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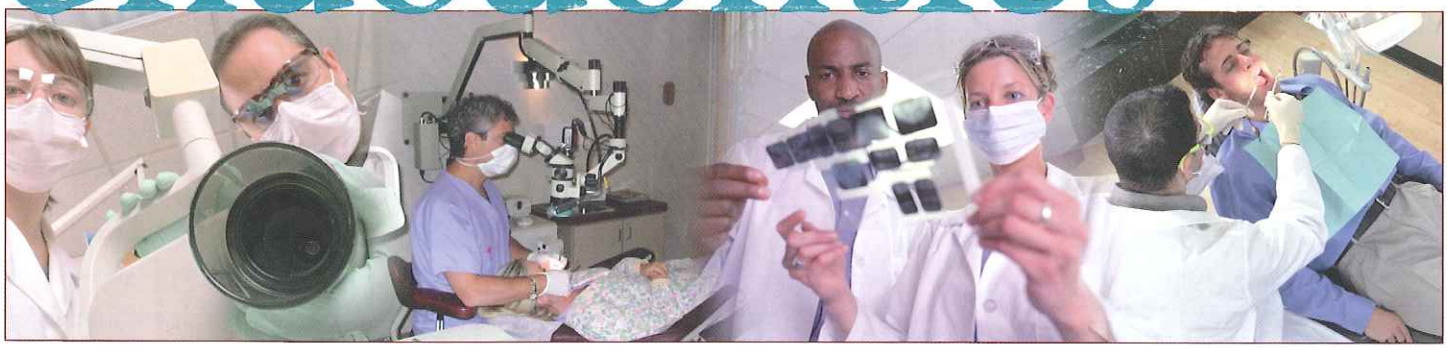

Orthograde Endodontic Retreatment: A Retrospective Outcome Analysis

A successful treatment modality, endodontic therapy yields a high long-term tooth-survival rate. In some cases, however, teeth that have undergone initial endodontic treatment present with persistent disease, and the patient's signs or symptoms might not resolve after the treatment. Failure of initial treatment could be the result of such factors as persistent infection from untreated canals, undiagnosed cracks or fractures, cystic lesions, extraradicular infections/biofilms, foreign body reaction to some extruded material, iatrogenic perforation and cholesterol crystals in apical tissues. While posttreatment disease can be managed with apical surgery or intentional replantation, orthograde retreatment—the least invasive approach—is often the preferred choice.

A limited number of studies have assessed the outcomes of orthograde endodontic retreatment, studies that vary considerably in design, treatment protocols and methodology, as well as in recall rates and duration of the observation periods. Among contemporary studies, 4 used current techniques and presented relevant evidence bases for retreatment outcomes.

An epidemiologic study assessing endodontic retreatment outcomes in large patient populations would enable a more realistic analysis of large-population response to the treatment, providing clinicians with better assessment of tooth prognosis and selection of appropriate treatment protocols. Thus, Salehrabi and Rotstein from the University of Southern California retrospectively analyzed the outcomes of endodontic retreatment and associated tooth survival during a 5-year follow-up period.

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The authors obtained their data from retreatments performed by endodontists participating in the Delta Dental Insurance Data Center. The Delta Dental Plans Association insures approximately 15 million individuals across the United States.

A computerized query for nonsurgical retreatment procedures identified 4744 procedures. After tracking the anterior, molar and premolar teeth in the database and recording additional procedures, it was found that 89% of teeth had been retained in the oral cavity 5 years after the endodontic retreatment.

Four percent of all teeth had undergone apical surgery, the majority of which had occurred within 2 years of completion of orthograde retreatment (Table 1). At the end of the 5-year observation period, 11% of teeth had been extracted.

Conclusion

In their retrospective analysis, the authors found that conventional endodontic retreatment yields an extremely high incidence of tooth retention after 5 years, regardless of etiology, specific treatment technique, tooth group or special patient characteristics. Patients considering orthograde endodontic retreatment should know that 89% of these teeth will be retained and functional at least 5 years after the procedure.

Salehrabi R, Rotstein I. Epidemiologic evaluation of the outcomes of orthograde endodontic retreatment. J Endod *2010;36:790-792.*

Repair of Root Perforations with Mineral Trioxide Aggregate

Root perforations are artificial communications between the root-canal system and the periodontium or the oral cavity. Examples of iatrogenic root perforations include those caused by access preparation or post space creation. Perforations can also occur during root-canal preparation with hand or rotary instruments, Peeso reamers, or Gates Glidden drills. The main noniatrogenic causes are progressive root resorption or caries.

Mente et al from Ruprecht-Karls University of Heidelberg, Germany, investigated the treatment outcome of root perforations repaired with mineral trioxide aggregate (MTA) between 2000 and 2006. Twenty-six patients received treatment with MTA in 26 teeth with root perforations. Perforation repair by all treatment providers was performed using a dental operating microscope. Clinical and radiographic outcomes were assessed 12–65 months after treatment (median, 33 months; 81% recall rate) for 21 patients. Pre-, intra- and postoperative information relating to potential prognostic factors was evaluated.

Minor differences in the healed rate were observed for several variables. Larger differences (≥15%) were noted for the following:

- Preoperative variables—number of roots, localization of perforation, size of perforation and pulp status (Table 2)
- Intraoperative variables—root-filling technique, treatment sessions and experience of the treatment providers
- Postoperative variables—quality of coronal restoration and type of restoration

Table 1. *Outcome of orthograde endodontic retreatments*

Additional procedures performed	0–12 months	13–24 months	25–36 months	37–48 months	49–60 months	Cumulative total (%)
Anterior teeth (n = 964*)						
Apical surgery	24	27	7	3	3	64 (6.6)
Extraction	9	17	11	17	14	68 (7.0)
Premolar teeth (n = 858†)						
Apical surgery	16	15	1	2	3	37 (4.3)
Extraction	17	27	27	12	13	96 (11.2)
Molar teeth (n = 2922‡)						
Apical surgery	46	31	13	7	7	104 (3.6)
Extraction	70	100	77	62	48	357 (12.2)

**10 underwent both procedures; †4 underwent both procedures; ‡22 underwent both procedures.*

Table 2. *Outcome distribution across preoperative variables*

Variable	Teeth *n* (%)	Healed *n* (%)	*p* value
Number of roots			.53
1	13 (62)	12 (92)	
≥2	8 (38)	6 (75)	
Localization of perforation			1.00
Furcal	4 (19)	4 (100)	
Crestal	7 (33)	6 (86)	
Midroot	5 (24)	4 (80)	
Apical third of root	5 (24)	4 (80)	
Size of perforation			.52
≤1 mm	10 (48)	9 (90)	
1–3 mm	8 (38)	7 (88)	
>3 mm	3 (14)	2 (67)	
Pulp status			1.00
Responsive	3 (14)	3 (100)	
Nonresponsive	18 (86)	15 (83)	

The healed rate for single-rooted teeth was 92%, and for multirooted teeth, it was 75%. The healed rate for teeth with larger perforations (>3 mm) was 67%; for those with smaller perforations (1–3 mm), it was 88%, and for perforations <1 mm, the healed rate was 90%. However, none of the observed differences was statistically significant.

Conclusion

Although this study was limited by the relatively small sample size, the results indicated that an extremely high success rate for treatment of root perforations in all areas of the root can be achieved with MTA. The results also showed that using MTA to repair root perforations is a valid option and that further longitudinal, prospective clinical studies are needed.

Mente J, Hage N, Pfefferle T, et al. Treatment outcome of mineral trioxide aggregate: repair of root perforations. J Endod *2010; 36:208-213.*

Synergistic Antimicrobial Effect on Biofilm Bacteria

An essential part of root-canal treatment, irrigation with antibacterial solutions complements instrumentation in facilitating the removal of pulp tissue and/or microorganisms. The effectiveness of irrigation depends on the working mechanisms of the irrigant and the ability to bring the irrigant into contact with the microorganisms and tissue debris in the root canal.

A biofilm is defined as an aggregation of bacteria embedded in an extracellular matrix of polysaccharide. Bacteria within biofilms generally have an increased resistance to many antimicrobial agents compared with their planktonic counterparts. Biofilms provide the microbes with protection against existing physical forces and chemical attack.

Shen et al from the University of British Columbia, Canada, investigated whether mechanical agitation (ultrasonic or sonic) improves the effectiveness of chlorhexidine (CHX) against biofilm bacteria in vitro. Collagen-coated hydroxyapatite disks were exposed to dispersed subgingival plaque—collected from the first or second molars from 1 of 3 healthy volunteers—in a brain–heart infusion broth for 3 weeks at 37° C. The established biofilms were subjected to CHX-Plus (Vista Dental Products, Racine, Wis.) or 2% CHX for 1 and 3 minutes, with or without mechanical agitation.

After treatment, viability staining and confocal laser scanning microscopy (CLSM) were used to analyze the amount of dead bacteria in biofilms. The morphology of biofilms, with or without mechanical agitation, was also examined by CLSM.

The biofilm structure did not show obvious change when the solutions surrounding the biofilm were exposed to continuous ultrasonic or sonic agitation. Combined mechanical agitation and CHX had a more pronounced antimicrobial effect against the biofilms than either one alone. Sonic activation (EndoActivator; Advanced Endodontics, Santa Barbara, Calif.) showed the highest levels of bactericidal activity with CHX-Plus after both the 1- and 3-minute exposure times. The proportion of bacteria killed also depended on the type of irrigant ($p < .001$) and the time of exposure ($p < .001$).

Conclusion

In studying the antimicrobial effect, the authors found a synergistic relationship between ultrasonic or sonic agitation and CHX, enhancing the antimicrobial effect against biofilm bacteria. The enhanced antimicrobial activity did not negate the normal absorption or the binding interactions between the disinfectant and components of the biofilm.

Shen Y, Stojicic S, Qian W, et al. The synergistic antimicrobial effect by mechanical agitation and two chlorhexidine preparations on biofilm bacteria. J Endod *2010;36:100-104.*

Diagnosing and Treating Fracture Necrosis

It has been well documented over the years that cracks and fractures in teeth pose difficulties in diagnosis, prognosis assessment and treatment recommendations. When a tooth has no significant restorations or caries—and the pulp is nonvital in the absence of a traumatic injury—the necrosis is likely caused by a significant longitudinal crack that extends from the occlusal surface into the pulp. This type of presentation has been termed "fracture necrosis."

The literature has described the following 5 types of longitudinal fractures:

1 Craze line—affects only the enamel, originates on the occlusal surface, arises typically from occlusal forces or thermocycling and is asymptomatic

2 Fractured cusp—occurs on the cusps and cervical margins of the root and can result in acute pain on mastication and exposure to cold

3 Cracked tooth—occurs on the crown and may extend into the root, develops from damaging occlusal forces or weakened tooth structure, and may exhibit variable signs and symptoms

4 Vertical root—occurs and originates only in the roots, has variable but a lesser degree of signs and symptoms, and is caused by wedging forces within the roots

5 Split tooth—a fracture through the crown and roots develops from damaging occlusal forces or weakened tooth structure, separating the tooth into 2 segments, with the tooth typically being painful upon mastication

Berman, a private practitioner from Maryland, and Kuttler from NOVA Southeastern University, Florida, evaluated 27 teeth with nonvital pulps. The teeth had either no restorations or minimally invasive restorations and no signs of caries. All the teeth had some suggestion of an occlusal mesial-to-distal crack as visualized by direct observation of the occlusal table using a dental operating microscope and by transillumination. None of the teeth exhibited any objective sign of a split tooth.

The teeth were extracted and evaluated as to the depth and location of any potential fracture. Micro-computed tomography (micro-CT) imaging with digital reconstruction was also used, digitally sectioning teeth in increments of 6.5 µm to determine more objectively the internal extent of these cracks. The proximity of the cracks with respect to the pulp and external root surface was assessed using coronal-apical, mesial-distal and buccal-lingual scanning.

All evaluated teeth were found to have cracks that extended from the occlusal surface into the pulp and progressed to an external root surface. The micro-CT scans revealed objective evidence of an occlusal crack extending from the coronal surface to the pulp, progressing further apically and continuing to a lateral root surface.

Conclusion

In the absence of restorations, caries or luxation injuries, pulp necrosis is likely caused by a longitudinal fracture extending from the occlusal surface into the pulp. Based on the available literature, these teeth may have a poor prognosis after endodontic treatment, and extraction may be considered the primary treatment option.

Berman LH, Kuttler S. Fracture necrosis: diagnosis, prognosis assessment, and treatment recommendations. J Endod *2010;36:442-446.*

In the next issue:

- Mineral trioxide aggregate and adhesive resin composite for apical surgery
- Interaction between sodium hypochlorite and chlorhexidine
- Retained instrument removal

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