Long-term Survival of Endodontically Treated Teeth at a Public Dental Specialist Clinic

Daniela Landys Borén, DDS, Peter Jonasson, DDS, PhD, and Thomas Kvist, DDS, PhD

Abstract

Introduction: The long-term survival of endodontically treated teeth is an issue of high priority focus in modern restorative dentistry. In available literature, survival is generally high and comparable with implants. For more compromised teeth treated in a specialist clinic, survival rate may be lower. This retrospective study aimed to investigate the 10-year survival rate of teeth treated in a public endodontic specialist clinic. **Methods:** From a database of 15,000 examined teeth, 420 teeth in 330 patients were randomly selected and included. Available potential preoperative, intraoperative, and postoperative prognostic factors were registered. Ten-year tooth survival was recorded by scrutinizing records and by contacting referring dentists and patients. **Results:** The overall Kaplan-Meier estimated 10-year survival rate was 81.5% (95% confidence interval [CI], 76.7%–85.5%). Placement of a crown, adjusted hazard ratio 0.27 (95% CI, 0.12–0.61), $P = .0016$, and age-adjusted hazard ratio 1.31 per 10 years (95% CI, 1.11–1.55), $P = .0012$, were significant independent predictors for estimated survival rate. Seventy-three teeth (17.4%) in 69 patients were extracted during the 10-year follow-up period. The declared reason for extraction was related to endodontic diagnoses in only 5 of the cases (6.8%). **Conclusions:** Approximately 80% of the teeth treated at this specialist clinic in endodontics survived at least for 10 years. Teeth in young persons and teeth restored with a crown postoperatively survived significantly better. To further explore the importance of the postoperative restoration in endodontically treated teeth, randomized controlled trials need be carried out. *(J Endod 2015;41:176–181)*

Key Words

Decision making, long-term survival, root filled teeth, specialists

From the Department of Endodontology, Institute of Odontology, The Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden.

Address requests for reprints to Dr Thomas Kvist, Department of Endodontology, Institute of Odontology, The Sahlgrenska Academy, University of Gothenburg, Box 450, SE 405 30 Göteborg, Sweden. E-mail address: kvist@odontologi.gu.se

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Despite improved oral and dental health, the demand for endodontic treatment and restoration is continuously high among individuals with relatively complete dentition and dental awareness (1).

The outcome of endodontic treatment is of interest not only to dental professionals and patients but also to third-party payers. In a systematic review on tooth survival after nonsurgical root canal treatment including 14 studies published between 1993 and 2007, the pooled proportion of teeth surviving during 2–10 years ranged between 86% and 93% (2).

Patients' expectations concerning the outcome of endodontic treatment are high. However, complications and technical difficulties such as persistent pain, perforations, and instrument fractures in conjunction with root canal treatment may put the successful outcome at risk. Sometimes endodontic retreatment may be necessary because of residual signs of disease. In such cases patients may be referred to a specialist clinic for management of treatment, retreatment, or endodontic surgery to save the tooth (3, 4).

Clinicians are increasingly often confronted with difficult choices regarding whether a tooth with compromised pulpal and/or periapical disease should be saved through endodontic procedures or should be extracted and replaced with a fixed prosthesis or implant. The survival rate of implants is reported to be high and comparable with endodontically treated natural teeth during studied time periods (5).

Saving the natural tooth through root canal therapy usually requires fewer resources than replacing it with an implant (6, 7). However, it may be argued that teeth referred to a specialist clinic represent a select sample of compromised teeth and that survival rate will be lower compared with a cohort of endodontically treated teeth in general practice (8). Therefore, extraction and implant is often a primary choice when a root canal treatment fails (9). Accordingly, it is important to investigate the long-term survival rate of teeth referred to and treated at specialist clinics in endodontics.

Patient registers provide statistics on patients examined, diagnosed, and treated at a particular clinic, organization, or insurance system. These data can be used to produce information about the outcome of treatment procedures and examine various prognostic factors. It gives insights of potential importance as a step in the scientific procedure. Yet they do not give results of the same high internal and external validity as do prospective cohort studies or randomized clinical trials. However, retrospective data from patient registers may be used for generating hypothesis for future prospective clinical studies.

A register at the Endodontic Clinic at the Public Dental Health in Gothenburg, Sweden included all patients referred to the clinic between 1996 and 2004. The development of the register was organized by an expert group in the endodontic clinic who decided to develop a local database for management of endodontic referrals. The register included information on age and gender of patients, preoperative status, specialist's diagnosis, endodontic therapy, and date of finalized treatment.

A primary aim of this retrospective study was to evaluate the 10-year survival rate of root canal–treated teeth at this specialist clinic. The second aim was to identify possible preoperative, intraoperative, or postoperative prognostic factors associated with the outcome survival in this cohort. Third, the study was also constructed to ease the planning and conduct of prospective studies in future examinations.

Materials and Methods

During the period 1996–2004, a data-based register was created for all referrals to the Endodontic Clinic at the Public Dental Health, Gothenburg, Sweden. A sample analysis, which was based on a pilot study of 35 teeth, showed that a sample of 350 teeth was sufficient to meet the statistical requirement of an adequate sample size. The sample selection was randomized by a lottery procedure. Two numbers between 1 and 31 were randomly selected for each year and represented the date of birth of those patients to be selected from the database.

The sampled patients' records were analyzed, and patients were included into the study if they had at least 1 tooth treated at the clinic. Excluded were patients not showing up for their first examination, those who after examination were recommended for extraction of the tooth involved, and patients who needed further referral but no endodontic treatment.

The recruiting procedure for the study was stopped in June 2012 when 330 patients with 420 teeth examined and treated at least 10 years previously had been included.

One researcher (D.L.B.) scrutinized all included patients' dental records and transferred preoperative, intraoperative, and postoperative registrations into an Excel (Microsoft Corp, Redmond, WA) data sheet. Data sheet cells were left empty when reliable data of a variable were absent. The factors registered for each included patient and tooth are presented in Table 1. Time 0 was defined as date of finalized endodontic treatment at the specialist clinic.

After the registration of included teeth, the outcome in terms of survival was searched by further study of dental records, telephone interviews with the patients' current dentist, and/or with the patient. One researcher (D.L.B.) executed all contacts and registrations. In instances in which the patient needed to be contacted by telephone, the subject was then given adequate oral and written information about the nature, purpose, possible benefit of the study, and that participation was entirely voluntary.

The tooth was specified as the smallest unit, and in subjects where more than 1 tooth had been endodontically treated, each tooth was evaluated individually. Longitudinal treatment information about each tooth was collected and registered in the database. In the case where the tooth had been extracted, the date was registered and, if possible, information about the reason for extraction. The end point was the last date of presence possible to establish by any of the 3 search methods. If a final date of presence after 10 years or more postoperatively could be established, no further follow-up was carried out. A flow chart of the study is presented in Figure 1.

The regional ethical review board of research involving humans in Gothenburg, Sweden approved the study protocol.

Statistical Methods

Continuous variables were described with mean, standard deviation, median, minimum, and maximum and categorical variables including dichotomous variables with number and percentage.

When predicting time to loss for each predictor in a univariable analysis, an extension to Cox proportional hazards regression (10) that allows for dependence within patients was used. Hazard ratios (HRs) were calculated for descriptive purposes. Multivariable survival analysis was performed with stepwise extended Cox proportional hazards regression, adjusting for dependence within patients. Only variables that influenced survival time at the univariable analysis ($P < .1$) were included as possible predictors in the stepwise extended Cox proportional hazards regression. Placement of a crown postoperatively was analyzed as a time-dependent variable.

TABLE 1. Characteristics of 420 Teeth in 330 Patients

Variable	All patients (n = 330)
Preoperative factors, patient-based	
Gender	
Men	138 (41.8%)
Women	192 (58.2%)
Age (y)	52.9 (15.9)
	53.0 (14.2; 90.7)
Age (y)	
<40	73 (22.1%)
40–<70	208 (63.0%)
70+	49 (14.8%)
Preoperative factors, tooth-based	All teeth (n = 420)
Jaw	
Lower	150 (35.7%)
Upper	270 (64.3%)
Teeth*	
Incisor	91 (21.9%)
Canine	53 (12.8%)
Premolar	119 (28.7%)
Molar	152 (36.6%)
Diagnosis	
No previous root filling*	244 (58.1%)
Vital	111 (45.9%)
Necrotic without AP	27 (11.2%)
Necrotic with AP	104 (43.0%)
Previous root filling*	176 (41.9%)
Without AP	24 (13.7%)
With AP	151 (86.3%)
Restoration	
Preoperative crown	105 (28.6%)
Part of fixed prosthesis	47 (46.1%)
Post	
Post present	42 (12.1%)
Intraoperative factors	
Retreatment	
Surgical retreatment	74 (42.0%)
Nonsurgical retreatment	102 (58.0%)
Treated 1996–1998/1999–2002	
Early period (1996–1998)	205 (48.8%)
Late period (1999–2002)	215 (51.2%)
Operator*	
Postgraduate student/GDP	202 (49.3%)
Specialist	208 (50.7%)
Postoperative factors	
Crown	150 (42.1%)
Part of fixed prosthesis	58 (38.9%)

AP, apical periodontitis; GDP, general dental practitioner.

For categorical variables, n (%) is presented. For continuous variables, mean (standard deviation)/median (minimum; maximum) is presented.

*Variable "type of teeth" has 5 missing values, and "operator" has 10 missing values. For "teeth with no previous root filling", 2 teeth have missing values for "AP classification", and for "teeth with previous root filling", 1 tooth has missing value for AP classification.

Kaplan-Meier estimates were calculated with 95% confidence intervals (CIs) by using the method of Ying and Wei (11), allowing for dependency within patients.

All tests were two-tailed and conducted at the 5% significance level.

Results

From January 1, 1996 until June 30, 2002, 8902 patients were registered in the database, and 569 patients were randomly selected. Three hundred thirty patients met the inclusion criteria. Fifty-three patients contributed with 2 or more teeth per individual, and 277 patients contributed with 1 tooth. All together, 420 teeth were included in the final analysis. The study flow is presented in Figure 1. Preoperative, intraoperative, and postoperative factors concerning the teeth are presented in Table 1.