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Irrigation in pediatric dentistry: A review

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Abstract: Success in primary teeth is mainly achieved by complete removal of the debris and necrotic tissue. However, complete removal of the debris and necrotic tissue is done by the root canal irrigants along with mechanical instrumentation. Studies have shown that combination of two or more irrigating solutions in a specific sequence will help to achieve optimal irrigation. Present review of literature provides information of about intra canal irrigant used in pediatric dentistry.
Keywords: Primary teeth, Pulpectomy, Irrigating solution, Root canal

Introduction: Primary teeth are as important as permanent teeth for the harmonious development of jaw, maintenance of arch length, mastication and speech. Endodontic therapy helps to preserve and maintain function of severely carious primary teeth. Successful root canal therapy relies on the combination of proper instrumentation, irrigation and obturation of the root canal.[1]

A clean root canal system along with a three-dimensional seal is the clinician's path to success. The contents of the root canal system are removed during the biomechanical preparation.[2] Anatomic variations in primary teeth such as curved and tortuous root canals, their close proximity to succedaneous tooth buds along with the uncertainty about the effects of root canal irrigants make the treatment in primary teeth altogether a challenging task.[3]

Intracanal irrigants can augment mechanical debridement by flushing out debris, dissolving tissue and disinfecting the root canal system.[1] Irrigants play a major role in pediatric endodontics because of the bizarre internal geometry and features like internal connections and horizontal anastomoses seen in primary teeth.[4]

Present review of literature provides information of about intra canal irrigant used in pediatric dentistry.

The ideal requisites of a root canal irrigant as given by Zehnder are:[5]

1. Broad antimicrobial spectrum
2. High efficacy against anaerobic and facultative microorganisms organized in bio films
3. Ability to dissolve necrotic pulp tissue remnants
4. Ability to inactivate endotoxin
5. Ability to prevent the formation of a smear layer during instrumentation or to dissolve the latter once it has formed.

6. Systemically nontoxic when they come in contact with vital tissues, noncaustic to periodontal tissues, and with little potential to cause an anaphylactic reaction.

The currently used irrigants can be grouped into anti-microbial and decalcifying agents or their combinations. Two or more irrigants in a specific sequence can tribute in a successful treatment outcome as no single irrigating solution is regarded optimal.

Commonly used irrigating solutions in pediatric dentistry

Normal saline: Normal saline is isotonic to the body fluids. It is universally accepted as the most common irrigating solution in all endodontic and surgical procedures. It is also found to have no side effects, even if pushed into the periapical tissues.[6] However, saline should not be the only solution to be used as an irrigant, it is preferably used in combination with or used in between irrigations with other solutions like sodium hypochlorite.[7]

Sodium Hypochlorite (NaOCl): NaOCl is the most commonly used solution used in dentistry. NaOCl gives rise to sodium and hypochlorite ions when combined with water, there by establishing equilibrium with hypochlorous acid which is responsible for the antibacterial activity. It also has the ability to dissolve organic components such as pulpal remnants and collagen. NaOCl cannot remove the smear layer produced during instrumentation. When hypochlorous acid, a substance present in NaOCl solution, comes in contact with organic tissue it acts as a solvent and releases chlorine, which combines with the protein amino group to form chloramines. Hypochlorous acid (HOCl−) and hypochlorite ions (OCl−) lead to amino acid degradation and hydrolysis.[1,8]

The chloramination reaction between chlorine and the amino group (NH) forms chloramines that interfere in cell metabolism. Chlorine (a strong oxidant) has an antimicrobial action, inhibiting bacterial enzymes and leading to an irreversible oxidation of SH groups (sulphydryl group) of essential bacterial enzymes. Thus, 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]

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 in to the peri-radicular tissues.
- It can damage permanent tooth follicles.
- It reacts with other irrigating solutions like chlorhexidine.

Chlorhexidine: Chlorhexidine digluconate is widely used in disinfection because of its excellent antimicrobial activity. However, it completely lacks tissue dissolving capability.[10]

Chlorhexidine Gluconate, currently used in endodontic therapy, seems to act by adsorbing onto the cell wall of the microorganisms and causing leakage of the intracellular components. At low concentrations, small molecular weight substances will leak out, especially potassium and phosphorus, resulting in a bacteriostatic effect. At high

concentrations, chlorhexidine gluconate has a bactericidal effect due to the precipitation and/or coagulation of the cellular cytoplasm, probably caused by cross-linking proteins.[11]

Ethylenediamine tetraacetic acid (EDTA): EDTA is a chelating agent used for the removal of the inorganic portion of the smear layer. NaOCl is an adjunct solution for removal of the remaining organic components. Irrigation with 17% EDTA for one minute followed by a final rinse with NaOCl is the most commonly recommended method to remove the smear layer.[12]

Hydrogen peroxide: Hydrogen peroxide is widely used in disinfection and sterilization. It is being used in dentistry in concentrations varying from 1% to 30%. H2O2 creates effervescence which facilitates debris removal, acts as an oxidizing agent and is capable of denaturing bacterial proteins and DNA. But in higher concentrations, it is not well tolerated and has the potential of causing cervical resorption.[13]

MTAD (Mixture of tetracycline isomer, acid and detergent): Torabinejad et al. developed an irrigant with combined chelating and antibacterial properties. MTAD is a mixture of 3% doxycycline, 4.25% citric acid, and detergent (Tween-80). It is recommended to be used as a final rinse after root canal preparation. It is capable of eliminating all bacteria and smear layer from the root canal system when used as a final rinse.[14]

Citric acid: Citric acid can also be used for irrigation of the root canal to remove the smear layer. Concentrations ranging from 1% to 50% have been used. The use of 10% citric acid as final irrigation has shown good results in smear layer removal and proven to be more biocompatible than 17% EDTA.[15]

Maleic acid (MA) - MA is a mild organic acid used to roughen enamel and dentin surfaces in adhesive dentistry. It removes the smear layer effectively at concentrations of 5% and 7%. In addition, when used at concentrations of 10% or higher, it causes demineralization and erosion of the root canal wall.[16]

Silver Diamine Fluoride - A 3.8% silver diamine fluoride solution was developed for use as an irrigation solution in root canal treatment. This solution is the1:10-diluted form of the original 38% solution of SDF, which was developed for the treatment of root canal infection.[17]

Tetraclean: Tetraclean is a mixture of doxycycline hyclate (at a lower concentration than in MTAD), an acid, and a detergent. It is recommended to be used as a final rinse after root canal preparation. It is similar to MTAD but with a reduced amount of doxycycline (50mg/5ml instead of 150mg/5ml for MTAD), with polypropylene glycol (a surfactant), citric acid, and cetrimide. This substance is supposedly capable of eliminating all bacteria and smear layer from the root canal system when used as a final irrigation. It is able to eliminate microorganisms and smear layer in dentinal tubules of infected root canals with a final 5-min rinse.[13]

Carisolv: Carisolv contains 0.5% sodium hypochlorite along with amino acids. The hypothesis was that this agent can also be effective in removal of smear layer from root canal

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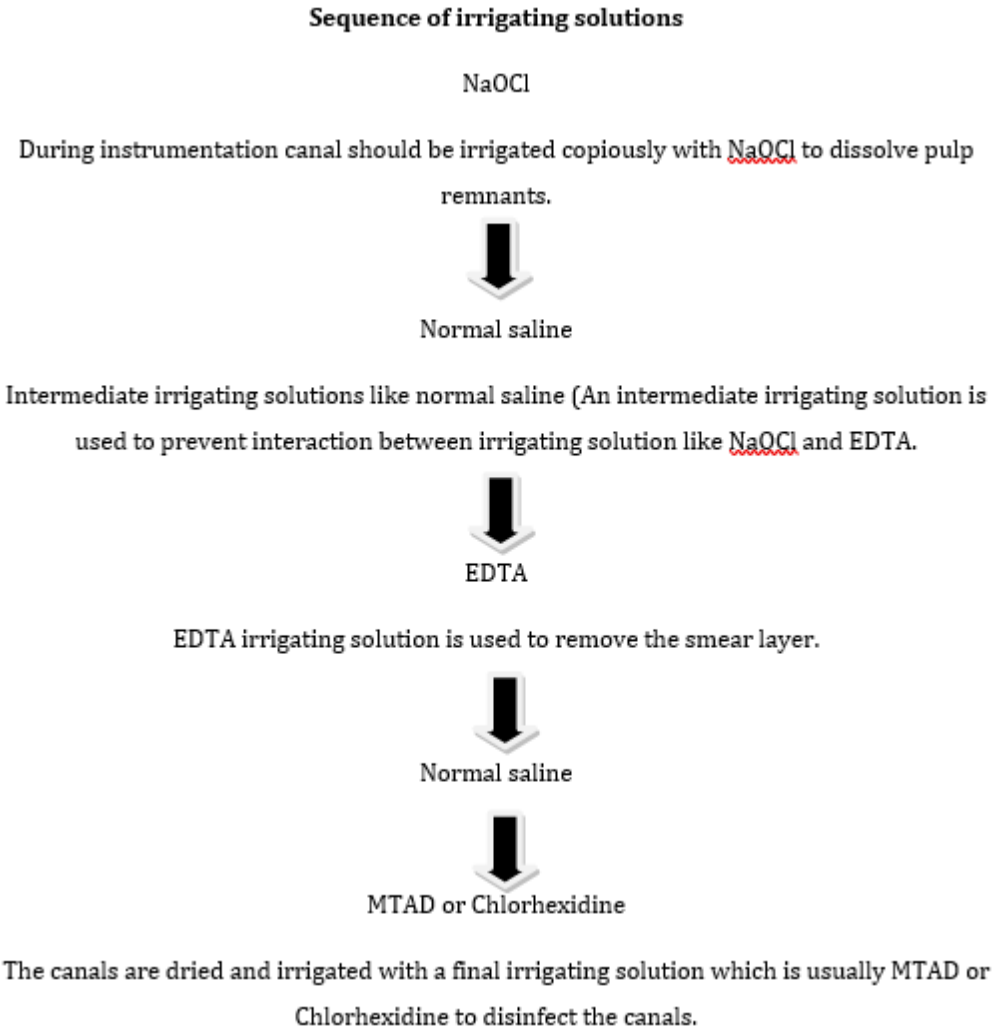
system when used as an irrigant studies have shown that carisolv was ineffective in removing smear layer.[18]

Ozonated water: Ozone is a chemical compound consisting of 3 oxygen atoms. Ozone is capable of oxidizing any biological entity due to its bacterial properties even at low concentrations. Studies have shown that when ozonized water was used with sonification as a irrigant, the bacterial ability of ozonized water and 2.5% sodium hypochlorite was found to be comparable.[19]

Ethanol: 95% ethanol has been studied as a final irrigant before obturation in primary teeth. It was used as a drying agent. Zmener et al. (2008) observed less leakage of dye in canals that were dried with 95% ethanol.[20]

Sequance of irrigation in pediatric dentistry



Review of literature

Author	Observations
Goerig AC et al. (1983)	Profuse irrigation with 5.25% sodium hypochlorite (NaOC1) is recommended to dissolve necrotic tissue left behind by routine instrumentation.[21]
Onçağ et al. (2003)	2% chlorhexidine gluconate has more antibacterial effect and less toxic effect than 5, 25% sodium hypochlorite.[22]
Götze Gda et al. (2005)	Suggested the use of 1% NaOCl and 6% citric acid as a chemical substance for irrigation for deciduous teeth.[23]
Nara A et al. (2010)	Author found MTAD to be better irrigant as compared to 3% Sodium hypochlorite.[24]
Kapdan et al. (2015)	Reported that the irrigation method with laser had antibacterial effect on deciduous tooth canals.[25]
Buldar B et al. (2017)	EndoVac has better performance than conventional needle irrigation in the removal of the Smear layer in the apical thirds of the primary molar root canals.[26]
Agnihotri A et al. (2020)	Herbs such as Tulsi, Miswak, and M. citrifolia definitely have a potential to replace the chemical irrigants in pediatric dental patients.[3]

Conclusion: Elimination of microorganisms from infected root canals of primary teeth is a complicated task. The chances of a favourable outcome with root canal treatment are significantly high if infection is destroyed effectively before obturation. Hence irrigating solutions play a key role in the success of endodontic treatment of primary teeth. The irrigants that are most commonly used include Saline, Sodium hypochlorite, Chlorhexidine, EDTA and MTAD. None of the irrigants has optimal properties to be termed an ideal irrigant. So it has been recommended to use of two or more solutions in a specific sequence or in combinations for better results.

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