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REVIEW ARTICLE

Irrigation in Endodontics: "Slow and Steady wins the Race, Clean and Tidy wins the Chase"

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ABSTRACT

Endodontic treatment is a predictable procedure with high success rates. Success depends on a number of factors, including appropriate instrumentation, successful irrigation, and decontamination of the root canal space to the apices and in areas, such as isthmuses. These steps must be followed by complete obturation of the root canals, and placement of a coronal seal, prior to restorative treatment. Diagnosis, instrumentation, obturation, and restoration are the main steps involved in the treatment of teeth with pulpal and periapical diseases. Elimination or significant reduction of irritants and prevention of recontamination of the root canal after treatment are the essential elements for successful outcomes. Although many advances have been made in different aspects of endodontics within the past few years to preserve natural dentition, the main objective of this field remains elimination of microorganisms from the root canal systems and prevention of recontamination after treatment.

Keywords: Irrigation, Root canal therapy, Successful outcome.

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INTRODUCTION

Endodontic treatment is a predictable procedure with high success rates. Success depends on a number of factors, including appropriate instrumentation, successful irrigation, and decontamination of the root canal space to the apices and in areas, such as isthmuses. These steps must be followed by complete obturation of the root canals, and placement of a coronal seal, prior to restorative treatment. Diagnosis, instrumentation, obturation, and restoration are the main steps involved in the treatment of teeth with pulpal and periapical diseases. Elimination or significant reduction of irritants and prevention of recontamination of the root canal after treatment are the essential elements for successful outcomes. Although many advances have been made in different aspects of endodontics within the past few years to preserve natural dentition, the main objective of this field remains elimination of microorganisms from the root canal systems and prevention of recontamination after treatment.[1]

In 1910, Hunter introduced the concept of "oral sepsis" and stated that this condition would lead to a wide array of systemic diseases, such as gastritis, anemia, ulcers, colitis, and nephritis. It was to give the fledgling field of endodontics the direction it needed to direct treatment and scientific investigation aimed at more definitive treatment. The thought that treatment of the pulpal chamber and root canal systems was viable had been challenged by a multitude of factors during the first half of the 20th century. The work of Hess and others had shown the root canal system to be a maze of interconnecting lateral canals, ramifications, fins, and isthmus.[2] It is this complexity that led L Grossman to remark, "One may well ask at this point if root canal work is justified in view of the complexity of the canals, since by no method can all the minute ramifications be filled."

This underlying conclusion had even gained popularity in the early 1900s due to the broad acceptance of the theory of "focal infection." It is only with progressive understanding of the biological systems involved in endodontic pathology that we have been able to overcome these barriers to treatment. By identifying bacteria as the underlying cause of periapical periodontitis and clearly showing the therapeutic benefit of removing these bacteria and their by-products, the field of endodontics has developed and continues to improve the standards of treatment.[3]

The importance of using an antimicrobial irrigant to reduce the bacteria load during root canal treatment, regardless of the irrigant or instrumentation technique, has been reported.[4]

Bystrom and Sundqvist[5] evaluated the antibacterial effectiveness of mechanical instrumentation and irrigation. They found considerable reduction in bacterial counts after instrumentation and irrigation with saline, yet all the teeth had a positive culture after the first appointment. When they used sodium hypochlorite (NaOCl) separately or combined with ethylene diamine

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tetraacetic acid (EDTA), the elimination of bacteria was significantly improved.[6,7]

It is truly said, "Instruments shape, irrigants clean."

NEW MODALITIES OF IRRIGANTS

- Lasers
- Light-activated disinfection
- Electrochemically activated water
- Oxidative potential water
- Cetrixidine
- Chitosan.

Lasers

According to Moshonov et al, Nd–YAG laser irradiation significantly reduced the number of bacteria but it is inferior to NaOCl irrigation, which disinfected the canals. According to Gutknecht et al, Ho–YAG shows excellent antibacterial efficacy against *Enterococcus faecalis*, while CO_2 laser shows mixed response. Takeda et al concluded that CO_2 laser removed and melted the smear layer on instrumented canal walls, while Er–YAG laser is most effective in removing the smear layer.

Light-activated Disinfection (LAD) (Figs 1 to 3)

It is a photodynamic antimicrobial chemotherapy. It has a photosensitizer (toluidine blue dye, methylene blue dye, etc.). The canal is then filled with a photosensitizer and then illuminated with a light source (laser, white light, red light, or a light eliminating diode).

In 1997, Leonov produced a new and unique anode–cathode system. It is extremely biocompatible. According to Marais, it produces a much clearer dentinal wall compared to NaoCl. Electrochemically activated water (ECA) is produced via a unique Ti anode–cathode system in two forms.

- An analytic solution having high oxidation potential (400–1200 mV). This makes it highly antibacterial.

Fig. 1: Light activated disinfection

- A catholytic solution with a high reducing potential (80–900 mV). This has a detergent kind of action.

Electrochemically activated water is produced from nothing more than tap water, salt, and electricity and thus is extremely biocompatibility. According to a study by JT Marais, ECA produced much clearer dentinal walls compared to NaOCl.

Oxidative Potential Water (Fig. 4)

Oxidative potential water (OPW) has been used extensively in Japan for household and agricultural disinfection because of its safety and bactericidal effectiveness. The antimicrobial and antiviral activities of OPW are sufficiently powerful to kill a wide variety of pathogens, including methicillin-resistant *Staphylococcus aureus* (MRSA) and HIV. The scientific basis for the development of the OPW is that microorganisms cannot survive in an aqueous environment with both low pH (less than 3) and high oxidation–reduction potential (greater than 0.9 V).[8] Oxidative potential

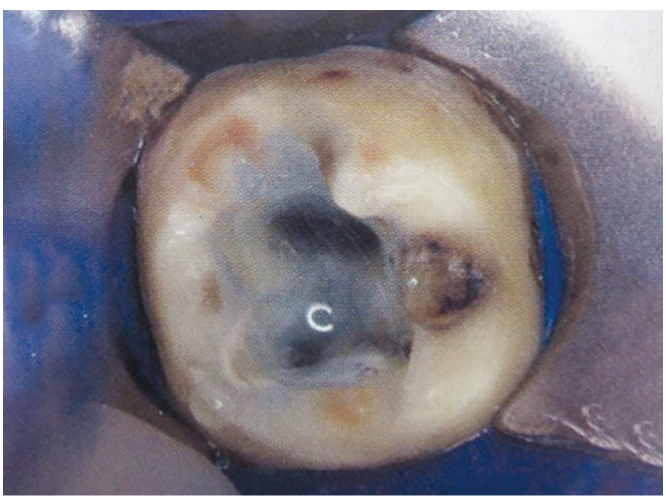

Fig. 2: Application of photosensitizer

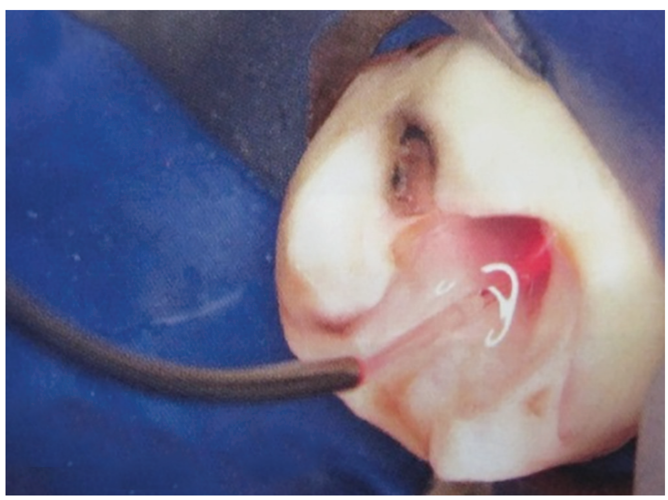

Fig. 3: Light-activated disinfection

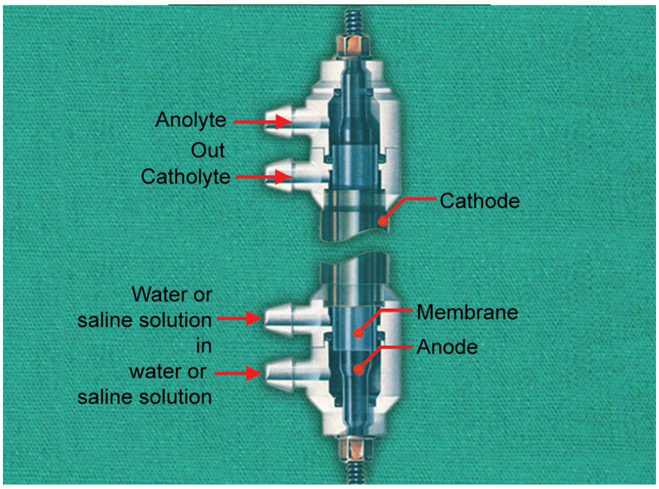

Fig. 4: Electrochemically activated water

water is an electrochemically created, highly acidic water that accumulates in the anode compartment of Aquacida (NDX-250KH, Nihon Aqua Co., Ltd, Kyoto, Japan) after sodium chloride (added for consuming the OH– ions) is added to water. It is the counterpart of alkaline water formed in the cathode compartment after the water that has consumed the H+ ions. Oxidative potential water is created electrochemically by the use of devices in which anode and cathode are separated by a membrane in order to form two compartments. Electrolysis of aqueous sodium chloride solution by the device can yield acidic and oxidative electrolyzed water (pH lower than 2.7 and oxidation–reduction potential higher than +1100 mV) at the anode side compartment, and the alkaline and reductive electrolyzed water (pH higher than 11 and oxidation–reduction potential lower than –800 mV) at the cathode side. Oxidative potential water has strong antimicrobial activity, killing viruses as well as bacteria, an unusually low pH of 2.7 or less, and oxidation–reduction potentials of 1050 mV or greater.[9] This is considerably greater than tap water, which, in Japan, averages 300 mV to 400 mV, and greater than several activated oxygen-containing antimicrobial constituents, such as HOCl and O_3. It has been confirmed that OPW can condition both enamel and dentin for bonding with composite resin because of its low pH.[10] Oxidative potential water is well suited for dental treatment because of its low toxicity and lack of irritation to soft tissues, and because it quickly loses its high oxidation–reduction potential and low pH when it reacts with light-sensitive and/or organic substances. For these reasons, it is completely safe as a root canal irrigant. A study by Hata et al in 1996 showed that OPW effectively removed the smear layer from instrumented canal walls when used as an irrigant.

Cetrixidine

It contains 0.2% CHX and 0.2% cetrimide and there is better penetration of CHX into the dentinal tubules and better antimicrobial efficacy.

Chitosan

It is a naturally occurring polysaccharide. Chitosan at 0.2% concentration has been proposed by Silva et al as an efficiating chelating agent without the negative effects of high concentration EDTA. It is easily available, cheap, biocompatible, biodegradable, has the property of bio-adhesion, and has antimicrobial activity.

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