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ENDODONTIC IRRIGANTS: A PATH FOR SUCCESSFUL TREATMENT

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ABSTRACT

The most common cause of pulpal inflammation (pulpitis) is bacteria and/or their toxic products entering the pulp through a deep carious lesion. Endodontic success is greatly dependent on the elimination of microorganisms and removal of smear layer during cleaning and shaping. The successful treatment of root canals in primary teeth depends on irrigation which serves as a valuable adjunct. The purpose of this article is to provide a brief insight into the root canal irrigants used for disinfection of infected root canals in pediatric dentistry.

KEYWORDS: Biofilm, Herbal extracts, Primary teeth, Smear layer, Sodium hypochlorite.

1. INTRODUCTION

The complete debridement of the infected root canals is one of the important step for a successful endodontic treatment. The reduction in bacterial load is achieved partly through the shaping of the canals and predominantly through irrigation. The principal role of irrigation is removal of the intracanal smear layer, elimination of bacterial biofilms, reduction in the bacterial count, and neutralizing the toxins produced by microorganisms. However, primary teeth have inaccessible zones of debridement, like accessory canals, ramifications, and dentinal tubules. Therefore, it's imperative to use auxiliary solutions that promote disinfection of these areas, mainly because infected primary teeth can harbor microorganisms inside the dentinal tubules, within the same way, permanent teeth do.[1]

2. MICROFLORA IN PRIMARY TEETH AND ITS ROLE

The microorganism found in endodontic infections of primary teeth are polymicrobial, typically dominated by obligatory anaerobic bacteria. The most frequently isolated species before root canal treatment are Gram positive anaerobic cocci, Gram negative and positive anerobic rods, lactobacillus and streptococcus species. Whereas, obligate anaerobes were easily removed during root canal treatment. On the other hand, facultative bacteria such as non mutans Streptococci, Enterococci, and Lactobacilli survived after chemo mechanical instrumentation and root canal medication. Cogulu et al found that the most predominant species of bacteria in primary teeth root canal were Enterococcus faecalis, Porphyromonas gingivalis and Treponema denticola.[2]

3. ROOT CANAL IRRIGANTS

It is generally believed that mechanical instrumentation with copious irrigation, reduces the load of microorganisms in the root canal. In advance era, research paradigm shifted from chemical irrigants to herbal and newer advancement in field of nano particles, ultrasonic, lasers. Description of irrigants, consist common properties (fig 1)[3] that influencing the efficacy of root canal irrigants (fig 2)[4] which are as follows.

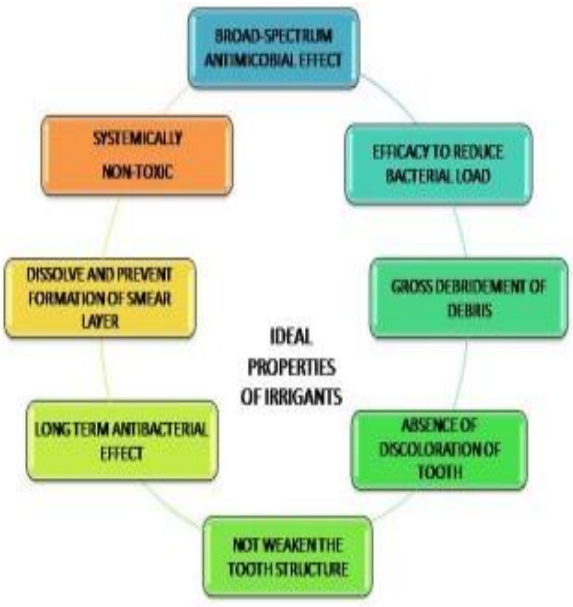

FIGURE 1: Shows ideal properties of irrigants.

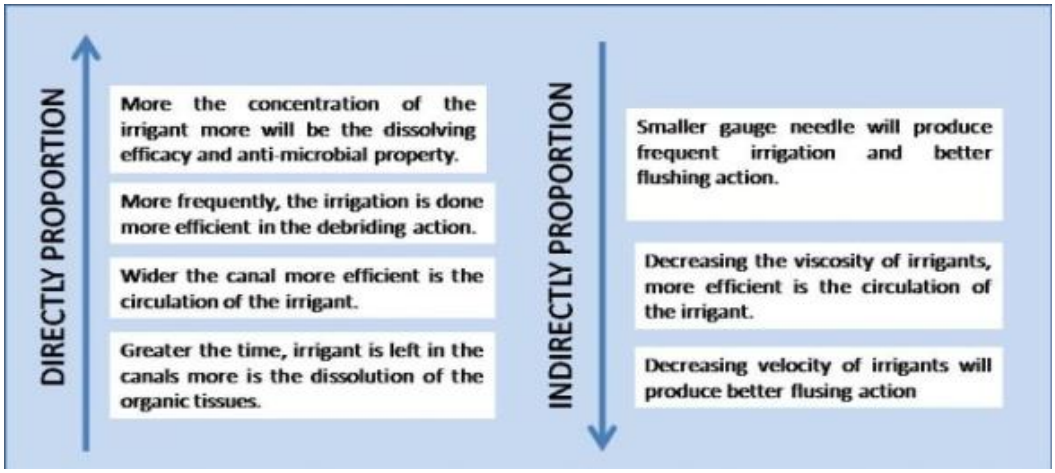

Figure 2: Shows the factor influencing the efficacy of root canal irrigants.

4. CHEMICAL AGENTS

4.1 Normal Saline

The most frequently used irrigant in pediatric endodontic is saline, which is isotonic in nature. Saline helps in mechanical debridement, lubrication, and final flush of the root canal to remove any chemical irrigants left in the canal. However, saline having no side effects, so it can be used in combination or in between irrigation with other irrigants. All micro-organism cannot be washed away mechanically from the root, requiring the use of such antibacterial irrigants, that must killed the micro-organism within the canal.[5]

4.2 Sodium Hypochlorite

Sodium hypochlorite (NaOCl) is most commonly used irrigant in root canal therapy, its concentration ranging from 0.5% to 5.25% and pH level is 11 to 12. Free chlorine in sodium hypochlorite responsible for dissolution of vital and necrotic tissues by breaking down proteins into amino acids. Sodium hypochlorite is a weak alkaline which denature the albumin contents of pulpal tissue and microorganisms and turning it, to make them more soluble in water. It can cause severe cellular damage, if extruded periapically. Inflammation is there, when comes in contact with gingiva because of its caustic nature. It has bad odour and taste (fig3).[6]

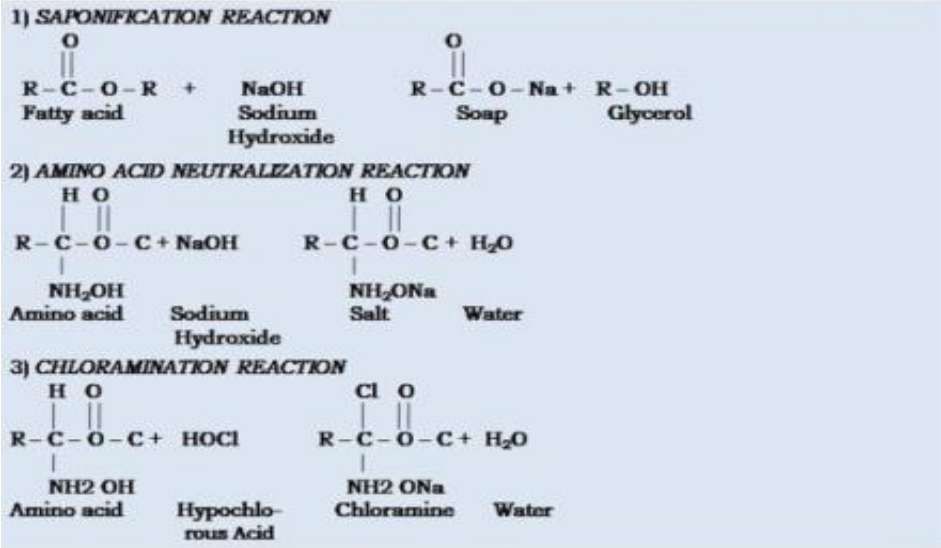

FIGURE 3: Chemical reaction between organic tissue and sodium hypochlorite.

4.3 Hydrogen peroxide

Hydrogen peroxide is a highly unstable, colorless liquid that decomposes in light and heat. Its concentration used in endodontic irrigation ranges from 1-30%. It is rapid release the nascent oxygen during contact with tissue and creates effervescence, which helps in mechanical debridement of necrotic tissue. Nascent oxygen reacts with blood, and pulpal debris which may result in severe pain due to pressure build up inside the canal. At high concentrations, hydrogen peroxide it might cause cervical resorption.[7]

4.4 Chlorhexidine

In the 1940s, chlorhexidine was developed in the research laboratories of Imperial Chemical Industries Ltd. (Macclesfield, England). It can be more effective as a disinfectant when compared to sodium hypochlorite because $HOCl^-$ (Hypochlorous acid) or OCl^-

(hypochlorite ions), two effective components of sodium hypochlorite, when come in contact with charged bacterial cell wall there could be repelled as both are negatively charged, thus causing less penetration and absorption of the disinfectant into the membranes whereas chlorine dioxide irrigant, exists a gas in water, which easily penetrate through bacterial cell membranes and bring about its destruction at a wide range of pH from 3 to 9. Chlorhexidine is less effective to dissolve necrotic tissue remnants. Chlorhexidine is less effective on Gram-negative than on Gram-positive bacteria.[8]

4.5 Silver Diamine Fluoride

Silver diamine fluoride (SDF), $Ag(NH_3)_2F$, is well known for its anti-cariogenic property and releasing of high fluoride. A 3.8% w/v silver diamine fluoride solution has been used for intracanal irrigation. This represents 1:10 dilution of the original 38% $Ag(NH_3)_2F$ solution used for root canal infection. When an SDF solution is used as irrigant a silver deposits can occlude tubular orifices in fact after the removal of the smear layer that deposit has been detected.[9]

4.6 Triclosan & Gantrez

Triclosan having broad-spectrum antimicrobial agent, which acts against gram-positive and gram-negative bacteria as well as some fungi and viruses. At high concentration it is bactericidal and at low concentration it seems to be bacteriostatic. In order to increase the anti-germs action of triclosan, another component has been addicted which is called Gantrez. Triclosan alone and in combination with Gantrez demonstrated bactericidal activity against the five specific endodontic pathogens P intermedia, F nucleatum, A naeslundii, P gingivalis, and E faecalis.[10]

5. HERBAL AGENTS

Herbal irrigants are gaining popularity due to their biocompatible and dentin friendly properties that can overcome the limitations of these chemical irrigants. The herbal extracts contain essential oils, flavonoids, tannins, alcohols which possess high medicinal properties such as anti-oxidant, antimicrobial, and anti-inflammatory properties which have favoured their use in Endodontics for canal disinfection. Recently, dental treatment has a growing trend to seek natural remedies and this approach may be termed phytotherapeutics or ethnopharmacology (table 1).[11] Aloe vera extract possesses antimicrobial effect against E.faecalis because its containing chloroform extract. Propolis has also shown to be an effective intracanal irrigant to eradicating E. faecalis and C. albicans and dentin disinfection in root canal treatment. Miswak having a great antimicrobial activity by inhibiting the growth of various against gram positive and gram negative bacterias by interfering extrapolysaccharides and glycosidase enzymes produced by these microorganisms. Curcumin showed a wide spectrum antibacterial activity against pathogens such as Porphyromonas species, P. intermedia, P. streptococci and E. faecalis.[12]

Table 1: Shows active ingradients of herbal agents.

PHYTOMEDICINES USED IN ENDODONTICS PROCEDURE	ACTIVE INGRADIENTS
Azadiarachta indica (Neem)	Neem Nimbin, nimbidinin, nimbolide and nimbidinic acid
Melaleuca alternifolia (Tea tree oil)	Terpinen-4-ol
Morinda citrifolia – Noni fruit	Acubin, L-asperuloside, atizarin & anthraquinone
Triphala	Tannins, quinones, flavonoids, gallic acid and vitamin C.
Syzigium aromaticum - Clove	Eugenol, isoeugenol and vanillin
Allium sativa - Garlic	Allicin
Zingiber officinale – Ginger	Zingerone, gingerol & 6-shagoal
Propolis – Honey bee wax	Flavonoids and cinnamic acid derivatives
Aloe barbadenis – Aloe vera	Aloin and aloe-emodin

6. RECENT ADVANCEMENT

6.1 Antibacterial Nanoparticles (NPS)

Antibacterial Nanoparticles show a broad-spectrum antimicrobial activity, where nanoparticle shows unique physiochemical properties and its size ranges 1-100 nano meter. The advantage are to interact with at the subcellular and molecular level of the human body to achieve maximal therapeutic efficacy with minimal side effects. The loss of membrane permeability and unsuitable membrane function takes place due to electrostatic interaction between negatively charged bacterial cells and positively charged nano particles.[13]

6.2 Antimicrobial Photodynamic Therapy (APDT)

The disinfection of root canals for endodontic purpose, APDT improves the antimicrobial efficacy by application of photosensitizer followed by illumination of sensitized tissues which might get generate toxic photochemistry on target cells. It enhances the penetration of irrigants into the dentinal tubules, killing of microorganism and antibiofilm properties.[14]

6.3 Photon-Induced Photoacoustic Streaming (PIPS)

PIPS consist of unique stripped tip that creates a powerful streaming of laser impulses when placed inside the pulp chamber instead of canal. Thus, there is no need for enlargement of canals in order to achieve effective irrigation. PIPS effectively removed vital and non-vital pulpal tissues, kill micro-organism and disinfect the dentin tubules.[15]

6.4 Gentlewave Irrigation

Gentlewave (GW) (Sonendo, Laguna Hills, CA, USA) system was first developed in 2007. It work on generation of broad spectrum sound waves which are initiated at the tip of GentleWave™ handpiece, when positioned inside the pulp chamber. GW easily disinfect the root canal delivers a stream of treatment solution from the handpiece tip into the pulp chamber while excess fluid is simultaneously removed by the built-in vented suction through the handpiece.[16]

7. SUMMARY

In primary root, antibacterial effect of sodium hypochlorite and chlorine dioxide was found. Triclosan and Triclosan added with Gantrez had been valid antibacterial activity. While, SDF has not proved significant. Sodium hypochlorite was superior antibacterial properties than aloe vera, chamomile hydroalcoholic extract, tea tree oil, and Triphala as an irrigant but miswak and triphala was superior to sodium hypochlorite. The standard root canal therapy reduced bacteria by 90% while antimicrobial photodynamic therapy alone reduced it by 95%. The combination of two procedures reduced it by more than 98%.[17-18]

8. CONCLUSION

For successful endodontic treatment of primary teeth, it is essential to reduce and eliminate the bacterial load of necrotic tissue. Till date, no irrigants provide 100% cleansing of the root canal. The gold standard irrigants in day-to-day clinical practice is Sodium Hypochlorite despite its disadvantage of the periapical accident. Although in the recent era, research is more focused on herbal irrigants and nanomaterials-based irrigants for root canal disinfection owing to their properties like easy availability, cost-effectiveness, increased shelf life, and low toxicity. Hence, successful root canal therapy depends on complete debridement and disinfection of endodontic treated primary teeth.

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