Treatment of Mature Permanent Teeth with Necrotic Pulps and Apical Periodontitis Using Regenerative Endodontic Procedures: A Case Series

Tarek Mohamed Saoud, BDS, MSC, PhD,[*] Gabriela Martin, DDS, PhD,[†] Yea-Huey M. Chen, DDS, MS,[‡] Kuang-Liang Chen, DDS,[‡] Chao-An Chen, DDS,[‡] Kamolthip Songtrakul, DDS, MS,[§] Matthew Malek, DDS,[§] Asgeir Sigurdsson, DDS, MS,[§] and Louis M. Lin, BDS, DMD, PhD[§]

Abstract

Introduction: Regenerative endodontic procedures (REPs) are usually used to treat human immature permanent teeth with necrotic pulps and/or apical periodontitis. Successful REPs result in the elimination of clinical signs/symptoms, the resolution of apical periodontitis, and, in some cases, thickening of the canal walls and/or continued root development with or without apical closure. REPs can restore the vitality of tissue in the canals of immature permanent teeth previously destroyed by infection or trauma. Vital tissue is inherited with immune defense mechanisms to protect itself from foreign invaders. Recently, REPs have also been used to successfully treat human mature permanent teeth with necrotic pulps and apical periodontitis. The purpose of this case series was to present the potential of using REPs for mature permanent teeth with necrotic pulps and apical periodontitis. **Methods:** This case series consisted of 6 patients, 4 females and 2 males. The patients' ages ranged from 8–21 years old. Seven permanent teeth, 4 anterior and 3 molar teeth, with necrotic pulps and apical periodontitis were treated using REP. Radiographically, the root development of all teeth was almost completed except the apices of 2 molars, which showed slightly open. Complete chemomechanical debridement of the canals of the teeth was performed, and the canals were dressed with Metapaste (Meta Biomed Co, Ltd, Chungbuk, Korea) during treatment visits. Periapical bleeding into the canals was induced at the last treatment visit by placing a hand #20 or #25 K-file with the tip slightly bent through the apical foramina into the periapical tissues. A 3-mm thickness of mineral trioxide aggregate was placed into the coronal canals over semicoagulated blood. The access cavities were restored with either composite resin or amalgam. **Results:** Follow-ups of the 7 teeth ranged from 8 to 26 months. The periapical lesions of 2 teeth were considered healed, and 5 teeth revealed healing. Clinical signs/symptoms were absent in all teeth at follow-up visits at different time points. None of the treated teeth responded to cold and electric pulp tests. **Conclusions:** This case series shows the potential of using REPs for mature teeth with necrotic pulp and apical periodontitis. *(J Endod 2016;42:57–65)*

Key Words

Apical periodontitis, immune defense mechanisms, mature teeth, necrotic pulps, regenerative endodontic therapy, vital tissue

Regenerative endodontics is defined as biologically based procedures designed to physiologically replace a damaged tooth structure, including dentin and root structures, and the pulp-dentin complex (1). Regenerative endodontic procedures (REPs) are currently used to treat immature permanent teeth with infected or noninfected necrotic pulps (2). REPs have been shown to be able to eliminate clinical signs/symptoms and resolve apical periodontitis. In addition, thickening of the canal walls and/or continued root development have been shown in some cases (3–5). According to the American Association of Endodontists Clinical Considerations for a Regenerative Procedure, the primary goal of REPs is elimination of clinical signs/symptoms and resolution of apical periodontitis (6). Increased thickening of the canal walls and/or continued root development are secondary goals in those considerations (6). Therefore, it can be stated that the primary goal of REPs is similar to that of nonsurgical root canal therapy.

Traditionally, mature permanent teeth with infected or noninfected necrotic pulps are treated with nonsurgical root canal therapy, which includes chemomechanical debridement, intracanal mediation, and root filling. The outcome of nonsurgical root canal therapy is considered predictable (7). Recently, REPs have been used to successfully treat mature teeth with necrotic pulps and apical periodontitis (8–10). The treatment also resulted in the elimination of clinical signs/symptoms and resolution of apical periodontitis. The difference between nonsurgical root canal therapy and an REP is that the disinfected canals are filled with biocompatible, nonvital foreign materials in the former therapy and vital tissue in the latter therapy.

From the*Department of Endodontics, Faculty of Dentistry, University of Benghazi, Benghazi, Libya; †Department of Endodontics, Faculty of Dentistry, National University of Cordoba, Cordoba, Argentina; ‡Department of Endodontics, Chi Mei Medical Center, Yong Kang and Liouying, Tainan, Taiwan; and §Department of Endodontics, College of Dentistry, New York University, New York, New York.

Address requests for reprints to Dr Louis M. Lin, Department of Endodontics, NYU College of Dentistry, 345 East 24th Street, New York, NY 1000. E-mail address: lml7@nyu.edu

0099-2399/$ - see front matter

http://dx.doi.org/10.1016/j.joen.2015.09.015

TABLE 1. Demographics of Patients

Patient no.	Sex	Age (y)	Tooth no.
1	M	14	25
2	F	18	8, 9
3	F	21	8
4	M	11	30
5	F	9	19
6	F	8	19

F, female; M, male.

The tissues generated in the canals of human immature permanent teeth with infected necrotic pulps and apical periodontitis after REPs are cementumlike, bonelike, periodontal ligament–like tissues; blood vessels; and nerve fibers (11–14). Although these tissues are not true pulp tissue, they are the host's own vital tissue, which is inherited with immune defense mechanisms to protect itself from foreign invaders. Therefore, REPs are able to restore the vitality of tissue in the canals of immature permanent teeth that was previously destroyed by infection or trauma. However, it is not known whether tissues can be generated in the canals of human mature permanent teeth after REPs because there are no histologic studies available.

Based on previous case reports (8–10) and the primary goal of REPs, it was believed that REPs might have the potential to be used to treat human mature permanent teeth with infected or noninfected necrotic pulp. The purpose of this case series was to present the potential of using REPs for human mature permanent teeth with infected or noninfected necrotic pulps and apical periodontitis in terms of elimination of clinical signs/symptoms and resolution of apical periodontitis. The present case series is part of our multiinstitutional clinical trials of REPs for human mature permanent teeth with infected or noninfected necrotic pulps. Written informed consents were obtained from the patients.

Case Series

Six patients were treated in the endodontic clinic at the faculty of dentistry, University of Benghazi. The patients' chief complaint and the dental and medical histories were obtained. Preoperative radiographs of all teeth were taken. Pulp tests using cold, heat, and an electric pulp tester were performed. Intraoral and extraoral examinations were conducted. Swelling, the presence of draining sinus tracts, and tooth discoloration were recorded. A diagnosis of pulpal-periapical disease was based on the chief complaint, clinical signs/symptoms, pulp tests, and radiographic findings.

The demographics of the patients are summarized in Table 1. The present case series consisted of 6 patients, 4 females and 2 males. The patients' ages ranged from 8–21 years. Seven mature teeth, 4 anterior and 3 molar teeth, were treated using REPs. Three teeth had caries, which caused pulp necrosis and apical periodontitis. Five teeth had a history of trauma and subsequently developed pulp infection and apical periodontitis. Four teeth were associated with intraoral swelling. Two traumatized teeth showed discoloration. Radiographically, the roots of all teeth had a periapical radiolucent lesion of endodontic origin (Table 2). The root development of all teeth was almost complete, except the apices of the distal roots of 2 mandibular first molars (#19), which showed exhibited slightly open (Figs. 1*A–D* and 2*A–D*).

Summary of Treatment Procedures

To avoid repetition of some treatment procedures among 7 cases, the treatment procedures are summarized as follows.

First Treatment Visit. Local anesthetic with 2% lidocaine containing 1:100,000 epinephrine was given as local infiltration for anterior teeth and an inferior alveolar block for molar teeth. The endodontically involved tooth was isolated with a rubber dam. All caries were removed. The access cavity was made through the lingual surface of the crown of anterior teeth and the occlusal surface of the crown of molar teeth. The canal/canals were located. The pulp chamber was irrigated with 2.5% sodium hypochlorite solution (Household Cleaning Products Company of Egypt, Cairo, Egypt). A working length 0.5 mm short of the radiographic apex was determined with the electronic apex locator and periapical radiographs. The canals were initially instrumented to the working length with hand K-files to #20 and then prepared with ProTaper Universal rotary files (Dentsply International, Ballaigues, Switzerland) to F1 (tip size #20) with copious amounts of sodium hypochlorite irrigation during instrumentation. The canals were dried with paper points and dressed with Metapaste (calcium hydroxide; Meta Biomed Co, Ltd, Chungbuk, Korea). The access cavity was closed with a sterile cotton pellet and intermediate restorative material (IRM) (Dentsply International) for 2 weeks.

Second Treatment Visit. Under local anesthesia with 2% lidocaine containing 1:100,000 epinephrine, the tooth was isolated with a rubber dam and reopened. The cotton pellet and IRM were removed from the access cavity. Metapaste was flushed out of the canal with sodium hypochlorite irrigation. The canal was again prepared with ProTaper Universal Rotary files to F5 (tip size #40) for teeth #8 and #9 and F3 (tip size #30) for tooth #25. The mesiobuccal and mesiolingual canals were prepared to F2 (tip size #25) and the distal canals to F4 (tip size #35) of teeth #19 and #30 with copious amounts of sodium hypochlorite irrigation. After complete chemomechanical debridement, a #15 K-file was used to penetrate into the periapical tissues through all canals to ensure the patency of the apical foramina. The canals were dried and dressed with Metapaste. The access cavity was closed with a cotton pellet and IRM for 2 weeks.

TABLE 2. Clinical Signs/Symptoms, Diagnosis, and Treatment Outcomes of 7 Teeth Treated Using RET

Patient no.	Tooth no.	Dental history	Clinical examination	Clinical tests	Radiologic examination	Clinical diagnosis	Periapical status	Last control (month)
1	25	Trauma	Tooth discoloration	e(−), pc(−), pp(−)	PAP	PN and AAP	Healed	13
2	8	Trauma pain	Crown fracture	e(−), pc(+), pp(+)	PAP	PN and SAP	Healing	12
	9	Trauma pain	Crown fracture	e(−), pc(+), pp(+)	PAP	PN and SAP	Healing	12
3	8	Trauma intraoral swelling, sinus tract	Tooth discoloration	e(−), pc(+), pp(+)	PAP	PN and CAA	Healed	26
4	30	Caries	Intraoral swelling	e(−), pc(+), pp(+)	PAP	PN and AAA	Healing	12
5	19	Caries	Intraoral swelling	e(−), pc(+), pp(+)	PAP	PN and AAA	Healing	12
6	19	Caries	Intraoral swelling	e(−), pc(+), pp(+)	PAP	PN and AAA	Healing	8

AAA, acute apical abscess; AAP, asymptomatic apical periodontitis; CAA, chronic apical abscess; e, electric pulp test; PAP, periapical pathology; pc, percussion; PN, pulp necrosis; pp, palpation; SAP, symptomatic apical periodontitis.