A Professional Courtesy of:

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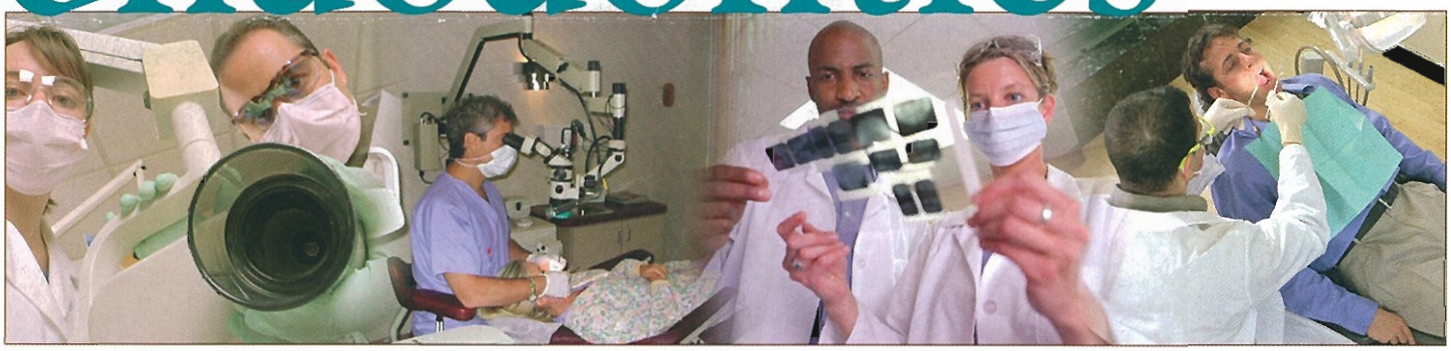

Orthodontic Root Resorption of Endodontically Treated Teeth

Apical root resorption, characterized by apical rounding and some loss of tooth length, is a well-known sequela of orthodontic treatment. The use of strong forces and prolonged treatment time appear to be directly related to an increase in root resorption; these risks are well understood by orthodontists. However, there are varying findings in the dental literature regarding the susceptibility of endodontically treated teeth to orthodontic forces. Esteves, a private practitioner from Maringá, PR, Brazil, et al, evaluated radiographically whether there is a significant difference in apical root resorption in vital and endodontically treated teeth that were subjected to orthodontic treatment.

Sixteen patients were selected who each had a vital maxillary central incisor (control) and an endodontically treated homolog, in which the periodontal ligament of the apical region was normal. All the selected patients had undergone orthodontic movement with the use of brackets for at least 20 months, and the treated incisor had had endodontic intervention at least 1 year before the orthodontic treatment began.

Pre- and posttreatment periapical radiographs, obtained from the initial and final records of the orthodontic cases, were measured. All teeth were measured along their greatest length, from the incisal edge to the root apex, to compare the same tooth before and after orthodontic movement. The findings were then subjected to statistical analysis. Eight patients (50%) showed a greater apical root resorption in the endodontically treated tooth compared with its vital homolog; the remaining 8 patients showed more resorption in the vital tooth.

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Conclusion

In this small study, no statistically significant difference was found in apical root resorption in the endodontically treated teeth compared with the group of vital teeth after orthodontic treatment. As such, it appears that endodontically treated teeth are not at a greater risk for root resorption secondary to orthodontic treatment.

Esteves T, Ramos AL, Pereira CM, Hidalgo MM. Orthodontic root resorption of endodontically treated teeth. J Endod *2007;33: 119-122.*

The Penetration of RealSeal into Root-canal Dentinal Tubules

Gutta-percha and sealer have been universally accepted as the "gold standard" root-filling materials, the materials against which others are compared. Sealers are used to attain an impervious seal between the gutta-percha core and root-canal walls. Ideally, these materials should seal the canal laterally and apically, and have good adaptation to the root-canal dentin.

The prevention of reinfection of the dentinal tubules and of the root canal itself is directly related to the ability of root-canal filling materials to penetrate into the dentinal tubules and entomb the bacteria that invade the dentinal tubules. Two recently introduced synthetic root-canal filling materials based on polymers of polyesters, Resilon (Resilon Research LLC, Madison, Conn.) and Epiphany (Pentron Clinical Technologies, LLC, Wallingford, Conn.), have been studied using several different methodologies.

Epiphany sealer forms a bond to both the Resilon core material and to the dentine wall, making the filling resistant to bacterial penetration. However, the mean penetration into the dentinal tubules of Resilon and Epiphany vs conventional sealers has never been evaluated. Patel et al from King's College London, United Kingdom, compared by means of confocal microscopy the penetration depth into dentinal tubules of RealSeal (Sybron-Endo, Orange, Calif.), a polyester polymer product similar to Resilon and Epiphany, with that of Tubliseal, a well-established endodontic zinc oxide-eugenol–based sealer, used in conjunction with laterally condensed gutta-percha.

Twenty intact extracted, single-rooted premolars were used. Following completion of root-canal instrumentation, the teeth were divided into 2 groups using a stratified sampling method ranking teeth according to size. In group 1, 10 teeth were filled with gutta-percha and Tubliseal using cold lateral condensation. In group 2, 10 teeth were filled with RealSeal according to the manufacturer's directions. Both sealers were labeled with Rhodamine B dye. The teeth were sectioned parallel to their long axis, resulting in 20 specimens per group. Confocal microscopy was used to assess the penetration depths of the sealers at 3 sites for each specimen (coronal, middle and apical). The data were then subjected to statistical analysis.

The penetration depth of RealSeal at each site was found to be greater than that of Tubliseal ($p < .05$; Table 1). The mean penetration value for the RealSeal group was 908.8 µm and 139.5 µm for the Tubliseal group. The penetration depths of the 2 sealers were found to be significantly different from each other ($p = .001$).

Conclusion

The results of this study appear to be different from other studies that have used scanning electron microscopy or transmission electron microscopy to assess gaps along the material–dentin interface. The use of confocal microscopy allowed visualization of the sealers within the dentinal tubules without resorting to specimen preparation techniques that may be responsible for producing artifacts. As such,

Table 1. *Penetration depths of the 2 experimental groups*

	Tubliseal			RealSeal		
Location of the observed section	Sample size	Mean penetration (µm)	SD	Sample size	Mean penetration (µm)	SD
Coronal	40	190.88	78.07	40	1114.88	291.19
Middle	40	142.25	79.26	40	914.88	229.70
Apical	40	85.50	62.55	40	696.75	313.55
Combined	120	139.54	84.90	120	908.83	326.65

these results may be more meaningful for assessing the properties of endodontic sealers.

Patel DV, Sherriff M, Ford TRP, et al. The penetration of RealSeal primer and Tubliseal into root canal dentinal tubules: a confocal microscopic study. Int Endod J *2007;40: 67–71.*

Ultrasonics in Endodontics

The concept of using ultrasonics (U/S) in endodontics was first introduced by Richman (*Med Dent J* 1957). However, it was not until Martin (*Oral Surg Oral Med Oral Pathol* 1976) demonstrated the ability of ultrasonically activated K-type files to cut dentin that this application found common use in the preparation of root canals before root filling. Martin and Cunningham (*Endod Dent Traumatol* 1985) coined the term "endosonics," defined as the ultrasonic and synergistic system of root-canal instrumentation and disinfection. Since then, the use of U/S has dramatically increased. Plotino et al from Catholic University of Sacred Heart, Italy, reviewed the literature to describe the uses of U/S in endodontics.

Access refinement, finding calcified canals and removal of attached pulp stones: In conventional access procedures, U/S tips are useful for access refinement, location of MB2 canals in upper molars and accessory canals in other teeth, location of calcified canals and removal of pulp stones. The visual access and superior control that U/S cutting tips provide during access procedures make them a most convenient tool, especially when treating molars. When

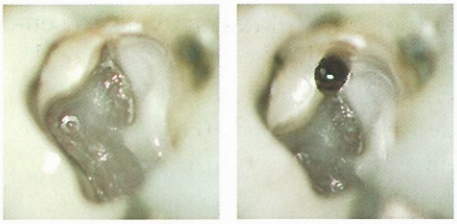

Figure 1. (Left) Photograph of molar access showing the differences in color between the floor (darker) and walls (lighter). (Right) Molar access after U/S removal of secondary dentin that was "hiding" MB1 and MB2. (Photographs courtesy of Dr. Gilberto Debelian.)

locating the MB2 canals in upper molars, U/S is an excellent means for the removal of secondary dentin on the mesial wall (Figure 1).

Removal of intracanal obstructions: U/S energy has proven effective as an adjunct in the removal of silver points, fractured instruments and cemented posts in cases that require endodontic retreatment. The position of the fragment in the root canal or the tooth involved does not restrict the U/S device.

Management of a tooth with a broken instrument requires an orthograde or a surgical approach. The creation of staging platforms to facilitate file removal is best accomplished with the use of modified LightSpeed files instead of Gates Glidden drills. The inability to visualize the instrument has contributed to a lack of success in removing fractured instruments. Teeth restored with intraradicular posts that require retreatment present a challenge because of the inherent difficulties of removing posts without weakening, perforating or fracturing the remaining root structure. U/S has provided clinicians with a useful adjunct to facilitate post removal with minimal loss of tooth structure and root damage. U/S energy is transferred through the post and breaks down the cement until the post loosens. This method of post removal minimizes loss of tooth structure and decreases the risk of tooth damage.

Increased action of irrigating solutions: The effectiveness of root-canal irrigation relies on both the mechanical flushing action and the chemical ability of irrigants to dissolve and disinfect tissue. The flushing action from syringe irrigation is relatively weak and dependent not only on the anatomy (taper) of the root canal but also on the depth of placement and the diameter of the needle. An increase in volume does not significantly improve flushing action and efficacy in removing debris in deep apical areas. Acoustic streaming has been shown to produce sufficient shear forces to dislodge debris in instrumented canals. When files are activated with U/S energy in a passive manner, acoustic streaming is sufficient to produce significantly cleaner canals compared with hand-filing alone.

U/S can also improve disinfection of root canals because the infected necrotic tissue that is subjected to the "energized" irrigant is disrupted. Thirty seconds to 1 minute of U/S activation seems to be sufficient to produce clean canals. Shorter passive irrigation time makes it easier to maintain the file in the center of the canal, thus preventing it from touching the canal walls.

Conclusion

U/S offers many applications and advantages in clinical endodontics. Improved visualization combined with a more conservative approach when selectively removing tooth structure, particularly in difficult situations in which a specific angulation or tip

design permits access to restricted work areas, offers opportunities that are not possible with conventional handpieces and burs. As a result, access refinement, location of calcified canals and removal of separated instruments or posts have generated more predictable results. In addition, enhanced action of irrigation solutions has resulted from the use of U/S. Therefore, integration of new technologies such as U/S, leading to improved techniques and use of materials, has changed the way endodontics is being practiced today.

Plotino G, Pameijer CH, Grande NM, Somma F. Ultrasonics in endodontics: a review of the literature. J Endod *2007;33: 81-95.*

Effect of Smear Layer on Sealing Ability of Canal Obturation

Although the smear layer was first identified 30 years ago, its effect during canal treatment has been debated. Some authors have suggested that keeping the smear layer may block the dentinal tubules and limit bacterial or toxin penetration by altering the dentinal permeability. A more contemporary opinion, however, is that the smear layer must be completely removed from the surface of the canal wall because

- It harbors bacteria;
- It can inhibit effective disinfection by preventing sodium hypochlorite, calcium hydroxide and other intracanal medicaments from penetrating into the dentinal tubules; and
- It can act as a barrier between the obturating materials and the canal wall, and thus interfere with the formation of an appropriate seal.

Shahravan et al from Kerman School of Dentistry, Iran, conducted a systematic review of the literature to determine whether in vitro smear layer removal reduces leakage of extracted human teeth obturated with gutta-percha and different sealers. A comprehensive search using PubMed was initiated to identify studies on the subject published in English from January 1975 to January 2005. Twenty-six articles were selected for the systematic review. If >1 comparison was performed in an article, the data were split into separate records resulting in a total of 65 comparisons.

Thirty-five studies (53.8%) showed no significant difference between removing or keeping the smear layer during canal preparation of extracted human teeth; 27 (41.5%) showed a significant difference in favor of removing the smear layer; and 3 (4.7%) showed a significant difference in favor of keeping the smear layer. The comparison of these percentages with subcategories for main factors such as type and site of leakage test, type of obturation and sealer used, and the year of publication revealed similar patterns ($p > .05$); however, studies with a large number of samples showed stronger evidence in favor of removing the smear layer ($p < .046$).

Because the studies differed in methodology used to measure the amount of leakage, the authors grouped them into 5 categories, and each group was analyzed separately.

1 Dye leakage test studies: The combined effect of these 39 studies showed that removing the smear layer decreased dye leakage ($p = .021$).

2 Fluid filtration test studies: Four of 7 studies showed a significant difference in favor of removing the smear layer.

3 Electrochemical test studies: Six of 7 studies favored removing the smear layer.

4 Bacterial leakage test studies: Two of 6 studies showed a significant difference in favor of smear layer removal; none suggested keeping it.

5 Volumetric dye leakage: The single study showed a significant difference in favor of smear layer removal.

Conclusion

Despite the variable conditions of these in vitro leakage studies, the results demonstrated that smear layer removal improves the fluid-tight seal of the root-canal system. Therefore, the use of irrigants (e.g., EDTA) to remove the smear layer is indicated prior to root-canal obturation.

Shahravan A, Haghdoost A-A, Adl A, et al. Effect of smear layer on sealing ability of canal obturation: a systematic review and meta-analysis. J Endod *2007;33:96-105.*

In the next issue:

- Review of the C-shaped root-canal anatomy
- Regenerative endodontics
- A chlorhexidine-based antimicrobial protocol

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