

Revascularization Procedure induced Maturogenesis of Upper Permanent Incisor

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Abstract

Treatment of carious or traumatized teeth with open apex is usually a challenge to a dentist. Recently, some case reports have shown that revascularization process induced maturogenesis of immature non-vital teeth. This case report describes the successful revascularization process of an immature central incisor. The upper left central incisor of 14-year-old boy was treated by revascularization process induced maturogenesis procedures. The tooth was symptomatic and caused a mucogingival swelling before the treatment. 3 years follow-up radiographs show a root elongation and an apical closure in the tooth treated with revascularization process. Revascularization procedure induced maturogenesis have several advantages over conventional apexification procedure.

Key Words: Apexification, Revascularization, Traumatized teeth, Trimix antibiotic

Introduction

Traditionally teeth with open apex are treated with calcium hydroxide apexification, which aimed at sealing the apex only without changing in the root canal wall [1]. The obturation after treatment results in a tooth that is liable to a fracture other than a tooth with a fully developed root. Mineral Trioxide Aggregate (MTA) has also been used to provide an artificial barrier. But it also has a limitation of non-reinforcement of root canal system.

Recently, revascularization is a regenerative treatment and an alternative approach to treat necrotic teeth [2]. Various explanations have been given to clarify why apexogenesis/maturogenesis can occur in these non-vital immature permanent teeth. Unlike calcium hydroxide apexification, the advantage of revascularization is that it allows root maturation to continue by generating vital tissue [3]. Regenerative endodontic procedures are biologically based procedures designed to restore function to a damaged and nonfunctioning pulp by stimulation of existing stem and progenitor cells present in the root canal [4-6]. If the root canal of a necrotic infected tooth is effectively disinfected, regeneration should occur in the presence of a suitable scaffold [7]. The blood clot in the apical part of the canal can act as a scaffold and might also contain growth and differentiation factors, which might be crucial for successful proliferation and differentiation of stem cells [8-10].

Case Report

A medically free 14-year-old boy was referred from the Dental Emergency Department (ER) of King Abdulaziz Medical City with a swelling and pain related to a traumatized upper left central incisor. Upon clinical examination in the first appointment there was a sinus tract related to the discolored

tooth, thermal testing gave negative response, and electric pulp testing was also negative.

Radiographically, the tooth appeared to have an open apex with apical radiolucency and a radio-opaque area, which revealed the impaction of the canine (*Figure 1*). No root fracture was detected. The canal was wide with thin root walls, slight flaring at apical third. After administration of local anesthesia 1.8 ml 2% lidocaine with epinephrine 1:100000 and rubber dam was placed for isolation, an access cavity was made and followed with pulpectomy. A trimix of antibiotics



Figure 1. Pre-Operative radiograph showing the upper left central incisor with an open apex and apical radiolucency.

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included metronidazole, ciprofloxacin, and minocycline was applied into the canal. The tooth was restored with Cavit as a temporary filling after application of cotton pellet. After 21 days the patient came for the second appointment, the tooth was asymptotic and the sinus tract disappeared. The root canal was irrigated with 5.25% Sodium Hypochloride and the blood was induced with #40 k-file (*Figure 2*). MTA was placed over the blood clot formed and a moistened cotton pellet was applied over the MTA; Cavit was placed as a temporary restoration (*Figure 3*). The third visit was after one week, the MTA was already set and composite was applied as a final build up restoration (*Figure 4*). The patient didn't

show up for follow up, but after 3 years he came once again to King Abdulaziz Medical City for Orthodontic appointment regarding the impacted canine. The upper left central incisor was examined.

There was no mobility, no pain and no sinus tract (*Figure 5*). Follow-up radiographs showed an elongation and thickening of dentinal walls. There was also apparently root end closure. The peri-apical radiolucency was also not present, except peri-apical Radiolucency in relation with the impacted canine.

Discussion

A healthy pulp is one of the most required factors for

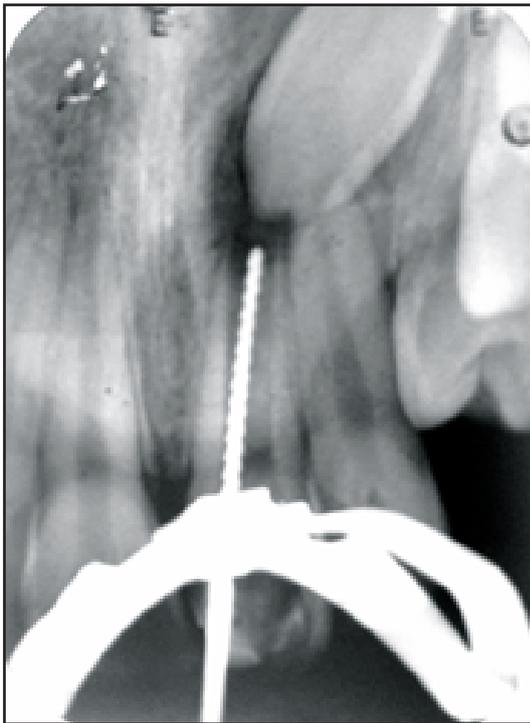


Figure 2. A Radiograph revealing #40 k-file extending for the intentional bleeding.



Figure 4. Composite build-up as a final restoration.



Figure 3. MTA applied over the blood clot formed.

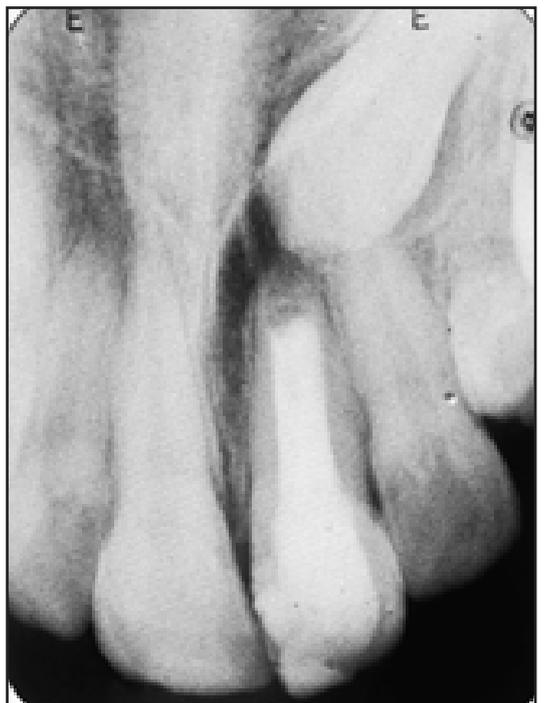


Figure 5. A radiograph showing apical root formation after 3-years follow-up.

achieving a successful treatment of vital pulp therapy [11,12]. A major challenge faced by most of the dentists is the treatment of thin, fragile open-apex canals in non-vital teeth. The duration between starting the treatment and traumatic exposure of the pulp is a mandatory factor during taking the medical history and clinical investigations. Otherwise, increasing that duration will lead to bacterial contamination and necrosis of the pulp. In the present case, many studies have shown successful end results with MTA in human teeth [13,14]. The upper left central incisor in this case report also clarified successful outcomes without any intervention for routine endodontic therapy. Many complications appear in necrotic pulp if left without any dental intervention to reduce number of bacterial contamination and avoid any infection. These complications might appear as tooth discoloration, facial swelling, pain or even fracture of remaining part of the tooth and, thus extraction of tooth might be the best solution at that time to avoid further systemic complications [15]. The routine endodontic treatment used for the treatment of necrotic open apex teeth has been calcium hydroxide apexification. Evidence Based Dentistry (EBD) show many disadvantage from using the calcium hydroxide during apexification pulp therapy such as bacterial contamination due to microleakage and longtime of the procedures [16-19]. Apical barrier of MTA and gutta-percha filling is currently the dentist's choice and it has several advantages over calcium hydroxide induced apexification and the treatment can be completed in a single visit. However, it does not strengthen the dentinal walls. Revascularization has been used as an alternative treatment. If the endodontist applies all strategies of revascularization under high standard of infection control, regeneration have to appear as in this case report [20]. One of the mandatory

three factors to start any regenerative medical therapy is the present of scaffold and here, the endodontist could use the blood clot as a natural scaffold that contain a lot of natural growth factors which are used as to differentiate the stem cells to desirable human cells [21-23]. EBD reveal that mixture of ciprofloxacin, metronidazole, and minocycline is considered as trimix antibiotic, which is significant against bacterial contamination [24,25]. In this fiction, the canal was irrigated and decontaminated with 5.25% NaOCl and filled with the trimix intra-canal antibiotic to disinfect the canals, and then Cavit acted as temporary dressing. After 5 weeks, the central incisor was asymptomatic. Here, we must consider the restoration between visits to prevent any salivary leakage and avoid any contamination [26]. From previous, we didn't use final restoration as we use it in case of apexogenesis, which is recommended in many clinical studies [27-29]. In this case report, it appears the final outcomes of regeneration therapy. Apical closure without any apical radiolucency showed in the radiographs. In addition, root length and thickness was increased normally [30].

This result shows that the final result was saving the tooth and a successful outcome and healing without any further symptoms.

Conclusion

With the increasing clinical evidence, revascularization or regenerative technique may become a standard procedure for treating immature necrotic teeth. However, various treatment methods were used in many revascularization case reports, so further clinical trials are required to standardize a treatment modality.

References

1. The role of endodontics after dental traumatic injuries. In: Sigurdsson A, Trope M, Chivian N, Hargreaves KM, Cohen S (Editors) *Cohen's Pathways of the Pulp* (10th edn.) St Louis, Mo: Mosby Elsevier; 2011, pp. 620-654.
2. Hargreaves K, Geisler T, Henry M, Wang Y. Regeneration potential of the young permanent tooth: what does the future hold? *Journal of Endodontics*. 2008; **34**: 51-56.
3. Yamauchi N, Yamauchi S, Nagaoka H, Duggan D, Zhong S, Lee SM, Teixeira FB, Yamauchi M. Tissue engineering strategies for immature teeth with apical periodontitis. *Journal of Endodontics*. 2011; **37**: 390-397.
4. Torneck CD, Smith JS, Grindall P. Biologic effects of endodontic procedures on developing incisor teeth: IV-effect of debridement procedures and calcium hydroxidecamphoratedparachlorophenol paste in the treatment of experimentally induced pulp and periapical disease. *Oral Surgery, Oral Medicine, Oral Pathology*. 1973; **35**: 541-554.
5. Cvek M. Prognosis of luxated non-vital maxillary incisors treated with calcium hydroxide and filled with gutta-percha: A retrospective clinical study. *Endodontics & Dental Traumatology*. 1992; **8**: 45-55.
6. Frank AL. Therapy for the divergent pulpless tooth by continued apical formation. *Journal of the American Dental Association*. 1966; **72**: 87-93.
7. Ding RY, Cheung GS, Chen J, Yin XZ, Wang QQ, Zhang CF. Pulp revascularization of immature teeth with apical periodontitis: A clinical study. *Journal of Endodontics*. 2009; **35**: 745-749.
8. Thibodeau B, Teixeira F, Yamauchi M, Caplan DJ, Trope M. Pulp revascularization of immature dog teeth with apical periodontitis. *Journal of Endodontics*. 2007; **33**: 680-689.
9. Hargreaves KM, Geisler T, Henry M, Wang Y. Regeneration potential of the young permanent tooth: What does the future hold? *Journal of Endodontics*. 2008; **34**: 51-56.
10. Kusgoz A, Yildirim T, Er K, Arslan I. Retreatment of a resected tooth associated with a large periradicular lesion by using a triple antibiotic paste and mineral trioxide aggregate: A case report with a thirty-month follow-up. *Journal of Endodontics*. 2009; **35**: 1603-1606.
11. Tronstad L, Mjör IA. Capping of the inflamed pulp. *Oral Surgery, Oral Medicine, Oral Pathology*. 1972; **34**: 477-485.
12. Swift EJ, Trope M. Treatment options for the exposed vital pulp. *Practical Periodontics & Aesthetic Dentistry*. 1999; **11**: 735-739.
13. Witherspoon DE, Small JC, Harris GZ. Mineral trioxide aggregate pulpotomies: A case series outcomes assessment. *Journal of the American Dental Association*. 2006; **137**: 610-618.
14. Barrieshi-Nusair KM, Qudeimat MA. A prospective clinical study of mineral trioxide aggregate for partial pulpotomy in cariously exposed permanent teeth. *Journal of Endodontics*. 2006; **32**: 731-735.
15. Kakehashi S, Stanley HR, Fitzgerald RJ. The effects of surgical exposures of dental pulps in germ-free and conventional laboratory rats. *Oral Surgery, Oral Medicine, Oral Pathology*. 1965; **20**: 340-349.
16. Chapter 36, Endodontic considerations in dental trauma. In: Trope M, Ingle JI, Bakland LK, Baumgartner JC (Editors) *Ingle's Endodontics* (6th edn.) Hamilton: BC Decker Inc; 2008. pp. 1330-1357.
17. Andreasen JO, Farik B, Munksgaard EC. Long-term calcium hydroxide as a root canal dressing may increase risk of root fracture. *Dental Traumatology*. 2002; **18**: 134-137.

18. Holden DT, Schwartz SA, Kirkpatrick TC, Schindler WG. Clinical outcomes of artificial root-end barriers with mineral trioxide aggregate in teeth with immature apices. *Journal of Endodontics*. 2008; **34**: 812-817.
19. Cvek M. Prognosis of luxated non-vital maxillary incisors treated with calcium hydroxide and filled with gutta-percha. A retrospective clinical study. *Endodontics & Dental Traumatology*. 1992; **8**: 45-55.
20. Ding RY, Cheung GS, Chen J, Yin XZ, Wang QQ, Zhang CF. Pulp revascularization of immature teeth with apical periodontitis: a clinical study. *Journal of Endodontics*. 2009; **35**: 745-749.
21. Thibodeau B, Teixeira F, Yamauchi M, Caplan DJ, Trope M. Pulp revascularization of immature dog teeth with apical periodontitis. *Journal of Endodontics*. 2007; **33**: 680-689.
22. Hargreaves KM, Geisler T, Henry M, Wang Y. Regeneration potential of the young permanent tooth: What does the future hold? *Journal of Endodontics*. 2008; **34**: 51-56.
23. Petrino JA, Boda KK, Shambarger S, Bowles WR, McClanahan SB. Challenges in regenerative endodontics: A case series. *Journal of Endodontics*. 2010; **36**: 536-541.
24. Hoshino E, Kurihara-Ando N, Sato I, Uematsu H, Sato M, Kota K, Iwaku M. In-vitro antibacterial susceptibility of bacteria taken from infected root dentine to a mixture of ciprofloxacin, metronidazole and minocycline. *International Endodontics Journal*. 1996; **29**: 125-130.
25. Windley W, Teixeira F, Levin L, Sigurdsson A, Trope M. Disinfection of immature teeth with a triple antibiotic paste. *Journal of Endodontics*. 2005; **31**: 439-443.
26. Banchs F, Trope M. Revascularization of immature permanent teeth with apical periodontitis: New treatment protocol? *Journal of Endodontics*. 2004; **30**: 196-200.
27. Thibodeau B, Trope M. Pulp revascularization of a necrotic infected immature permanent tooth: Case report and review of the literature. *Pediatric Dentistry*. 2007; **29**: 47-50.
28. Yamauchi N, Yamauchi S, Nagaoka H, Duggan D, Zhong S, Lee SM, Teixeira FB, Yamauchi M. Tissue engineering strategies for immature teeth with apical periodontitis. *Journal of Endodontics*. 2011; **37**: 390-397.
29. Da Silva LA, Nelson-Filho P, Da Silva RA, Flores DS, Heilborn C, Johnson JD, Cohenca N. Revascularization and periapical repair after endodontic treatment using apical negative pressure irrigation versus conventional irrigation plus triantibioticintra canal dressing in dogs' teeth with apical periodontitis. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontics*. 2010; **109**: 779-787.
30. Wang X, Thibodeau B, Trope M, Lin LM, Huang GT. Histologic characterization of regenerated tissues in canal space after the revitalization/revascularization procedure of immature dog teeth with apical periodontitis. *Journal of Endodontics*. 2010; **36**: 56-63.