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Intracanal Medicaments and Its Recent Advances: A Review

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ABSTRACT

The crucial goal for an endodontic treatment to be successful is absolute eradication of microorganisms, thereby products and pulp residues from the affected root canals with absolute sealing and depuration from the microorganisms present in the canal space. Therefore intracanal medicaments have been used in RCT. There are several intracanal medicaments which have been tested; out of which calcium hydroxide is the best but it also has various limitations/disadvantages. Certain new materials which can be used as intracanal medicaments have been advocated, such as bioactive glass, Triple antibiotic paste, PDA, etc. This article aim's to highlight uses and limitations of calcium hydroxide as well as the recent advances in intracanal medicaments. Success of the root canal treatment lies on 1) Biomechanical preparation of the root canals 2) Depuration 3) Obturation. Intracanal medicaments plays an important role in destroy.

Key words: Intra canal medicaments, Root canal, Calcium hydroxide, Disinfection

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INTRODUCTION

Microorganisms are crucial etiologic factor for pulpal and periradicular diseases to occur [1]. However when the infection continuous it leads to necrosis and apical periodontitis furthermore the whole root canal will be infected by microorganisms. Objective of root canal treatment is to eradicate also depurate the bacteria completely which are present in the root canal and nullify the residual agents which are remaining in the root canal after depurating all the bacteria [2]. Success of the root canal treatment lies on: Biomechanical preparation of the root canals, depuration and obturation [3].

To prevent secondary infection and bactericidal action are the main motive behind intracanal medicament. The microorganisms which are present after obturation might get killed when there are no nutrients in the root canal; if they do not get killed then they grow. Chemo mechanical preparation cannot eliminate the microorganisms that are surviving in the dentinal tubules. The remaining microorganisms might duplicate in number same as the initial stage of the treatment if the antiseptic intracanal medicaments are not applied properly in between the visits. Henceforth there is a necessity to utilize effectual intracanal medicament [4]. There is a need to establish medicament which has prolonged outcome and minimal irritation to the apical peridontium for infiltrating dentinal tubules and eliminating microorganisms when the treatment cannot be completed in a single visit. Intracanal medicaments are indicated/recommended to be filled in middle of appointments because their effects are prolonged than the irrigants [5].

LITERATURE REVIEW

Objectives for intra canal medicaments

- **Eradication of bacteria:** The crucial goal of intracanal medicament is destruction of living bacteria or to depurate all microorganisms which are present in root canal.
- **Providing contents of canal inactive:** Utilizing chemicals that will mummify or deactivate the tissue/ debris which are retained in the pulp space. Suppose if this procedure is applicated effectively, that can deactivate the remaining microorganisms in the pulp space.
- **To prevent the after treatment agony:** The crucial goal of endodontic treatment is to reduce the inflaming reaction. The antibacterial action of the intracanal medicaments will help in doing so. Also the pharmacological action might help in reducing the inflammatory effect. There may be reduction in the pain and inflammation due to the pharmacological or chemical action of the medicament but sometimes it can elicit pain in the pulp and periapical tissues if it is applied directly on the sensory nerves.

- **Enhancing anesthesia:** There are certain conditions in which anesthetizing pulp is difficult, but there are some preferable agents that are given to decrease the pain in the inflamed pulp. In between appointments pulp can be taken out easily with slight anesthetic problems.
- **Controlling the continuing periapical infection:** Remarkable pain and swelling after the treatment or a draining canal depicts that there is an active lesion in periapical region. Intracanal medicaments are used to reduce this kind of difficult situations. There should be direct entry for these medicaments into the periapical lesions. A healthy balance should be restored by this [6].

Classification: Intracanal medicaments were classified by Grossman DCNA (Dental Clinicsof North America): based on their chemical nature.

Calcium hydroxide as intracanal medicaments: The intracanal medicament used most widely is calcium hydroxide. Clinically it is applied to attain bacteria under control, break down the organic residues, give therapy for periapical inflammatory action, stop root resorption by inflammation, restore organization of inorganic component of the tooth and can be used as a temporary obturating material between appointments [7,8]. One of the properties of calcium hydroxide is its high PH which provides antimicrobial action that leads to inactivation of microbial surface enzymes [9]. The research proves that *Enterococcus faecalis* is immune against $Ca(OH)_2$ and it resists calcium hydroxide for about ten days [10]. The action of calcium hydroxide is minimal in case of facultative anaerobes and candida species but is effectual in case of obligate anaerobes [11]. Calcium hydroxide should be eradicated entirely prior to the obturation from root canal to acquire a proper seal for permanent root filling material [12]. It is proven by the studies that when calcium hydroxide is mixed with two percent chlorhexidine digluconate that was extra affective in opposition to *Enterococcus faecalis* in comparison when it was triturated with more chemicals. $Ca(OH)_2$ is affective to a certain limit at concentrations of hundred and two hundred microgram/millilitres [13]. Calcium hydroxide is a very helpful intracanal medicament for preventing the flare ups that can occur in between the appointments [14]. Studies have shown that calcium hydroxide causes weakening of root dentin by twenty three to 43.9% following root canal filing [15].

Limitations of calcium hydroxide: Despite of having numerous indications and advantages there are certain limitations for $Ca(OH)_2$. There should be proper handling and accurate application for calcium hydroxide which requires great skill on the side of a doctor. Application is difficult at the back region of the jaws even though there are numerous formulations available. Moreover withdrawal of calcium hydroxide cannot be done completely, which causes twenty to forty-five percent of the canal wall to be filled with the residue even after extensive irrigation with saline, sodium hypochlorite and EDTA [16]. Remaining $Ca(OH)_2$ present inside the root canal also can cause for worry because it's ineffective in opposition to a variety of microorganisms which results in secondary infections or blow ups. Numerous studies have cast doubt on the capacity of calcium hydroxide to entirely eliminate microorganisms out of the canal [17]. One of the laboratory studies found in particular dentin has inhibited calcium hydroxide's antimicrobial action, while another clinical investigation found that one week later to the $Ca(OH)_2$ treatment, the numerical value of microbial colonies inside the root canals actually rose. Other investigations have found that calcium hydroxide did not reliably eradicate germs also that the microbial culture gave false negative response after subsequent administration of $Ca(OH)_2$ in the canal [18]. Based on the available proof, calcium hydroxide has restricted efficacy in eradication of microbes from canal in case of culture mediums. But clinically when comparison is made between cases where medicament is applied the results are quite good as in the infection was resolved than in cases where medicament is not applied [19].

Eugenol: Chemically, this comprises of clove oil and is a derivative of phenol. It acts as an antiseptic and exhibits dull effect on pulp and are a moderately greater irritant when compared to the clove oil. It is a pale yellow liquid which turns dark if stored for a longer time. It is known to have mild anaesthetic action along with its antiseptic properties with the characteristic clove like odour.

Phenol: Phenol was first used in 1867 by Lord Lister which is considered to be one of the oldest antiseptic medicines. This compound acts as a sedative for the pulp tissue and also has its use as a medication in the root canals along with disinfection for caries while cavity preparation and periapical surgery. Its use has also been extended to cauterize the tissue tags which are otherwise difficult to remove with broaches or files. On the basis of disinfection property antibacterial were compared to phenols. Therefore, it is disclosed as phenol derivative.

Cresatin: It is an antibacterial and it also reduces pain, transparent, greasy, less volatile liquid with a phenolic acetic smell. Its antimicrobial impact is enhanced by its less surface tension also its impact is prolonged which produces its less vapour pressure. Grossman stated that antibacterial influence of cresatin is not that good when it is compared with several medicaments of the same family. It has a property to be non-caustic, has low irritation, also incapable of precipitating albumin.

Parachlorophenol: Like phenol, this compound comprises of colourless needle like crystals which turn dark on exposure to light. One of the hydrogen atoms of phenol is replaced with chlorine to form parachlorophenol. The crystalline substances dissolve in ethers, alcohol; alkalies also there are mildly dissolvable in water. It mixes with gum camphor to generate an oily liquid after being triturated.

Camphorated parachlorophenol: This is an intracanal antiseptic which comprises of P-cholorophenol and gum camphor in the ratio 2:3. The presence of camphor in camphorated parachlorophenol helps in reducing the irritation which is caused by pure chlorophenol and also acts as a diluent and vehicle. Grossman identified its

antimicrobial action and year's later wantulor and brown stated vapours of camphorated chlorophenol of cresatin has capacity of traveling through the apex of the root.

CMPC: This is created by mixing paramonochlorophenol crystals with camphor and liquefying them spontaneously. There are numerous ratios proposed for camphor and paramomochlorophenol among which 7:3 is the most commonly used. It causes less irritation and has potent bactericidal action when compared to phenol which does not coagulate albumin.

Cresanol: Cresatin, P-chlorophenol, and camphor are mixed in a 1:1:2 ratios. It has been proven to be better as a medicament than cresatin and low in irritation when compared to chlorophenol.

N_2: Sargenti and Richter demonstrated that N_2 is employed as intra canal medicament also a sealer comprising paraformaldehyde and phenyl mercuric borate. The properties in N_2 have a long lasting disinfection effect as well as an uncommon antiseptic agent that is unpleasant and poisonous while also having a high level of antibacterial activity. The antibacterial effect of N_2 has been found to be short lived and to degrade in around 7 to 10 days.

Formocresol: Buckley introduced it in 1905 as a blend of formalin and cresol in a ratio ranging from 1:2 to 1:1. It has a unique odour and appears as a translucent crimson liquid that is a blend of three isomers. Formocresol is a water based mixture of nineteen percent formaldehyde, thirty-five percent cresol, and forty-six percent glycerine.

Heavy metal salts: These are protoplasm toxins that cause albumin to precipitate and create new chemicals that discolour tooth structure. Long ago, ammoniated silver nitrate was used to disinfect root canals, but its use has been curtailed due to the stain it causes on tooth structure. Organic mercurial salts with a lower tendency to precipitate albumin, such as metaphen, merthiolate, and mercurophen, are potent disinfectants. Because of its staining qualities, it has a limited use in endodontic treatment.

Halogens: The halogens' disinfectant effect is proportional to their at. Wt. and their activity are inversely proportionate. Chlorine' is the most effective disinfectant between the members of this group, and it also has the smallest at. Wt. Active chlorine is obtained from sodium hypochlorite and chloramines, which are utilized for root canal dressing [20].

CHX: It's a molecule with a positive hydrophobic and lipophilic charge which binds on bacteria's cell membrane also enters in the cell *via* a passive or active transport mechanism. Its effectiveness on microbial cell walls is due to interactions between the positive charge of the molecule and the negatively charged phosphate groups, resulting in cell osmotic equilibrium. Its impact enhances cell wall permeability, allowing the Chlorhexidine molecule to enter the bacteria [21].

PBSC: Dentists frequently utilize PBSC, according to Grossman. Nystatin has replaced sodium caprylate as the antifungal agent in PBSN, as an equivalent medication. Paste based medications can be injected in root canals also can be impregnated on paper points. The medicine should be applied into the canal space while taking into consideration its stability in order to get the intended effect. Penicillin may be inactivated by PBSC interfering with the consecutive culture procedure. It is necessary to include penicillinase. It must be altered on the incubation paper point. Because of the risk of sensitivity from topical antibiotics and the declining popularity of intra canal injections, the use of PBSC has become outdated.

Sulphonamides: Due to their bacteriostatic properties rather than bactericidal properties, sulphonamides interfere with bacterial metabolism, making microorganisms more susceptible to destruction by the body's defensive mechanisms. It is used by moistening paper points and inserting them in a full pot which has powder, or by putting in some sterile distilled water. It has been reported that after using sulphonamides, teeth develop a yellowish discoloration. The impact of sulphonam is reduced when pus is present also is affected by tissue debris and breakdown products of protein, PABA.

DISCUSSION

Recent advances in intracanal medicaments

Bioactive glass: Bioactive glass as an intracanal medicament is still under investigation. It isn't as effective as 2% chlorhexidine, although it is better than $Ca(OH)_2$ [22]. Bioactive glass was discovered to be effective in disinfecting germs from canals, although the action was not pH dependent, and the dentin had no effect [23].

Triple antibiotic paste: Root canal infection is caused by a polymicrobial infection that includes both aerobic and anaerobic bacteria [24]. The use of a single antibiotic to eradicate the bacteria in the root canal system may not be efficient. To achieve the best results, a combination of antibiotics must be used, which may reduce the risk of developing resistant bacterial strains [25]. Sato, et al. evaluated the effect of combining metronidazole, ciprofloxacin, and minocycline in killing bacteria in the deep layers of the root canal in dentin. Within 24 hours of applying the triple antibiotic paste to the diseased dentin of the root canal wall *in situ*, no germs were recovered.

PAD: For a long time, the photosensitization approach has been employed in medicine. PAD is rich in tolonium chloride and photoactive agent. Because of its antibacterial properties, it is used in endodontic applications. The photosensitizer molecule is activated using a red laser with a wavelength of 635 nm. The light is directed into the root canal through the tip of a small flexible optical fibre with a maximum power of 100 mW, ensuring that the surrounding tissue is not damaged. The powerful oxidant produced during the process can attack on many targets in a microbial cell, producing membrane damage, enzyme inactivation, and genomic and plasmid DNA damage, culminating in rapid death.

ENDOX: The endox endodontic system sterilises the root canal by producing high frequency electrical impulses. According to the manufacturer, the endox endodontic system can eradicate pulp and germs from the whole root canal, and sterilising occurs as a result of fulguration. According to a new study, the unit was unable to remove pulp tissue from the root canal without the use of mechanical cleaning. The studies recognize that the unit can be used instead of traditional cleaning and shaping, but they do not propose high frequency electric pulses as a sole endodontic treatment [26].

Curcumin: Curcumin is a natural compound which has its derivation from plant that is the roots of *Curcumin longa* (turmeric root). It has known to possess antimicrobial and anti-inflammatory features along with its antioxidant and anti-cancer properties owing to its relevance in clinical dentistry for management and prevention of various diseases.

Incorporation of curcumin into polymeric fibres was put in to test to assess its antimicrobial activity and its probable usage in root canal disinfection.

Recent studies have highlighted the potential use of curcumin as an effective alternative to triple antibiotic paste in terms of controlling infection. But to use this property of the above natural compound, a minimal concentration of (2.5 mg/mL) is required for its effectively.

To further enhance the antibiofilm activity, curcumin based medicaments have been subjected to photo activation.

CONCLUSION

There is a need for intracanal medicaments in case of non-vital tooth, periapical diseases, periapical abscess and the tooth in trauma. The aim for application of intracanal medicament is to disinfect the root canal and their by decrease the microbial load, this leads to a good prognosis. This article sums up numerous medicaments which can be used for RCT. There are several intracanal medicaments which have been tested; out of which calcium hydroxide is the best but it also has various limitations/disadvantages. Recent advances in intracanal medicaments are in implicated so as to overcome the limitations of calcium hydroxide.

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