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Case Report

Regenerative Endodontic Management of maxillary central incisor with an immature apex – A Case Report

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ABSTRACT:
Regenerative endodontic procedures hold promising outcomes in cases of immature necrotic permanent teeth. The treatment outcomes have shown increase in root length as well as dentinal wall thickening. In this case report, a 28 year old female with the history of trauma wrt 21 & diagnosis of previously initiated endodontic treatment with immature necrotic root apex was treated with regenerative endodontics. In the first visit, access was prepared, working length was determined and chemo-mechanical preparation was done along with copious irrigation of 1.5% sodium hypochlorite & 17% EDTA to remove the necrotic debris & triple antibiotic paste (TAP) was used as intracanal medicament. During the second visit, following the removal of TAP and drying the canal, bleeding was initiated from periapical region of canal and PRF was placed in apical & middle third of canal against blood clot. Then, MTA was condensed against the PRF and restored temporarily. Non-vital bleaching was done followed by permanent restoration. The patient was followed up at 6 months, 1 year, 1.5 years. Clinically, tooth was asymptomatic with no presentation of swelling and pus discharge or any tenderness to percussion or palpation during follow up intervals. Radiographic examinations revealed resolution of periapical lesion, thickening of root dentinal walls and further root development wrt 21.

Keywords: Immature necrotic permanent tooth, regenerative endodontics, platelet rich fibrin, MTA, non-vital bleaching, open apex.

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INTRODUCTION

The treatment of immature non-vital teeth in endodontic practice is a major clinical problem. The lack of apex closure and the thin dentinal walls make the tooth difficult to obturate and more vulnerable to fracture. Traditionally, calcium hydroxide or MTA were used for apexification of open apex to form an apical barrier to allow root canal obturation [(1)]. But, these modalities involve multiple visits, also the apical barrier formed was porous, more susceptible to vertical root fractures, no dentinal wall thickening and root lengthening following these procedures [(2)], currently there is a paradigm shift of treatment protocol from apexification to regenerative endodontic procedures.

"Regenerative endodontics" is defined as biologically based procedures designed to replace damaged structures, including dentine and root structure as well as cells of the pulp–dentine complex [(3)]. All three components i.e. growth factors, stem cells and scaffolds are important for the in-growth of new tissues from the periapical area in an empty canal. Natural blood clot, collagen, platelet rich fibrin (PRF) and platelet-rich plasma (PRP) have been investigated as potential scaffold materials for revascularization [(4)]. According to Norsat et al [(5)], this approach is based on the presence of osteo/odonto progenitor stem cells in

the apical papilla that are resistant to the infection and necrosis caused by proximity to periodontal blood supply. In this treatment, the ideal goal is to prepare an appropriate environment inside the root canal space (i.e. absence of bacteria and necrotic pulp tissue, presence of a scaffold and a tight coronal seal) that promotes repopulation of these stem cells, regeneration of pulp tissue, and continuation of root development.

The aim of present case report was to manage an immature maxillary central incisor with regenerative endodontic treatment modality and non-vital bleaching of the discolored tooth.

CASE REPORT

A 28-year-old female with a non-contributing medical history reported to Department Conservative Dentistry and Endodontics, with a chief complaint of discoloration and mild pain in upper left front tooth. Patient had history of fall while playing 15 years ago and since then she had discoloured tooth. A couple of years ago she got her treatment started but could not get it completed due to her job profile.

Upon clinical examination, discoloration and temporary filling on palatal aspect were present wrt 21. There was no mobility and the periodontal status was normal. The thermal and electrical pulp vitality tests elicited no response. Radiographic examination revealed open apex and periapical lesion.

Based on the clinical (Figure 1) and radiographic findings (Figure 2), the final diagnosis made was previously initiated endodontic therapy with immature root apex wrt 21 and final treatment plan was regenerative endodontic management followed by non-vital bleaching and post-operative permanent restoration wrt 21.

Figure 1: Pre-operative picture

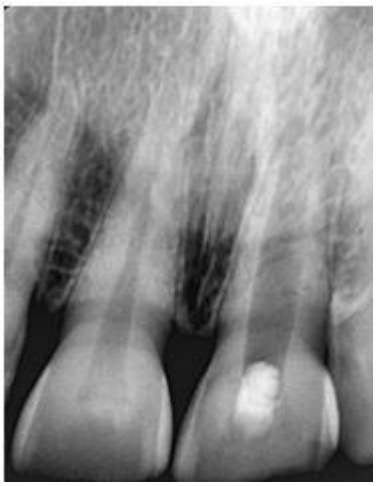

Figure 2: Pre-operative radiograph

After discussing with the patient the procedure, the potential risks and benefits, the cost involved, and the prognosis of the aforementioned treatment options, the patient opted for regenerative endodontic treatment. Informed consent was obtained from the patient.

Local anesthesia (2% lidocaine) without epinephrine was given to the patient and access opening was done under rubber dam, temporary filling was removed wrt #21 (Figure 3).

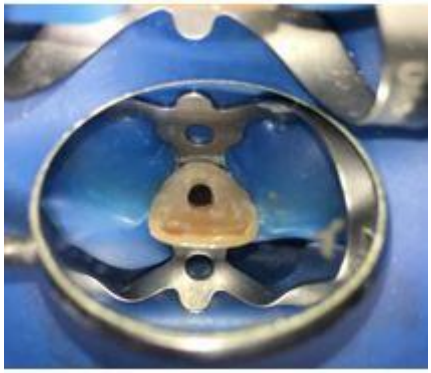

Figure 3: Access Preparation

Working length was determined with electronic apex locator (Root Z Apex, J Morita) & radiographically. Chemomechanical preparation was done and the canal was irrigated with 20 mL of 1.5% NaOCl. It was dried with paper points. Equal proportions of ciprofloxacin, metronidazole, and minocycline were grounded and mixed with distilled water to a thick paste consistency. This antibiotic mixture was placed in the canal using

lentulospiral and packed with endodontic plugger. The access cavity was sealed with temporary filling (Cavit, 3M). After 4 weeks, tooth #21 was asymptomatic and showed no sensitivity to percussion and palpation. The intracanal medicament was removed and canal was irrigated with 30 ml of 17% EDTA and was agitated with ultrasonics device. A 5 ml of whole blood was collected from the median cubital vein of the patient for the preparation of PRF (Figure 4).

Figure 4: PRF prepared

Bleeding was induced in the canal by filing with hand K-file #25 beyond the working length and blood clot was formed as a result (Figure 5).

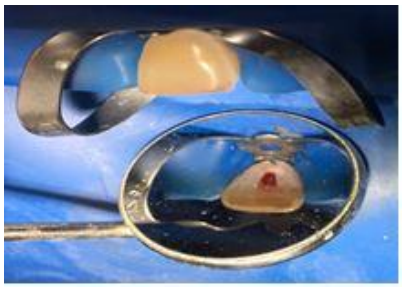

Figure 5: Bleeding induced

Blood clot was confined to middle third of canal by keeping wet cotton at the level of middle third of root for 3-5 minutes. PRF was placed against the blood clot at junction of middle and apical third of tooth length (Figure 6).

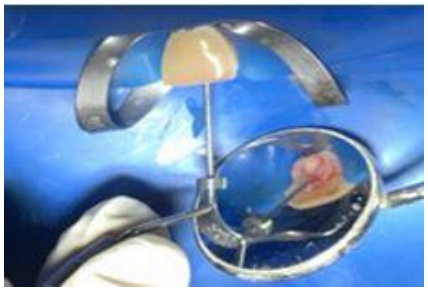

Figure 6: PRF placed against

MTA was placed directly over the PRF and wet cotton was placed against MTA followed by temporary restoration (Cavit, 3M) in the tooth for 24 hours (Figure 7).

Figure 7: MTA placed using messing gun

Figure 8: MTA placed against PRF & blood clot

Figure 9: MTA placed

Figure 10: Immediate Post-Op IOPA

Figure 11: Pre-operative shade matching

Figure 12: 1 Week Post-operative shade matching

Figure 13: Bleaching gel applied irt #21 using inside – outside bleaching technique

Initial shade of tooth was 5M3 and walking bleaching technique was initiated using sodium perborate and normal saline; however, after 2 appointments (10 days) of the bleaching the shade achieved was 4M3 and the results were not satisfactory. So, modified inside outside non-vital bleaching technique was performed in office

using 35% hydrogen peroxide whitening gel (FGM Whiteness HP Maxx bleaching kit). Tooth shade was lightened to 2M3 and outcome was aesthetically pleasing (Figure 14).

Figure 14: Post-bleaching shade

Figure 15: Post-operative picture

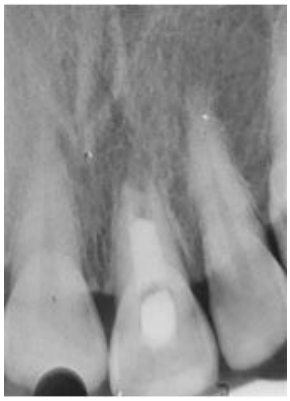

Figure 16: Post-operative radiograph

Figure 17: Follow-up Picture after 6 months

Figure 18: Follow-up Radiograph after 6 months

Figure 19: Follow-up Picture after 1 year

Figure 20: Follow-up Radiograph after 1 year

Figure 21: Follow-up Picture after 1.5 years

Figure 22: Follow-up Radiograph after 1.5 years

After 2 weeks, permanent restoration was done with composite. The patient was recalled at time intervals of 6 months (Figure 17, 18), 1 year (Figure 19, 20) and 1.5 year (Figure 21, 22) for clinical as well as radiographic evaluations. Tooth #21 was asymptomatic and no positive response was elicited to percussion or palpation tests. There was no intraoral swelling or pus discharge seen during the follow-up time periods. Radiographic examinations revealed resolution of the periapical lesion, thickening of root dentinal walls and further root development wrt 21.

DISCUSSION

Traditionally, immature non-vital permanent teeth in young patients have been managed using calcium hydroxide apexification or MTA plug technique, in which the aim is to create an apical barrier to allow root canal obturation [(1)]. Thus, improving the retention of tooth in longer term. Treatment with calcium hydroxide resulted in formation of porous hard tissue apical barrier but it had been shown that either the short-term or long-term use of calcium hydroxide could reduce the root strength due to denaturation of collagen, also multiple visits required was the additional disadvantage. With the MTA apexification, apical barrier was formed but dentinal wall thickening and root lengthening was not seen. The teeth with poor crown root ratio and thin dentinal walls are more susceptible to fracture by secondary injuries and are also poor candidates for the restorative procedures [(2)].

Therefore, there was a shift in the treatment protocol of such teeth from apexification to regenerative procedures. Regenerative procedure in immature teeth was introduced in the field of endodontics by Ostby in 1961 and later reintroduced in 1966 by Rule and Winter [(2)]. It leads to apexogenesis and maturogenesis in nonvital immature permanent teeth. The thickened and convergent dentinal walls add to the long-term prognosis of the tooth by increasing its fracture resistance, hence, in the present case this novel technique was used.

Intracanal medicaments and irrigants used in regenerative endodontic procedure play important role in the disinfection of canal. After minimal or no instrumentation, the irrigation must be copious and gentle, minimizing the possibility of extrusion into the periapical space. Sodium hypochlorite (NaOCl) is the most commonly used irrigant & its concentrations ranges from 1% to 6%. However, the viability of the existing cell population is maintained when using lower concentrations of NaOCl, leading to an increase of success in treatment outcome and using it would prevent further damage in cases of inadvertent extrusion beyond apical foramen [(6)] and this was the reason for using 1.5% NaOCl in the present study. Sodium hypochlorite is used to remove the organic components in the root canal whereas 17% EDTA is advocated for the removal of inorganic component of smear layer. Also, EDTA induces cell adhesion, migration, differentiation towards or on to dentin thus augmenting environment for SCAP proliferation. Rinsing with 17% EDTA followed by 1.5% NaOCl is beneficial for SCAP cells [(7)].

The current American Association of Endodontists (AAE) regenerative endodontic clinical consideration guidelines suggest the use of a 1 to 5 mg/ml final concentration antibiotic paste mixture. The most used intracanal antibiotic dressing is the tri-antibiotic paste (TAP), introduced by Hoshino et al [(8)] as an effective solution to eradicate bacteria from the dentin of the infected root and promote healing of the apical tissues. It is a mixture of equal parts of ciprofloxacin, metronidazole, and minocycline with sterile saline to form a paste-like consistency mixture. Another medication that can be alternatively used is calcium hydroxide, Ca (OH)2, a root canal disinfectant and hard tissue repair stimulator. When there is sensitivity to one of the antibiotics of triple antibiotic paste or double antibiotic paste, its use was advised. Due to its high pH, this medication can destroy cells from the apical papilla and periapical tissues that are fundamental for the repair process, could be conducive to uncontrolled calcification of the canal space, preventing the ingrowth of soft tissue with an odontogenic potential and may limit the possibility to induce bleeding on the second visit. This is the reason

why $Ca(OH)_2$ must be applied only in the coronal half of the root canal, to permit a positive outcome [6].

Different scaffold materials such as blood clot, collagen, PRF and PRP are used for this purpose. Therefore, in the present case, blood clot and PRF are used. Treatments with blood clot, PRP or PRF are similarly effective for the regeneration of immature permanent teeth. The advantages of the blood clot scaffold are that it is technically simple and does not require any additional technology. Furthermore, the regeneration provided by blood clot helps to avoid the possibility of immune rejection and infection. However, in clinical practice, it might not always be possible to promote sufficient bleeding in the root canal space [9]. PRP has advantage of osteogenic potential but there is risk in its application, as PRP requires the addition of exogenous compounds like bovine thrombin which may generate antibodies to certain blood clotting factors that could cause coagulopathies and harm the host [10]. PRF has advantages such as completely autologous, easy to penetrate, inexpensive and much more efficient than its predecessors in terms of trapping platelets and sustained release of various growth factors [11].

The intention behind regenerative endodontic treatment (RET) is regeneration of pulp-dentin complex, in which it is hoped that dentinal wall thickening and root lengthening and maturation of root apex can be promoted. Success rates of periapical pathosis resolution following regenerative endodontic treatment was comparable to treatment with either MTA apical plug technique or apexification, which suggests that disinfection protocol for both regenerative endodontic procedure and apexification have similar efficacy for bacterial elimination [9]. Tight coronal seal is an important component of successful regenerative endodontic treatment [12, 13]. Most of the studies have used a double seal consisting of MTA and a permanent resin restoration over the blood clot [13, 14, 15] similar to what was done in the presented case. The calcium ion released from MTA reacts with environmental phosphorus and leads to formation of hydroxyapatite crystals on the surface of MTA [16] and MTA-dentin interface [17].

Inside-Outside bleaching technique is variation of the non-vital whitening technique, also been called as internal/external bleaching (Settembrini et al. 1997), patient-administered intracoronal bleaching, and modified walking bleach technique (Liebenberg 1997) [18]. In this technique, bleaching agents (lower concentrations) can be placed into the pulp chamber, while the lab fabricated vinyl bleaching tray is applied intra-coronally to retain the material on the tooth. Whitening can thus take place internally and externally at the same time and patient wears it at home [7]. In the present case, initially non-vital walking bleach technique (using sodium perborate & normal saline) was preformed; however results were not satisfactory. So, in the following appointment, modified Inside-Outside bleaching technique using (35% hydrogen peroxide whitening gel) was performed in-office and treatment outcome was aesthetically pleasing. Also, procedural time was reduced which was more acceptable to the patient. The permanent restoration was placed after 2 weeks so that the free radicals present as a result of bleaching would not interfere with the polymerization of composite and hence, inhibit its bond with the tooth [18].

CONCLUSION

Platelet-rich fibrin is a potential scaffold in pulp revascularization procedures, as it is rich in growth factors, enhances cellular proliferation and differentiation, augments angiogenesis, acts as a matrix for tissue ingrowth, regulates inflammation reactions and has anti-infective properties. Additionally, it acts as an excellent matrix to support MTA placement [19]. Also, modified inside-outside bleaching technique offers non-invasive alternative in the management of non-vital discolored teeth.

HIGHLIGHTS

- This case report signifies the role of regenerative endodontics in the treatment of immature non-vital permanent teeth.
- Also, non-invasive management of discolored necrotic tooth using bleaching as an imperative procedure.
- Clinical as well as radiographic resolution of symptoms was seen.

DISCLOSURES

1. **Informed consent:** Patient's written informed consent was obtained.
2. **Conflict of interest:** The author declares no conflict of interest.
3. **Ethics Committee Approval:** All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Informed consent was obtained from the patient for being included in the study.
4. **Peer-review:** Externally peer-reviewed.
5. **Financial Disclosure:** The author denied any form of financial supports from any institution or manufacturer company.

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