ECRONICON OPEN ACCESS

EC DENTAL SCIENCE
Review Article

Irrigating Solutions in Pediatric Dentistry: A Big Deal in Little Teeth

Nilotpol Kashyap[1]*, Manisha Upadhyay[2], Jyoti Sharma[2], S J Das[3] and Tulsi Katlam[4]

[1]*Professor and HOD, Department of Pedodontics and Preventive Dentistry, Ucms, College of Dental Surgery, Bhairahawa, Nepal*

[2]*Senior Lecturer, Department of Pedodontics and Preventive Dentistry, Ucms, College Of Dental Surgery, Bhairahawa, Nepal*

[3]*Professor and HOD, Department of Periodontics, RDC, Guwahati, Assam, India*

[4]*PG Student, Rungta College of Dental Sciences, Bhilai, India*

***Corresponding Author:** Nilotpol Kashyap, Professor and HOD, Department of Pedodontics and Preventive Dentistry, Ucms, College of Dental Surgery, Bhairahawa, Nepal.

Received: June 11, 2019; **Published:** June 27, 2019

Abstract

Although preventive measures have reduced caries, premature loss of primary teeth due to pulpal involvement remains a very common problem. The premature loss of primary molars may result in mesial drift of the permanent teeth thus causing malocclusion. Although space maintainers can be used to preserve arch space, retention of pulpally involved primary teeth is more preferable if they can be restored and free of pulpal pathology.

Because of high failure rates, pulp capping is not recommended for carious exposures in primary teeth other than mechanical exposure in a healthy tooth. All pulp exposures in primary teeth should be treated with direct pulp capping, pulpotomy, pulpectomy and extractions. Pulpectomy is done in case of teeth which are irreversibly inflamed and with necrotic radicular canals.

Keywords: *Pediatric Dentistry; Pulpotomy; Pulpectomy; Pulp Capping*

Introduction

Primary teeth are as valuable as permanent teeth because they act like natural space maintainers in children. It is necessary to save primary teeth because they serve other important functions like mastication, speech, aesthetics and also helps in the development of jaws. Pediatric endodontics serves as an important role in saving primary teeth which are symptomatic. In cases of irreversible pulpits or in cases of trauma where the pulp is exposed, pulpectomy plays an important role in preserving the primary teeth. The difference between pulpectomy in primary teeth and root canal treatment in permanent teeth lies in the preparation of the teeth. Before beginning root canal therapy, the dentist should understand the differences between the root canal morphology of the permanent and primary teeth [1].

The root canals of primary anterior teeth are relatively simple having fewer irregularities and are relatively easy to treat endodontically whereas root canal systems of primary molars frequently contains many ramifications and deltas between canals making thorough debridement quite difficult.

Root canal morphology of primary molars [2]:

Generally there is only one root canal present in each of the roots of the primary molar.

The root canals of primary teeth begin to resorb as soon as root length is completed. This resorption causes the position of the apical foramen to change continually.

Secondary dentin is deposited within the root canal system. This deposition produces variations in the number and size of the root canal, as well as many small connecting branches between the facial and lingual aspect of the canals.

Continued deposition of dentin within the root divides it into separate canals.

In addition to this, accessory canals, lateral canals and apical ramifications of the pulp can be found in 10% to 20% of primary molars.

According to Goerig, maxillary primary molars may have two to five canals, with the palatal root usually rounder and longer than the two buccal roots. The mesiobuccal root may have two canals in 75% of the primary maxillary first molars and in 85% to 90% in the primary maxillary second molars. Also, fusion between the distobuccal and palatal root occurs in one –third of primary maxillary first molars and occasionally in the primary maxillary molars.

Rationale for using irrigating solutions [3]

The success of root canal therapy in primary teeth is determined by thorough removal of debris and necrotic tissue. Due to the presence of deltas and fins in the root canal system of the primary teeth complete elimination of bacteria by cleaning with endodontic instrument is impossible, this is where adjunctive use of root canal irrigants along with mechanical instrumentation comes in. 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.

The ideal requirements of an irrigating solution are [3]:

It should possess broad antimicrobial spectrum.

It should possess high efficacy against anaerobic and facultative micro-organisms present in the bio-films.

It should completely dissolve necrotic pulp tissue.

It should be able to avoid formation or dissolve smear layer formed during instrumentation.

It should be non-toxic to vital tissue and non-caustic to periapical and periodontal tissues.

Commonly used irrigating solutions in pulpectomy are

Sodium hypochlorite (NaOCl) [4]

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. The concentration of NaOCl should be 2.5%.

The disadvantages of NaOCl

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 [5]

Chlorhexidine reacts with negatively charged groups on the surface of bacterial cells, thereby damaging and reducing intracanal bacteria. Chlorhexidine generally suggested to be used in pulpectomy of necrotic primary teeth at 2% concentration.

Disadvantages of Chlorhexidine

Inflammatory responses were seen when chlorhexidine is accidently injected beyond the root apex.

It is incapable dissolving necrotic tissue.

It has limited action on gram negative organisms.

EDTA and citric acid [6]

EDTA is commonly used as 17% neutralized solution while citric acid is available in various concentrations ranging from 1% to 50%. EDTA and citric acid are available in gels and liquids. They both effectively dissolve the inorganic components and smear layer with little or no effect on organic tissue. Studies have shown the irrigation with 6% citric acid or 15 to 30 seconds is quite effective in removing all the components of the smear layer of the primary teeth.

Disadvantages EDTA and citric acid

Both are incapable of destroying bacteria.

Mixture of doxycycline and citric acid with a detergent (MTAD) [7]

This mixture was introduced by Torabinejad., *et al.* this mixture contains 3% doxycycline, 4.25% of citric acid and a detergent Tween 80 (0.5% Polysorbate detergent). It is used as an alternative to EDTA to remove smear layer effectively and to disinfect the root canals of primary teeth when used as a final rinse. The mixture also possesses bacteriostatic activity. It is effective as an intracanal irrigant only when used in full dosage i.e. 5ml per root canal.

Tetraclean [8]

Tertaclean 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 contains doxycycline (50 mg per 5 ml) with polypropylene glycol (a surfactant) citric acid and cetrimide. It is capable of eliminating all bacteria and smear layer from the root canal system when used as a final rinse.

Hydrogen peroxide (H_2O_2) [9]

Hydrogen peroxide was used for many years as an endodontic irrigant. H_2O_2 is a widely used biocide for disinfection and sterilization. Hydrogen peroxide is a clear colorless liquid that is used in a variety of concentrations in dentistry ranging from 1% to 30%. H_2O_2 is active against viruses, bacteria, yeast and even bacterial spores. It has greater activity against gram positive bacteria. H_2O_2 produces hydroxyl free radicals which attacks cell components such as proteins in bacteria.

Disadvantages of hydrogen peroxide (H_2O_2)

At high concentration hydrogen peroxide is not well tolerated in the body and might play a role in the development of cervical resorption.

Maleic acid [10]

It is a mild organic acid used as an acid conditioner in adhesive dentistry. Ballal., *et al.* reported that final irrigation with 7% maleic acid for 1 min. was more efficient than 17% EDTA in removing smear layer.

Carisolv [11]

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

Smear clear [12]

Smear clear contains 17% EDTA along with cetrimide and additional proprietary surfactants. These components aid in the removal of inorganic matter left in the canal during instrumentation. According to different studies smear clear has been found to be effective against gram positive and gram negative organisms due to the presence of cetrimide which is a quaternary ammonium compound and a cationic detergent.

Electrochemically activated solutions [13]

A mixture of tap water in low concentrated salt solution forms the electrochemically activated solutions. This results in the synthesis of anolyte and catholyte. The oxidative properties of anolyte exhibit antimicrobial activity against bacterias, viruses, fungus and protozoa. The solution is also known as superoxidized water or oxidative potential water. Due to various advantages such as removal of debris and smear layer as well as having non-toxic properties, it can be used as potential root canal irrigants.

Ozonated water [14]

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.

Herbal irrigants

Triphala and green tea polyphenols [15]:

Triphala is an ayurvedic formulation consisting of dried powdered fruits of 3 medicinal plants.

Terminalia bellerica

Terminalia chebula

Emblica officinalis

Triphala consist of fruits that are rich in citric acid, which may aid in the removal of smear layer.

The polyphenols found in green tea are known as flavanols. Theses favanols have significant anti- oxidant, anti-cariogenic, anti-inflammatory, thermogenic, probiotic and antimicrobial properties. Studies have shown that triphala and green tea when used as an irrigant had antimicrobial activity.

Morinda citrifolia (Noni) [16]

Morinda citrifolia also known as noni or Indian mulberry as a broad range of therapeutic effects such as antibacterial, anti-inflammatory, analgesic, anti-helminthic , antiviral and immunity enhancing property.

Miswak [17]

Miswak is derived from *Salvadora persica* which is mainly used as a chewing stick.

Wolinsky and Sote, by isolation of the active ingredient of *S. persica* found at the limonoid had a great antimicrobial activity against gram positive and gram negative bacterias. *In vivo* studies have found that 10% to 20% extract of miswak was an effective antifungal and antibacterial agent when used as an irrigant in the endodontic treatment of teeth with necrotic pulp against *C. albicans* and *E fecalis*.

German Chamomile and Tea tree oil [18]

German chamomile is a medicinal plant known for the anti-inflammatory, antimicrobial, antisporic and sedative properties. An SEM study done with German Chamomile extract and tea tree oil found that the smear layer removing efficacy of German chamomile and tea tree oil to be superior to NaOCl and inferior to EDTA.

Reaction of sodium hypochlorite with EDTA [19]

EDTA is used at concentration of 15% - 17% which has a neutral or slightly alkaline pH. At this pH sodium hypochlorite reacts with EDTA which results in a decrease of free available fluorine.

$4HOCl = 2Cl_2 + O_2 + H_2O$

Clinical implication

Mixtures of EDTA and NaOCl which have a low pH results in the loss of free available chlorine which significantly reduces the ability of NaOCl to dissolve the organic tissue.

Reaction of sodium hypochlorite with chlorhexidine

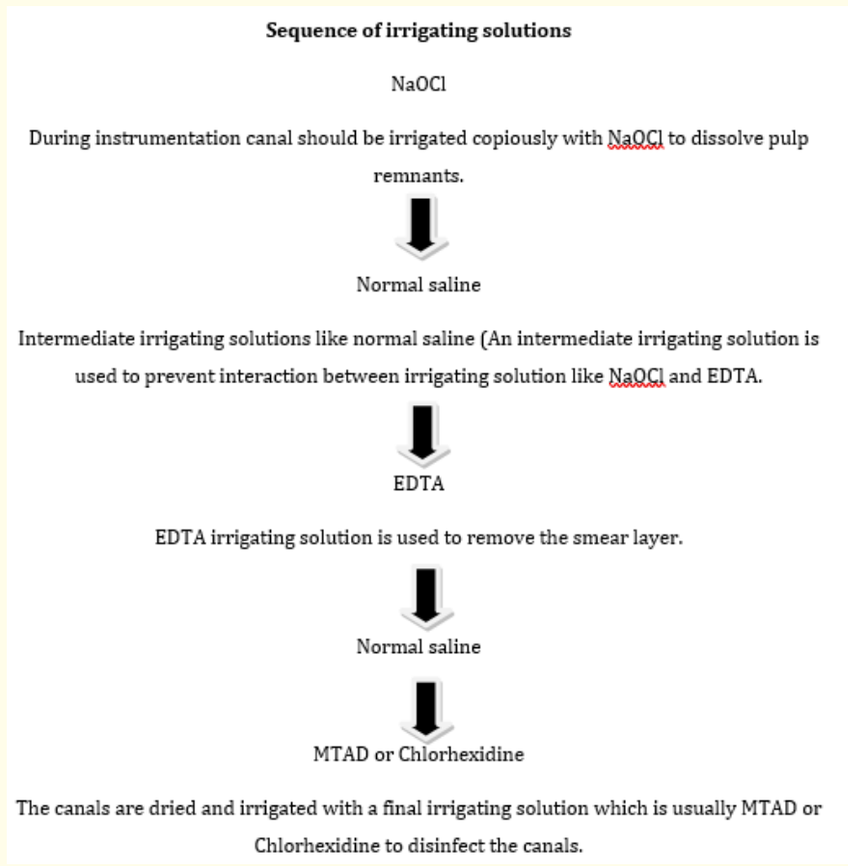
Chlorhexidine is a cationic bisguanide with broad spectrum antimicrobial properties against gram positive bacteria. When NaOCl solution is mixed with chlorhexidine an orange brown precipitate is formed. This precipitation product has not been clearly identified but is similar to chloroguanide which is a toxin.

Clinical implications

The coloured precipitate can stain dentin.

The precipitate can occlude dentinal tubules and canal orifice, thus lowering the efficacy of endodontic irrigant.

The toxin chloroguanide can harm the cells of the periodontal ligament.



Conclusion

For the successful preparation of the canals in primary teeth irrigation serves as a valuable adjunct. It is specially true in cases of primary teeth with tortuous canals. Irritants helps in removing the smear layer dissolving necrotic debris and removing bacterias from the root canal system. In pulpectomy procedures in primary teeth the main goal is to make the root canal system free of bacteria and not shaping of the canals as is done in cases of permanent teeth. Researches is still going on to produce an irrigating solution which has all the ideal properties.

Bibliography

1. Kaur R., *et al*. "Irrigating solutions in pediatric dentistry: literature review and update". *Journal of Advanced Medical and Dental Sciences Research* 2.2 (2014): 104-115.
2. AC Goerig and JH Camp. "Root canal treatment in primary teeth: a review". *Pediatric Dentistry* 5.1 (1983): 33-37.
3. Ramachandra JA., *et al*. "Root canal irrigants in primary teeth". *World Journal of Dentistry* 6.4 (2015): 229-234.
4. Esterla C., *et al*. "Mechanism of action of sodium hypochlorite". *Brazilian Dental Journal* 13.2 (2002): 113-117.
5. Russell AD. "Activity of biocides against mycobacteria". *Journal of Applied Bacteriology Symposium* 25 (1996): 87S-101S.
6. Calt S and Serpen A. "Smear layer removal by EGTA". *Journal of Endodontics* 26.8 (2000): 459-461.
7. Newberry BM., *et al*. "The antimicrobial effect of biopure MTAD on eight strains of Enterococcus faecalis: an in vitro investigation". *Journal of Endodontics* 33.11 (2007): 1352-1354.
8. Giardino L., *et al*. "Surface tension comparison of four common root canal irrigants and two new irrigants containing antibiotic". *Journal of Endodontics* 32.11 (2006): 1091-1093.
9. Mcdonnell G and Russell D. "Antiseptics and disinfectants: activity, action, and resistance". *Clinical Microbiology Reviews* 12.1 (1999): 147-179.
10. Ballal NV., *et al*. "Comparison of the efficacy of maleic acid and ethylenediaminetetraacetic acid in smear layer removal from instrumented human root canal: a scanning electron microscopic study". *Journal of Endodontics* 35.11 (2009): 1573-1576.
11. Singhal P., *et al*. "Carisolv as an endodontic irrigant in deciduous teeth: an SEM study". *Indian Journal of Dental Research* 23.1 (2012): 120-121.
12. Dunavant TR., *et al*. "Comparative evaluation of endodontic irrigants against enterococcus faecalis biofilms". *Journal of Endodontics* 32.6 (2006): 527-531.
13. A M Soloyyeva and Dummer P M. "Clinical effectiveness of root canal irrigation with electrochemically activated anolyte and catholyte solutions: a pilot study". *International Endodontic Journal* 33.6 (2000): 494-504.
14. Ihsan Hubbezoglu., *et al*. "Antibacterial efficacy of aqueous ozone in root canals infected by enterococcus faecalis". *Jundishapur Journal Of Microbiology* 7.7 (2014): E11411.
15. J Prabhakar., *et al*. "Evaluation of antimicrobial efficacy of herbal alternatives (triphala and green tea polyphenols), MTAD, and 5% sodium hypochlorite against enterococcus faecalis biofilm formed on tooth substrate: an in vitro study". *Journal of Endodontics* 36.1 (2010): 83-86.

16. Ferreira FA., *et al*. "Antimicrobial effect of propolis and other substances against selected endodontic pathogens". *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology* 104.5 (2007): 709-716.

17. Poonam Shingare and Vishwas Chaugle. "Comparative evaluation of antimicrobial activity of miswak, propolis, sodium hypochlorite and saline as root canal irrigants by microbial culturing and quantification in chronically exposed primary teeth". *Germs* 1.1 (2011): 12-21.

18. Lahijani MS., *et al*. "The Effect of german chamomile (Marticaria Recutitia L.) extract and tea tree (Melaleuca Alternifolia L.) oil used as irrigants on removal of smear layer: a scanning electron microscopy study". *International Endodontic Journal* 39.3 (2006): 190-195.

19. Prado M., *et al*. "Interaction between irrigants commonly used in endodontic practice: a chemical analysis". *Journal of Endodontics* 39.4 (2013): 505-510.

Volume 18 Issue 7 July 2019