

A Professional Courtesy of:



Raaed Batniji, DMD
Samir Batniji, DDS

Your ENDODONTIC SPECIALTY

www.endodontic.net

1111 S. Grand Ave., Ste. D
Diamond Bar, CA 91765
909-396-9944 • Fax: 909-396-9984

1111 W. Covina Blvd., Ste. 130
San Dimas, CA 91773
909-592-9197 • Fax: 909-592-8860

9353 Fairway View Place, Ste. 210
Rancho Cucamonga, CA 91730
909-945-5008 • 909-243-7575
Fax: 909-581-6668



The Relationship Between Missed Canals and Periapical Lesions

An overlooked canal can have a serious effect on an endodontically treated tooth, serving as a potential reservoir for microorganisms that may lead to persistent apical periodontitis. Cone-beam computed tomography (CBCT), a significant improvement in imagery previously available from 2-dimensional, creates a 3-dimensional view of pulpal anatomy that better visualizes a tooth's canal system to better guide endodontic treatment. Baruwat et al from Universidade de Lisboa, Portugal, reviewed CBCT images to determine the prevalence of undetected canals and their impact on periapical lesions in endodontically treated teeth.

The study included 2305 maxillary or mandibular teeth treated endodontically at 8 different private dental clinics. Recorded information included the tooth number and specific roots, any missed roots and any periapical pathology (as defined by the CBCT periapical index score). The evaluators found that 12.0% of all canals in endodontically treated teeth were missed; the greatest number of missed canals were found in

- maxillary first molars (59.5%)
- maxillary second molars (40.0%)
- mandibular first molars (11.2%)
- mandibular second molars (9.5%)

The highest prevalence among frequently missed roots was found in the mesiobuccal root of maxillary first molars, which was missed >60% of the time, followed by the mesiobuccal root of maxillary second molars. More than two-thirds of these missed roots were associated with periapical lesions.

Missed second mesiobuccal canals in maxillary first molars were significantly more likely than distobuccal and palatal roots with no missed canals in the same tooth to harbor periapical lesions. Similar results were found when comparing mesiobuccal roots with and without a missed second mesiobuccal canal in individual patients. In total, periapical lesions were found in 82.6% of all teeth with missed canals.

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While a missed root canal can be a cause for endodontic therapy failure, its diagnosis represents a clinical challenge because it is not associated with any specific symptoms. Studies have demonstrated the widespread prevalence of second mesiobuccal canals in maxillary first molars, a variable and complex anatomy that can make detection difficult. These anatomical difficulties may also be a contributing factor to the high rates of missed canals in the distal roots of maxillary first molars and the mesial roots of maxillary second molars.

The results of this study highlight the need for practitioners to have a full understanding of tooth anatomy, root canal configurations and possible variations before beginning endodontic treatment.

Baruwa AO, Martins JNR, Meirinhos J, et al. *The influence of missed canals on the prevalence of periapical lesions in endodontically treated teeth: a cross-sectional study.* J Endod 2020;46:34-39.

Success of Replanting Traumatologically Avulsed Teeth

The chances of successful replantation following traumatic tooth avulsion have increased over the last several decades, primarily due to the development of proper endodontic treatment limiting pulp space infection and the resultant root resorption. The key element is minimizing damage to the cementum and the periodontal ligament (PDL), which can regenerate

Table 1. Estimated risk of ankylosis based on dry time.

Dry time	Risk of ankylosis	
	Immature root	Mature root
<20 minutes	33.9%	59.4%
20-40 minutes	49.6%	78.3%
40-60 minutes	54.4%	81.9%
>60 minutes	60.0%	86.4%

themselves to heal resorption cavities. However, extensive damage to the cementum or the PDL may prevent spontaneous revascularization, leading to external root resorption.

The PDL of an avulsed tooth exposed to the air may become necrotic due to drying out. The resultant necrotic PDL leads to ankylosis, an ingrowth of bone that will eventually substitute for the tooth, causing the replanted tooth to fail.

Most studies reporting on the impact of drying time on avulsed teeth have involved in vivo experiments on dogs and monkeys, but very little clinical data exist reflecting human dental experience. Lauridsen et al from Copenhagen University Hospital, Denmark, reanalyzed older, long-term data to determine dry time's effect on the long-term survival of and the development of ankylosis in replanted teeth.

Patients in the study had been treated over a 23-year period at the emergency room of 1 hospital for avulsion of a permanent incisor. The tooth had been placed in saline, cleaned if obviously contaminated and replanted in its socket using digital pressure. The time between the tooth's avulsion and placement of the tooth either in a storage medium or by replantation was recorded. Teeth with mature root formation were treated endodontically 7 to 14 days after replantation;

teeth with immature roots were treated only if signs of pulp necrosis or infection-related root resorption were observed. Patients underwent a standard follow-up program for up to 20 years.

After reviewing the results of 400 replanted teeth (from 322 patients), the authors found that the stage of root development and the amount of dry time were the most important factors in the development of ankylosis. Teeth with immature roots fared better than did teeth with mature roots; longer time periods exposed to air correlated with poorer outcomes (Table 1).

Conclusion

One interesting takeaway from this study was that 40% of teeth with immature roots (and nearly 14% of teeth with mature roots) did not develop ankylosis even after being exposed to the air for >60 minutes. Thus, the authors recommended that replantation should be an option for all avulsed teeth, regardless of dry time, and that the current standard calling for the removal of the PDL in teeth exposed for >60 minutes should be reconsidered.

Lauridsen E, Andreasen JO, Bouaziz O, Andersson L. *Risk of ankylosis of 400 avulsed and replanted human teeth in relation to length of dry storage: a re-evaluation of a long-term clinical study.* Dent Traumatol 2020;36:108-116.

Influence of Dental Anxiety on Intraoperative Pain

Dental anxiety often causes patients to delay treatment until they feel oral pain, which can lead to a vicious cycle of anxiety-pain. A heightened fear of dental procedures may be particularly strong among patients facing root canal treatment. Two main concerns of patients facing root canal treatment are duration of procedure and pain.

Studies have suggested that increased dental anxiety, along with fear of pain, may actually trigger an increase in intraoperative pain felt by patients during root canal treatment. Evaluating dental anxiety can help the practitioner manage patients with anxiety, along with providing evidence-based information about the psychological component that often prevents patients from seeking endodontic treatment.

Murillo-Benítez et al from the University of Sevilla, Spain, analyzed whether anxiety influences a patient's intraoperative pain after controlling for other factors (e.g., preoperative pain, gender, age, endodontic diagnosis and premedication) that might contribute to their perception of pain during root canal treatment. The investigators enrolled 90 consecutive men and 90 consecutive women (age range, 18–68 years) who had sought

treatment at 2 private dental clinics located in middle-class neighborhoods after they had been found to require root canal treatment on any tooth. Patients who needed any other dental treatment were excluded. Demographic data and medication use were recorded for each patient, along with decayed, missing and filled teeth (DMFT) index, affected tooth, endodontic diagnosis and periapical status.

Before treatment, each patient completed the short-form Dental Anxiety Inventory (S-DAI), which requires individuals to evaluate each of the 9 statements on the questionnaire, such as, “When I think of the sound of the drilling machine on my way to the dentist, I would rather go back,” on a scale of 1 (never) to 5 (always); anxiety scores were grouped as

- mild (9–21)
- moderate (22–34)
- high (35–45)

Self-reported preoperative and intraoperative pain was evaluated using a 10-cm visual analog scale (VAS) that ranked pain levels from 0 (absent) to 10 (unbearable). Treatment duration ranged from 40 to 90 minutes (mean, 63 minutes).

Slightly more than 75% of patients rated their intraoperative pain as mild or none, with no difference seen by gender. More than half the patients had moderate or high anxiety as

shown on the S-DAI, with more men than women scoring mild anxiety levels. Patients who scored higher anxiety levels on the S-DAI reported higher levels of intraoperative pain (Table 2). On multivariate regression analysis, 2 factors—a diagnosis of apical periodontitis and increased S-DAI score—correlated significantly with greater intraoperative pain.

Conclusion

While this study demonstrated that intraoperative pain during root canal treatment is tolerable for most patients, the findings suggest that practitioners may underestimate the pain patients experience during treatment, especially patients who demonstrate dental anxiety.

Before treatment begins, it may prove beneficial to determine a patient's level of dental anxiety, then promote any activities that lessen and avoid any activities that increase that anxiety. Knowing a patient's degree of anxiety can help the practitioner decide whether to use anxiety medication and/or anesthesia to control patient pain during endodontic treatment.

Murillo-Benítez M, Martín-González J, Jiménez-Sánchez MC, et al. Association between dental anxiety and intraoperative pain during root canal treatment: a cross-sectional study. Int Endod J 2020;53:447-454.

Factors Influencing Endodontic Success In Older Patients

Successful endodontic treatment of patients requires consideration of health factors that have an impact on a patient's dental status.

Table 2. Patients' perceived pain level by differing anxiety levels.

Anxiety level	Pain level			
	Absent	Mild	Moderate	Intense
Mild (n = 72)	40.3%	48.6%	11.1%	0%
Moderate (n = 41)	34.1%	48.8%	14.6%	2.4%
High (n = 67)	17.9%	38.8%	32.8%	10.4%

Unfortunately, little data exist on how nonendodontic factors may affect the outcome of nonsurgical root canal treatment in older populations.

Although increased patient age does not appear to be a predictive factor in the outcome of root canal treatment, some nonendodontic factors frequently found in older populations may affect periapical healing after nonsurgical root canal treatment. Jahreis et al from University Hospital of Würzburg, Germany, investigated whether periodontitis or chronic use of medication for systemic disorders (e.g., type 2 diabetes mellitus, hypertension, metabolic syndrome) influenced the outcome of nonsurgical root canal treatment in a population ≥ 60 years of age.

Their study enrolled 177 endodontic patients ≥ 60 years of age treated by students at a university dental clinic between 2010 and 2013. Data collected included the periodontal screening index (PSI) along with information on medication taken by patients for chronic diseases, including

- agents for treating diabetes
- antihypertensives
- anticoagulants
- statins
- uricostatic drugs
- immunosuppressants
- bisphosphonates

Rotary nickel–titanium (NiTi) files were used to shape the canals, which were then filled using gutta-percha cones and a matching-taper single-cone filling technique. Posterior teeth were restored with regular crowns, anterior teeth with partial or full composite fillings.

A total of 93 patients completed their recall appointments, including 41 who were ≥ 70 years of age; average follow-up time was 39 months. Healing occurred in 81 of the 93 teeth included in the study. The only primary factor that showed a significant impact on endodontic outcome was preoperative periapical status; all failures came in teeth that had demonstrated periapical lesions before treatment. Patients taking medication for chronic diseases were no more likely to have poor results than were patients not on medication regimens, with one exception: Patients undergoing long-term anticoagulant therapy had a significantly higher rate (>8 times) of endodontic failure than did patients not taking this medication.

Conclusion

The authors noted some peculiarities in their findings. Neither the adequacy of the root canal filling nor the quality of the coronal restoration had any significant influence on outcomes, nor did the quality of coronal restoration. Similarly, they found no correlation between outcomes and whether the patient was undergoing primary nonsurgical root canal treatment or retreatment.

All of these findings contradict those of other studies. These results may be the product of a limited sample size and the fact that the students performing the root canals had limited endodontic experience. In addition, the overall technical quality of the root canal filling was deemed inadequate in 34.4% of recalled teeth.

Within the limitations of this study, the results indicate that, among patients aged ≥ 60 years of age, those on a medication regimen for chronic disease do not have poorer endodon-

tic treatment outcomes than those not on medication regimes. Anticoagulant medications may be an exception to this rule, although the difference in outcomes may be caused not by the medication but by the underlying conditions that require the patient to take anticoagulants.

Jahreis M, Soliman S, Schubert A, et al. Outcome of non-surgical root canal treatment related to periodontitis and chronic disease medication among adults in age group of 60 years or more. Gerodontology 2019;doi:10.1111/ger.12407.

In the next issue:

- Outcome and survival rate of endodontically treated cracked posterior teeth
- Reliable and accurate screening for endodontic disease

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