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Original Research

Root canal irrigants

[1]Dr.Sukomal, [2]Dr Saurabh, [3]Dr Himanshu Kalia

[1]BDS, Private Practioner, India;
[2]MDS, Senior lecturer, Department of Conservative Dentistry and Endodontics, BJS Dental College and Hospital, Ludhiana, Punjab, India;
[3]MDS, Private Practitioner, India

ABSTRACT:
One of the main goals of root canal treatment is the elimination of microorganisms from the contaminated root canal system. Instrumentation alone will not allow for adequate debridement and disinfection of the complex and diverse root canal system. Chemomechanical debridement is required. The importance of the use of irrigants during non-surgical root canal treatment has frequently been neglected both during instruction of dental students and later in the clinical practice of endodontics.
Key words: Irrigants, Root canal

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Corresponding author: Dr. Sukomal, BDS, Private Practioner, India

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INTRODUCTION

Bacteria have long been recognized as the primary etiologic factors in the development of pulp and periapical lesions. Successful root canal therapy depends on thorough chemomechanical debridement of pulpal tissue, dentin debris, and infective microorganisms. Irrigants can augment mechanical debridement by flushing out debris, dissolving tissue, and disinfecting the root canal system. Chemical debridement is especially needed for teeth with complex internal anatomy such as fins or other irregularities that might be missed by instrumentation.[1]

IDEAL REQUIREMENTS OF ROOT CANAL IRRIGANTS

- Broad antimicrobial spectrum
- High efficacy against anaerobic and facultative microorganisms organized in biofilms
- Ability to dissolve necrotic pulp tissue remnants
- Ability to inactivate endotoxin
- Ability to prevent the formation of a smear layer during instrumentation or to dissolve the latter once it has formed.
- Systemically nontoxic when they come in contact with vital tissues, noncaustic to periodontal tissues, and with little potential to cause an anaphylactic reaction.[2-4]

ROOT CANAL INFECTION

As the host defense loses its access to the necrotic pulp space, opportunistic microorganisms selected by harsh ecological conditions and the low-oxygen environment aggregate in the root canal system. These microbial communities may survive on organic pulp tissue remnants and exudate from the periodontium. Consequently, clusters of microorganisms in necrotic teeth and teeth with failed root canal treatments are typically found in the apical root canal area, where they have access to tissue fluid. In long-standing infections, root canal bacteria can invade the adjacent dentin via open dentinal tubules.[5]

Primary root canal infections are polymicrobial, typically dominated by obligately anaerobic bacteria. The most frequently isolated microorganisms before root canal treatment include Gram-negative anaerobic rods, Gram-positive anaerobic cocci, Gram-positive anaerobic and facultative rods, Lactobacillus species and Gram-positive facultativeStreptococcus species. The obligate anaerobes are rather easily eradicated during root canal treatment. On the other hand, facultative bacteria such as nonmutans Streptococci, Enterococci, and Lactobacilli, once established, are more likely to survive chemomechanical instrumentation and root canal medication. In particular Enterococcus faecalis has gained attention in the endodontic literature, as it can frequently be isolated from root canals in cases of failed root canal treatments. In addition, yeasts may also be found in root canals associated with therapy-resistant apical periodontitis. It is likely that all of the microorganisms able to colonize the necrotic root canal system cause periapical inflammatory lesions. Enterococci can survive in monoculture, but cause only minor lesions. Certain Gram-negative taxa appear to be more virulent. The outer membrane of Gram-negative bacteria contains endotoxin, which is present in all necrotic teeth with periapical lesions, and is able to trigger an inflammatory response even in the absence of viable bacteria. Furthermore, the levels of endotoxin in necrotic root canals are positively correlated to clinical symptoms such as spontaneous pain and tenderness to percussion. Virulent Gram-negative anaerobic rods depend on the presence of other bacteria in their environment to survive and establish their full pathogenic potential. Such aggregations of microorganisms in an extracellular polysaccharide matrix associated with a surface (in our case the inner root canal wall) are called biofilms.[6- 8]

There is convincing evidence that microorganisms organized in this manner are far less susceptible to antimicrobial agents than their planktonic counterparts, which have traditionally been used to test the antimicrobial efficacy of substances in vitro. If a bacterially inoculated broth is confronted with an antimicrobial fluid, the efficacy of that agent can appear to be very convincing, similar as with agar-diffusion tests. However, in the root canal system biofilms and infected dentinal tubules make disinfection much more difficult and thus study models such as standardized infected bovine dentin blocks or in vivo models appear to be more valid than the above mentioned study designs. Furthermore, it has been shown that organic and inorganic dentin components, which are suspended in the irrigant during chemomechanical instrumentation, inhibit most antimicrobial agents.[6- 9]

SODIUM HYPOCHLORITE

Chlorine is one of the most widely distributed elements on earth. It is not found in a free state in nature, but it exists in combination with sodium, potassium, calcium, and magnesium. In the human body, chlorine compounds are part of the nonspecific immune defense. They are generated by neutrophils via the myeloperoxidase-mediated chlorination of a nitrogenous compound or set of compounds. Hypochlorite preparations are sporicidal and virucidal and show far greater tissue dissolving effects on necrotic than on vital tissues. These features prompted the use of aqueous sodium hypochlorite in endodontics as the main irrigant as early as 1920. Ultrasonic activation of sodium hypochlorite has also been advocated, as this would "accelerate chemical reactions, create cavitational effects, and achieve a superior cleansing action". However, results obtained with ultrasonically activated hypochlorite versus irrigation alone are contradictory, in terms of both root canal cleanliness and remaining microbiota in the infected root canal system after the cleaning and shaping procedure. it should also be noted that time is a factor that has gained little attention in endodontic studies. Even fast-acting biocides such as sodium hypochlorite require an adequate working time to reach their potential.[10- 12]

EDTA

Although sodium hypochlorite appears to be the most desirable single endodontic irrigant, it cannot dissolve inorganic dentin particles and thus prevent the formation of a smear layer during instrumentation. Demineralizing agents such as ethylenediamine tetraacetic acid (EDTA) and citric acid have therefore been recommended as adjuvants in root canal therapy. These are highly biocompatible and are commonly used in personal care products. Although citric acid appears to be slightly more potent at similar concentration than EDTA, both agents show high efficiency in removing the smear layer. In addition to their cleaning ability, chelators may detach biofilms adhering to root canal walls. An alternating irrigating regimen of NaOCl and EDTA may be more efficient in reducing bacterial loads in root canal systems than NaOCl alone.[13- 18]

CHLORHEXIDINE

Chlorhexidine was developed in the late 1940s in the research laboratories of Imperial Chemical Industries Ltd. (Macclesfield, England). The original salts were chlorhexidine acetate and hydrochloride, both of which are relatively poorly soluble in water. Hence, they have been replaced by chlorhexidine digluconate. Chlorhexidine is a potent antiseptic, which is widely used for chemical plaque control in the oral cavity. Aqueous solutions of 0.1 to 0.2% are recommended for that purpose, while 2% is the concentration of root canal irrigating solutions usually found in the endodontic literature. It is commonly held that chlorhexidine would be less caustic than sodium hypochlorite. However, that is not necessarily the case.[17- 19]

CONCLUSION

Root canal irrigants, when used individually and in sequence, appear to decrease the flexural strength and microhardness of dentin, with disproportionation of the inorganic and organic components. NaOCl dissolves the pulp tissue and microbial biofilms, at the same time non-uniformly creating and spreading throughout the deproteinization channels. When EDTA is used subsequently, it removes the hard tissue debris, opens up the dentinal tubules and exposes the collagen fibers.

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