

Healing with Incomplete Root Development After Forty Months Following: A Case Report

Revaskularizasyon Sonrası Tamamlanmamış Kök Gelişimi ile İyileşme: Kırk Aylık Takipli Olgu Raporu

Merve Erkmen Almaz¹, Melis Bahar Akyıldız², Işıl Şaroğlu Sönmez²

¹Kırıkkale University Faculty of Dentistry, Department of Pediatric Dentistry, Kırıkkale, Turkey

²Adnan Menderes University Faculty of Dentistry, Department of Pediatric Dentistry, Aydın, Turkey



Keywords

Incomplete root development, necrotic immature teeth, revascularization

Anahtar Kelimeler

Tamamlanmamış kök gelişimi, nekrotik açık apeksli diş, revaskularizasyon

Received/Geliş Tarihi : 10.05.2017

Accepted/Kabul Tarihi : 15.05.2017

doi:10.4274/meandros.10820

Address for Correspondence/Yazışma Adresi:

Melis Bahar Akyıldız MD,
Adnan Menderes University Faculty of
Dentistry, Department of Pediatric Dentistry,
Aydın, Turkey
Phone : +90 538 797 07 03
E-mail : baharmeliss@hotmail.com
ORCID ID: orcid.org/0000-0001-9714-7321

©Meandros Medical and Dental Journal, Published by Galenos Publishing House.
This is article distributed under the terms of the Creative Commons Attribution NonCommercial 4.0 International Licence (CC BY-NC 4.0).

Abstract

In recent years, the concept of revascularization has been developed that employs the use of a mixture of antibacterial drugs for disinfection of infected root canals. The clinical and radiographic examinations showed deep coronal caries, immature root, and periapical radiolucency in mandibular second premolar (#35) of a 13-year-old girl. The exam findings suggested revascularization treatment. Revascularization with triantibiotic mix was administered for 2 weeks. Then, a blood clot was created in the canal, over which mineral trioxide aggregate was placed. Coronal sealing was performed with composite resin. After 40 months follow-up, the tooth was asymptomatic with a positive response to the pulp test and periapical radiolucency was healed. However, no evidence of root development was observed. In spite of numerous reports of revascularization treatment, no incomplete root development was reported after long-term follow-up. Despite incomplete root development, positive response to the pulp test is controversial.

Öz

Son yıllarda gelişen revaskularizasyon tedavisi, antibakteriyel ilaçların karışım halinde uygulanması ile enfekte kök kanallarında dezenfeksiyonun sağlanmasını amaçlayan bir yaklaşımdır. Klinik ve radyolojik değerlendirme sonucunda, 13 yaşında kız hastada açık apeksli alt ikinci premolar dişinde (#35) derin çürük ve periapikal radyolüsenzi tespit edilmiştir. Muayene bulgularına göre revaskularizasyon tedavisi önerilmiştir. Revaskularizasyon tedavisi için üçlü antibiyotik patı 2 hafta süre ile uygulanmıştır. Sonrasında kanal içinde kan pıhtısı oluşturulmuş ve üzerine mineral trioksit agregatı yerleştirilmiştir. Koronal restorasyon için kompozit rezin kullanılmıştır. Kırk aylık takip sonucunda diş asemptomatik, pulpa testine pozitif yanıt alınmıştır ve periapikal lezyonda iyileşme gözlenmiştir. Ancak, kök gelişiminde devamlılık gözlenmemiştir. Revaskularizasyon tedavisi ile ilgili literatürdeki birçok çalışma olmasına rağmen, uzun dönem takipte kök gelişimi devam etmeyen çalışma daha önce rapor edilmemiştir. Kök gelişiminin devamlılığının sağlanamamasına rağmen pulpa testlerine pozitif pulpal yanıt alınması dikkat çekici bir bulgudur.

Introduction

Revascularization is a biologically-based procedure that allows for repopulation of the root canal with vital tissues for further root development. The treatment is based on the theory that in the absence of microorganism and necrotic tissue and in the presence of a scaffold and stem cells inside the root canal space, regeneration of the pulp tissue would be possible (1).

Previous studies reported that the outcomes of revascularization of necrotic immature teeth were lower than ideal (2-4). These outcomes were not increased in root length (2,3) and root canal thickness (3), lack of formation of tooth apex (4).

The purpose of this report is to present an unusual healing of immature permanent tooth with apical periodontitis after revascularization procedure.

Case Report

A 13-year-old girl was referred to our clinic with pain on the left side of her lower jaw. The medical history was unremarkable. Clinical examination showed an extensive caries on the lower left second premolar (#35), with sensitivity to percussion. In addition, a sinus tract was observed on the buccal mucosa adjacent to the tooth. The tooth was nonresponsive to cold testing and electric pulp test. Radiographic examination revealed an immature tooth and radiolucent lesion at the periapical area of the root (Figure 1). Considering the clinical tests,

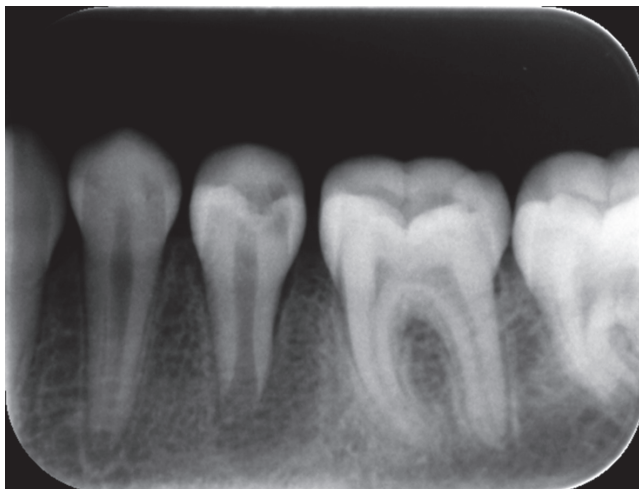


Figure 1. Radiographic examination showed an immature tooth and radiolucent lesion at the periapical area of the root

the final diagnosis was pulpal necrosis with apical periodontitis. According to the diagnosis, our first and optimal treatment option was revascularization.

An informed consent form was obtained from the patient's parents. The tooth was anesthetized with a local injection of articaine hydrochloride 4% with epinephrine 1:100.000 (Ultracaine DS, Hoechst Co., Frankfurt, Germany) and isolated with rubber dam. After the access cavity was prepared, the root canal was gently irrigated with 10 mL of 5.25% sodium hypochlorite solution (NaOCl) positioned 1-2 mm below the root canal orifice. Then the canal was dried with sterile paper points and triple antibiotics paste (TAP) was prepared (5), dressed into the root canal and left for 2 weeks. The access cavity was sealed with Cavit G (3M ESPE, St. Paul, MN, USA).

Second appointment has been 2 weeks later than the first one. The tooth was asymptomatic, and the sinus tract was healed. The temporary restoration was removed under local anaesthesia (Citanest; AstraZeneca, London, UK) and rubber dam isolation. The paste was removed by rinsing with 5.25% NaOCl, then the canal was dried with sterile paper points. A sterile size #15 K-file was used to evoke bleeding into the root canal. The bleeding was provided at the level of 3 mm below the cemento-enamel junction. Then mineral trioxide aggregate (MTA) (ProRoot MTA, Dentsply Maillefer, Ballaigues, Switzerland) was placed over the blood clot in the canal followed by a wet cotton pellet and sealed with Cavit G (Figure 2). Three hours later, the set of the MTA was confirmed,

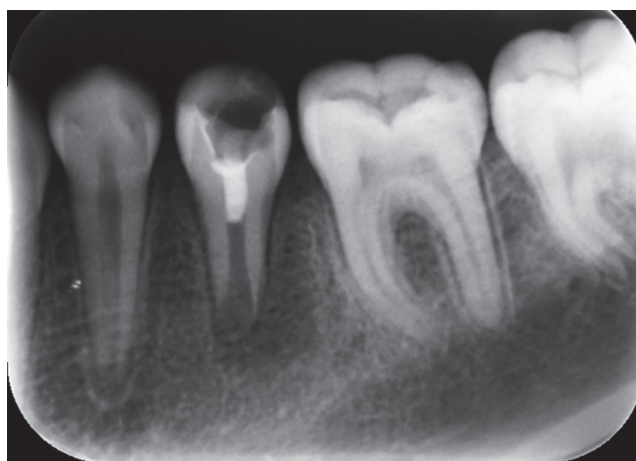


Figure 2. Mineral trioxide aggregate was placed over the blood clot in the canal followed by a wet cotton pellet and sealed with temporary restoration

and permanent restoration was completed with composite resin. The patient was followed periodically after treatment.

All follow-up appointments included standard clinical tests, and radiographic examinations. At 1-month follow-up, the tooth had no clinical symptoms (Figure 3). After 6 months, the tooth was asymptomatic clinically and the tooth did not show any indication on root canal development in radiographic examinations, but there was a dramatic decrease in the size of the apical radiolucency (Figure 4). At the 12-months follow-up, the patient remained asymptomatic and also the tooth responded positively to electrical stimulation. Radiographically, the apical radiolucency was resolved

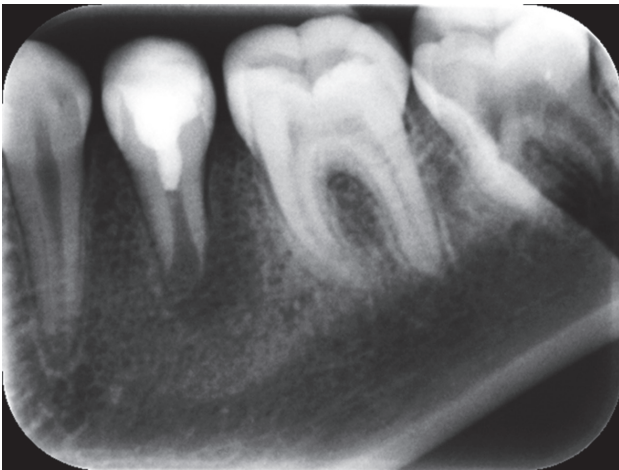


Figure 3. At 1-month follow-up, the tooth was functional, without sensitivity to percussion and palpation or presence of a sinus tract, with normal periodontal condition

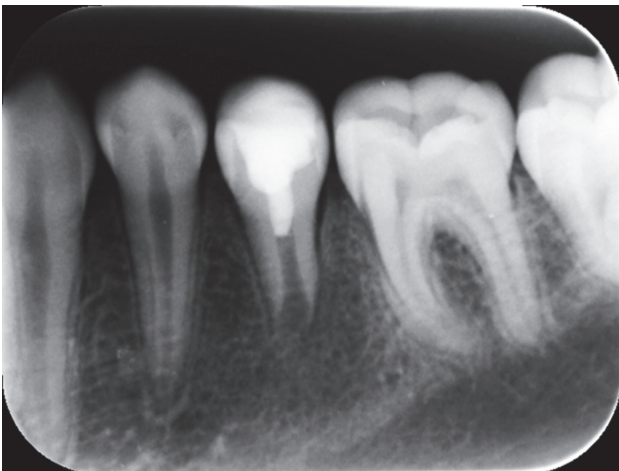


Figure 4. At 6-months follow-up, the tooth showed no indication of root canal development, but there was a dramatic decrease in the size of the apical radiolucency

completely, no increase in root length and root wall thickness was observed (Figure 5). Orthodontic treatment had begun at 18th months. Forty months after the revascularization, the tooth was found to be asymptomatic and functional in the mouth. There were no clinical signs of infection or inflammation such as sinus tract, swelling or sensitivity to percussion and palpation. Periodontal examinations revealed normal physiologic mobility and there was no pocket depth greater than 3 mm. Although radiographically there was no periapical pathology, there was no evidence about root development (Figure 6). Unexpectedly, the tooth had positive response to electrical pulp tests.

Discussion

Currently, the revascularization of necrotic immature teeth is a relatively common procedure.

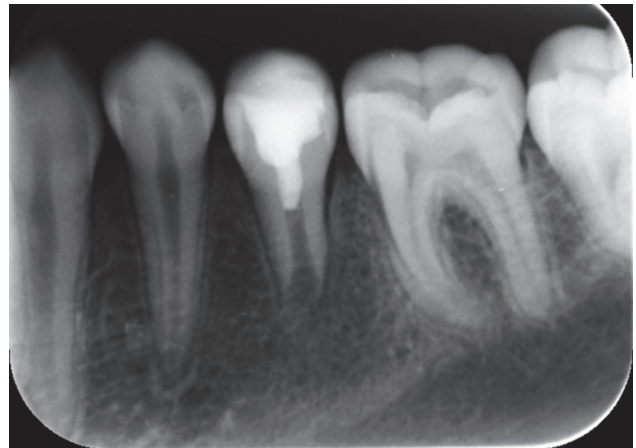


Figure 5. At the 12-months follow-up, the apical radiolucency was resolved completely, no increase in root length and root wall thickness was observed



Figure 6. Forty months after revascularization, there was no periapical pathology but still no increase in the thickness of the root walls or increase in the length of the root was found

Although there were many successful revascularization cases, there are still some concern areas and several problems that may occur with the revascularization protocol. These include insufficient bleeding, lack of root development and tooth discoloration (3,6,7).

Ding et al. (8) claimed that one of the reasons for treatment failures in revascularization might be failure of inducing the bleeding after disinfection. Local anaesthetics without vasoconstrictors are recommended to facilitate bleeding (3). However, insufficient bleeding after using local anesthetics without a vasoconstrictor is also reported (2,3,9), which has been shown to be related to poor root development in some cases (2). On the contrary, some cases with sufficient bleeding and lack of root development have also been reported (3,10). Similar to these results, in our case in spite of providing sufficient bleeding in root canal space, the root canal development was not observed. Lenzi and Trope (10) supposed that there is a possibility that blood clot breaks down and leaves the root canal space without scaffold into which the new vital tissue can grow. Furthermore, there are few cases about successful revascularization and continued root development without bleeding induction (11,12).

Stem cells apical papilla (SCAP) and Hertwig epithelial root sheath cells have a significant role in increasing root length and the root apex formation (13). Huang et al. (14) showed that vital pulp tissue is not responsible for root development. It appears that apical disease is responsible for stopping root development after pulp necrosis. SCAP may survive apical infection as a result of close proximity to the periodontal blood supply (14) in the same way that dental pulp stem cells survive and remain functional in the presence of irreversible pulpitis (15).

Nosrat et al. (6) suggested that longer the duration of pulp necrosis is related to the poor root development after revascularization procedure. Such an association could be found in studies that reported decreased or no root development (3,10). The authors discussed the possibility that long-lasting infection might destroy the cells capable of pulp regeneration. But on the basis of successful outcomes of revascularizations in cases with long-lasting apical periodontitis, they concluded that this might not be the reason. Long-term apical disease before treatment (>6 months) has been suggested to

be responsible for the absence of viable stem cells in periapical tissues and consequently the lack of pulp regeneration and poor root development (6). This might be the reason of poor root development in the present case reported.

One possibility about the lack of root development is that irrigation with copious amounts of 5.25% NaOCl solution might have damaged apical vital tissue (16) and possibly progenitor/stem cells after revascularization procedures (4). In the present case, we have also used 5.25% and this could be attributed as the reason of poor root development, but there have been several cases with very satisfactory results in spite of having used high concentration solutions of sodium hypochlorite (11,17,18).

TAP was shown to be biocompatible, and any tissue reaction to the paste decreased over time (19). On the other hand, severe inflammation of the tissues inside the root canal has been reported in other animal studies. A possible cause of this inflammation might be residual TAP inside the canal (20). The presence of toxic concentrations of antibiotics inside the root canal for several weeks and their spread to the dental papilla might be a reason for a reduction of viable SCAP. Consequently, the regenerative treatment could fail. Residual antibiotics inside the root canal space might behave as a potential threat to SCAP. Both hypotheses deserve further study.

In conclusion, the outcomes of revascularization may not be predicted in all cases. Although apical periodontitis and/or abscess was healed, sustained root development may be achieved. Controlled clinical studies with long-term follow-up are required to determine the outcomes of revascularization.

Ethics

Informed Consent: Informed consent was signed by patient's legal guardian.

Peer-review: Internally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: M.E.A., Concept: I.Ş.S., Design: I.Ş.S., M.E.A., Data Collection or Processing: M.E.A., Analysis or Interpretation: M.B.A., Literature Search: M.B.A., Writing: M.B.A.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. Hargreaves KM, Giesler T, Henry M, Wang Y. Regeneration potential of the young permanent tooth: what does the future hold? *J Endod* 2008; 34: 51-6.
2. Nosrat A, Seifi A, Asgary S. Regenerative endodontic treatment (revascularization) for necrotic immature permanent molars: a review and report of two cases with a new biomaterial. *J Endod* 2011; 37: 562-7.
3. Petrino JA, Boda KK, Shambarger S, Bowles WR, McClanahan SB. Challenges in regenerative endodontics: a case series. *J Endod* 2010; 36: 536-41.
4. Chen MY, Chen KL, Chen CA, Tayebaty F, Rosenberg PA, Lin LM. Responses of immature permanent teeth with infected necrotic pulp tissue and apical periodontitis/abscess to revascularization procedures. *Int Endod J* 2012; 45: 294-305.
5. Hoshino E, Kurihara-Ando N, Sato I, Uematso H, Sato M, Kota K, et al. In-vitro antibacterial susceptibility of bacteria taken from infected root dentine to a mixture of ciprofloxacin, metronidazole and minocycline. *Int Endod J* 1996; 29: 125-30.
6. Nosrat A, Homayounfar N, Oloomi K. Drawbacks and unfavourable outcomes of regenerative endodontic treatments of necrotic immature teeth: a literature review and report of a case. *J Endod* 2012; 38: 1428-34.
7. Nosrat A, Li KL, Vir K, Hicks ML, Fouad AF. Is pulp regeneration necessary for root maturation? *J Endod* 2013; 39: 1291-5.
8. Ding RY, Cheung GS, Chen J, Yin XZ, Wang QQ, Zhang CF. Pulp revascularization of immature teeth with apical periodontitis: a clinical study. *J Endod* 2009; 35: 745-9.
9. Cehreli ZC, Isbitiren B, Sara S, Erbas G. Regenerative endodontic treatment (revascularization) of immature necrotic molars medicated with calcium hydroxide: a case series. *J Endod* 2011; 37: 1327-30.
10. Lenzi R, Trope M. Revitalization procedures in two traumatized incisors with different biological outcomes. *J Endod* 2012; 38: 411-4.
11. Shin SY, Albert JS, Mortman RE. One step pulp revascularization treatment of an immature permanent tooth with chronic apical abscess: a case report. *Int Endod J* 2009; 42: 1118-26.
12. Chueh L, Huang G. Immature teeth with periradicular periodontitis or abscess undergoing apexogenesis: a paradigm shift. *J Endod* 2006; 32: 1205-13.
13. Luukko K, Kettunen P, Fristad I, Berggreen E. Structure and function of dentin-pulp complex. In: Hargreaves KM, Cohen S, editors. *Pathways of the Pulp*, 10th ed. St Louis: Mosby Elsevier; 2011: 452-503.
14. Huang G, Sonoma W, Liu Y, Wang S, Shi S. The hidden treasure in apical papilla: the potential role in pulp/dentin regeneration and bioroot engineering. *J Endod* 2008; 34: 645-51.
15. Alongi DJ, Yamaza T, Song Y, Fouad AF, Romberg EE, Shi S, et al. Stem/progenitor cells from inflamed human dental pulp retain tissue regeneration potential. *Regen Med* 2010; 5: 617-31.
16. Rosenfeld EF, James GA, Burch BS. Vital pulp tissue response to sodium hypochlorite. *J Endod* 1978; 4: 140-6.
17. Torabinejad M, Turman M. Revitalization of tooth with necrotic pulp and open apex by using platelet-rich plasma: a case report. *J Endod* 2011; 37: 265-8.
18. Reynolds K, Johnson JD, Cohenca N. Pulp revascularization of necrotic bilateral bicuspid using a modified novel technique to eliminate potential coronal discolouration: a case report. *Int Endod J* 2009; 42: 84-92.
19. Gomes-Filho JE, Duarte PC, de Oliveira CB, Watanabe S, Lodi CS, Cintra LT, et al. Tissue reaction to a triantibiotic paste used for endodontic tissue self-regeneration of nonvital immature permanent teeth. *J Endod* 2012; 38: 91-4.
20. da Silva LA, Nelson-Filho P, da Silva RA, Flores DS, Heilborn C, Johnson JD, et al. Revascularization and periapical repair after endodontic treatment using apical negative pressure irrigation versus conventional irrigation plus triantibiotic intracanal dressing in dogs' teeth with apical periodontitis. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2010; 109: 779-87.