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Reviving Immature Permanent Teeth: A Case Report on Regenerative Endodontic Treatment as a Retreatment Option

Dr. Ahammed Moosa.S., Dr. Praveena G. (Professor), Dr. Radhakrishnan Nair(HOD), Dr. Gopika G Krishnan
Department of Conservative Dentistry and Endodontics Azeezia college of Dental Science and Research
Kollam. Kerala, India

Abstract:- Endodontic intervention in necrotic immature permanent teeth often presents a clinical challenge. However, with careful case selection, regenerative treatment can be an effective approach, yielding favorable outcomes. Nevertheless, there is currently no consensus on the optimal disinfection protocol or the method to achieve predictable clinical results in regenerative treatment. One of the advantages of regenerative endodontic treatment is its potential to stimulate further root development. In cases where regenerative treatment fails, conventional methods such as MTA apexification can be considered as an alternative treatment option. This article presents a case report of regenerative endodontic treatment in necrotic immature tooth #21, along with a 24-month follow-up review, showcasing the outcomes of the treatment.

Keywords:- *Regeneration; Endodontics; Dental Pulp Necrosis; Stem Cells.*

I. INTRODUCTION

Regenerative endodontic procedures (REPs) have revolutionized the treatment approach for necrotic pulps in immature permanent teeth. Traditionally, the focus was on creating a barrier using calcium hydroxide or mineral trioxide aggregate (MTA). However, REPs now offer a biologically driven treatment strategy that promotes root maturation. Managing necrotic immature teeth poses challenges due to their delicate dentinal walls and complex anatomy. Achieving proper preparation and obturation of the apical portion can be challenging. In the past, multiple sessions of apexification using calcium hydroxide were the preferred approach for such cases. Subsequently, a one-step apexification technique was proposed, involving the creation of artificial barriers using materials like MTA. This approach reduced treatment duration and session frequency (3). Nonetheless, both techniques have a significant drawback: they do not support continued root development, leading to fragile roots that are prone to fracture.

Revascularization presents a biologically driven alternative for treating immature necrotic teeth, offering a departure from the conventional methods of apexification and artificial apical barrier formation. Unlike those approaches, revascularization promotes root maturation (5, 6). In cases of necrotic open apex teeth, remnants of vital apical pulp tissue or Hertwig's epithelial root sheath may be present. Given proper disinfection of the canal and resolution of the inflammatory process, these tissues have the potential to proliferate and contribute to root development (6).

The modern era of regenerative endodontics was initiated by Banchs and Trope in 2004, marking a significant milestone in this field (7). Their proposed regenerative treatment protocol involved chemical disinfection using a low concentration of Sodium hypochlorite, followed by the application of a triple antibiotic paste as an intracanal medicament. The paste consisted of ciprofloxacin, metronidazole, and minocycline, as recommended by Hoshino et al (8).

In the regenerative endodontic procedure, a triple seal with MTA/Biodentine is applied, followed by a 2mm layer of GIC and composite material. Periodic reviews are conducted to work towards achieving the three primary goals of regenerative endodontics. The first goal is the elimination of symptoms and the evidence of bony healing. The second goal is the potential increase in root wall thickness and/or root length, which is desirable but not necessarily essential. The third goal is to observe a positive response to vitality testing, which may indicate the presence of more organized vital pulp tissue (9).

The present case report describes the clinical procedures and outcome of RET in a tooth with persistent apical periodontitis. Post treatment 2 years review showed a clinical and radiographic successful outcome.

II. CASE REPORT

A healthy 11-year-old male patient presented to the Department of Endodontics with a chief complaint of pain in the upper front tooth region. The patient had a history of trauma one year prior but had not received any follow-up care after an initial root canal treatment at a nearby clinic.

Clinical examination revealed an Ellis class 2 fracture with an open orifice in relation to tooth #21. The tooth was tender upon percussion, and radiographic examination (RVG) revealed an immature root with a periapical lesion. The diagnosis was asymptomatic persistent apical periodontitis, and the proposed treatment plan was regenerative endodontic treatment for tooth #21.

During the first visit, local anesthesia (1:200,000 epinephrine) was administered. Access cavity modification was performed under rubber dam isolation. The working length was determined, and the canal was irrigated copiously with 20 mL of 1.5% sodium hypochlorite (NaOCl) followed by 20 mL of saline. A triple antibiotic paste consisting of

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ciprofloxacin, metronidazole, and cefixime in a 1:1:1 proportion was used as an intracanal medicament, and the tooth was temporarily sealed with IRM.

Two weeks later, the patient was asymptomatic. The antibiotic intracanal medicament was removed and flushed out of the canal with copious irrigation using 1.5% sodium hypochlorite (NaOCl), followed by 20 milliliters (mL) of saline and 20 mL of 17% ethylenediaminetetraacetic acid (EDTA). The canal was dried with paper points, and bleeding was induced inside the canal by gently stimulating the periapical area with a sterile number 50 K file inserted 2 millimeters beyond the apical foramen. Platelet-rich fibrin (PRF) was then placed in the canal. The coronal part of the canal was sealed with Biodentine, followed by 2 mm of glass ionomer cement (GIC). Finally, the tooth was restored with composite resin (Dentsply).

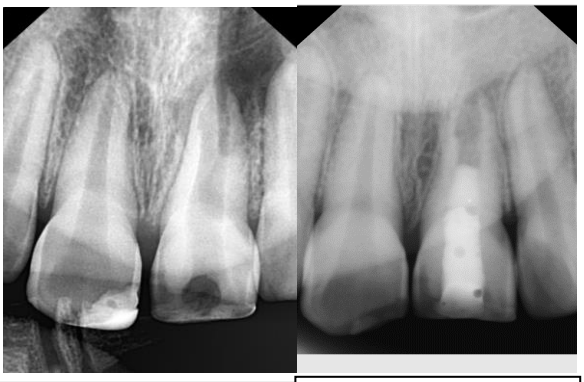
The patient remained asymptomatic throughout the course of periodic reviews, and at the two-year follow-up, the periapical lesion had healed, accompanied by continued root development.

PRE OPERATIVE RADIOGRAPH	WORKING LENGTH DETERMINATION

Fig. 1

PRF PLACEMENT FOLLOWED BY TRIPLE SEAL WITH BIODENTINE,GIC AND COMPOSITE	2 YEAR FOLLOW UP

Fig. 2



PRE OPERATIVE	2 YEAR FOLLOW UP

Fig. 3

III. DISCUSSION

In this case report, we evaluated an immature necrotic tooth with persistent periapical lesion. Even though endodontic treatment was started following pain 1 year back further follow up treatment was not taken. Immature necrotic tooth can be fracture prone. Pulp revascularization was considered as a treatment modality as it enables further root development and reinforcement of the tooth. Conventional apexification still remains as a treatment option even if revascularization fails.

In this case the primary goal of RET such as elimination of symptoms and evidence of bony healing was achieved with in 1-2 year. The secondary goal of increased root wall thickness and/or root length was seen minimally in 24 months after treatment. The tertiary goal of regaining a positive response to pulp vitality testing was not achieved (which if achieved, could indicate a more organized vital pulp tissue). Both the secondary and tertiary goals are desirable but possibly not essential to determine the clinical success.

Root canal disinfection is a complex and challenging procedure in regenerative endodontic treatment. The goal is to remove all bacteria from the root canal system while preserving the regenerative potential of the periapical tissues. This is a critical consideration, as some antimicrobial agents that are effective at killing bacteria can also be toxic to periapical tissues. In cases where the tooth has an immature apex, the root canal is typically larger in size, which makes it easier for the antimicrobial agent to reach the root canal system. However, even in these cases, it is important to use a low concentration of the antimicrobial agent to reduce the risk of toxicity.

For regenerative purposes, low concentrations of sodium hypochlorite (NaOCl) have been successfully utilized. In this particular case, the canal was irrigated with 20 ml of 1.5% NaOCl, and the triple antibiotic paste (TAP) was placed. During the second session, to remove the TAP, irrigation was performed using 20 ml of 1.5% NaOCl and normal saline. As a final irrigant, 17% EDTA was used. The use of EDTA is advantageous as it helps provide dentin-derived growth factors.

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It is important to note that high concentrations of NaOCl, such as 3% or 6%, can be toxic to stem cells. These concentrations have been shown to inhibit the attachment of stem cells to dentin surfaces and can also be toxic to SCAP, which are stem cells that are found in the apical region of the root canal.Hence, the use of low concentrations is preferred in order to avoid these potential detrimental effects on stem cells (SCAP). In this case, a triple antibiotic paste (TAP) was utilized as an intracanal medicament. The paste was prepared by mixing ciprofloxacin, metronidazole, and minocycline in equal proportions (1:1:1) to achieve a final concentration of 0.1-1.0 mg/ml (9). However, due to the potential tooth discoloration associated with minocycline, it was replaced by cefixime in this particular case. After the application of the TAP, the patient was scheduled for a recall visit in two weeks.

Previous research has demonstrated that EDTA irrigation can lead to the release of growth factors from the dentinal walls of the root canal.

The success of revascularization/revitalization therapy depends on the thorough disinfection of the root canal system. If bacteria remain in the root canal, regeneration will be impaired and the pulp-periapical tissue complex will not be able to heal. The length of time that a tooth has been necrotic may also affect the quality of root development. Studies have shown that teeth that have been necrotic for a longer period of time are less likely to develop properly after regenerative treatment. This may be because long-term infection can destroy cells that are necessary for regeneration, as hypothesized by Lenzi and Trope (7).

Although long-term infection can have a negative impact on the success of regenerative endodontic treatment, there have been cases where treatment has been successful even in teeth with long-standing apical periodontitis. Lenzi and Trope (7) suggest that long-term infection may not be the only factor that limits the regenerative potential of teeth. They propose that the maturation of bacterial biofilm may also play a role, as this can make it more difficult to eliminate bacteria using conventional protocols.

The case study mentioned above showed that the periapical lesion healed after regenerative endodontic treatment. The American Association of Endodontists (AAE) guidelines state that the healing of apical periodontitis is essential for clinical success in regenerative endodontic treatments. This highlights the importance of resolving the apical inflammatory process and subsequent healing of the surrounding tissues as a key indicator of successful treatment outcomes.

In this case initial endodontic treatment was left incomplete with no access seal. The bacterial biofilm present in the canal might have been highly resistant strains. Regenerative endodontic procedure led to healing of apical periodontitis with a functional and aesthetic central incisor.

IV. CONCLUSION

Regenerative endodontic procedures are a promising treatment option for immature teeth with apical periodontitis. These procedures can help to preserve the tooth and promote continued root development. Studies have shown that regenerative endodontic procedures are effective in resolving the clinical signs and symptoms of apical periodontitis in immature teeth. However, to achieve successful outcomes in regenerative endodontic treatment, careful case selection and long-term follow-up are crucial. Prudent case selection ensures that appropriate candidates are chosen for this specialized treatment approach, taking into consideration factors such as the stage of tooth development and the extent of pulpal and periapical pathology. Additionally, long-term follow-up allows for the evaluation of treatment success and the monitoring of continued root development, ensuring the sustainability of positive clinical outcomes over time.

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