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Endodontics NewsletterTM

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Inside this issue

- Predicting Intraoperative Endodontic Pain
- Regenerating Pulp with Autologous Platelet Concentrates
- Maxillary First Molars: The Morphology of The Palatal Roots

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Association Between Endodontic Therapy and Cardiovascular Disease

Some 20 years ago it was suggested that untreated periodontal disease could be an unrecognized risk factor for coronary heart disease and stroke. The central hypothesis behind this theory was that periodontal disease, which is mainly characterized by chronic gram-negative infections, caused a biological burden of endotoxins and inflammatory cytokines that could initiate and/or exacerbate atherogenesis and thromboembolic events, leading to cardiovascular diseases and/or stroke. The debate is still ongoing, but most researchers agree that there may be a correlation between untreated periodontal disease and cardiovascular disease and/or stroke.

Pulpal diseases, especially in the advanced stages, when the pulp has become infected and all or portions of the tissue have become necrotic, share many common factors with advanced periodontal disease. There may be a

large number of gram-negative flora in the canal space, and the periapical area may have chronic inflammatory infiltrate.

Few studies have attempted to investigate a possible association between endodontic diseases and cardiovascular events. Some studies have found a modest association, but no study has established a direct cause-and-effect relationship. This might be because successful endodontic therapy renders the pulpal space free of bacteria and heals the periapical area. While Lin et al from National Yang-Ming University, Taiwan, hypothesized that endodontic therapy might prevent cardiovascular events by eliminating the possible causes, uncompleted root canal therapy could result in reinfected canals, leaving the patient with an increased risk for a cardiovascular event.

The authors investigated the possible connection between endodontic and cardiovascular disease by evaluating the information in a nationwide population-based database. In Taiwan, a compulsory national health insurance program covers nearly 99% of the 23.5 million residents. All treatments rendered are recorded in the Longitudinal Health Insurance Database. The study

included all patients without a history of cardiovascular diagnosis prior to 2005 who underwent ≥ 1 root canal treatments between 2001 and 2011. They also identified a subset of patients who began root canal treatment but who, according to the database, never completed endodontic therapy. The authors then compared those patients with patients who completed treatment.

In the initial sample of 283,590 patients with ≥ 1 root canal treatment, 3626 patients were hospitalized for cardiovascular disease between 2005 and 2011. The study found that, compared with patients who completed endodontic therapy, the hospitalization hazard ratio (HR) for patients with 1 or 2 unfinished endodontic therapies was 1.22; for those with ≥ 3 unfinished therapies the HR was 3.61 (Figure 1). These findings indicated that unfinished endodontic therapy could be associated with a higher risk of hospitalization due to cardiovascular diseases.

However, it is important to emphasize that, given the study's limitations, the results should be viewed with great caution. Crucial risk factors such as smoking, body mass index, alcohol consumption, dietary status and family history were not adjusted for, leading to an inability to establish a cause-and-effect relationship. More studies that control for other risk factors are needed before one can conclude that unfinished endodontic therapy leads to cardiovascular events.

Lin P-Y, Chien K-L, Chang H-J, Chi L-Y. Unfinished root canal treatments and the risk of cardiovascular disease. *J Endod* 2015; doi:10.1016/j.joen.2015.08.031.

Predicting Intraoperative Endodontic Pain

Successful pain management during endodontic therapy is essential for the patients' comfort while boosting their confidence in their doctor. Unfortunately, pain is common during endodontic therapy for a variety of reasons, including preoperative inflammation of the pulp and/or surrounding structures, anatomic variations, technical errors of anesthetic administration and, importantly, patient anxiety about the planned endodontic therapy. Knowledge of pain's predictability could be beneficial for the clinician. If anesthesia could be difficult to achieve, then preventive measures could be used to increase the success and comfort the patient.

Kayaoglu et al from Gazi University, Turkey, developed a model for predicting the probability of intraoperative pain using multiple logistic regression analysis. The authors conducted a prospective observational clinical study of 1655 treated teeth in 1435 patients (628 men, 807 women). Pulpal and periapical diagnoses were established prior to treatment. Patients' health was categorized as either not good (if they suffered from allergies, chronic infectious diseases or other systemic conditions) or good. A note was made regarding duration of pain prior to the treatment and whether analgesics taken during the previous 24 hours had relieved the preoperative pain.

All teeth with previously initiated endodontic therapies were excluded from the study as were teeth with periodontic–endodontic lesions. Patients with multiple treatment needs were also excluded. A standard anesthetic protocol was followed: a local infiltration for all maxillary teeth and mandibular incisors; regional anesthesia (inferior alveolar or mental nerve block) for other teeth. If needed, a supplementary buccal and lingual or palatal local infiltration was given followed by intraligamental and intrapulpal anesthesia in the most severe cases. During therapy, patients were asked to rate their pain once the working length was established.

In 22% of the teeth, patients reported moderate-to-severe pain during therapy. After supplementary local infiltration, the moderate-to-severe pain reported dropped to 6% of all cases. Anesthetic failure was

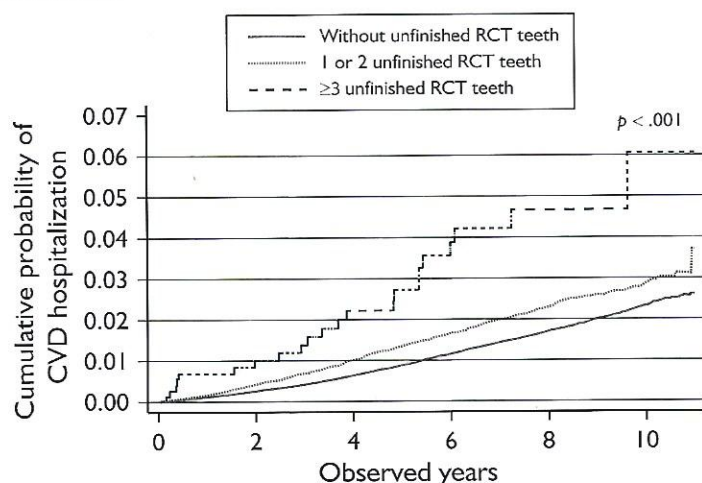


Figure 1. Cumulative hazard probabilities for cardiovascular disease (CVD) hospitalization categorized by the number of unfinished root canal treatments (RCTs) between 2005 and 2011.

more often seen in patients who had taken an analgesic in the previous 24 hours, those with a diagnosis of irreversible pulpitis and those who reported pain in the previous 24 hours. Molar teeth, especially mandibular molars, were also more likely to have intraoperative pain. Interestingly, this model did not find a difference in reported pain between men and women, but older patients were less likely to report intraoperative pain.

Based on these findings, the authors concluded that younger patients with a diagnosis of irreversible pulpitis in a molar are more likely to have intraoperative pain during endodontic therapy. Therefore, the dentist could prophylactically give analgesics to these patients or plan on using nitrous oxide during the procedure. Alternatively, the clinician could attempt to reduce intraoperative pain by increasing the volume of the anesthetic solution, selecting a more potent anesthetic solution or administering supplementary anesthesia prior to initiating therapy.

Kayaoglu G, Gürel M, Sarıcam E, et al. Predictive model of intraoperative pain during endodontic treatment: prospective observational clinical study. *J Endod* 2015;doi:10.1016/j.joen.2015.09.021.

Regenerating Pulp with Autologous Platelet Concentrates

Over the past decade, studies have shown that, under certain conditions, it is possible to stimulate regrowth of tissue into necrotic and infected root canal space. Three primary factors are necessary for tissue regeneration:

- a scaffold
- growth factors
- stem cells

If tissue regeneration is successful, the tooth will regain vitality and, in cases of immature teeth, there is a likelihood that further maturation of the root will occur (Figure 2). Although several approaches have been suggested for revascularization, no single accepted standard protocol exists.

Disinfection may consist of either

- triple antibiotic paste—metronidazole, ciprofloxacin and minocycline

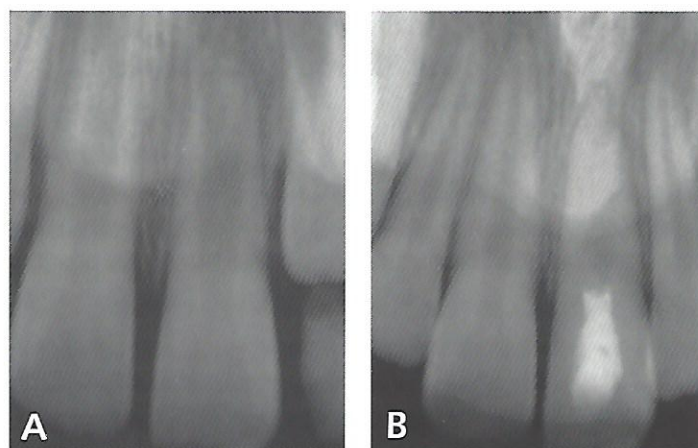


Figure 2. A 7-year-old girl was referred to an endodontic practice because of swelling and facial pain in the upper left central tooth. She had had a history of trauma to the tooth 6 months earlier. (A) At the time of referral, a diagnosis of necrotic pulp with symptomatic apical periodontitis was made. A 3-week regimen of triple antibiotic paste was followed by a blood clot formation in the canal space and placement of an intermediate restorative material followed by composite. (B) At the 4-year follow-up, the pulp was responding normally to an electric pulp tester, the tooth had erupted normally and the color of the crown was normal. The radiograph indicates continuation of root development and a normal periapical area. (Images courtesy of Dr. Asgeir Sigurdsson.)

- double antibiotic paste—metronidazole and ciprofloxacin
- calcium hydroxide only

After disinfection, most clinicians stimulate bleeding into the canal space by agitating the bone and tissue beyond the apex. However, this approach has its drawbacks because it can be difficult to achieve enough bleeding into the canal space and control the coagulation of the clot. Nor can there be certainty that enough of the patient's growth factors exist in the clot to stimulate ingrowth of the progenitor cells.

To counter this approach, the use of autologous platelet concentrates (APCs) to enhance the predictability and success of pulpal revascularization has been suggested. APCs obtained by centrifugation of the patient's blood have been used in oral and maxillofacial surgery as well as in orthopedics, plastic surgery and sports medicine to increase the predictability of hard and soft tissue regeneration after surgery and bone grafting. Centrifugation creates a concentrate of the most active components of the blood, including the growth factors that help promote angiogenesis.

Only a few small in vivo animal studies have been performed to investigate the benefit of using APCs for



endodontic therapy, making it hard to evaluate the usefulness of APC in pulpal revascularization. Del Fabbro et al from the University of Milan, Italy, conducted a systematic review of the literature to combine published studies into meaningful information.

They found 7 articles (covering 6 studies) that fit their inclusion criteria. None of them were human studies; the animals used included beagles, monkeys and ferrets. Evaluation of the results was difficult because only 2 articles were classified as having a low risk of bias; the other 5 presented a high risk of bias in the outcomes measured in the systematic review.

The researchers found that using APC stimulated tissue repair but did not lead to true regeneration of pulp tissue. Without any additional benefits, using APC only adds to the cost and complexity of the procedure. Revascularization of a necrotic immature tooth should still be considered, given the obvious benefits if revascularization is successful. However, the patients and/or their caregivers should be warned that the predictability of success still remains elusive, and if tissue growth is not achieved, the more traditional apexification procedures should be performed.

Del Fabbro M, Lolato A, Bucchi C, et al. Autologous platelet concentrates for pulp and dentin regeneration: a literature review of animal studies. J Endod 2016;doi:10.1016/j.joen.2015.10.012.

Maxillary First Molars: The Morphology of the Palatal Roots

Knowledge of the root morphology is essential for those providing endodontic therapy, aiding the clinician in finding canals and helping to successfully clean and shape the canals. Over the years, the morphology of the mesio-facial root of upper molars has been well documented regarding both the presence of a second mesio-buccal canal (almost always there) and its relationship with the main mesio-buccal canal. Few studies have been done on the palatal roots of the same teeth.

Marceliano-Alves et al from Estácio de Sá University, Brazil, used micro-computed tomography to assess the anatomy of the palatal canals in 169 maxillary first molars with fully formed apices and patent root

canals. After the roots were scanned, the researchers qualitatively analyzed them for the number of canals in the palatal root, classification of the main canal, presence and location of lateral canals, degree of curvature of the main canal, position of the anatomic foramen relative to the apex, and presence or absence of the apical constriction. The roots were then quantitatively analyzed for the volume and surface area of the palatal canal, minor and major diameter of the canal, and thickness of the dentin 1 and 2 mm from the apex and 1 mm from the foramen. Cross sections of the canals were classified as either round, oval or long oval.

All palatal roots in this study were classified as Vertucci type I with a single main canal from the pulp chamber to the apical foramen. The cross section was oval in 61% of the canals; lateral canals were found in 25% of the roots, while the main foramen coincided with the root apex in 5% of the cases. Most were classified as having moderate or severe curvature; only 8% of the canals were classified as straight. The palatal canal had an average volume of 6.91 mm³ and a surface area of 55.31 mm² with a rod-like shape in all cases. Apical constriction was identified in only 38% of the roots. This study highlighted the anatomic complexity of maxillary first molar palatal canals. Care must be taken to confirm the working length prior to instrumenting so that obturation material stays within the canal space.

Marceliano-Alves M, Alves FRF, Mendes Dde M, Provenzano JC. Micro-computed tomography analysis of the root canal morphology of palatal roots of maxillary first molars. J Endod 2016;doi:10.1016/j.joen.2015.10.016.

In the next issue

Summer 2016

- Cone-beam computed tomography's ability to detect vertical root fractures
- New pulp-capping agents and discoloration of crowns

Our next report will focus on these issues and studies that discuss them, as well as other articles exploring topics of vital interest to you as a practitioner.

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