Assessment of Regaining Pulp Sensibility in Mature Necrotic Teeth Using a Modified Revascularization Technique with Platelet-rich Fibrin: A Clinical Study

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Abstract

Introduction: The aim of the present study was to evaluate the possibility of regaining pulp sensibility in mature necrotic teeth using modified regenerative endodontic procedures by inducing bleeding in root canals and using platelet-rich fibrin (PRF). **Methods:** Fifteen patients with necrotic pulp with symptomatic or asymptomatic apical periodontitis were included. At the first visit, the tooth was anesthetized, and an access cavity was performed. Mechanical preparation of root canals was performed using the standardized technique reaching apical canal preparation to K-file size #60–80. Double antibiotic paste was injected into the canal, and the cavity was temporarily sealed using glass ionomer cement. Three weeks from the first visit, regenerative endodontic procedures were performed by inducing bleeding, and a freshly prepared PRF membrane was placed in the canal. White mineral trioxide aggregate was placed directly over the PRF matrix, and the tooth was restored with a glass ionomer cement base and resin composite restoration. The electric pulp test was used to record if the teeth included in the study regained sensibility or not every 3 to 12 months follow-up. Readings at different times were compared as categoric qualitative data using the chi-square test and compared as means and standard deviations using the analysis of variance test. **Results:** Readings of tooth sensibility revealed a highly significant difference ($P < .0001$) between baseline and the 12-month follow-up period. **Conclusions:** The presence of sensibility is indicative of the formation of vital pulplike tissue. Reestablishing real pulp tissue after regenerative endodontic treatment is debatable and still needs high level of evidence with large-scale investigations. *(J Endod 2018;■:1–8)*

Key Words

Modified revascularization technique, platelet-rich fibrin, pulp sensibility

Significance

The gain of nerve function in regenerated pulp tissues and maintaining possible proprioceptive defense mechanisms of the pulp will provide an alarm system during tissue injury and protect the pulp from further damage or the probability of tooth fracture.

Preservation of the natural dentition remains a primary objective in endodontic practice. When the pulp is diseased or necessitates removal for restorative reasons, it is replaced with an artificial filling material. Endodontists are looking forward to using natural resources instead of artificial ones, especially after the introduction of tissue engineering in many medical and dental fields (1).

Endodontics is a rich branch for applying tissue engineering science in many aspects, such as dentin-pulp complex regeneration, periodontal regeneration, and bone healing and regeneration. The regenerative endodontic procedure is an example of tissue engineering and was limited to immature teeth, but recently it extended to mature teeth as an alternative to conventional endodontic treatment (2).

Conventional endodontic treatment has some drawbacks as highlighted by many studies that concluded that endodontic treatment is a major etiologic factor for tooth discoloration (3) and tooth fracture (4, 5). Generally, an endodontically treated tooth undergoes coronal and radicular tissue loss because of prior pathology, endodontic treatment and/or restorative procedures, and a loss of protective mechanism of proprioception. There is evidence that these teeth have reduced levels of proprioception (6, 7). Therefore, the gain of nerve function in regenerated pulp tissues and maintaining possible proprioceptive defensive mechanisms of the pulp will provide an alarm system during tissue injury and protect the pulp from further damage or the probability of tooth fracture (7, 8).

According to numerous histologic studies (9–13) on extracted human teeth, information regarding regenerated tissues is conflicting; some studies showed that regenerated tissues are pulplike tissues, cementumlike tissues, bonelike tissues, and periodontal-like tissues. Nerve regeneration was identified in some cases (14), so reconstitution of the neurovascular system in root canals by regenerative endodontic

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procedures will provide regenerated tissues with immune system cells, which will function as the primary line of the defense mechanism against microbial attacks (15–18). In addition to pulp regeneration, reparative dentin may be deposited along the root canal walls that had been lost during mechanical instrumentation after regenerative therapy (19) and below mineral trioxide aggregate (MTA), which acts as a coronal seal material above the regenerated tissues (20–22).

Regenerative endodontic therapy was limited to pulp revascularization of immature necrotic teeth by disinfection of the root canal system followed by establishing bleeding into the canals via overinstrumentation (23–25). Shah and Logani (26) were the first to attempt pulp revascularization in mature teeth followed by several case reports (15–18). Their results were promising, relieving clinical signs and symptoms and showing periapical healing. Some cases showed regained tooth sensibility.

A second-generation platelet concentrate known as Choukroun's platelet-rich fibrin (PRF) is totally autologous in nature, a very simple technique, and inexpensive. PRF contains platelets, growth factors, and cytokines that might enhance the healing potential of both soft and hard tissues (27). In the present study, modified regenerative endodontic procedures were used to induce bleeding in the root canal using PRF as a scaffold and source of growth factors to treat necrotic mature teeth with a closed apex and to evaluate the possibility of regaining pulp sensibility.

Materials and Methods

Fifteen patients with necrotic upper central incisors were recruited from the outpatient clinic of the Endodontic Department, Faculty of Oral and Dental Medicine, Cairo University, Cairo, Egypt, between 2015 and 2017. The protocol of the trial was approved by the Ethics Committee of Cairo University. The treatment procedures and the aim of the study were thoroughly explained for all the patients. The patients were asked about their dental and medical history; medically compromised patients were excluded. Patients were asked to follow the general instructions, sign a printed informed consent that explained the aim of the study, and conform with the clinical and radiographic follow-up period every 3 months up to 1 year.

Inclusion criteria for the study were patients 18–40 years old with no sex predilection, medically free, suffering from necrotic pulp in maxillary permanent central incisor teeth with a closed apex associated with or without periapical radiolucency, no response of vital pulp with thermal (cold) and electric pulp testing, no tooth mobility, and a pocket depth <3 mm. A full history of the chief complaint was taken including intensity, quality, onset, duration, location, course, and initiating and relieving factors of pain. Fifteen patients who fulfilled the inclusion criteria were included in the study. Few of the included patients were complaining of mild to moderate dull pain on percussion and palpation tests with or without a fistula tract. Other patients were complaining of moderate to severe pain with intraoral swelling and pain on biting and palpation and percussion tests. Some patients were complaining of tooth discoloration from previous trauma. The final diagnosis of the included patients was necrotic pulp with symptomatic or asymptomatic apical periodontitis.

At the first visit, the tooth was anesthetized with the buccal infiltration technique using 1.8–3.6 mL 2% lidocaine with 1:100,000 epinephrine local anesthetic solution. An access cavity was performed, and the tooth was isolated with a rubber dam. Negotiation of the canals was performed using stainless steel hand K-files size #15. The working length was determined using an electronic apex locator and then confirmed with intraoral periapical radiography to be 0.5–1 mm shorter than the radiographic apex. Mechanical preparation of the root canals was performed using the standardized technique reaching apical canal preparation to K-file size #60–80. The canals were thoroughly irrigated between each successive file using 1.5% sodium hypochlorite (NaOCl). The canal was dried with paper points. Double antibiotic paste (DAP) was prepared by grinding 1 tablet of metronidazole (500 mg) and 1 tablet of ciprofloxacin (500 mg), which were then mixed with saline to form a homogenous paste of reasonable creamy consistency. This mix was then injected into the canal to a level just below the cementoenamel junction (CEJ). A cotton pellet was placed, and the cavity was temporarily sealed with glass ionomer cement.

At the second visit, the participants were recalled after 3 weeks from the first visit for completion of the regenerative endodontic procedures. A plain anesthesia 1.8-mL 3% mepivacaine buccal infiltration was administered. The rubber dam was placed, temporary filling was removed using a high-speed handpiece, and reirrigation of root canals was performed with 20 mL 17% EDTA for 1 minute followed by saline irrigation (22, 28). The canals were dried using paper points. Intentional overinstrumentation 2–3 mm past the apex into the periapical region was done with K-files #20–#40 to induce bleeding near the apical foramen to a level below the CEJ. The file was gently given 2 to 3 clockwise turns and then withdrawn using counterclockwise rotation. Excess blood reaching the pulp chamber was dried using a small cotton pellet held with tweezers. A 5-mL sample of whole venous blood was drawn from the patient's forearm (right median cubital vein). The blood sample was then transferred into a test tube without anticoagulant and centrifuged immediately using a tabletop centrifuge at 3000 rpm for 10 minutes (29). Three distinct layers were formed in the tube: platelet-poor plasma at the top, a PRF clot in the middle, and red blood cells at the bottom. Then, the freshly prepared PRF membrane was fragmented, and the fragments were placed incrementally in the canal using a hand plugger and a finger spreader size 40 up to the level of the CEJ. A 3-mm-thick layer of white MTA was placed directly over the PRF matrix. A moist cotton pellet was placed over the MTA, and the tooth was temporized using a temporary filling for complete setting of the MTA. The patient was recalled after 2 days to remove the cotton pellet, and the tooth was restored using a glass ionomer cement base and resin composite restoration (Figs. 1–5).

Thermal (cold) and electric pulp tests were used to record if the teeth included in the study regained sensibility or not. The preoperative electric pulp test reading for the included tooth in the study was recorded to ensure pulp necrosis of the involved tooth. The average of 2 readings was recorded for each tooth with an interval of 5 minutes according to the manufacturer's instructions. Data were recorded every 3 months for a follow-up of 1 year.

Results

The mean age was 25 years, and there were more female patients than male patients. However, the chi-square test revealed no significant difference of sex distribution. Clinical evaluation results showed that there was no pain, swelling, or fistula through the follow-up period in all of the cases. Nine patients had sensitivity on the cold test. All the cases with preoperative apical radiolucency showed radiographic resolution of apical periodontitis, and no teeth without preoperative radiolucency showed any bony changes after 12 months of follow-up.

According to the manufacturer's electric pulp test instructions, if the readings are between 0 and 39 and the patient feels ache, tingling, or anesthesia, the result is a tooth with vital pulp. If the readings are between 40 and 79 with ache or a tingling sensation, the result is part of a tooth nerve is nonvital. Finally, if the readings are 80 with