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## Analysis of factors related to extraction of endodontically treated teeth

Yehdua Zadik, DMD, MHA,<sup>a</sup> Vadim Sandler, DMD,<sup>b</sup> Ron Bechor, DMD,<sup>c</sup> and Robert Salehrabi, DDS,<sup>d</sup> Jerusalem, Israel and Los Angeles, CA, USA  
ISRAEL DEFENSE FORCES AND UNIVERSITY OF SOUTHERN CALIFORNIA

**Background.** Endodontic therapy is a predictable treatment, resulting in up to 97% retention rate for the treated teeth. However, about 3% of endodontically treated teeth require further treatment, including extraction of the tooth.

**Study design.** This retrospective study analyzed all endodontically treated permanent teeth that were extracted in a multidisciplinary clinic in 2006-2007 (n = 547). Associations among the extractions' indications and the patients' gender, education, and smoking status, as well as tooth type and coronal restoration, were investigated.

**Results.** Of the 547 endodontically treated teeth that were subjected to extraction, mandibular (44.6%) and maxillary (20.5%) first molars were the most common. Fifteen percent of the extracted teeth were restored with a crown, whereas 57.4% of the extracted teeth did not have a permanent coronal restoration. The reasons for extraction were nonrestorable caries (61.4%), endodontic failure (12.1%), vertical root fracture (8.8%), iatrogenic perforation (8.8%), periodontal disease (4.6%), unrestorable cusp fracture (2.4%), orthodontic (1.3%), and prosthetic (0.2%) considerations and dental trauma (0.5%). Periodontitis was more prevalent among current smokers than among nonsmokers ( $P < .05$ ). Gender and education had no influence on the extraction of the tooth. Vertical root fracture was more prevalent in mandibular than in maxillary first molars ( $P < .05$ ). Caries was more prevalent in unrestored teeth than coronally restored or crowned teeth ( $P = .001$ ). Endodontic failure and VRF were more prevalent in restored than in unrestored teeth ( $P < .05$ ).

**Conclusions.** The most common extracted tooth profile was the mandibular first molar without permanent coronal restoration, which was lost due to caries destruction. Endodontically treated teeth were prone to extraction mainly due to nonrestorable carious destruction and to a lesser extent to endodontic-related reasons such as endodontic failure, VRF, or iatrogenic perforation. (*Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2008;106:e31-e35)

The survival or functionality of the endodontically treated tooth is currently the emerging aspect of endodontic treatment outcome, rather than healing.<sup>1</sup> Salehrabi and Rotstein<sup>2</sup> analyzed 1,462,936 teeth after initial endodontic treatment for 8 years. At the end of this period, 1,420,963 (97%) teeth were retained in the oral cavity. Most untoward events, such as retreatment, apical surgery, or extraction, occurred during the first 3 years after the initial endodontic treatment.<sup>2</sup>

There are few studies in the literature that have analyzed the reasons for extraction of endodontically treated teeth. Fuss et al.<sup>3</sup> studied 147 extracted teeth. The most common reason (44%) was a restorative consideration, with endodontic, endorestorative, and vertical root fracture (VRF) the next most frequent reasons (21%, 19%, and 11%, respectively). Vire<sup>4</sup> found that 59% of 116 extractions of endodontically treated teeth were due to prosthetic reasons, 32% to periodontal reasons, and 9% to endodontic failures.

The aims of the present retrospective study, involving Israeli adults, were to investigate the distribution of reasons for extraction of endodontically treated teeth (nonrestorable caries or cusp fracture, endodontic failure, VRF, perforation, periodontal disease, orthodontic or prosthetic reasons, and trauma) and whether there were associations between these reasons and the personal characteristics of the patients (gender, education, and smoking status), tooth location, and the postendodontic permanent coronal restorations.

### METHODS

Data were gathered from 1,858 non-third-molar permanent teeth extractions that took place during the years 2006 and 2007 in the Zrifin military multidisciplinary

<sup>a</sup>Zrifin Central Dental Clinic, and The Center for Health Promotion and Preventive Medicine, Medical Corps, Israel Defense Forces; and the Department of Oral Medicine, Hebrew University-Hadassah School of Dental Medicine.

<sup>b</sup>Zrifin Central Dental Clinic, and The Center for Health Promotion and Preventive Medicine, Medical Corps, Israel Defense Forces; and the Department of Endodontics, Hebrew University-Hadassah School of Dental Medicine.

<sup>c</sup>Zrifin Central Dental Clinic, and The Center for Health Promotion and Preventive Medicine, Medical Corps, Israel Defense Forces.

<sup>d</sup>Division of Surgical, Therapeutic, and Bioengineering Sciences, University of Southern California School of Dentistry.

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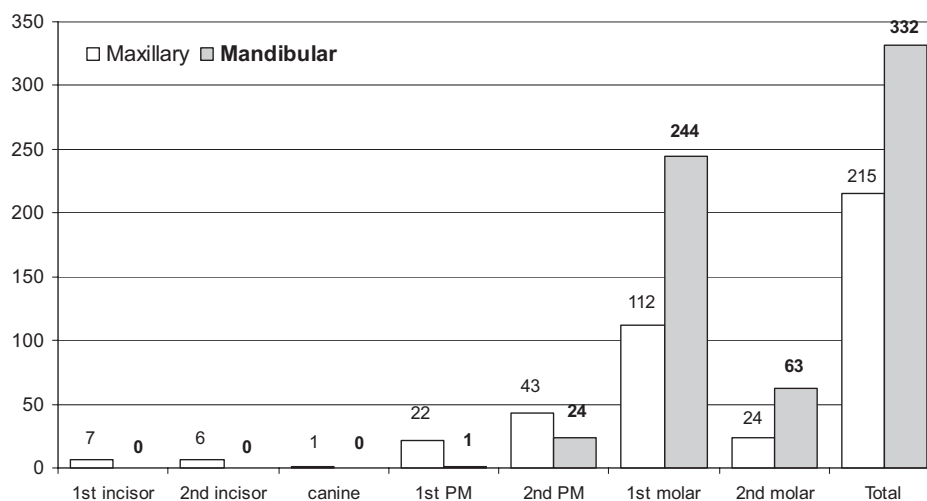


Fig. 1. Distribution of the 547 studied extracted endodontically treated permanent teeth. *PM*, Premolar.

plinary dental clinic. Of these teeth, 547 (29.4%) extracted teeth with a preexisting radiographic appearance of some (permanent) canal obturation were included in the analysis. Teeth that were extracted before the endodontic treatment was completed were not included in the analysis.

The authors checked the reason noted in the patient's file as the main reason for extraction. The reason was confirmed by reexamining the tooth's x-ray periapical photograph and by checking the reason that was noted in the clinic procedures list on the day of the operation (in which only 1 diagnosis can be noted for each operation). If >1 main reason was found, the more untreatable condition was chosen (e.g., VRF over dental caries). Disagreements were discussed until a consensus was reached.

Patients' gender, age, and education as well as smoking status were obtained from the patients' dental files. The preexisting coronal restoration of the teeth (restoration without a post, posted restoration, crown, or no permanent restoration at all) was obtained from the preextraction periapical radiographs. Teeth with temporary coronal filling were considered to be teeth without a permanent restoration.

Data were pooled and analyzed by SPSS 10.0 (SPSS, Chicago, IL). The associations between extraction reasons (caries, endodontic failure, VRF, perforation, and periodontal disease) and patient characteristics (male vs. female, smokers vs. nonsmokers, and high school vs. college graduates), tooth characteristics (maxillary vs. mandibular first molars), or restoration characteristics (restoration without a post, posted restoration, crown, and no permanent restoration) were examined using a  $\chi^2$  test. A value of  $P < .05$  was considered to be statistically significant.

## RESULTS

The mean age of the patients was 35.3 ( $\pm 8.6$ , range 18 to 55) years. The gender distribution of the patients was 73.8% male versus 26.2% female. Of the 547 extracted teeth, 258 (47.2%) were of currently smoking patients and 78 (14.3%) were of academically educated patients.

The distribution of the analyzed teeth is presented in Fig. 1. The most commonly extracted teeth were the mandibular first molar ( $n = 244$ ; 44.6%), maxillary first molar ( $n = 112$ ; 20.5%), mandibular second molar ( $n = 63$ ; 11.5%), and maxillary second premolar ( $n = 43$ ; 7.9%). There were no extracted mandibular incisors or canines. Sixty-one teeth (11.2%) were previously coronally restored by an amalgam or composite material without a post, 172 teeth (31.4%) were restored by an amalgam or composite material with a post, and 314 teeth (57.4%) were not permanently restored and at the time of extraction were with temporary coronal restoration or without coronal restoration at all. Eighty-two teeth (15.0%) were crowned (in addition to the amalgam or composite material restoration with or without a post).

The reasons on which the decisions to extract a tooth were based are presented in Fig. 2, with nonrestorable caries the most common reason (61.4%). Other reasons were: endodontic failure (12.1%), VRF and iatrogenic perforation or stripping (8.8% each), periodontal disease (4.6%), unrestorable cusp fracture (2.4%), orthodontic (1.3%) and prosthetic (0.2%) reasons, and trauma (0.5%). Periodontal disease as a reason for extraction was more prevalent among currently smoking patients (8.1%) than among nonsmoking patients (1.4%;  $P = .02$ ). No significant differences were found in the reasons for extraction between male and female

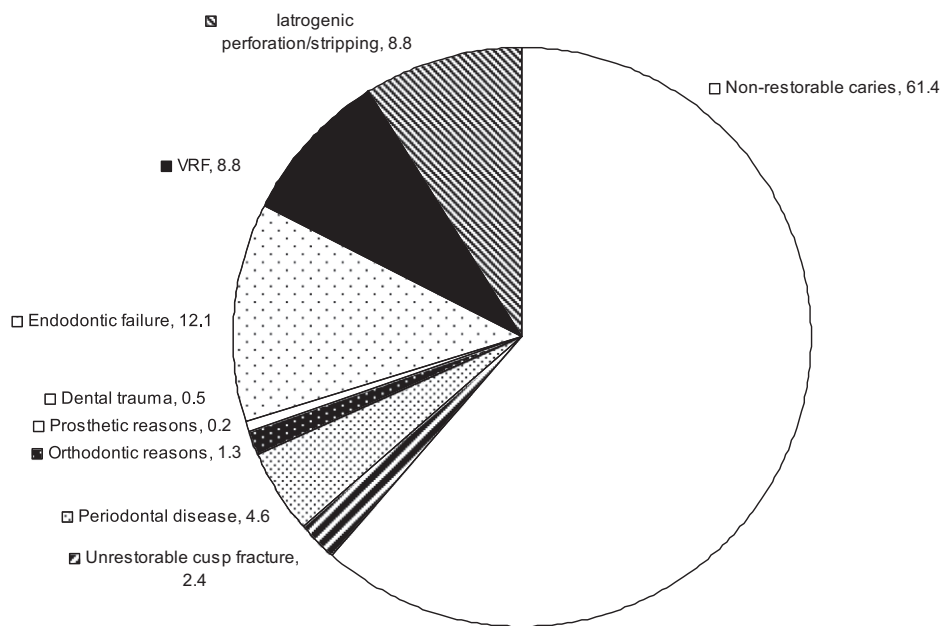


Fig. 2. Reasons for extraction of the 547 extracted endodontically treated teeth, %. VRF, Vertical root fracture.

or between high school- and college-graduated patients. Vertical root fracture as a reason for extraction was more prevalent in mandibular first molars (9.8%) than in maxillary first molars (1.8%,  $P = .021$ ).

Fig 3 presents the main reasons for extraction by postendodontic permanent restoration: restoration without a post, posted restoration, crown, or no permanent restoration. Caries as a reason for extraction was more prevalent in unrestored teeth, followed by teeth that were restored with coronal amalgam/composite material (with or without a post) and by teeth that were restored with a crown ( $P = .001$ ). Endodontic failure and VRF as reasons were more prevalent in restored teeth than in unrestored teeth ( $P < .001$ ;  $P = .022$ ; respectively).

**DISCUSSION**

The present study suffers from some limitations, for example, being retrospective, the restricted studied population (due to the age limitations of a military population), the obscure identity of the operator (specialist vs. general dentist), and postendodontic time span. Probably the relatively young age of the study patients is responsible for the relatively low percentage of extractions for periodontal reasons (4.6%).

However, previous studies demonstrated that the systemic<sup>5</sup> as well as dental<sup>6</sup> characteristics of the Israeli military population are similar to those of its age-matched Israeli general population.<sup>7</sup> Moreover, the age-restricted studied population seems to have no influ-

ence; a meta-analysis determined that there was no significant relationship between endodontic success rate and age.<sup>8</sup>

Despite the limitations, this study presents an interesting picture of endodontic treatment outcome. The vast majority of the endodontically treated teeth were extracted due to nonrestorable conditions such as carious destruction and fracture of unprotected cusps. Endodontic-related reasons (endodontic failures, VRF, and perforations) were less common.

The present results are in agreement with those of Fuss et al.,<sup>3</sup> who reported that 63% of postendodontically extracted teeth suffered from unrestorable caries destruction or cusp breakage: 44% were extracted solely because of their unrestorability (“restorative” reason), and another 19% were extracted because of a combination of restorative considerations and endodontic failure. Endodontic-related extractions constituted 51% of Fuss et al.’s series: 21% were extracted solely due to endodontic failure, 19% due to restorative-endodontic reasons, and 11% due to VRF.<sup>4</sup> Similarly, in Vire’s study,<sup>5</sup> 59% were for restorative reasons, 9% because of endodontic failures, and 13% because of VRF. In contrast, Sjogren et al.<sup>9</sup> reported a 31% prevalence of VRF among extracted endodontically treated teeth.

The aim of the present study was, beyond these cited reports, to study the possible influences of patient gender, education, and smoking status, as well as tooth

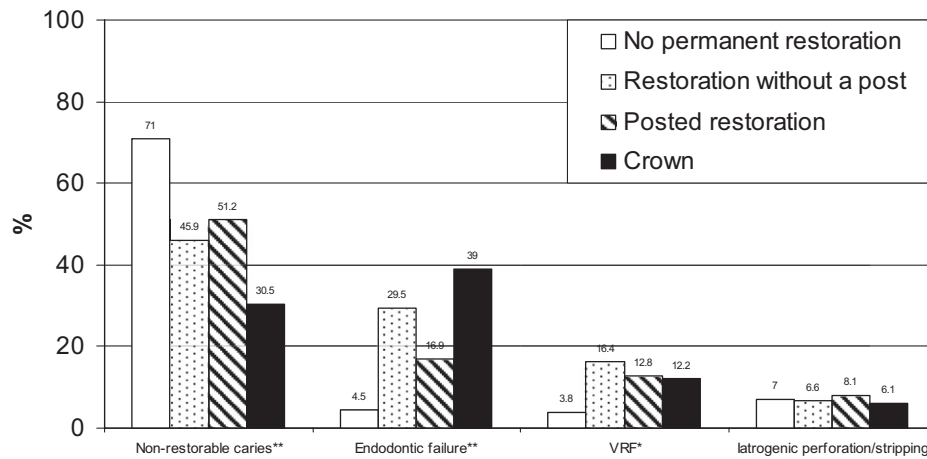


Fig. 3. Main reasons for extraction by postendodontic restoration, %. \* $P < .05$ . \*\* $P \leq .001$ .

type and postendodontic coronal restoration type, on the distribution of the reasons for extractions.

Regarding overall (not necessarily endodontically treated) tooth loss, the patient's gender as well as education and smoking status were reported as influencing factors.<sup>10,11</sup> However, in the present study, the only significant influence was the 5.8-fold increase in prevalence of periodontal disease as an extraction reason among current smokers compared with nonsmokers. This increase is in agreement with the well established notion of smoking as risk factor for chronic periodontitis. Smoking is associated with a 2–8-fold increased risk for periodontal attachment and/or alveolar bone loss.<sup>12</sup> No significant influences of patient gender or educational status were found in the present study.

When we compared the reasons for extraction of mandibular first molars and those of maxillary first molars, the only significant difference was a higher prevalence of VRF in the mandibular first molars (9.8%) than in the maxillary molars (1.8%). This finding is similar to the findings of Tamse et al.,<sup>13</sup> who reported a higher prevalence of VRF in mandibular molars than in maxillary molars.

Previous publications concluded that the postendodontic coronal restoration affected the survival of these teeth.<sup>2,14</sup> Those studies reported that endodontically treated teeth without full coronal coverage were lost at a rate 5–6-fold higher than fully covered teeth.<sup>2,14</sup> In the present study, 85% of the extracted endodontically treated teeth were not crowned. Evaluation of the reasons according of postendodontic coronal restoration revealed a significant reduction of caries prevalence from unrestored teeth to teeth with coronal restoration, followed by crowned teeth (Fig. 3).

The elevated VRF prevalence in restored teeth may

be due to intracanal post insertion and/or amalgam condensing.<sup>15</sup> According to the present results, intracanal post did not significantly increase the prevalence of VRF or iatrogenic perforation compared with non-posted restored teeth.

### Conclusions

Endodontically treated teeth were prone to extraction mainly due to nonrestorable carious destruction and to a lesser extent to endodontic-related reasons, such as endodontic failure, VRF, or iatrogenic perforation.

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*Reprint requests:*

Dr. Yehuda Zadik  
16 Zemach St.  
96190 Jerusalem  
Israel  
[yzadik@gmail.com](mailto:yzadik@gmail.com)