



INTRACANAL MEDICAMENTS - A REVIEW

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Abstract:

One of the neglected phases of endodontic treatment is the eradication of microorganisms and complete removal of minute fragments of organic debris, necrotic tissue, pulp remnants and dentinal shavings from root canal. The cleaning and shaping of root canal reduces the microbial content to a great extent, however the root canal anatomy provides areas in which bacteria can persist and thrive. Therefore, there is a need of use of an intracanal medicament in addition to the irrigants.

Keywords: intracanal medicaments, disinfection, calcium hydroxide, antibiotics, herbal medicaments.

Introduction

Microorganisms are the main causative factor of pulp and periapical diseases. If they invade into root canals, infection, necrosis and apical periodontitis occurs. Therefore, the success of treatment depends upon the ability to remove these microorganisms and prevent reinfection.

There are mainly three phases of endodontic treatment: biomechanical preparation, disinfection and obturation of the root canal. Disinfection of pulp space with intracanal medicaments have been thought an essential step in eliminating the bacteria, however, in modern endodontics, shaping and cleaning may be assumed of greater importance than intracanal medicaments as a means of disinfecting root canals.

However, most of the root canals still harbored bacteria after careful cleaning and shaping and using an antimicrobial irrigating solution. Thus, more intensive treatment of the root canal with an antibacterial substance must still remain an important adjunct in the total elimination of bacteria during endodontic treatment.¹

Different medicaments with different chemical natures are applied to eradicate multiple microorganisms. For disinfecting root canals advanced technology are developed, like, photoactivated disinfection, ultrasonics, endox, ozone, lasers and electrochemically activated water. Long effective intracanal medicaments are applied to inactivate bacterial inflammatory consequences between endodontic appointments.²

Rationale for intracanal medication

The rationale behind intracanal antiseptic medication is to eliminate bacteria from the root canal and prevent

reinfection. Residual bacteria in obturated root canal may be denied access to nutrients and die or they may survive and ultimately proliferate. Although chemo mechanical preparation has an important cleaning effect, it cannot remove all the bacteria from the root which are harbored in dentinal tubules. The remaining bacteria may multiply during the period between appointments often reaching the same level that it was at the start of the previous session in case where the canal is not dressed with a disinfectant between visits.³ Thus the use of effective intracanal medication for disinfection of root canal is required. Medicament with long effect and least irritated to periradicular tissue has to be introduced to infiltrate the dentinal tubule eliminating bacteria when time does not allow to complete the treatment in one visit. As the effect of intracanal medicaments is longer than irrigants, it is generally recommended to fill the root canal between appointments with intracanal medicaments.²

IDEAL REQUIREMENTS OF INTRACANAL MEDICAMENTS

- A. It should be an effective germicide and fungicide
- B. It should be non-irritating.
- C. It should remain stable in solution.
- D. It should have a prolonged antibacterial effect.
- E. It should be active in presence of blood, serum and protein derivatives of tissue.
- F. It should be capable of penetrating the tissue deeply.
- G. It shouldn't interfere with repair of periapical tissues.
- H. It shouldn't strain tooth structure
- I. It should be easily introduced into the root canal.

J. It should be capable of being inactivated or neutralized in culture medium.

K. Prevent coronal microleakage and not diffuse through the temporary restoration.⁴

INDICATIONS OF INTRACANAL MEDICAMENTS

- To dry persistently wet or the so-called weeping canals
- To eliminate any remaining microbes in the pulp space
- To render root canal contents inert
- To neutralize tissue debris
- To act as a barrier against leakage from an inter appointment dressing in symptomatic cases.⁵

Formocresol

Formocresol, which is categorized into the aldehydes, has been used extensively in endodontic therapy since Buckley referred to it as an effective intracanal medicament in 1904.⁶ Formaldehyde is volatile and releases antimicrobial vapors when applied to a cotton pellet for the disinfection of pulp chamber.⁵ Studies have shown that formocresol exhibits cytotoxicity, teratogenicity and tumorigenicity and induce immune reactions.

Chlorhexidine

Chlorhexidine has antimicrobial activity against both Gram-positive and Gram-negative organisms. The antimicrobial effect of chlorhexidine is caused by the cationic molecule binding to negatively charged bacterial cell walls, thereby altering the cell's osmotic equilibrium.⁷ It is bactericidal at higher concentrations and bacteriostatic at lower concentrations. Chlorhexidine gluconate gel is widely used as an intracanal medicament.⁸ Ohara et al.⁹ evaluated the antibacterial effects of six irrigants against anaerobic bacteria and reported that chlorhexidine was the most effective.

The disadvantage is that it does not act as a physical barrier against microbial recolonization and does not have any detoxifying ability against endotoxins. Thus, it stays in the canal for a shorter time. Chlorhexidine both alone and along with calcium hydroxide shows more antibacterial efficacy against *E. faecalis* than calcium hydroxide alone.⁸

Calcium hydroxide

Calcium hydroxide is the most commonly used intracanal medicament since Hermann introduced it to dentistry in 1920. It has been clinically used to obtain microbial control, dissolve organic remnants, heal periapical inflammation, inhibit inflammatory root resorption, stimulate hard tissue formation and serve as a temporary obturating material between appointments. It is highly alkaline with a pH of approximately 12.5.⁸

The antimicrobial activity of calcium hydroxide is dependent on the release of hydroxyl ions in an aqueous environment.

Furthermore, hydroxyl ions are highly oxidant free radicals that show extreme reactivity with several biomolecules which includes damage to the bacterial cytoplasmic membrane, denaturation of proteins, or damage to the DNA.¹⁰

Uses:

1. Prevention of root resorption
2. Repair of iatrogenic perforation
3. Treatment of horizontal root fracture
4. Apexification
5. Apexogenesis
6. Root resorption
7. In weeping canals³

PBSC

Grossman first mentioned about the utilization of polyantibiotic paste as an intracanal medicament in weeping canals or where there was continuous seepage from the pulp space. It consisted of Penicillin, bacitracin, and streptomycin, with caprylate sodium (PBSC). PBSC contained penicillin to target Gram-positive organisms, bacitracin for penicillin-resistant strains, streptomycin for Gram-negative organisms, and caprylate sodium to target yeasts – these components were suspended in a silicone vehicle.⁵ Later on, PBSC was revised as Penicillin, bacitracin, and streptomycin, with nystatin (PBSN) for nystatin as an antifungal agent.¹¹

The usage of PBSC has become obsolete considering the potential for sensitivity due to topical use of antibiotics and deteriorating in popularity of intracanal medicament.²

Ledermix paste

It is a glucocorticoid antibiotic paste developed by Schroeder and Triadon in 1960. It is used to control pain and inflammation. Addition of the antibiotic component to ledermix compensates for a possible corticoid induced reduction in the host immune response. Ledermix paste is a combination of tetracycline antibiotics, demeclocycline, HCL (at a concentration of 3.2%) and a corticosteroid triamcinolone acetoxide (concentration 1%) in a polyethylene glycol base.¹¹ It is a non-setting, water-soluble paste material used as root canal medicament or as a pulp capping agent.⁵

Sulphonamides

The sulfonamides are mainly bacteriostatic agents which interfere with bacterial metabolism and render the micro-organisms more vulnerable to destruction by the defensive mechanism of the body. They are used as medicaments by mixing with sterile distilled water or by placing a moistened

paper points into a fluffed jar containing the powder. It might lead to yellowish tooth discoloration after use. Also, it is ineffective in the presence of pus, protein breakdown products, tissue debris and p-aminobenzoic acid.¹²

Triple antibiotic paste

Root canal infections are polymicrobial consisting of both aerobic and anaerobic bacterial species. Because of the complexity of root canal infections, the use of single antibiotic may not result in effective disinfection of the root canals. A combination of antibiotic may be needed to address the diverse flora encountered.³ The combination consists of metronidazole, ciprofloxacin and minocycline. Triple antibiotic powder, either mixed with normal saline or 2% chlorhexidine, produced the largest zone of inhibition against *E. faecalis*.⁸ The efficacy of triple antibiotic paste for elimination of bacteria was first discussed by Hoshino et al. (1996).

A potential concern of using an intracanal antibiotic paste is that it may cause bacterial resistance. In addition, intracanal use of minocycline can cause tooth discoloration, creating potential cosmetic complications. To overcome this disadvantage, double antibiotic paste eliminating minocycline has been advocated.⁵

Medicated gutta-percha

There are new gutta-percha points in the market that contain Ca(OH)_2 in a 50 - 51% concentration instead zinc oxide, which makes Ca(OH)_2 placement and removal easy.¹³

Photo-activated disinfection (PAD)

This technique utilizes photoactive agent toloum chloride. Because of its antimicrobial effectiveness it is used in endodontic application. The activation of photosensitizer molecule by red laser emitting radiation of wavelength 635nm. The light is directed to the tip of a small flexible optical fibre that is inserted into the root canal. The maximum power setting of 100 mW ensures that the unit does not generate sufficient heat to harm the adjacent tissue. The strong oxidizer generated during the process can act on multiple targets in a microbial cell resulting in membrane damage, enzyme inactivation and genomic and plasmid DNA damage, resulting in instantaneous death. In addition, the light activated killing of bacteria has a wide spectrum of antimicrobial activity with a minimal chance of giving rise to a resistant microbial population making it an ideal disinfectant. Fighting bio-film medicated localized human infection is one of the potential medical application of LAT (light activated therapy).¹³

ENDOX

The endox endodontic system sterilizes the root canal by emitting high frequency electrical impulses. Sterilization

occurs as a result of fulguration and manufacture claims it is able to remove both pulp and bacteria from the entire root canal system. A recent study showed that the unit was not able to eliminate pulp tissue from the root canal system without mechanical cleaning. High frequency electric pulses cannot be recommended as the sole endodontic treatment but the unit may be utilized as a supplement to traditional cleaning and shaping.²

Herbal Intracanal medicaments

Many plants are used as Phytomedicines in dentistry as they possess varying degree of biological and antibacterial effects. In endodontics, these can be used as intracanal medicament to overcome the potential side effects caused by chemical agents:

- **Propolis** is prepared from resin collected by bees from trees of poplars, conifers and flowers of genera clusia. The pharmacologically active constituents in propolis are flavonoids, phenolics and aromatics. Propolis has antimicrobial and anti-inflammatory properties, which can serve as an intracanal irrigant and intracanal medicament.⁸
- **Curcumin** (Turmeric) has been used in traditional medicine for the treatment of numerous diseases. Curcumin, the main yellow bioactive component of turmeric, has antimicrobial, anti-inflammatory and anti-oxidant activities. Curcumin does not affect the micro hardness of root dentin and is a potential intracanal medicament.⁸
- **Aloe vera** contains clear gel surrounded by the green part of leaf. The two active components of aloe vera are aloin and aloe-emodin. Its antibacterial action is due to protein synthesis in the bacterial cells and it is rich in vitamins, minerals, enzymes, sugars, lignin, saponins, salicylic acids and aminoacids. It is effective against *S. pyogenes* and *E. faecalis* due to the presence of anthraquinone which inhibits the formation of these two organisms.¹⁴
- **Green Tea** consists of poly phenols that have antimicrobial, antioxidant, anti-cariogenic, anti-inflammatory properties. Green tea has antibacterial property against *E. faecalis* planktonic cells.⁸
- **Arctium Lappa** plant is known for its therapeutic applications. It possess antibacterial, antifungal, antiplatelet, antioxidant, diuretic, anxiolytic and HIV inhibitory effect. Arctium lappa contains sterols, tannins, sulphur containing polyacetylene, volatile fatty oils & polysaccharides. Studies have concluded that the constituents of Arctium lappa showed a great effect against the most organisms such as *E. faecalis*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Bacillus subtilis* & *Candida albicans* which makes it a potential root canal medicament.¹⁴
- **Lemon Solution** has pH of 2.21 with lower acidity. It is effective in removing the smear layer thereby acting as a

chelating agent. Fresh lemon solution has antibacterial property making it an ideal root canal medicament without any side effects.¹⁴

➤ **Nisin** is a naturally occurring antimicrobial peptide, produced by *Streptococcus lactis* sub species *lactis*. It has antimicrobial activity against a wide range of bacteria and their spores. Studies show that it is effective in elimination of *E faecalis* from root canal.⁸

Conclusion

When the root canal is extensively infected and interappointment time periods are long, there is a merit in using an intracanal medicament as part of controlled sepsis. Intracanal medicaments play a secondary role, and should not be used as an alternative to thorough cleaning and adequate shaping of the root canal. When a tooth does not respond to root canal treatment, bacteriological sampling should be done to determine the bacteria present. This can aid in the choice of intracanal medicament to be used and monitoring of the treatment progress. Every case should be judged on the advantages and disadvantages of using an intracanal medicament. After all, what is removed from the root canal is of greater significance with regard to the success of root canal treatment than what is placed in the root canal system.

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