

Literature Review

A review of sodium diclofenac as a potential medicament to eliminate *Enterococcus faecalis* in regenerative endodontic treatment

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ABSTRACT

Background: Traumatic dental injuries often occur in the community reaching 85% of patients and in preschool children the proportion reaches 17%. Among the injuries are tooth fracture, tooth luxation, tooth avulsion and open apex which causes pulp death or necrosis, causing root growth to stop. Regenerative endodontic treatment (RET) with a biological approach to treat necrotic immature permanent teeth can promote pulpal growth, increase the thickness of the dentin wall and form apical foramens. *Enterococcus faecalis* bacteria can be resistant to some drugs and root canal irrigation substances and may persist in the root canal system. Recently, sodium diclofenac has been reported to retain a new potential to eliminate *Enterococcus faecalis* biofilm. This shows that sodium diclofenac is potential as an anti-biofilm material. **Purpose:** To evaluate the potential use of sodium diclofenac in RET. **Review:** This review was investigated in PubMed and Google Scholar containing keywords: Sodium Diclofenac, *Enterococcus faecalis* and Regenerative Endodontic Treatment. Sodium diclofenac is a potential medicament to eliminate *Enterococcus faecalis* biofilm therefore has a potency to be used in Regenerative Endodontic Treatment. **Conclusion:** The success rate of RET depends on the elimination of microorganisms in the root canal systems. The use of sodium diclofenac as a medicament to eliminate *Enterococcus faecalis* biofilm is potential to be used in RET. Further researches are encouraged to explore the benefits of sodium diclofenac as a medicament in RET.

Keywords: sodium diclofenac; regenerative endodontic treatment; *Enterococcus faecalis*; medicament; disinfection

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INTRODUCTION

Traumatic injuries involving teeth are very common in the community and account for 85% of patients with trauma to the oral area and in preschool children the proportion is as high as 17%. Frequent traumatic dental injuries are tooth fracture, tooth laceration, tooth avulsion and open apex. An open apex is a tooth fracture that causes pulp death, namely necrosis so that root growth is stopped and the root canal is wider at the apex than the cervical region.¹ To manage pain in patients, pain management can be carried out in the form of analgesic drugs to reduce pain. Analgesics are known as one of the pain managements are divided into two major groups, one of which is the non-steroid anti-inflammatory drugs (NSAID) group. Types of NSAIDs mostly used in dentistry are sodium diclofenac, mefenamic acid, ibuprofen, or a combination of paracetamol and analgesics.²

Sodium diclofenac is an NSAID with high potency and tolerance. The usual dose used is 100 to 200 mg per day, given in several doses. Side effects occur in about 30% of patients, including gastrointestinal ulceration, elevation of hepatic enzymes, thrombocytopenia, impaired renal function, central nervous system disorders, and allergies. This drug may cause oliguria and increased serum creatinine levels, as well as interstitial nephritis. Their use for over a longer time can increase the risk of adverse effects of these drugs on the kidneys.³ Dental and oral health problems are generally cavities which often require further treatment. An action like tooth extraction is carried out with various indications, for example teeth with caries that have already expanded and cannot be treated, crown fracture or root residue, extractions associated with prosthetic and orthodontic treatment. Tooth extraction may also be indicated if the tooth can cause other odontogenic diseases

such as periodontal abscesses, cysts, periapical disease and pulp necrosis. To treat the patients who are in pain, drugs in the form of painkillers are given to relieve pain before or after extraction.⁴

Regenerative endodontic treatment (RET) is one of the emerging treatments in endodontics that is growing. RET can utilize biologic principles to restore the root canal into a healthy state, allowing the development of tooth root and periapical tissues. One of RET goals is to treat necrotic immature permanent teeth with a biological approach that results in root growth, increased dentin thickness and the development of an apical foramen. In dental practices, RET requires root canal disinfection without damaging endogenous stem cells available in the apical region of the pulp. Root canal system disinfection is considered serious to the success of RET as it can prevent infection.⁵

Root canal disinfection is an action that aims to eliminate root canal microorganisms during endodontic procedure. *Enterococcus faecalis* is the most common pathogenic bacteria found in infections of dental root canals. Despite all the endodontic treatment, the bacteria *Enterococcus faecalis* can be resistant to some drugs and root canal irrigation materials. Sodium diclofenac can be used as a root canal disinfection to kill bacterial *Enterococcus faecalis* in RET. This shows that sodium diclofenac has the potential as a root canal disinfection to kill bacterial *Enterococcus faecalis* in RET.⁶

METHODS

Article quest was conducted in English, via PUBMED and Google Scholar databases to find researches on regenerative endodontics issued from 2013 to 2024. The subsequent keywords were investigated: “Sodium Diclofenac”, “Regenerative Endodontic Treatment (RET)”, and “*Enterococcus faecalis*”.

RESULTS

Regenerative Endodontic Treatment

Regenerative Endodontic Treatment (RET) is a new treatment concept that focuses on replacing the damaged tooth structure including the dentin structure and the re-establishment of pulp vitality, the continuation of root growth, and the cells of the pulp and dentin complex. and the cell complex of pulp and dentin. The core goal of regenerative endodontics is to eliminate symptoms and promote bone repair while the other objectives are to increase root dentin length and thickness, and to restore the pulp vitality response. Clinical considerations in endodontic procedures are root canal disinfection, scaffold engagement, and adequate coronal restoration to avoid reinfection. This procedure may use stem cells, scaffold and growth factor. These essentials must be followed by root canal disinfection. Elimination of bacteria from the root canal is necessary to achieve healing of the pulp and apical tissues.⁷

American Association of Endodontics (AAE) recommends that regenerative endodontic procedure can be done on patient's teeth which are necrotic, undeveloped apices, and spaces where post and core procedures are not required. On the first visit for RET, the potential benefits and risks must be described to the patient. The teeth are anesthetized first and isolated with rubber to create access openings. The tooth is gently irrigated with sodium hypochlorite solution through an irrigation system which minimizes irrigation material extrusion into the apical area. It is recommended that the concentration of sodium hypochlorite (NaOCl) is slightly low to lessen toxicity to apical tissues stem cells. Root canals are dried using sterile paper points, and then antimicrobial medication is given into the root canal.⁸

On the second visit, the involved tooth is evaluated for any symptoms or signs of infection. If no signs or symptoms are detected, the next step would be RET. Local anesthesia without vasoconstrictors was suggested to induce bleeding. After rubber dam isolation and coronal access opening, the tooth was irrigated with ethylenediamine tetra acetic acid 20 mL followed by saline. Then, antimicrobial drugs were removed carefully. After root canal drying with paper points, file is positioned a few millimeters beyond apical foramen to trigger bleeding until 3 mm from the cemento-enamel junction (CEJ). To place the mineral trioxide aggregate (MTA), Colla-Plug, which acts as an absorbable medium, is placed into the canal. Then approximately 3 mm of MTA was positioned, followed by with final restoration.⁸

DISCUSSION

Disinfection in Regenerative Endodontic Treatment

Disinfection of the root canal system is a must in Regenerative Endodontic Treatment (RET).⁹ Disinfection methods through mechanical preparation, sodium hypochlorite irrigation, and calcium hydroxide dressing, were not effective in cases of infections involving biofilm. Therefore, extra intracanal drugs were suggested for canal disinfection, such as double or triple antibiotic pastes.¹⁰ The key point of RET in mature teeth with necrotic pulps and immature teeth with necrotic pulps is minimal preparation, as a result of fragile and thin root dentin walls. Consequently, immature teeth disinfection is done with plentiful irrigation and intracanal dressings. Total biomechanical debridement is critical to eradicate infection and necrotic tissue removal in the root canal system.

Disinfection in RET is an action that aims to eliminate microorganisms in the root canal system during and after the preparation procedure. Bacteria and their endotoxins can induce inflammation^{11,12} and this will eventually impact the success of RET. *Enterococcus faecalis* is the most common bacteria found in root canal infections. Despite treatment, *Enterococcus faecalis* bacteria can be resistant to some drugs and root canal irrigation materials. Many experiments were done to find ideal disinfection materials.¹³⁻¹⁵ and *Enterococcus faecalis* is one of the most targeted bacteria

to eliminate.¹⁶⁻¹⁸ Sodium diclofenac has new potential as a root canal disinfection to eliminate *Enterococcus faecalis* in regenerative endodontic treatment. Challenges are encountered in regenerative endodontic treatment particularly in immature teeth with open apex.⁶

Certain chemicals and biomaterials have been researched to have positive and negative effects on cells.¹⁹⁻²² These materials would influence the viability of stem cells.^{23,24} There is strong evidence that the disinfection agents can affect the viability and differentiation potential of stem cells and affect the presence of growth factors. Calcium hydroxide, the golden standard of intracanal medicament has certain effects on stem cells.²⁵⁻²⁷ Therefore, the use of disinfection agents that are biocompatible with stem cells is what guarantees success in RET. Currently stem cells are explored to further optimize their use in regenerative treatment.²⁸⁻³⁰

Sodium Diclofenac in Regenerative Endodontic Treatment

Inter-appointment pain might happen during RET. Contributing factors include chemical, mechanical, and microbial penetration into peri radicular area during treatment. Anxiety or fear during treatment, and other psychological reasons will impact patients' pain threshold and perception. Sodium diclofenac and other anti-inflammatory analgesics can be used as preoperative drugs during RET.³¹

Compared to ibuprofen and ciprofloxacin, sodium diclofenac reduces more biofilms. Calcium hydroxide pastes along with ibuprofen, diclofenac, or amoxicillin were not cytotoxic and biocompatible.³² A paste mixture of antibiotics in the form of triple antibiotic paste (TAP) is commonly used as root canal medicament in RET.³³

Several studies informed nonsteroidal anti-inflammatory drugs (NSAIDs) retain antibacterial properties.³⁴ Sodium diclofenac, an effective anti-inflammatory drug, has displayed significant antibacterial action against both gram-negative and gram-positive bacteria.³⁵ Sodium diclofenac and ibuprofen also have significant antibacterial potency against *Enterococcus faecalis* biofilm comparable to calcium hydroxide and the antibiotic pastes.³⁶

In conclusion, root canal disinfection is a step to eradicate microorganisms in the root canals during RET. *Enterococcus faecalis* is the most common pathogenic bacteria found in the infections of root canals. Despite the treatment, *Enterococcus faecalis* biofilm can be resistant to some drugs and root canal irrigation materials. The use of sodium diclofenac would increase the success of RET by eliminating *Enterococcus faecalis* biofilm.

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