



## REVIEW ARTICLE

# 2% Chlorhexidine in Root Canal Treatment: A Review

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### Abstract

Microorganisms and their by-products are considered to be the major cause of pulp and peri-radicular pathologies, and for the dis-infection of these canals we need proper shaping, cleaning of these canals with mechanical instruments and chemical irrigants. Here we are discussing about the chlorhexidine with a concentration of 2% in root canal treatment. It has been found that there is a highly significant reduction in the number of microorganisms in the chlorhexidine-treated specimens after instrumentation and irrigation. Here we will discuss the merits and de-merits of chlorhexidine and its use in root canal as an irrigant or medicaments.

**Keywords:** Chlorhexidine, root canal, irrigants, less toxicity

## 1 | INTRODUCTION

Microorganisms and their by-products are considered to be the major cause of pulp and peri-radicular pathologies. In root canal treatment the foremost aim is to eliminate the microbes from the root canals by shaping, cleaning & irrigation of the canals. It is foremost important that an irrigating solution should have these properties –

1. It should be antibacterial in action
2. Tissue dissolving properties
3. Ability to debride the canal system
4. Non-toxic to tissues
5. Lubrification of canal
6. Ability to remove bacterial biofilm and to avoid alteration of dentinal structure

7. Have broad spectrum antimicrobial properties.
8. Have low surface tension so that it can easily flow into inaccessible areas
9. Be able to effectively sterilize the root canal

There are many irrigating solutions that being used by dentists since many years. These include sodium hypochlorite, EDTA, hydrogen peroxide, povidine-iodine, chlorhexidine, etc; but here we will discuss about the chlorhexidine with a concentration of 2% in root canal treatment.

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## 2 | HISTORY OF CHX

Chlorhexidine has been in use for almost 60 years and has been used in various pharmaceuticals and medical devices. Over that period, it has proven its broad-spectrum efficacy and safety. Chlorhexidine is discovered by the Imperial Chemical Industries, Limited (Manchester, UK) while researching the synthesis of anti-malarial agents (1). Since then, it has been used as general antiseptic purposes in humans as well as in animals.

## 3 | STRUCTURE AND MECHANISM OF ACTION OF CHLOROHEXIDINE

Chlorohexidine is almost colorless to pale-straw colored substance that is almost odorless also. It is widely used in the field of dentistry, medicine, veterinary & food sciences. Most common used concentration of CHX mouth rinses are 0.12% to 0.2%. The 2% concentration can be prepared by pharma companies for the use in endodontics with a brand name like Asep-RC, chlorhexidine, etc.

CHX is a synthetic cationic bis-guanide that consists of two symmetric 4-chlorophenyl rings and two biguanide groups connected by a central hexamethylene chain (2).

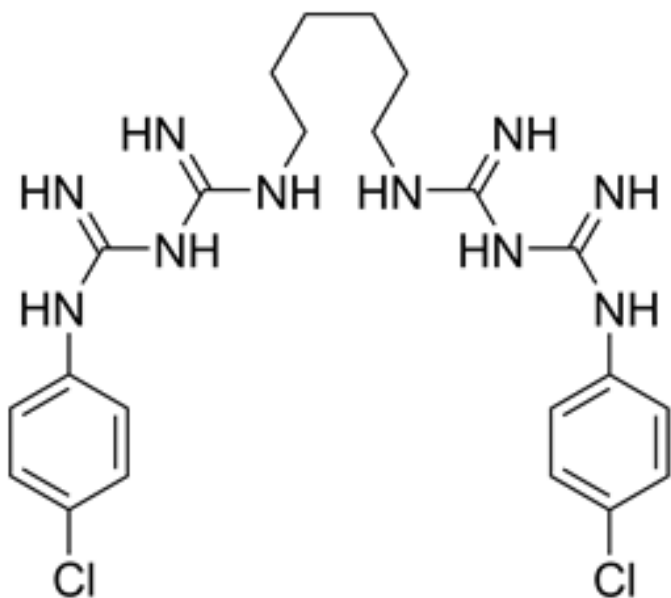


FIGURE 1: Chemical structure of Chlorhexidine

Chlorhexidine is a wide spectrum antimicrobial agent which is active against gram positive as well as gram negative bacteria, yeasts. Chlorhexidine is capable of electrostatically binding to negatively charged surfaces of bacteria and can damage the outer layers of cell wall & making them permeable to it (3). Aqueous solutions of chlorhexidine are more stable in Ph range of 5 to 8. Its bactericidal effect is due to the cationic molecule binding to extra microbial complexes and negatively charged microbial cell walls and thus altering the osmotic equilibrium of the cells. At low concentrations it act as bacteriostatic where as at higher concentrations it acts as bactericidal by coagulating or precipitating the cytoplasm of bacterial cells (4).

### Storage-

The expected shelf life of 2% chlorhexidine is 1-2 years provided the packaging is adequate in a dark, refrigerated bottles.

## 4 | PROPERTIES OF CHX IN ROOT CANAL PROCEDURES

1. **Anti-microbial action of 2% CHX in root canal system-** There is a highly significant reduction in the number of microorganisms in the Chlorhexidine-treated specimens after instrumentation and irrigation.

### Antibacterial activity against *Actinomyces israelii* –

Basson & Tait (2001) compared the ex vivo effectiveness of calcium hydroxide, iodine potassium iodide and a CHX solution in disinfecting root canal systems that were infected with *Actinomyces israelii*. The root canals were exposed to either IKI, calcium hydroxide or 2% CHX for periods of 3, 7 and 60 days. CHX was the only disinfectant that was able to eliminate *A. israelii* from all samples at all time periods whilst 25% of the specimens treated with IKI and 50% of the specimens treated with Ca(OH)<sub>2</sub> still had viable *A. israelii* after treatment (5).

### Antibacterial activity against *E. faecalis* –

Oncag et al. (2003) evaluated the antibacterial properties of 5.25% sodium hypochlorite, 2% CHX and

0.2% CHX plus 0.2% cetrimide (Cetrexidin) after 5 min and 48 h in extracted human teeth after the canals had been infected by *Enterococcus faecalis*. The 2% CHX and Cetrexidin were significantly more effective against *E. faecalis* than the 5.25% NaOCl at both time slots (5).

Antibacterial activity against Staph, *Candida* & other microbes –

Besides the antibacterial action on *E. faecalis* & *A. israelii*, it has been demonstrated that CHX is also antibacterial in action against various bacteria as well as fungi. Two studies (Gomes et al. 2001, Vianna et al. 2004) have investigated the ex vivo antimicrobial activity against endodontic pathogens of three concentrations (0.2%, 1% and 2%) of two forms of CHX (gel and liquid) and compared them with five concentrations of NaOCl (0.5%, 1%, 2.5%, 4% and 5.25%). Both the 2% gel and 2% liquid formulations of CHX eliminated *Staphylococcus aureus* and *Candida albicans* within 15 s, whereas the gel formulation killed *E. faecalis* within 1 min. All of the tested irrigants eliminated *Porphyromonas endodontalis*, *Porphyromonas gingivalis* and *Prevotella intermedia* within 15 secs. The time required for 1.0% and 2.0% CHX liquid to eliminate all microorganisms was the same as the time required for 5.25% NaOCl.

Ercan et al.19 evaluated the antibacterial activity of 2% CHX and 5.25% sodium hypochlorite in infected root canals of incisors and premolars and concluded that both CHX and sodium hypochlorite were significantly effective in reducing the microorganisms in the teeth with necrotic pulps, periapical pathologies, or both, and could be used successfully as an irrigant solution (2).

**2. Tissue dissolving action-** Although chlorhexidine is a potent antibacterial tissue dissolving capability is very little or nil in comparison to NaOCl. Chlorhexidine is a potent antiseptic, which is widely used for chemical plaque control in the oral cavity. Solutions of 0.1 to 0.2% are normally used for periodontal therapy, while 2% is the concentration of root canal irrigating solutions usually found in the endodontic literature. Chlorhexidine does not have any tissue dissolution properties and therefore cannot be used as a primary irrigant in Endodontics. It is however used as an adjuvant to NaOCl.

NaOCl dissolves the organic tissue effectively & kills microbes and EDTA dissolves the inorganic tissue effectively at the concentration of 17% (6).

**3. Post-op pain-** In comparison to sod. Hypochlorite the post-operative pain with chlorhexidine at 6TH hour after irrigation was less with chlorhexidine. There was more post-op pain significantly in teeth irrigated with 5.25% NaOCl in comparison to teeth that were irrigated with 2% CHX (7). But at other time periods like after 24 hours, 4th, 7th day there was no significant difference in the pain level in between two.

**4. Substantivity-** Chlorhexidine is shown to have the unique ability to bind to the proteins present in human tissues. Protein bound chlorhexidine releases slowly leading to prolonged activity & this phenomenon is known as substantivity that allows for a longer duration of antimicrobial action against a broad spectrum of bacteria and fungi. It is considered that the delivery of an agent to its site of action, in a biologically active form, and in effective doses, increases this agent effects for prolonged periods of time.

Substantivity of chlorhexidine, or its ability to be retained in dentin matrices, could be the reason why chlorhexidine-treated acid-etched dentin may form hybrid layers that are more stable over time. The success of chlorhexidine in increasing the durability of resin-dentin bonds requires that more efforts be made toward understanding the mechanisms responsible for chlorhexidine binding to mineralized and demineralized dentin, in an attempt to optimize how chlorhexidine should be used clinically to maximize its retention and effectiveness (8).

**5. Less cytotoxic-** The major advantages of chlorhexidine over NaOCl are its lower cytotoxicity and lack of foul smell. Although clinically, 5.25% NaOCl & 17% EDTA has been advocated; but these have serious limitations that include marked reduction in mechanical properties of dentin and erosion of dentinal tubular microstructure. Most complications of the use of NaOCl is its accidental injection beyond the root apex which can cause violent tissue reactions characterized by pain, swelling, hemorrhage, and in some cases, development of secondary infection & paresthesia. In one study, results suggest that

chlorhexidine was least cytotoxic followed by IKI and MTAD at any test concentration and NaOCl was most cytotoxic (9).

**6. Intracanal medicament-** Chlorhexidine is one of the most versatile medicaments in dentistry in both vital as well as non-vital tooth, mainly because of its alkaline pH & also because of its antibacterial action, it can neutralize the remaining tissue debris in root canal. CHX when used as an intracanal medicament is more effective than calcium hydroxide in eliminating *E. faecalis* from inside dentinal tubules.

**7. CHX & Dentin bonding-** Coronal leakage involves the recontamination of the tooth's interior. It is a major contributor to endodontic failure. It has been shown that chlorhexidine application prior to acid etching has no adverse effect on immediate composite adhesive bonds in coronal dentine & pulp chamber dentin. Erdemir et. al, reported that endodontic irrigation with chlorhexidine solution significantly increases the bond strength to root dentin. In vitro & in vivo studies, application of 2% chlorhexidine in cavities after acid etch & before hybridization with adhesive monomers prevents the loss of bond strength with time & preserves the integrity of hybrid layer. In radicular dentin, use of chlorhexidine as an endo irrigant may also inhibit the bacteria related activation of metalloproteinases (3).

**8. Allergic reactions to CHX-** Although sensitivity to chlorhexidine is rare, contact dermatitis is a common adverse reaction. Apart from that, chlorhexidine is liable to a number of rare side effects, such as desquamative gingivitis, discoloration of teeth and tongue or dysgeusia (distorted taste) (2)

#### **Interaction of CHX & NaOCl-**

The combination of sodium hypochlorite (NaOCl) and chlorhexidine (CHX) forms a precipitate. The presence of the precipitate that is formed due to interaction between NaOCl and CHX has negative effect on the sealing ability of gutta-percha and AH26 sealer (10).

## **5 | ADVANTAGES AND DIS-ADVANTAGES OF CHX-**

### **Advantages and Uses**

1. 2% CHX solution is used as root irrigant in canals.
2. A 0.2% solution can be used in controlling plaque activity.
3. It is more effective on gram-positive bacteria than gram negative bacteria.
4. Used in combination with  $\text{Ca(OH)}_2$  as intracanal medicament.
5. Effective against *E. faecalis*
6. Less toxic and irritant to peri-radicular tissue than NaOCl.
7. Act as intra-canal medicaments in necrotic tissue, retreatment cases and in vital pulp also.
8. Unlike povidone-iodine, chlorhexidine is not affected by the presence of body fluids such as blood.
9. Due to its antimicrobial substantivity, it seems that CHX preparations delay microleakage into the root canal.

### **Disadvantages**

1. It is not considered as the main irrigant in standard endodontic therapy.
2. It is unable to dissolve necrotic tissue remnants.
3. It is less effective on gram-negative than on gram-positive bacteria.
4. Does remove smear layer.
5. Forms ppt with sod. Hypochlorite thus effects on sealing, so not be used along with NaOCl.

## **6 | CONCLUSION**

From the overall above points we can conclude that in spite of the fact that chlorohexidine possesses broad spectrum of antimicrobial activity and substantivity and less toxicity, but due to the lack of

tissue dissolution ability as well CHX is also not able to remove smear layer thus it should not be used as a routine main root canal irrigant. Rather than we can consider CHX as a final rinse irrigant as well as an intracanal medicament in re-treatment cases or incase total or partial necrosis of pulp.

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