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ROLE OF LASER, PRP IN ADJUNCT WITH CHLORHEXIDINE IN ROOT CANAL DISINFECTION AGAINST PATHOGENIC MICROORGANISMS – A NEW SPHERE IN ENDODONTIC THERAPY

Dentistry

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ABSTRACT

The objective of endodontic treatment is to eradicate all the microorganisms and microbial outcomes from root canal system. This aim can be reached through proper chemical and biomechanical debridement of root canals of the particular infected teeth. This review article narrates the distinct requirements of the agents with the specific antimicrobial efficacy. Sodium hypochlorite is the primary irrigant by virtue of its organic tissue dissolution capacity and broad antimicrobial properties. EDTA, chelating agents are recommended as additional solutions to remove the smear layer and to hinder its formation on dentin surface.. This article reviews the new agents which can be used in future endodontic treatment with good antimicrobial efficacy and no side effects.

KEYWORDS

Laser, Platelet rich plasma, Sodium hypochlorite

INTRODUCTION:

The effectiveness of endodontic instruments, chelating agents and solutions in cleaning, shaping and disinfecting the root canal determines the success, longevity and reliability of the treatment.

Elimination of microorganisms from infected root canals is a challenge. There is a higher chance of getting favourable results from root canal treatment if the infection is eradicated well. However, if bacteria remain and enter the canal after the intervention, the risks of treatment failure will increase[1].

There are various ways to reduce infection and disinfect the root canal, including the use of various instrumentation and irrigation techniques and intracanal medications[1]. Cleaning all aspects of the root canals using a variety of irrigation protocol is important for effective dental care. Bone healing plays an important role. The effectiveness of irrigation depends on how the irrigant works and how long it remains in contact with the bacteria and tissues in the root canal.

Root canal disinfection is a very ardous process because once the tooth becomes infected; the fins, cul de sacs, accessory canals and dead spaces continue to be a source of infection. A large number of bacterial morphotypes and the accumulation of different bacterial morphotypes have been shown to be closely associated with teeth.

Although there are many disinfecting agents in the market, none can eliminate microorganisms completely and their success is limited.

Mycobiome Of Root Canal:-. The microbiome of the root system is polymicrobial[2]. Microbial organisms in endodontic treatment comprise of anaerobic bacteria, Gram-negative anaerobic bacilli, Gram-positive anaerobic cocci, Gram-positive anaerobic and facultative bacilli, Lactobacilli, and Gram-positive facultative Streptococci. Obligate anaerobes are easily eliminated during root canal treatment, while facultative bacteria such as non-mutant Streptococci, Enterococci and Lactobacilli remain even after chemomechanical instrumentation and root canal treatment[2]. Enterococcus faecalis is often isolated in root canal treatment failure.

Irrigant

Sodium Hypochlorite: Sodium hypochlorite is an endodontic irrigation agent with antibacterial, sporicidal and virucidal properties. Chloride compounds are part of the immune system[1]. They are produced by neutrophils through myeloperoxidase-mediated chlorination of a nitrogenous compound or group of compounds and are more histolytic in nasal necrotic tissues than in tissues[1]. Have a pulp dissolution effect and also antimicrobial effect depending on concentration and temperature[4] It is a strong oxidant that can dissolve organic substances such as tissues and organs.

When used as irrigation, sodium hypochlorite can help kill bacteria in the root canal, dissolve necrotic tissue, and remove debris. Commonly used concentrations range from 0.5% to 5.25%.

However, there are some risks associated with using sodium hypochlorite as a root canal agent. If it extends beyond the roots, it can damage tissue, causing pain, swelling and other problems. Additionally, sodium hypochlorite can discolor teeth, especially when used with metal tools. For safe and effective use, it is important to use sodium hypochlorite carefully and follow proper procedures. This involves using appropriate concentrations, volumes and methods for each situation, as well as taking steps to reduce the risk of extrusion.

Chlohexidine Chlorhexidine is antimicrobial, this effect is due to its positive charge which attract the negatively charged bacterial cell wall and increases the permeability of bacterial contents[5]. It is bacteriostatic at low concentrations and becomes bacteriocidal at higher concentrations. Chlorhexidine is effective against Gram-positive microbes and due to this reason it can be used in retreatment root canal cases. At higher concentrations it causes extensive bacterial cell damage, coagulation of cytoplasm, and precipitation of proteins and nucleic acids. CHX is active against Gram-positive and Gram-negative bacteria, bacterial spores, lipophilic viruses, yeast, fungi, and dermatophytes[6]. The antimicrobial activity of CHX depends on the achievement of an optimal pH (5.5–7)[6] It shows increased antimicrobial activity against various pathogens like Staphylococcus aureus, Porphyromonas endodontalis, Prevotellaintermedia, E. faecalis, C. albicans, and Streptococcus mutants[5]. It is used as in liquid or gel forms and in paper point. Its gel formulation makes the instrumentation easier which in turn reduces the smear layer formation better than the liquid formulation. Due to its cationic structure, it is adsorbed by hydroxyapatite and teeth.

While CHX can kill bacteria, it is not effective in removing biofilm and other organic matter. A 2% CHX solution was designed to achieve the maximum desired antimicrobial effect at the end of the chemomechanical preparation. CHX has a long-lasting antibacterial effect; CHX preserves its antibacterial effect by binding to hard tissue. This effect is due to the number of CHX molecules interacting with dentin. White et al. Effects of 2% CHX have been reported for 72 hours to 12 weeks. The disadvantage of CHX is its lack of resolution. CHX is a broad-spectrum matrix metalloproteinase (MMP) inhibitor (anticollagenolytic). Although CHX does not cause long-term tissue damage, it can cause side effects if accidentally extruded from the root. There are a few rare side effects of CHX, such as exfoliative gingivitis, tooth and mouth pigmentation, and nausea (mouth discomfort). The

addition of surfactants to CHX products (CHX-Plus) reduces surface tension and increases resistance to bacteria and biofilms. However, there are no studies examining the complications that may occur if surfactant-containing irrigation fluids escape from the periapical tissue in clinical practice. QMix is a solution specifically designed for final channel cleaning. The combination of CHX with additional surfactants and EDTA was used to increase penetration into dental canals[6].

EDTA: Complete cleaning of the root canal requires the use of organic and inorganic tissue-dissolving irrigation solutions. Since NaOCl can only be used on organic tissues, other solutions must be used to remove smears and debris from the root canal. It is recommended to use demineralizing agents such as EDTA and CA as adjuvants during root canal treatment. In 1957, Nygaart-Ostby proposed the use of chelating agents to help prepare narrow and calcified canals. The initial recommended EDTA solution is 15% and pH 7.3. EDTA is often used as a 17% neutralizing solution. These chemicals interact with calcium ions in the teeth to form soluble calcium chelates[4].

MTAD (Mixture of Tetracycline, Acid and Detergent) It was introduced as an alternative to EDTA by Torabinejad and colleagues. Remove the smear layer. It is a combination of 3% doxycycline, 4.25% citric acid and Tween 80 detergent. It has complex antimicrobial chelating properties, but its antimicrobial properties can be inhibited by the buffering effect of dentin and serum albumin.flow. The success process is achieved when citric acid removes the soil layer, allowing doxycycline to enter the dental canal and create its antimicrobial effect. A 20-minute initial rinse with 1.3% NaOCl is recommended, followed by a 5-minute final rinse with MTAD. Their disadvantage is that they do not dissolve organic tissue and are therefore used after sodium hypochlorite at the end of the chemical preparation. MTAD is reported to have antibacterial properties and is available from Dentsply as BioPure MTAD

H2O2 (Hydrogenperoxide) It is a clear, odorless liquid widely used in dentistry. It is a very unstable substance that decomposes from heat and light. When oxygen enters tissue enzymes, it will produce bactericidal bacteria, affecting bacterial metabolism. Additionally, the rapid release of newly formed oxygen creates bubbles that are said to help eliminate waste product by eliminating necrotic tissue and dentin debris. However, higher concentrations of hydrogen peroxide are toxic to tissues. While concentrations of 1-30% are used in dentistry, only 3-5% is used in endodontic treatment. Using water in combination with NaOCl has proven to be less effective than using it alone because the reaction causes the release of oxygen. Lack of rapid oxygen production can also cause problems because it interferes with the blood and tissues and causes pressure to build up that can cause severe pain[5].

Iodinecompounds

These are bactericidal, virucidal, fungicidal, tuberculocidal and sporicidal. 2% iodine in 4% potassium iodide (IPI) is commonly used in endodontic treatment. This combination exhibits no toxicity and reduces the tendency for dentin staining. The main advantage of iodine is that its 2% formulation is less toxic and less irritating than formocresol, Camphorated Monochlorophenol (CMCP) and Cresatine, and rapidly reduces disease.

Hydroxyethylidene Bisphosphonate (HEBP) HEBP, also known as etidronic acid or etidronate, is a decalcifying agent that reacts slightly with NaOCl. EDTA or EDTA replacement has been suggested.by HEBP prevents osteoporosis and is therefore used as an agent in the treatment of osteoporosis and Paget's disease. However, further research is needed to determine whether this solution improves or shortens endodontic irrigation time[6].

Ozonated Water

Ozone (O3) effectively kills bacteria, including spores, even in small amounts (0.01 ppm). It can be easily produced with an ozone generator. Ozone dissolves easily and quickly in water. In one study, researchers compared the bactericidal activity of ozonated water and 2.5% NaOCl under sonic activation. They reported that ozonated water did not neutralize E. coli or lipopolysaccharide in the root canal and that residual lipopolysaccharide could be toxic by inducing periapical inflammation. More research is needed before ozonated water can be used in routine medical care for root canal treatment[6].

Tetraclean

Like MTAD, Tetraclean (Ogna Laboratori Farmaceutici, Muggiò (Mi), Italy) is a mixture of citric acid, doxycycline (at a lower concentration than MTAD), and detergent. The concentration of the antibiotic (doxycycline - 50 mg/ml) and the type of cleaning agent (propylene glycol) differ from those in MTAD. It does not dissolve organic tissues and after NaOCl is tetraclean recommended after biomechanical preparation. It shows high activity against anaerobic and facultative anaerobic bacteria. It is more effective than MTAD against planktonic E. coli. E. coli Enterococcus faecalis and in vitro biofilms composed of mixed species[6]

Herbal Alternatives

Various plant species have been tested to determine their ability to kill root canal microorganisms during root canal treatment. Root canal disinfection from propolis, miswak, neem, Morinda citrifolia (MC), Myrtus communis, Myristica fragrance, turmeric, chamomile, babool, garlic, aloe vera, triphala, green tea polyphenols (GTP), and myrtle, coconut extract, turmeric, chamomile, babool, garlic, aloe vera, ternary, green tea polyphenols (GTP) and other terrestrial plant antibiotics were tested. The main advantages of using herbal alternatives in root canal treatment are; easy availability, low cost, long life, non-toxicity and lack of microbial resistance. Most options include.

Triphala: Triphala is a botanical mixture made by drying and crushing the fruits of three medicinal plants: terminabellerica, termina chebula, and emblica officinalis Triphala kills 100% of Enterococcus faecalis in 6 minutes. When used in different proportions, its effects will increase synergistically. Topbas and Adiguzel Endodontic Irrigation Solutions International Dental Research © 2017. Triphala is a fruit rich in citric acid, which helps removal of the smear layer. Green tea polyphenols are obtained from the fresh leaves of Camellia sinensis, an important part of traditional Japanese and Chinese culture. They revealed significant antibacterial activity against Enterococcus faecalis biofilms grown in dental culture, killing all Enterococcus faecalis within 6 minutes.

Morinda Citrifolia (MC) Morinda Citrifolia (MC) (Noni) has many therapeutic properties such as antibacterial, antiviral, antifungal, antitumor, antihelminthic, analgesic, hypotensive, antiinflammatory, and immune-developmental effects. It contains L-asperuloside and alizarin, which have antibacterial properties. Using MC for endodontic irrigation may be beneficial because it has more biological antioxidants. In addition, it has no harmful effect on the patient or the environment, which is relevant in the context of NaOCl irrigation accidents[6].

Electrochemically Activated Water (Superoxidized Water)

Electrochemically activated solutions (ECA) are produced from tap water and salt solutions with low concentrations. Anolyte solutions include combinations of oxidizing agents with microbicidal activity against bacteria, viruses, fungi, and protozoa. They are referred to as superoxidized water or oxidative potential water. They do not damage vital biological tissues and are not toxic Electrochemical activation has produced promising results in terms of effective root canal irrigation[6].

Laser Activation- The interaction between lasers and intracanal irrigants opens new areas of research in the field of endodontic disinfection. This concept forms the basis of Laser Activated Irrigation (LAI) and PIPS technology (Photon Initiated Photoacoustic Flow). This interactive process is due to the effectiveness of the sodium hypochlorite laser. This causes the liquid to evaporate and form bubbles that expand and collapse under the influence of secondary cavitation. PIPS technology is based on the energy of the erbium:YAG laser, which produces photoacoustic shock waves in the water entering the root canal. The high absorption of laser light by the hypochlorite and the high peak energy produced by short pulses (50 μs) when the fluid box is opened determines the photomechanical effect, which cannot be completely eliminated by biofilm-covering the first three root canals and bacteria in the tooth, but the laser produces poorer tests in terms of culture of more bacteria. It did not completely remove the biofilm from the apical third of the root canal and infected dentinal tubules but by laser activation generated a higher number of samples with negative bacterial cultures and a lower number of bacteria in the apical third was a promising result on the effectiveness of the technique, also confirmed by more recent studies[7].

Lasers

According to the research, current findings show that the diode laser can kill Enterococcus faecalis in the bacteria in the canal, therefore it

can be effective against all kinds of bacteria in endodontic diseases, and the technology may have clinical applications in root diseases[8]. 1064 nm diode laser for endodontic treatment has a significant antibacterial effect on root infections caused by Enterococcus faecalis. The sterilization effect depends on the laser parameters and the effects are different at different powers. Laser irradiation time plays an important role with the laser flat fiber tip for irradiation process[8].

Laser irradiation has been shown to have the ability to kill bacteria and remove debris and smearlayer from the root canal. When it comes to root canal treatment, there is not enough evidence to show that any laser is superior to conventional endodontic treatment. Erbium and Nd:YAG wavelengths can be used in root canal debridement and cleaning; Erbium laser for laser-activated irrigation and photon-induced photoacoustic flow, and Nd:YAG laser for evaporation and shrinkage of the smear layer. Finally, it is recommended that tihe laser can be used in addition to debridement protocol, not instead of NaOCl or any irrigating agents[9]. More clinical studies are needed to evaluate the results of endodontic treatment after laser use. The laser wavelengths used to clean and disinfect the root canal are: Erbium: Yttrium Aluminum Garnet (Er: YAG), 2940 nm; Erbium, Chromium: Yttrium Aluminum Garnet (Er, Cr: YSGG), 2780 nm; Neodymium: Yttrium aluminum garnet (Nd:YAG), 1064 nm; diode, 635 to 980 nm; potassium titanyl phosphate (KTP), 532 nm; carbon dioxide (CO2), 9600 and 10 600 nm[9].

Nd: YAG Laser is the most popular laser. The device is the system used to clean and shape the root canal as a thin fiber optic transmission system enables the canal to enter the narrow root canal. Lasers can remove smear layers and debris; However, it is difficult to clean the entire root canal wall with this device because the linear emission of the laser beam makes it almost impossible to irradiate the lateral canal walls and leaves them rough and uneven The root canal pieces are not very straight; they are usually curved in at least two dimensions.

Bioactive Glass

Recently, the bioactive glass or bioactive glass-ceramics have been the object of considerable interest for endodontic disinfection due to their antibacterial properties, but with conflicting results[7].

Platelet-rich Plasma

In conclusion, Platelet Concentrate is safe autologous products, which can be easily prepared during surgery and possess an antibacterial activity. They could be potentially useful substances in the fight against postoperative infections and might represent the linking of Osteoinductive and antimicrobial activity. Further research should investigate Platelat Concentrate antimicrobial capacity compared to antibiotics, their exact antibacterial spectrum and prove its efficacy in the in vivo situation. The influence of characteristics (sex, age, hematocrit, platelet count, drug assumption, etc....) on antimicrobial activity should be clarified[12].

According to the study of Thuy Anh Vu Pham et al, PRP also showed bacteriostatic effects against a major periodontal pathogen, P. gingivalis. It is possible to use this material as an adjunct with antibiotics to reduce the amount of bacteria, as well as the best mechanical treatment to prevent bacterial adhesion and biofilm formation on periodontal tissue[13].

Based on the study conducted by Agata CieVlik-Bielecka, it can be determined that L-PRP can evoke in vitro antimicrobial effects and might be used to treat selected infections in the clinical field. The major volume of thrombin as an activator increases the strength of the L-PRP antimicrobial effect. The use of platelet concentrate technologies for the collection and use of natural antimicrobial agents of the body is a very interesting approach[14].

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