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# ORIGINAL ARTICLE

# Assessment of extracting molars and premolars after root canal treatment: A retrospective study

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**Abstract**  *Background:*  The loss of dentition after root canal treatment is a multifactorial entity which might differ between different teeth. The extraction can be more critical, as well as the rehabilitation options.

*Aim:*  To analyze if the etiology of extracting root canal treated teeth is different between premolars and molars.

*Materials and methods:*  The study included a total of 403 cases with non-surgical root canal therapy (NSRCT) and crown coverage that was referred to the oral surgery clinic for extraction. Tooth type, patient's age, gender, time since treatment completion, and the reason for extractions were recorded and analyzed.

*Results:*  The most frequently extracted teeth were molars (55.6%), followed by premolars (30.3%) and anterior teeth (14.1%). The reasons for extraction were subgingival decay (SGD) (62.5%), vertical root fractures (VRF) (25.3%), and patient demands after uncomfortableabscess discharge (12.2%). Most of the teeth survived between 13 and 36 months after NSRCT. The statistical power of 0.92 was demonstrated, and a P-value of less than 0.05 presented significant correlations.

*Conclusion:*  Molars were extractedafter NSRCT due to SGD followed by premolars, which were extracted due to VRF. Special care should be taken while planning NSRCT treatment for molars, in particular, with emphasis on the importance of oral hygiene and follow-up visits.
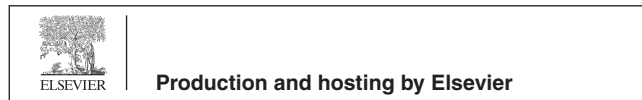
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## 1. Introduction

The goal of non-surgical root canal therapy (NSRCT) is to prevent pulp space infection and subsequent inflammatory ramifications while maintaining the functionality of the tooth in the oral cavity (Trope and Bergenholtz, 2002). However, NSRCT inflicts an accumulative effect on the root dentin that alters its physical and chemical structure (Hülsmann, 2013). At any point during the path of dental treatment, failures may result, anddental extraction becomes inevitable. Hence, further

rehabilitation plans are considered which usually include replacement with dental implant and grafting procedures (Almasri et al., 2012). The endodontics literature is rich with studies that address the success and failure of NSRCT and the factors contributing to either outcome (Marquis et al., 2006).

In an epidemiological study, it was found that the survival rate was 97% among 1,462,936 endodontically treated teeth over 8 years follow-up. The remaining 3% needed further intervention (surgical and non-surgical endodontic retreatment or extraction). However, the vast majority of extracted teeth (85%) had no coronal coverage (Salehrabi and Rotstein, 2004).

Moreover, a study enrolling 110,766 subjects to determine the occurrence of untoward events concluded that 94.4% of the endodontically treated teeth remained functional over an average of 3.5 years. It was found that the incidence of subsequent extraction increased with patient age as well as among teeth that were not restored after NSRCT (Lazarski et al., 2001).

In a study of a Taiwanese population involving 1,588,217 teeth that underwent NSRCT over a 5-year follow-up visit, a comparable high survival rate of 92.1% with a slightly higher incidence rate of untoward events was reported; of which tooth extraction was the most common one (Chen et al., 2008).

In Oral and Maxillofacial Surgery practice, the exodontia of endodontically treated teeth is not an uncommon scenario. However, such extractions possess some drawbacks, such as requiring trans-alveolar surgery, more time, and causing some anxiety to the patients. The aim of this study was to investigate the behavior of premolars and molars and verify if their extractions have different etiologiesin a pilot study in Jeddah city, Saudi Arabia. Moreover, a study in Riyadh examined the pattern of dental extractions, in general, and found that dental caries to be the main reason (Alesia and Khalil, 2013). Since non-restored cases after NSRCT have shown to be more liable to extractions, only cases with final crowns have been included in this study (Nagasiri and Chitmongkolsuk, 2005).

## 2. Materials and methods

This study was approved by the Research and Ethics Committee at the Faculty of Dentistry of King Abdulaziz University (KAU). Each subject enrolled in this study signed an informed consent in accordance with the ethical principles of Helsinki declaration (revised in 2013) for medical research involving human subjects.

The inclusion criteria were cases of teeth that had been endodontically treated with final crowns inserted. All the cases have been referred by the specialized personnel in the triage or the endodontic clinics indicating the reasons for extraction after thorough clinical and radiographic examination. The following data were also documented: age, gender, tooth number, and date of placement of the crown. The total number of teeth which met the inclusion criteria were 403.

The reasons for extraction were categorized into three groups: vertical root fracture (VRF), subgingival decay (SGD) induced non-restorability or cases in which the disease has persisted or emerged in the form of uncomfortable abscess or sinus tract where the patient elected to go for extraction and declined further presented treatment options. Other factors

that might affect the presentation of dental caries were not counted in this study, such as the decayed missing filled teeth (DMFT) index, as it is a pilot cross-sectional study, and hence to be considered in future work.

The pertinent data were extracted, tabulated, and analyzed for statistical analysis using the SPSS statistical software version 21.0, looking at frequencies, percentages, mean, mode, in addition to Spearman's coefficient correlation: 2-tailed test. P-value of less than 0.05 was considered as significant.

## 3. Results

Four hundred and three cases were eligible for this study during the investigation period (2015–2018). The average age of the patients was $39.8 \pm 12.4$ years; 66% of which were females (140 females and 84 males).

Almost two-thirds of the sample was at the age range between 21 and 45 years. Fig. 1 illustrates the distribution of the sample according to age.

With regards to tooth type, molars were found to be the most commonly extracted teeth constituting 55.6% of the sample (n = 224, 140 females, 84 males). Amongst all molars, the mandibular ones were the most extracted (66.5%). In particular, the mandibular first right molars were followed by the mandibular left first molars.

Premolars were composed of one-third of the sample size, with 30.3% (n = 122, 87 females and 35 males) mainly falling in the same age group between 21 and 45 years old, followed by the anterior teeth representing the remaining 14.1% of the sample (n = 57). Overall, a total of 214 mandibular teeth were extracted (53.1%), of which 189 were maxillary teeth (46.89%)(Fig. 2).

The reasons for extraction and the distribution of the tooth type showed that SGD (62.5%) was the most common cause of extraction, especially for molars (62.9%) and anterior teeth. On the other hand, VRF (25.3%) was the main reason for extracting the premolars (36.8%). An additional 12.2% of the teeth were extracted based on patient request after presenting with an uncomfortable abscess, swelling or sinus tract; most of which were molars (Fig. 3).

The survival duration of the teeth functioning in the oral cavity ranged from 0.1 to 240 months, while the age range was categorized into four groups. The majority of the teeth, 32% (n = 129), survived between 13 and 36 months before
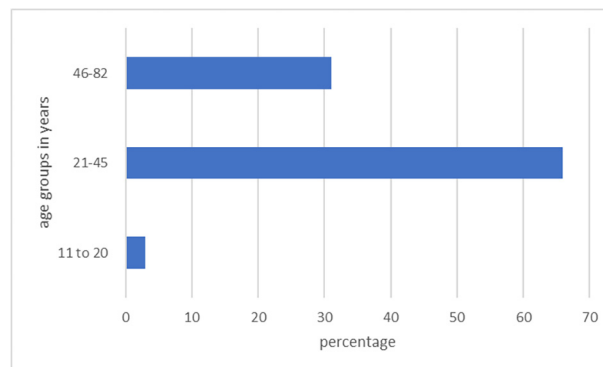


**Fig. 1** The graph shows the distribution of patient age groups in years showing the incidence of the extraction in each age group.
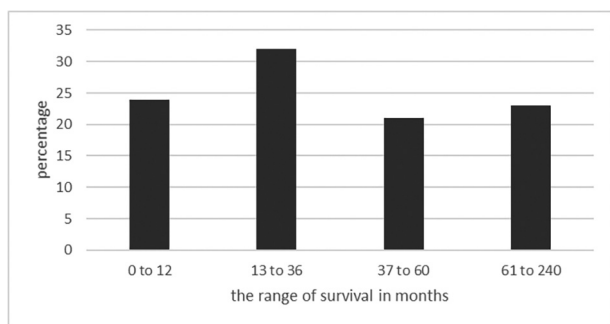
**Fig. 2** The graph shows the difference in the survival group duration as recorded in months.
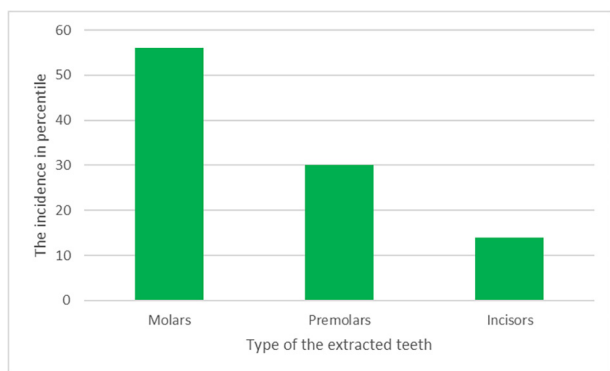


**Fig. 3** The graph shows that molar teeth were most commonly to be extracted in comparison to other teeth.

being extracted, most of which were molars that were removed due to SGD. In the other groups, 24% (n = 97) of the cases presented for extraction 0–12 months after completion of the NSRCT, 21% (n = 84) presented 37–60 months after treatment, and finally,23% (n = 93) presented 61–240 months after treatment (Fig. 4).

The Power analysis showed a statistical power of 0.92 out of 1 which indicates a strong study. Spearman's coefficient correlation: 2-tailed test revealed significant correlations between the variables demonstrated, P < 0.05 (Table 1).
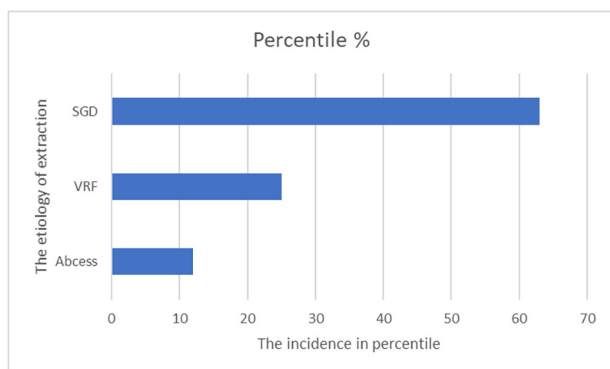


**Fig. 4** The graph shows the etiology of extraction of the pertinent teeth type.

**Table 1** The table shows the correlation between premolars and subgingival decay is 0.510 (average median). The correlation between premolars and vertical crack is 0.883 (very strong). The correlation between premolars and patient request is 0.565 (average median). The correlation between molars and subgingival decay is 0.866 (very strong). The correlation between molars and vertical crack is 0.520 (average median). The correlation between molars and patient request is 0.333 (weak).

| Comparing | R | P-value | Significance |
|---|---|---|---|
| Premolar vs. Subgingival decay | 0.510 | 0.000 < 0.05 | Significance. (average median) |
| Premolar vs. Vertical crack | 0.883 | 0.000 < 0.05 | Significance (Strong). |
| Premolar vs. Abscess | 0.565 | 0.000 < 0.05 | Significant. (average median) |
| Molar vs. Subgingival decay | 0.866 | 0.000 < 0.05 | Significance (Strong). |
| Molar vs. Vertical crack | 0.520 | 0.000 < 0.05 | Significant. (average median) |
| Molar vs. Abscess | 0.333 | 0.000 < 0.05 | Significant. (weak) |

## 4. Discussion

It is of prime importance that a dental health care provider to take careful steps in diagnosingdental disease and planning the rehabilitation process. A lot of factors do contribute to selecting one plan over the other.

In this study, the most frequently extracted teeth after NSRCT were molars, followed by premolars and anterior teeth. This is in accordance with similar previous studies in a different population sample (Fransson et al., 2016) (Toure et al., 2011). Furthermore, mandibular molars were the most frequently extracted amongst molars (66.5%). This predominance has been noted in multiple studies which have shown a mandibular molar extraction rate up to 51.3% (Zadik et al., 2008).

It was found in our study that mandibular right molars showed a higher incidence of extraction (13.9%) when compared to the left ones (10.9%). This requires further investigation with higher mandibular molar sample size to analyze whether dental care in variable quadrants affects the pattern of NSRCT failure and the subsequent extractions.

SGD was found to be the most likely reason for extraction in this study (62.5%). This finding is in consonance with other studies that reported the percentage of extracted teeth due to non-restorable caries to reach up to 63% (Fuss et al., 1999). The same was reported in a study including 275 teeth that were followed for three years and reported 79% extracted teeth (maxillary molar presented 36.2%, while mandibular molars 32.9%) (Tzimpoulas et al., 2012). The study stated non-restorable caries or SGD as the main reason for extractions, which proves the necessity of strict oral hygiene instructions and flossing to reduce the chances of teeth loss.

The situation is different in premolars, as the reason for extraction was more likely to be VRF. Some studies suggested that the buccal root is more prone to be damaged and is mainly a technique sensitive factor (Chai and Tamse, 2018). However, different factors were reported, including the internal topogra-

phy of the canals, the isthmus width or the obturation pressure (wedging effect) (Chai and Tamse, 2015). It was reported in a study including a Chinese population, that males between the age of 40–69 years old are more prone to VRF. Nevertheless, the reason was not fully understood and speculated to be related to the hard chewy diet, severe attrition or the presence of restorations (Lim et al., 2017). Other studies suggested that females are more prone to VRFs than males, especially in the presence of post or when the endodontically treated tooth is used as an abutment for a prosthesis (Matsuda et al., 2011). The aforementioned indicates the multifactorial nature of the problem (Seo et al., 2012). In this study, the percentage of extracted teeth due to VRF was 25.3%. Other studies have reported a lower percentage of VRF ranging between 6.2% and 13.4% (Olcay et al., 2018). While other studies documented a VRF incidenceto be as high as 31% (Sjogren et al., 1990). These variations could be due to the different study design (retrospective as in Zadik et al. vs. prospective in this study), inclusion criteria (Vire et al. included only teeth that were obturated using lateral condensation technique), different population, and different sample size (Zadik et al., 2008) (Olcay et al., 2018).

It has been shown that endodontically treated teeth with no coronal coverage were 5–6 folds more likely to be lost than teeth with the coronal coverage (Aquilino and Caplan 2002). In our study, only teeth that have been restored after NSRCT by crowns were included while ruling out temporary fillings and absence of fillings but not permanent filling materials, such as amalgam or composite. A significant reduction in caries disease was noticed in crowned teeth after NSRCT when compared to unrestored teeth (Olcay et al., 2018). Although knowing that dental caries is a multifactorial disease and factors, such as DMFT index and periodontal/plaque index, would have affected the results, these measures were not included in our study.

A relatively small percentage of teeth in the present study were extracted based on patient demand (12.2%) after presenting with discomforting abscess or sinus tract discharge where the patient elects not to peruse other treatment options except extraction and future dental implants. This has been reported at a lower percentage, (0.9%), in another study of a Turkish population sample (Olcay et al., 2018). The difference is potentially due to different cultural backgrounds, dental awareness, financial investment preference, and patients' attitude.

Most of the sample, 32%, survived for up to 3 years after NSRCT before presenting for extraction. This is in agreement with other studies proving that 38.5% of their cases presented for some kind of intervention in the first 2 years after completion of the NSRCT, in the form of extraction of other care (Aquilino and Caplan, 2002) (Olcay et al., 2018).

The prophylactic recommendation to maintain molar teeth after crowning NSRCT would be strict oral hygiene instructions, dental flossing, and regular dental checkups to reduce the chances of SGD. As for premolars, the chance of decay might be less due to the better accessibility. Nevertheless, the dentist should carefully evaluate the factors, such as the high force of occlusion, bruxism, and clenching habits, that might increase the chances of VRF and minimize them as much as possible. Patients should be presented with variable comprehensive treatment plans andalternative options to help their choice toward an intervention over the other.

## 5. Conclusion

As the most frequent reason for extracting molars and premolars differs (SGD vs. VRF), the prophylactic recommendation to keep them functional after NSRCT for longer periods might also differ. In our study, a survival period of 13–36 months was documented for most teeth before extraction. Interestingly, most of the teeth that were extracted less than 12 months after commencing NSRCT were molars. Therefore, a cautious approach must be taken with molars with regard to careful endodontic treatment (preferably to be done by endodontists), final full coronal coverage, further oral hygiene practice, and regular follow-up visits. Furthermore, this result shed light into some prognostic information to be discussed with the patients to go for NSRCT vs. extraction and implant placement. These findings also indicate some clinical observations with an intent to improve the health care service. However, understating the limitations of the study, the message is to approach each case separately with care toward the recommended treatment plans as per the available manpower and resources.

## 6. Disclousre

The author denies any conflicts of interest related to this study. The authors disclose no funding sources that supported the work as well as all institutional or corporate affiliations of the authors.

### Declaration of Competing Interest

This statement is to attest that " no conflict of interest " is known to the study presented.

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