

REVIEW ARTICLE

INTRACANAL MEDICAMENTS - REVISITED

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ABSTRACT

The main objective of endodontic treatment of pulpless necrotic teeth is removal of maximum possible bacteria and their byproducts from the root canal system and then finally completely seal the disinfected root canals in three dimensions. In treatment of infected root canals the number of appointments needed to achieve disinfection of the root canal system is controversial. The concept of interappointment dressing in multiple visit endodontic therapy is well documented in endodontic literature. Many materials have been suggested for use as interappointment dressing. Research on endodontic microbiology and biofilms have demystified few earlier concepts and opened up new ideas with regard to interappointment dressing material and the method of application. This literature review is an attempt to rationalise the use of interappointment dressing based on scientific evidence.

Key Words: Intracanal medicaments, Interappointment dressing, Calcium hydroxide, Antibiotic Pastes.

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INTRODUCTION

The pathogenesis of pulpal and periapical disease is attributed to bacteria. The microenvironment of the root canal is a complex one which provides excellent condition for microbial growth⁽¹⁾. The objective of endodontic therapy in a necrotic teeth is to eliminate the maximum number of bacteria from the root canal systems and finally seal the disinfected root canal in all dimensions so that microorganism if any left out in the canal system would not survive. The success rate of endodontic therapy is significantly increased when the infectious bacteria is effectively eradicated prior to root canal filling^(2,3,4)

Proper disinfection of the root canal system is achieved by proper asepsis during procedure, chemico mechanical preparation of the root canal, use of irrigating solutions and judicious use of intracanal interappointment medicaments⁽⁵⁾

INTRACANAL MEDICAMENTS- WHY AND WHEN

Medicament is an effective antimicrobial agent placed inside the root canal between treatment appointments in order to destroy remaining microorganisms and prevent the growth of any new arrivals⁽⁶⁾

Many materials have been suggested to be used as an intracanal medicament in multiple visit endodontic therapy. The status of the tooth at the time of start of treatment, the diagnosis and the scientific knowledge about the most likely organism involved with the pathology being treated plays a key role in selection of the medicament for intracanal usage. It is also imperative to have knowledge about the microbiology of endodontic infection such as the mechanism of growth of the microorganism and its virulence including biofilm. Chong et al have suggested bacteriological sampling if a tooth does not respond to treatment, to help in the choice of intracanal medicament.

Biomechanical preparation of the root canal along with copious irrigation during the process remarkably reduces the number of bacteria from the root canal system. This reduction is however temporary since the remaining microorganisms proliferate

quickly between appointments^(7,8) the maintenance and enhancement of root canal cleansing is achieved by the use of intracanal medicament between appointments. Predictable disinfection of the root canal system is only achieved by placement of interappointment intracanal medicaments^(9,10). In contemporary endodontic practice cleaning and shaping of the root canal is accorded greater importance and the role of usage of intracanal medicaments are being neglected for the worst. Mechanical instrumentation of the root canal leaves significant portions of the root canal walls untouched⁽¹¹⁾. So there is less likely chance of complete elimination of bacteria from the root canal system only by instrumentation.⁽¹²⁾

ROLE OF INTRACANAL MEDICAMENTS

Bacteria particularly anaerobes is implicated in periapical lesions.⁽¹³⁾ For an intracanal medicament to be effective in teeth with periapical infection the used substance should be germicidal in action. In an infected root canal the intracanal medicament is used for

- 1) Eliminate any residual bacteria remaining in the root canal system after biomechanical preparation of the root canal.
- 2) To make the root canal contents inert and neutralize the bacterial toxins and tissue remnants.
- 3) Reduce the periapical inflammation.
- 4) Aids in drying weeping canals.
- 5) Temporarily fills the canal and prevents leakage and percolation into the canal from the coronal aspect.

SINGLE VISIT ENDODONTICS

Performing endodontic therapy in a single visit is not now contraindicated and numerous studies have shown that the clinical outcomes between single- and multiple- visit endodontics are similar. Selection of cases for such protocol is the key. The general consensus is that in case of vital pulp the treatment should be ideally completed in one visit provided factors such as time, operator skill and anatomical considerations are favourable. Single visit endodontics of necrotic pulp with periradicular

lesion is one of the main controversial issues in endodontics⁽¹⁴⁾. One of the main advantages of single visit endodontics is the elimination of risk of recontamination of the cleansed root canal in between appointments. In such a protocol intracanal interappointment dressings are not used.

INTRACANAL DRESSINGS

The concept of open dressing in infected endodontic teeth is a common practice among a section of clinicians. This does not carry any scientific basis. The only indication when the access of a teeth being left open is when there is continued drainage from the canal after instrumentation and copious irrigation. Leaving a canal open allows for ingress of bacteria from the oral cavity along with salivary contamination. This provides a niche medium for the bacterial growth within the canal. The colonised bacteria undergo complex interactions and forms colonies which are totally different from the microbiota which inhabits the root canal at the start of endodontic therapy. This change in characteristics makes the microbiota less vulnerable to elimination by conventional means leading to higher chance of resistant or persistent root canal and periapical infection. Providing an open dressing is not within the acceptable limits of contemporary endodontic practice with very few exceptions.

When multiple visits endodontic therapy is planned or needed based on the clinical scenario intracanal dressings is recommended. Biocompatibility and stability are essential properties for intracanal medicaments. The more modern meaning of intracanal dressing is for a blockade against coronal leakage from the gap between filling materials and cavity wall.

Commonly used medicaments include calcium hydroxide, antibiotic preparations / combinations, Phenolic compounds, Non phenolic biocides and iodine compounds. Each has advantages and disadvantages, no single preparation has been found to be completely predictable or effective in all cases.

CALCIUM HYDROXIDE

Calcium hydroxide has been determined as suitable for use as an intracanal medicament as it is stable for

long periods, harmless to the body, and bactericidal in a limited area. It also induces hard tissue formation and is effective for stopping inflammatory exudates.

The mode of action of calcium hydroxide can be categorised into two prominent effects. Antibacterial effect by virtue of its high pH (approximately 12.5 to 12.8). The released hydroxyl ion produces a lethal effect on bacterial cells by damage to the bacterial cytoplasmic membrane; protein denaturation; and damage to the DNA. It also affects bacterial endotoxins. Its effect on microbial biofilm is controversial. Another notable and favourable effect of calcium hydroxide as an intracanal medicament is its biological activity. Calcium hydroxide activates tissue enzymes and thereby mineralization.

The dissociation coefficient of Ca(OH)_2 is 0.17 which allows a slow, controlled release of both calcium and hydroxyl ions. This low solubility proves to be a good clinical characteristic as it remains insoluble in tissue fluids for a longer period of time when in direct contact with vital tissues.

There is limitation in its effectiveness to disinfect the entire root canal system owing to its inherent physiochemical properties. It is also reported that calcium hydroxide alone is not effective against all the species of bacteria present within the root canal system. The efficacy of calcium hydroxide paste as an intracanal medicament is mainly depended on the vehicle used. Research have suggested association of calcium hydroxide with other medicaments to enhance its activity to obtain pronounced effect against certain pathogenic bacteria often observed in persistent infection. One of the recommended combinations is to mix calcium hydroxide with chlorhexidine gluconate so as to have an enhanced antibacterial effect against *Enterococcus faecalis*.⁽¹⁵⁾

ANTIBIOTIC PASTE

Antibiotics play a key adjunct role in bacterial infection control. Systemic administration of antibiotic has the potential risk of adverse effects. Moreover systemic antibiotics are often ineffective in necrotic pulpless teeth and in infected periradicular region⁽¹⁶⁾. Local application of antibiotics has been used in endodontic practice for long and is believed to a

more effective mode for delivery to the area of bacterial colonization within the root canal and periradicular tissues.

Local application of a single antibiotic as well as paste made of combination of antibiotics has been tried in endodontics as intracanal medicaments.

Tetracycline group of antibiotic are bacteriostatic and has been used as intracanal medicament either alone or in combination with corticosteroid to produce an antibacterial, anti inflammatory and antiresorptive effect. It has been suggested for use in teeth associated with traumatic injury to minimise inflammatory root resorption.

Metronidazole a synthetic antimicrobial agent is bactericidal in action. It has exceptional antianaerobic activity and has been tried as an intracanal medicament in paste form. The efficacy of this medicament alone on eradication of persistent bacteria within the root canal is questionable.

A combination of Metronidazole, Ciprofloxacin and Minocycline has been tried as triple antibiotic paste in cases with persistent weeping canal and non healing periradicular lesions⁽¹⁷⁾. Triple antibiotic mixture (TAM) was found to be effective against *E. faecalis* a common organism isolated from persistent root canal and periapical infection⁽¹⁸⁾. Triple antibiotic paste is also recommended and used to disinfect the canal in an immature tooth in revascularisation procedure. One of the draw backs of this triple antibiotic paste is the occurrence of tooth discolouration owing to the presence of minocycline in the mixture⁽¹⁹⁾.

PROPOLIS

Propolis (Bee glue) is a by-product of honeybee and has been in use in traditional medicine for years. It is a natural antimicrobial agent which is found to have a pronounced antibacterial, antifungal and antiviral properties. Few studies have evaluated the effect of propolis on root canal flora particularly *E. faecalis* and has been recommended as an intracanal medicament⁽²⁰⁾. It has been concluded by Maryam et al.⁽²¹⁾ that propolis was more effective than calcium hydroxide after 10 day incubation period within the root canal. Stepanovic et al have observed a syner-

gistic action when propolis is used with antibiotic. More research is needed on this natural antimicrobial for suggesting it as a routine intracanal medicament.

FORMOCRESOL

Until recently, formocresol and its relatives were frequently used as intracanal medicaments, but it was pointed out that such bactericidal chemicals dressed in the canal distributed to the whole body from the root apex and so might induce various harmful effects including allergies. It was also observed that formocresol has potent genotoxic effect⁽²²⁾ and mutagenic potential⁽²³⁾ Formaldehyde the primary component in formocresol, is considered a probable human carcinogen by many researchers and statutory bodies. Present day contemporary endodontic therapy does not indicate this chemical in endodontic practice.

CHLORHEXIDINE GLUCONATE

Chlorhexidine is a positively charged hydrophobic and lipophilic molecule which interacts with phospholipids and lipopolysaccharides on the cell membrane of bacteria and then enters the cell⁽⁵⁾ leading to cell death.

At a higher concentrations of 2%, which is mainly used for endodontic purpose chlorhexidine is bactericidal. At this concentration there will be precipitation of cytoplasmic content of the bacteria cell resulting in cell death. A paste of calcium hydroxide mixed with chlorhexidine⁽²⁴⁾ has been found to very effective against *E. faecalis* and is recommended as an intracanal medicament in retreatment cases in place of calcium hydroxide alone as a medicament.

Chlorhexidine is also an effective antifungal agent and its comparison with sodium hypochlorite in antifungal activity is not studied much.

ENDODONTIC MICROBIOTA AND ENDOTOXINS

The microbial flora of the root canal exists as a biofilm of co aggregated communities in an extracellular matrix. Microbiota of an infected root canal before start of treatment usually consist of a mix of approximately equal proportions of Gram-

positive and Gram-negative species, dominated by obligate anaerobes. On the other hand the microbial flora of root-filled tooth with persistent apical periodontitis is very different with the presence of one or very few species, predominantly Gram-positive micro-organisms with an equal distribution of facultative and obligate anaerobes⁽²⁵⁾. In most of the studies *Enterococcus faecalis* is found in persistent infection of the root canal. Gram negative bacteria play an important role in primary endodontic infections. Endotoxins, a virulence factor of these bacteria leads to initiation and perpetuation of apical periodontitis. The use and selection of the intracanal medicament should keep in mind this complexity of the root canal microflora and the variations that occur with persistent infections. This implies that one medicament may not produce the desirable result in all infected cases.

CONCLUSION

The successful outcome of endodontic therapy mainly depends on elimination of the cause viz bacteria from the root canal system. Total disinfection of the canal is difficult to achieve by mechanical means alone considering the complexity of the root canal system and the microbial interactions that occur in the infected root canal. Usage of intracanal medicament that has a deleterious effect on the bacteria, their endotoxins and biofilm is an important adjunct in contemporary endodontic practice. Intracanal medicaments such as calcium hydroxide are popular but have its own limitations in certain infections. Other medicaments such as chlorhexidine, propolis have been documented to have better antibacterial efficiency. Use of antibiotic paste which has earlier been overlooked may be required in many persistent infection cases to eradicate the microbiota prior to obturation of the root canal.

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