Periapical Microsurgery: Can Ultrasonic Root-end Preparations Clinically Create or Propagate Dentinal Defects?

Peter Z. Tawil, DMD, MS, FRCD(C), Dip ABE

Abstract

Introduction: This clinical study evaluates the effect of ultrasonic root-end preparations on dentinal defect creation and propagation. **Methods:** Eighty-four teeth were treated with periapical microsurgery using a modern microsurgical protocol in a private practice setting. The root apices were resected and inspected for dentinal defects with a surgical operating microscope and a 0.8-mm diameter light-emitting diode microscope diagnostic probe light, both before and after ultrasonic root-end preparations. A 3-grade scale (none, partial, and full dentinal defect) was used to assess the status of the roots before and after ultrasonic root-end preparation. **Results:** Of the 84 treated teeth, 3 had a vertical root fracture, leaving a total of 81 teeth for assessment. Fifty-one teeth were intact upon resection and remained intact after root-end preparation. Twenty-six teeth had partial dentinal defects, and 14 (54%) of these propagated into full dentinal defects after root-end preparation. **Conclusions:** This periapical microsurgery study showed that ultrasonic root-end preparations are safe to use on intact roots. Preexisting dentinal defects can be propagated by ultrasonic root-end preparations. Through the use of light-emitting diodes, dentinal defects can be detected, special root-end management can be implemented, and more predictable outcomes may be achieved. *(J Endod 2016;■:1–4)*

Key Words

Dentinal defect, endodontic microsurgery, fracture, root-end preparation, ultrasonics

From the Department of Endodontics, UNC School of Dentistry, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

Address requests for reprints to Dr Peter Z. Tawil, Department of Endodontics, UNC School of Dentistry, 1150 First Dental Building, CB #7450, Chapel Hill, NC 27599-7450. E-mail address: pzt@unc.edu

0099-2399/$ - see front matter

http://dx.doi.org/10.1016/j.joen.2016.07.016

Significance

Periradicular microsurgery is an important treatment option in modern endodontics. Dentinal defects have been shown to negatively affect treatment outcomes in periapical microsurgeries. This study investigates the effect of ultrasonic root-end preparation on the creation and propagation of dentinal defects in a clinical periapical microsurgery model.

Periradicular surgery is an important treatment option in modern endodontic practices (1). Current surgical, endodontic protocols using ultrasonics for root-end preparations in conjunction with contemporary root-end filling materials have shown excellent outcomes (2–5). The endodontic literature has suggested that dentinal defects (also referred to as microcracks or craze lines) on the root canal walls can appear after root canal procedures (6–10). Dentinal defects have been shown to negatively affect treatment outcomes in a periapical microsurgery model (3). It is speculated that radicular dentinal defects may propagate during normal function and result in potential pathways for leakage or root fractures (11, 12).

Several *ex vivo* study designs have shown conflicting results regarding the presence of dentinal cracks after ultrasonic root-end preparation (13–18). All previous *ex vivo* studies have limitations. Extraction forces, along with storage procedures, can have a significant impact on the dentinal integrity of the teeth in question (19, 20). Transferring obtained knowledge based on studies that trend toward overestimating the presence of dentinal defects may not be prudent for the practicing clinician (20). The effect of ultrasonic root-end preparation on the creation and propagation of dentinal defects has never been investigated in a clinical periapical microsurgery model. Therefore, the purpose of this study was to clinically evaluate the effect of ultrasonic root-end preparation on the creation and propagation of dentinal defects.

Materials and Methods

Case Selection

The study subjects were patients in need of periapical microsurgery in an endodontic private practice setting. Each was enrolled consecutively between 2009 and 2010. Patients were informed in detail about the surgical procedure and were instructed about postoperative care, follow-up examinations, and available alternative treatment options. Informed, written, signed consent was acquired from all participants according to the Declaration of Helsinki, and exempt status for the study was approved by the Institutional Review Board Office of Human Research Ethics.

Radiographs of all teeth were exposed (Gendex GX 770; Gendex Dental Systems, Lake Zurich, IL) using a digital sensor (Visualix eHD, Gendex Dental Systems, Lake Zurich, IL) and paralleling devices (Dentsply Rinn, Elgin, IL). A straight periapical radiograph was taken along with a second 20° distal angled view. All root-filled cases diagnosed with symptomatic or asymptomatic apical periodontitis as defined by the American Association of Endodontists Consensus Conference Recommended Diagnostic Terminology (21) were included. Teeth with severe periodontal mobility (class II or greater), furcation involvement, localized probing defects greater than 5 mm, and any form of perforations were excluded from the study.

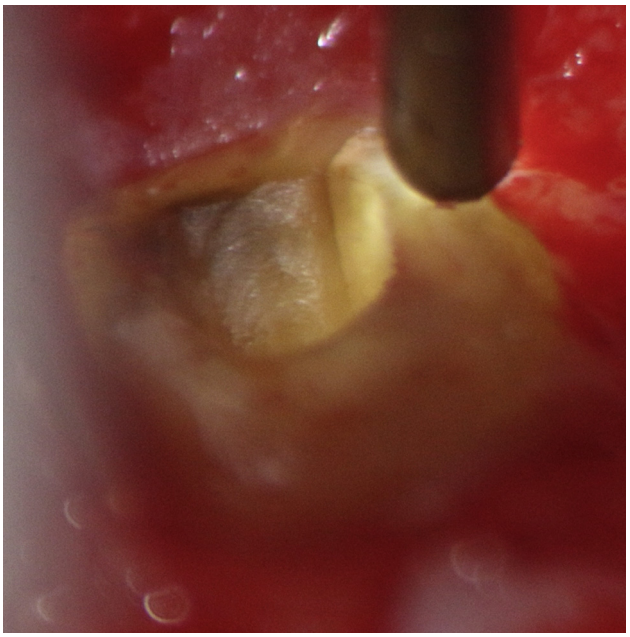

Figure 1. Transillumination of the root tip using a 0.8-mm-diameter LED microscope diagnostic probe light.

Surgical Phase

All the experimental, microsurgical procedures in this study were performed using direct vision principles through a surgical operating microscope (Global G6 Microscope; Global Surgical Corporation, St Louis, MO) (3, 22, 23).

After achieving anesthesia, a full-thickness periosteal flap was reflected, and a bony window was prepared. Granulation tissue, when present, was carefully curetted from the periapical region of each root. Racellet epinephrine pellets (Pascal Co, Bellevue, WA) were applied with pressure in the bony crypt for 5 minutes to obtain hemostasis (24). Three millimeters of the root ends were resected as perpendicular as practical to the long axis of the root (25). After resection, the root tips were smoothed and polished with a carbide Endo Z bur (Brasseler USA, Savannah, GA). Finally, an application of methylene blue stain confirmed the completed root resection indicated by the 360° presence of periodontal ligament surrounding the root. The initial baseline inspection (before the root-end preparation) was performed at this stage with direct vision through the surgical operating microscope and an HD Micro Surgical Mirror (JEDMED, St Louis, MO). Transillumination of the root tip was performed to help with the examination process using a 0.8-mm head diameter light-emitting diode (LED) microscope diagnostic probe light (Q-optics Quality Aspirators, Duncanville, TX). Root-end preparations of 3-mm depth were then prepared using ProUltra diamond-coated surgical ultrasonic tips (Dentsply Maillefer, Johnson City, TN) powered by a Satelec P5 ultrasonic unit (Acteon, Mount Laurel, NJ) according to the manufacturer's instructions. All ultrasonic tips were used with a featherlike back-and-forth movement to reach the length and circumferentially clean the root-end anatomy. Ultrasonic tips were discarded after 9 roots or when the diamond coating was lost. The root-end cavities were rinsed, dried with a Stropko irrigator (SybronEndo Corporation, Orange, CA), and prepared for the final inspection with direct vision through the surgical operating microscope and the HD Micro Surgical Mirror. Transillumination of the root tip was redone in a similar fashion using the 0.8-mm head diameter LED microscope diagnostic probe light (Q-optics Quality Aspirators) (Fig. 1).

To avoid confusing definitions such as microfractures, microcracks, incomplete cracks, and craze lines, 2 distinct categories were defined by Shemesh et al (7). *Intact* was defined as root dentin on the resected root end devoid of any lines or cracks either on the external surface of the root or within the internal root canal wall. This "intact" group served as the control group. *Dentinal defects* were defined as all lines that appeared to disrupt the integrity of the dentin on the root-end surface that extended either from the external root surface onto the resected dentin surface or from within the root canal lumen onto the resected root surface (7). Defects were classified as partial or complete (Fig. 2). None of the dentin defects as defined in this study exhibited staining from methylene blue or resulted in a tactile catch when an explorer tine was passed across the defect. After the inspection was completed and documented, Gray MTA (Dentsply Maillefer, Johnson City, TN) root-end fillings were placed. The wound area was debrided and irrigated, the reflected soft tissues were repositioned, and primary wound closure was accomplished with interrupted 5-0 Chromic Gut Sutures (Hu-Friedy, Chicago, IL). The patients returned 5 to 7 days postoperatively for checkups and suture removal.

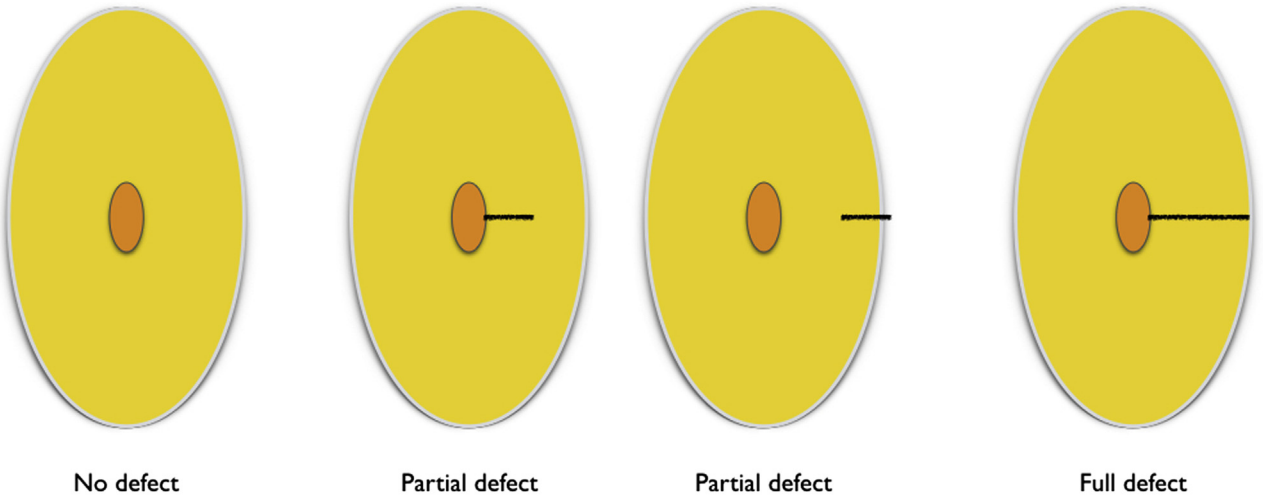

Figure 2. Classification of defects.