Case Report

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Revitalization of necrotic mature permanent anterior tooth with a large periapical lesion : A case report

Abstract:

Revitalization procedures can be described as biologically based procedures intended to replace the diseased or missing pulp–dentin complex. Over the years, this procedure has been referred to by a variety of names, including regeneration, rejuvenation and pulp revascularization. Conventionally, root canal therapy involving chemomechanical debridement, intracanal medication, and root filling, is used to treat adult permanent teeth with infected or noninfected necrotic pulps. The revitalization approach may be an effective alternative that offers enhanced biological properties compared to traditional root canal therapy. Permanent mature teeth with necrotic pulps are treated with revitalization procedures in an attempt to relieve symptoms, resolve apical periodontitis, and restore vitality. The present report describes the treatment and outcome using modified revitalization therapy in a traumatized maxillary permanent anterior tooth with infected necrotic pulp and a large periapical lesion.

Key-words: Mature tooth, modified revitalization therapy, necrotic pulp, periapical lesion, root canal treatment

Introduction:

The revitalization procedures have been proposed as a biological approach to treat immature necrotic permanent teeth with apical periodontitis using the principles of tissue engineering.[1] As an alternative to traditional endodontic therapy, these procedures have recently been effectively used for treating mature necrotic teeth with apical periodontitis. The treatment eliminated clinical signs and symptoms along with resolution of apical periodontitis.[2] For infected necrotic mature teeth, the main difference in revitalization procedures are the need for thorough mechanical debridement to eradicate the necrotic tissue and root canal infection.[3]

The first attempt of pulp revitalization in mature teeth were made by Shah and Logani and further case reports subsequently. Their outcomes were favorable, demonstrated periapical healing, relieved clinical indications and symptoms, and in certain cases showed regaining of tooth sensibility.[4] It appears that revitalization procedures can restore the viability of tissue in canals which have been compromised by trauma or infection, as well as enhance the healing processes of wound. From the biological prespective, it could be better to fill diseased root canals with the host's own vital tissues as opposed to not vital foreign substances.[5] Revitalization procedures are regarded as a successful treatment, with the positive results varying from 78% to 100%.[6]

The following benefits of pulp revitalization in mature teeth are seen from a tissue engineering aspect. The neurovascular system in root canals will be reconstituted, and pulp-like tissues will develop an immune defense system through pulp regeneration. Innate immunity within the root canal which is lost after traditional endodontic therapy may have the ability to lower the risk of reinfections and can be restored after

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revitalization procedure.[7] After revitalization, periodontal ligament-like, bone-like, cementum-like, blood vessel, and nerve fiber tissues are generated in the canals of necrotic immature permanent teeth with apical periodontitis. Although they are not true pulp tissue, but these are the host's own pulplike vital tissue inherited with immune defense mechanisms.[8] The current case report explains the successful use of blood clot and PRF in modified revitalization therapy to treat a necrotic mature anterior permanent tooth with a large periapical lesion.

Case report:

A 22-year-old man reported to the department of endodontics with the chief complaint of pain in the right maxillary anterior region. The patient's right maxillary lateral incisor was reportedly injured in an accident when the patient was 12 years old. Because there was no pain or tooth fracture at the time of the event, the patient did not seek dental treatment. The tooth had not shown any symptoms for the previous 10 years, but more recently, presented with constant pain. Clinically, the tooth crown was intact with no discoloration, had physiologic mobility and probing depths within normal limits (< 3 mm). There were no symptoms of sinus tracts or swelling, but the tooth showed minimal sensitivity to percussion. The tooth showed no response to electric pulp test (Parkell Inc., NY, USA) and cold test (Endo-Ice, Coltene, Altstätten, Switzerland) but the opposite and contralateral showed sensitivity to both tests.

Radiographic examination showed fully developed roots and a large periapical radiolucency which revealed a extensive osteolytic lesion involved the distal aspect of root of tooth #7 and mesial root surface of tooth #6 [Figure A]. Adiagnosis of tooth#7 was symptomatic apical periodontitis and pulp necrosis based on clinical and radiographic evidence. Due to an inconclusive pulp-periapical tissue complex diagnosis, it was decided to keep observing tooth #6. Regenerative endodontic therapy, a biologically based treatment plan was made for tooth #7. A thorough discussion was conducted with the patient regarding the potential outcomes of the therapy as well as the application of traditional endodontic therapy in the scenario of a failure. The patient had no relevant medical history. Following a thorough explanation of the entire procedure, the patient's signed consent was obtained and the revitalization procedure was initiated on the same appointment.

The tooth weas anesthetized using 2% lidocaine and 1:100,000 adrenaline. Following isolation of tooth with rubber dam,the canal was accessed through the lingual surface. A straw-colored fluid oozed through the access opening. A large amount of 2.5% NaOCL (HYPOSOL; Prevest DenPro, India) was used to gently irrigate the access cavity and canal and was then followed by 10 mL of sterile solution of saline. Using an apex locater (iPex; NSK, Japan), the working length was determined and confirmed by an IOPA radiograph [Figure B]. The canal was prepared with NiTi hand K-files (NITIFLEX; Dentsply, Switzerland) by employing the step-back technique. After each file, 2 ml of 1.5% sodium hypochlorite solution were injected into the root canal and the apical foramina was extended to K-file size #60. The final irrigation step involved applying 5 ml of 1.5% NaOCl and the same volume of 17% EDTA (NEOEDTA; Orikam, India) for a duration of one minute each. Irrigation needles (30-G) with two side vents (RC Twents; Prime, India) were used for all irrigation process. The canal was dried with sterile paper points.

A fresh preparation of a triple antibiotic paste (TAP) comprising 100 mg of each of ciprofloxacin, metronidazole, and clindamycin was made by combining the ingredients with sterile distilled water to create a thin, creamy paste. Using a lentulo spiral, the antibiotic paste was inserted into the apical part of the root canal. After inserting a sterile cotton pellet beneath the CEJ into the canal, intermediate restorative material (IRM; Dentsply, Germany) was used to seal the access cavity [Figure C]. The patient was recalled after 2 weeks for the completetion of regenerative endodontic treatment.

The tooth was asymptomatic two weeks following the initial treatment visit. The tooth was not sensitive to palpation and percussion. The tooth was isolated using a rubber dam after being anesthetized with 2% mepivacaine without the use of a vasoconstrictor. The cotton pellet and IRM were taken out from the access cavity. Using large volumes of sodium hypochlorite and then 10 mL of sterile distilled water, the triple antibiotic paste was rinsed out of the canal. A final rinse of 17% EDTA was used in the root canals for a minute, and any excess was removed with paper points. Gently using sterile size 20–40 K-files 1-2 mm beyond the apices, apical bleeding was induced. Once there was visible bleeding within the canal using surgical microscope, a sterile cotton pellet was inserted for 4 minutes to encourage the formation of a blood clot nearly 3-4 mm below the CEJ.

A fresh PRF gel was made and the PRF gel was separated using sterile scissor. With a sterile gauge, PRF gel was compressed into a fibrin membrane and then cut into small fragments. These pieces were gradually placed over the

partially coagulated blood below the CEJ using a finger plugger. Using an amalgam carrier, a 2-3 mm thick covering of mineral trioxide aggregate (MTA; Dentsply Tulsa Dental) was carefully applied over the PRF. MTA was covered with a moist cotton pellet, then glass ionomer cement was used to temporarily restore access cavity. One week later, resin composite (3M ESPE, USA) was used to restore the tooth.At the 6-month follow-up, tooth #7 was asymptomatic and non-sensitive to palpation and percussion. Along the distal side of the root, there was a reduction in size of radiolucency and partially formation of trabecular bone [Figure D]. The tooth revealed no symptoms during the 1 year follow-up and the size of radiolucency was further decreased and more trabecular bone formation [Figure E]. Every six months, the patient was recalled for clinical and radiological assessments. At the 5-year follow-up, there was a complete resolution of the periradicular lesion and regeneration of the periapical tissues with intact lamina dura and normal periodontal ligament space [Figure F]. Clinically,the tooth showed no symptoms and was not sensitive to palpation or percussion. The tooth showed positive response to both the cold and electric pulp tests.

The difference in dentin thickness, root space dimension and lesion size from pre-operative and post-operative radiographic images was determined using Image J software (V.1.53e, National Institutes of Health, USA).The recall and final radiographs were digitally aligned with the TurboReg plug-in (Biomedical Imaging Group, Swiss Federal Institute of Technology, Switzerland) using the preoperative radiograph as the source image and this was followed by linear measurements in Image-J software. After a 5-year follow-up period, the results of the measurements demonstrated that dimensions of the root space had not changed.[9]

Discussion:

A promising modified revitalization approach was used in the current case report, which involved the induction of bleeding and the use of PRF as a scaffold and source of growth factors. Mature permanent teeth with diseased necrotic pulps and apical periodontitis have recently been effectively treated with revitalization procedures. Apical periodontitis was resolved and clinical signs/symptoms were eliminated as a result of this treatment.[2,4,8]

Compared to immature necrotic teeth, mature necrotic teeth are more difficult to disinfect. Furthermore, because to their more complex root canal anatamy, necrotic mature teeth may require more extensive chemomechanical instrumentation. For efficient root canal disinfection, the apical foramina were prepared to reach ISO K-file #60, as previously mentioned. It has been demonstrated that the larger preparation sizes offer adequate irrigation, remove debris, and significantly reduce the quantity of microorganisms. [10] NaOCL at a concentration of 5.25% was shown to be cytotoxic to stem cells and to inhibit odontoblastic differentiation.[11] In this case report, a closed-end, side-vented needle was utilized to deliver copious irrigations (20 mL 1.5% NaOCl) for 5 minutes with final irrigation of EDTA for 1 minute to reduce the possibility of irrigant extrusion into the periapical area. The final irrigation with EDTA may encourage the release of growth factors embedded in the dentin matrix and improve angiogenesis and the odontogenic differentiation of migrating cells.[12]

One of the main concerns with regenerative procedure appears to be the size of the apical foramen. Mature teeth have restricted apical pathways for cell migration than in young immature teeth. It has been demonstrated that effective revitalization of the pulp tissue in reimplanted human permanent incisors required an apical foramen with a diameter of at least 1.1 mm.[13] However, a previous study employing an animal model revealed that upon transplantation, revitalization and the ingrowth of newer tissue into canals were not inhibited by an apical foramen measuring 0.32 mm in diameter.[14] Furthermore, El-Kateb et al., using MRI assessment, found that the widening of the foramen had no impact on the ingrowth of pulplike tissue in mature teeth utilizing revitalization procedures.[15]

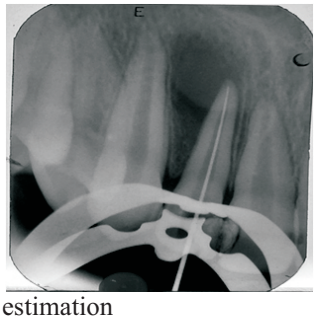
A crucial step in the revitalization treatment of permanent necrotic teeth is the disinfection of the root canal space. Whereas TAP would eradicate any potential bacteria causing apical periodontitis, tooth discoloration was an unfavorable effect of the minocycline. Minocycline was recently introduced in the place of clindamycin because to its wider range of activity with no discoloration.[16] As a result, a TAP containing clindamycin, metronidazole, and ciprofloxacin was employed in this case report. Moreover, it has been demonstrated that stem cell survival is adversely affected by high TAP concentrations. According to Ruparel et al., regenerative endodontic therapy should use low concentrations of antibiotics with sufficient antibacterial activity. Concentrations less than 1 mg/mL might be recommended as they have the potential to increase SCAP survival rates to nearly 100%.[17]

When periapical bleeding is induced into the sterilized canal of permanent teeth, either immature or mature, mesenchymal stem cells along with growth factors primarily derived from platelets, are introduced.[18] The current report employed a modified revitalization approach that combines PRF as a scaffold and supply of growth factors with induced bleeding to create a blood clot (BC) in the canal. This was supported by a priveous study conducted by Zhou et al. , in which excellent periapical healing in revitalization endodontic therapy was demonstrated with BC + PRF as scaffolds.[19]

A bacterially-tight coronal sea is essential for the effective revitalization procedures. Several unsuccessful cases of regenerative endodontic treatment have been described with a nonintact coronal seal.[20] For bacteria free tight coronal seal, placing MTA as a pulp space barrier and then applying adhesive resin-based restorations are the usual methods used in revitalization procedures. MTA is well known for its conductive and inductive properties, tight sealing ability, and biocompatibility.[21]

Despite the lack of a histologic examination, the formation of vital pulplike tissue which is innervated by nerve fibers and inherited with innate immune defense mechanisms to fight with foreign invaders is indicated by the presence of a positive response to cold and electric pulp testing.

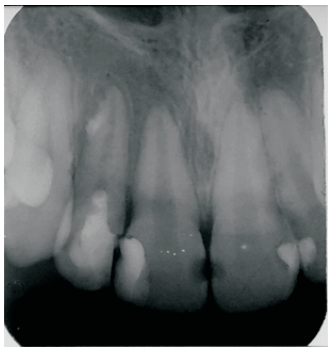
(A) Preoperative periapical radiograph showing a large periapical osteolytic lesion involving the distal aspect of root of tooth #7 and the mesial aspect of root of tooth #6



(B) Working length estimation

(C) Postopertaive periapical radiograph showing tooth #7 after revitalization procedure

(D) 6-month follow-up periapical radiograph showing healing of periapical lesion with trabecular bone formation and increase in density of bone



(E) 1 year follow-up periapical radiograph showing further healing of osteolytic lesion and more trabecular bone formation

(F) 5 year follow-up periapical radiograph showing that the large periapical osteolytic lesion is completely filled with trabecular bone formation indicating complete healing of

periapical lesion with intact lamina dura and normal periodontal ligament space

Conclusion:

Based on the clinical and radiographic outcomes of the current case, the modified revitalization protocol, which included root canal disinfection, evoked bleeding, and PRF in root canal therapy, was found to be an acceptable replacement for traditional root canal therapy during the 5-year follow-up period. More case reports, case series and clinical studies are required to formulate the hypothesis to test the predictability of revitalization therapy in necrotic mature permanent teeth with large periapical lesions.

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