

Pathobiology of Vital and Non-Vital Canals in Endodontics

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Abstract

The ultimate goal of root canal treatment is to disinfect the canal completely in all cases under any circumstance so that the microbes are completely eliminated from the dentinal tubules, ramifications and extra canals which are not accessible to instrumentation. The residual bacteria in the canal can cause post treatment disease and eventually resulting in the failure of the endodontic treatment.

Keywords: Diagnosis; Non-Vital Root Canals; Vital Root Canals.

Introduction

What is necrotic pulp?

Pulp necrosis is a clinical diagnostic category indicating death of the dental pulp, necessitating root canal treatment. The pulp is non-responsive to pulp testing and is asymptomatic. Pulp necrosis by itself does not cause apical periodontitis (pain to percussion or radiographic evidence of osseous breakdown) unless the canal is infected. Some teeth may be non-responsive to pulp testing because of calcification, recent history of trauma, or simply the tooth is just not responding. As stated previously, this is why all testing must be of a comparative nature (e.g. patient may not respond to thermal testing on any teeth)[1].

The conditions associated with necrotic pulp are:

1. The possible result of an untreated pulpitis or trauma.
2. Total necrosis usually asymptomatic until the periodontal ligament (PDL) is affected.
3. No response to pulp vitality tests.

4. The crown will darken occasionally with anterior teeth.
5. Possible combination of responses from multirooted teeth.

Recommended Treatment for Necrotic Teeth

The recommended treatment for teeth with necrotic pulp is a pulpectomy. There are two methods for performing a pulpectomy on an emergency visit:

1st technique: The ideal method is to obtain accurate working lengths and instrument the canals to their apical constrictions. However, the demands of our emergency clinics may not allow the practitioner adequate time to determine working lengths and instrument the canals. While the use of electronic apex locators can be an efficient and accurate adjunct, many clinics do not possess them [2,3].

2nd technique: Due to these restrictions, an alternate pulpectomy method is suggested. This method involves canal debridement slightly short of the root length.

In dentin caries, selective bacterial invasion occurs with the progress of caries deeper in dentin bacteria becomes more proteolytic. Also, the substratum of these microbes need to make the infectious process endure is now obtained from the organic part of the dentin and not just from the oral medium. Within the tubules, apart from odontoblastic processes and nerve fibrils there is significant amount of collagen type I and V, especially in the innermost dentinal region which acts as substratum. Proteoglycan, tenascin, fibronectin, serum albumin, alpha 2Hs and transferring may also be found constituting a complex matrix in the form of hydrogel.

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The rate of invasion of bacteria within the tubules is roughly around 1.6microns/day during the initial 3weeks and 14microns/day for the next 4 months. Depth of bacterial penetration was 3.0mm after 210 days. Also, Nagaoka et al, under similar research conditions observed that maximum depth of penetration was 2.1mm for non-vital teeth in 6 months, and in vital teeth, 18.9% of the dentinal tubules evaluated were invaded by bacteria during that 6 months period.

Irrigation for non vital tooth is always started using warm sodium hypochlorite (5.25%) for its antibacterial effect or with chlorhexidine (0.02%) for 30-40 seconds to eliminate the various bacterial types present in the root canals and dentinal because of its antibacterial action.

Infected and non-infected root canals [1,4]

The difficulty of disinfecting the canal increases with the progress of the inflammation and following infection. The degree of success diminishes with increased severity of pulp and periapical pathosis. This emphasizes the significance of prompt diagnosis and treatment in pursuance of a flawless result post treatment. Pulp inflammation should be diagnosed ahead of necrosis, and necrosis should be diagnosed and treated prior to the onset of apical periodontitis.

A healthy pulps instantaneous response is inflammatory in nature, increased blood flow to the pulp aggravating the flow of dentinal fluid outwards, which eliminates the bacteria through hydrostatic pressure. This drains out bacterial toxins and bacteria away from the pulp (Maita et al 1991; Nagaoka et al. 1995).

In the case of a weak and damaged pulp, bacteria are able to perfuse through the tubules. Out of the roughly around 800 various bacterial taxa that can thrive in the oral cavity (Paster et al 2006), few manage to diffuse through the dentinal tubules.

Aseptic technique: An approach that is essentially not contaminated by any bacteria, fungi, virus, or other microorganisms is called aseptic technique.

Antiseptic technique: The use of a compound that perishes (bactericidal) or inhibits (bacteriostatic) the growth and development of bacteria or other microorganisms is called antiseptic technique.

Effect of instrumentation in primary vs. retreatment [3,4,5]

Elimination of infection in root-filled teeth with apical periodontitis by chemo-mechanical preparation is even more difficult than in primary cases.

This suggestion is based on the following facts:

- (i) *E. faecalis* is relatively tolerant to NaOCl when compared with other bacteria.
- (ii) dentine and other canal components weaken the effect of the antibacterial solutions.
- (iii) Remnants of old root-filling materials may obstruct the penetration of disinfecting agents to parts of the root canal system.

Extraradicular infection

1. Bacteria present in periapical lesions
2. Biofilms on surfaces of root
3. Microbiota of recalcitrant lesions

The evolution of periradicular lesions forms a blockage for preventing progression of microbes further into periapical region. Bone tissue is resorbed and subsequently replaced by a granulomatous tissue that contains defense elements, like cells (phagocytes) and molecules (antibodies and complement molecules) (Siqueira 1997). A thick wall composed of polymorphonuclear leucocytes, or less frequently an epithelial plug, is usually present at the apical foramen, blocking the egress of microorganisms into the periradicular tissues (Nair 1987). Very few endodonto-pathogens can pass through such biologic blockades. Nevertheless, microbial products can seep through these protective biologic fencing and can generate periradicular pathosis.

Rate of success of endodontic treatment of vital and non vital pulps

Success rate for endodontic treatment of teeth with vital pulp was greater when compared to teeth with a non-vital pulp. This result may be coupled to the fact that the pulp space of non-vital teeth often is infected. The contributing factor to success was confining the obturation material to the working length as confirmed with apex locator and radiographically. Also, adequate enlargement of the canal and periapical status was also significant. Success was more in cases where there was no periapical lesion [2,3,6,7].

The goals of endodontic treatment are complete elimination of the microbes, their byproducts, and pulpal remnants from within the infected root canal system. This process will promote periradicular healing. When a patient has signs and symptoms related to severe infection, the canals should be thoroughly disinfected and the access cavity must be sealed to avoid coronal leakage.

Sodium hypochlorite and urea peroxide mixture: The collagenic anti-aggregation effect due to the proteolytic and lipidic affinity of urea peroxide.

Immediately after access cavity preparation we should not insert the file to locate the orifices instead use copious amount of irrigant for following reasons:

- a) The spread of bacterial toxins in all of the endodontic system and in the periapical area and this will affect a successful prognosis for the endodontic treatment due to the post-operative "flare-up" that may occur.
- b) The breakdown and the accumulation of the pulp tissue with its collagen may create from the beginning an organic plug within the root canal.

Conclusion

The treatment of vital and non-vital canals is different. The degree of infection in necrotic root canals is more and even more difficult to eliminate completely because of the presence of microbes deep within the dentinal tubules. Appropriate irrigant and intracanal medicament should be used to thoroughly disinfect the canals to ensure complete success of the treatment.

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References

1. Rationale and efficacy of root canal medicaments and root filling materials with emphasis on treatment outcome, Larz s. W. Spångberg & Markus Haapasalo, *Endodontic Topics* 2002; 2: 35–58.
2. Invasion Of Dentinal Tubules By Oral Bacteria, R.M. Love, H.F. Jenkinson, 2002; 13(2):171-183 *Crit Rev Oral Biol Med*.
3. Eradication of endodontic infection by instrumentation and irrigation solutions, Markus haapasalo, Unni endal, Homan zandi & Jeffrey m. coil, *Endodontic Topics* 2005; 10: 77–102.
4. Aetiology of root canal treatment failure: why well-treated teeth can fail, J. F. Siqueira Jr, *International Endodontic Journal*, 1–10, 2001.
5. The evolving new understanding of endodontic infections, Leif tronstad & Pia Titterud Sunde, *Endodontic Topics* 2003; 6: 57–77.
6. Persistent, recurrent, and acquired infection of the root canal system post-treatment, Markus Haapasalo, Trude Udnæs, & Unni Endal, *Endodontic Topics* 2003; 6: 29–56.
7. Microorganisms in root canal infections: a review Vytaute Peciuliene, Rasmute Maneliene, Estera Balcikonyte, Saulius Drukteinis, Vygandas Rutkunas, *Stomatologija, Baltic Dental and Maxillofacial Journal*, 2008; 10: 4-9.
8. Success rate of endodontic treatment of teeth with vital and nonvital pulps. A meta-analysis, Koko Kojima, DDS,a Kyoko Inamoto, DDS,a Kumiko Nagamatsu, DDS,a Akiko Hara, DDS, Kazuhiko Nakata, DDS, PhD,b Ichizo Morita, DDS, PhD,c Haruo Nakagaki, DDS, PhD,d and, Hiroshi Nakamura, DDS, PhD,e Nagoya, Japan, *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2004; 97: 95-9.
9. Isolation And Identification Of Root Canal Bacteria From Symptomatic Nonvital Teeth With Periapical Pathosis Anuradha Rani, Ashok Chopra, *Endodontology*, Volume: 18 Issue 1 June 2006; 18(1): 1-48.