Management of an infected immature tooth with a talon cusp using regenerative endodontic treatment: A case report

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Objective: *Regenerative endodontic treatment (RET) has been considered a successful approach to manage infected immature teeth; however, cases associated with dental anomalies, i.e., talon cusp, need to be further investigated.* ***Case Report:*** *A 7-year-old girl with local swelling associated with the permanent maxillary right central incisor was referred; cone-beam computed tomography revealed a talon cusp, an immature root and two well-defined endodontic lesions. The treatment consisted of regenerative endodontic treatment (RET); the canal was chemically cleaned and a modified triple antibiotic paste was used as intracanal medication. In the next appointment, RET was performed through the creation of blood clot scaffold in the canal covered/sealed with calcium-enriched mixture (CEM) cement.* ***Results:*** *In the 7-day recall session, clinical examination showed that the swelling had completely resolved. At 24-month recall, the treated tooth was asymptomatic and functional. CBCT images demonstrated evidence of maturation in the apical third of the root, healing of two large endodontic lesions and complete dentinal bridge formation beneath CEM cement.* ***Conclusion:*** *RET for an infected immature tooth with a dental anomaly, i.e., talon cusp, may be a desirable treatment option and result in the resolution of endodontic lesions as well as regeneration of new vital tissues; allowing continuous root maturation.*

Keywords: *Regenerative endodontics, Calcium-silicate-based cements, Dental anomaly, Immature teeth, Modified triple antibiotic paste*

INTRODUCTION

Currently, the management strategy for saving non-vital/infected immature permanent teeth is moving from traditional calcium hydroxide apexification or one-step apical plug to regenerative endodontic therapy (RET). The biologically-based endodontic protocol, with its exponential growth in the past decade, is aimed at the repair/replacement of damaged tooth structures due to trauma, deep caries and developmental dental anomalies, and regeneration of the dentin-pulp complex [1,2]. In addition to the resolution of signs/symptoms and thorough healing of periradicular lesions, the main purpose of RET is to allow continued root development coupled with apical closure; in contrast with apexification/apical plug techniques, where the dental pulp tissue is unquestionably not revitalized. Considering the basis of tissue engineering, RETs rely on the triad of stem cells, growth factors and scaffolds; to allow repopulation of stem cells, regeneration of dental pulp connective tissue, and continuation of root maturation [3]. Current best evidence has demonstrated that the induction of bleeding from periapical tissues within a disinfected root canal and covering it with a suitable biomaterial can result in the stimulation of the tissue engineering triad [4]. However, no strict consensus/guidelines for RET are

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Talon cusp is an uncommon unilateral/bilateral dental anomaly referring to an accessory cusp-like structure projecting from the labial/lingual aspects of the upper/lower maxillary/mandibular anterior primary/permanent teeth in men/women; the name was proposed in 1970 due to its characteristic shape resemblance to an eagle's talon[5]. The anomaly occurs in ~1.67% of the population[6] and based on the degree of cusp formation/extension, the talon cusps are classified into three types[7]: (i) talon cusp; as the most frequent type, which prominently projects/extends at least half the distance from cemento-dentinal junction (CEJ) to the incisal edge, (ii) semi-talon cusp; which extends less than half the distance from CEJ to the incisal edge, and (iii) a trace talon or an enlarged/prominent cingula in any of its variants; originating from the cervical third of the root.

The purpose of the current case study was to present a very rare case in which RET was performed as a conservative method to manage an infected immature tooth with talon cusp and two separate large periradicular lesions.

CASE REPORT

A 7-year-old girl was referred to an endodontic clinic for further evaluation and proper treatment of mild local swelling on the palatal mucosa of her permanent maxillary right central incisor tooth; a symptom which had started one month before, as was reported by her parents. In addition, there had been no report of any other symptoms/complaints. Her medical/dental histories were initially taken; which were considered unremarkable, with the patient having no previous record of traumatic injuries. Intraoral examination revealed mixed dentition with the maxillary central incisors the only anterior permanent teeth erupted at normal chronological age. Oral hygiene was acceptable and periodontal health was good. The involved tooth was tender to percussion/palpation and showed no response to sensibility tests. The crown was caries-free but had a pronounced talon cusp well-extended from CEJ to beyond the incisal edge with two developmental grooves present on its lateral aspect (Fig. 1). Due to occlusal interference, the anomalous tooth had not fully erupted.

Diagnostic panoramic/periapical radiographies revealed that the crown of the affected tooth presented morphologic signs of malformation (*i.e.,* a well-shaped talon cusp extending beyond CEJ) with an open apex and large radiolucency at the mid-root (Fig. 2 and 3a). Furthermore, cone-beam computed tomography (CBCT) was performed in order to elucidate tooth anatomy and detect the dimensions of the lesion. The CBCT showed an open apex, two large lesions on the apical and palatal mid-root of the infected tooth, and an anomaly that originated from beyond CEJ and extended to the incisal edge. The root canal of the main tooth and the anomaly had communicated (Fig. 3).

The final diagnosis of the incisor was pulpal necrosis and symptomatic apical periodontitis. Treatment options/procedures, including apexification, one-step apical plug and RET, were comprehensively explained to the patient's parents; however, RET was recommended. After reviewing the risks/benefits of the proposed ministrations and possible complications with her parents, informed consent was obtained for performing the procedure.

Figure 1: Buccal and occlusal views of upper central incisor teeth; the right incisor shows a talon cusp associated with redness/swelling in its distopalatal aspect.

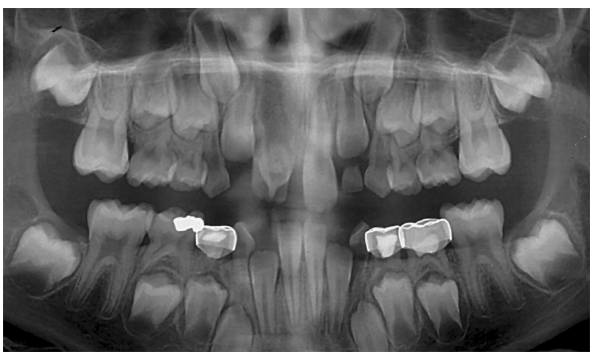

Figure 2: Diagnostic orthopantomograph (OPG) shows a mixed dentition in a 7-year-old patient. A unilateral dental anomaly (*i.e.,* talon cusp) in the right central incisor tooth is evident.

In the first session, no anesthesia was administered, the tooth was then isolated, and after the reduction of talon cusp due to its interference with occlusion, access cavity was prepared. The pulp chamber as well as the root canal space were gently irrigated with full-strength sodium hypochlorite for ~5 minutes with no mechanical instrumentation. Next, the canal was irrigated with sterile normal saline and dried with sterile

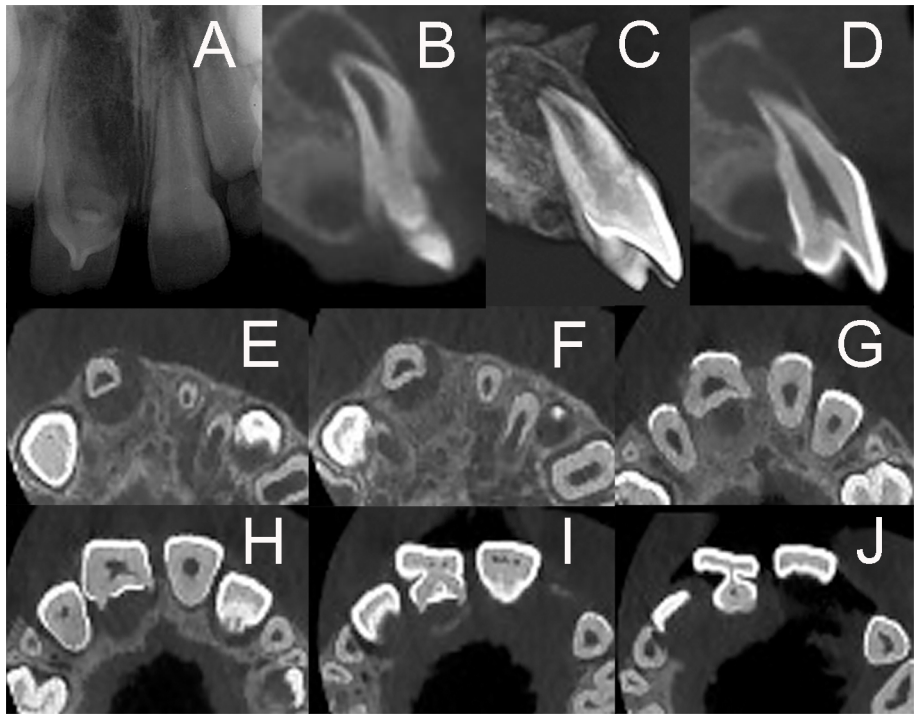

Figure 3: Conventional radiograph and cone-beam computed tomography of the case. (A) Preoperative periapical radiograph showed a talon cusp on the right maxillary incisor tooth and bone rarefaction around its root. (B–J) CBCT scans in the sagittal (B–D) and axial planes (E–J) showed two large endodontic lesions surrounding the immature root of the infected tooth.

Figure 4: Recall radiographs and cone-beam computed tomographies of the case. (A) Immediate postoperative periapical radiograph after the first appointment demonstrated a severe cusp reduction of the talon cusp for the elimination of occlusal interference. (B) Postoperative radiograph after the second appointment demonstrated the filling/sealing of the coronal part of the root canal with CEM cement (over the blood clot). (C–D) Two-year follow-up CBCT clearly showed evidence of thorough healing of two endodontic lesions, complete dentinal bridge formation beneath CEM cement endodontic biomaterial, and maturation in the apical third of the root.

paper points. A modified triple antibiotic paste (MTAP; penicillin G, metronidazole, and ciprofloxacin) was placed into the canal as intracanal medication, and the access cavity was temporized with a sterile cotton pellet and self-cure glass ionomer cement (Fig. 4A).

In the next appointment, MTAP was removed via irrigating the root canal system with copious amount of sterile saline solution. Subsequently, the canal was dried with paper points. The irritation of apical tissues beyond the apex was performed using a #40 headstrom file. After the filling of the root canal with blood, calcium-enriched mixture (CEM cement; BioniqueDent, Tehran, Iran) plug was placed over the newly-

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formed blood clot. Finally, the access cavity was permanently filled/sealed with light-cured resin-bonded dental composite restorative material (Z250; 3M, ESPE, USA) (Fig. 4B).

One week postoperative recall revealed complete resolution of the swelling and total disappearance of clinical symptoms. The patient was scheduled for recall every 3 months; nevertheless, due to Coronavirus disease 2019 (COVID-19) pandemic, the patient returned in two years. At two-year recall, the incisor was clinically asymptomatic/functional; however, it did not respond to sensibility tests. CBCT scans of the tooth revealed evidence of maturation in the apical third of the root, healing of the endodontic lesions and complete dentinal bridge formation immediately beneath CEM cement (Fig. 4C–D).

DISCUSSION

Resolution of endodontic lesions is the intensive evidence of healing and is generally interpreted as the successful primary outcome of RET; however, there are other extra aims, *e.g.*, the increased thickness of root canal walls (reducing the risk of root fracture), continued root development/maturation (improving the overall crown/root ratio), formation of hard tissue barrier in the canal beneath the plug (sealing the path of reinfection), and expression of positive response to the sensibility tests, which are interpreted as favorable secondary outcomes [8] This clinical case described a very rare case of talon cusp on an infected immature incisor, in which after RET, the treated tooth (a) exhibited complete healing of the two separate periapical/periradicular lesions, (b) created a thorough dentinal bridge, separating the pulp from the body exterior, and (c) revealed some root development; all of which were detected on CBCT. These features overlapped types 1 and 5 responses of immature permanent teeth with infected necrotic pulpal tissue associated with apical periodontitis to RET [9]. Nevertheless, the tooth did not respond to sensibility tests.

It has been reported that the overall success rate of RET for non-vital teeth with dental anomaly is 93%; however, the success rates for teeth with traumatic injuries or carious lesions are 95% and 96%, respectively; which yield high survival and/or healing rates accompanied by an acceptable rate for root development [10]. Although there is no universal consensus on the RET protocol/guideline, RET generally comprises (i) chemical disinfection of root canals (using irrigation solutions (*i.e.,* sodium hypochlorite, chlorhexidine, Ethylenediaminetetraacetic acid (EDTA)) with intracanal medicaments (*i.e.,* calcium hydroxide (CH), double/triple antibiotic paste, MTAP), or using novel disinfectants (*i.e.,* ozone, nitric oxide, photodynamic therapy, nanobubble water, cold atmospheric plasma, and probiotics)), (ii) employment of a scaffold (smart/loaded scaffold (*i.e.,* interleukin-loaded), biologically inspired scaffolds (*i.e.,* blood clot, platelet-rich fibrin, extracellular matrix)) and, (iii) permanent restoration of canal orifice(s) (using calcium-silicate-based biomaterials; *i.e.* MTA, CEM cement) as well as the coronal cavity [11,12]. Moreover, the "American Association of Endodontists" presented the latest protocol for RET in 2018, and recommended canal irrigation using sodium hypochlorite (1.5%) followed by the application of CH/antibiotics (low concentration) in the first and EDTA (17%) in the second visit.

Researchers found that the above-mentioned regimen may decrease dentin microhardness and cause demineralization [13]. Furthermore, in the presented investigation, sodium hypochlorite, normal saline solution and MTAP were employed in the first visit, while normal saline solution and CEM cement were used for apical plug in the second appointment.

Triple antibiotic paste, despite its benefits, has a discoloration effect; mostly due to the presence of minocycline. In the proposed MTAP, minocycline has been replaced with penicillin G with white appearance. While minocycline has shown no effectiveness against *Enterococcus Faecalis*, penicillin G is effective [14]. The promising outcome in the presented case showed that MTAP could lead to treatment success in teeth with large endodontic lesions. The juxtaposition of penicillin G and ciprofloxacin/metronidazole makes a strong antibacterial combination that probably plays an important role in the treatment of endodontic lesions.

A positive pulp test response indicating the regeneration of organized dental pulp tissues was not achieved in the present case. RET recruits stem cells from endogenous sources (*i.e.,* apical papilla, periodontal tissues, bone marrow and peripheral blood) which, with/without the application of scaffolds/growth factors, seem to result in cementum/bone-like tissue formation with PDL/bone marrow tissue occupying the root canal space. However, after the transplantation of dental pulp stem cells, there is a chance that the regenerated tissue can successfully reconstruct neurovascularized dental pulp, which, in turn, is able to simulate the physiological structure of natural pulp with dentin/dentin-like deposition [15].

ProRoot MTA, due to its sealing ability and biocompatibility can induce biomineralization and odontogenic/osteogenic differentiation of human dental pulp stem cells; however, it has revealed a number of drawbacks; *i.e.,* long setting time, tooth discoloration potential, handling difficulty and high price. Many calcium silicate-based materials, *e.g.*, CEM cement, have been introduced to challenge and possibly overcome the drawbacks. Previous reports have revealed that CEM can promote the maturation of immature roots in vital and non-vital teeth [16–18]; probably due to its appropriate biocompatibility and bioactivity [19,20].

CONCLUSION

This case report showed that RET is able to provide favorable treatment outcomes for an infected immature anomalous tooth associated with endodontic lesions. Therefore, this modality may be considered a first-line treatment option for teeth with the aforementioned and/or similar involvements.

ETHICS APPROVAL

The informed consent was obtained.

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