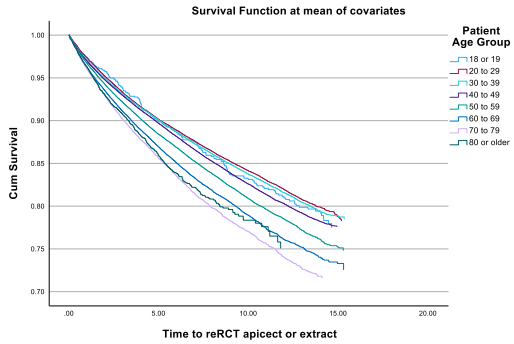
8.00	80 or older	858	7237	89.4%
Total		94037	697338	88.1%

a. The strata variable is : Patient Age Group

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2124174.471



9.3.4 Charge Status of the Patient

```
* Encoding: windows-1252.
* RF All Teeth x charge status 02.sps.

* Written by ML on 24/04/2020 modified 23/05/2023.

* This uses random censoring to calculate survival statistics using the CoxR procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel plotting.
* Used for assessment of individual teeth types and crown placement.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created		25-APR-2024 21:06:33
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav

	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:01:03.83
	Elapsed Time	00:01:39.08
Variables Created or Modified	survall	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

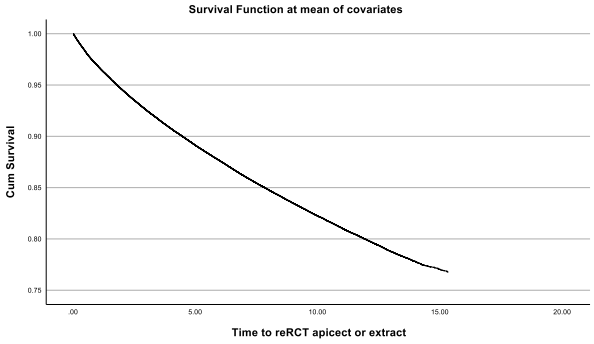
a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model

Coefficients

-2 Log Likelihood
2452517.472



* What happens if the patient is exempt from paying?.

```
COXREG time
  /STATUS=reint(1)
  /strata = Chargestatus
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survchargestatus).
```

Cox Regression

Notes

Output Created	25-APR-2024 21:08:12
Comments	

Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = Chargestatus /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survchargestatus).
Resources	Processor Time	00:01:51.13
	Elapsed Time	00:02:24.20
Variables Created or Modified	survchargestatus	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Strata label	Event	Censored	Censored Percent
1	Full charge	57868	463004	88.9%

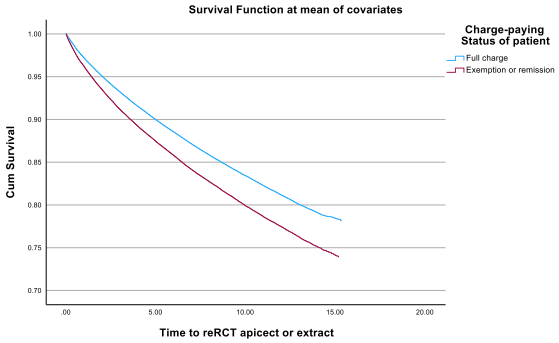
2	Exemption or remission	36169	234334	86.6%
Total		94037	697338	88.1%

a. The strata variable is : Charge-paying Status of patient

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2326143.357



9.4 Patient Tooth Factors

9.4.1 Restoration Placed After the RCT on All Teeth

```
* Encoding: windows-1252.
* RF All Teeth survival 01.sps.

* Written by ML on 27/07/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created	27-JUL-2024 16:01:38
Comments	

Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:01:11.03
	Elapsed Time	00:01:16.31
Variables Created or Modified	survall	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav

Case Processing Summary

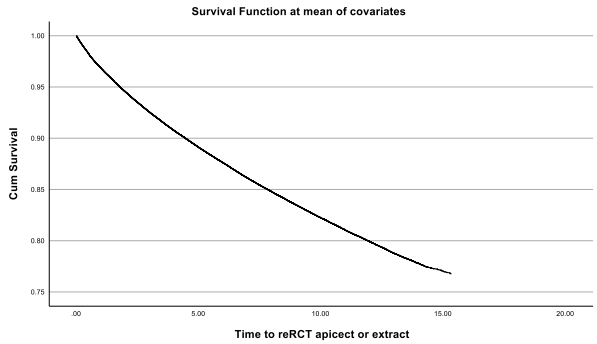
		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2452517.472



**********.

**********.

*What happens to upper or lower teeth ?

* Create descriptive variables.

String upplow (a1).

If (Any(quadrant,'UR','UL')) upplow= '1'.

```
If (Any(quadrant,'LR','LL')) upplow= '2'.

Execute.

value labels
/upplow
'1' 'Upper teeth'
'2' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.


COXREG time
  /STATUS=reint(1)
  /strata = upplow
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survUL).
```

Cox Regression

Notes

Output Created		27-JUL-2024 16:04:11
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = upplow /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL

		/Save survival (survUL).
Resources	Processor Time	00:00:01.89
	Elapsed Time	00:00:02.47
Variables Created or Modified	survUL	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Strata label	Event	Censored	Censored Percent
1	Upper teeth	59886	428397	87.7%
2	Lower teeth	34151	268941	88.7%
Total		94037	697338	88.1%

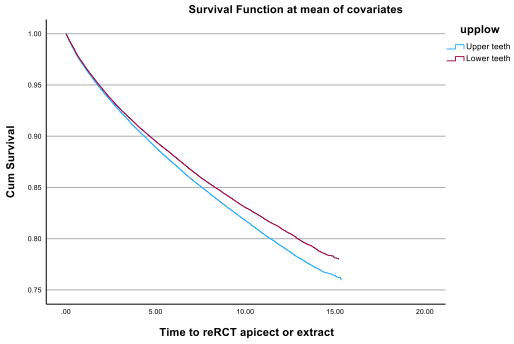
a. The strata variable is : upplow

Block 0: Beginning Block

Omnibus Tests of Model

Coefficients

-2 Log Likelihood
2329201.582



**********.

*What happens to anterior vs posterior teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

* Create descriptive variables.

String antpost (a1).

If (Any(tooth,'1','2','3')) antpost= '1'.
If (Any(tooth,'4','5','6','7','8')) antpost= '2'.

Execute.

value labels
/antpost
'1' 'Anterior teeth'
'2' 'Posterior teeth'.

```
save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

COXREG time
  /STATUS=reint(1)
  /strata = antpost
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootAP).
```

Cox Regression

Notes

Output Created		27-JUL-2024 16:04:15
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = antpost /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survtootAP).
Resources	Processor Time	00:00:01.97
	Elapsed Time	00:00:02.33
Variables Created or Modified	survtootAP	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

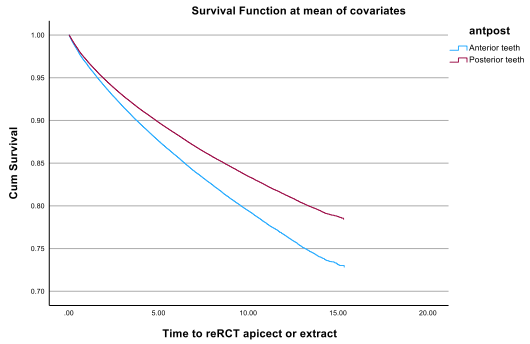
Stratum	Strata label	Event	Censored	Censored Percent
1	Anterior teeth	31995	196631	86.0%
2	Posterior teeth	62042	500707	89.0%
Total		94037	697338	88.1%

a. The strata variable is : antpost

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2330936.467



**********.

*What happens to quadrant?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

```
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootQ).
```

Cox Regression

Notes

Output Created		27-JUL-2024 16:04:17
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = Quadrant /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survtootQ).
Resources	Processor Time	00:00:01.69
	Elapsed Time	00:00:02.44
Variables Created or Modified	survtootQ	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Event	Censored	Censored Percent
LL	16765	132834	88.8%

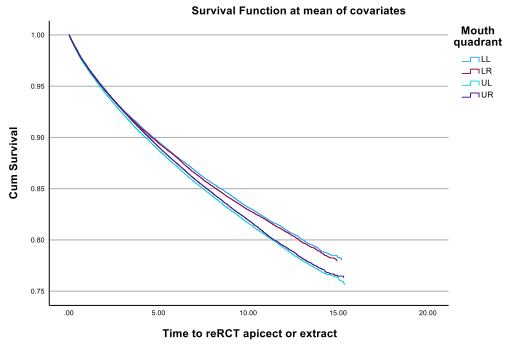
UL	30583	215845	87.6%
LR	17386	136107	88.7%
UR	29303	212552	87.9%
Total	94037	697338	88.1%

a. The strata variable is : Mouth quadrant

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2198866.828



**********.

*What happens to tooth position of teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

```
* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.


COXREG time
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootTP).
```

Cox Regression

Notes

Output Created		27-JUL-2024 16:04:21
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = toothpos /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL

		/Save survival (survtootTP).
Resources	Processor Time	00:00:01.97
	Elapsed Time	00:00:02.63
Variables Created or Modified	survtootTP	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697336	88.0%
	Total	791373	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	888	0.1%
	Total	888	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Event	Censored	Censored Percent
L1	1864	11606	86.2%
U1	8044	51118	86.4%
L2	2065	10720	83.8%
U2	10261	59186	85.2%
L3	2181	14830	87.2%
U3	7580	49171	86.6%
L4	4105	33315	89.0%
U4	8798	65087	88.1%
L5	7647	66764	89.7%
U5	11207	84491	88.3%
L6	10011	78120	88.6%
U6	8249	72678	89.8%
L7	5494	46605	89.5%
U7	5158	42369	89.1%

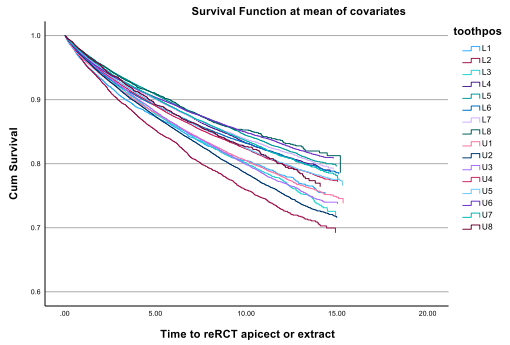
L8	784	6981	89.9%
U8	589	4295	87.9%
Total	94037	697336	88.1%

a. The strata variable is : toothpos

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1968170.669



**********.

9.4.1.1 Crown

```
* Encoding: windows-1252.
* RF All Teeth survival with a Crown 11.sps.

* Written by ML on 09/08/2020. Modified 04/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created		20-APR-2024 08:37:55
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav

	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:01:11.75
	Elapsed Time	00:01:14.52
Variables Created or Modified	survall	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav

Case Processing Summary

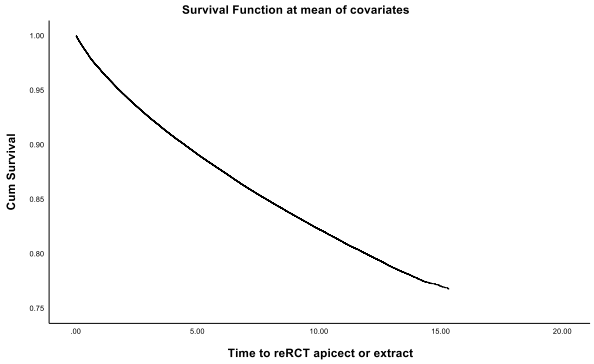
		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2452517.472



**********.

* What happens if there is a Crown?.

COXREG time
  /STATUS=reint(1)
  /strata = Crown
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survcrown).

Cox Regression

Notes

Output Created		20-APR-2024 08:39:10
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = Crown /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survcrown).
Resources	Processor Time	00:01:48.11
	Elapsed Time	00:01:51.79
Variables Created or Modified	survcrown	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

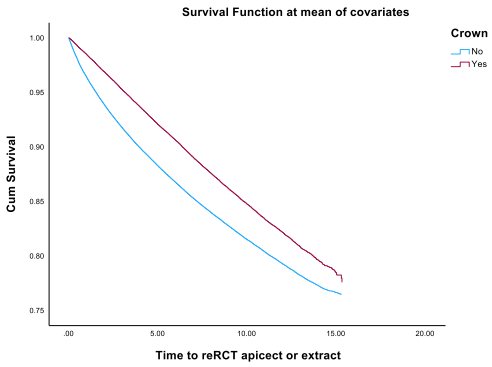
Stratum	Strata label	Event	Censored	Censored Percent
.00	No	76900	536317	87.5%
1.00	Yes	17137	161021	90.4%
Total		94037	697338	88.1%

a. The strata variable is : Crown

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2362170.381



**********.

*What happens to upper or lower teeth that are crowned ?

* Create descriptive variables.

String upplow (a1).

If (Any(quadrant,'UR','UL')) upplow= '1'.
If (Any(quadrant,'LR','LL')) upplow= '2'.

Execute.

value labels
/upplow
'1' 'Upper teeth'
'2' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (crown = 1).

COXREG time
  /STATUS=reint(1)
  /strata = upplow
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survCUL).

Cox Regression

Notes

Output Created		20-APR-2024 08:41:40
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>

	N of Rows in Working Data File	178365
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = upplow /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survCUL).
Resources	Processor Time	00:00:05.53
	Elapsed Time	00:00:06.68
Variables Created or Modified	survCUL	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	17137	9.6%
	Censored	161021	90.3%
	Total	178158	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	207	0.1%
	Total	207	0.1%
Total		178365	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Strata label	Event	Censored	Censored Percent
1	Upper teeth	12508	108804	89.7%
2	Lower teeth	4629	52217	91.9%

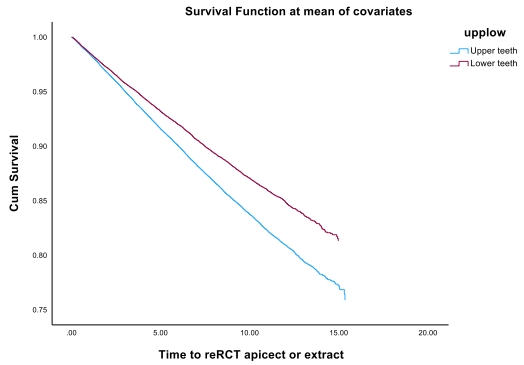
Total		17137	161021	90.4%

a. The strata variable is : upplow

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
371599.514



**********.

*What happens to anterior vs posterior of crowned teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

* Create descriptive variables.

```
String antpost (a1).

If (Any(tooth,'1','2','3')) antpost= '1'.
If (Any(tooth,'4','5','6','7','8')) antpost= '2'.

Execute.


value labels
/antpost
'1' 'Anterior teeth'
'2' 'Posterior teeth'.


save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

select if (crown = 1).
COXREG time
  /STATUS=reint(1)
  /strata = antpost
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootCAP).
```

Cox Regression

Notes

Output Created		20-APR-2024 08:41:48
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	178365
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.

Syntax		COXREG time /STATUS=reint(1) /strata = antpost /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survtootCAP).
Resources	Processor Time	00:00:05.42
	Elapsed Time	00:00:06.71
Variables Created or Modified	survtootCAP	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	17137	9.6%
	Censored	161000	90.3%
	Total	178137	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	228	0.1%
	Total	228	0.1%
Total		178365	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

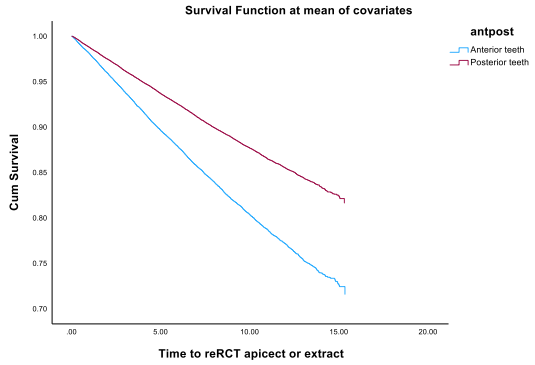
Stratum	Strata label	Event	Censored	Censored Percent
1	Anterior teeth	8757	60232	87.3%
2	Posterior teeth	8380	100768	92.3%
Total		17137	161000	90.4%

a. The strata variable is : antpost

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
366940.125



**********.

*What happens to quadrant to crowned teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

```
select if (crown = 1).
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
```

/Save survival (survtootCQ).

Cox Regression

Notes

Output Created		20-APR-2024 08:41:55
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	178365
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = Quadrant /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survtootCQ).
Resources	Processor Time	00:00:05.44
	Elapsed Time	00:00:06.91
Variables Created or Modified	survtootCQ	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	17137	9.6%
	Censored	161004	90.3%

	Total	178141	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	224	0.1%
	Total	224	0.1%
Total		178365	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

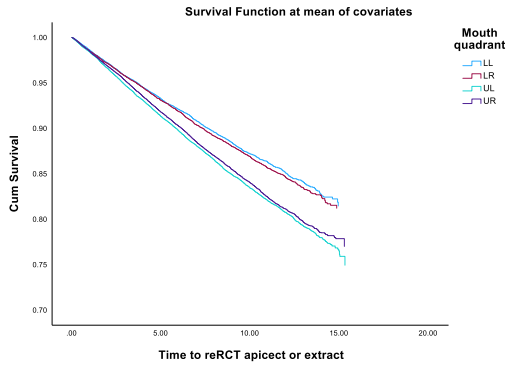
Stratum	Event	Censored	Censored Percent
LL	2252	25708	91.9%
UL	6411	54342	89.4%
LR	2377	26492	91.8%
UR	6097	54462	89.9%
Total	17137	161004	90.4%

a. The strata variable is : Mouth quadrant

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
347847.342



**********.

*What happens to tooth position to crowned teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.

select if (crown = 1).
COXREG time
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootCTP).

Cox Regression

Notes

Output Created		20-APR-2024 08:42:03
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	178365
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = toothpos /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survtootCTP).
Resources	Processor Time	00:00:05.31
	Elapsed Time	00:00:07.00
Variables Created or Modified	survtootCTP	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	17137	9.6%
	Censored	160865	90.2%
	Total	178002	99.8%

Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	363	0.2%
	Total	363	0.2%
Total		178365	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Event	Censored	Censored Percent
L1	276	2056	88.2%
U1	2344	16920	87.8%
L2	318	2078	86.7%
U2	3709	22944	86.1%
L3	274	3002	91.6%
U3	1836	13185	87.8%
L4	644	7604	92.2%
U4	1583	16931	91.4%
L5	1115	15036	93.1%
U5	1786	21718	92.4%
L6	1293	13738	91.4%
U6	708	10633	93.8%
L7	647	7684	92.2%
U7	496	5984	92.3%
L8	62	941	93.8%
U8	46	411	89.9%
Total	17137	160865	90.4%

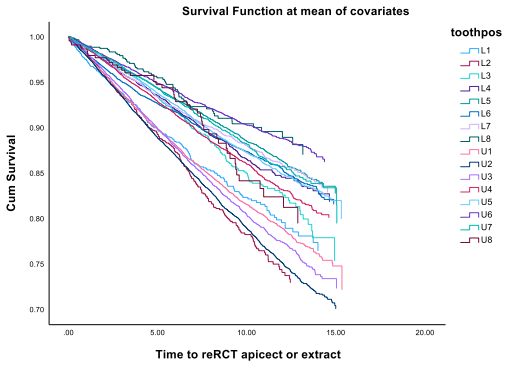
a. The strata variable is : toothpos

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood

308403.516


Survival Function at mean of covariates
toothpos
L1
L2
L3
L4
L5
L6
L7
L8
U1
U2
U3
U4
U5
U6
U7
U8
Cum Survival
1.00
0.95
0.90
0.85
0.80
0.75
0.70
.00
5.00
10.00
15.00
20.00
Time to reRCT apicect or extract

**********.

```
* Encoding: windows-1252.
* RF All Teeth survival with various crowns 01.sps.

* Written by ML on 19/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
crown Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created		19-APR-2024 23:54:38
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth crown Preparation.sav
	Filter	<none>

	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:00:25.52
	Elapsed Time	00:01:37.07
Variables Created or Modified	survall	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth crown Preparation.sav

Case Processing Summary

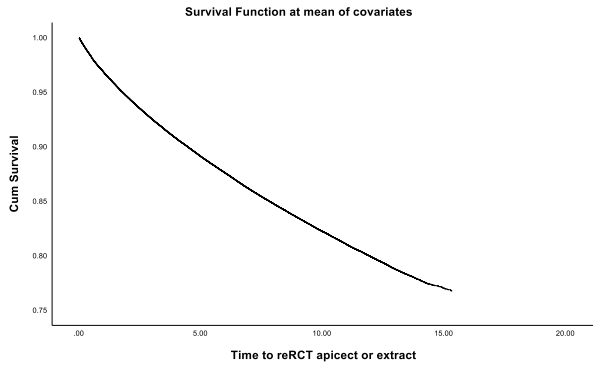
		N	Percent
Cases available in analysis	Event[a]	94036	11.9%
	Censored	697338	88.0%
	Total	791374	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	887	0.1%
	Total	887	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2452487.143



**********.

* What happens if there is a gold crown placed?.

```
COXREG time
  /STATUS=reint(1)
  /strata = GoldCrown
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		19-APR-2024 23:56:15
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth crown Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = GoldCrown /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:19.13
	Elapsed Time	00:01:33.06

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	818	0.1%
	Censored	8377	1.1%
	Total	9195	1.2%
Cases dropped	Cases with missing values	783066	98.8%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	0	0.0%
	Total	783066	98.8%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Strata label	Event	Censored	Censored Percent
1.00	Yes	818	8377	91.1%

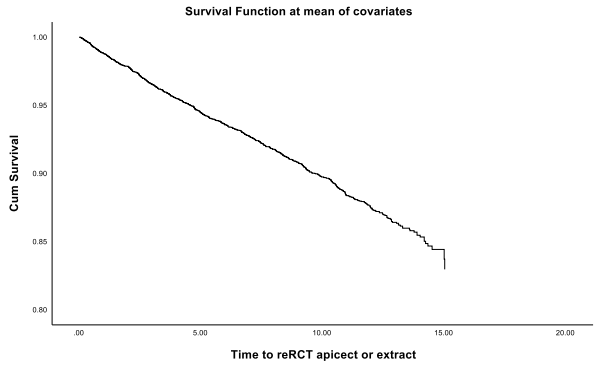
Total		818	8377	91.1%

a. The strata variable is : GoldCrown

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
14134.414



**********.
* What happens if there is a metal crown placed?.

```
COXREG time
  /STATUS=reint(1)
  /strata = MetalCrown
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
```

/PLOT = SURVIVAL.

Cox Regression

Notes

Output Created		19-APR-2024 23:57:48
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth crown Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = MetalCrown /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:41.11
	Elapsed Time	00:01:32.98

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	918	0.1%
	Censored	17370	2.2%
	Total	18288	2.3%
Cases dropped	Cases with missing values	773923	97.7%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	50	0.0%
	Total	773973	97.7%

Total	792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

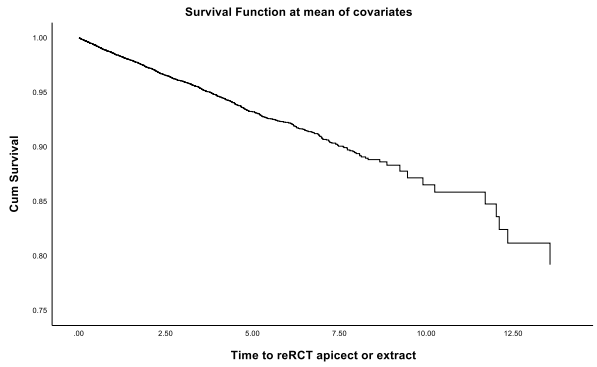
Stratum	Strata label	Event	Censored	Censored Percent
1.00	Yes	918	17370	95.0%
Total		918	17370	95.0%

a. The strata variable is : MetalCrown

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
16791.873



```
**************************************************.
* What happens if there is a PJC crown placed?.

COXREG time
  /STATUS=reint(1)
  /strata = PJCCrown
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		19-APR-2024 23:59:21
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth crown Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = PJCCrown /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:21.20
	Elapsed Time	00:01:33.19

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	469	0.1%
	Censored	2272	0.3%

	Total	2741	0.3%
Cases dropped	Cases with missing values	789517	99.7%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	3	0.0%
	Total	789520	99.7%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

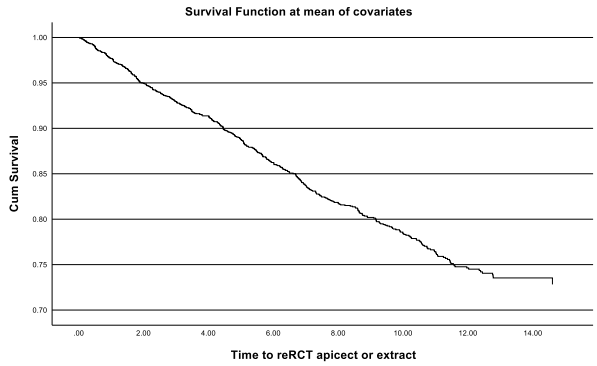
Stratum	Strata label	Event	Censored	Censored Percent
1.00	Yes	469	2272	82.9%
Total		469	2272	82.9%

a. The strata variable is : PJCCrown

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
6954.206



**********.
* What happens if there is a bonded crown placed?.

```
COXREG time
  /STATUS=reint(1)
  /strata = BondedCrown
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		20-APR-2024 00:00:54
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth crown Preparation.sav
	Filter	<none>
	Weight	<none>

	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = BondedCrown /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:28.05
	Elapsed Time	00:01:33.01

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	14888	1.9%
	Censored	132710	16.8%
	Total	147598	18.6%
Cases dropped	Cases with missing values	644509	81.4%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	154	0.0%
	Total	644663	81.4%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Strata label	Event	Censored	Censored Percent
1.00	Yes	14888	132710	89.9%
Total		14888	132710	89.9%

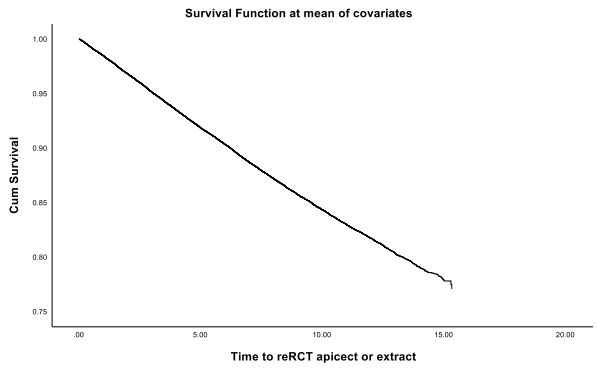
a. The strata variable is : BondedCrown

Block 0: Beginning Block

Omnibus Tests of

Model Coefficients

-2 Log Likelihood
335140.586



**********.
* What happens if there is a other crowns including temporary crowns are placed?.

```
COXREG time
  /STATUS=reint(1)
  /strata = OtherCrown
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created	20-APR-2024 00:02:27
Comments	

Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth crown Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = OtherCrown /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:29.28
	Elapsed Time	00:01:33.23

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	51	0.0%
	Censored	325	0.0%
	Total	376	0.0%
Cases dropped	Cases with missing values	791885	100.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	0	0.0%
	Total	791885	100.0%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

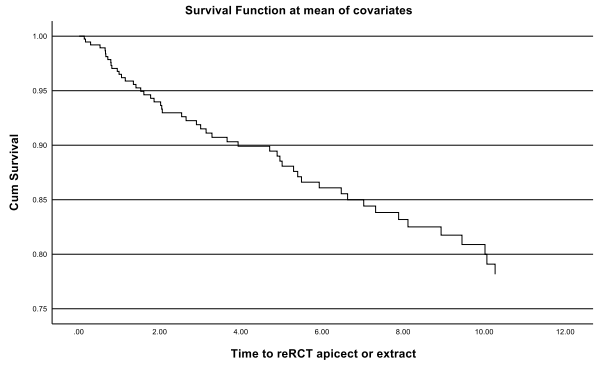
Stratum	Strata label	Event	Censored	Censored Percent
1.00	Yes	51	325	86.4%
Total		51	325	86.4%

a. The strata variable is : OtherCrown

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
554.677



**********.

9.4.1.2 Bridge

```
* Encoding: windows-1252.
* RF All Teeth survival with being a bridge abutment 06.sps.

* Written by ML on 22/05/2022. Modified 13/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created		19-APR-2024 15:20:20
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav

	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:01:11.58
	Elapsed Time	00:01:38.75
Variables Created or Modified	survall	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav

Case Processing Summary

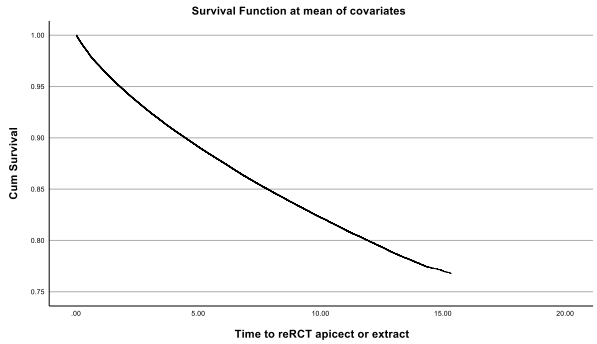
		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2452517.472



**********.

* What happens if there is a bridge abutment?.

```
COXREG time
  /STATUS=reint(1)
  /strata = Abutment
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survabut).
```

Cox Regression

Notes

Output Created		19-APR-2024 15:21:59
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = Abutment /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survabut).
Resources	Processor Time	00:01:47.13
	Elapsed Time	00:01:52.11
Variables Created or Modified	survabut	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697315	88.0%
	Total	791352	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	909	0.1%
	Total	909	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

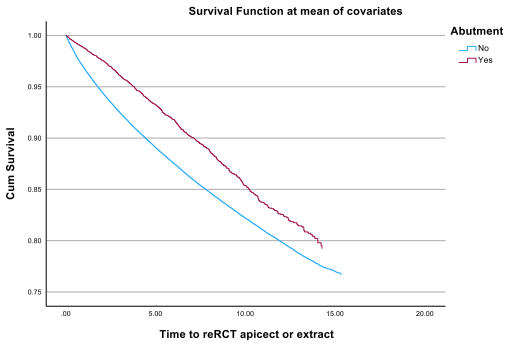
Stratum	Strata label	Event	Censored	Censored Percent
.00	No	93039	686267	88.1%
1.00	Yes	998	11048	91.7%
Total		94037	697315	88.1%

a. The strata variable is : Abutment

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2441316.748



**********.

*What happens to upper or lower teeth that are bridge abuted ?

```
* Create descriptive variables.

String upplow (a1).

If (Any(quadrant,'UR','UL')) upplow= '1'.
If (Any(quadrant,'LR','LL')) upplow= '2'.

Execute.

value labels
/upplow
'1' 'Upper teeth'
'2' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.


select if (Abutment = 1).

COXREG time
  /STATUS=reint(1)
  /strata = upplow
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survAUL).
```

Cox Regression

Notes

Output Created		19-APR-2024 15:24:29
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	12097

Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = upplow /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survAUL).
Resources	Processor Time	00:00:00.41
	Elapsed Time	00:00:01.06
Variables Created or Modified	survAUL	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	998	8.2%
	Censored	11046	91.3%
	Total	12044	99.6%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	53	0.4%
	Total	53	0.4%
Total		12097	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

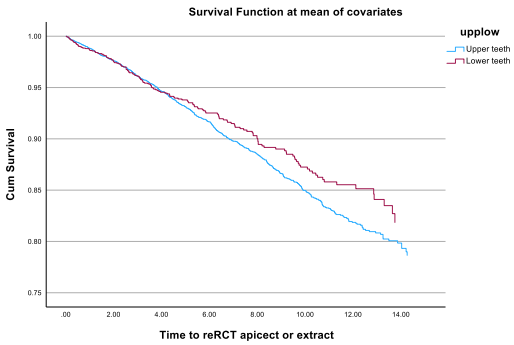
Stratum Status[a]

Stratum	Strata label	Event	Censored	Censored Percent
1	Upper teeth	828	8851	91.4%
2	Lower teeth	170	2195	92.8%
Total		998	11046	91.7%

a. The strata variable is : upplow

Block 0: Beginning Block

Omnibus Tests of Model Coefficients
-2 Log Likelihood
16324.019



**********.

*What happens to anterior vs posterior of abutment teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

* Create descriptive variables.

String antpost (a1).

If (Any(tooth,'1','2','3')) antpost= '1'.

```
If (Any(tooth,'4','5','6','7','8')) antpost= '2'.

Execute.


value labels
/antpost
'1' 'Anterior teeth'
'2' 'Posterior teeth'.


save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

select if (Abutment = 1).
COXREG time
  /STATUS=reint(1)
  /strata = antpost
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootAAP).
```

Cox Regression

Notes

Output Created		19-APR-2024 15:24:31
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	12097
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = antpost /CRITERIA=PIN(.05)

		POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survtootAAP).
Resources	Processor Time	00:00:00.45
	Elapsed Time	00:00:00.98
Variables Created or Modified	survtootAAP	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	998	8.2%
	Censored	11043	91.3%
	Total	12041	99.5%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	56	0.5%
	Total	56	0.5%
Total		12097	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Strata label	Event	Censored	Censored Percent
1	Anterior teeth	611	5860	90.6%
2	Posterior teeth	387	5183	93.1%
Total		998	11043	91.7%

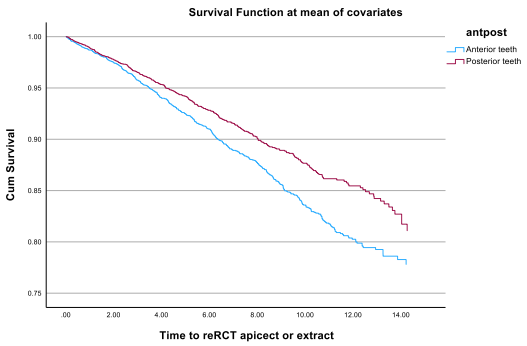
a. The strata variable is : antpost

Block 0: Beginning Block

Omnibus Tests of

Model Coefficients

-2 Log Likelihood
15888.993



**********.

*What happens to quadrant to abutment teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (Abutment = 1).
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootAQ).

Cox Regression

Notes

Output Created		19-APR-2024 15:24:32
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	12097
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = Quadrant /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survtootAQ).
Resources	Processor Time	00:00:00.52
	Elapsed Time	00:00:01.06
Variables Created or Modified	survtootAQ	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	998	8.2%
	Censored	11034	91.2%
	Total	12032	99.5%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	65	0.5%

Total	65	0.5%
Total	12097	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

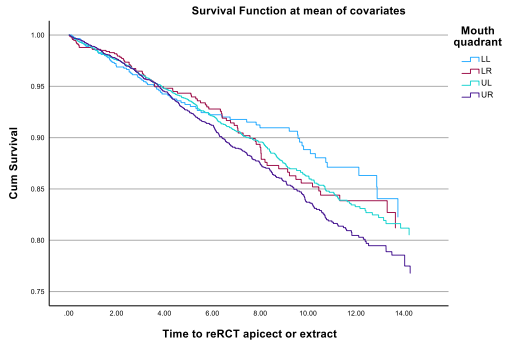
Stratum	Event	Censored	Censored Percent
LL	81	1113	93.2%
UL	382	4372	92.0%
LR	89	1075	92.4%
UR	446	4474	90.9%
Total	998	11034	91.7%

a. The strata variable is : Mouth quadrant

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
14940.177



**********.

*What happens to tooth position to abutment teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.

select if (Abutment = 1).
COXREG time
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootATP).

Cox Regression

Notes

Output Created		19-APR-2024 15:24:34
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	12097
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = toothpos /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survtootATP).
Resources	Processor Time	00:00:00.30
	Elapsed Time	00:00:01.00
Variables Created or Modified	survtootATP	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	998	8.2%
	Censored	10953	90.5%
	Total	11951	98.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%

	Censored cases before the earliest event in a stratum	146	1.2%
	Total	146	1.2%
Total		12097	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

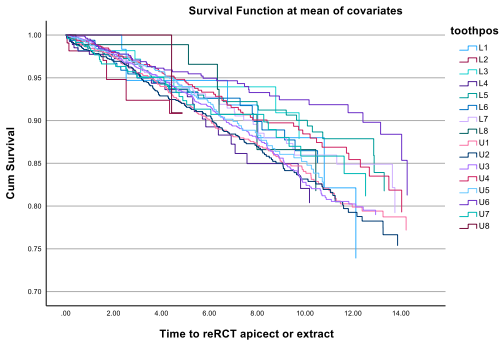
Stratum	Event	Censored	Censored Percent
L1	7	53	88.3%
U1	186	1686	90.1%
L2	8	100	92.6%
U2	168	1455	89.6%
L3	9	156	94.5%
U3	233	2384	91.1%
L4	25	246	90.8%
U4	70	915	92.9%
L5	44	600	93.2%
U5	92	1111	92.4%
L6	24	302	92.6%
U6	43	810	95.0%
L7	47	616	92.9%
U7	35	426	92.4%
L8	6	83	93.3%
U8	1	10	90.9%
Total	998	10953	91.6%

a. The strata variable is : toothpos

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
12759.207


Survival Function at mean of covariates
toothpos
L1
L2
L3
L4
L5
L6
L7
L8
U1
U2
U3
U4
U5
U6
U7
U8
Cum Survival
1.00
0.95
0.90
0.85
0.80
0.75
0.70
.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
Time to reRCT apicect or extract

**********.

9.4.1.3 Post

```
* Encoding: windows-1252.
* RF All Teeth survival with a post 01.sps.

* Written by ML on 13/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created		13-APR-2024 18:22:53
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav

	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:00:55.13
	Elapsed Time	00:01:46.12
Variables Created or Modified	survall	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav

Case Processing Summary

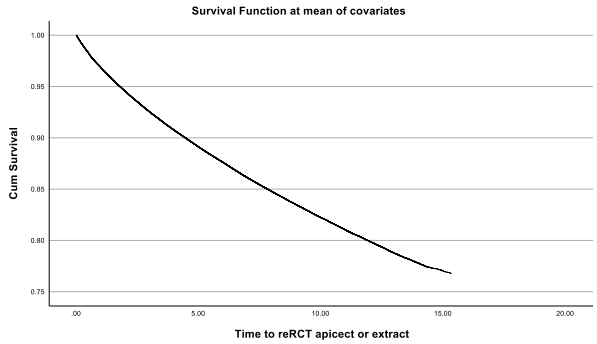
		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2452517.472



**********.

* What happens if there is a post placed?.

```
COXREG time
  /STATUS=reint(1)
  /strata = post
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survpost).
```

Cox Regression

Notes

Output Created		13-APR-2024 18:24:39
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = post /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survpost).
Resources	Processor Time	00:01:51.81
	Elapsed Time	00:03:30.76
Variables Created or Modified	survpost	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

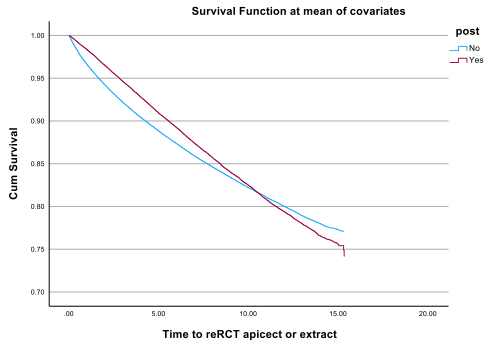
Stratum	Strata label	Event	Censored	Censored Percent
.00	No	81620	595137	87.9%
1.00	Yes	12417	102201	89.2%
Total		94037	697338	88.1%

a. The strata variable is : post

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2378965.277



**********.

*What happens to upper or lower teeth that have a post ?

```
* Create descriptive variables.

String upplow (a1).

If (Any(quadrant,'UR','UL')) upplow= '1'.
If (Any(quadrant,'LR','LL')) upplow= '2'.

Execute.

value labels
/upplow
'1' 'Upper teeth'
'2' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.


select if (post = 1).

COXREG time
  /STATUS=reint(1)
  /strata = upplow
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survPOUL).
```

Cox Regression

Notes

Output Created		13-APR-2024 18:30:02
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	114761

Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = upplow /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survPOUL).
Resources	Processor Time	00:00:02.52
	Elapsed Time	00:00:06.72
Variables Created or Modified	survPOUL	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	12417	10.8%
	Censored	102191	89.0%
	Total	114608	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	153	0.1%
	Total	153	0.1%
Total		114761	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

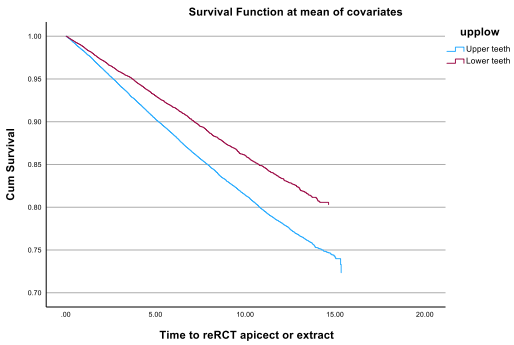
Stratum Status[a]

Stratum	Strata label	Event	Censored	Censored Percent
1	Upper teeth	10131	76851	88.4%
2	Lower teeth	2286	25340	91.7%
Total		12417	102191	89.2%

a. The strata variable is : upplow

Block 0: Beginning Block

Omnibus Tests of Model Coefficients
-2 Log Likelihood
260492.733



**********.

*What happens to anterior vs posterior of a post in teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

* Create descriptive variables.

String antpost (a1).

If (Any(tooth,'1','2','3')) antpost= '1'.

```
If (Any(tooth,'4','5','6','7','8')) antpost= '2'.

Execute.

value labels
/antpost
'1' 'Anterior teeth'
'2' 'Posterior teeth'.


save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

select if (post = 1).
COXREG time
  /STATUS=reint(1)
  /strata = antpost
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootPOAP).
```

Cox Regression

Notes

Output Created		13-APR-2024 18:30:10
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	114761
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = antpost /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)

		/PLOT = SURVIVAL /Save survival (survtootPOAP).
Resources	Processor Time	00:00:02.33
	Elapsed Time	00:00:06.43
Variables Created or Modified	survtootPOAP	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	12417	10.8%
	Censored	102180	89.0%
	Total	114597	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	164	0.1%
	Total	164	0.1%
Total		114761	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Strata label	Event	Censored	Censored Percent
1	Anterior teeth	8482	54695	86.6%
2	Posterior teeth	3935	47485	92.3%
Total		12417	102180	89.2%

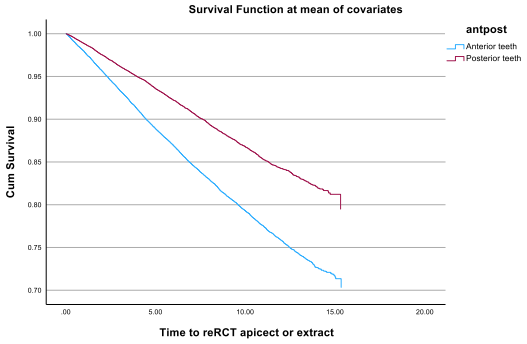
a. The strata variable is : antpost

Block 0: Beginning Block

Omnibus Tests of Model

Coefficients

-2 Log Likelihood
256272.262



**********.

*What happens to quadrant to post in teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (post = 1).
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootPOQ).

Cox Regression

Notes

Output Created		13-APR-2024 18:30:17
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	114761
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = Quadrant /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survtootPOQ).
Resources	Processor Time	00:00:02.36
	Elapsed Time	00:00:06.48
Variables Created or Modified	survtootPOQ	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	12417	10.8%
	Censored	102175	89.0%
	Total	114592	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	169	0.1%
	Total	169	0.1%

Total	114761	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

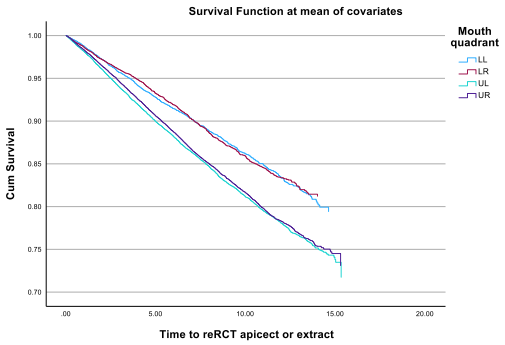
Stratum	Event	Censored	Censored Percent
LL	1148	12550	91.6%
UL	5163	38358	88.1%
LR	1138	12774	91.8%
UR	4968	38493	88.6%
Total	12417	102175	89.2%

a. The strata variable is : Mouth quadrant

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
243279.603



**********.

*What happens to tooth position to post in teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.

select if (Post = 1).
COXREG time
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootPOTP).

Cox Regression

Notes

Output Created		13-APR-2024 18:30:25
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	114761

Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = toothpos /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survtootPOTP).
Resources	Processor Time	00:00:02.81
	Elapsed Time	00:00:06.26
Variables Created or Modified	survtootPOTP	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	12417	10.8%
	Censored	102099	89.0%
	Total	114516	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	245	0.2%
	Total	245	0.2%
Total		114761	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Event	Censored	Censored Percent
L1	231	1525	86.8%
U1	2326	14718	86.4%
L2	260	1602	86.0%
U2	3591	21429	85.6%
L3	234	2301	90.8%
U3	1840	13099	87.7%

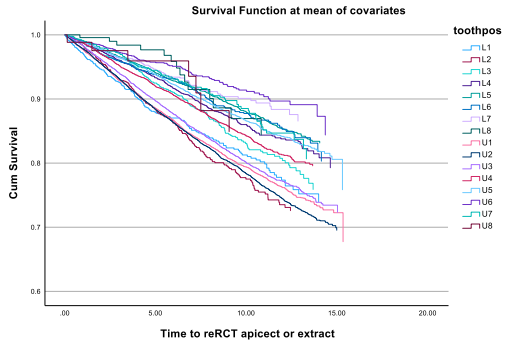
L4	448	5092	91.9%
U4	998	9901	90.8%
L5	764	9915	92.8%
U5	1151	13906	92.4%
L6	222	2853	92.8%
U6	120	2354	95.1%
L7	113	1787	94.1%
U7	98	1319	93.1%
L8	14	219	94.0%
U8	7	79	91.9%
Total	12417	102099	89.2%

a. The strata variable is : toothpos

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
219271.652



**********.

9.4.1.4 Pin or Screw

```
* Encoding: windows-1252.
* RF All Teeth survival with pin and screws 08.sps.

* Written by ML on 09/08/2020. Modified 13/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created		13-APR-2024 17:53:20
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD

		Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:00:44.42
	Elapsed Time	00:01:44.46
Variables Created or Modified	survall	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav

Case Processing Summary

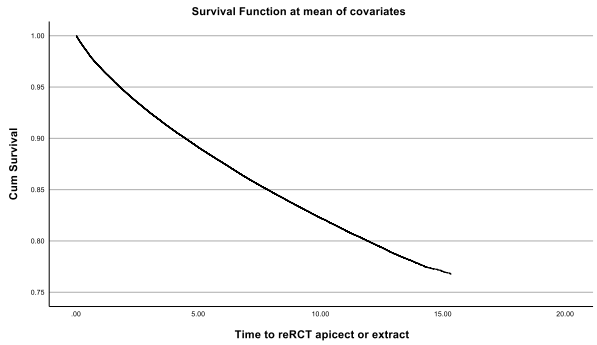
		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2452517.472



**********.

* What happens if there is a pin or screw placed?.

```
COXREG time
  /STATUS=reint(1)
  /strata = pinorscrew
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survpin).
```

Cox Regression

Notes

Output Created		13-APR-2024 17:55:05
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = pinorscrew /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survpin).
Resources	Processor Time	00:01:17.13
	Elapsed Time	00:02:35.25
Variables Created or Modified	survpin	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%

Total	792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

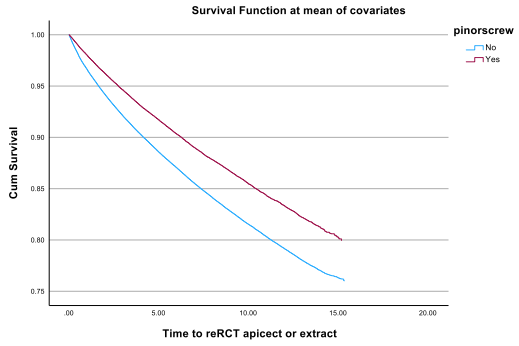
Stratum	Strata label	Event	Censored	Censored Percent
.00	No	80565	575195	87.7%
1.00	Yes	13472	122143	90.1%
Total		94037	697338	88.1%

a. The strata variable is : pinorscrew

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2374440.192



**********.

*What happens to upper or lower teeth that have a pin or screw ?

* Create descriptive variables.

String upplow (a1).

If (Any(quadrant,'UR','UL')) upplow= '1'.
If (Any(quadrant,'LR','LL')) upplow= '2'.

Execute.

value labels
/upplow
'1' 'Upper teeth'
'2' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (pinorscrew = 1).

COXREG time
  /STATUS=reint(1)
  /strata = upplow
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survPUL).

Cox Regression

Notes

Output Created		13-APR-2024 17:58:34
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>

	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	135710
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = upplow /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survPUL).
Resources	Processor Time	00:00:03.50
	Elapsed Time	00:00:06.65
Variables Created or Modified	survPUL	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	13472	9.9%
	Censored	122143	90.0%
	Total	135615	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	95	0.1%
	Total	95	0.1%
Total		135710	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Strata label	Event	Censored	Censored Percent
1	Upper teeth	7722	68218	89.8%

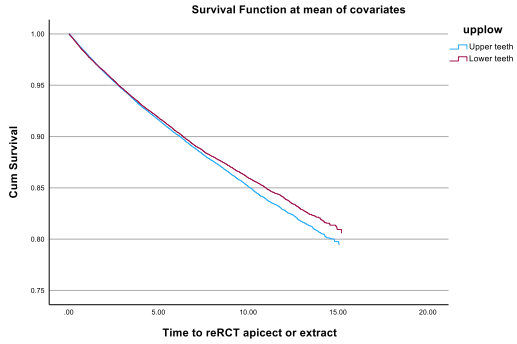
2	Lower teeth	5750	53925	90.4%
Total		13472	122143	90.1%

a. The strata variable is : upplow

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
284961.697



**********.

*What happens to anterior vs posterior of pin or screw in teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

* Create descriptive variables.

```
String antpost (a1).

If (Any(tooth,'1','2','3')) antpost= '1'.
If (Any(tooth,'4','5','6','7','8')) antpost= '2'.

Execute.

value labels
/antpost
'1' 'Anterior teeth'
'2' 'Posterior teeth'.


save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

select if (pinorscrew = 1).
COXREG time
  /STATUS=reint(1)
  /strata = antpost
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootPAP).
```

Cox Regression

Notes

Output Created		13-APR-2024 17:58:42
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	135710
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.

Syntax		COXREG time /STATUS=reint(1) /strata = antpost /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survtootPAP).
Resources	Processor Time	00:00:03.33
	Elapsed Time	00:00:07.49
Variables Created or Modified	survtootPAP	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	13472	9.9%
	Censored	122140	90.0%
	Total	135612	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	98	0.1%
	Total	98	0.1%
Total		135710	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

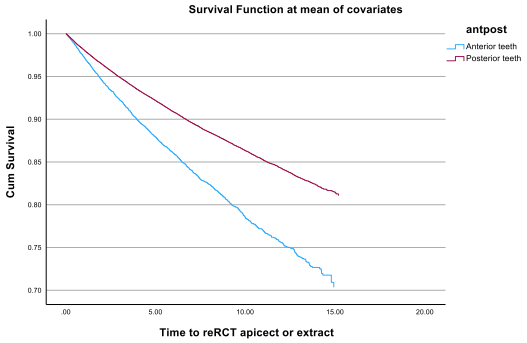
Stratum	Strata label	Event	Censored	Censored Percent
1	Anterior teeth	2116	12745	85.8%
2	Posterior teeth	11356	109395	90.6%
Total		13472	122140	90.1%

a. The strata variable is : antpost

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
291281.537



**********.

*What happens to quadrant to pin or screw in teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

```
select if (pinorscrew = 1).
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
```

/Save survival (survtootPQ).

Cox Regression

Notes

Output Created		13-APR-2024 17:58:49
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	135710
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = Quadrant /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survtootPQ).
Resources	Processor Time	00:00:02.39
	Elapsed Time	00:00:07.68
Variables Created or Modified	survtootPQ	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	13472	9.9%
	Censored	122137	90.0%

	Total	135609	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	101	0.1%
	Total	101	0.1%
Total		135710	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

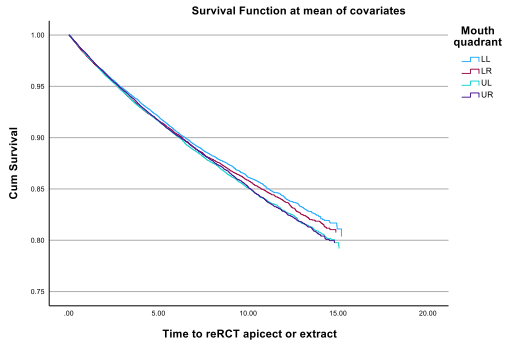
Stratum	Event	Censored	Censored Percent
LL	2823	26982	90.5%
UL	3923	34323	89.7%
LR	2927	26943	90.2%
UR	3799	33889	89.9%
Total	13472	122137	90.1%

a. The strata variable is : Mouth quadrant

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
266288.570



**********.

*What happens to tooth position to pin or screw in teeth?

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.

select if (Pinorscrew = 1).
COXREG time
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootPTP).

Cox Regression

Notes

Output Created		13-APR-2024 17:58:59
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	135710
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = toothpos /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survtootPTP).
Resources	Processor Time	00:00:03.88
	Elapsed Time	00:00:07.60
Variables Created or Modified	survtootPTP	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	13472	9.9%
	Censored	122112	90.0%
	Total	135584	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%

	Censored cases before the earliest event in a stratum	126	0.1%
	Total	126	0.1%
Total		135710	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

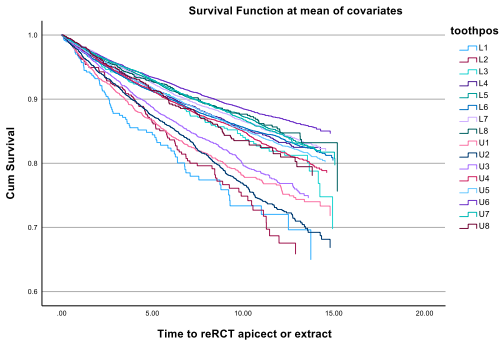
Stratum	Event	Censored	Censored Percent
L1	82	396	82.8%
U1	477	2806	85.5%
L2	116	612	84.1%
U2	653	3562	84.5%
L3	149	1239	89.3%
U3	639	4120	86.6%
L4	571	5240	90.2%
U4	1503	12663	89.4%
L5	1125	11581	91.1%
U5	1805	16181	90.0%
L6	2343	20968	89.9%
U6	1512	17699	92.1%
L7	1185	12086	91.1%
U7	1007	10149	91.0%
L8	179	1799	91.0%
U8	126	1011	88.9%
Total	13472	122112	90.1%

a. The strata variable is : toothpos

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
236964.878


Survival Function at mean of covariates
toothpos
L1
L2
L3
L4
L5
L6
L7
L8
U1
U2
U3
U4
U5
U6
U7
U8
Cum Survival
1.0
0.9
0.8
0.7
0.6
.00
5.00
10.00
15.00
20.00
Time to reRCT apicect or extract

**********.

9.4.2 Restoration Placed After the RCT on Anterior Teeth

9.4.2.1 Incisal Edge

```
* Encoding: windows-1252.
* RF Incisor Teeth survival with incisal edge restoration 03.sps.

* Written by ML on 09/08/2020.  Modified 12/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created	13-APR-2024 18:50:37
Comments	

Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:01:10.94
	Elapsed Time	00:02:17.35
Variables Created or Modified	survall	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav

Case Processing Summary

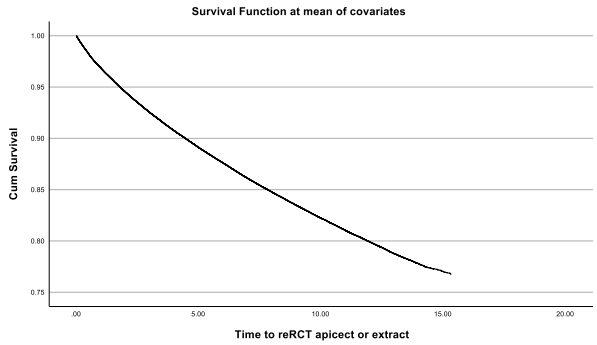
		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2452517.472



**********.

* Restrict to anterior teeth.
* What happens if there is an incisal edge filling?.

```
select if (Range (Tooth,'1', '3')).
COXREG time
  /STATUS=reint(1)
  /strata = Incisaledge
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (surviedg).
```

Cox Regression

Notes

Output Created		13-APR-2024 18:52:55
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	228893
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = Incisaledge /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (surviedg).
Resources	Processor Time	00:00:55.02
	Elapsed Time	00:01:49.22
Variables Created or Modified	surviedg	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	31995	14.0%
	Censored	196631	85.9%
	Total	228626	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%

	Censored cases before the earliest event in a stratum	267	0.1%
	Total	267	0.1%
Total		228893	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

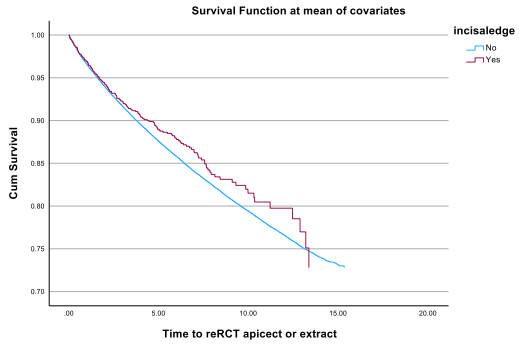
Stratum	Strata label	Event	Censored	Censored Percent
.00	No	31782	194712	86.0%
1.00	Yes	213	1919	90.0%
Total		31995	196631	86.0%

a. The strata variable is : incisaledge

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
751359.735



**********.

*What happens to upper or lower teeth that are filled ?

* Create descriptive variables.

String upplow (a1).

If (any(quadrant,'UR','UL')) upplow= '0'.
If (any(quadrant,'LR','LL')) upplow= '1'.

Execute.

value labels
/upplow
'0' 'Upper teeth'
'1' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (Incisaledge= 1).
COXREG time

/STATUS=reint(1)
/strata = upplow
/CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
/PLOT = SURVIVAL
/Save survival (suriedgUL).

Cox Regression

Notes

Output Created		13-APR-2024 18:55:06
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	2134
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = upplow /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (suriedgUL).
Resources	Processor Time	00:00:00.06
	Elapsed Time	00:00:00.47
Variables Created or Modified	suriedgUL	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	213	10.0%
	Censored	1919	89.9%
	Total	2132	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	2	0.1%
	Total	2	0.1%
Total		2134	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

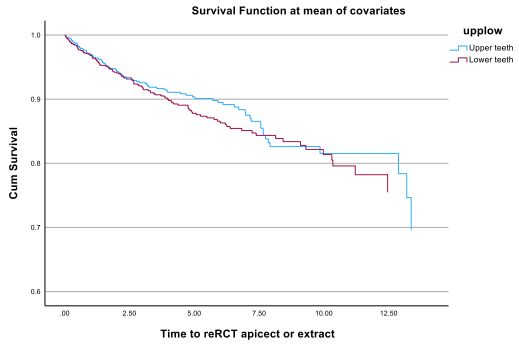
Stratum	Strata label	Event	Censored	Censored Percent
0	Upper teeth	95	947	90.9%
1	Lower teeth	118	972	89.2%
Total		213	1919	90.0%

a. The strata variable is : upplow

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2699.830



**********.

*What happens to quadrant to filled teeth?

get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (Incisaledge = 1).
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (suriedgQ).

Cox Regression

Notes

Output Created		13-APR-2024 18:55:07
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	2134
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = Quadrant /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (suriedgQ).
Resources	Processor Time	00:00:00.37
	Elapsed Time	00:00:00.57
Variables Created or Modified	suriedgQ	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	213	10.0%
	Censored	1918	89.9%
	Total	2131	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	3	0.1%
	Total	3	0.1%
Total		2134	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Event	Censored	Censored Percent
LL	55	483	89.8%
UL	49	494	91.0%
LR	63	489	88.6%
UR	46	452	90.8%

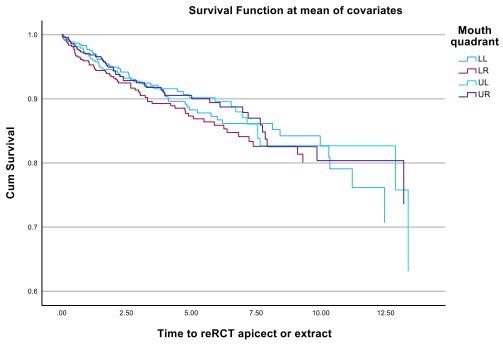
Total	213	1918	90.0%

a. The strata variable is : Mouth quadrant

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2404.780



**********.

*What happens to tooth position to filled teeth?

* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).

```
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

select if (Incisaledge = 1).
COXREG time
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (suriedgTP).
```

Cox Regression

Notes

Output Created		13-APR-2024 18:55:07
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	2134
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = toothpos /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (suriedgTP).
Resources	Processor Time	00:00:00.14
	Elapsed Time	00:00:00.20

Variables Created or Modified	suriedgTP	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	213	10.0%
	Censored	1913	89.6%
	Total	2126	99.6%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	8	0.4%
	Total	8	0.4%
Total		2134	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

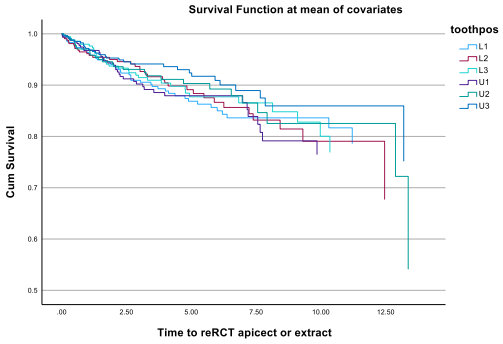
Stratum	Event	Censored	Censored Percent
L1	48	370	88.5%
U1	36	284	88.8%
L2	35	282	89.0%
U2	29	281	90.6%
L3	35	318	90.1%
U3	30	378	92.6%
Total	213	1913	90.0%

a. The strata variable is : toothpos

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2233.719



**********.

9.4.2.2 One incisal angle

```
* Encoding: windows-1252.
* RF Incisor Teeth survival with one incisalangle restoration 04.sps.

* Written by ML on 09/08/2020. Modified 12/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created		13-APR-2024 19:18:22
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav

	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:01:12.11
	Elapsed Time	00:01:14.41
Variables Created or Modified	survall	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav

Case Processing Summary

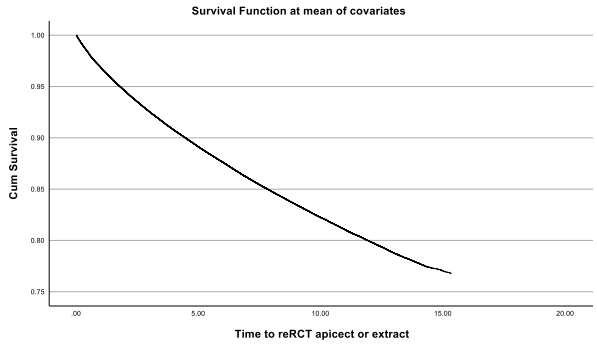
		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2452517.472



**********.

* Restrict to anterior teeth.
* What happens if there is one incisal angle filling?.

```
select if (Range (Tooth,'1', '3')).
COXREG time
  /STATUS=reint(1)
  /strata = oneangle
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survangle).
```

Cox Regression

Notes

Output Created		13-APR-2024 19:19:36
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	228893
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = oneangle /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survangle).
Resources	Processor Time	00:00:57.20
	Elapsed Time	00:00:59.67
Variables Created or Modified	survangle	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	31995	14.0%
	Censored	196631	85.9%
	Total	228626	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	267	0.1%

Total	267	0.1%
Total	228893	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

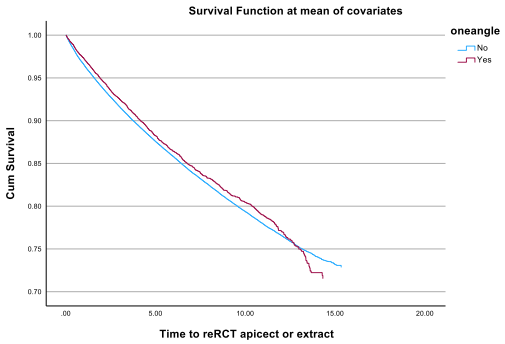
Stratum	Strata label	Event	Censored	Censored Percent
.00	No	30562	186920	85.9%
1.00	Yes	1433	9711	87.1%
Total		31995	196631	86.0%

a. The strata variable is : oneangle

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
742195.780



**********.

*What happens to upper or lower teeth that are filled ?

* Create descriptive variables.

String upplow (a1).

If (any(quadrant,'UR','UL')) upplow= '0'.
If (any(quadrant,'LR','LL')) upplow= '1'.

Execute.

value labels
/upplow
'0' 'Upper teeth'
'1' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (oneangle= 1).
COXREG time
  /STATUS=reint(1)
  /strata = upplow
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (surangleUL).

Cox Regression

Notes

Output Created		13-APR-2024 19:20:48
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>

	Split File	<none>
	N of Rows in Working Data File	11149
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = upplow /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (surangleUL).
Resources	Processor Time	00:00:00.27
	Elapsed Time	00:00:00.61
Variables Created or Modified	surangleUL	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	1433	12.9%
	Censored	9711	87.1%
	Total	11144	100.0%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	5	0.0%
	Total	5	0.0%
Total		11149	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Strata label	Event	Censored	Censored Percent
0	Upper teeth	1038	7130	87.3%

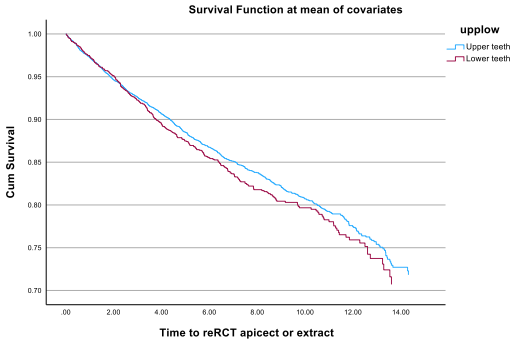
1	Lower teeth	395	2581	86.7%
Total		1433	9711	87.1%

a. The strata variable is : upplow

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
23213.467



**********.

*What happens to quadrant to filled teeth?

get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (oneangle = 1).

```
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (surangleQ).
```

Cox Regression

Notes

Output Created		13-APR-2024 19:20:49
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	11149
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = Quadrant /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (surangleQ).
Resources	Processor Time	00:00:00.44
	Elapsed Time	00:00:00.63
Variables Created or Modified	surangleQ	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
	Event[a]	1433	12.9%

Cases available in analysis	Censored	9710	87.1%
	Total	11143	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	6	0.1%
	Total	6	0.1%
Total		11149	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

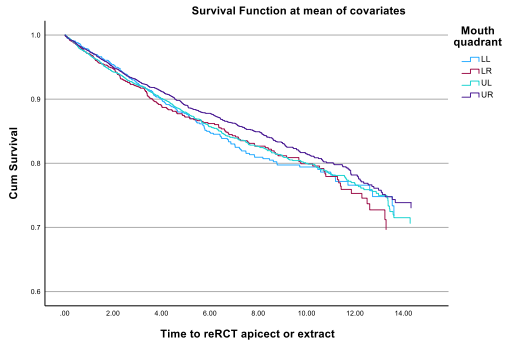
Stratum	Event	Censored	Censored Percent
LL	200	1323	86.9%
UL	544	3564	86.8%
LR	195	1258	86.6%
UR	494	3565	87.8%
Total	1433	9710	87.1%

a. The strata variable is : Mouth quadrant

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
21227.377



**********.

*What happens to tooth position to filled teeth?

* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

select if (oneangle = 1).
COXREG time
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (surangleTP).

Cox Regression

Notes

Output Created		13-APR-2024 19:20:50
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	11149
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = toothpos /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (surangleTP).
Resources	Processor Time	00:00:00.33
	Elapsed Time	00:00:00.19
Variables Created or Modified	surangleTP	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	1433	12.9%
	Censored	9708	87.1%
	Total	11141	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%

	Censored cases before the earliest event in a stratum	8	0.1%
	Total	8	0.1%
Total		11149	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

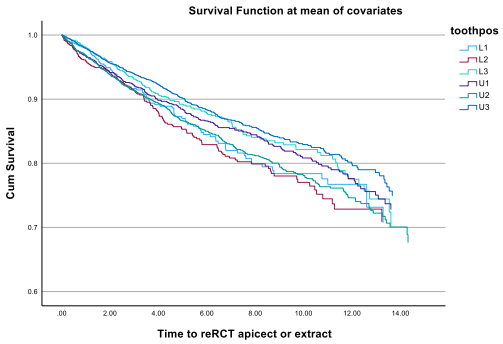
Stratum	Event	Censored	Censored Percent
L1	93	562	85.8%
U1	250	1682	87.1%
L2	143	791	84.7%
U2	419	2469	85.5%
L3	159	1226	88.5%
U3	369	2978	89.0%
Total	1433	9708	87.1%

a. The strata variable is : toothpos

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
20107.144


Survival Function at mean of covariates
toothpos
L1
L2
L3
U1
U2
U3
Cum Survival
1.0
0.9
0.8
0.7
0.6
.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
Time to reRCT apicect or extract

**********.

9.4.2.3 Two Incisal Angles

```
* Encoding: windows-1252.
* RF Incisor Teeth survival with two incisal angle restorations 04.sps.

* Written by ML on 09/08/2020.   Modified 12/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created		13-APR-2024 19:55:24
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav

	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:01:15.75
	Elapsed Time	00:01:17.13
Variables Created or Modified	survall	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav

Case Processing Summary

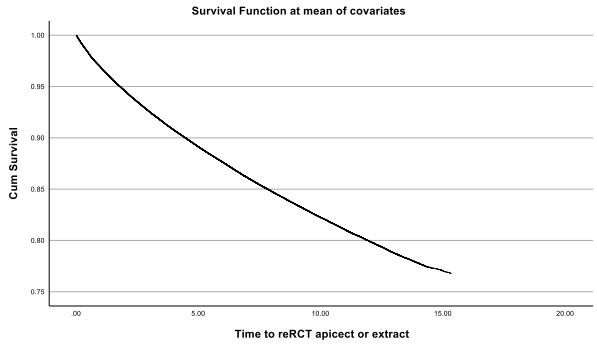
		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2452517.472



**********.

* Restrict to anterior teeth.
* What happens if there is two incisal angle fillings?.

```
select if (Range (Tooth,'1', '3')).
COXREG time
  /STATUS=reint(1)
  /strata = twoangles
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survangles).
```

Cox Regression

Notes

Output Created		13-APR-2024 19:56:41
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	228893
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = twoangles /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survangles).
Resources	Processor Time	00:01:01.13
	Elapsed Time	00:01:02.54
Variables Created or Modified	survangles	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	31995	14.0%
	Censored	196631	85.9%
	Total	228626	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	267	0.1%

Total	267	0.1%
Total	228893	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

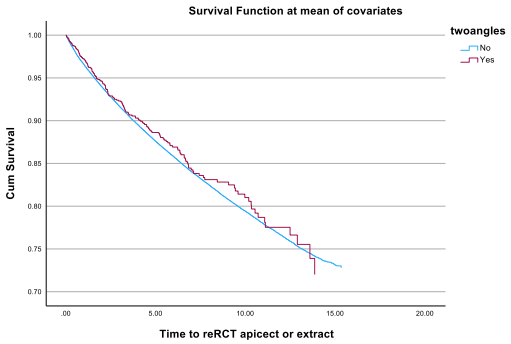
Stratum	Strata label	Event	Censored	Censored Percent
.00	No	31819	195278	86.0%
1.00	Yes	176	1353	88.5%
Total		31995	196631	86.0%

a. The strata variable is : twoangles

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
751728.185



**********.

*What happens to upper or lower teeth that are filled ?

* Create descriptive variables.

String upplow (a1).

If (any(quadrant,'UR','UL')) upplow= '0'.
If (any(quadrant,'LR','LL')) upplow= '1'.

Execute.

value labels
/upplow
'0' 'Upper teeth'
'1' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (twoangles= 1).
COXREG time
  /STATUS=reint(1)
  /strata = upplow
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (suranglesUL).

Cox Regression

Notes

Output Created		13-APR-2024 19:57:57
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>

	Split File	<none>
	N of Rows in Working Data File	1530
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = upplow /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (suranglesUL).
Resources	Processor Time	00:00:00.28
	Elapsed Time	00:00:00.29
Variables Created or Modified	suranglesUL	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	176	11.5%
	Censored	1351	88.3%
	Total	1527	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	3	0.2%
	Total	3	0.2%
Total		1530	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Strata label	Event	Censored	Censored Percent
0	Upper teeth	127	948	88.2%

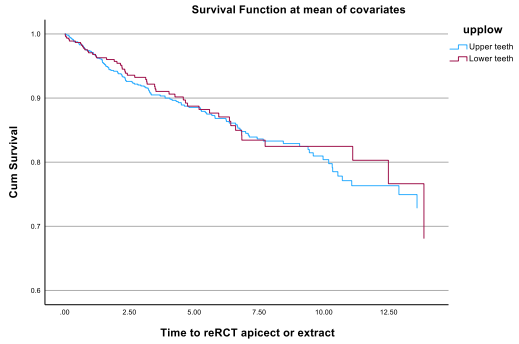
1	Lower teeth	49	403	89.2%
Total		176	1351	88.5%

a. The strata variable is : upplow

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2137.624



**********.

*What happens to quadrant to filled teeth?

get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (twoangles = 1).

```
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (suranglesQ).
```

Cox Regression

Notes

Output Created		13-APR-2024 19:57:57
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	1530
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = Quadrant /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (suranglesQ).
Resources	Processor Time	00:00:00.23
	Elapsed Time	00:00:00.32
Variables Created or Modified	suranglesQ	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
	Event[a]	176	11.5%

Cases available in analysis	Censored	1351	88.3%
	Total	1527	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	3	0.2%
	Total	3	0.2%
Total		1530	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

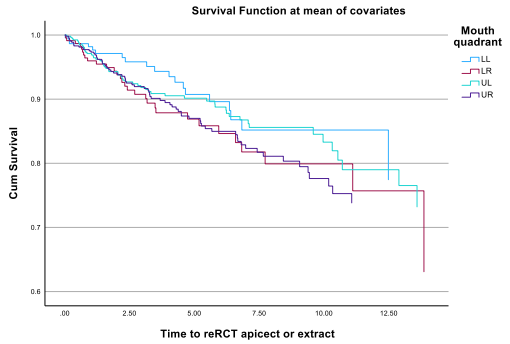
Stratum	Event	Censored	Censored Percent
LL	19	205	91.5%
UL	57	480	89.4%
LR	30	198	86.8%
UR	70	468	87.0%
Total	176	1351	88.5%

a. The strata variable is : Mouth quadrant

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1896.101



**********.

*What happens to tooth position to filled teeth?

* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

select if (twoangles = 1).
COXREG time
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (suranglesTP).

Cox Regression

Notes

Output Created		13-APR-2024 19:57:57
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	1530
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = toothpos /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (suranglesTP).
Resources	Processor Time	00:00:00.33
	Elapsed Time	00:00:00.17
Variables Created or Modified	suranglesTP	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	176	11.5%
	Censored	1344	87.8%
	Total	1520	99.3%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%

	Censored cases before the earliest event in a stratum	10	0.7%
	Total	10	0.7%
Total		1530	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

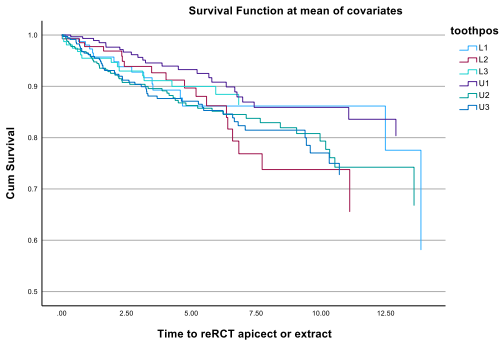
Stratum	Event	Censored	Censored Percent
L1	16	142	89.9%
U1	24	283	92.2%
L2	18	118	86.8%
U2	54	355	86.8%
L3	15	141	90.4%
U3	49	305	86.2%
Total	176	1344	88.4%

a. The strata variable is : toothpos

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1757.578


Survival Function at mean of covariates
toothpos
L1
L2
L3
U1
U2
U3
Cum Survival
1.0
0.9
0.8
0.7
0.6
0.5
.00
2.50
5.00
7.50
10.00
12.50
Time to reRCT apicect or extract

**********.

9.4.3 Restoration Placed After the RCT on Posterior Teeth

9.4.3.1 Occlusal

```
* Encoding: windows-1252.
* RF Posterior Teeth survival with Occlusal 05.sps.

* Written by ML on 09/08/2020.  Modified 12/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created	13-APR-2024 20:07:57
Comments	

Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:01:09.31
	Elapsed Time	00:01:17.96
Variables Created or Modified	survall	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav

Case Processing Summary

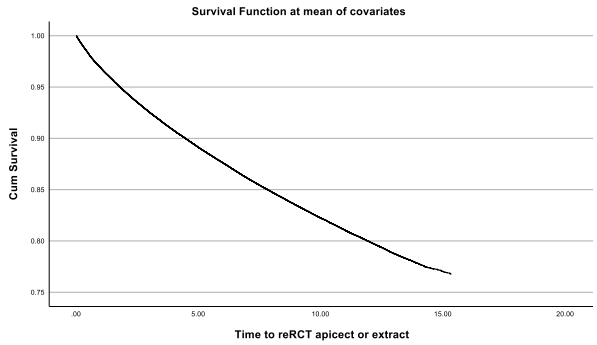
		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2452517.472



**********.

* Restrict to posterior teeth.
* What happens if there is an Occlusal filling?.

```
select if (Range (Tooth,'4', '8')).
COXREG time
  /STATUS=reint(1)
  /strata = Occlusal
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survo).
```

Cox Regression

Notes

Output Created		13-APR-2024 20:09:15
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	563368
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = Occlusal /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survo).
Resources	Processor Time	00:01:30.03
	Elapsed Time	00:01:34.45
Variables Created or Modified	survo	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	62042	11.0%
	Censored	500707	88.9%
	Total	562749	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	619	0.1%

Total	619	0.1%
Total	563368	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

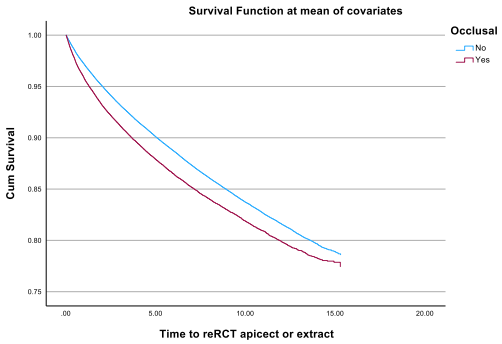
Stratum	Strata label	Event	Censored	Censored Percent
.00	No	51223	427076	89.3%
1.00	Yes	10819	73631	87.2%
Total		62042	500707	89.0%

a. The strata variable is : Occlusal

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1519337.633



**********.

*What happens to upper or lower teeth that are filled ?

* Create descriptive variables.

String upplow (a1).

If (any(quadrant,'UR','UL')) upplow= '0'.
If (any(quadrant,'LR','LL')) upplow= '1'.

Execute.

value labels
/upplow
'0' 'Upper teeth'
'1' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (Occlusal = 1).

COXREG time
  /STATUS=reint(1)
  /strata = upplow
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (surOUL).

Cox Regression

Notes

Output Created		13-APR-2024 20:11:18
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>

	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	84495
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = upplow /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (surOUL).
Resources	Processor Time	00:00:02.25
	Elapsed Time	00:00:04.13
Variables Created or Modified	surOUL	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	10819	12.8%
	Censored	73631	87.1%
	Total	84450	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	45	0.1%
	Total	45	0.1%
Total		84495	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Strata label	Event	Censored	Censored Percent
0	Upper teeth	5828	38293	86.8%

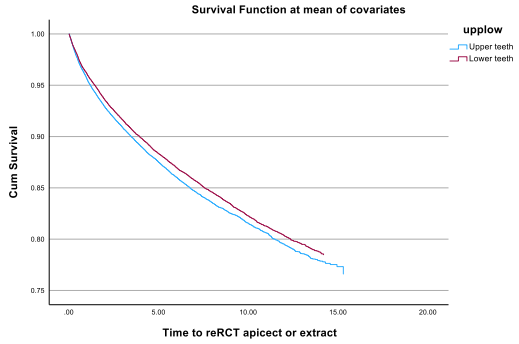
1	Lower teeth	4991	35338	87.6%
Total		10819	73631	87.2%

a. The strata variable is : upplow

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
220582.985



**********.

*What happens to quadrant to filled teeth?

get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (Occlusal = 1).

```
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootOQ).
```

Cox Regression

Notes

Output Created		13-APR-2024 20:11:22
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	84495
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = Quadrant /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survtootOQ).
Resources	Processor Time	00:00:02.88
	Elapsed Time	00:00:04.05
Variables Created or Modified	survtootOQ	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
	Event[a]	10819	12.8%

Cases available in analysis	Censored	73631	87.1%
	Total	84450	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	45	0.1%
	Total	45	0.1%
Total		84495	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

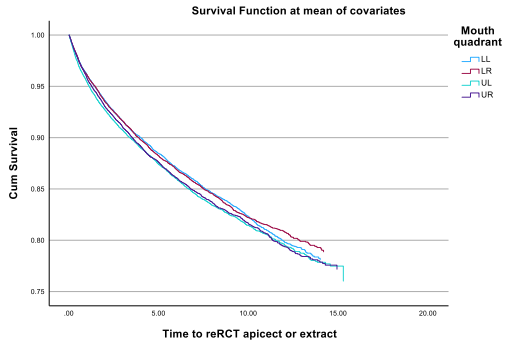
Stratum	Event	Censored	Censored Percent
LL	2505	17608	87.5%
UL	2938	19134	86.7%
LR	2486	17730	87.7%
UR	2890	19159	86.9%
Total	10819	73631	87.2%

a. The strata variable is : Mouth quadrant

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
205586.344



**********.

*What happens to tooth position to filled teeth?

* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

select if (Occlusal = 1).
COXREG time
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtootOTP).

Cox Regression

Notes

Output Created		13-APR-2024 20:11:30
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	84495
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = toothpos /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survtootOTP).
Resources	Processor Time	00:00:00.30
	Elapsed Time	00:00:00.44
Variables Created or Modified	survtootOTP	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	10819	12.8%
	Censored	73624	87.1%
	Total	84443	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%

	Censored cases before the earliest event in a stratum	52	0.1%
	Total	52	0.1%
Total		84495	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

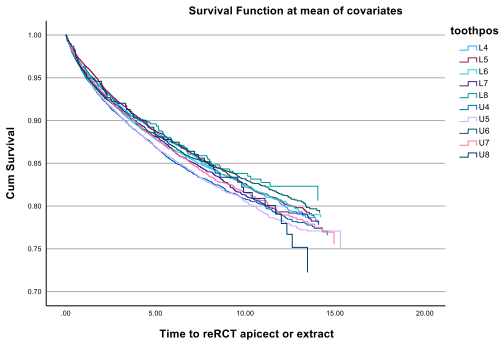
Stratum	Event	Censored	Censored Percent
L4	880	6131	87.4%
U4	1450	8926	86.0%
L5	1329	9514	87.7%
U5	1859	11487	86.1%
L6	1641	11706	87.7%
U6	1628	11873	87.9%
L7	990	6841	87.4%
U7	810	5468	87.1%
L8	151	1146	88.4%
U8	81	532	86.8%
Total	10819	73624	87.2%

a. The strata variable is : toothpos

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
189769.137


Survival Function at mean of covariates
toothpos
L4
L5
L6
L7
L8
U4
U5
U6
U7
U8
Cum Survival
1.00
0.95
0.90
0.85
0.80
0.75
0.70
.00
5.00
10.00
15.00
20.00
Time to reRCT apicect or extract

**********.

9.4.3.2 MO or DO

```
* Encoding: windows-1252.
* RF Posterior Teeth survival with one proximal ridge loss ( marginal ridge i.e. MO or DO) =oneproximalridge 07.sps.

* Written by ML on 07/08/2020.  Modified 12/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created		13-APR-2024 20:16:12
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD

		Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:00:51.56
	Elapsed Time	00:01:25.35
Variables Created or Modified	survall	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav

Case Processing Summary

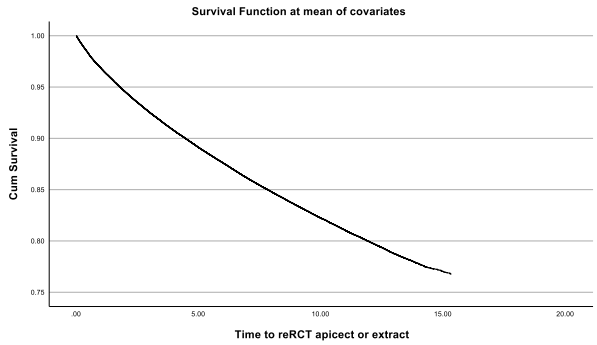
		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2452517.472



**********.

* Restrict to posterior teeth.
* What happens if there is an MO or DO filling?.

```
select if (Range (Tooth,'4', '8')).
COXREG time
  /STATUS=reint(1)
  /strata = oneproximalridge
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survmodo).
```

Cox Regression

Notes

Output Created		13-APR-2024 20:17:37
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	563368
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = oneproximalridge /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survmodo).
Resources	Processor Time	00:01:26.86
	Elapsed Time	00:01:35.78
Variables Created or Modified	survmodo	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	62042	11.0%
	Censored	500707	88.9%
	Total	562749	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%

	Censored cases before the earliest event in a stratum	619	0.1%
	Total	619	0.1%
Total		563368	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

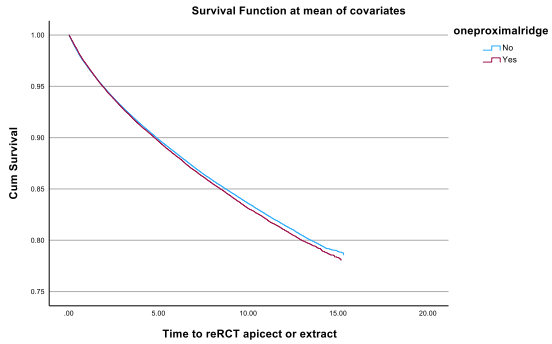
Stratum	Strata label	Event	Censored	Censored Percent
.00	No	44626	363638	89.1%
1.00	Yes	17416	137069	88.7%
Total		62042	500707	89.0%

a. The strata variable is : oneproximalridge

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1503364.240



**********.

*What happens to upper or lower teeth that are filled ?

* Create descriptive variables.

String upplow (a1).

If (any(quadrant,'UR','UL')) upplow= '0'.
If (any(quadrant,'LR','LL')) upplow= '1'.

Execute.

value labels
/upplow
'0' 'Upper teeth'
'1' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (oneproximalridge = 1).
COXREG time
  /STATUS=reint(1)
  /strata = upplow

```
/CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
/PLOT = SURVIVAL
/Save survival (surmodoUL).
```

Cox Regression

Notes

Output Created		13-APR-2024 20:19:43
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	154562
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = upplow /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (surmodoUL).
Resources	Processor Time	00:00:01.95
	Elapsed Time	00:00:06.55
Variables Created or Modified	surmodoUL	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

Case Processing Summary

	N	Percent

Cases available in analysis	Event[a]	17416	11.3%
	Censored	137069	88.7%
	Total	154485	100.0%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	77	0.0%
	Total	77	0.0%
Total		154562	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

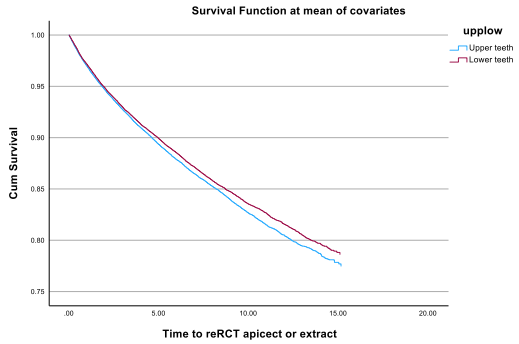
Stratum	Strata label	Event	Censored	Censored Percent
0	Upper teeth	9044	69304	88.5%
1	Lower teeth	8372	67765	89.0%
Total		17416	137069	88.7%

a. The strata variable is : upplow

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
373436.079



**********.

*What happens to quadrant to filled teeth?

get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (oneproximalridge = 1).
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survmodoQ).

Cox Regression

Notes

Output Created		13-APR-2024 20:19:50
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	154562
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = Quadrant /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survmodoQ).
Resources	Processor Time	00:00:02.42
	Elapsed Time	00:00:06.46
Variables Created or Modified	survmodoQ	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	17416	11.3%
	Censored	137069	88.7%
	Total	154485	100.0%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	77	0.0%
	Total	77	0.0%
Total		154562	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Event	Censored	Censored Percent
LL	4038	33215	89.2%
UL	4759	35145	88.1%
LR	4334	34550	88.9%
UR	4285	34159	88.9%

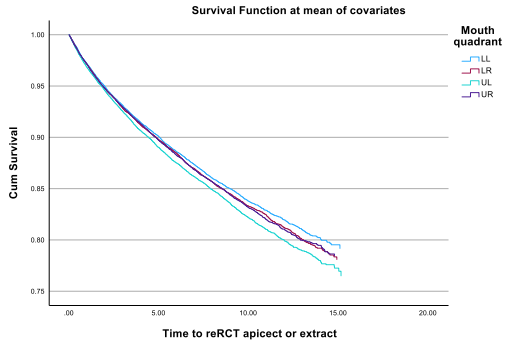
Total	17416	137069	88.7%

a. The strata variable is : Mouth quadrant

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
349315.275



**********.

*What happens to tooth position to filled teeth?

* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).

```
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

select if (oneproximalridge = 1).
COXREG time
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survmodoTP).
```

Cox Regression

Notes

Output Created		13-APR-2024 20:20:03
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	154562
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = toothpos /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survmodoTP).
Resources	Processor Time	00:00:00.47
	Elapsed Time	00:00:00.94

Variables Created or Modified	survmodoTP	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	17416	11.3%
	Censored	137067	88.7%
	Total	154483	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	79	0.1%
	Total	79	0.1%
Total		154562	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

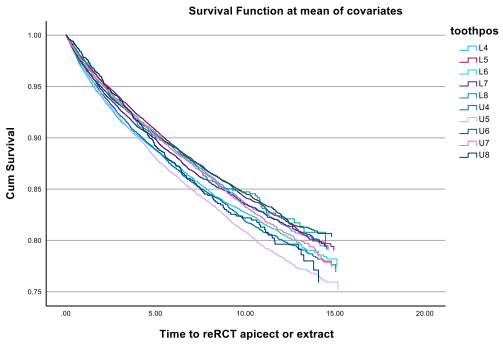
Stratum	Event	Censored	Censored Percent
L4	1173	9608	89.1%
U4	2039	14760	87.9%
L5	2504	21336	89.5%
U5	2631	17883	87.2%
L6	2641	19899	88.3%
U6	2255	19594	89.7%
L7	1774	14596	89.2%
U7	1866	15216	89.1%
L8	280	2326	89.3%
U8	253	1849	88.0%
Total	17416	137067	88.7%

a. The strata variable is : toothpos

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
322663.864



**********.

9.4.3.3 MOD

```
* Encoding: windows-1252.
* RF Posterior Teeth survival with a MOD 07.sps.

* Written by ML on 18/6/2021.  Modified 12/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created		13-APR-2024 20:24:47
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav

	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:01:14.58
	Elapsed Time	00:01:14.97
Variables Created or Modified	survall	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav

Case Processing Summary

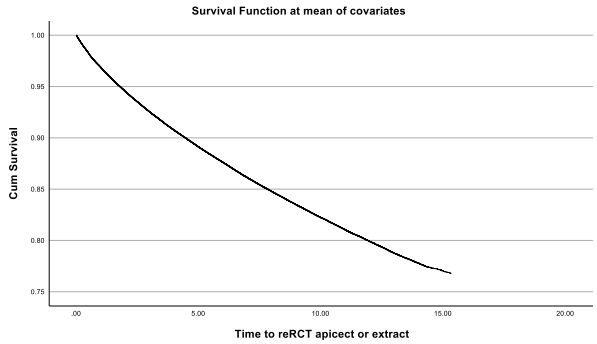
		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2452517.472



**********.

```
* Restrict to posterior teeth.
* What happens if there is an MOD  filling?.

select if (Range (Tooth,'4', '8')).
COXREG time
  /STATUS=reint(1)
  /strata = MOD
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survMOD).
```

Cox Regression

Notes

Output Created		13-APR-2024 20:26:02
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	563368
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = MOD /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survMOD).
Resources	Processor Time	00:01:31.94
	Elapsed Time	00:01:33.55
Variables Created or Modified	survMOD	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	62042	11.0%
	Censored	500707	88.9%
	Total	562749	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	619	0.1%

Total	619	0.1%
Total	563368	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

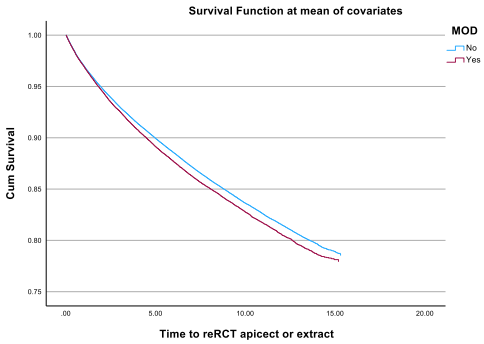
Stratum	Strata label	Event	Censored	Censored Percent
.00	No	48656	402182	89.2%
1.00	Yes	13386	98525	88.0%
Total		62042	500707	89.0%

a. The strata variable is : MOD

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1512286.650



**********.

*What happens to upper or lower teeth that are filled ?

* Create descriptive variables.

String upplow (a1).

If (any(quadrant,'UR','UL')) upplow= '0'.
If (any(quadrant,'LR','LL')) upplow= '1'.

Execute.

value labels
/upplow
'0' 'Upper teeth'
'1' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (MOD = 1).
COXREG time
  /STATUS=reint(1)
  /strata = upplow
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (surmodUL).

Cox Regression

Notes

Output Created		13-APR-2024 20:28:04
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>

	Split File	<none>
	N of Rows in Working Data File	111974
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = upplow /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (surmodUL).
Resources	Processor Time	00:00:04.27
	Elapsed Time	00:00:05.04
Variables Created or Modified	surmodUL	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	13386	12.0%
	Censored	98525	88.0%
	Total	111911	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	63	0.1%
	Total	63	0.1%
Total		111974	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Strata label	Event	Censored	Censored Percent
0	Upper teeth	8184	57947	87.6%

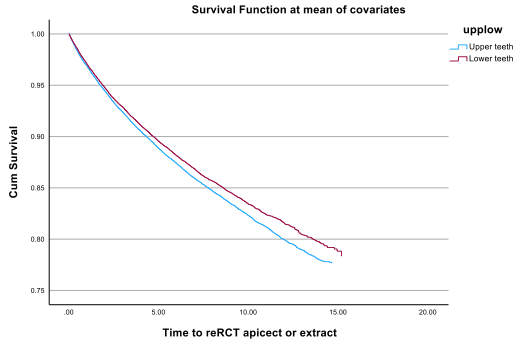
1	Lower teeth	5202	40578	88.6%
Total		13386	98525	88.0%

a. The strata variable is : upplow

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
279830.956



**********.

*What happens to quadrant to filled teeth?

get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (MOD = 1).

```
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survmodQ).
```

Cox Regression

Notes

Output Created		13-APR-2024 20:28:09
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	111974
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = Quadrant /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survmodQ).
Resources	Processor Time	00:00:04.19
	Elapsed Time	00:00:04.93
Variables Created or Modified	survmodQ	Survival function evaluate at the current case

Case Processing Summary

	N	Percent
Event[a]	13386	12.0%

Cases available in analysis	Censored	98525	88.0%
	Total	111911	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	63	0.1%
	Total	63	0.1%
Total		111974	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

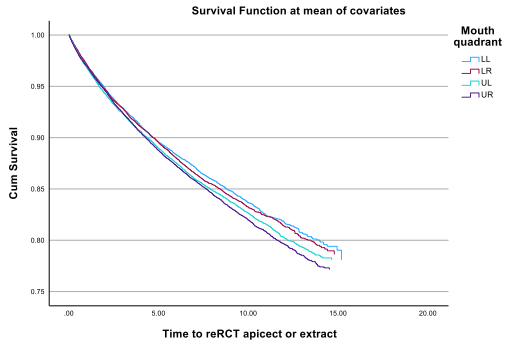
Stratum	Event	Censored	Censored Percent
LL	2531	20044	88.8%
UL	4170	29887	87.8%
LR	2671	20534	88.5%
UR	4014	28060	87.5%
Total	13386	98525	88.0%

a. The strata variable is : Mouth quadrant

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
261279.208



**********.

*What happens to tooth position to filled teeth?

* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

select if (MOD = 1).
COXREG time
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survmodTP).

Cox Regression

Notes

Output Created		13-APR-2024 20:28:19
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	111974
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = toothpos /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survmodTP).
Resources	Processor Time	00:00:00.34
	Elapsed Time	00:00:00.54
Variables Created or Modified	survmodTP	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	13386	12.0%
	Censored	98510	88.0%
	Total	111896	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%

	Censored cases before the earliest event in a stratum	78	0.1%
	Total	78	0.1%
Total		111974	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

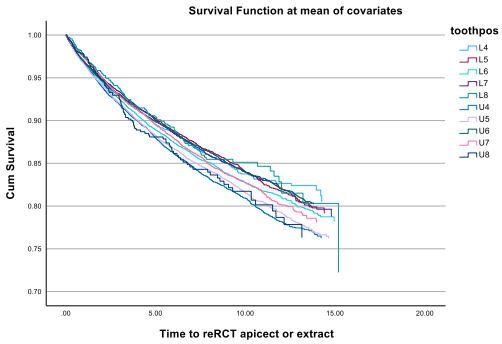
Stratum	Event	Censored	Censored Percent
L4	425	3367	88.8%
U4	1841	11774	86.5%
L5	1217	9477	88.6%
U5	2854	18779	86.8%
L6	2420	18131	88.2%
U6	2177	17643	89.0%
L7	1021	8597	89.4%
U7	1207	9061	88.2%
L8	119	998	89.3%
U8	105	683	86.7%
Total	13386	98510	88.0%

a. The strata variable is : toothpos

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
243382.826


Survival Function at mean of covariates
toothpos
L4
L5
L6
L7
L8
U4
U5
U6
U7
U8
Cum Survival
1.00
0.95
0.90
0.85
0.80
0.75
0.70
.00
5.00
10.00
15.00
20.00
Time to reRCT apicect or extract

**********.

9.4.3.4 Inlay

```
* Encoding: windows-1252.
* RF Posterior Teeth survival with an Inlay 04.sps.

* Written by ML on 09/08/2020.  Modified 12/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created		13-APR-2024 20:48:41
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav

	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:00:56.77
	Elapsed Time	00:01:46.79
Variables Created or Modified	survall	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav

Case Processing Summary

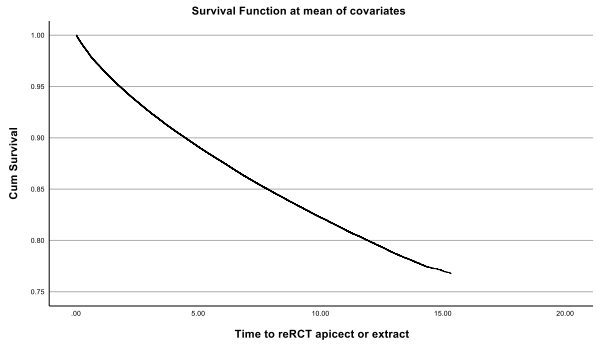
		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2452517.472



**********.

* Restrict to posterior teeth.
* What happens if there is an inlay?.

```
select if (Range (Tooth,'4', '8')).
COXREG time
  /STATUS=reint(1)
  /strata = Inlay
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survInlay).
```

Cox Regression

Notes

Output Created		13-APR-2024 20:50:28
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	563368
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = Inlay /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survInlay).
Resources	Processor Time	00:01:06.08
	Elapsed Time	00:02:10.74
Variables Created or Modified	survInlay	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	62042	11.0%
	Censored	500699	88.9%
	Total	562741	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	627	0.1%

Total	627	0.1%
Total	563368	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

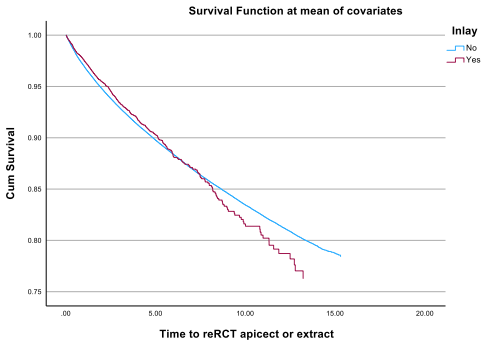
Stratum	Strata label	Event	Censored	Censored Percent
.00	No	61446	493720	88.9%
1.00	Yes	596	6979	92.1%
Total		62042	500699	89.0%

a. The strata variable is : Inlay

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1570312.894



**********.

*What happens to upper or lower teeth that are filled ?

* Create descriptive variables.

String upplow (a1).

If (any(quadrant,'UR','UL')) upplow= '0'.
If (any(quadrant,'LR','LL')) upplow= '1'.

Execute.

value labels
/upplow
'0' 'Upper teeth'
'1' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (Inlay = 1).
COXREG time
  /STATUS=reint(1)
  /strata = upplow
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (surInlayUL).

Cox Regression

Notes

Output Created		13-APR-2024 20:53:19
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>

	Split File	<none>
	N of Rows in Working Data File	7596
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = upplow /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (surInlayUL).
Resources	Processor Time	00:00:00.27
	Elapsed Time	00:00:01.09
Variables Created or Modified	surInlayUL	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	596	7.8%
	Censored	6976	91.8%
	Total	7572	99.7%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	24	0.3%
	Total	24	0.3%
Total		7596	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Strata label	Event	Censored	Censored Percent
0	Upper teeth	297	3558	92.3%

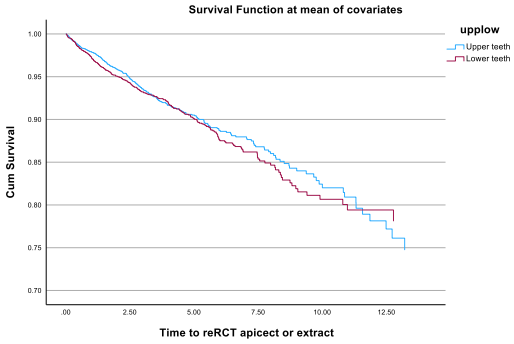
1	Lower teeth	299	3418	92.0%
Total		596	6976	92.1%

a. The strata variable is : upplow

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
8953.497



**********.

*What happens to quadrant to filled teeth?

get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (Inlay = 1).

```
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survInlayQ).
```

Cox Regression

Notes

Output Created		13-APR-2024 20:53:20
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	7596
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = Quadrant /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survInlayQ).
Resources	Processor Time	00:00:00.47
	Elapsed Time	00:00:00.99
Variables Created or Modified	survInlayQ	Survival function evaluate at the current case

Case Processing Summary

	N	Percent
Event[a]	596	7.8%

Cases available in analysis	Censored	6970	91.8%
	Total	7566	99.6%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	30	0.4%
	Total	30	0.4%
Total		7596	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

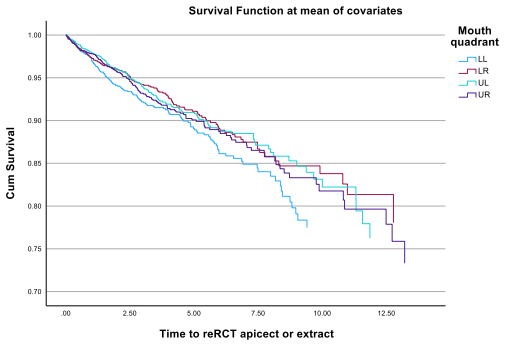
Stratum	Event	Censored	Censored Percent
LL	163	1652	91.0%
UL	143	1790	92.6%
LR	136	1763	92.8%
UR	154	1765	92.0%
Total	596	6970	92.1%

a. The strata variable is : Mouth quadrant

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
8126.520



**********.

*What happens to tooth position to filled teeth?

* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

select if (Inlay = 1).
COXREG time
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survInlayTP).

Cox Regression

Notes

Output Created		13-APR-2024 20:53:22
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	7596
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = toothpos /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survInlayTP).
Resources	Processor Time	00:00:00.27
	Elapsed Time	00:00:00.24
Variables Created or Modified	survInlayTP	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	596	7.8%
	Censored	6962	91.7%
	Total	7558	99.5%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%

	Censored cases before the earliest event in a stratum	38	0.5%
	Total	38	0.5%
Total		7596	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

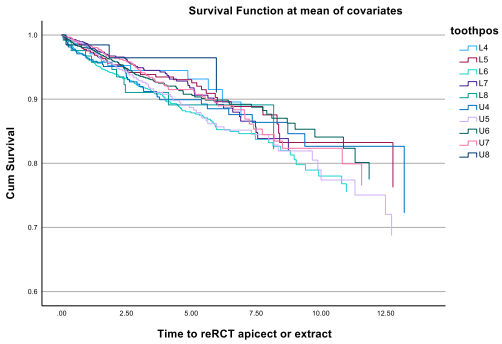
Stratum	Event	Censored	Censored Percent
L4	14	214	93.9%
U4	43	445	91.2%
L5	41	516	92.6%
U5	73	668	90.1%
L6	171	1627	90.5%
U6	115	1542	93.1%
L7	62	942	93.8%
U7	63	832	93.0%
L8	11	114	91.2%
U8	3	62	95.4%
Total	596	6962	92.1%

a. The strata variable is : toothpos

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
7420.338


Survival Function at mean of covariates
toothpos
L4
L5
L6
L7
L8
U4
U5
U6
U7
U8
Cum Survival
1.0
0.9
0.8
0.7
0.6
.00
2.50
5.00
7.50
10.00
12.50
Time to reRCT apicect or extract

**********.

9.4.3.5 Tunnel

```
* Encoding: windows-1252.
* RF Posterior Teeth survival with tunnel restoration 03.sps.

* Written by ML on 22/5/2022.  Modified 12/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables and a file for Excel
plotting.
* Used for assessment of individual teeth types and the restorations placed.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth
Preparation.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160502.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created		13-APR-2024 20:40:35
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav

	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	792261
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:01:13.69
	Elapsed Time	00:01:14.22
Variables Created or Modified	survall	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav

Case Processing Summary

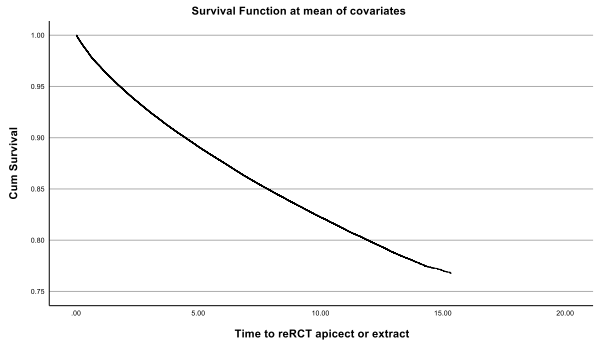
		N	Percent
Cases available in analysis	Event[a]	94037	11.9%
	Censored	697338	88.0%
	Total	791375	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	886	0.1%
	Total	886	0.1%
Total		792261	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
2452517.472



**********.

* Restrict to posterior teeth.
* What happens if there is an Tunnel filling?.

```
select if (Range (Tooth,'4', '8')).
COXREG time
  /STATUS=reint(1)
  /strata = tunnel
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtun).
```

Cox Regression

Notes

Output Created		13-APR-2024 20:41:50
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All Teeth Preparation.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	563368
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = tunnel /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survtun).
Resources	Processor Time	00:01:29.34
	Elapsed Time	00:01:31.19
Variables Created or Modified	survtun	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	62042	11.0%
	Censored	500707	88.9%
	Total	562749	99.9%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	619	0.1%
	Total	619	0.1%

Total	563368	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

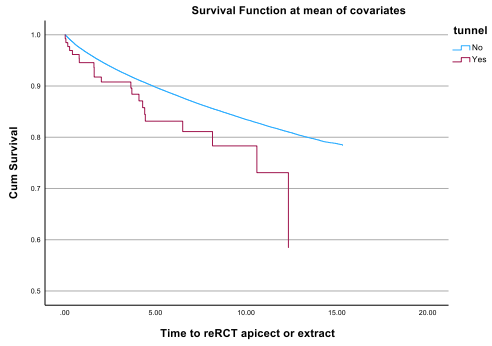
Stratum	Strata label	Event	Censored	Censored Percent
.00	No	62021	500598	89.0%
1.00	Yes	21	109	83.8%
Total		62042	500707	89.0%

a. The strata variable is : tunnel

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1576643.974



**********.

*What happens to upper or lower teeth that are filled ?

* Create descriptive variables.

String upplow (a1).

If (any(quadrant,'UR','UL')) upplow= '0'.
If (any(quadrant,'LR','LL')) upplow= '1'.

Execute.

value labels
/upplow
'0' 'Upper teeth'
'1' 'Lower teeth'.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (tunnel = 1).
COXREG time
  /STATUS=reint(1)
  /strata = upplow
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (surtunUL).

Cox Regression

Notes

Output Created		13-APR-2024 20:43:49
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>

	Split File	<none>
	N of Rows in Working Data File	130
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = upplow /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (surtunUL).
Resources	Processor Time	00:00:00.19
	Elapsed Time	00:00:00.48
Variables Created or Modified	surtunUL	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	21	16.2%
	Censored	109	83.8%
	Total	130	100.0%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	0	0.0%
	Total	0	0.0%
Total		130	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Strata label	Event	Censored	Censored Percent
0	Upper teeth	9	48	84.2%

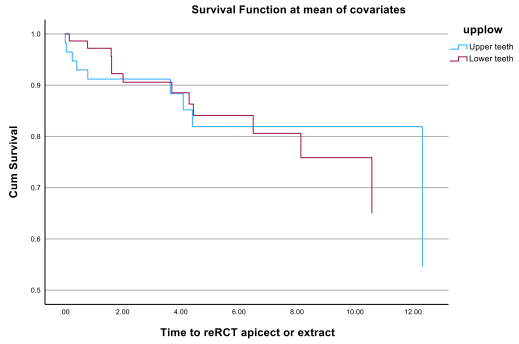
1	Lower teeth	12	61	83.6%
Total		21	109	83.8%

a. The strata variable is : upplow

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
149.989



**********.

*What happens to quadrant to filled teeth?

get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

select if (tunnel = 1).

```
COXREG time
  /STATUS=reint(1)
  /strata = Quadrant
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtunQ).
```

Cox Regression

Notes

Output Created		13-APR-2024 20:43:50
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	130
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = Quadrant /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survtunQ).
Resources	Processor Time	00:00:00.25
	Elapsed Time	00:00:00.51
Variables Created or Modified	survtunQ	Survival function evaluate at the current case

Case Processing Summary

		N	Percent
	Event[a]	21	16.2%

Cases available in analysis	Censored	107	82.3%
	Total	128	98.5%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	2	1.5%
	Total	2	1.5%
Total		130	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

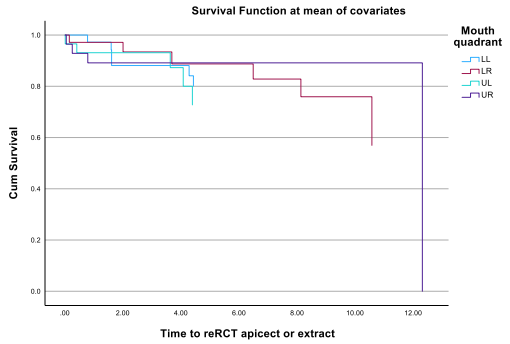
Stratum	Event	Censored	Censored Percent
LL	6	30	83.3%
UL	5	24	82.8%
LR	6	29	82.9%
UR	4	24	85.7%
Total	21	107	83.6%

a. The strata variable is : Mouth quadrant

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
121.286



**********.

*What happens to tooth position to filled teeth?

* Create descriptive variables.

String toothpos (a2).

If (any(quadrant,'UL','UR')) toothpos=concat('U',tooth).
If (any(quadrant,'LL','LR')) toothpos=concat('L',tooth).

Execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.

select if (tunnel = 1).
COXREG time
  /STATUS=reint(1)
  /strata = toothpos
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survtunTP).

Cox Regression

Notes

Output Created		13-APR-2024 20:43:51
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	130
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = toothpos /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survtunTP).
Resources	Processor Time	00:00:00.19
	Elapsed Time	00:00:00.14
Variables Created or Modified	survtunTP	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	21	16.2%
	Censored	87	66.9%
	Total	108	83.1%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%

	Censored cases before the earliest event in a stratum	22	16.9%
	Total	22	16.9%
Total		130	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

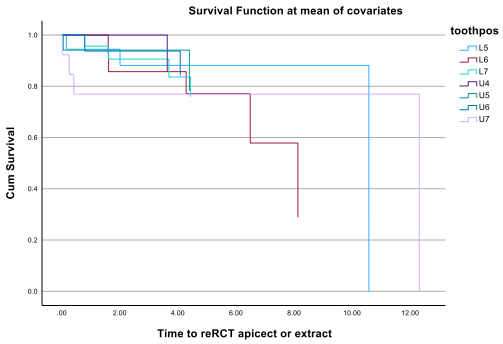
Stratum	Event	Censored	Censored Percent
U4	1	6	85.7%
L5	3	15	83.3%
U5	2	15	88.2%
L6	5	9	64.3%
U6	2	14	87.5%
L7	4	19	82.6%
U7	4	9	69.2%
Total	21	87	80.6%

a. The strata variable is : toothpos

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
90.642


Survival Function at mean of covariates
toothpos
L5
L6
L7
U4
U5
U6
U7
Cum Survival
1.0
0.8
0.6
0.4
0.2
0.0
.00
2.00
4.00
6.00
8.00
10.00
12.00
Time to reRCT apicect or extract

**********.

9.4.4 Historic Restoration Placed Before RCT

9.4.4.1 Based on 3 years of Treatment History

```
* Encoding: windows-1252.
* RF All History Teeth charts 02 3y.sps.

* Written by ML on 17/2/2024. Modified on 14/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All
History Teeth Preparation 3y.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160429.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created		14-APR-2024 22:52:17
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF

		All History Teeth Preparation 3y.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	431945
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:00:23.00
	Elapsed Time	00:00:24.28
Variables Created or Modified	survall	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All History Teeth Preparation 3y.sav

Case Processing Summary

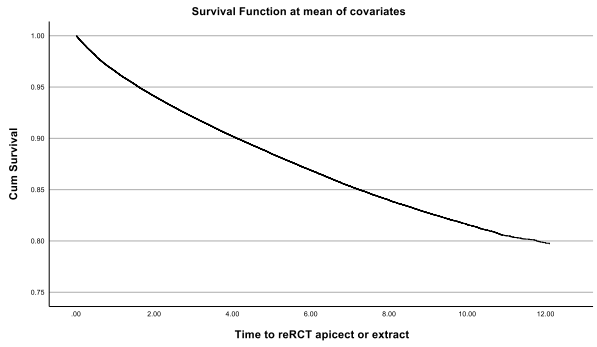
		N	Percent
Cases available in analysis	Event[a]	46853	10.8%
	Censored	384337	89.0%
	Total	431190	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	755	0.2%
	Total	755	0.2%
Total		431945	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1170083.303



****
*

* What happens if there is a root filling history?.

* Create descriptive variables.

RECODE hroot
(0 =1)
(1 thru 9=2)
into hrootgr.

```
value labels
/hrootgr
1 'No previous Root Filling'
2 'Previous Root Filling'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.


COXREG time
  /STATUS=reint(1)
  /strata = hrootgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:53:05
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	431945
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hrootgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.

Resources	Processor Time	00:00:00.47
	Elapsed Time	00:00:00.59

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	46853	10.8%
	Censored	384337	89.0%
	Total	431190	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	755	0.2%
	Total	755	0.2%
Total		431945	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

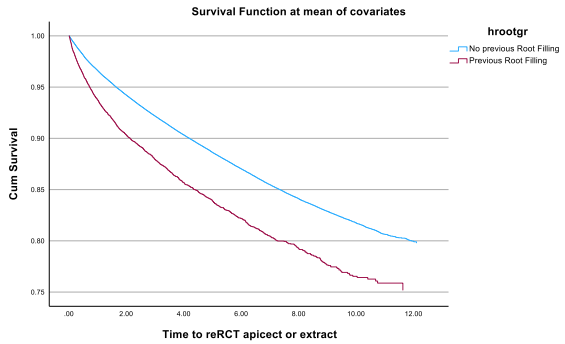
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Root Filling	45099	374505	89.3%
2.00	Previous Root Filling	1754	9832	84.9%
Total		46853	384337	89.1%

a. The strata variable is : hrootgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1154917.228



* What happens if there is a history of apicectomy?.

* Create descriptive variables.

```
RECODE hApicect
(0 =1)
(1 thru 9=2)
into hApicectgr.

value labels
/hApicectgr
1 'No previous Apicectomy'
2 'Previous Apicectomy'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.


COXREG time
  /STATUS=reint(1)
  /strata =        hApicectgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
```

/PLOT = SURVIVAL.

Cox Regression

Notes

Output Created		14-APR-2024 22:53:06
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	431945
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hApicectgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.30
	Elapsed Time	00:00:00.68

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	46853	10.8%
	Censored	384336	89.0%
	Total	431189	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%

	Censored cases before the earliest event in a stratum	756	0.2%
	Total	756	0.2%
Total		431945	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

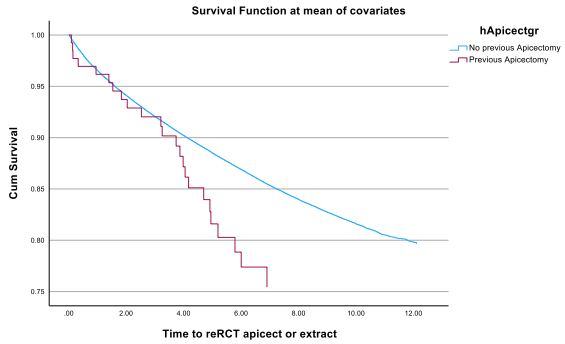
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Apicectomy	46829	384229	89.1%
2.00	Previous Apicectomy	24	107	81.7%
Total		46853	384336	89.1%

a. The strata variable is : hApicectgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1169670.401



****

*Restoration in all teeth.

* What happens if there is a history of pin or screw?.

* Create descriptive variables.

```
RECODE hpinorscrew
(0 =1)
(1 thru 9=2)
into hpinorscrewgr.

value labels
/hpinorscrewgr
1 'No previous Pin or Screw'
2 'Previous Pin or Screw'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.

COXREG time
  /STATUS=reint(1)
```

```
/strata =      hpinorscrewgr
/CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
/PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:53:08
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	431945
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hpinorscrewgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.42
	Elapsed Time	00:00:00.68

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	46853	10.8%
	Censored	384337	89.0%
	Total	431190	99.8%

Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	755	0.2%
	Total	755	0.2%
Total		431945	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

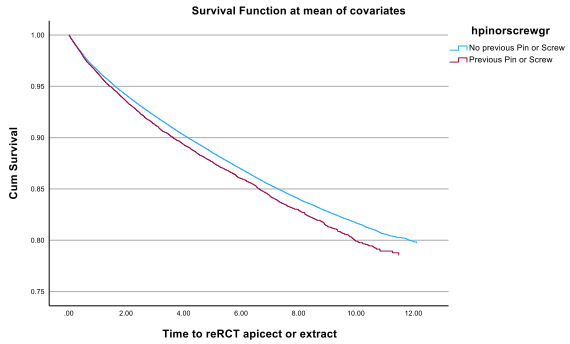
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Pin or Screw	44348	366784	89.2%
2.00	Previous Pin or Screw	2505	17553	87.5%
Total		46853	384337	89.1%

a. The strata variable is : hpinorscrewgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1150525.117



* What happens if there is a history of post?.

* Create descriptive variables.

```
RECODE hpost
(0 =1)
(1 thru 9=2)
into hpostgr.

value labels
/hpostgr
1 'No previous Post'
2 'Previous Post'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      hpostgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT =  SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:53:09
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	431945
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hpostgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.42
	Elapsed Time	00:00:00.60

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	46853	10.8%
	Censored	384337	89.0%
	Total	431190	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	755	0.2%
	Total	755	0.2%
Total		431945	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

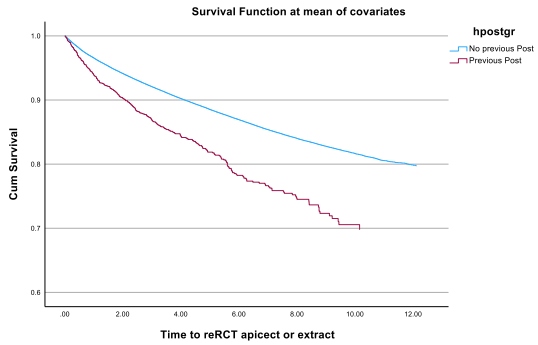
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Post	46534	382865	89.2%
2.00	Previous Post	319	1472	82.2%
Total		46853	384337	89.1%

a. The strata variable is : hpostgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1166190.650



```
* What happens if there is a crown history?.

* Create descriptive variables.

RECODE hCrown
(0 =1)
(1 thru 9=2)
into hcrowngr.

value labels
/hcrowngr
1 'No previous Crown'
2 'Previous Crown'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav'.

COXREG time
  /STATUS=reint(1)
  /strata = hcrowngr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:53:10
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	431945

Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hcrowngr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.55
	Elapsed Time	00:00:00.62

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	46853	10.8%
	Censored	384337	89.0%
	Total	431190	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	755	0.2%
	Total	755	0.2%
Total		431945	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

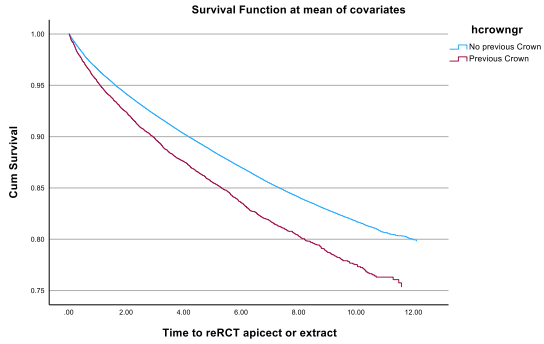
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Crown	44908	372783	89.2%
2.00	Previous Crown	1945	11554	85.6%
Total		46853	384337	89.1%

a. The strata variable is : hcrowngr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1153786.037



* What happens if there is a history of bridge abutment?.

* Create descriptive variables.

```
RECODE hAbutment
(0 =1)
(1 thru 9=2)
into hAbutmentgr.

value labels
/hAbutmentgr
1 'No previous Bridge Abutment'
2 'Previous Bridge Abutment'.

compute caseid=$casenum.
```

execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav'.

COXREG time
  /STATUS=reint(1)
  /strata = habutmentgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

Cox Regression

Notes

Output Created		14-APR-2024 22:53:12
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	431945
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = habutmentgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.52
	Elapsed Time	00:00:00.61

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	46853	10.8%
	Censored	384337	89.0%
	Total	431190	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	755	0.2%
	Total	755	0.2%
Total		431945	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

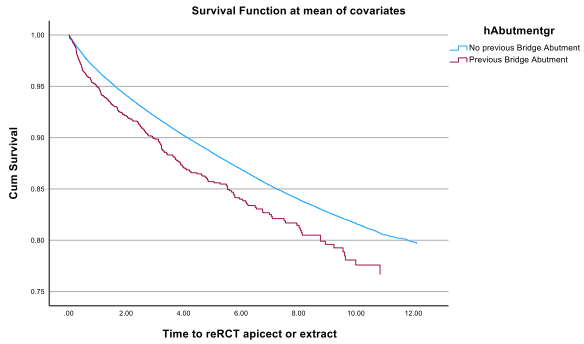
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Bridge Abutment	46587	382550	89.1%
2.00	Previous Bridge Abutment	266	1787	87.0%
Total		46853	384337	89.1%

a. The strata variable is : hAbutmentgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1166791.681



****

*Restoration in anterior teeth.

* What happens if there is a history of incisal edge?.

* Create descriptive variables.

```
RECODE hincisaledge
(0 =1)
(1 thru 9=2)
into hincisaledgegr.

value labels
/hincisaledgegr
1 'No previous Incisal edge'
2 'Previous Incisal edge'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp7.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp7.sav'.

COXREG time
  /STATUS=reint(1)
```

```
/strata =      hincisaledgegr
/CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
/PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:53:13
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp7.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	431945
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hincisaledgegr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.55
	Elapsed Time	00:00:00.64

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp7.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	46853	10.8%
	Censored	384337	89.0%
	Total	431190	99.8%

Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	755	0.2%
	Total	755	0.2%
Total		431945	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

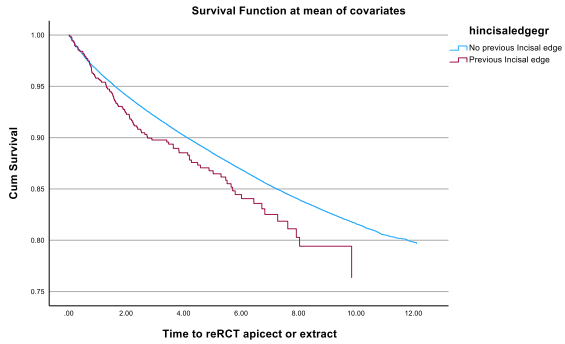
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Incisal edge	46748	383550	89.1%
2.00	Previous Incisal edge	105	787	88.2%
Total		46853	384337	89.1%

a. The strata variable is : hincisaledgegr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1168590.312



* What happens if there is a history of an incisal angle?.

* Create descriptive variables.

```
RECODE honeangle
(0 =1)
(1 thru 9=2)
into honeanglegr.

value labels
/honeanglegr
1 'No previous one Angle'
2 'Previous one Angle'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp8.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp8.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      honeanglegr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:53:14
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp8.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	431945
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = honeanglegr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.50
	Elapsed Time	00:00:00.62

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp8.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	46853	10.8%
	Censored	384337	89.0%
	Total	431190	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	755	0.2%
	Total	755	0.2%
Total		431945	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

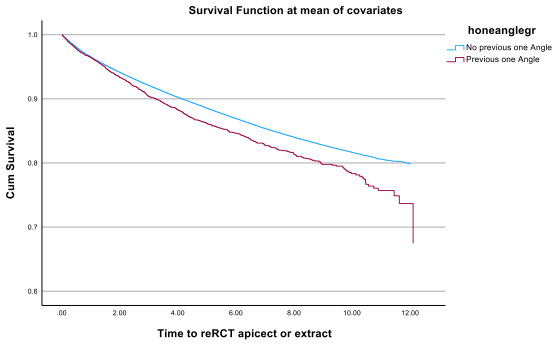
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous one Angle	46029	378826	89.2%
2.00	Previous one Angle	824	5511	87.0%
Total		46853	384337	89.1%

a. The strata variable is : honeanglegr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1161767.680



```
* What happens if there is a history of two incisal angles?.

* Create descriptive variables.

RECODE htwoangles
(0 =1)
(1 thru 9=2)
into htwoanglesgr.

value labels
/htwoanglesgr
1 'No previous two angles'
2 'Previous two angles'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp9.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp9.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      htwoanglesgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:53:16
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp9.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	431945

Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = htwoanglesgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.47
	Elapsed Time	00:00:00.61

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp9.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	46853	10.8%
	Censored	384337	89.0%
	Total	431190	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	755	0.2%
	Total	755	0.2%
Total		431945	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

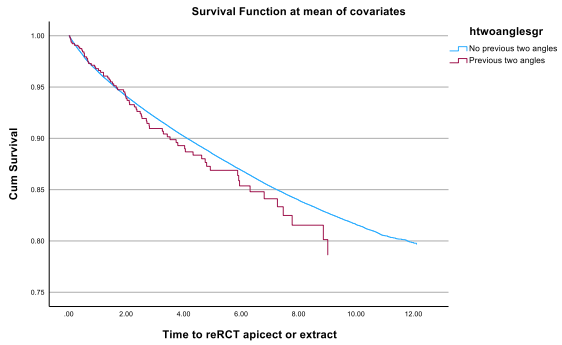
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous two angles	46782	383759	89.1%
2.00	Previous two angles	71	578	89.1%
Total		46853	384337	89.1%

a. The strata variable is : htwoanglesgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1169018.815



****
****

*Restoration in posterior teeth.

* What happens if there is an occlusal history?.

* Create descriptive variables.

RECODE hOcclusal
(0 =1)
(1 thru 9=2)
into hOcclusalgr.

```
value labels
/ hOcclusalgr
1 'No previous Occlusal'
2 'Previous Occlusal'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp10.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp10.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =  hOcclusalgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:53:17
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp10.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	431945
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hOcclusalgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.56

Elapsed Time	00:00:00.63

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp10.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	46853	10.8%
	Censored	384337	89.0%
	Total	431190	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	755	0.2%
	Total	755	0.2%
Total		431945	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

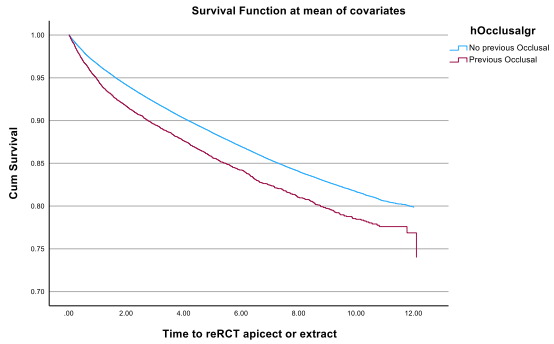
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Occlusal	45331	375207	89.2%
2.00	Previous Occlusal	1522	9130	85.7%
Total		46853	384337	89.1%

a. The strata variable is : hOcclusalgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1156566.594



* What happens if there is a history of one proximal ridge (MO or DO)?.

* Create descriptive variables.

```
RECODE honeproximalridge
(0 =1)
(1 thru 9=2)
into honeproximalridgegr.

value labels
/honeproximalridgegr
1 'No previous MO/DO'
2 'Previous MO/DO'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp11.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp11.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =   honeproximalridgegr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:53:19
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp11.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	431945
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = honeproximalridgegr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.45
	Elapsed Time	00:00:00.66

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp11.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	46853	10.8%
	Censored	384337	89.0%
	Total	431190	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%

	Censored cases before the earliest event in a stratum	755	0.2%
	Total	755	0.2%
Total		431945	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

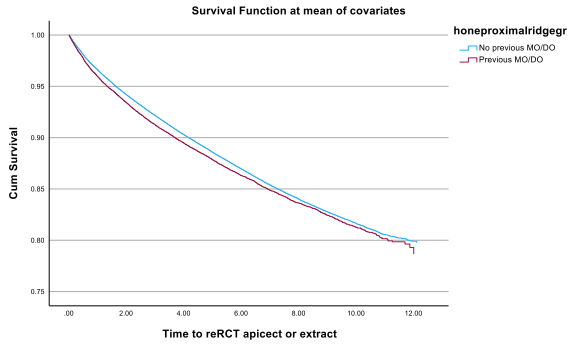
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous MO/DO	41404	343217	89.2%
2.00	Previous MO/DO	5449	41120	88.3%
Total		46853	384337	89.1%

a. The strata variable is : honeproximalridgegr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1136364.769




```
* What happens if there is a history of MOD?.

* Create descriptive variables.

RECODE hMOD
(0 =1)
(1 thru 9=2)
into hMODgr.

value labels
/hMODgr
1 'No previous MOD'
2 'Previous MOD'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp12.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp12.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =    hMODgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:53:20
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp12.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	431945
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hMODgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.52
	Elapsed Time	00:00:00.65

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp12.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	46853	10.8%
	Censored	384337	89.0%
	Total	431190	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	755	0.2%

Total	755	0.2%
Total	431945	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

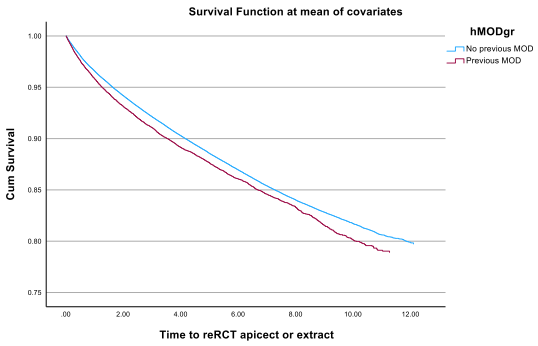
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous MOD	43336	359694	89.2%
2.00	Previous MOD	3517	24643	87.5%
Total		46853	384337	89.1%

a. The strata variable is : hMODgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1145065.535



```
* What happens if there is a history of tunnel restoration?.

* Create descriptive variables.

RECODE  htunnel
(0 =1)
(1 thru 9=2)
into  htunnelgr.

value labels
/htunnelgr
1 'No previous Tunnel'
2 'Previous Tunnel'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp13.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp13.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =     htunnelgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:53:21
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp13.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	431945

Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = htunnelgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.50
	Elapsed Time	00:00:00.62

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp13.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	46853	10.8%
	Censored	384336	89.0%
	Total	431189	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	756	0.2%
	Total	756	0.2%
Total		431945	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

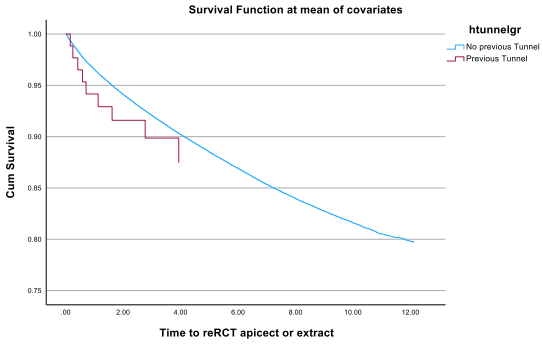
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Tunnel	46844	384259	89.1%
2.00	Previous Tunnel	9	77	89.5%
Total		46853	384336	89.1%

a. The strata variable is : htunnelgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1169911.666



* What happens if there is a history of inlay?.

* Create descriptive variables.

```
RECODE hInlay
(0 =1)
(1 thru 9=2)
into hInlaygr.

value labels
/hInlaygr
1 'No previous Inlay'
2 'Previous Inlay'.

compute caseid=$casenum.
execute.
```

```
save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp14.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp14.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =       hlnlaygr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:53:23
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp14.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	431945
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hlnlaygr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.50
	Elapsed Time	00:00:00.63

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp14.sav

Case Processing Summary

	N	Percent
Event[a]	46853	10.8%

Cases available in analysis	Censored	384337	89.0%
	Total	431190	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	755	0.2%
	Total	755	0.2%
Total		431945	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

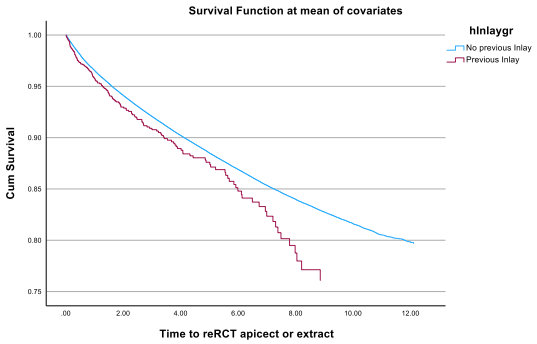
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Inlay	46704	383108	89.1%
2.00	Previous Inlay	149	1229	89.2%
Total		46853	384337	89.1%

a. The strata variable is : hInlaygr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
1168068.586


Survival Function at mean of covariates
hInlaygr
No previous Inlay
Previous Inlay
Cum Survival
1.00
0.95
0.90
0.85
0.80
0.75
.00
2.00
4.00
6.00
8.00
10.00
12.00
Time to reRCT apicect or extract

**********.

9.4.4.2 Based on 5 years of Treatment History

```
* Encoding: windows-1252.
* RF All History Teeth charts 09 5y.sps.

* Written by ML on 24/03/2023. Modified on 14/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All
History Teeth Preparation 5y.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160429.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created		14-APR-2024 22:40:49
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All History Teeth Preparation 5y.sav
	Filter	<none>

	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	324326
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:00:16.56
	Elapsed Time	00:00:18.90
Variables Created or Modified	survall	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All History Teeth Preparation 5y.sav

Case Processing Summary

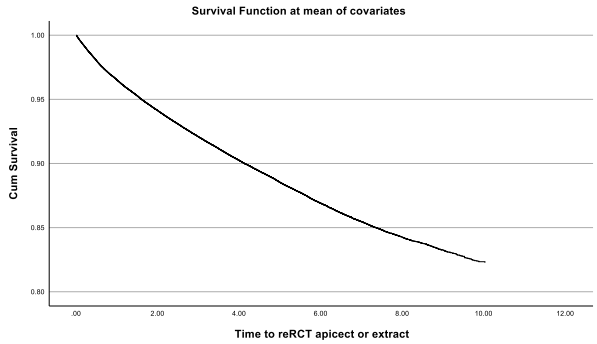
		N	Percent
Cases available in analysis	Event[a]	31285	9.6%
	Censored	292310	90.1%
	Total	323595	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	731	0.2%
	Total	731	0.2%
Total		324326	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
764639.183



****
*

* What happens if there is a root filling history?.

* Create descriptive variables.

RECODE hroot
(0 =1)
(1 thru 9=2)
into hrootgr.

value labels
/hrootgr
1 'No previous Root Filling'
2 'Previous Root Filling'.

```
compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.


COXREG time
  /STATUS=reint(1)
  /strata = hrootgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:41:26
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	324326
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hrootgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.33
	Elapsed Time	00:00:00.49

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	31285	9.6%
	Censored	292310	90.1%
	Total	323595	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	731	0.2%
	Total	731	0.2%
Total		324326	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

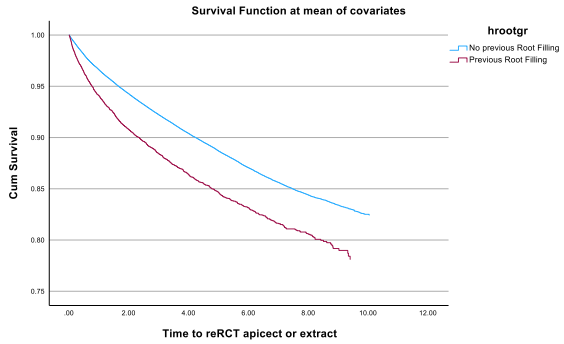
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Root Filling	29693	281966	90.5%
2.00	Previous Root Filling	1592	10344	86.7%
Total		31285	292310	90.3%

a. The strata variable is : hrootgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
751888.994



* What happens if there is a history of apicectomy?.

* Create descriptive variables.

```
RECODE hApicect
(0 =1)
(1 thru 9=2)
into hApicectgr.

value labels
/hApicectgr
1 'No previous Apicectomy'
2 'Previous Apicectomy'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.


COXREG time
  /STATUS=reint(1)
  /strata =        hApicectgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
```

/PLOT = SURVIVAL.

Cox Regression

Notes

Output Created		14-APR-2024 22:41:27
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	324326
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hApicectgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.28
	Elapsed Time	00:00:00.50

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	31285	9.6%
	Censored	292309	90.1%
	Total	323594	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%

	Censored cases before the earliest event in a stratum	732	0.2%
	Total	732	0.2%
Total		324326	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

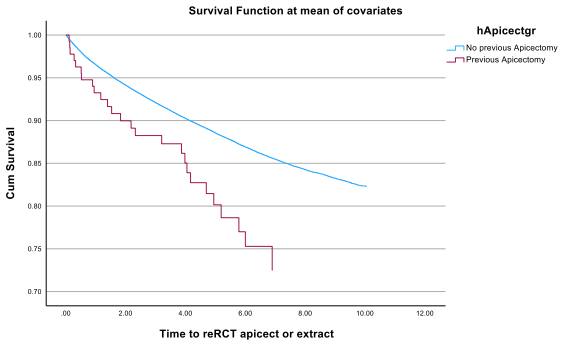
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Apicectomy	31259	292201	90.3%
2.00	Previous Apicectomy	26	108	80.6%
Total		31285	292309	90.3%

a. The strata variable is : hApicectgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
764211.851



****

*Restoration in all teeth.

* What happens if there is a history of pin or screw?.

* Create descriptive variables.

```
RECODE hpinorscrew
(0 =1)
(1 thru 9=2)
into hpinorscrewgr.

value labels
/hpinorscrewgr
1 'No previous Pin or Screw'
2 'Previous Pin or Screw'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.

COXREG time
  /STATUS=reint(1)
```

```
/strata =      hpinorscrewgr
/CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
/PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:41:28
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	324326
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hpinorscrewgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.23
	Elapsed Time	00:00:00.55

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	31285	9.6%
	Censored	292310	90.1%
	Total	323595	99.8%

Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	731	0.2%
	Total	731	0.2%
Total		324326	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

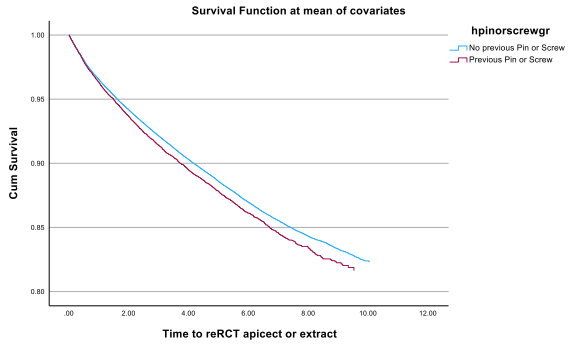
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Pin or Screw	29004	273827	90.4%
2.00	Previous Pin or Screw	2281	18483	89.0%
Total		31285	292310	90.3%

a. The strata variable is : hpinorscrewgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
748295.331



* What happens if there is a history of post?.

* Create descriptive variables.

```
RECODE hpost
(0 =1)
(1 thru 9=2)
into hpostgr.

value labels
/hpostgr
1 'No previous Post'
2 'Previous Post'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      hpostgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT =  SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:41:30
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	324326
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hpostgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.36
	Elapsed Time	00:00:00.50

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	31285	9.6%
	Censored	292306	90.1%
	Total	323591	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	735	0.2%
	Total	735	0.2%
Total		324326	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

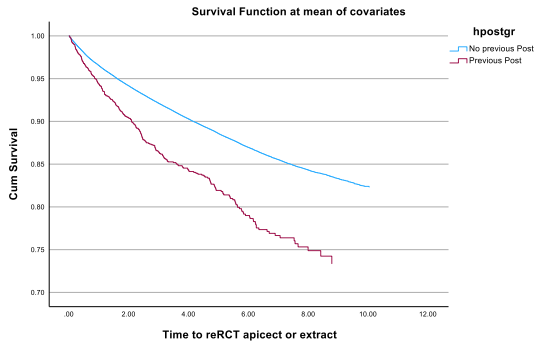
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Post	30970	290641	90.4%
2.00	Previous Post	315	1665	84.1%
Total		31285	292306	90.3%

a. The strata variable is : hpostgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
761044.465



```
* What happens if there is a crown history?.

* Create descriptive variables.

RECODE hCrown
(0 =1)
(1 thru 9=2)
into hcrowngr.

value labels
/hcrowngr
1 'No previous Crown'
2 'Previous Crown'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav'.

COXREG time
  /STATUS=reint(1)
  /strata = hcrowngr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:41:31
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	324326

Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hcrowngr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.30
	Elapsed Time	00:00:00.53

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	31285	9.6%
	Censored	292310	90.1%
	Total	323595	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	731	0.2%
	Total	731	0.2%
Total		324326	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

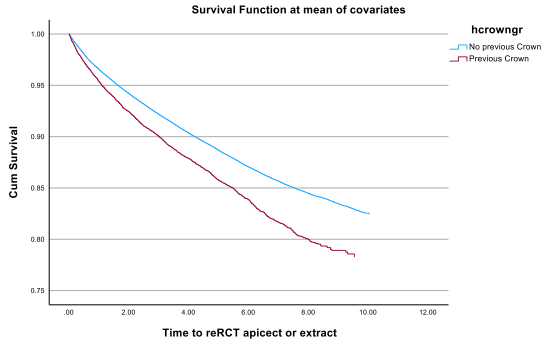
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Crown	29404	279636	90.5%
2.00	Previous Crown	1881	12674	87.1%
Total		31285	292310	90.3%

a. The strata variable is : hcrowngr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
750309.915



* What happens if there is a history of bridge abutment?.

* Create descriptive variables.

```
RECODE hAbutment
(0 =1)
(1 thru 9=2)
into hAbutmentgr.

value labels
/hAbutmentgr
1 'No previous Bridge Abutment'
2 'Previous Bridge Abutment'.

compute caseid=$casenum.
```

```
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =        habutmentgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:41:32
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	324326
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = habutmentgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.34
	Elapsed Time	00:00:00.52

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	31285	9.6%
	Censored	292310	90.1%
	Total	323595	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	731	0.2%
	Total	731	0.2%
Total		324326	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

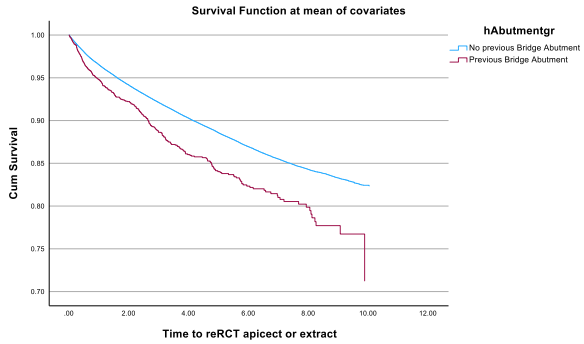
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Bridge Abutment	30961	290110	90.4%
2.00	Previous Bridge Abutment	324	2200	87.2%
Total		31285	292310	90.3%

a. The strata variable is : hAbutmentgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
761000.802



****

*Restoration in anterior teeth.

* What happens if there is a history of incisal edge?.

* Create descriptive variables.

```
RECODE hincisaledge
(0 =1)
(1 thru 9=2)
into hincisaledgegr.

value labels
/hincisaledgegr
1 'No previous Incisal edge'
2 'Previous Incisal edge'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp7.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp7.sav'.

COXREG time
  /STATUS=reint(1)
```

```
/strata =      hincisaledgegr
/CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
/PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:41:33
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp7.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	324326
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hincisaledgegr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.37
	Elapsed Time	00:00:00.50

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp7.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	31285	9.6%
	Censored	292310	90.1%
	Total	323595	99.8%

Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	731	0.2%
	Total	731	0.2%
Total		324326	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

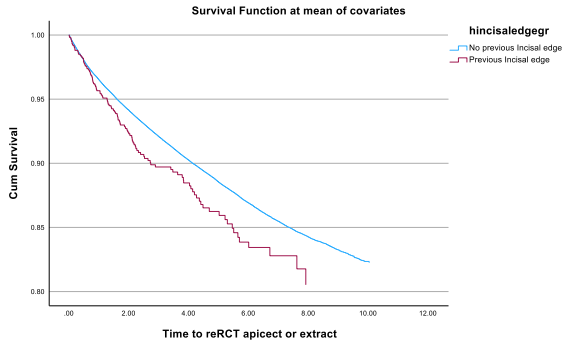
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Incisal edge	31173	291406	90.3%
2.00	Previous Incisal edge	112	904	89.0%
Total		31285	292310	90.3%

a. The strata variable is : hincisaledgegr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
763151.015



* What happens if there is a history of an incisal angle?.

* Create descriptive variables.

```
RECODE honeangle
(0 =1)
(1 thru 9=2)
into honeanglegr.

value labels
/honeanglegr
1 'No previous one Angle'
2 'Previous one Angle'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp8.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp8.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      honeanglegr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:41:34
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp8.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	324326
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = honeanglegr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.42
	Elapsed Time	00:00:00.51

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp8.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	31285	9.6%
	Censored	292309	90.1%
	Total	323594	99.8%
Cases dropped	Cases with missing values	1	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	731	0.2%
	Total	732	0.2%
Total		324326	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

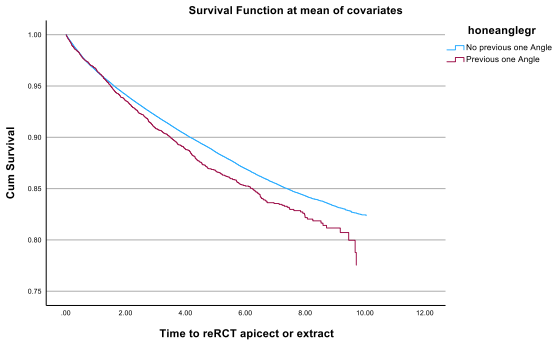
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous one Angle	30558	286471	90.4%
2.00	Previous one Angle	727	5838	88.9%
Total		31285	292309	90.3%

a. The strata variable is : honeanglegr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
757721.125



```
* What happens if there is a history of two incisal angles?.

* Create descriptive variables.

RECODE htwoangles
(0 =1)
(1 thru 9=2)
into htwoanglesgr.

value labels
/htwoanglesgr
1 'No previous two angles'
2 'Previous two angles'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp9.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp9.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      htwoanglesgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:41:35
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp9.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	324326

Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = htwoanglesgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.31
	Elapsed Time	00:00:00.50

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp9.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	31285	9.6%
	Censored	292310	90.1%
	Total	323595	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	731	0.2%
	Total	731	0.2%
Total		324326	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

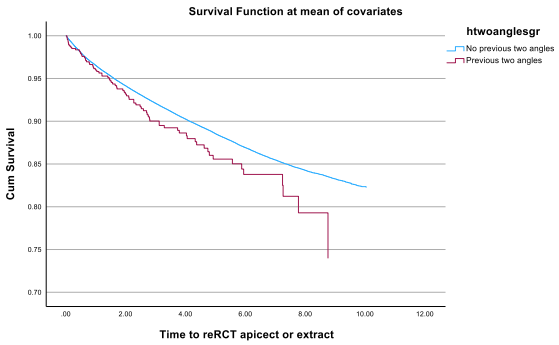
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous two angles	31210	291709	90.3%
2.00	Previous two angles	75	601	88.9%
Total		31285	292310	90.3%

a. The strata variable is : htwoanglesgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
763580.286



****

*Restoration in posterior teeth.

* What happens if there is an occlusal history?.

* Create descriptive variables.

```
RECODE hOcclusal
(0 =1)
(1 thru 9=2)
into hOcclusalgr.
```

```
value labels
/ hOcclusalgr
1 'No previous Occlusal'
2 'Previous Occlusal'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp10.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp10.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =  hOcclusalgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:41:36
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp10.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	324326
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hOcclusalgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.42

Elapsed Time	00:00:00.52

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp10.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	31285	9.6%
	Censored	292310	90.1%
	Total	323595	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	731	0.2%
	Total	731	0.2%
Total		324326	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

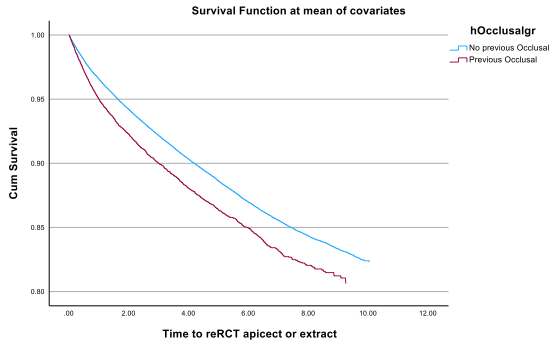
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Occlusal	29874	282254	90.4%
2.00	Previous Occlusal	1411	10056	87.7%
Total		31285	292310	90.3%

a. The strata variable is : hOcclusalgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
753070.655



* What happens if there is a history of one proximal ridge (MO or DO)?.

* Create descriptive variables.

```
RECODE honeproximalridge
(0 =1)
(1 thru 9=2)
into honeproximalridgegr.

value labels
/honeproximalridgegr
1 'No previous MO/DO'
2 'Previous MO/DO'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp11.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp11.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =   honeproximalridgegr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:41:37
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp11.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	324326
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = honeproximalridgegr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.36
	Elapsed Time	00:00:00.55

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp11.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	31285	9.6%
	Censored	292310	90.1%
	Total	323595	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%

	Censored cases before the earliest event in a stratum	731	0.2%
	Total	731	0.2%
Total		324326	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

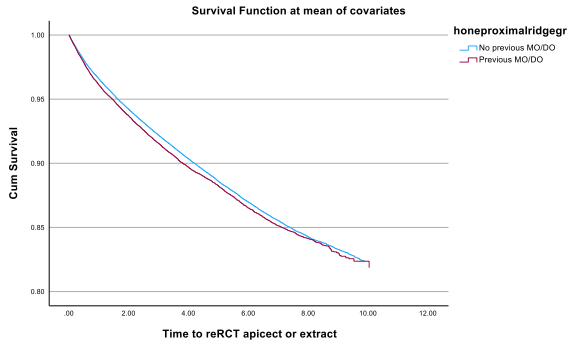
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous MO/DO	26354	249452	90.4%
2.00	Previous MO/DO	4931	42858	89.7%
Total		31285	292310	90.3%

a. The strata variable is : honeproximalridgegr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
737356.826



* What happens if there is a history of MOD?.

* Create descriptive variables.

```
RECODE hMOD
(0 =1)
(1 thru 9=2)
into hMODgr.

value labels
/hMODgr
1 'No previous MOD'
2 'Previous MOD'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp12.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp12.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =    hMODgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:41:38
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp12.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	324326
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hMODgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.53
	Elapsed Time	00:00:00.55

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp12.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	31285	9.6%
	Censored	292310	90.1%
	Total	323595	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	731	0.2%

Total	731	0.2%
Total	324326	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

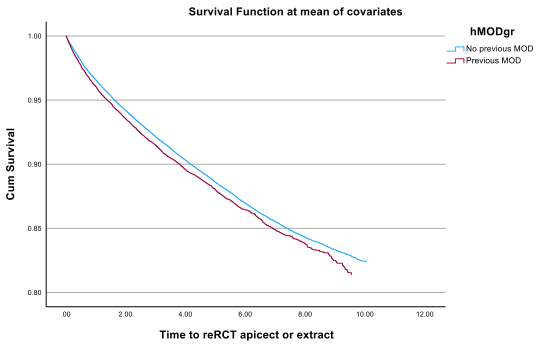
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous MOD	28174	266539	90.4%
2.00	Previous MOD	3111	25771	89.2%
Total		31285	292310	90.3%

a. The strata variable is : hMODgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
744356.876



* What happens if there is a history of tunnel restoration?.

* Create descriptive variables.

```
RECODE  htunnel
(0 =1)
(1 thru 9=2)
into  htunnelgr.

value labels
/htunnelgr
1 'No previous Tunnel'
2 'Previous Tunnel'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp13.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp13.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =     htunnelgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:41:40
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp13.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	324326

Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = htunnelgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.44
	Elapsed Time	00:00:00.52

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp13.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	31285	9.6%
	Censored	292309	90.1%
	Total	323594	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	732	0.2%
	Total	732	0.2%
Total		324326	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

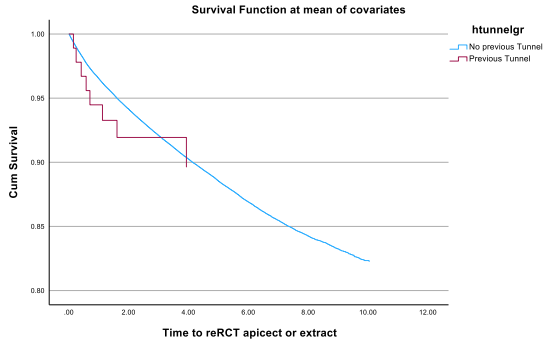
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Tunnel	31277	292226	90.3%
2.00	Previous Tunnel	8	83	91.2%
Total		31285	292309	90.3%

a. The strata variable is : htunnelgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
764490.713



* What happens if there is a history of inlay?.

* Create descriptive variables.

RECODE hInlay
(0 =1)
(1 thru 9=2)
into hInlaygr.

value labels
/hInlaygr
1 'No previous Inlay'
2 'Previous Inlay'.

compute caseid=$casenum.

```
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp14.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp14.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =       hInlaygr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 22:41:41
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp14.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	324326
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hInlaygr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.36
	Elapsed Time	00:00:00.51

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp14.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	31285	9.6%
	Censored	292310	90.1%
	Total	323595	99.8%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	731	0.2%
	Total	731	0.2%
Total		324326	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

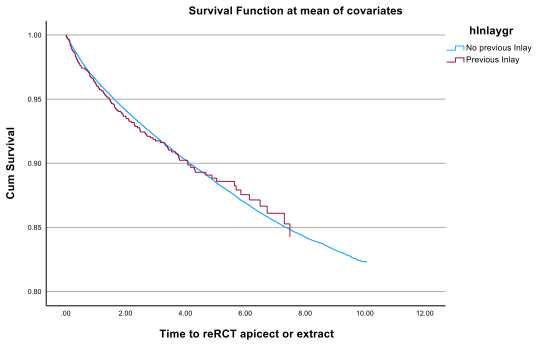
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Inlay	31156	290922	90.3%
2.00	Previous Inlay	129	1388	91.5%
Total		31285	292310	90.3%

a. The strata variable is : hInlaygr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
762971.929


Survival Function at mean of covariates
hInlaygr
No previous Inlay
Previous Inlay
Cum Survival
1.00
0.95
0.90
0.85
0.80
.00
2.00
4.00
6.00
8.00
10.00
12.00
Time to reRCT apicect or extract

****

**********.

9.4.4.3 Based on 8 years of Treatment History

```
* Encoding: windows-1252.
* RF All History Teeth charts 02 8y.sps.


* Written by ML on 17/2/2024. Modified on 14/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All
History Teeth Preparation 8y.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160429.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created		14-APR-2024 23:00:11
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All History Teeth Preparation 8y.sav

	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	191477
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:00:05.37
	Elapsed Time	00:00:14.98
Variables Created or Modified	survall	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All History Teeth Preparation 8y.sav

Case Processing Summary

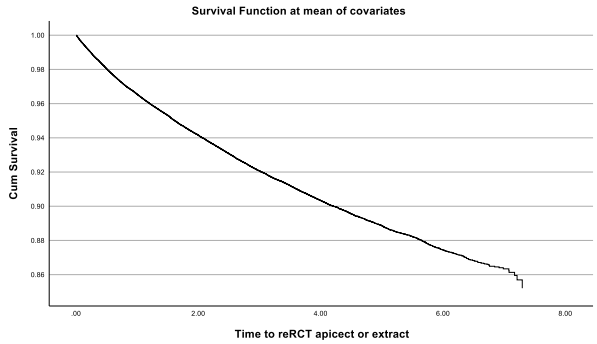
		N	Percent
Cases available in analysis	Event[a]	14552	7.6%
	Censored	176241	92.0%
	Total	190793	99.6%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	684	0.4%
	Total	684	0.4%
Total		191477	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
341169.813



****
*

* What happens if there is a root filling history?.

* Create descriptive variables.

RECODE hroot
(0 =1)
(1 thru 9=2)
into hrootgr.

value labels
/hrootgr
1 'No previous Root Filling'

2 'Previous Root Filling'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

COXREG time
  /STATUS=reint(1)
  /strata = hrootgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

Cox Regression

Notes

Output Created		14-APR-2024 23:00:40
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	191477
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hrootgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.13
	Elapsed Time	00:00:00.39

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	14552	7.6%
	Censored	176229	92.0%
	Total	190781	99.6%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	696	0.4%
	Total	696	0.4%
Total		191477	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

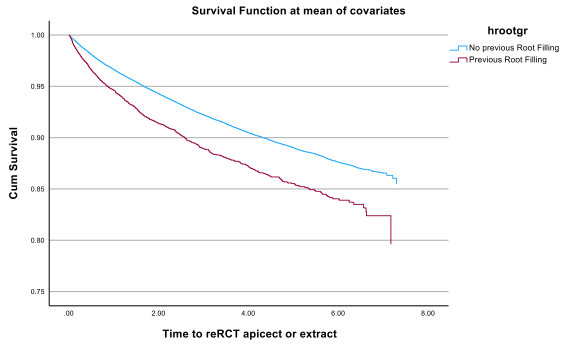
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Root Filling	13611	168270	92.5%
2.00	Previous Root Filling	941	7959	89.4%
Total		14552	176229	92.4%

a. The strata variable is : hrootgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
334096.835




```
* What happens if there is a history of apicectomy?.

* Create descriptive variables.

RECODE hApicect
(0 =1)
(1 thru 9=2)
into hApicectgr.

value labels
/hApicectgr
1 'No previous Apicectomy'
2 'Previous Apicectomy'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.


COXREG time
  /STATUS=reint(1)
  /strata =        hApicectgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
```

/PLOT = SURVIVAL.

Cox Regression

Notes

Output Created		14-APR-2024 23:00:41
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	191477
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hApicectgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.11
	Elapsed Time	00:00:00.37

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	14552	7.6%
	Censored	176240	92.0%
	Total	190792	99.6%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%

	Censored cases before the earliest event in a stratum	685	0.4%
	Total	685	0.4%
Total		191477	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

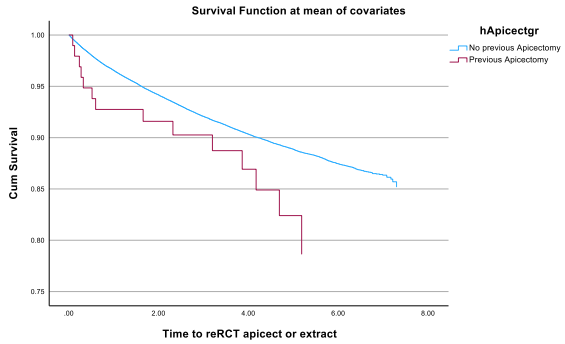
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Apicectomy	14538	176157	92.4%
2.00	Previous Apicectomy	14	83	85.6%
Total		14552	176240	92.4%

a. The strata variable is : hApicectgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
340945.551




```
**********************************************************************************************************
********************

*Restoration in all teeth.

* What happens if there is a history of pin or screw?.

* Create descriptive variables.

RECODE hpinorscrew
(0 =1)
(1 thru 9=2)
into hpinorscrewgr.

value labels
/hpinorscrewgr
1 'No previous Pin or Screw'
2 'Previous Pin or Screw'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.

COXREG time
  /STATUS=reint(1)
```

```
/strata =      hpinorscrewgr
/CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
/PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 23:00:42
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	191477
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hpinorscrewgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.11
	Elapsed Time	00:00:00.39

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	14552	7.6%
	Censored	176241	92.0%
	Total	190793	99.6%

Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	684	0.4%
	Total	684	0.4%
Total		191477	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

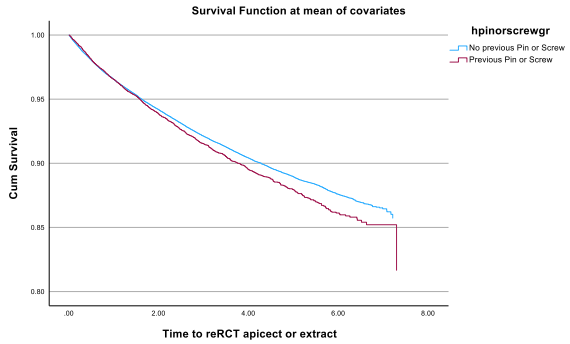
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Pin or Screw	13192	161798	92.5%
2.00	Previous Pin or Screw	1360	14443	91.4%
Total		14552	176241	92.4%

a. The strata variable is : hpinorscrewgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
332137.131



* What happens if there is a history of post?.

* Create descriptive variables.

```
RECODE hpost
(0 =1)
(1 thru 9=2)
into hpostgr.

value labels
/hpostgr
1 'No previous Post'
2 'Previous Post'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      hpostgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT =  SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 23:00:43
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	191477
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hpostgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.05
	Elapsed Time	00:00:00.36

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	14552	7.6%
	Censored	176237	92.0%
	Total	190789	99.6%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	688	0.4%
	Total	688	0.4%
Total		191477	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

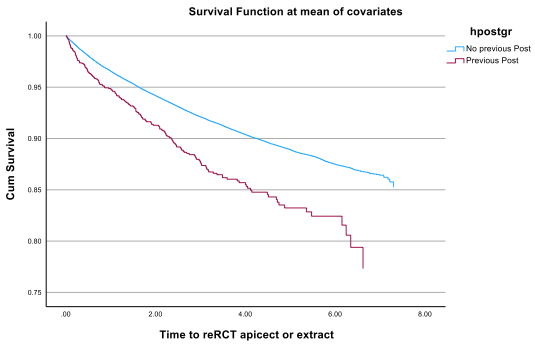
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Post	14357	174774	92.4%
2.00	Previous Post	195	1463	88.2%
Total		14552	176237	92.4%

a. The strata variable is : hpostgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
339067.234



```
* What happens if there is a crown history?.

* Create descriptive variables.

RECODE hCrown
(0 =1)
(1 thru 9=2)
into hcrowngr.

value labels
/hcrowngr
1 'No previous Crown'
2 'Previous Crown'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav'.

COXREG time
  /STATUS=reint(1)
  /strata = hcrowngr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 23:00:44
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	191477

Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hcrowngr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.25
	Elapsed Time	00:00:00.40

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	14552	7.6%
	Censored	176241	92.0%
	Total	190793	99.6%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	684	0.4%
	Total	684	0.4%
Total		191477	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

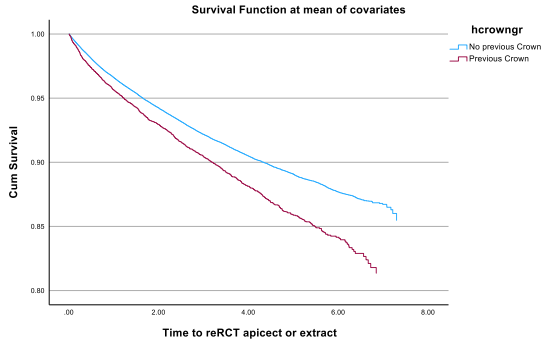
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Crown	13371	165498	92.5%
2.00	Previous Crown	1181	10743	90.1%
Total		14552	176241	92.4%

a. The strata variable is : hcrowngr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
332915.344



* What happens if there is a history of bridge abutment?.

* Create descriptive variables.

```
RECODE hAbutment
(0 =1)
(1 thru 9=2)
into hAbutmentgr.

value labels
/hAbutmentgr
1 'No previous Bridge Abutment'
2 'Previous Bridge Abutment'.

compute caseid=$casenum.
```

execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav'.

COXREG time
  /STATUS=reint(1)
  /strata = habutmentgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

Cox Regression

Notes

Output Created		14-APR-2024 23:00:44
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	191477
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = habutmentgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.03
	Elapsed Time	00:00:00.38

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	14552	7.6%
	Censored	176241	92.0%
	Total	190793	99.6%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	684	0.4%
	Total	684	0.4%
Total		191477	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

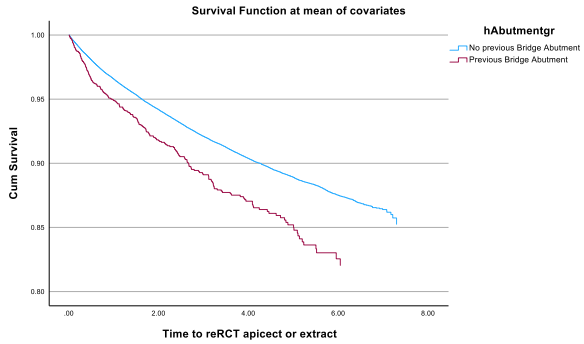
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Bridge Abutment	14300	174103	92.4%
2.00	Previous Bridge Abutment	252	2138	89.5%
Total		14552	176241	92.4%

a. The strata variable is : hAbutmentgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
338599.681



****

*Restoration in anterior teeth.

* What happens if there is a history of incisal edge?.

* Create descriptive variables.

```
RECODE hincisaledge
(0 =1)
(1 thru 9=2)
into hincisaledgegr.

value labels
/hincisaledgegr
1 'No previous Incisal edge'
2 'Previous Incisal edge'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp7.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp7.sav'.

COXREG time
  /STATUS=reint(1)
```

```
/strata =      hincisaledgegr
/CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
/PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 23:00:45
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp7.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	191477
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hincisaledgegr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.39

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp7.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	14552	7.6%
	Censored	176237	92.0%
	Total	190789	99.6%

Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	688	0.4%
	Total	688	0.4%
Total		191477	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

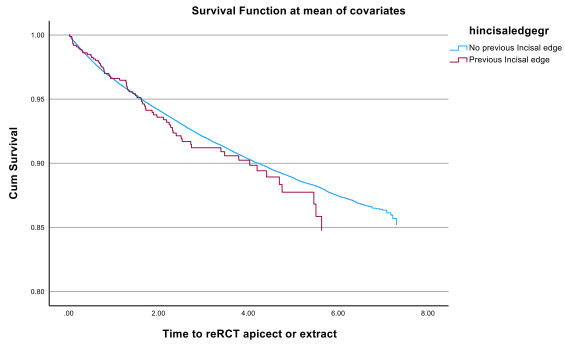
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Incisal edge	14483	175431	92.4%
2.00	Previous Incisal edge	69	806	92.1%
Total		14552	176237	92.4%

a. The strata variable is : hincisaledgegr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
340293.106



* What happens if there is a history of an incisal angle?.

* Create descriptive variables.

```
RECODE honeangle
(0 =1)
(1 thru 9=2)
into honeanglegr.

value labels
/honeanglegr
1 'No previous one Angle'
2 'Previous one Angle'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp8.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp8.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      honeanglegr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 23:00:46
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp8.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	191477
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = honeanglegr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.13
	Elapsed Time	00:00:00.38

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp8.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	14552	7.6%
	Censored	176237	92.0%
	Total	190789	99.6%
Cases dropped	Cases with missing values	1	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	687	0.4%
	Total	688	0.4%
Total		191477	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

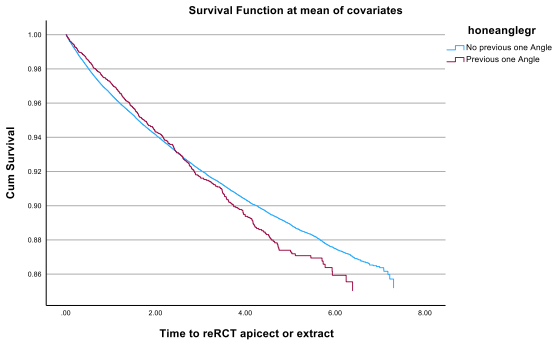
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous one Angle	14140	171604	92.4%
2.00	Previous one Angle	412	4633	91.8%
Total		14552	176237	92.4%

a. The strata variable is : honeanglegr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
337420.539



```
* What happens if there is a history of two incisal angles?.

* Create descriptive variables.

RECODE htwoangles
(0 =1)
(1 thru 9=2)
into htwoanglesgr.

value labels
/htwoanglesgr
1 'No previous two angles'
2 'Previous two angles'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp9.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp9.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      htwoanglesgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 23:00:47
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp9.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	191477

Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = htwoanglesgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.03
	Elapsed Time	00:00:00.35

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp9.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	14552	7.6%
	Censored	176241	92.0%
	Total	190793	99.6%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	684	0.4%
	Total	684	0.4%
Total		191477	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

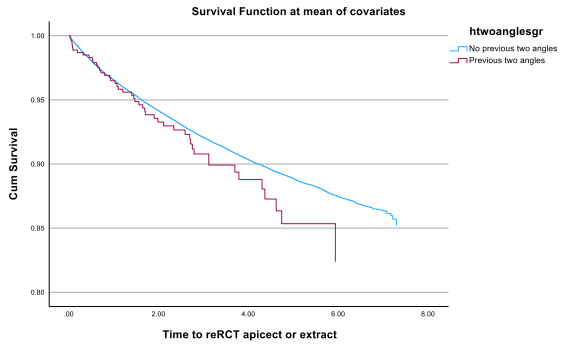
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous two angles	14505	175747	92.4%
2.00	Previous two angles	47	494	91.3%
Total		14552	176241	92.4%

a. The strata variable is : htwoanglesgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
340535.059



****

*Restoration in posterior teeth.

* What happens if there is an occlusal history?.

* Create descriptive variables.

RECODE hOcclusal
(0 =1)
(1 thru 9=2)
into hOcclusalgr.

```
value labels
/ hOcclusalgr
1 'No previous Occlusal'
2 'Previous Occlusal'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp10.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp10.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =  hOcclusalgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 23:00:48
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp10.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	191477
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hOcclusalgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.14

Elapsed Time	00:00:00.41

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp10.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	14552	7.6%
	Censored	176241	92.0%
	Total	190793	99.6%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	684	0.4%
	Total	684	0.4%
Total		191477	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

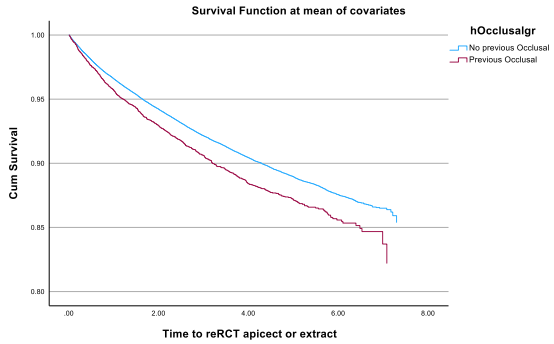
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Occlusal	13659	167780	92.5%
2.00	Previous Occlusal	893	8461	90.5%
Total		14552	176241	92.4%

a. The strata variable is : hOcclusalgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
334426.697



* What happens if there is a history of one proximal ridge (MO or DO)?.

* Create descriptive variables.

```
RECODE honeproximalridge
(0 =1)
(1 thru 9=2)
into honeproximalridgegr.

value labels
/honeproximalridgegr
1 'No previous MO/DO'
2 'Previous MO/DO'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp11.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp11.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =   honeproximalridgegr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 23:00:49
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp11.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	191477
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = honeproximalridgegr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.08
	Elapsed Time	00:00:00.41

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp11.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	14552	7.6%
	Censored	176241	92.0%
	Total	190793	99.6%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%

	Censored cases before the earliest event in a stratum	684	0.4%
	Total	684	0.4%
Total		191477	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

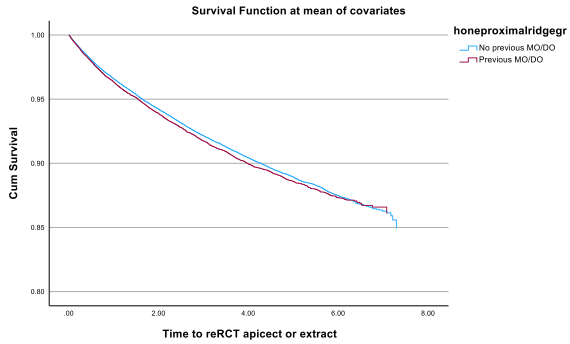
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous MO/DO	11620	142657	92.5%
2.00	Previous MO/DO	2932	33584	92.0%
Total		14552	176241	92.4%

a. The strata variable is : honeproximalridgegr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
326539.266




```
* What happens if there is a history of MOD?.

* Create descriptive variables.

RECODE hMOD
(0 =1)
(1 thru 9=2)
into hMODgr.

value labels
/hMODgr
1 'No previous MOD'
2 'Previous MOD'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp12.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp12.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =    hMODgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 23:00:49
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp12.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	191477
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hMODgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.06
	Elapsed Time	00:00:00.39

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp12.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	14552	7.6%
	Censored	176241	92.0%
	Total	190793	99.6%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	684	0.4%

Total	684	0.4%
Total	191477	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

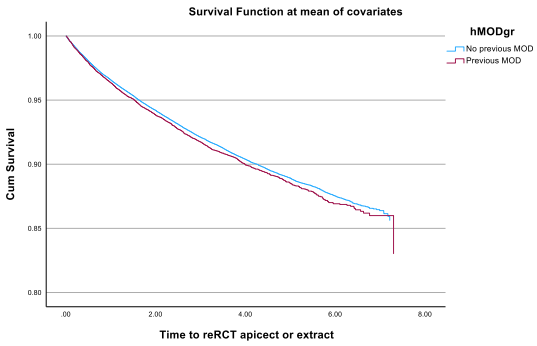
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous MOD	12713	155862	92.5%
2.00	Previous MOD	1839	20379	91.7%
Total		14552	176241	92.4%

a. The strata variable is : hMODgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
330125.467



```
* What happens if there is a history of tunnel restoration?.

* Create descriptive variables.

RECODE  htunnel
(0 =1)
(1 thru 9=2)
into  htunnelgr.

value labels
/htunnelgr
1 'No previous Tunnel'
2 'Previous Tunnel'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp13.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp13.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =     htunnelgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 23:00:50
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp13.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	191477

Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = htunnelgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.14
	Elapsed Time	00:00:00.36

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp13.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	14552	7.6%
	Censored	176240	92.0%
	Total	190792	99.6%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	685	0.4%
	Total	685	0.4%
Total		191477	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

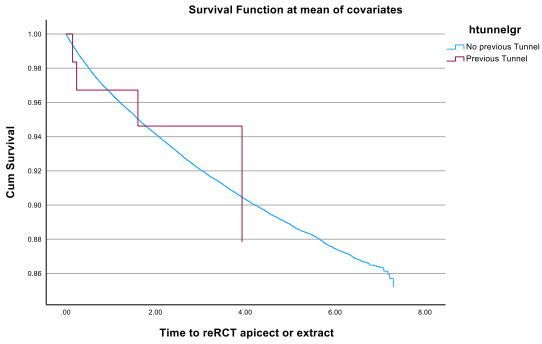
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Tunnel	14548	176183	92.4%
2.00	Previous Tunnel	4	57	93.4%
Total		14552	176240	92.4%

a. The strata variable is : htunnelgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
341095.962



* What happens if there is a history of inlay?.

* Create descriptive variables.

```
RECODE hInlay
(0 =1)
(1 thru 9=2)
into hInlaygr.

value labels
/hInlaygr
1 'No previous Inlay'
2 'Previous Inlay'.

compute caseid=$casenum.
```

```
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp14.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp14.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =       hInlaygr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 23:00:51
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp14.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	191477
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hInlaygr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.11
	Elapsed Time	00:00:00.38

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp14.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	14552	7.6%
	Censored	176241	92.0%
	Total	190793	99.6%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	684	0.4%
	Total	684	0.4%
Total		191477	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

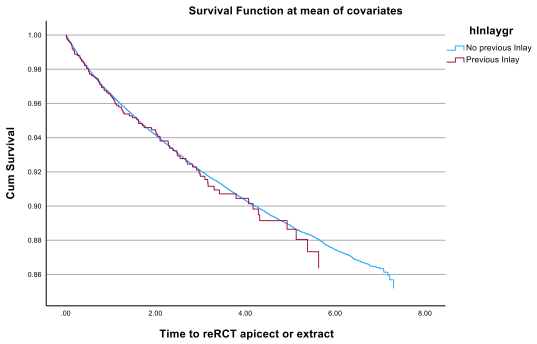
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Inlay	14459	175068	92.4%
2.00	Previous Inlay	93	1173	92.7%
Total		14552	176241	92.4%

a. The strata variable is : hInlaygr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
340044.819


Survival Function at mean of covariates
hInlaygr
No previous Inlay
Previous Inlay
Cum Survival
1.00
0.98
0.96
0.94
0.92
0.90
0.88
0.86
.00
2.00
4.00
6.00
8.00
Time to reRCT apicect or extract

****

**********.

9.4.4.4 Based on 10 years of Treatment History

```
* Encoding: windows-1252.
* RF All History Teeth charts 02 10y.sps.

* Written by ML on 17/2/2024.Modified on 14/04/2024.

* This uses random censoring to calculate survival statistics using the CoxR
procedure.
* Produce survival curves for some values of descriptive variables.

Get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All
History Teeth Preparation 10y.sav'.

* Censor the proportion prreatt of all non-returners at the end of the observation
period (instead of earlier).

Set seed = 20160429.
select if (recid=1).
compute random=uniform(1).
If (reint=0 and random<prreatt) time=max((yrmoda(2006,03,31)- doplacn),0).

* First check overall survival.

compute time = time/365.

COXREG time
  /STATUS=reint(1)
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL
  /Save survival (survall).
```

Cox Regression

Notes

Output Created		14-APR-2024 23:03:34
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All History Teeth Preparation 10y.sav

	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	116528
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL /Save survival (survall).
Resources	Processor Time	00:00:01.61
	Elapsed Time	00:00:04.76
Variables Created or Modified	survall	Survival function evaluate at the current case

C:\Users\maria\OneDrive\Documents\PhD Results\SPSS Sav\RF All History Teeth Preparation 10y.sav

Case Processing Summary

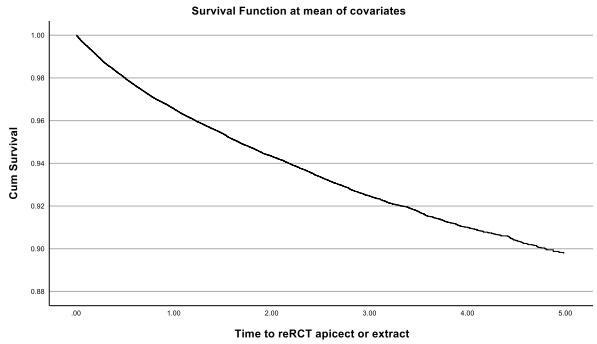
		N	Percent
Cases available in analysis	Event[a]	6844	5.9%
	Censored	109053	93.6%
	Total	115897	99.5%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	631	0.5%
	Total	631	0.5%
Total		116528	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
154101.038



****

* What happens if there is a root filling history?.

* Create descriptive variables.

```
RECODE hroot
(0 =1)
(1 thru 9=2)
into hrootgr.

value labels
/hrootgr
1 'No previous Root Filling'
```

2 'Previous Root Filling'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav'.

COXREG time
  /STATUS=reint(1)
  /strata = hrootgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.

Cox Regression

Notes

Output Created		14-APR-2024 23:03:44
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	116528
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hrootgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.09
	Elapsed Time	00:00:00.30

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp1.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	6844	5.9%
	Censored	109042	93.6%
	Total	115886	99.4%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	642	0.6%
	Total	642	0.6%
Total		116528	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

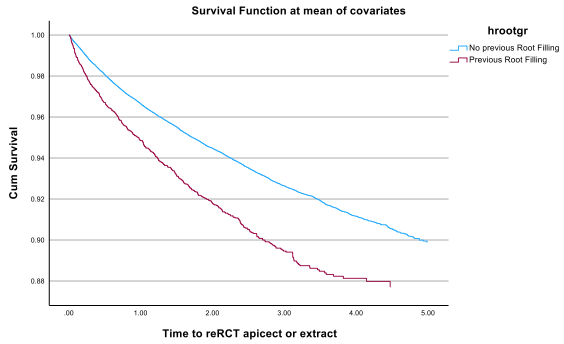
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Root Filling	6341	103533	94.2%
2.00	Previous Root Filling	503	5509	91.6%
Total		6844	109042	94.1%

a. The strata variable is : hrootgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
150447.480



* What happens if there is a history of apicectomy?.

* Create descriptive variables.

```
RECODE hApicect
(0 =1)
(1 thru 9=2)
into hApicectgr.

value labels
/hApicectgr
1 'No previous Apicectomy'
2 'Previous Apicectomy'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav'.


COXREG time
  /STATUS=reint(1)
  /strata =        hApicectgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
```

/PLOT = SURVIVAL.

Cox Regression

Notes

Output Created		14-APR-2024 23:03:45
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	116528
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hApicectgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.13
	Elapsed Time	00:00:00.28

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp2.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	6844	5.9%
	Censored	109052	93.6%
	Total	115896	99.5%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%

	Censored cases before the earliest event in a stratum	632	0.5%
	Total	632	0.5%
Total		116528	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

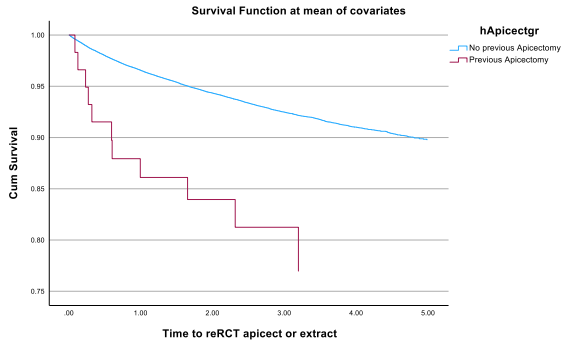
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Apicectomy	6833	109004	94.1%
2.00	Previous Apicectomy	11	48	81.4%
Total		6844	109052	94.1%

a. The strata variable is : hApicectgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
153927.900



****

*Restoration in all teeth.

* What happens if there is a history of pin or screw?.

* Create descriptive variables.

```
RECODE hpinorscrew
(0 =1)
(1 thru 9=2)
into hpinorscrewgr.

value labels
/hpinorscrewgr
1 'No previous Pin or Screw'
2 'Previous Pin or Screw'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav'.

COXREG time
  /STATUS=reint(1)
```

```
/strata =      hpinorscrewgr
/CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
/PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 23:03:45
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	116528
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hpinorscrewgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.06
	Elapsed Time	00:00:00.29

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp3.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	6844	5.9%
	Censored	109053	93.6%
	Total	115897	99.5%

Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	631	0.5%
	Total	631	0.5%
Total		116528	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

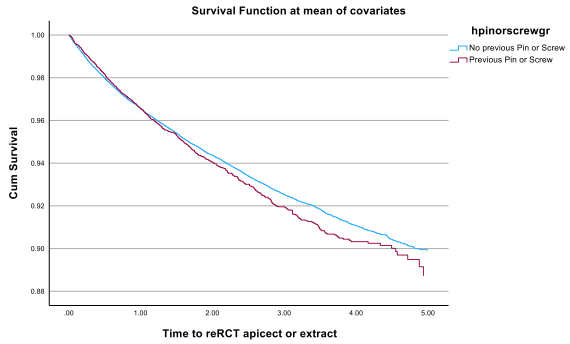
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Pin or Screw	6140	98881	94.2%
2.00	Previous Pin or Screw	704	10172	93.5%
Total		6844	109053	94.1%

a. The strata variable is : hpinorscrewgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
149567.475




```
* What happens if there is a history of post?.

* Create descriptive variables.

RECODE hpost
(0 =1)
(1 thru 9=2)
into hpostgr.

value labels
/hpostgr
1 'No previous Post'
2 'Previous Post'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      hpostgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT =  SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 23:03:46
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	116528
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hpostgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.13
	Elapsed Time	00:00:00.31

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp4.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	6844	5.9%
	Censored	109050	93.6%
	Total	115894	99.5%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	634	0.5%
	Total	634	0.5%
Total		116528	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

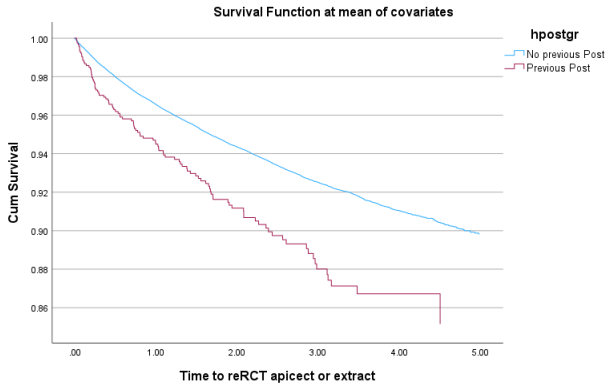
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Post	6739	108015	94.1%
2.00	Previous Post	105	1035	90.8%
Total		6844	109050	94.1%

a. The strata variable is : hpostgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
152996.718



* What happens if there is a crown history?.

* Create descriptive variables.

```
RECODE hCrown
(0 =1)
(1 thru 9=2)
into hcrowngr.

value labels
/hcrowngr
1 'No previous Crown'
2 'Previous Crown'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav'.

COXREG time
  /STATUS=reint(1)
  /strata = hcrowngr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 23:03:46
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	116528
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hcrowngr

		/CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.06
	Elapsed Time	00:00:00.28

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp5.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	6844	5.9%
	Censored	109053	93.6%
	Total	115897	99.5%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	631	0.5%
	Total	631	0.5%
Total		116528	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Crown	6179	101036	94.2%
2.00	Previous Crown	665	8017	92.3%
Total		6844	109053	94.1%

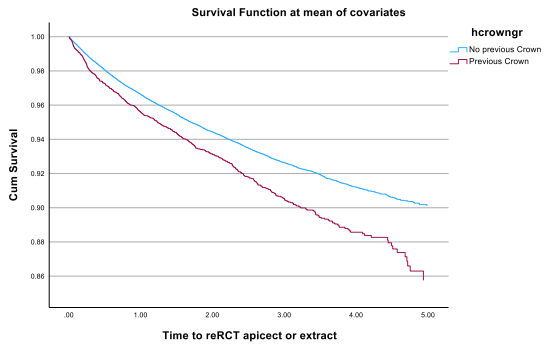
a. The strata variable is : hcrowngr

Block 0: Beginning Block

Omnibus Tests of Model

Coefficients

-2 Log Likelihood
149698.213



* What happens if there is a history of bridge abutment?.

* Create descriptive variables.

```
RECODE hAbutment
(0 =1)
(1 thru 9=2)
into hAbutmentgr.

value labels
/hAbutmentgr
1 'No previous Bridge Abutment'
2 'Previous Bridge Abutment'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav'.
```

```
COXREG time
  /STATUS=reint(1)
  /strata =        habutmentgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 23:03:47
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	116528
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = habutmentgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.13
	Elapsed Time	00:00:00.30

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp6.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	6844	5.9%
	Censored	109053	93.6%

	Total	115897	99.5%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	631	0.5%
	Total	631	0.5%
Total		116528	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

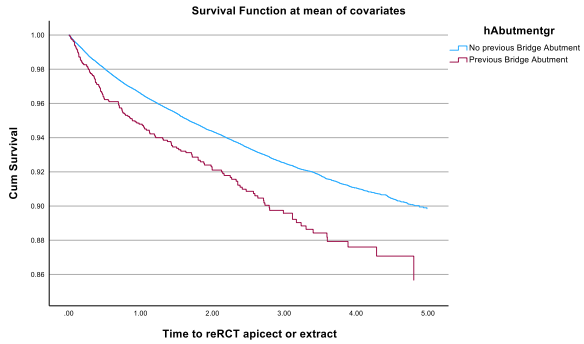
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Bridge Abutment	6691	107378	94.1%
2.00	Previous Bridge Abutment	153	1675	91.6%
Total		6844	109053	94.1%

a. The strata variable is : hAbutmentgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
152618.286



****

*Restoration in anterior teeth.

* What happens if there is a history of incisal edge?.

* Create descriptive variables.

```
RECODE hincisaledge
(0 =1)
(1 thru 9=2)
into hincisaledgegr.

value labels
/hincisaledgegr
1 'No previous Incisal edge'
2 'Previous Incisal edge'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp7.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp7.sav'.

COXREG time
  /STATUS=reint(1)
```

```
/strata =      hincisaledgegr
/CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
/PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 23:03:47
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp7.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	116528
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hincisaledgegr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.03
	Elapsed Time	00:00:00.26

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp7.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	6844	5.9%
	Censored	109049	93.6%
	Total	115893	99.5%

Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	635	0.5%
	Total	635	0.5%
Total		116528	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

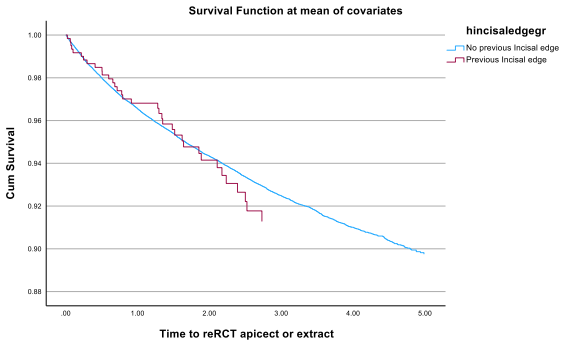
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Incisal edge	6809	108477	94.1%
2.00	Previous Incisal edge	35	572	94.2%
Total		6844	109049	94.1%

a. The strata variable is : hincisaledgegr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
153661.675




```
* What happens if there is a history of an incisal angle?.

* Create descriptive variables.

RECODE honeangle
(0 =1)
(1 thru 9=2)
into honeanglegr.

value labels
/honeanglegr
1 'No previous one Angle'
2 'Previous one Angle'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp8.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp8.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      honeanglegr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 23:03:48
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp8.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	116528
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = honeanglegr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.29

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp8.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	6844	5.9%
	Censored	109041	93.6%
	Total	115885	99.4%
Cases dropped	Cases with missing values	1	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	642	0.6%
	Total	643	0.6%
Total		116528	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

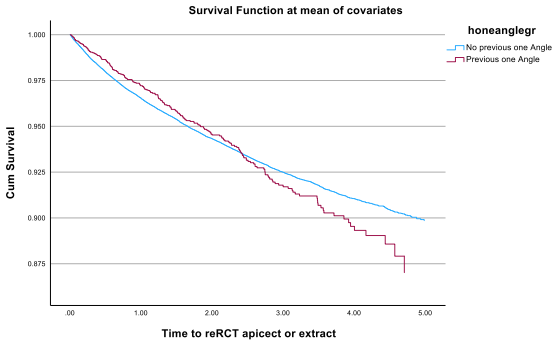
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous one Angle	6629	105832	94.1%
2.00	Previous one Angle	215	3209	93.7%
Total		6844	109041	94.1%

a. The strata variable is : honeanglegr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
152189.836



```
* What happens if there is a history of two incisal angles?.

* Create descriptive variables.

RECODE htwoangles
(0 =1)
(1 thru 9=2)
into htwoanglesgr.

value labels
/htwoanglesgr
1 'No previous two angles'
2 'Previous two angles'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp9.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp9.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =      htwoanglesgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 23:03:48
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp9.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	116528

Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = htwoanglesgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.27

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp9.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	6844	5.9%
	Censored	109052	93.6%
	Total	115896	99.5%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	632	0.5%
	Total	632	0.5%
Total		116528	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

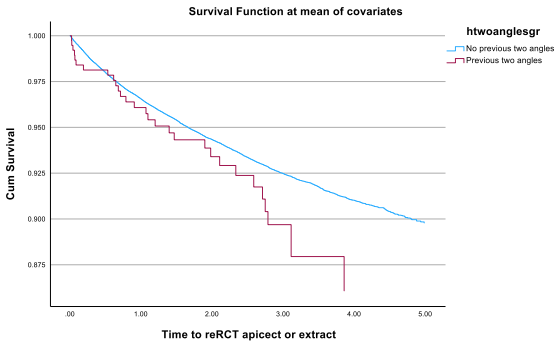
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous two angles	6814	108702	94.1%
2.00	Previous two angles	30	350	92.1%
Total		6844	109052	94.1%

a. The strata variable is : htwoanglesgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
153713.240



****

*Restoration in posterior teeth.

* What happens if there is an occlusal history?.

* Create descriptive variables.

RECODE hOcclusal
(0 =1)
(1 thru 9=2)
into hOcclusalgr.

```
value labels
/ hOcclusalgr
1 'No previous Occlusal'
2 'Previous Occlusal'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp10.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp10.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =  hOcclusalgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 23:03:49
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp10.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	116528
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hOcclusalgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.00

Elapsed Time	00:00:00.28

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp10.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	6844	5.9%
	Censored	109053	93.6%
	Total	115897	99.5%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	631	0.5%
	Total	631	0.5%
Total		116528	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

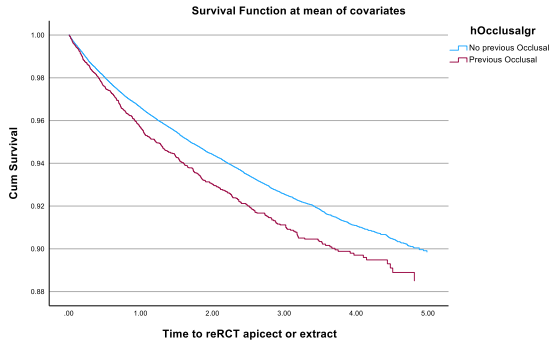
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Occlusal	6351	102800	94.2%
2.00	Previous Occlusal	493	6253	92.7%
Total		6844	109053	94.1%

a. The strata variable is : hOcclusalgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
150539.441



* What happens if there is a history of one proximal ridge (MO or DO)?.

* Create descriptive variables.

```
RECODE honeproximalridge
(0 =1)
(1 thru 9=2)
into honeproximalridgegr.

value labels
/honeproximalridgegr
1 'No previous MO/DO'
2 'Previous MO/DO'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp11.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp11.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =   honeproximalridgegr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 23:03:50
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp11.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	116528
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = honeproximalridgegr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.11
	Elapsed Time	00:00:00.30

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp11.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	6844	5.9%
	Censored	109052	93.6%
	Total	115896	99.5%
Cases dropped	Cases with missing values	1	0.0%
	Cases with negative time	0	0.0%

	Censored cases before the earliest event in a stratum	631	0.5%
	Total	632	0.5%
Total		116528	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

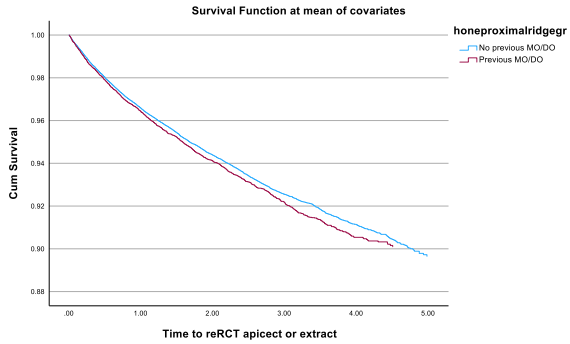
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous MO/DO	5288	85671	94.2%
2.00	Previous MO/DO	1556	23381	93.8%
Total		6844	109052	94.1%

a. The strata variable is : honeproximalridgegr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
146759.076




```
* What happens if there is a history of MOD?.

* Create descriptive variables.

RECODE hMOD
(0 =1)
(1 thru 9=2)
into hMODgr.

value labels
/hMODgr
1 'No previous MOD'
2 'Previous MOD'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp12.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp12.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =    hMODgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 23:03:50
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp12.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	116528
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hMODgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.13
	Elapsed Time	00:00:00.31

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp12.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	6844	5.9%
	Censored	109053	93.6%
	Total	115897	99.5%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	631	0.5%

Total	631	0.5%
Total	116528	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

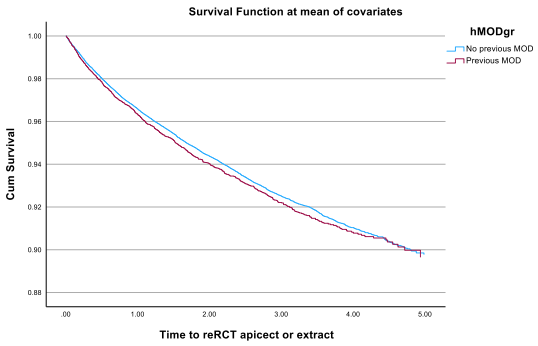
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous MOD	5894	94942	94.2%
2.00	Previous MOD	950	14111	93.7%
Total		6844	109053	94.1%

a. The strata variable is : hMODgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
148584.294



```
* What happens if there is a history of tunnel restoration?.

* Create descriptive variables.

RECODE  htunnel
(0 =1)
(1 thru 9=2)
into  htunnelgr.

value labels
/htunnelgr
1 'No previous Tunnel'
2 'Previous Tunnel'.

compute caseid=$casenum.
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp13.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp13.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =     htunnelgr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 23:03:51
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp13.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	116528

Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = htunnelgr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.06
	Elapsed Time	00:00:00.28

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp13.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	6844	5.9%
	Censored	109052	93.6%
	Total	115896	99.5%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	632	0.5%
	Total	632	0.5%
Total		116528	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

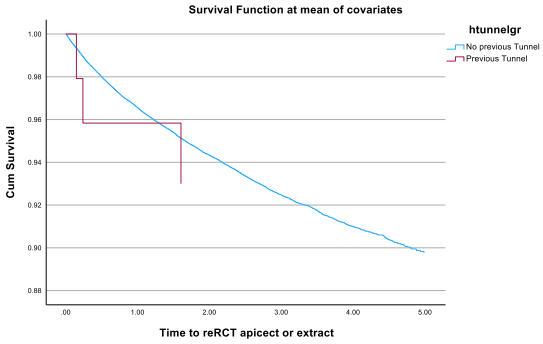
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Tunnel	6841	109007	94.1%
2.00	Previous Tunnel	3	45	93.8%
Total		6844	109052	94.1%

a. The strata variable is : htunnelgr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
154048.856



* What happens if there is a history of inlay?.

* Create descriptive variables.

```
RECODE hInlay
(0 =1)
(1 thru 9=2)
into hInlaygr.

value labels
/hInlaygr
1 'No previous Inlay'
2 'Previous Inlay'.

compute caseid=$casenum.
```

```
execute.

save outfile= 'C:\Users\maria\OneDrive\Documents\PhD
Results\mltemp\temp14.sav'.
get file= 'C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp14.sav'.

COXREG time
  /STATUS=reint(1)
  /strata =       hInlaygr
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20)
  /PLOT = SURVIVAL.
```

Cox Regression

Notes

Output Created		14-APR-2024 23:03:51
Comments		
Input	Data	C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp14.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	116528
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
Syntax		COXREG time /STATUS=reint(1) /strata = hInlaygr /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) /PLOT = SURVIVAL.
Resources	Processor Time	00:00:00.11
	Elapsed Time	00:00:00.29

C:\Users\maria\OneDrive\Documents\PhD Results\mltemp\temp14.sav

Case Processing Summary

		N	Percent
Cases available in analysis	Event[a]	6844	5.9%
	Censored	109053	93.6%
	Total	115897	99.5%
Cases dropped	Cases with missing values	0	0.0%
	Cases with negative time	0	0.0%
	Censored cases before the earliest event in a stratum	631	0.5%
	Total	631	0.5%
Total		116528	100.0%

a. Dependent Variable: Time to reRCT apicect or extract

Stratum Status[a]

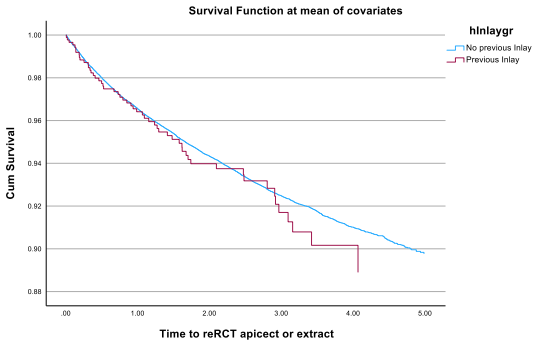
Stratum	Strata label	Event	Censored	Censored Percent
1.00	No previous Inlay	6790	108227	94.1%
2.00	Previous Inlay	54	826	93.9%
Total		6844	109053	94.1%

a. The strata variable is : hInlaygr

Block 0: Beginning Block

Omnibus Tests of Model Coefficients

-2 Log Likelihood
153469.950


Survival Function at mean of covariates
hInlaygr
No previous Inlay
Previous Inlay
Cum Survival
1.00
0.98
0.96
0.94
0.92
0.90
0.88
.00
1.00
2.00
3.00
4.00
5.00
Time to reRCT apicect or extract

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