Endodontic Irrigants: A Review

[1]Dr Qurat Ul Ain, [2]Dr Durga Devi Dasari, [3]Dr Shari Devarajan

Department of conservative Dentistry and Endodontics
The oxford dental college Bangalore

Abstract- **Role of endodontic therapy is always depending on the combination of proper, irrigation and obturation of the root canal. Of these three essential steps of root canal therapy, irrigation of the root canal is the most important step which aids in the healing of the periapical tissues. The root canal is shaped under constant irrigation to remove the inflamed and necrotic tissue, microbes, biofilms and other debris from the root canal space. There is no single irrigating solution that can alone cover all of the functions required from an irrigant. Optimal irrigation is based on the combined use of 2 or several irrigating solutions, in a proper sequence, to predictably obtain the goals of safe and effective irrigation. This article reviews various irrigants, ideal requirements of irrigants and newer irrigants used for irrigation.**

Keywords: **Root canal treatment, Irrigants, chlorhexidine, Q-Mix**

INTRODUCTION

Endodontics is that discipline which is responsible for the diagnosis and treatment of dental pulp and surrounding periodontal tissues. To appreciate the full scope of endodontics, an understanding of pulpal and periodontal pathology and treatment is necessary. One such treatment is root canal therapy, which involves the cleaning, and shaping of the root canal. The maxim in endodontics states that “it is what you take out of the root canal that is important, and not what you put in”. While canal preparation is the primary mechanism for removal of canal contents, irrigation serves, as a valuable aid in this process.

The success of endodontic treatment depends on the eradication of microbes (if present) from the root-canal system and prevention of reinfection. The root canal is shaped with hand and rotary instruments under constant irrigation to remove the inflamed and necrotic tissue, microbes/biofilms, and other debris from the root-canal space.

The main goal of instrumentation is to facilitate effective irrigation, disinfection and filling of the root canal. Elimination of microorganisms from infected root canals is a complicated task. The chances of a favourable outcome with root canal treatment are significantly higher if infection is eradicated effectively before the root canal system is obturated. However, if microorganisms persist at the time of obturation, or if they penetrate into the canal after obturation, there is a high risk of treatment failure.

Some irrigating solutions dissolve either organic or inorganic tissue in the root canal. In addition, several irrigating solutions have antimicrobial activity and actively kill bacteria and yeasts when introduced in direct contact with the microorganisms. However, several irrigating solutions also have cytotoxic potential, and they may cause severe pain if they gain access into the periapical tissues

HISTORY OF ROOT CANAL IRRIGANTS

Bonwill in 19th century made numerous contributions to dentistry including diamond tipped reamer for root canal work. This clearly reveals that by 19th century root canal therapy was practiced and specialized instruments like reamers were developed but nowhere the use of irrigants is mentioned although we can assume that during preparation of the root canal they might have used something to flush out the debris from the canals.

Rickert and Dixon (1931) gave the “hollow tube concept” which stated that if a treated root canal were left unfilled or incompletely filled, the tissue fluid would enter the root canal by way of apical foramen and will stagnate and form breakdown products in the canals. These products would in turn diffuse back into the periapical region and lead to renewed periapical irritation. The first reported use of a root canal irrigant was by Steward in 1935 who recommended the use of urea peroxide solution of glycerin as an irrigant for the root canals in 1941 Grossman and Mieman et al recommended the use of 5.2 % NaOCl as a root canal irrigant.

In 1943 Grossman also recommended 3% H2O2 to be used as root canal irrigant. In 1947 Prader F recommended a stream of hot water (140 – 176o F) to be used as an irrigant which was discharged from an insulated syringe. Blecman et al in 1951 recommended the use of 30 % solution of urea as an irrigant. The use of chloramine as an irrigant was recommended by Collidge et al in 1956. In 1956 Sir G.V black has mentioned the use of eugenol as a medium to flush out debris during root canal preparation, which also has some inherent mild antiseptic properties.

For many years intra canal irrigation was among the most neglected of all the procedures involved in endodontic therapy. In almost every case either sodium hypochlorite, hydrogen peroxide, or a combination of both was used, and very little importance was given to their mechanism of action in their indications. The medicaments were considered to have better antimicrobial action, and were considered to be more important than the irrigants Although no irrigant meets all the criteria for an ideal irrigant, commonly used are the ones which have the maximum desirable properties.

IDEAL REQUIREMENTS OF A ROOT CANAL IRRIGANT ′

Gross Debridement The irrigant should be capable of mechanically flushing away the pulpal debris and the dentin slurry from the root canals before they are further pushed down to the apex by instrumentation.

Sterilization or at least disinfection. The irrigant should possess broad spectrum antimicrobial properties so that it is able to efficiently disinfect the root canal. Most irrigants are germicidal.

Tissue or Debris Solvent In the regions which are inaccessible to the root canal instruments, the irrigants should dissolve or disrupt the soft tissue or hard tissue remnants so as to permit their easy removal.
Non-Toxicity Ideally the irrigant should be non-injurious to peri radicular tissues so that if the irrigant is inadvertently pushed out of the confines of the root canal it should not cause any inflammatory reaction, but practically this is not possible because all irrigants are usually chemicals with a definite inflammatory response if pushed out of the canal.
Low Surface Tension This property promotes flow into the inaccessible areas. Alcohol which is added to the irrigant decreases the surface tension and increases the penetrability.
Lubricant Lubrication helps root canal instruments to slide down the canal. This makes the instrumentation easier. All liquids have this affect but to a different extent.

IDEAL REQUIREMENTS OF A ROOT CANAL IRRIGANT

Removal of Smear Layer The smear layer is a layer of microcrystalline and organic particle debris spread on the walls after canal preparation. Solutions that chelate and decalcify the hard tissues, removes the smear layer. ′ Bleaching Action The irrigant should possess a bleaching action so that they lighten the teeth discoloured by trauma or silver amalgam restoration and decrease the chance of post-operative darkening. ′
Dilution / Concentration Ideally the concentration of the irrigant should be "minimum concentration with maximum efficacy" that is maximum dilution should be done to minimize the toxicity without compromising on the irrigant efficiency.
Effectiveness The irrigant should be effective enough to produce the desired results like that of tissue dissolution in minimal time so that the overall time spent in cleaning the canal is minimized.
Viscosity The prime function of the root canal irrigant is to flush out the loose, necrotic, contaminated material out of the canal before they are inadvertently pushed deeper in the canals. To accomplish this function the viscosity of the irrigant should be kept minimal so that they can easily enter the non-accessible areas.
Duration of Action The irrigant should remain active for a longer duration so that the desired results are produced without frequent exchange of the irrigant**.**
Other Factors Other factors include availability, moderate cost, user friendliness, convenience, adequate shelf life, and ease of storage. An additional important requirement is that the chemical should not be easily neutralized in the canal to retain effectiveness for a longer time.

FUNCTIONS OF IRRIGATION

Following are some of the important functions of the irrigants:
Gross Debridement The infected root canal system is filled with microorganism and materials that have inflammatory potential. Instrumentation of the canal generates additional debris, which can elicit additional inflammatory response. Much of the debris and organic tissue are removed by the flushing action of the irrigants. The goals of irrigation are to flush out the pulpal debris and dentin slurry from the root canal and to lubricate the endodontic instruments, thereby facilitating their cutting action. Frequency of irrigation and volume of irrigant used are important factors in the removal of debris. The frequency of irrigation should increase as the instrument approaches apical constriction because apical portions of the root canals are especially important because of its relationship to the periradicular tissue. An appropriate volume of irrigant should be at least 1-2 ml each time the canal is flushed. Best way to improve the apical efficacy of irrigant is to use a patency file before each irrigation. The patency file simply moves debris, compacted into the apex back into the solution. Loosened in this manner, the apical debris is more likely to be flushed out by the irrigant. When the preparation diameter is small, placing the file into the apical third is the best way to move the irrigant to that region. The instrument displaces the canal contents, and when it is removed, irrigant is allowed to flow into the vacated space. This action is sufficient to remove the pulpal tissue from a canal with a small calibre.
Elimination of Microbes Irrigants have a minimum antimicrobial effect, but are essential for the reduction of number of bacteria in an infected root canal. Therefore, they do not render pulp space free of bacteria but only disinfect the canals. Most irrigants are germicidal. Also, during instrumentation, the irrigants loosen the debris, pulpal tissue and microorganisms from the irregular dentin walls so that they can be removed from the canals ′
Dissolution of Pulpal Remnants Baumgartner and Madder confirmed 2.5 % NaOCl is extremely effective in removing vital pulpal tissue from dentinal walls.11 The solvent action of the irrigants remove the tissue from accessory canals and other narrow areas where the instruments cannot reach, which can be later packed with filling materials. Dissolution efficacy depends upon structural integrity of the pulpal tissue. If the pulpal tissue is necrosed then it is readily dissolved and if the pulp is vital then it takes longer time to dissolve. So, the cleaning procedures should not be hurried especially when the tooth is vital. The irrigants are capable of causing inflammation of the periradicular tissue. Therefore, instrumentation should be confined within the canal to limit the forcing of irrigant through the apical foramen ′
Removal of Smear Layer Smear layer is composed of debris compacted into the surface of dentinal tubules by the action of instruments. It is burnished into the surface as the edges of instruments slide by. It is composed of fractured Functions of Irrigation bits of dentin and soft tissue from the canal. These materials are released into the flute space of preparation instruments and smeared over the canal by the trailing cutting edges. Since the smear layer is primarily calcific, it is most effectively removed by the action of mild acids like EDTA.
Bleaching Action Some irrigants like H2O2 have an additional bleaching action by virtue of which they lighten the discolouration of the teeth either caused by trauma or by extensive silver amalgam restoration and decrease the chance of post-operative darkening.
Cleaning of the Root Canal Instrument Irrigants prevents the clogging of the debris to the instrument surface. Without irrigation the instrument rapidly becomes ineffective because of accumulation of debris. Thus, irrigation cleans the instruments, making it more effective. So, liberal amount of irrigation is necessary for the effective function of the files.

TYPES OF ROOT CANAL IRRIGANTS

NORMAL SALINE

The primary objective of an irrigating solution is to facilitate the removal of debris during the mechanical instrumentation and this objective can be attained with the help of normal saline Baker et al (1999) advocated the use of physiological saline. In isotonic concentration, it produces no recognized tissue damage and in one study it was demonstrated that it can flush out the debris from the canals as thoroughly as sodium hypochlorite. Saline accomplishes gross debridement and lubrication. Irrigation with saline sacrifices chemical destruction of microbiologic matter and dissolution of mechanically inaccessible tissues (e.g., in accessory canals and intercanal tissue bridges). Isotonic saline is too mild to thoroughly clean canals. So, it should not be the only solution to be used as a root canal irrigant rather it should be used as an adjunct to the chemical disinfection, in which the chemical irrigant provides the disinfecting, and dissolution properties and the saline helps in the mechanical debridement. It can also be used as a final flush of the root canal to remove any chemical irrigant left in

SODIUM HYPOCHLORITE

Sodium hypochlorite is one of the most widely used irrigating solutions. NaOCl ionizes in water into Na1 and the hypochlorite ion, OCl-, establishing equilibrium with hypochlorous acid (HOCl). At acidic and neutral pH, chlorine exists predominantly as HOCl, whereas at high pH of 9 and above, OCl predominates (Mcdonnell and Russell, 1999). Hypochlorous acid is responsible for the antibacterial activity; the OCl ion is less effective than the undissolved HOCl. Hypochloric acid disrupts several vital functions of the microbial cell, resulting in cell death (Barrette et al., 1989; McKenna and Davies, 1988. The antibacterial effectiveness and tissue dissolution capacity of aqueous hypochlorite is a function of its concentration, and so is its toxicity (Zehnder, 2006). Chlorine molecules are the most commonly distributed elements on earth. It is seen in combination with sodium, potassium, calcium, and magnesium. In the body, it is formed in neutrophils through the myeloperoxidase-mediated chlorination of a nitrogenous compound. Buffered 0.5% sodium hypochlorite was initially used for the irrigation of the infected wounds. Sodium hypochlorite is sporicidal, viricidal and shows tissue dissolving effect on tissues. These characteristics popularized the use of aqueous sodium hypochlorite in endodontics as early as 1920. Furthermore, sodium hypochlorite solutions have minimum cost and easily available and demonstrated good shelf life. There are other derivatives of chlorine like chloramine-T and sodium dichloroisocyanurate. These, however, are less effective than sodium hypochlorite at similar concentrations.

MECHANISM OF ACTION

NaOCl has two important properties, namely, antimicrobial activity, and organic tissue dissolution. This can be shown by reactions that take place when NaOCl comes in contact with the organic tissues or microorganisms

NaOCl has organic tissue dissolving properties which will help in degrading fatty acids and transforming them into fatty acid salts (soap) and glycerol (alcohol) which will help to reduce the surface tension of the remaining solution in the next step, hypochlorous acid combines with protein amino groups to form chloramines. This reaction between chlorine and the amino group (NH) leads to the formation of chloramines that interfere with the cell metabolism. Antimicrobial action of chlorine occurs by inhibiting bacterial enzymes and leading to an oxidation of SH groups (sulfhydryl groups) of bacterial enzymes. Methods to increase the efficacy of NaOCl

1. **Temperature** Warming of low concentration NaOCl solution increases the efficacy of tissue dissolution and its antibacterial properties. Recent studies showed that a temperature rise of 25°C increased NaOCl efficacy by 100 times. The temperature and concentration effect suggest that the capacity of 1% of NaOCl at 45°C to dissolve pulp tissue is found to be equal to that of a 5.25% of the solution at 20°C.
2. **Ultrasonic agitation** the ultrasonic agitation with a small file (mostly ISO no. 15) in canals filled with NaOCl lead to the development of ultrasonic energy which warms the solution in the canal. The vibrations cause movement of aqueous NaOCl into the ramifications in the canal, this effect being called as “acoustic streaming.”
3. **Use of fresh solution** Freshly prepared NaOCl solutions have better antimicrobial and tissue dissolving effects. Since NaOCl decomposes quickly, it is stored in opaque containers. 4. Increasing the volume and the duration of the irrigation.

CHLORHEXIDINE GLUCONATE

Chlorhexidine in the chemical form is a cationic bis-biguanide that is usually marketed as a gluconate salt. It belongs to the poly biguanide family, substances which have a positive charge. The antibacterial effect of CHX is due to its positive charge, which is attracted to the negatively charged bacterial cell wall and increases the permeability of bacterial contents.

CHX is effective against Gram-positive microbes and thus can be used in retreatment cases. Studies have shown that it can be used against C. albicans and E. faecalis A commercially available oral rinse contains 0.12% chlorhexidine gluconate in base containing water.

MECHANISM OF ACTION

Being a cationic agent, chlorhexidine electrostatically binds to negatively-charged surfaces of bacteria, damaging the outer layers of the bacterial cell wall and rendering it permeable. The resulting penetration of chlorhexidine into the cell causes precipitation of the cytoplasm, preventing repair of the cell membrane and leading to the destruction of the bacterial cell. At low concentrations, chlorhexidine is only bacteriostatic, causing low molecular weight substances, such as potassium and phosphorus, to leak out without the cell being irreversibly damaged. At higher concentrations, chlorhexidine causes precipitation of the cytoplasm exerting a bactericidal effect. At neutral pH, chlorhexidine is absorbed rapidly and the concentration of free chlorhexidine molecules in solution is low. Under acidic conditions, surface ionization of bacteria is suppressed, reducing the bactericidal effect of chlorhexidine.

ANTIBACTERIAL ACTIVITY

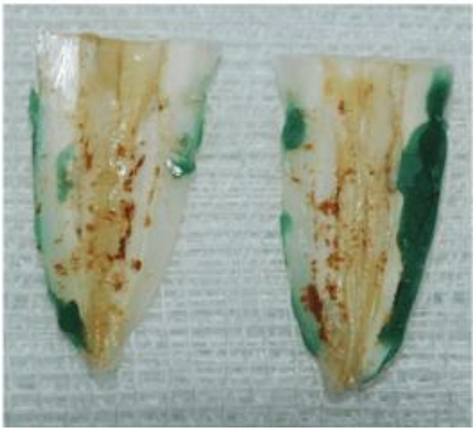
Chlorhexidine is a wide spectrum antibacterial agent, and is active against Gram-positive and Gram-negative bacteria, facultative anaerobic and aerobic bacteria, spores, viruses and yeast. Hennessey found that chlorhexidine had a greater antibacterial activity against Gram-positive than Gram-negative bacteria dermatophytes. It shows increased antimicrobial activity against endodontic pathogens like Staphylococcus aureus, Porphyromonas endodontalis, Porphyromonas gingivalis, Provotella intermedia, E. faecalis, C. albicans, and Streptococcus mutants. It can be used in liquid or gel formulations. The CHX gel makes the instrumentation easier and also reduces the smear layer formation better than the liquid formulation

SUBSTANTIVITY

Due to the cationic nature of the CHX molecule, it can be adsorbed by the hydroxyapatite and the teeth. At concentrations >0.02%, a layer of CHX is formed on the tooth surface which may reduce or prevent bacterial colonization. Rossi-Fedele et al. in their study quoted Rosenthal et al. saying substantivity of 2% CHX solution within the root canal is present after 10 min of application. CHX was antimicrobial effective in the root canal dentine for a period of up to 12 weeks

Precipitate from a combination of sodium hypochlorite and chlorhexidine

During the cleaning and shaping of the root canal, various irrigants have been used to reduce the residual debris, necrotic tissue, and bacteria, as well as to remove smear layer. Though sodium hypochlorite (NaOCl) is the most common irrigant used in root canal treatment, chlorhexidine (CHX) has been suggested as either an alternative or an adjunct root canal irrigant because of its antimicrobial qualities and substantivity. combination of NaOCl and CHX for root canal irrigation has been advocated to enhance their antimicrobial properties. However, the presence of NaOCl in the canals during irrigation with CHX produces an orange-brown precipitate known as parachloroaniline (PCA). The precipitate occludes the dentinal tubules and may compromise the seal of the obturated root canal to solve this problem, we have to try to prevent or minimize precipitation by preventing or minimizing the chance for the two irrigants to come in contact with each other.



Precipitate formation

IODINE

Iodine, used in endodontics in 1979, was found to be an antiseptic against a large number of microbes. Iodine is bactericidal, fungicidal, viricidal, sporicidal, degrades proteins, nucleotides, and fatty acids, leading to bacterial cell death. The advantages of iodine over the other irrigants is that 2% of preparations are shown to be less irritating, poisonous, and rapidly reduces the bacterial load Iodine has the capability to penetrate all the way through dentinal tubules and destroy bacteria, though the period of its antimicrobial action is less. It has the disadvantage of staining dentin tissue.

HYDROGEN PEROXIDE

Hydrogen peroxide solution (H202) is also a widely used irrigant in endodontics. It has two modes of action. ′ The effervescence of the solution when in contact with tissue and certain chemicals physically foams debris from the canal. ′ In addition, the liberation of oxygen destroys strictly anaerobic microorganisms. H2 O2 is available in 3% to 5% of concentrations. It is effective against bacteria, spores, viruses, and yeasts by the formation of free radicals which causes degradation of cell components such as proteins and DNA. The antibacterial action and tissue dissolving capability of H2 O2 are less than that of NaOCl. Combined action of H2 O2 and CHX has better antibacterial action.

EDTAC (Ethylene diamine tetra acetic acid)

Fehr and Nygaard-Østby introduced EDTAC (N-O Therapeutics Hd, Sweden), quaternary ammonium bromide, used to reduce surface tension and increase penetration. t is available in concentrations of 17% as a root canal irrigant with a pH of 7. It kills microbes by chelating with metallic ions needed for growth of bacteria. The concentrations of 15-17% eliminates calcium from dentine leaving an organic matrix and removes the smear layer. The addition of Cetavlon, a quaternary ammonium compound, to EDTA produces a solution called EDTAC, which has greater germicidal activity. However, it has greater inflammatory potential to tissue as well. Goldberg and Abramovich have shown that EDTAC increases permeability into dentinal tubules, accessory canals, and apical foramina. The inactivator for EDTAC is NaOCl

Q-MIX

Q-MIX is an aqueous solution of EDTA, chlorhexidine and N-acetyl-N, N-trimethylammonium bromide. QMix irrigating solution is a single solution used as a final rinse after bleach for one-step smear layer removal and disinfection. Its nonantibiotic, premixed formula provides a "best practice" irrigation protocol in fewer steps for proven and effective irrigation made easy. Fast working, effective and affordable. It offers superior effectiveness at removing smear layer as 17% EDTA. Its excellent bacteria-killing properties eliminate greater than 99.99% of planktonic bacteria -- including the resistant species Enterococcus faecalis

QMix 2in1 irrigating solution offers a fast working time of 60-90 seconds for complete effectiveness. It is premixed and ready to use straight from the bottle with easy chair-side handling. And because QMix 2in1 irrigating solution removes smear layer and disinfects in one easy step, it saves time over using EDTA and chlorhexidine sequentially.

EGTA

Recently ethylene glycol-bis (/3-aminoethyl ether)-N,N.N'.N'-tetra acetic acid (EGTA), a more specific calcium ion chelator has been proposed as alternative chelator for removing the smear layer. For an effective use of EGTA it must be applied with thin files, introducing into the root canal as deep as feasible. Therefore, leakage of EGTA to periapical tissues during root canals preparation is possible.

EGTA is a specific calcium ion chelator. Chelators react with calcium ions in the hydroxyapatite crystals to produce a metallic chelate. Removal of calcium ions from the dentin makes the dentinal tissue softer, especially the hydroxyapatite rich peritubular dentin and increases the diameter of exposed dentinal tubules

CITRIC ACID

Citric acid It is available in 10-50% concentration which is a demineralizing solution that is used during the endodontic therapy to remove the smear layer from the prepared root canal. Citric acid interferes with the mechanism of action of NaOCl. Citric acid 10% is more biocompatible and effective in removing smear layer than 17% of EDTA.

OZONATED WATER AS A ROOT CANAL IRRIGANT

Ozonated water is known to be powerful antimicrobial agent against bacteria, fungi, protozoa, and viruses. It occurs in the environment either in gaseous form or as ozonated water. It is an antiseptic, powerful oxidant, and antibacterial agent. It is a strong oxidizer of cell walls and the cytoplasmic membranes of microorganisms, making it a bactericidal, antiviral, and antifungal agent. The advantages of ozone in the aqueous phase are its potency, ease of handling, lack of mutagenicity, rapid microbicidal effects, and suitability for use as a soaking solution for medical and dental instruments. Recently, it was found that it reduced the viability of oral microorganisms including Gram-positive oral microorganisms, Gram-negative oral microorganisms, and Candida albicans, suggesting that ozonated water might be useful to control oral infectious microorganisms.

PHOTO-ACTIVATED DISINFECTION:

Oscar Raab introduced the photo-activated therapy for the inactivation of microorganisms in the endodontic management.[26] PAD is the placement of a dye (toluidine blue or methylene blue) into the root canals which is then activated by the laser radiation emitted from a low power (100 mW) laser device, causing interference with the microbial cell walls and bacterial death.[27,31] After normal irrigation, the canals are washed with sterile water, and they are dried by sterilized paper points before the application of the PAD solution into the canals. The photosensitizer molecules will attach to the membrane of the microorganisms and the irradiation with a precise wavelength coordinated to the absorption of the photosensitizer will form singlet oxygen which causes cell wall rupture and death of the microbes. The benefit of PAD is that the dye is only poisonous to bacteria, and there are no side effects to adjacent tissues.

MTAD

Itis a mixture of (3% doxycycline), citric acid (chelating agent), and a detergent (Tween 80). Since its introduction, it is a material that has been researched extensively for its properties.it is an irrigant solution with ingredients capable of disinfecting the dentin, removing the smear layer, opening the dentinal tubules and allowing the antibacterial agents to penetrate the entire root canal system. Various antibiotics such as penicillin, bacitracin, and streptomycin have been used in the past to disinfect the root canals. However, because of the ineffectiveness of these antibiotics against the flora of infected root canals and their potential antigenicity, their use has been very limited. Tetracycline including tetracycline-HCI, minocycline, and doxycycline, are broad spectrum antibiotics that are effective against a wide range of microorganisms. Tetracycline is bacteriostatic in nature. This property may be advantageous because in the absence of bacterial cell lysis, antigenic by-products (i.e., endotoxin) are not released. Tetracycline has many unique properties other than its anti-microbial effect. It has a low pH, and thus can act as a calcium chelator and cause enamel and root surface demineralization.

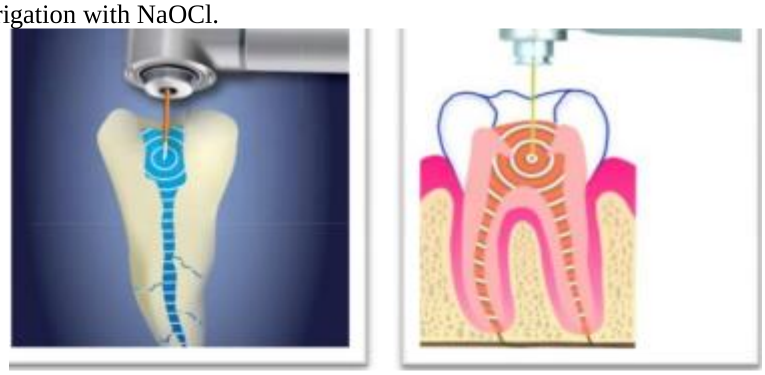
TETRACLEAN

Tetraclean is similar to MTAD, the only difference being the addition of doxycycline-50 mg/ml and a detergent (polypropylene glycol). It is effective against both anaerobic and facultative bacteria. It removes the smear layer and opens up the dentinal tubule orifices. It has shown low surface tension which allows better penetration of the solution into the dentinal tubule.

Lasers Neodymium: Yttrium aluminum garnet lasers have been recently introduced for the disinfection in endodontic therapy. However, it was established that when there was direct contact to the laser, all root canal systems were not entirely eliminated of bacteria and lasers were not superior to irrigation with NaOCl

LASERS

Neodymium: Yttrium aluminium garnet lasers have been recently introduced for the disinfection in endodontic therapy. However, it was established that when there was direct contact to the laser, all root canal systems were not entirely eliminated of bacteria and lasers were not superior to irrigation with NaOCl.



Laser activated irrigation

MALIEC ACID

Maleic acid is a mild organic acid used as an acid conditioner in adhesive dentistry at 5-7% concentration. Final irrigation with 7% of maleic acid is more efficient than 17% of EDTA in the removal of smear layer from the apical third of the root canal system, which is a crucial area for disinfection. 7% of maleic acid produces maximum surface roughness on root canal walls as compared to 17% of EDTA. This surface roughness provides an important role in micromechanical bonding of resin sealers.

BIS -DEQUALINIUM ACETATE

Bis-dequalinium Acetate BDA, a dequalinium compound and an oxime derivative with the trade name Salvizol has been shown to remove the smear layer throughout the canal, even in the apical third. Kaufman et al. has showed that Salvizol, with a neutral pH, has a broad spectrum of bactericidal activity and the ability to chelate calcium. This gives it a cleansing potency while being biologically compatible. Its low surface tension and chelating effect aids in biomechanical cleansing.

Salvizol induces irritation of tissue at levels similar to those of iodophores but less than those of sodium hypochlorite BDA is well-tolerated by periodontal tissues and has a low surface tension allowing good penetration. Salvizol is a detergent suggested for irrigating root canals during instrumentation.

HERBAL IRRIGANSTS

TRIPHALA

Triphala consists of dried and powdered fruits of three medicinal plants Terminalia bellerica, Terminalia chebula, and Emblica officinalis. Triphala achieved 100% killing of E. faecalis at 6 min. Triphala contains fruits that are rich in citric acid, which may aid in removal of the smear layer.

GREEN TEA

Green tea polyphenols showed a statistically significant antibacterial activity against E. faecalis biofilm formed on tooth substrate. It takes 6 min to achieve 100% killing of E. faecalis.

MORINDO CITRIFOLIA JUICE

Morinda citrifolia juice (MCJ) has a broad range of therapeutic effects, including antibacterial, antiviral, antifungal, antitumor, anthelmintic, analgesic, hypotensive, anti-inflammatory, and immune-enhancing effects. MCJ is a biocompatible antioxidant and not likely to cause severe injuries to patients as might occur through NaOCl accidents

CONCLUSION

Newer irrigating solutions are posing a strong challenge towards replacing NaOCl, However till such time that newer irrigating solutions are proven more efficacious than NaOCl, the latter will remain the most dominant and widely used irrigating solution. Selection and use of the correct irrigant for the different clinical situations will help to achieve predictable endodontic success.

REFERENCES:

1. Barkhordar RA, Russel T. Effect of doxycycline on the apical seal of retrograde filling materials. J Calif Dent Assoc 1998; 26:842-5 7. Barkhordar RA, Watanabe LG, Marshall GW, Hussain, MZ, Removal of intracanal smear by doxycycline in vitro. Oral Surge Oral Moo Oral Pathos 1997; 84:420-
2. Baumgartner J, Madder CL. A SEM survey of root canal debridement using three irrigants. JOE 1985; 11:144 9.
3. Baumgartner JC, Cuenin PR. Efficacy of several concentrations of sodium hypochlorite for root canal irrigation. JOE 1992; 18:605.
4. http://dx.doi.org/10.5395/rde.2012.37.3.18
5. Bjortvan K, Skaug N, Selvig KA. Tetracycline-impregnated enamel and dentin: duration of anti-microbial capacity. Scand J Dent Res 1985; 93:192-7
6. Grossman Lt. Sterilization of the root canal. In: Root canal therapy, 4th ed. Philadelphia, Lea & Febiger, 1955:269.
7. Ballal NV, Kandian S, Mala K, Bhat KS, Acharya S. Comparison of the efficacy of maleic acid and ethylenediaminetetraacetic acid in smear layer removal from instrumented human root canal: A scanning electron microscopic study. J Endod 2009; 35:1573-6.
8. Kaufman AY, Binderman I, Tal M, Gedalia I, Peretz G. New chemotherapeutic agent for root canal treatment. A preliminary electron microscopic study on an in vivo and in vitro endodontically treated tooth. Oral Surg Oral Med Oral Pathol 1978; 46:283-95.
9. Chandler NP, Lilley JD. Clinical trial of a bis-dequalinium-acetate solution as an endodontic irrigant. J Dent Res 1987; 66:842
10. Peciuliene V, Reynaud AH, Balciuniene I, Haapasalo M. Isolation of yeasts and enteric bacteria in root-filled teeth with chronic apical periodontitis. Int Endod J 2001; 34:429-34.
11. Asghar S, Ali A, Somoro S, Rashid S. Antimicrobial solutions used for root canal disinfection. Pak Oral Dent J 2013; 33:165-71