Evaluation for Cracks Associated with Ultrasonic Root-End Preparation of Gutta-Percha Filled Canals

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Many clinicians use ultrasonics for root-end preparations. The purpose of this study was to evaluate resected root-end surfaces of bilaterally matched human teeth for cracks before and after ultrasonic root-end preparation. Twenty matched pairs of extracted single rooted teeth were divided into two experimental groups. In group 1, root-end resection was performed on uninstrumented teeth. In group 2, root-end resection was performed after the canals were instrumented and filled with gutta-percha. All teeth in both groups received root-end preparations using ultrasonic instrumentation at low power. Two examiners evaluated the root-ends after root-end resection and again after root-end preparation using zoom magnification of 20x to 63x. The number, types, and location of cracks were mapped. There were no significant differences when gutta-percha filled roots were compared to uninstrumented roots with regard to the number or type of cracks after root-end resection or root-end preparation. In addition, there were no significant differences in the number or type of cracks following root resection and ultrasonic root-end preparation when compared to teeth with root resection alone.

The use of ultrasonics in endodontics was first introduced by Richman in 1957 (1) who used a modified ultrasonic scaler for root canal debridement and apicoectomy. Martin (2) and Cunningham et al. (3) advocated the use of ultrasonics for canal instrumentation. In addition, ultrasonics have been used for irrigation, retrieving canal debridement and apicoectomy. Martin (2) and Cunningham et al. (3) advocated the use of ultrasonics for canal instrumentation. Martin (2) and Cunningham et al. (3) advocated the use of ultrasonics for canal instrumentation.
percha filled roots with uninstrumented roots. The purpose of this study was to evaluate the use of ultrasonics for apical root-end preparation in gutta-percha filled roots versus uninstrumented canal systems and to examine the root-ends for cracks.

MATERIALS AND METHODS

Forty bilaterally matched single-rooted human teeth with single canals and relatively straight roots were used in this study. The teeth were extracted for periodontal or prosthodontic reasons and were stored in 0.9% saline with 0.2% sodium azide to inhibit microbial growth. Buccal-lingual and mesio-distal radiographs were taken to evaluate the number of canals and canal curvature.

All teeth were initially examined for the presence of root surface cracks using 20× magnification (Nikon SMZ-2T, Melville, NY) with a fiberoptic light source for illumination (Quality Aspirators, Duncanville, TX). Each root was wrapped in wet gauze during inspection. Matched teeth were randomly placed in one of two groups. In group 1, teeth were uninstrumented. In group 2, standard access openings were made. Crown-down, step-back instrumentation with 2.5% sodium hypochlorite (Master X, Portland, OR) was selected that provided an apical stop at least 1/2 inch from the root surface. The roots were kept moist and the observation time never exceeded 2 minutes. The presence, location, and number of cracks were mapped for each tooth, and the cracks were classified as intra-dentin cracks, canal cracks, or complete cracks (16). Any teeth scored differently by the two observers were jointly reevaluated until a consensus was reached.

All teeth then received a root-end preparation using the Excellence in Endodontics (EIE) ultrasonic unit with ultrasonic retroprep tips (EIE, San Diego, CA). The EIE unit was set on the lowest power setting and a feather-like back and forth motion was used with the tip enveloped in water spray. The unobturated canals were first scored with the Carr explorer (EIE, San Diego, CA) to create a small groove in which to place the retrotip. The CT-5 tip was used first to reach a depth of 3 mm. The CT-1 tip was then used to flatten the floor and complete the preparation. The CT-1 and CT-5 tips were used to prepare 17 pairs of teeth. Three pairs of mandibular incisors were prepared with Slim-Jim retroprep tips (EIE, San Diego, CA). These tips are recommended for teeth with thin roots or those with a concavity that encroaches on a canal leaving a thin wall of dentin. Preparation was done with the roots held in moist saline-soaked gauze. The preparation time was noted for each tooth, and they were returned to their vials containing methylene blue dye solution. One operator (KLB) performed the instrumentation, obturation, root resection, and root-end preparations.

After at least 48 h in the methylene blue dye solution, the root-ends were again independently examined using the same criteria as before by the same evaluators (16).

The data were statistically analyzed using ANOVA for differences in the numbers and types of cracks observed following root-end resection and root-end preparation in obturated and unobturated canals. All variables were evaluated for statistical significance level of \( p = 0.05 \).

RESULTS

There were no statistically significant differences between any of the groups evaluated.
Following resection of the forty roots, ten cracks were observed on six root-ends (Table 1). There was an even distribution of cracks present in gutta-percha filled or unfilled canals after root resection. Five cracks were associated with two filled teeth, and five cracks were associated with four unfilled teeth. Eight of ten cracks seen were intra-dentin cracks. The other two cracks were incomplete canal cracks (2 unfilled roots), both of which were removed by the subsequent root-end preparation.

Following root-end preparation, there were 13 cracks present on eight of the forty root-ends (Table 2). Seven cracks were found in four filled teeth, and six were found in four unfilled teeth. There were five new cracks after root-end preparation. All of these were incomplete canal cracks. Two of the cracks occurred in two filled roots, and three of the new cracks were found in two unfilled roots.

No change was seen in the intra-dentin cracks following root-end preparation. There were no complete cracks seen in any of the specimens.

The time for root-end preparation ranged from 3 to 5 min using the Slim-Jim tips compared to 25 to 90 s when using the CT-5 and CT-1 tips.

### DISCUSSION

Bilaterally matched pairs of teeth were used in an attempt to minimize differences in age and root dimensions from unmatched teeth. The evaluators did not notice any difference in the ability to detect cracks in either the unfilled or filled canals.

Dessication of dentin may lead to cracking and therefore the roots were kept moist at all times to minimize any tendency for this to occur. In addition, the fiberoptic light source was held at a distance of at least 1/2 inch from the root to minimize any heat that could contribute to cracking of the root surface (15).

It is possible to crack roots during obturation. Depending on the tooth being obturated, the force necessary to cause vertical root fracture can vary (18, 19). Holcomb et al. (18) reported that a load of 3.3 pounds can vertically fracture mandibular incisors. In this study, an obturation force of 1.5 to 2.0 pounds was used to minimize the possibility of vertical fracture.

Previous studies have noted the presence of dentinal cracks after the use of ultrasonics for root-end preparation (15, 16). This study unlike the study by Layton et al. (16) found no statistical increase in cracks after ultrasonic root-end preparation even though one of the groups (group 1: uninstrumented canals, low power ultrasonic root end preparation) was identical. Layton et al. (16) found canal cracks in 10 of 30 teeth (30%) after root-end preparation of uninstrumented teeth at low power. This was significantly greater than the number of teeth with canal cracks after root resection alone. In this study, 3 new cracks were detected in only 2 of 20 teeth (10%) after root-end preparation of uninstrumented teeth. This study used the identical EIE unit set at the same low power as Layton et al. (16). Variations in the studies that may have contributed to a difference in number of cracks include EIE retroprep tips from a different batch, the samples of matched teeth came from diverse populations, and different clinicians doing the root-end preparations. This finding seems to highlight the technical sensitivity of the procedure.

The Slim-Jim tips were used with the ultrasonic unit to create the root-end preparations in three pairs of mandibular incisors. These retroprep tips have a smaller diameter than the CT-1 and CT-5 tips. It is reasonable to assume that the possibility of producing a root fracture would exist to a greater extent in those teeth with a smaller root-end diameter or thin dentinal walls. Root-end preparation time for uninstrumented canals was greatly increased when the Slim-Jim tips were used.

In general it took less time to prepare gutta-percha filled canals than unfilled canals. The use of ultrasonics for root-end preparation in gutta-percha filled canal systems offers the clinician the tactile sensation of “tracking” the canal as the gutta-percha is softened and removed by ultrasonic vibration of the retrotip. The gutta-percha seemed to soften easily when using the CT-5 and CT-1 tips. The Slim-Jim tips were much slower than the other retroprep tips and did not seem to remove the gutta-percha as easily as the CT-5 and CT-1 tips.

Two canal cracks were eliminated by root-end preparations. The cracks were seen on the root-ends of two unfilled canals following root resection. Crack elimination occurred when the incomplete canal cracks were removed as part of the root-end preparation.

Ultrasonic energy used to create root-end preparations in root-ends during surgical endodontics has raised the question of whether this can produce dentinal cracks. This study evaluated single-rooted teeth for the presence of cracks before and after resection and again following ultrasonic root-end preparations in both gutta-percha filled and unfilled canals. It was found that within the parameters of this study, there were no statistically significant differences between the number of cracks in the uninstrumented or obturated canal systems.

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**References**

A Word for the Wise

A very cursory scanning of the scientific literature would reveal that the distinction between "prevalence" and "incidence" is not rigorously observed. Prevalence is of course the number of things affected by a variable at any one time compared to the whole number of such things that could possibly have been affected. Incidence, in contrast, is the number of newly affected things in a specific interval of time compared to the whole number of such things that could possibly be affected.

Prevalence, therefore, is first order, i.e. how many a's per b. Incidence is second order, the rate of change of a's per unit time per b. Chronic diseases would therefore have a high prevalence while acute, virulent, epidemic infections might have a relatively high incidence for a period of time.

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