Survival of Root-filled Teeth in the Swedish Adult Population

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Abstract

Introduction: The aim was to assess survival in the Swedish population of teeth treated by nonsurgical root canal treatment during 2009. **Methods:** Data from the Swedish Social Insurance Agency were analyzed by Kaplan-Meier analysis to assess cumulative tooth survival during a period of 5–6 years of all teeth that were root-filled during 2009. **Results:** In 2009, 248,299 teeth were reported as root-filled. The average age of the patients at the time of the root filling was 55 years (range, 20–102 years). The teeth most frequently root-filled were the maxillary and mandibular first molars. During the 5- to 6-year period 25,228 of the root-filled teeth (10.2%) were reported to have been extracted; thus 223,071 teeth (89.8%) survived. Tooth survival was highest in the youngest age group (93.2%). The highest survival (93.0%) was for the mandibular premolars, and the lowest (87.5%) was for the mandibular molars. Teeth restored with indirect restorations within 6 months of the root filling had higher survival rates (93.1%) than those restored with a direct filling (89.6%). **Conclusions:** In the adult population of Sweden, teeth that are root-filled by general practitioners under the tax-funded Swedish Social Insurance Agency have a 5- to 6-year survival rate of approximately 90%. *(J Endod 2016;42:216–220)*

Key Words

Endodontics, epidemiology, Kaplan-Meier estimate, public health, tooth extraction, treatment outcome

It is generally acknowledged that oral health is important for general health and well-being (1). Tooth loss is often used as an indicator of oral health, and retention of the natural dentition teeth may determine people's perceptions of good oral health (1–5). Accordingly, to avoid extractions and maintain the standing dentition, root canal treatments are undertaken to eradicate or prevent an infection within the root canal system. This trend during a 20-year period was confirmed by analysis of a national treatment database in Denmark, which disclosed a marked decrease in the number of extractions and an increase in the number of root fillings (6). However, a root filling does not always achieve the desired goal of retaining the natural dentition; extractions of root-filled teeth are more common than those of teeth without root fillings (7).

Studies on tooth survival after root canal treatment, assessed in a systematic review (8) together with recent studies conducted in Taiwan, Germany, England, and Wales, report 2- to 10-year outcomes ranging from 72% to 94.4% (9–11). It is possible that the benefits available under the prevailing dental care reimbursement system and cultural priorities influence the decision as to whether to recommend extraction of a root-filled tooth rather than further intervention by endodontic retreatment or restorative treatment. Consequently, the proportion of surviving teeth after root canal treatment may be influenced by factors other than the clinical treatment outcome. To date, most large studies of tooth survival after root canal treatment have been based on data from insurance companies and are thus selected samples (9, 12, 13). Thus there is a need for international data on survival of root-filled teeth in well-defined populations; therefore, the aim of this study was to analyze Swedish Social Insurance Agency (SSIA) data to assess the survival rate in the Swedish adult population of teeth that were root-filled during 2009.

Materials and Methods

All citizens of Sweden are insured by the tax-funded SSIA; thus data are available for the whole population. An SSIA database of treatment reported by affiliated dentists was searched to identify all teeth that were root-filled in Sweden between January 1 and December 31, 2009. The SSIA covers all 9.3 million residents of Sweden, and the database includes all residents aged 20 years and older. Because the SSIA covers most dental procedures including fixed prosthodontics and implants, practically all dentists in Sweden are affiliated with the SSIA. Therefore, they are obliged to report interventions, regardless of whether a fee for service claim is made. Reimbursement is stepwise; the patient will be charged 100% of an itemized fee up to a cumulative cost in 1 calendar year of 3000 Swedish crowns (SEK) ($360), 50% of costs between SEK 3000 and 15,000 ($360–$1802), and 15% of costs exceeding SEK 15,000 ($1802). The itemized fee for nonsurgical root canal treatment of a tooth was SEK 2015 to 4510 ($242–$542), depending on the number of canals treated. The amounts in $ are based on exchange rates ($1 = 8.32 SEK) on March 6, 2015. The SSIA does not differentiate between

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patients receiving private or public dental care. The public dental service is municipally organized, but in all other respects it is equivalent to private dental care; all residents of Sweden may decide independently whether they prefer private or public dental care.

The root-filled teeth were identified in the SSIA database by searching for codes applied to completion of root fillings of 1–4 root canals (items 501–504). The database allows for identification of completed root fillings in a specific tooth as well as in the specific individual. All root-filled teeth were tagged and tracked in the database until December 31, 2014 (ie, for a period of 5–6 years). To identify root-filled teeth lost during this period, the database, now comprising all teeth that were root-filled during 2009, was searched for item numbers indicating extractions (items 401–404).

Kaplan-Meier analysis was used to quantify the distribution of survival times of the teeth that were root-filled in 2009. In addition to overall tooth survival, the following substrata were assessed:

1. Gender (male/female) and age of the patient (20–29, 30–49, 50–64, 65–74, 75 years and older)
2. Dental service provider (private, public, dental school)
3. Tooth group (maxillary and mandibular molars, premolars, canines, and incisors)
4. Coronal restoration within 6 months of root filling (indirect restoration fabricated in a laboratory, direct restoration, unknown)

IBM SPSS Statistics Version 22 (SPSS Inc, Chicago, IL) was applied for statistical analysis. The study was approved by the Committee on Investigations Involving Human Subjects at Lund University, Sweden (Dnr 2011/800).

Results

Obvious erroneous duplicates of data, such as reporting completion of a root filling on the same tooth twice or more on the same day, and incomplete data were excluded (n = 952). The data reported to the SSIA during 2009 comprised 249,444 root fillings, which were undertaken in 217,047 individuals. Some of the root-filled teeth were reported to be root-filled more than once during 2009 (n = 1145), and thus after correction, the material comprised 248,299 root-filled teeth.

Characteristics of Population

Of the individuals registered, 108,013 (49.8%) were women. The average age of the individuals at the time of the root filling was 55 years (range, 20–102 years) (Fig. 1*A*). In most individuals, 88.9% had 1 tooth root-filled during 2009, 8.9% had 2 teeth root-filled, and 2.2% had 3 or more teeth root-filled. The maximum number of root fillings registered in one single individual in 2009 was 15. The mean number of root fillings in men (1.16) and women (1.13) was very similar. Twice as many root fillings were undertaken in the private sector (166,299, 67.0%) as in the public sector (81,401, 32.8%). Root fillings were also undertaken at dental schools (599, 0.02%). The tooth most frequently root-filled was the mandibular first molar.

Figure 1*B* shows the frequency of root fillings for each tooth type. Six months after registration of the completed root filling, 142,264 of the teeth (57.3%) were registered as restored with a direct restoration and 64,092 (25.8%) with indirect restorations. For the remaining 41,942 root-filled teeth (16.9%), no registrations of restorations were found.

Cumulative Tooth Survival

During the following 5–6 years, extraction was reported for 25,228 teeth (10.2%). Thus the overall cumulative survival rate of the root-filled teeth was 89.8%. The Kaplan-Meier graph on overall tooth survival during the 5–6 years showed a steady linear decrease in the survival rate. The rates were similar for men (90.0%) and women (89.7%). Tooth survival was influenced by the individual's age at the time of the root filling; the youngest age group (20–29 years) had the highest survival rate, 93.2%, and the age group 65–74 years had the lowest, 88.9%. Similar survival rates were disclosed for private (89.5%), public (90.6%), and dental schools (89.8%). Mandibular premolars had the highest survival rate (93.0%), and mandibular molars had the lowest (87.5%). Teeth restored with an indirect restoration within 6 months of root canal treatment had a higher survival rate (93.1%) than those restored with direct restorations (89.6%). Teeth still unrestored 6 months after root canal treatment had the lowest survival rate (85.8%). Figure 2 shows the Kaplan-Meier graphs of tooth survival, stratified according to Figure 2*A* individuals' ages, Figure 2*B* dental service provider, Figure 2*C* tooth group, and Figure 2*D* type of coronal restoration.

Discussion

For the adult population of Sweden, the 5- to 6-year cumulative survival rate for root-filled teeth was 89.8%. Only a small proportion of Swedish dentists (0.6%) are specialists in endodontics (14); thus the cumulative survival rates presented here essentially represent root canal treatments undertaken by general dental practitioners.

Although this study provides an estimated outcome for an extensive number of individuals undergoing root canal treatment, the study has some limitations. The database covers all citizens 20 years and older; there is a lack of data on people younger than 20. Although dentists are obliged to report all interventions regardless of any payment claim, it is possible that some interventions were not reported. For instance, indications for extraction may have emerged very soon after completion of the root canal treatment, or the individual may have undergone extraction of the root-filled tooth abroad. Without clinical documentation such as patient charts and radiographs, it is not possible to differentiate survival rates for primary root canal treatment or retreatment. The codes used by SSIA for diagnosis do not give adequate information as to whether the reported root canal treatment was primary or secondary. Root-end surgery has a unique code and is not included in our database. Furthermore, no data were available about the preoperative status of the pulp or periapical tissue, treatment procedures, or reasons for undertaking root canal therapy. Consequently, the study could not differentiate between survival rates for teeth with vital pulps or teeth with apical periodontitis. Likewise, the reason for extraction is unknown. To the patient this might not be of any particular interest, but it would be of value to the dental profession to have access to information as to whether extraction was indicated because of a persisting root canal infection, cracked root, vertical root fracture, caries, or marginal periodontitis. Thus prospective clinical studies, preferably in general practice, are warranted.

As in the study conducted in the General Dental Service in England and Wales (10), tooth survival was influenced by patient age; root fillings in younger adults had the best survival rate. The reason is unclear. It may be hypothesized that when root canal treatment is indicated in a young person but long-term survival of the tooth is doubtful, the dentist may consider alternative therapies such as an implant. Attempts to retain teeth of doubtful prognosis may be more frequent in the elderly, leading to lower long-term survival of these teeth. In the elderly, root-filled teeth are more likely to be compromised by caries and existing extensive coronal restorations, making them more susceptible to fractures; thus they may more frequently be considered unrestorable.

Under the Swedish insurance system, root canal treatment of third molars is not covered unless the third molar is in the position of the second molar. A similar German study (9) with a number of restrictions