Evaluation of Related Factors in the Failure of Endodontically Treated Teeth: A Cross-sectional Study

Keziban Olcay, DDS, PhD, Hanife Ataoglu, DDS, PhD,† and Sema Belli, DDS, PhD‡*

Abstract

Introduction: The aim of this study was to review the factors related to the failure and extraction of unsuccessful endodontically treated teeth. **Methods:** A total of 1000 teeth treated with nonsurgical root canal therapy were analyzed, and the following information was recorded for each patient: reasons for failure and extraction, type of tooth, presence and type of coronal restoration, smoking status, age, gender, and level of education. One main reason was recorded for each failed tooth. The associations between reasons for failure, patient, and tooth were tested by using χ^2 analysis. **Results:** Of the 1000 endodontically failed teeth analyzed in this study, 28.1% ($n = 281$) were extracted, 66% ($n = 660$) were re-treated, and 5.9% ($n = 59$) were treated with apical surgery. Among the reasons for failure, restorative and endodontic reasons were seen most frequently (43.9%, $n = 439$), whereas orthodontic reasons were seldom seen (0.1%, $n = 1$). The most common reason for extraction was for prosthetic reasons (40.8%), and perforation/stripping was the least common (2.9%). The mandibular first molars were the most frequently extracted teeth (27.4%, $n = 77$). **Conclusions:** The most common reason for the extraction of endodontically treated teeth was for prosthetic reasons. Among the reasons for failure, restorative and endodontic reasons were the most frequently seen, and orthodontic reasons were the most seldom. The teeth that failed most frequently were mandibular first molars, and the teeth that failed least frequently were maxillary third molars. The most common reason for the extraction of failed endodontically treated teeth was for prosthetic reasons. *(J Endod 2018;44:38–45)*

Key Words

Endodontically treated teeth, extraction, failure, retreatment, root canal treatment

Significance

The results of this study show that those teeth without appropriate/sufficient coronal restoration after root canal treatment are more likely to fail in the future.

The main goal of nonsurgical root canal treatment is the healing of periapical tissues (1) by eliminating infected or necrotic remnants from the root canal system (2), while maintaining the function of the tooth in the oral environment (1, 3). Although previous studies have shown a nearly 90% success rate for endodontic treatment (4), nonsurgical root canal treatment often fails when adequate standards are not achieved (insufficient preparation and irrigation and short/long root canal filling length) (2). However, "well-treated" cases can also fail (5). Surgical and nonsurgical procedures are 2 of the major therapies applied after a failed nonsurgical root canal treatment (6). Other than these, clinicians may decide to extract endodontically treated teeth for various reasons.

Several studies in the literature have analyzed the reasons for the failure of extraction of endodontically treated teeth (7, 8). However, these studies only focused on the specific reasons for the extraction of endodontically treated teeth, with small sample size of patients. For example, Vire (7) listed the most common reasons for the extraction of endodontically treated teeth as prosthetic failure (59.4%), periodontal reasons (32%), and endodontic causes (8.6%). Fuss et al (9) reported that 43.5% of the extractions of endodontically treated teeth were due to restorative reasons. They also reported that the major extraction reasons were for endodontic treatment (21.1%) and vertical root fractures (10.9%). According to Chen et al (10) and Zadik et al (11), the most common reason for extraction was non-restorable caries (46.4%–61.4%). Toure et al (12) prepared a questionnaire to plan a prospective study to evaluate the reasons for extraction in endodontically treated teeth. They reported that the extraction reasons were periodontal disease (40.3%), endodontic failures (19.3%), vertical root fractures (13.4%), non-restorable cuspid and crown fractures (15.1%), non-restorable caries (5.2%), iatrogenic perforations and stripping (4.2%), and prosthetic reasons (0.8%). Tzimpoulas et al (8) found that the most prevalent reason for extraction was non-restorable caries (37.1%).

To our knowledge, the majority of these studies used retrospective processes, with a few exceptions (8, 12). Because this is an important topic requiring further evaluation, our research focused not only on extraction but also included most of the reasons for the failure of endodontically treated teeth within a larger sample size.

The aims of the present cross-sectional study were to investigate the reasons for the failure of endodontically treated teeth (ie, vertical root fractures, prosthetic reasons,

From the *Department of Endodontics, Faculty of Dentistry, Istanbul Medipol University, Istanbul, Turkey; †Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Selcuk University, Konya, Turkey; and ‡Department of Endodontics, Faculty of Dentistry, Selcuk University, Konya, Turkey.

Address requests for reprints to Dr Keziban Olcay, Department of Endodontics, Faculty of Dentistry, Istanbul Medipol University, Atatürk Bulvarı, No: 27, Unkapanı, Fatih, Istanbul, Turkey. E-mail address: kolcay@medipol.edu.tr

0099-2399/$ - see front matter

https://doi.org/10.1016/j.joen.2017.08.029

periodontal reasons, endodontic failures, non-restorable caries, non-restorable cusp/tooth fractures, and perforations/stripping), and whether there were associations between these reasons and the personal characteristics of the patients (ie, age, gender, level of education, and smoking status), tooth locations, and post-type endodontic permanent coronal restorations.

Methods

This study was approved by the Ethics Committee of the Selcuk University Faculty of Dentistry (no: 2011/02-08). All of the patients included in this study presented to the Selcuk University, Faculty of Dentistry, Department of Oral Diagnosis and Radiology for various complaints or routine care during a 17-month period (January 2011–May 2012). After the clinical and radiographic examinations, all of the failed endodontically treated teeth were referred to the Department of Endodontics for consultation (ie, Should the tooth be treated or extracted?). Two endodontists (S.B., K.O.) evaluated all of the endodontically failed teeth. Endodontically treated tooth failure was defined on the basis of the following situations: clinical problems such as percussion, palpation, swelling, fistula, fracture, marginal leakage, and loss of coronal restoration and/or radiographic problems such as an unhealed periapical lesion (after 4 years), insufficient obturation, and perforation/stripping.

The study was explained to the patients whose teeth were to be retreated, and informed written consent was obtained from each patient. After the clinical and radiographic examinations of the tooth, the questionnaire was filled out by the same practitioner (K.O.) via dialogue with each patient. The questionnaire included the following information:

- Personal characteristics of the patient (age, gender, level of education)
- Smoking status (currently smoking, never smoked, quit at least 4 years ago)
- Examination of the failed tooth (status of coronal restoration, root canal filling)
- Reason for failure (vertical root fracture, prosthetic reasons, periodontal reasons, endodontic failure, non-restorable caries, non-restorable cusp/tooth fracture, perforation/stripping).

A total of 1000 endodontically failed teeth from 671 patients were evaluated in this cross-sectional study. Only one reason for failure was noted for each tooth. In those cases with no treatment possibilities (eg, vertical root fracture, non-restorable cusp/tooth fracture, non-restorable caries), the worst condition was selected as the main reason for failure versus the other treatable reasons (eg, restorative, endodontic, periodontal reasons). The quality of the root canal filling and coronal restoration was confirmed via radiographs. Those teeth extracted before finishing the initial endodontic treatment were not included in this study. When determining the main causes for the failure of the root canal treatment and extraction, the following criteria were used:

- Vertical root fracture: a severe crack in the tooth extending longitudinally down the long axis of the root. It often extends through the root to the periodontium.
- Prosthetic reasons: teeth with an insufficient crown-to-root ratio, teeth that are considered not able to bear a prosthetic load as an abutment tooth, teeth that are excluded from the prosthetic treatment plan after consultation with a prosthodontist from the Department of Prosthodontics because of poor prognosis.
- Periodontal reasons: teeth with excessive bone loss, mobility outside of acceptable limits, furcal problems, and/or teeth that have extraction indication according to a consultant from Department of Periodontology.
- Orthodontic reasons: teeth that were chosen for extraction in an orthodontic treatment plan.
- Endodontic failure: Although the root canal treatment was adequate and there were no caries, marginal staining, and/or leakage of the coronal restorations, the root canal treatments were considered clinically unsuccessful if the patient has complaints from related tooth. In some cases, the related teeth may exhibit persistent/unhealed periapical problem radiographically.
- Non-restorable caries or non-restorable cusp fractures: teeth with cavity borders below the gingival line and/or reaching the furcal area or fractures that cannot be restored successfully within the limitations of the current dental technology.
- Perforation/stripping: teeth that must be extracted because of the formation of untreatable perforations/stripping as detected by radiography.
- Restorative reasons: teeth that have caries, marginal staining, and/or leakage of the coronal restoration, although the root canal treatment was radiographically successful.
- Endodontic reasons: teeth that have short or overextended filling from the root canal apex and/or exhibited insufficient root canal filling radiographically. These teeth are considered failed, although there were no caries, marginal staining, and/or leakages in the coronal restoration.
- Restorative and endodontic reasons: teeth that failed for both endodontic and restorative reasons (as described above) at the same time.
- Patient request: The patient was insistent on having the tooth extracted, even after the treatment options and success rates were described. Generally, these patients experienced previous traumatic endodontic treatment. The failed teeth in this group could have been treated surgically or nonsurgically, but the patient certainly did not accept the treatment.

A 3-level classification was used for the patient's level of education:

- Basic education or less: up to 9 years of education. Those patients without educational degrees belonged to this class.
- Secondary education: approximately 10–12 years of education. This group included patients with vocational training as well as those with upper secondary school certificates but without further training.
- Higher education: an educational level of 13 years or more. This group included people with institute or university-level certificates or degrees.

The acquired data were statistically analyzed by using SPSS 17.0 (SPSS Inc, Chicago, IL). The associations between the patient's gender, level of education, and smoking status were examined by using a χ^2 test.

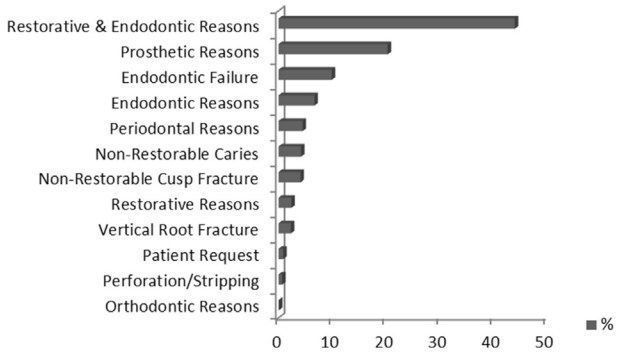

Figure 1. Distribution of reasons for failure of endodontically treated teeth.