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Intracanal Medicaments Past to Future – A Review

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KEYWORDS

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ABSTRACT:

Microorganisms and their metabolites play a crucial role in initiating and progressing pulp periapical pathosis. Intracanal medicaments are essential for endodontic effectiveness because they eliminate microorganisms that persist after chemo-mechanical preparation. Dental caries, a progressive disease affecting dental hard tissue, can lead to pulpal and periapical infections if left untreated. Biomechanical preparation may be more critical than intracanal medicaments for disinfecting root canals in pediatric endodontics. Different medicaments with varying chemical properties eradicate multiple microorganisms in various ratios. Intracanal dressing aims to prevent coronal discharge between filling materials and cavity walls. Biocompatibility and stability are crucial properties of intracanal medications. These medicaments exhibit antimicrobial activity against bacteria commonly found in root canals. The review focuses on various intracanal medicaments used in paediatric endodontics.

1. Introduction

Paediatric dentists play a vital role in treating children's primary teeth, especially when the pulp is involved. Pulp therapy for primary teeth aims to maintain overall health and functionality until permanent teeth replace them [1]. A pulpectomy is a common procedure used to remove infections by eliminating bacteria and microbes from the root canals. This treatment is essential for primary teeth damaged by decay, injuries, or other causes. Root canals and periapical tissues often harbor various microorganisms, with anaerobic bacteria being the most prevalent. These infections must not be left untreated, as they can lead to further complications. Endodontic therapy aims to eradicate bacteria and their by-products to prevent re-infection, though complete elimination of all bacterial niches is challenging [2].

Intracanal medications destroy residual microorganisms and prevent their proliferation between appointments [3]. The complexity of root canal systems, including the presence of microbial biofilms and deep invasion into dentinal tubules, makes it difficult to eradicate all bacteria through chemo-mechanical preparation alone [4]. Common bacterial species in root canal infections include Bacteroides, Fusobacterium, Prevotella, Porphyromonas, Treponema, Peptostreptococcus, Eubacterium, Actinomyces, and Streptococcus. Intracanal medicaments help prevent bacterial multiplication and reinfection [5]. Due to the rise in antibiotic-resistant strains and the side effects of

synthetic drugs, researchers are increasingly exploring herbal alternatives for endodontic treatments [6].

2. Ideal requirements of intracanal medicaments

According to Grossman

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 the 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 the repair of periapical tissues.
h. It shouldn’t stain tooth structure.
i. It should be easily introduced into the root canal.

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

k. Prevent coronal microleakage and not diffuse through the temporary restoration [6].

3. Classification of Intracanal Medicaments

Table 1: Grossman's Classification [7].

Essential Oils	Eugenol
Phenolic Compounds	Phenol Parachlorophenol Camphorated Parachloro phenol (CMPP) Cresol Formocresol Creosoate Cresatin
N_2	
Salt of Heavy Metals	Metaphen Merthiolate Mercurophen
Halogens	Sodium hypochlorite Iodine Chlorhexidine
Quaternary Ammonium Compounds	9-Aminoacridine
Fatty Acids	Propionic acid Caproic acid Cuprylic acid
Sulphonamides	

Table 2: Ingle's Conventional Antiseptics as Intracanal Medicaments [8].

Phenolic Compounds	Eugenol Camphorated Parachloro phenol (CMPP) Parachlorophenol (PCP) Camphorated para chlorophenol (CPC) Metacresylacetate (Cresatin) Cresol Creosote (Beechwood) Thymol
Alcohols	Ethyl alcohol Isopropyl alcohol
Heavy Metal Salts	Salts of silver, mercury, copper
Halides	Sodium hypochlorite Iodine-Potassium iodide
Cationic Detergents	Quaternary ammonium compounds

4. Calcium hydroxide

Calcium hydroxide is the most popular intracanal medicament in use since its introduction by Hermann in 1920. Its use is related to antibacterial properties and the ability to induce repair and hard tissue formation. It has a high pH so it is considered a bactericidal agent. It is used as pulp capping material, intracanal medicament, and as a component of many dental materials and pastes [2,4,9]. The lethality of calcium hydroxide is observed only when it comes into direct contact with the bacteria and this may not always be possible clinically [2].

Disadvantages

1. It is hard to remove it from the walls of the canals [2].

2. It alters the zinc-oxide eugenol cement by reducing its setting time [10].

5. Triple antibiotic paste

The triple antibiotic paste is a mixture of 3 antibiotics, metronidazole, ciprofloxacin, and tetracycline (either minocycline or doxycycline). It is also known as Hoshino's paste (Qiu and Wang, 2015). The paste is prepared by mixing these antibiotic powders in a ratio of 1:1:1 which is then mixed with a solvent in a ratio of 7:1 [4]. In high concentrations this paste can have a toxic effect on the stem cells in the apical papilla, therefore it is used in low concentrations only. In low concentration, it is sufficient to eradicate E.faecalis [5].

The antibacterial effect of this paste is attributed to the following [4,14,15].

1. The broad-spectrum antibacterial action of metronidazole.

2. The bactericidal effect of ciprofloxacin on gram-negative bacteria.

3. The bacteriostatic and anti-resorptive properties of tetracycline. The combination of these drugs makes it

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effective against the polymicrobial nature of endodontic infections [4].

Disadvantages

1. Discoloration of teeth is the most common complaint associated with triple antibiotic paste use. This discoloration is due to minocycline. Minocycline chelates with calcium to form a compound that cannot be removed [11]. Therefore, minocycline was replaced with amoxicillin or cofactor in the triple antibiotic paste. An alternative is the use of double antibiotic paste which consists of metronidazole and ciprofloxacin only [12,15,2].

2. Reduces the microhardness of dentine when applied for a prolonged period [4,15].

3. Toxic and cause damage to the stem cells in the apical papilla when applied in higher concentration [4,7].

4. Bacterial resistance. However, there is no clear evidence of triple antibiotic paste association with increased bacterial resistance [2,14].

6. Newly synthetic/engineered intracanal medicaments

The shift from mechanical to biomechanical preparation of the root canal has resulted in the development of many agents that are biocompatible and less toxic to the stem cells of the apical dental papilla [4].

Bio ceramic: Bio ceramic was used for different purposes in medicine. Their use in endodontics began in 1990. Initially, they were used as root canal-filling materials [13]. Later they were modified and used as root canal sealers, root perforation repair materials, and coated gutta-percha points [16,12]. The first introduced bio ceramic material was mineral trioxide aggregate (MTA). Nowadays the MTA is considered the golden standard in many endodontic procedures [2].

Nano silver: Nano silver use in endodontics begins with the use of gutta-percha points coated with nano silver for enhanced antibacterial sealing. Nano silver in high concentration is effective against several microbes including E.Faecalis, S. aureus, C.albican, and E.coli. Nano silver gel was proven to be more effective than chlorhexidine, CMCP, and calcium hydroxide [4,12]. Nano silver was also used in combination with other intracanal medicaments such as calcium hydroxide and mesophporous calcium silicate nanoparticles [16].

7. Herbal medicaments

Herbal products have been used since ancient times in folk medicine, involving both Eastern and Western medicinal traditions. Many plants with biological and antimicrobial properties have been studied since there has been a relevant increase in the incidence of antibiotic overuse and misuse. In dentistry, Phytomedicines have been used as anti-inflammatory, antibiotic, analgesic, and sedative agents. In endodontics because of the cytotoxic reactions of most of the commercial intracanal medicaments used and their ability to eliminate bacteria from dentinal tubules, the trend of recent medicine attends to use biological medication extracted from natural plants

The major advantages of using herbal alternatives are easy availability, cost-effectiveness, increased shelf life, low toxicity, and lack of microbial resistance reported so far. But at the same time, many herbal drugs bear potential risks, side effects, and drug interactions that may affect the safe practice of dentistry [4].

Bee glue (propolis): Propolis is a resin-like natural product obtained from poplar and coniferous trees or clusiafowers by honey bees. It is composed of more than 300 constituents related to flavonoids, phenolic acids, and esters. These components are responsible for the immune stimulatory, antioxidant, anti-inflammatory, and antimicrobial properties [4]. The pH of the environment in which propolis is applied has little effect on its activity. Some authors found that this activity was better in a slightly acidic environment. Propolis reduces the acid production of S.mutans. it also inhibits C.albicans, Prevotella intermedia, and P.nigrescenes [15,16]. It is more effective against E.faecalis than triple antibiotic paste and calcium hydroxide but less effective than chlorhexidine [16].

Aloe vera (Aloe barbadensis miller): Aloe vera also known as babosa is a plant that is used widely in medicine. It is available as powder and gel. The gel is famous around the world for its antibacterial, anti-inflammatory, and healing action [1]. It is highly effective against several species of bacteria but its effectiveness against E.faecalis is still controversial. It also diffuses easily through the dentinal tubules [4,16]. It

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can stimulate and intimate fibroblast proliferation and stimulation of keratinocyte growth factor 1, vascular endothelial growth factor, and type 1 collagen expression [16].

Chitosan: Chitosan is a naturally occurring biopolymer. Chitosan has gained popularity in dentistry in the last few years due to its biocompatibility, adhesion, and biodegradability. It is non-toxic and extracted by alkaline deacetylation of chitin [16]. Nowadays, chitosan has a wide range of uses in dentistry. This is mainly due to its properties which include biocompatibility, biodegradability, and antibacterial effect [14,16].

Curcumin (Curcuma longa): The antibacterial activity of curcumin is by inhibiting the proliferation of bacteria by deactivating the assembly dynamics of a specific gene required for the division of bacterial cells. It has a wide range of activity against gram-positive and gram-negative bacteria and it is effective against E. faecalis. Curcumin was modified and new light-activated curcumin was introduced. Studies have proven that curcumin has superior antibacterial properties to that of triple antibiotic paste. Light activation of curcumin results in hydrogen peroxide which has an antibacterial effect that reaches a long distance. It also does not affect the microhardness of dentine [4,16].

8. Conclusion

The use of intracanal medicament in routine endodontic practice is still controversial. Therefore, the decision of whether to use or not to use these agents is dependent on the difficulty of the case and the experience and skills of the endodontist in dealing with the different types of intracanal medicaments available. Different types of medicaments are available and different methods for their placement and removal have been developed to achieve the maximum efficiency from them. However, these materials vary considerably in their properties and interactions with the vital tissues and filling materials. Some of them are more effective compared to others. In addition to the old medicaments, new synthetic and herbal medicaments are being developed and modified and are getting more popular as alternatives to the old toxic non-biocompatible materials. However, much is yet to be known about most of these medicaments before their use as intracanal medicaments.

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