



Intracanal Medicaments in Pediatric Dentistry - A Review

¹Meenakshi Arumugam, ²Dr. Joyson Moses, ³Dr. R. Sharanya Ravindran

¹B.D.S, Junior Resident, Thai Moogambigai Dental College and Hospital Chennai, Tamil Nadu, India.

²M.D.S, Senior Lecturer, Department of Pedodontics, Thai Moogambigai Dental College and Hospital Chennai, Tamil Nadu, India

³M.D.S, Professor and Head, Department of Pedodontics, Thai Moogambigai Dental College and Hospital Chennai, Tamil Nadu, India

ABSTRACT:

Microorganisms and their metabolites are the primary etiological agents in the initiation and progression of pulpoperiapical pathosis. Intracanal medicament is critical for endodontic effectiveness because it kills microorganisms that persist after chemomechanical preparation. Dental caries, a progressive disease of the dental hard tissue, if left untreated in its initial stages, may lead to pulpal and periapical infections. Intracanal medicaments were considered to be an important step in eliminating microorganisms in root canals, in paediatric endodontics, biomechanical preparation may be more important than intracanal medicaments in disinfecting root canals. Different medicaments with different chemical natures are applied to eradicate multiple microorganisms with single dose in different ratio. The goal of Intracanal Dressing is to prevent coronal discharge from the space between the filling materials and the cavity walls. Biocompatibility and stability are becoming critical properties for intracanal medications. The antimicrobial activities of medicaments act against obligate and facultative anaerobic bacteria commonly found in root canals. This review focuses on the use of intracanal medicament in paediatric endodontics, their effects, techniques, and duration and mechanism of action.

Keywords: pediatric Endodontics, primary tooth, intracanal medicaments,

INTRODUCTION

Pediatric Endodontics aims to preserve a child's health and deciduous teeth that have pulp tissue injury from caries, dental trauma, or other reasons until they are replaced by permanent teeth. A root canal therapy is required when the pulp has become irreversibly infected or necrotic. It is a technique-sensitive procedure, as instrumentation of the morphologically complicated canals of the primary molars encased in curved roots programmed for physiological resorption is quite challenging. In addition, the presence of accessory canals makes biomechanical preparation difficult, and complete removal of necrotic pulp tissue is almost impossible. Because effective mechanical preparation of wide canal walls is difficult, it is recommended that treatment be done in two appointments, with placement of an antiseptic dressing between visits. Intracanal medicament is generally recommended when treatment cannot be completed in one appointment; there are chances that surviving intracanal bacteria often proliferate between appointments.^[1] In primary teeth, Ciprofloxacin, Metronidazole & minocycline are used for sterilization of infected root dentine to prevent the resistance development against microorganisms. These drugs penetrate deep into the root dentine which eradicates bacteria. Calcium hydroxide is still the intracanal medication that congregates the largest number of ideal properties for the eradication of endodontic infections, control of root resorption, and induction of mineralization.

Classification of Intracanal Medicaments

According to Grossman intracanal medicament can be classified as

1. Essential oils

- Eugenol

2. Phenolic compounds

- Phenol
- Parachlorophenol
- Camphorated parachlorophenol • Cresol
- Formocresol

- Creosote
- Cresatin
- Cresol

3. N2

4. Salt of heavy metals

- Metaphen
- Merthiolate
- Mercuraphen

5. Halogens

- Sodium hypochlorite
- Iodides
- Chlorexidine

6. Quaternary ammonium compounds

- 9-aminoacidine

7. Fatty acids

- Propionic acid
- Caproic acid
- Cuprylic acid

8. Sulphonamides^[2]

IDEAL REQUIREMENTS

- It should be an effective germicide and fungicide.
- It should be non-irritating to the periapical tissues.
- It should remain stable in solution. It should have prolonged antimicrobial effect
- It should be active in the presence of blood, serum and protein derivatives of tissues.
- It should have low surface tension. It should not interfere with repair of periapical tissues.
- It should not stain tooth structure It should not induce cell mediated immune response.
- It should prevent coronal microleakage and not diffuse through the temporary restoration^[3]

USES OF INTRACANAL MEDICAMENTS :

- Elimination of remaining microorganisms in pulp space.
- To act as a barrier against leakage from an interappointment dressing
- Rendering contents of canal inert
- To neutralize tissue debris
- Prevention or control of post treatment pain
- Enhancing Anesthesia
- Control of persistent periapical abscess

COMPOSITION OF MEDICAMENTS

For Primary Tooth:	It includes medicaments such as Formocresol, Glutaraldehyde, Calcium Hydroxide and Ferric Sulphate.
For Permanent Teeth:	It includes medicaments such as Calcium Hydroxide, Electrosurgery, Laser Pulpotomy, Bone Morphogenic Proteins (BMP), Osteogenic Proteins I, II, Mineral Trioxide Aggregate (MTA)

Mode of application:

Two methods are basically followed for placement.

1. By placing the medicament with a cotton pellet in the pulp chamber
2. Prepared medicament can be flooded in the root canal.[3]

For dressing a root canal, a short, blunt absorbent point moistened with the medicament and carried into the canal or a cotton pledget from which overload medicament has been articulated is placed in the pulp chamber, and the access cavity is sealed. , on the other hand in narrow canals a moist absorbent point does not have sufficient rigidity to be introduced into the canal. In such cases, a dry absorbent is inserted, and a cotton pledget moistened with the medicament is placed against the absorbent point to moisten it. A dry cotton pledget is used to absorb the excess medicament, and the cavity is sealed.[4,5] While sealing the pulp chamber, considerable care should be taken in order to prevent recontamination from marginal leakage or actual loss of seal before next appointment[3].

INDIVIDUAL MEDICAMENTS

- **PHENOL** : It is the oldest compound used for many years for its disinfectant property . rarely used as an intracanal medicament.
- **Camphorated Phenol** : This contains 30% phenol, 60% camphor, 10% ethyl alcohol. It is the least toxic of the phenolic compounds. It has excellent antimicrobial effect and also relieves pain. Camphorating process aims at developing a less caustic medicament as a result of the slow release of phenol. Camphor serves as a vehicle and diluent.
- **Monochlorophenol (MCP)** -It is a derivative of phenol and has three isomers of which paramonochlorophenol is the most effective. - Mono chlorophenol is more effective antiseptic and is also more toxic than phenol.
- **Camphorated Paramonochlorophenol (CMPCP)** -(Developed by Walkhoff 1891) - Contains : 35% monochlorophenol 65% camphor - Its antimicrobial effect is good. CMCP is much less irritating to periapical tissues than either phenol or eugenol. The vapors can pass through the apical foramen
- **Formocresol** -Developed by BUCKLEY in 1906 . Formalin & cresol in the proportion of 1:2 .It is used as an intratreatment medicament when a pulpotomy is performed as emergency treatment to relieve pain, in situations where pulp inflammation is confined to the pulp chamber. The bactericidal effect of formocresol is good at levels as low as 2%.
- **Glutaraldehyde** -It is a colorless slightly soluble in H₂O. -Slightly acidic -It is a strong disinfectant and fixative -Used in concentration of 2% - Extent of toxicity is less compared to formaldehyde. Its molecular weight is high compared to formaldehyde hence does not penetrate into the periapical tissues. In Primary Tooth, 2% Glutaraldehyde solution placed over root stumps and a drop into ZOE paste, the solutions give better outcome (2% solution) than the drop. Because of smaller molecular size, it cannot reach the apical foramen creating a minimal disturbance in the systematic circulation.

Glutaraldehyde was preferred to formaldehyde :

- Irreversible bonding with proteins.
- Limited diffusion into tooth structure.
- No periapical irritation.
- Appears to cause a softening of dentin for limited duration, facilitating the mechanical preparation of the root canal.
- Greater reduction in microorganisms with glutaraldehyde 2% can be attributed to the fixative property rendering the microorganisms inert and non-toxic. [6]

- **Cresatin** - Also known as metacresylacetate. It is a clear, stable, oily liquid of low volatility. It has both antiseptic and obtundant properties. Compared to formocresol or camphorated parachlorophenol the antimicrobial effect of cresatin is less.
- **Creosote** - Beachwood creosote has long been used in endodontic therapy. There are several reports on severe tissue irritation and necrosis.
- **Eugenol** - It is used as an intracanal medicament after partial or complete pulpectomy. It has both an antiseptic and an obtundant action. It is slightly more irritating than oil of clove.
- **Heavy metal salts** - Salts of silver, copper and mercury are used. They coagulate proteins and act as enzyme inhibitors. They are toxic. The mercury salts are rendered less effective by the tissue fluid proteins present in the root canal. Hence they are not often used.
- **Sodium Hypochlorite (NaOCl)**: It is most commonly used solution used in dentistry. It has the ability to dissolve pulpal remnants. It cannot remove the smear layer produced during instrumentation. NaOCl alone is not very effective in removal of the smear layer. The saponification, amino acid neutralization and chloramination reactions that occur in the presence of microorganisms and organic tissue lead to the antimicrobial effect and tissue dissolution process[8].

ACTIONS:

Antibacterial: NaOCl exerts its antibacterial action either by:

- Direct contact with microorganisms
- Vapour action.

Destruction of the bacteria takes place in two phases:

- Penetration into the bacterial cell.
- Chemical combination with the protoplasm of the bacterial cell that destroys it. **Sodium hypochlorite at 5.25% is an extremely effective antimicrobial agent.** • Studies have shown that this solution will destroy most of the microorganisms found in the root-canal system after exposure of 1 minute or less.

The disadvantages of Sodium Hypochlorite [9]

- It has an unpleasant odour and taste.
- It does not consistently disinfect the root canal system.
- It is toxic when extruded into the peri-radicular tissues.
- It can damage permanent tooth follicles.
- It reacts with other irrigating solutions like chlorhexidine. unpleasant taste and odour, removes the smear layer
- only partially, does not consistently disinfect the root canal, is toxic to the periradicular tissues and damages the permanent tooth follicle, peripheral tissues and oral mucosa
- **Ledermix paste:** Ledermix is available in a polyethylene glycol form combining tetracycline antibiotics, demeclocycline, HCL (at a concentration of 3.2%) and corticosteroid triamcinolone acetoxide (concentration 1%). It is considered to be a compound of glucocorticoid antibiotic. For controlling pain and inflammation, ledermix paste is used.
- **Calcium Hydroxide:** Lentilspiral is used for placing the paste inside the canal to full working length. They are used for root inflammatory resorption is inhibited and microbial control is obtained. It serves as temporary obturating material. It stimulates hard tissue formation. It heals the inflammation of the periapical region.
- Uses of calcium hydroxide :
 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 canal

Recent Advancement of Intracanal Medicaments

- **Propolis:** It serves as a better Intracanal Medicament because of its anti-inflammatory and good antimicrobial agent but when compared with saline and NaCl, propolis activity is equal to that of NaCl. In the case of pulp and periapical pathologies, it can be used as short term medications. Propolis exhibits good antibacterial and anti-inflammatory activity its removal from the root canal is also important for it to be used as a medicament a study was undertaken to investigate through scanning electron microscopy the cleaning of root canal walls after the use of experimental propolis or calcium hydroxide root canal dressings using 20 single-rooted teeth. Removal was initiated with a K-file and 5 ml of 1% NaOCl irrigation with 2 ml of 17% ethylenediaminetetraacetic acid for 3 min as a final flush. The cleaning of the root canal walls was determined by the number of open dentinal tubules. The experimental propolis pastes presented acceptable physical characteristics and can be used as intracanal medicaments as no statistically significant difference between the calcium hydroxide and propolis groups was evident[14].
- **Chlorhexidine Digluconate:** It has been recommended that Chlorhexidine Digluconate can be used both as a root canal irrigant and an intracanal medicament in the form of 2% Chlorhexidine gel, Mixture of Chlorhexidine and Ca(OH)₂. Chlorhexidine is an effective intracanal medicament. In the clinically used concentrations, CHX has optimal biocompatibility. But in bactericidal concentrations it is lethal to canine embryonic fibroblasts while non-cytotoxic concentrations aids survival of bacteria[10].
- **Triple antibiotic paste:** Ciprofloxacin, Metronidazole and Minocycline is used in primary teeth referred to as “Lesions Sterilization and Tissue Repair” Polymicrobial comprising both aerobic and anaerobic bacterial species is responsible for root canal infection. The usage of single antibiotic may not be effective to kill the microbes in root canal system. A combination of antibiotic is required to be applied for getting suitable result which may also decrease the probability of developing resistant bacterial strains. Combining metronidazole, ciprofloxacin and minocycline might bring promising result in killing bacteria in the deep layers of root canal in dentin has been assessed by Sato et al. After the application of the triple antibiotic paste, no bacteria were recovered within 24 hrs. from the infected dentin of the root canal wall in situ[11].
- **Medicated gutta-percha:** New gutta-percha points containing Ca(OH)₂ in a 50% to 51% concentration in place of zinc oxide is available in the market which makes easier placement and removal of Ca(OH)₂[12].
- **Bioactive glass:** The bio-active glass is effective to disinfect bacteria from root canals but the action was not pH related and the dentin did not seem to alter its effect[12].
- **NISIN:** It is a naturally occurring antimicrobial peptide and class I bacteriocin. Nisin has been used extensively over 40 years as food preservative which is safe to human being. Due to interaction with the phospholipid membrane of the target bacterial cell, the mode of action of Nisin is undiscoverable. It can interrupt the cellular membrane by persuading leakage of small intracellular contents from the cell^[13].
- **ENDOXY:** By emitting high frequency electrical impulses, endox endodontic system sterilizes the root canal. Endox endodontic system can eliminate both pulp and bacteria from the entire root canal as claims by manufacture and sterilization happens as a result of fulguration. It has been reported citing a recent study that without mechanical cleaning, the unit was not able to eliminate pulp tissue from the root canal. The authors realize that the unit may be utilized as a substitute to traditional cleaning and shaping without recommending high frequency electric pulses as a sole endodontic treatment^[13].

CONCLUSION

Biomechanical preparation with copious irrigation along with the use of intra canal medicament will increase the prognosis and success rate of endodontic treatment. While our understanding of persistent micro-organisms in the root canal, properties of disinfecting agents, and the chemical milieu of the necrotic root canal has grown significantly, there is no doubt that more innovative clinical research is required to optimise the use of existing methods and materials, and to discover new techniques and materials, or combinations of materials, to achieve the goal complete root canal system disinfection. Debridement of the root canal systems, Identification and removal of bacteria and their necrotic products from the canal using proper irrigation is most important for a successful endodontic treatment outcome. In modern dentistry practise, intracanal medicaments are used in particular situations to maximise the effectiveness of root canal therapy.

REFERENCES

- [1] Paquette L, Legner M, Fillery ED, Friedman S. Antibacterial efficacy of chlorhexidine gluconate intracanal medication in vivo. *J Endod* 2007;33:788-95.
- [2] Grossman L I Disinfection of the root canal *Endodontic Practice* 10th edition vargheses publishing House Bombay ;1998;247-259.
- [3]. Alexandra Almyroudi et al. The effectiveness of various Disinfectants used as endodontic Intracanal Medications An In Vitro study, *Journal of Endodontics* 2002; 28(3): 163-167.
- [4] Mohammadi, Zahed. *International Dental Journal*. Systemic, prophylactic and local applications of antimicrobials in endodontics: an update review. Aug 2009, Vol. 59 Issue 4, p175-186.
- [5]. Cohen S, Hargreaves KM. *Pathways of the pulp*. 10th edn. St. Louis, Mo.: Elsevier Mosby, 2011.

-
- [6] Gomes BP, Montagner F, Berber VB, et al. Antimicrobial action of intracanal medicaments on the external root surface. *J Dent.* 2009;37(1):76-81.
- [7]. Kandaswamy D, Venkateshbabu N. Root canal irrigants. *Journal of Conservative Dentistry.* 2010; 13(4):256.
- [8]. Estrela C, Estrela CR, Barbin EL, Spanó JC, Marchesan MA, Pécora JD. Mechanism of action of sodium hypochlorite. *Braz Dent J.* 2002;13(2):113-7
- [9]. Kashyap N, Upadhyay M, Sharma J, Das S, Katlam T. "Irrigating Solutions in Pediatric Dentistry: A Big Deal in Little Teeth". *EC Dental Science.* 2019;8(7):1620-26.
- [10] Sanchez IR, Nusbaum KE, Swaim SF, Hale AS, Henderson RA, McGuire JA. Chlorhexidine diacetate and povidone-iodine cytotoxicity to canine embryonic fibroblasts and *Staphylococcus aureus*. *Vet Surg.* 1988;17:182-5
- [11]. Mohammadi Z and Abbott PV. On the local application of antibiotics and antibiotic-based agents in endodontics *Dental Traumatology International Endodontics Journal* 2009; 42; 555-567.
- [12]. Cohen, *Instrument Materials and Device* 10th edition Mosybelservier 245-282.
- [13]. Turner SR et al An in Vitro investigation of antibacterial effect of nisin in root canals and canal
- [14]. Victorino FR, Bramante CM, Zapata RO, Casaroto AR, Garcia RB, Moraes IG, et al. Removal efficiency of propolis paste dressing from the root canal. *J Appl Oral Sci* 2010;18:621-4.