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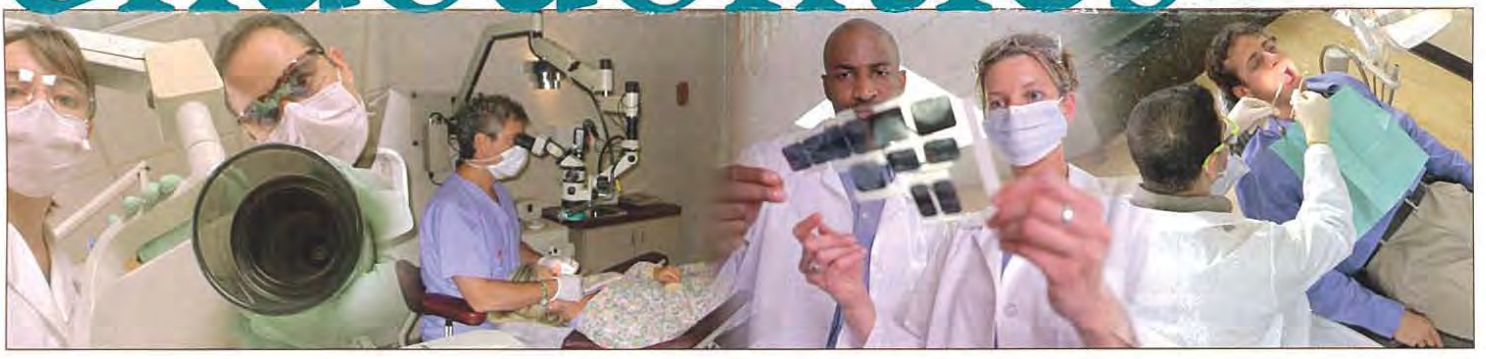

An Evaluation of Cracked Teeth with Reversible Pulpitis

The purpose of this investigation by Krell from the University of Iowa and Rivera from the University of North Carolina at Chapel Hill was to report on the clinical outcomes of cracked teeth diagnosed with reversible pulpitis (RP). During a 6-year period, 8175 patients referred for evaluation and treatment had medical and dental histories, radiographs, pulpal and periapical diagnosis, periodontal probings, direct identification of crack(s) with transillumination and biting responses on various cusps recorded.

Treatment was planned according to the pulpal and periapical diagnosis, except for cases of RP, which were treatment-planned for crowns only, regardless of periapical diagnosis. All patients were recalled at 1 year, unless root-canal treatment was needed before the anniversary.

Of the 8175 patients seen during the 6-year study period, 796 were diagnosed with cracked teeth (9.7%). The largest incidence was with mandibular second molars (30%), followed by mandibular first molars (29%) and maxillary first molars (21%).

Among the cases of RP, 32% were mandibular first molars, 25% were maxillary first molars and 23% were mandibular second molars. Of the 127 patients specifically diagnosed with RP, 27 converted to irreversible pulpitis ($n = 21$) in 58 days or to necrotic pulp ($n = 6$) in 149 days.

All teeth had initial interproximal probings <3 mm in the space associated with the crack. Of the 27 teeth requiring root-canal treatment, only 5 had increased interproximal probings associated with the fractured marginal ridge. The greatest increase in probing depth was 2 mm, for 2 of the 5 teeth.

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Among the 27 cases requiring root-canal treatment,

- 15 had the crack on the distal marginal ridge;
- 4 had the crack on the mesial marginal ridge; and
- 8 had both marginal ridges involved.

None of the teeth had fractures extending into the floor of the chamber or rendering them nonrestorable. Of the original remaining 100 cases of RP, none required root-canal treatment.

Conclusion

The authors found that if a crack is identified early enough in patients with RP and a crown is placed, root-canal treatment will be needed about 20% of the time within a 6-month period. In only a very small percentage of cases will there be progression of interproximal periodontal defects associated with the crack.

Krell KV, Rivera EM. A six year evaluation of cracked teeth diagnosed with reversible pulpitis: treatment and prognosis. J Endod *2007;33:1405-1407.*

Endodontic Treatment of Teeth with Periapical Lesions

The goal of endodontic treatment of teeth with apical periodontitis is complete elimination of bacteria within the root-canal system. Previous studies showed that while instrumentation and irrigation of the root-canal system substantially reduce the number of microorganisms, they rarely lead to total eradication of the microorganisms.

Antibacterial dressings such as calcium hydroxide ($CA[OH]_2$) are widely used to combat microbiota, though inclusion of $CA(OH)_2$ in a treatment strategy has disadvantages. It does not kill all of the intracanal bacteria, and it needs ≥2 visits to be optimally potent. Effectiveness of a clinical strategy must take into account other factors including total costs, patient comfort and effort put into the treatment.

It is beneficial to search for a 1-visit treatment regimen as biologically effective as a $CA(OH)_2$-based 2-visit procedure. The search for an effective 1-visit procedure has used 2 approaches: the exclusion of an antibacterial intracanal dressing and the inclusion of a short-time dressing.

After a review of the literature, Sathorn et al (*Int Endod J*, 2005) included 3 studies in their final meta-analysis. Each study used the first approach for the 1-visit treatment, and the meta-analysis could not show any statistically significant difference in the healing rate to the 2-visit alternative. However, conclusions must be made with care because the studies are few, the sample size is small (only 146 cases total) and the methods of $CA(OH)_2$ placement in 2 of the studies have been questioned.

Kvist et al (*J Endod*, 2004) compared the microbiologic outcome of a 1-visit treatment regimen, including a 10-minute intra-appointment dressing with 5% iodine-potassium-iodide, with a standard $CA(OH)_2$ 2-visit procedure. In the postmedication microbial samples, residual microorganisms were recovered from 29% of the 1-visit treated teeth and in 36% of the 2-visit treated teeth. No statistically significant difference between the groups was found.

The present investigation by Molander et al from the Public Dental Health Service, Sweden, aimed to record the 2-year clinical and radiographic outcome of the material from Kvist et al and to study the significance of the microbiologic sampling results on the outcome of treatment. A randomization procedure allocated 53 teeth to 1-visit treatment and 48 teeth to 2-visit treatment.

At the end of the study period, 32 teeth (65%) in the 1-visit treatment group and 30 teeth (75%) in the 2-visit treatment group were classified as healed (Table 1). Although the 2-visit treatment group had a 10% higher success rate, statistical analysis did not show any significant difference between the groups ($p = .75$). However, 80% of teeth that were obturated after a negative microbiologic sample were classified as healed. Teeth obturated after positive samples healed in 44%.

Table 1. *Distribution of teeth according to outcome classification in the experimental groups**

Outcome	1 visit	2 visits	Total
Healed	32	30	62
Uncertain healing	13	5	18
Not healed	4	5	9
Total	49	40	89

**Mantel-Haenszels χ^2 test was used to test trends in the contingency table.*

Conclusion

The authors showed that similar healing results might be obtained through 1- and 2-visit antimicrobial treatment. Their most significant finding was the clear association of periapical bone healing in teeth that are root-filled after effective disinfection (negative culture).

Molander A, Warfvinge J, Reit C, Kvist T. Clinical and radiographic evaluation of one- and two-visit endodontic treatment of asymptomatic necrotic teeth with apical periodontitis: a randomized clinical trial. J Endod *2007;33:1145-1148.*

Persistence of Bacterial DNA After Cell Death

While all bacterial species in the oral cavity can enter the root canal, only a restricted group can establish a viable infection. This is because the root-canal system selects for only a limited assortment of the oral flora.

While the use of advanced anaerobic culturing methods has characterized the polymicrobial nature of the infected root canal, more diverse endodontic microflora have been described by sophisticated molecular methods. Through use of polymerase chain reaction (PCR) techniques, several culture-difficult species have been reported as more prevalent in root-canal samples than previously thought.

However, because PCR-based techniques cannot distinguish between DNA from viable and dead cells, it is unclear whether the detected organisms represent the living endodontic flora or a record of organisms that have entered the root canal but not survived. Nonsurviving species presumably disintegrate, but DNA fragments might be detected and amplified by PCR techniques. How long amplifiable DNA might persist is of considerable relevance for the validity of PCR-based methods.

This 1-year experimental in vitro study by Young at al from the University of Melbourne, Australia, tested the hypothesis that PCR-detectable DNA from dead bacteria might persist after cell death and investigated the efficiency of sodium hypochlorite (NaOCl) as a decontamination agent. Using heat-killed *Enterococcus faecalis*, the persistence of DNA encoding the 16S rRNA gene was monitored by PCR. After 60-second incubation at room temperature, NaOCl was inactivated by sodium thiosulfate. One microliter of solution was then used as PCR template.

Experiments were repeated with DNA extracted from heat-killed cells 1 month after inactivation. An additional positive control was included in NaOCl experiments to exclude PCR inhibition by thiosulfate-inactivated NaOCl. In this group, NaOCl was inactivated by sodium thiosulfate before being added to DNA suspensions.

Treatment with 1% NaOCl for 60 seconds destroyed amplifiable DNA. Dead-cell DNA was more susceptible to NaOCl degradation, presumably, as a result of its more advanced state of decay.

Although this finding is consistent with other reports, previous studies did not control for inhibition of PCR by thiosulfate-inactivated NaOCl or were unable to distinguish NaOCl-based DNA destruction from inhibition of PCR by thiosulfate-inactivated NaOCl. Inactivation of NaOCl by sodium thiosulfate produces sodium salts such as sodium chloride, which inhibit DNA polymerase at elevated concentrations, and these results demonstrate concentration-dependent salt-induced inhibition of the PCR reaction.

Conclusion

The authors found that while DNA can persist and be detected by PCR for ≥1 year after the death of a cell, NaOCl efficiently destroys DNA. They also highlighted an overlooked problem of inhibition of the PCR reaction by thiosulfate-inactivated NaOCl. This establishes the authenticity of PCR-based isolates as active participants in the endodontic flora.

Young G, Turner S, Davies JK, et al. Bacterial DNA persists for extended periods after cell death. J Endod *2007;33:1417-1420.*

Identifying Root-canal Systems With Cone-beam Computed Tomography

Compared with conventional radiography, digital radiography offers the benefits of less radiation exposure, faster image acquisition, no requirement for chemicals and a number of image processing tools such as magnification. Two types of currently available digital radiography systems are solid-state sensors with either a charge-coupled device (CCD) or complementary metal oxide semiconductor (CMOS) chip and photostimulable

Table 2. *Average number of root-canal systems (RCSs) identified with the 3 radiographic methods*

Tooth type	Average no. of RCSs identified with CCD	Average no. of RCSs identified with PSP	Average no. of RCSs identified with CBCT
Mandibular incisor	1.0	1.3	1.5
Mandibular first premolar	1.0	1.1	1.2
Maxillary first molar	3.1	3.0	3.6

phosphor plate (PSP) technology. CCD-based digital detectors include x-ray or light-sensitive elements that, when stimulated by x-rays, generate an electrical charge proportional to the intensity of the x-ray beam that reached them.

Advantages include faster image acquisition, digital image processing, lower radiation exposure and more effective image archiving. Disadvantages include cost, bulkiness and a relatively small active area.

CMOS-based digital detectors acquire the radiographic image in a similar fashion. A disadvantage of CMOS-based digital detectors is a smaller active area. No differences have been found between CMOS and CCD technology in diagnostic efficacy.

PSP technology uses a reusable detector that captures the radiographic image on an emulsion (storage phosphor) as a latent image initially. With proper stimulation, the energy stored on the emulsion is emitted and captured as a charge.

Advantages of this system include a thinner detector for better patient comfort, lower cost and the ability to be reused by simply exposing to white light, which erases a previous image. Durability stands as the main disadvantage of PSP detectors. However, Ang et al (*Oral Surg Oral Med Oral Pathol Oral Radiol Endod*, 2006) reported that PSP detectors demonstrate similar diagnostic quality to CCD/CMOS detectors.

Still another technique is cone-beam computed tomography (CBCT). This uses a cone-shaped beam and multiple exposures around an object to reveal the object's internal architecture. Thus, the clinician can view morphologic features, as well as pathology, from different 3-dimensional (3-D) perspectives.

A distinct advantage of CBCT is that it allows for 3-D reconstruction of root-canal systems. Three-D information, along with tactile feedback during instrumentation, gives the clinician a more thorough understanding of the true morphology of root-canal systems.

This investigation by Matherne et al from the University of Missouri-Kansas City compared the diagnostic efficacy of contemporary digital imaging modalities (CCD, PSP) with that of CBCT. Seventy-two extracted teeth were exposed to CCD (Gendex, Des Plaines, Ill.), PSP (Gendex) and CBCT(IS I-CAT Imaging Sciences International, Inc., Hatfield, Pa.) radiography. Specimens included 24 maxillary molars, 24 mandibular premolars and 24 mandibular incisors. Tooth-type selections were based on the greater possibility of multiple root-canal systems.

Three board-certified endodontists evaluated CCD and PSP images to determine the number of root-canal systems. CBCT images established "ground truth" for the comparisons and were evaluated by a board-certified oral and maxillofacial radiologist who also determined the number of root-canal systems. The average number of root-canal systems identified with CCD and PSP images compared with CBCT are listed in Table 2.

Conclusion

The authors of this study found that evaluators of either CCD or PSP methods failed to identify ≥1 root-canal system in approximately 4 of 10 teeth. They also found that evaluation of CBCT images always resulted in a greater number of root-canal systems identified than evaluations of PSP or CCD images.

Matherne RP, Angelopoulos C, Kulild JC, Tira D. Use of cone-beam computed tomography to identify root canal systems in vitro. J Endod *2008;34:87-89.*

In the next issue:

- Retreatment outcomes in endodontics
- Anesthetic efficacy of a repeated intraosseous injection
- Interaction between sodium hypochlorite and chlorhexidine

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