PULP FICTION

A Quarterly Newletter

By Westside Endodonics

FALL 2015

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Greetings!

Wow…what a summer! Whew! I think I am officially done with the heat and on to cooler weather. Well, we are off to our biennial European Endodontic conference in Barcelona… well deserved trip for the staff. We will be back on the September 20th and ready to take on the last quarter. Looks like the grapes will ripen early this year and winemaking will be right around the corner as well! Strap on your seatbelts people…this year is flying by! The holidays will be here before you know it. Grab your pumpkin spice lattes (they're back!) and enjoy the Fall edition of Pulp Fiction!

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Pulpal Response to Acute Dental Injury

Pulpal reactions after acute dental injury have puzzled many clinicians. Besides potential injury to the periodontium and surrounding bone, there can be disruption/rupture of the neurovascular supply to the pulp, leading to pulp tissue infarct and coagulation necrosis. If the tooth is otherwise intact (i.e., without caries, restorations or periodontal disease), the immunologic systems can aid in pulpal healing. Final outcome can be sterile necrosis, infection-related necrosis or revascularization/regeneration/repair of the traumatized pulp.

The extent of pulpal involvement is determined by the type and severity of injury. A traumatic injury in immature teeth can lead to pulp necrosis (PN) followed by arrested root maturation, leaving the root thin and susceptible to fracture and tooth loss. Andreasen from King's College London, United Kingdom, and Kahler from the University of Queensland, Australia, reviewed the existing literature to demystify pulpal response to trauma as it relates to blood supply and bacterial invasion and to foster a better understanding of dental trauma and its appropriate treatment.

The researchers employed multivariate analysis to determine the prognosis for PN after luxation injuries. Archive material from the University Hospital in Copenhagen, Denmark, provided the basis for the prediction of PN, pulp canal obliteration (PCO) and pulp survival without radiographic change after luxation injuries. A PubMed search for relevant articles employed the keywords luxation, avulsion, root frac ture, crown fracture, dental trauma, multivariate analysis and Kaplan-Meier statistics.

The risk of PN increased with the extent of injury (risk factors in order from smallest to greatest: concussion, subluxation, extrusion, lateral luxation, intrusion). Teeth with completed root formation had a greater risk of PN than did teeth with incomplete root formation.

Regarding secondary PN risk after PCO, pooled Scandinavian data of traumatized incisors with PCO were gathered for up to 20 years after injury. Of those teeth, only 1% per year developed PN, irrespective of later trauma, dental caries, orthodontic treatment or restorative procedures.

Conclusion

With its neurovascular supply and immunologic defenses, dental pulp is an integral part of the human organ system. Compromise of the neurovascular supply following acute dental injury can lead to altered function of the pulp, ingress of bacteria and pulpal death. If we can use correct diagnostic methods to determine the true status of the dental pulp following trauma, a more conservative approach to treatment may be achieved.

Andreasen FM, Kahler B. Pulpal response after acute dental injury in the permanent dentition: clinical implications—a review. J Endod 2015;41:299-308.

Bioceramic Retrofilling Material in Endodontic Microsurgery

The success rate of modern endodontic surgery using the operating microscope and microsurgical techniques has been reported to be as high as 94%, compared with a 60% success rate for traditional root-end surgery. Root-end filling materials have advanced over the years, with the ideal material sealing the contents of the root canal system within the canal and preventing egress of any bacteria, bacterial by-products or toxic material into the surrounding periradicular tissues. The material should be nonresorbable, biocompatible and dimensionally stable over time. It should be capable of inducing regeneration of the periodontal ligament complex, specifically cementum formation, over the root-end filling itself.

Bioceramic-based materials, composed of calcium silicate and calcium phosphate, have recently been introduced to endodontic practice because of their advantageous physical and biological properties. A bioceramic-based material (EndoSequence BC Root Repair [ES-BCRR]; Brasseler USA; Savannah, GA) can be used for root-end filling as well as for root perforation repair.
Despite encouraging evidence from in vitro and animal studies, patient-based studies on the clinical performance of ES-BCRR are lacking. The purpose of this retrospective study by Shinbori et al from Baylor College of Dentistry, Texas, was to determine the clinical and radiographic outcome of root-end surgery when ES-BCRR was used as the root-end filling material and to identify any factors that may have affected healing.

A search of records for all patients treated at a private endodontic practice from 2009 through 2013 found 94 individuals with 113 treated teeth who met the study's inclusion criteria:

1. a tooth that had surgical root canal treatment with ES-BCRR used as the retrofilling material
2. adequate existing root canal treatment
3. American Society of Anesthesiologists physical status of I or II
4. diagnostic-quality radiographs documenting pretreatment, posttreatment and follow-up
5. documented 1-year minimum recall

All procedures were performed by a single endodontist using a surgical operating microscope. ES-BCRR was used as the root-end filling material in all cases. Recall visits included a routine examination and periapical radiographs. The clinical data, which covered all signs and/or symptoms or loss of function, tenderness to percussion or palpation, subjective discomfort, mobility, sinus tract or periodontal pocket formation, and postoperative complications, were included in the recall record form.

The postoperative radiographs were evaluated independently by 2 board-certified endodontic faculty members from Baylor College of Dentistry.

The radiographic healing classifications were as follows:

- Complete healing: the reestablishment of the lamina dura
- Incomplete healing: some reduction of the former radiolucency
- Unsatisfactory healing: either no reduction or an increase of the original radiolucency

The outcome was categorized into healed, healing and nonhealing on the basis of clinical and radiographic findings. The healed and healing cases were pooled and considered successful; nonhealing cases were considered failures.

Follow-up time ranged from 12 to 33 months (mean, 14.5 months). Of the 113 cases recalled, 104 were deemed successful, for an overall success rate of 92%. Of the 9 teeth deemed failures, 5 were radiographic failures, and 4 were clinically symptomatic teeth that had pain to percussion or palpation, or still had a sinus tract present.

Conclusion
The use of ES-BCRR as a root-end filling material resulted in a healing rate of 92% at a minimum 1-year recall examination. Evidence suggests that ES-BCRR is a suitable root-end filling material. Future studies with a larger sample size are needed to confirm the findings and to identify potential factors that may impact the treatment outcome.

Shinbori N, Grama AM, Patel Y, et al. Clinical outcome of endodontic microsurgery that uses EndoSequence BC Root Repair material as the root-end filling material. J Endod 2015;41:607-612.

The Role of Biofilm in Endodontics

Jhajharia et al from Melaka Manipal Medical College, Malaysia, reviewed the literature pertaining to biofilm and its role in endodontic disease. The etiology of pulpal and periradicular disease has been attributed to bacteria from the oral flora. These microorganisms have the capacity to create biofilms on hard or soft tissues of the mouth. Dental plaque is perhaps the most prevalent oral biofilm.

Biofilms are comprised of microorganisms embedded within a matrix of extracellular polymeric substances (EPS)—primarily carbohydrates, proteins and lipids. For biofilms to form, microorganisms must first adhere to a solid surface, forming a monolayer, which then attracts the secondary bacterial colonizers. These microcolonies produce the EPS, which create the biofilm's structure. Portions of the microcolonies may detach from the biofilm community. During the process of detachment, the biofilm transfers cells, polymers and precipitates to the fluid surrounding it.

Bacteria in a biofilm are able to survive difficult growth and environmental conditions. This unique capacity of bacteria in a biofilm state is due to the following features:

- Residing bacteria are protected from environmental threats mainly due to the EPS.
- Microorganisms within a biofilm can be 100 times to 1000 times more resistant to antibacterial agents than their planktonic counterparts.
- Nutrients are trapped within the biofilm structure, with metabolic cooperation between the different microorganisms.
- Microorganisms can communicate via signaling molecules (quorum sensing) and can exchange genetic materials, possibly leading to the development of resistance to antibiotics.

Endodontic disease is a biofilm-centered infection. The biofilms may be classified by their location:

- Intracanal biofilms are attached to the root canal dentin in infected teeth.

- Extraradicular biofilms, found on the surface of the root, are associated with *Fusobacterium nucleatum, Porphyromonas gingivalis* and *Tannerella forsythensis* (Figure 1).

- Periapical biofilms are associated with *Actinomyces* species and *Propionibacterium propionicum* that may produce sulfur granules (Figure 2).

- Foreign body–centered biofilms are attached to an artificial biomaterial surface (e.g., extruded gutta-percha).

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Mechanical instrumentation allows for the gross removal of necrotic tissue and biofilm from the main root canals. However, not all root canal surfaces are fully cleansed by instrumentation alone; tissue and biofilm are left behind. Sodium hypochlorite is the most widely used and effective solution for root canal irrigation. Its tissue-dissolving and antibacterial properties reduce the microbial load, disrupting the biofilm and killing the bacteria within it.

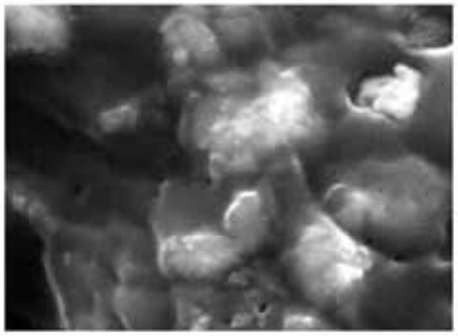

Figure 1. Scanning electron micrograph of smooth surface biofilm covering root apex after apicoectomy. Microorganisms (white) are observed within the biofilm. (*Image courtesy of Dr. Fred Barnett.*)

Figure 2. Sulfur granule (4-mm diameter) taken from periapical lesion during apicoectomy. (*Image courtesy of Dr. Gilberto J. Debelian.*)

Conclusion

Endodontic disease is caused by the growth of microorganisms that form biofilm. It is important to understand the role of biofilm in endodontic treatment to better control its pathogenic potential and determine the best approach for disinfection.

Jhajharia K, Parolia A, Shetty KV, Mehta LK. Biofilm in endodontics: a review. J Int Soc Prev Communit Dent 2015;5:1-12.

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