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## Success of Nonsurgical Root Canal Retreatment

Primary root canal treatment has been a very successful modality, with a reported success rates ranging from 85% to 98%; however, failures requiring retreatment still occur. Although nonsurgical root canal retreatment is the least invasive approach with favorable results, reported success rates (ranging from 62% to 91%) fail to match those for primary treatment. Olcay et al from Istanbul Medipol University, Turkey, studied a cohort of patients who underwent nonsurgical root canal retreatment to determine what, if any, factors contributed to the success or failure of retreatment.

This retrospective study tracked outcomes for 236 teeth in 161 patients treated at a university endodontic department between March 2014 and December 2015. Information collected included

- Root Repair Material Compared with MTA as a Root-end Filling
- Prediction of an Isthmus in A Mandibular First Molar
- Prevalence of Second Mesiobuccal Canals in Molars

- patient age and sex
- time to retreatment after original treatment

- preoperative, intraoperative and postoperative signs and symptoms
- root canal filling density
- coronal restoration type and quality

All retreatments were performed by the same endodontist using a multiple-visit protocol.

Patients were recalled 2 to 3 years after treatment completion. Teeth were evaluated for palpation/percussion pain or discomfort, sinus tract swelling, fistula or sign of infection in the gingival tissue, marginal integrity of the coronal restoration, and quality of root-canal filling; they were classified using a 3-category framework:

- **healed:** no clinical signs or symptoms; normal periapical tissue with an intact periodontal ligament space and lamina dura
- **healing:** no clinical signs or symptoms; periapical radiolucency still present but reduced in size
- **not healed:** presence of clinical signs or symptoms and/or unchanged, enlarged or new periapical radiolucency

Outcomes in the “healed” or “healing” categories were considered successes; those in the “not healed” category were

considered failures. The overall success rate (healed plus healing) at a mean of 34 months was 85%; 94% of teeth remained asymptomatic and fully functional. The most frequent causes of endodontic failure included

- insufficient restoration and/or root canal filling
- missing coronal restoration
- other prosthetic issues

The only factor significantly associated with retreatment failure was tooth type, with mandibular molar teeth more likely than other teeth to fail.

### Conclusion

The applicability of this study may be limited because more than half the original patient cohort did not return for a recall examination, which may have had an impact on the study's findings. Studies involving a longer follow-up period and a larger group of patients are needed to determine outcome predictors for nonsurgical root canal retreatment.

*Olcay K, Eyüboğlu TF, Özcan M. Clinical outcomes of non-surgical multiple-visit root canal retreatment: a retrospective cohort study. Odontology 2019;doi:10.1007/s10266-019-00426-6.*

## Root Repair Material Compared with MTA As a Root-end Filling

Treating persistent and recurrent apical periodontitis using modern microsurgical techniques has led to a dramatic increase in success rates over those achieved with traditional endodontic surgery. At the same time, mineral trioxide

**Table 1. Success rate by imaging modality.**

	Success	Failure
<b>By periapical radiographs</b>	93.3%	6.7%
MTA	94.8%	5.2%
RRM	92.1%	7.9%
<b>By CBCT imaging</b>	85.0%	15.0%
MTA	85.9%	14.1%
RRM	84.1%	15.9%

*CBCT, cone beam computed tomography; MTA, mineral trioxide aggregate; RRM, bioceramic root repair material.*

aggregate (MTA) has become the filling material of choice for endodontic therapy because it fulfills many of the ideal aspects of a root-end filling material: MTA is biocompatible, dimensionally stable and bactericidal while providing an excellent seal. But MTA is difficult to handle, takes a long time to set and may cause discoloration of the tooth. The recently introduced EndoSequence bioceramic root repair material (RRM) shows promise as a root-end filling material by combining excellent handling characteristics with the positive aspects of MTA.

Safi et al from the University of Pennsylvania conducted a prospective randomized controlled clinical trial comparing the surgical outcome of teeth treated using MTA with that of teeth treated using RRM. Before surgery, a periapical radiograph and a cone beam computed tomography (CBCT) image of each tooth to be treated was taken.

All patients underwent endodontic microsurgery performed by post-graduate students at a university clinic using a standardized protocol; the only difference was the randomized use of MTA or RRM as the filling material. At a follow-up visit  $\geq 12$  months after the procedure, patients received a clinical exami-

nation, including a new periapical radiograph and CBCT image.

Half the treated teeth were available for follow-up analysis at a mean time of 15 months. Based on the periapical radiographs, the overall success rate was 93%, with MTA- and RRM-filled teeth showing similar results. The success rate dropped to 85% based on CBCT images; again, the two filling materials showed similar results (Table 1). Depth of root-end filling was the only significant prognostic outcome factor, regardless of imaging modality.

### Conclusion

The use of 3-dimensional CBCT imaging detected more apical periodontitis and minute changes in periodontal ligament reformation than did 2-dimensional periapical radiographs. However, MTA and RRM showed similar results regardless of the imaging modality. This study suggested that RRM is a suitable material for root-end filling in endodontic microsurgery.

*Safi C, Kohli MR, Kratchman SI, et al. Outcome of endodontic microsurgery using mineral trioxide aggregate or root repair material as root-end filling material: a randomized controlled trial with cone-beam computed tomographic evaluation. J Endod 2019;doi:10.1016/j.joen.2019.03.014.*

## Prediction of An Isthmus in a Mandibular First Molar

**B**ecause mandibular first molars have a variety of anatomical variations, they can present a challenge for the practitioner performing endodontic treatment on a patient. Two of these variations, an isthmus (a narrow pulp space extending between 2 main root canals) and a middle mesial canal (a third canal in the mesial root between the mesiobuccal and the mesiolingual canals), may harbor microorganisms that can cause root canal treatment to fail. Unfortunately, identifying an isthmus in the apical portion using periapical radiographs is not possible, nor is an isthmus visible under a dental operating microscope during nonsurgical root canal treatment.

Hu et al from Sun Yatsen University, China, hypothesized that certain clinical indicators might predict the presence of an isthmus in the apical third of mandibular first molars. They reviewed cone beam computed tomography (CBCT) imaging of 496 patients (823 mandibular first molars) taken over an 8-year period to determine the prevalence of isthmi and middle mesial canals, as well as whether an association exists between the presence of isthmi in the apical third and any potential predictors based on the patient's demographics or the anatomic characteristics of the mesial root.

The researchers recorded the following information for each tooth:

- patients' age (divided into 4 groups: ≤20 years; 21–40 years; 41–60 years; and >60 years)

- number of root canals in mesial roots
- presence and location of any isthmus and/or middle mesial canal
- distance between mesiobuccal and mesiolingual root canal orifices
- Weine canal configuration: type 1 (single canal); type 2 (2 canals ending in a single apical foramen); or type 3 (2 canals ending in separate apical foramina)

An isthmus was present in 64.6% of all mandibular first molars. While sex and side (left vs right) were not significant predictive factors, isthmi were found in a significantly larger percentage of younger patients, with the percentage decreasing steadily as patient age increased. Middle mesial canals were present in 10.8% of the molars, with patients aged 41 to 60 years showing a significantly increased frequency compared with patients aged 21 to 40 years.

Several factors other than age were associated with the presence of isthmi in the apical third, including the absence of an isthmus in the cervical third, shorter distance between the mesiobuccal and mesiolingual root canal orifices, and Weine type 2 mesial root canal system (Table 2). After a logistic regression analysis, age ≤60 years, distance between root orifices and Weine type 2 configurations remained significant predictive factors for the presence of an isthmus in the apical third. No association was found between the presence of a middle mesial canal and an isthmus.

### Conclusion

The authors noted that the prevalence of middle mesial canals was much lower in their study, in which all patients were Chinese, than had been reported in a study of an American population. Given similar variances found in studies conducted in Brazilian and Turkish populations,

**Table 2. Association of an isthmus in the apical third of mandibular first molars with demographic and anatomic characteristics.**

Variable	Isthmus present in the apical third	Isthmus absent in the apical third	<i>p</i> value
<b>Age</b>			<.01
≤20 years	59.4%	40.6%	
21–40 years	44.2%	55.8%	
41–60 years	36.1%	63.9%	
>60 years	23.4%	76.6%	
<b>Isthmus in the cervical third</b>			<.01
Present	47.3%	52.2%	
Absent	36.7%	63.3%	
<b>Middle mesial canal</b>			.86
Present	40.4%	59.6%	
Absent	41.4%	58.6%	
<b>Mean distance between mesiobuccal and mesiodistal orifices</b>			<.01
	2.82 mm	2.95 mm	
<b>Weine configuration</b>			<.01
Type 2	95.5%	4.5%	
Type 3	31.0%	69.0%	

they suggested that middle mesial canals in mandibular first molars may have a genetic basis. The prevalence of isthmi, however, was in line with that found in previous studies. Their findings of predictive factors may help practitioners identify those patients likeliest to have an isthmus.

Hu X, Huang Z, Huang Z, et al. Presence of isthmi in mandibular mesial roots and associated factors: an in vivo analysis. *Surg Radiol Anat* 2019;doi:10.1007/s00276-019-02231-w.

## Prevalence of Second Mesio Buccal Canals in Molars

Endodontic treatment of maxillary molars fails more frequently than does treatment of most other teeth due to the complexity of their root canal anatomy and the lack of a standard morphology in their mesio buccal roots. While many studies of molar mesio buccal roots have revealed the presence of second mesio buccal canals, their prevalence remains uncertain. Given that retreatment often reveals the presence of a previously undiscovered second mesio buccal canal, failure to detect the additional canal may be an important factor in the failure of primary endodontic treatment.

Practitioners most often rely on preoperative periapical radiographs to determine root morphology. Unfortunately, these 2-dimensional radiographs cannot assess the presence of extra canals in mesio buccal molar roots. Cone beam computed tomography (CBCT) may solve this difficulty with a non-invasive, nondestructive technology.

Fernandes et al from the University of Pretoria, South Africa, used CBCT images to determine the prevalence of second mesio buccal canals in permanent maxillary molars.

This retrospective study reviewed 200 CBCT scans (100 women, 100 men) taken over a 3-year period at a university dental clinic. In addition to determining the prevalence of second mesio buccal canals in maxillary molars, the researchers also calculated the probability that a second mesio buccal canal in one molar would be predictive of a similar canal in a contralateral or adjacent molar.

Second mesio buccal canals were found in

- 92% of maxillary right first molars (tooth #3)
- 87% of maxillary left first molars (tooth #14)
- 69% of maxillary right second molars (tooth #2)
- 65% of maxillary left second molars (tooth #15)

Prevalence was not significantly affected by patients' sex or age. Among the patients with a second mesio buccal canal in a first molar, 97% also had an extra canal in the contralateral first molar; in second molars, the rate was 88%. Second mesio buccal canals in tooth #3 or tooth #14 were most likely to predict the existence of a second canal in the contralateral molar. Adjacent occurrence was present in 95% of molars with a second canal.

### Conclusion

Although the prevalence found in this study was higher than in some previous studies, the use of CBCT hardware and software are the most

likely reasons. Many studies have shown a decline in prevalence in older patients; although this study did not find a significant relationship between prevalence and age, that may have been due to the fact that the study had few patients >50 years of age.

Because untreated second mesio buccal canals in molars "remain a source of persistent microbial infection and contamination contributing to endodontic treatment failure," determining whether these canals exist in a tooth undergoing treatment can make the difference between successful and unsuccessful primary endodontic therapy.

Fernandes NA, Herbst D, Postma TC, Bunn BK. The prevalence of second canals in the mesio buccal root of maxillary molars: a cone beam computed tomography study. *Aust Endod J* 2019;45:46-50.

### In the next issue:

- Analysis of palatal roots of maxillary molars
- Overuse of antibiotics for irreversible pulpitis
- Evaluation of root canal treatment using different irrigation systems

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