

Intracanal Medicaments - A Review Of Literature

Research Article

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Abstract

The presence of bacteria in teeth with apical periodontitis is a well established fact. The success of endodontic treatment depends on minimising the microbial load and preventing it from getting recolonised within the canal system. The disinfection protocol depends on the ample usage of irrigants and intracanal medicaments. Intracanal medicaments tend to eliminate bacteria in the inter-appointment phases.

Hence, it is imperative for clinicians to understand the factors that affect the action of an intracanal medicament and factors that help in choosing the right one depending on the case.

The current review was performed to check for various intracanal medicaments available and their effect.

Keywords: Endodontic Therapy; Medicament; Microbial; Natural; Pain.

Introduction

The contribution of bacteria causing infection of the root canal system has been proven over time again and again. The periapical inflammation is initiated and maintained by bacteria and their by-products [1]. Various species including aerobic, facultative anaerobes and anaerobic bacteria are found in the root canals and periapical tissues. Anaerobic bacteria dominate the bacterial flora in root canal infections and several different species are commonly found. Periapical destruction with vital pulp is a rare occurrence [2].

The inflammation and/or infection of the pulpal and/or periapical tissues cannot be left untreated [3]. Based on diagnosis, endodontic therapy or root canal treatment may become the treatment of choice for such an infection. The aim of endodontic therapy is to eliminate bacteria and bacterial by-products and to avert re-infection [4]. Even after following a proper cleaning and

shaping protocol, it is important to understand that not all of the bacterial niches get cleared off. Bacteria may multiply exponentially in roots left with no dressing or filling inter-appointment [5]. Interappointment bacterial growth can be reduced by placing an appropriate intracanal medicament dressing [6]. Studies have indicated the predominance of strict anaerobes and facultative anaerobes in the root canal systems. As pulp becomes necrotic an increase in strict anaerobic Gram-negative and Gram-positive species such as *E. Faecalis* occurs at the expense of facultative anaerobic species [7].

Intracanal medication destroys residual microorganisms, toxins and residual bacteria that are failed from removal via chemomechanical preparation [5]. The aim of chemomechanical preparation is to remove microbes and the byproducts, the complexity of the root canal system makes it difficult to render it completely bacteria-free. Also, studies have reported that the bacteria exist in the form of thick microbial biofilms and invade deep in to den-

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tinal tubules and isthmus [8, 9]. Intracanal medicaments prevent microbial multiplication and recolonisation, kill residual bacteria and prevent reinfection [10].

The bacterial species commonly associated with primary root canal infections belong to the genera *Bacteriodes*, *Fusobacterium*, *Prevotella*, *Porphyromonas*, *Treponema*, *Peptostreptococcus*, *Eubacterium*, *Actinomyces* and *Streptococcus* [11]. *Actinomyces* species is found in approximately 10 to 15% of primary root canal infections. *Actinomyces gerencseriae* and *Actinomyces israeli* are the most prevalent species in periradicular abscess cases. *Streptococcus intermedius*, *Streptococcus constellatus*, *Streptococcus anginosus* form a part of the normal microbiota of oral cavity, gastrointestinal tract and genito-urinary tract are associated with purulent infections. Facultative anaerobes are commonly associated with infected root canals [12].

Previously our team has a rich experience in working on various research projects across multiple disciplines [13-27]. Now the growing trend in this area motivated us to pursue this project. The aim of the current review is to analyse and discuss the intracanal medicaments available and studied around the globe.

Ideal Requirements Of Intracanal Medicaments [28]

An ideal intracanal medicament should be an effective germicide and fungicide and have a prolonged antimicrobial effect. It should be non-irritating to periapical tissues in case of extrusion, remain stable in the form of solution, have low surface tension, not stain tooth structure, stay active in the presence of protein derivatives of tissues, blood and serum, not alter physiological activities of host tissues, not interfere with repair of periapical tissues and induce healing and hard tissue formation. It may contribute to reduce pain, control inflammatory root resorption, eliminate apical exudates and not alter the physiologic activities of the host tissues. Other properties like reasonable shelf life, availability and cost effectiveness also contribute to the selection of a suitable intracanal medicament.

Factors Influencing Antiseptic Action (By Calvin D Torneck)

Amongst the most important features of a root canal antiseptics is its ability to reduce the concentration of microbial flora in the root canal and whenever possible, its complete elimination. The antiseptic action of these drugs can be modified by several factors such as the drug itself, types of microorganisms, physical disposition of the bacteria and metabolic activity of the bacteria.

Drugs itself is the major factor. The antimicrobial effect of some drugs are better, extensive and more rapid than others. Another important feature is the mechanism of action which could be bacteriostatic or bactericidal. Bactericidal drugs are better in the long run. The root canal system inhabits a wide range of bacteria, hence the spectrum of action of these drugs must be wide. Combination of drugs, rotation or changing them is a strategy to have prolonged effect on polymicrobial infections. The concentration of the drug as well as the form in which it is available also extends an effect on the antimicrobial action. The drugs that are available in adequate concentrations and are available for a prolonged pe-

riod are more effective than the ones the short lived ones. Also, the drugs that tend to disintegrate quickly and release the active component of the drug provide a better antimicrobial action.

The type, location, availability of nutrients and ability of species to survive, develop resistance and transmit the drug resistance all influence the efficacy of intracanal medicaments abundantly. It is essential for an intracanal medicament to be able to eliminate persist bacteria, microbial colonies residing deep with in and in inconspicuous areas like lateral canals, isthmus, irregular crevices. Residual necrotic tissue and wet canals contribute to the failure of complete disinfection.

The bacteria existing in the root canal systems are in the form of colonies or biofilms and hence their removal is more difficult than when compared in ideal in-vitro conditions. The antimicrobial agents which interfere with the metabolic activity of the bacteria almost instantly kill them and are more effective than others.

Commonly Used Intracanal Medicaments

Phenol [28]

Phenol is one of the oldest antiseptics introduced by Lord Lister into medicine in 1876. It is derived from coal tar or petroleum, is white in color and crystalline with a specific odour. Phenol has been used for sterilising dentin after cavity preparation, disinfection of root canals and to destroy pulpal remnants. Phenol's use as a disinfectant has been reduced because of its caustic nature, pungent aroma and inferior bacteriostatic action. Parachlorophenol, metacresylacetate and cresol are derived from it. The mechanism of action by which phenol acts as an antimicrobial is by its ability to disrupt and penetrate the cell wall of bacteria and subsequently precipitate protoplasmic protein. In lower concentrations it inactivates essential enzyme systems that cause cell death.

Eugenol [28]

Eugenol is an essential oil but chemically is related to phenolic compounds. In low concentrations, it has anodyne effect. It is a more effective antiseptic and less irritating than phenol and has hemolytic action. It is used as temporary dressings and antiseptic dressings following pulpectomy as it increases the microhardness of dentin and controls neural conduction. It has a wide range of action and is bacteriostatic in nature.

Formaldehyde [6]

It is a 37% solution of formaldehyde gas with a stabilizer like menthol (8-15%) to reduce release of formaldehyde in the form of polymers. It cannot be refrigerated. Formaldehyde can be placed in the pulp chamber or in the cervical third of the root canal space and it is effective in the apical portion when the canal is reasonably clean and dry. Rapid necrosis of pulp tissue has been reported by the use of formaldehyde and hence it is used for fixing of the pulp tissue [29].

Chlorhexidine

It is a cationic bisguanide with low toxicity to periapical tissues and good antimicrobial efficacy against a broad range of micro-

organisms. The active agent stays in contact with the canal wall and dentinal tubules due to low viscosity [30]. CHX adsorbs in to the cell wall of microorganisms and causes leakage of intracellular components. At lower concentrations, it is bacteriostatic causing intracytoplasmic contents to leak out while it is bactericidal at higher concentrations due to precipitation and coagulation of cytoplasm [31]. The combination of CHX and calcium hydroxide inhibits complete growth of *E. faecalis* after 24-48 hours with tapered decline over a week which can be attributed to the high pH of the combination product. CHX is an extremely efficient antimicrobial agent.

Calcium Hydroxide [5, 32]

Hermann introduced calcium hydroxide in 1920 as Calxyl. It has been put to use for managing root fractures, perforations, resorptions, traumatic injuries, etc. It is a white odourless powder with the formula Ca(OH)₂, a high pH of 12 to 12.8 and a molecular weight of 73.08. It induces deposition and mineralisation of hard tissues as the high pH activates the alkaline phosphatase activity. The antimicrobial action is dependent on the release of hydroxyl ions which damage the bacterial cytoplasmic membrane resulting in destruction of phospholipid structure of cell membrane, denatures proteins and adsorbs carbon dioxide disturbing the root canal ecosystem. Three types of vehicles namely aqueous, viscous and oily vehicles are used to deliver calcium hydroxide to root canals. The various aqueous vehicles used are sterile water, distilled water, bidistilled water, sterile saline, anaesthetic solutions, Ringer’s solution, methylcellulose, carboxymethylcellulose. The various viscous vehicles used are glycerine, polyethylene glycol, propylene glycol. The various oily vehicles are olive oil, fatty acids, camphorated parachlorophenol, metacresylacetate, eugenol. The vehicles which prolong the action of calcium hydroxide and have a synergistic effect are chosen as vehicles for delivering this extremely effective medicament.

Antibiotics [33]

Certain selected antibiotics have been reportedly used as a root canal antiseptic. These are active in the presence of tissue fluid, do not stain the tooth and are virtually non-irritant to tissue cells along with being antimicrobial. Triple antibiotic paste (TAP) contains both bactericidal (metronidazole, ciprofloxacin) and bacteriostatic (minocycline) agents to allow for successful resolution of periapical infection [34]. The concern of triple antibiotic paste

is that minocycline may cause tooth discoloration, hence DAP is used [35]. Another antibiotic paste PBSC consisting of penicillin, bacitracin, streptomycin and caprylate has been widely used. Another combination where nystatin has replaced sodium caprylate named as PBSN has also been used.

Ledermix [36]

It is a glucocorticoid antibiotic compound containing triamcinolone acetonide and demeclocycline at concentrations of 1% and 3.21% respectively.

Natural Intracanal Medicaments

Propolis

Propolis has a complex composition. It has active constituents like flavonoids, phenolics and aromatics. Propolis has a very wide range of biologic activities including antimicrobial, anti-inflammatory, antioxidant, anaesthetic, and cytotoxic properties. Propolis has significant antibacterial efficacy and can be used as an intracanal medicament [37, 38].

Azadirachta Indica

Commonly known as neem. Has an excellent and wide range of antimicrobial activity. The most important active constituents that contribute to the wide range of antimicrobial activity are azadirachtin, nimbolinin, nimbin, nimbidin. Neem has been tested for its antibacterial and antifungal activities in dentistry. Intracanal medicaments and irrigants that contained neem have been tried and tested over time [39-41].

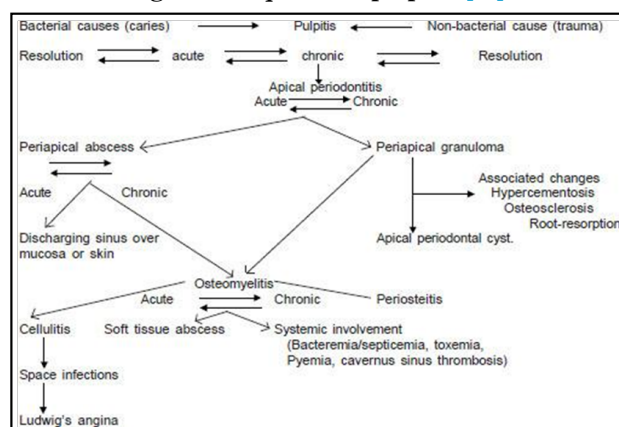
Arctium Lappa

Arctium lappa is a plant obtained in japan and acclimated in Brazil. It has been widely used in medicine as it possesses significant antibacterial, antioxidant and antifungal properties. The antibacterial activity has been attributed to the presence of polyacetylonenes. Great antimicrobial potential by arctium lappa against root canal microbes has been observed [42].

Eucalyptus Oil

It is an essential oil, obtained from the leaf of Eucalyptus with

Figure 1. Sequelae of pulpitis [71].



anti-inflammatory and antibacterial activities. It has a wide spectrum of antimicrobial action [43] and its potential use as a vehicle for calcium hydroxide has indicated towards its use as being an effective intracanal medicament.

Ricinus Communis

It is rich in ricinoleic acid (castor acid) and can be used as a root canal irrigant as well as an intracanal medicament [44].

Uncaria Tomentosa

An Amazonian herb possessing anti-inflammatory, antiviral, antibacterial, and antioxidant activities. It consists of oxindole alkaloids, triterpenes, vegetal steroids, phenolic compounds, glycosides, tannin and flavonoids which contribute to its antimicrobial activity. In dentistry, it can be used as an intracanal medicament [45].

Casearia Sylvestris

It is a medicinal plant found in tropical America and Brazil with antiseptic and antimicrobial activity. *Casearia sylvestris* can become a valid alternative for a short term intracanal medicament in cases of pulp and periapical inflammatory processes [46].

Curcuma Longa

Commonly known as turmeric. It exhibits good antioxidant, antimicrobial and anticancer activity with curcumin as an active ingredient. *Curcuma longa* can be used as an intracanal medicament as reported by Kumar et al 2013 [47].

Morinda Citrifolia

Widely known as Indian mulberry. It possesses a wide range of uses given its antibacterial, antiviral, anti-inflammatory, antioxidant and analgesic properties. *Morinda citrifolia* exhibits a good inhibition zone against *E. Faecalis* and hence can be used as an efficient intracanal medicament [38, 48].

Papain

Papain is a proteolytic cysteine enzyme with significant antibacterial and anti-inflammatory properties. It can be used as an intracanal medicament [48, 49].

Ocimum Sanctum

Widely known as Tulsi, it belongs to the Labiateae family and exhibits antibacterial, antifungal and antiviral properties. *Ocimum sanctum*'s essential oil extract has excellent antibacterial effect [41, 50] which increases with increase in concentration.

Allium Sativum

Also known as Garlic. It has a broad spectrum of antimicrobial properties with both bacteriostatic and bactericidal activities. The antimicrobial potency is due to its ability to inhibit toxin production and expression of enzymes for pathogenesis. It could be an alternative intracanal medicament [51].

Lemon Solution

Lemon solution is a natural source of citric acid with low acidity. Fresh lemon solution was shown to have wide antibacterial efficacy including against *E. Faecalis* and hence can be used as an intracanal medicament [52].

Cumimum Cynimum

Commonly known as cumin, it has been reported to have excellent antioxidant, antibacterial, antifungal and analgesic properties. Activity against *E. Faecalis* tested and presents with good biocompatibility, effective to be used as an intracanal medicament [53, 54].

Aloe Vera

Aloe vera belongs to the liliaceae family. Medicinal products are made from the mucilaginous tissue in the centre of the aloe vera leaf and is called aloe vera gel. Total leaf extracts contain anthraquinones, which have antibacterial properties. Aloe vera has also been evaluated for its antibacterial efficacy and tested as an intracanal medicament [48, 55].

Glycyrrhiza glabra [56]

Liquorice is known for anti-inflammatory, antiviral and anticarcinogenic properties. Among various active ingredients is Glycyrrhizin, a triterpenoid compound which is active against different strains of *S. Mutans*. It has greater biocompatibility when compared to calcium hydroxide.

Triphala (Haritaki, Bibhitaki and Amalaki)

Triphala; a famous ayurvedic formulation has been proven to effectively inhibit biofilm. Can be tried as an intracanal medicament [57].

Syzigium Aromaticum

Available as an essential oil with antibacterial, antioxidant and anodyne properties [58].

Foeniculum Vulgare

Commonly called as fennel seed, belonging to the family of family *A piaceas* with reported antimicrobial, anti-inflammatory, analgesic, antispasmodic, antioxidant, diuretic, carminative and anti-cancer properties. In-vitro analysis suggested its use as an intracanal medicament [59]. Our institution is passionate about high quality evidence based research and has excelled in various fields [60-70].

Conclusion

Intracanal medications' contribution to the disinfection of the canal space is immense. The microbial load reduction by the combined use of irrigants and medicaments influences the treatment outcome. To choose an appropriate medicament, one has to analyse the properties, pros and cons. Most natural products are easily available and have good antimicrobial properties, but their efficiency in clinical setup needs to be evaluated.

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