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The resurrection of an immature upper anterior tooth: A case report

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Abstract

Revascularization of necrotic dental pulp has regained interest as an alternative treatment for immature permanent teeth. An 18-year-old female patient was referred for management of an immature upper anterior tooth with symptomatic apical periodontitis. Patient presented with an unsightly tooth 21 with no symptoms. Patient experienced dental trauma approximately 10 years ago. Clinical examination revealed a light-yellow discoloration with Class IV composite restoration on tooth 21, no carious lesion, Grade 1 tooth mobility, tenderness to percussion, and probing depths within normal limit. Periapical radiograph of tooth 21 revealed a periapical lesion, root of normal length but thin root dentin, and an open apex. Revascularization of tooth 21 was carried out in two visits. The first visit focused on disinfection of the root canal, while the second visit focused on the induction of bleeding followed by placement of mineral trioxide aggregate (MTA). The 6-month and 24-month follow-up visits revealed an absence of periapical lesion, although a significant reduction in the size of root apex could not be observed. An immature permanent tooth presents clinical challenges that affects both the short-term and the long-term treatment outcomes, therefore, an appropriate case selection taking into consideration various factors, and the skills and experience of the clinician are of upmost importance to ensure the predictability of the treatment provided. This procedure could eliminate intraradicular infection, however, increased dentin thickness on the root canal wall could not be observed, suggesting an indeed challenging procedure despite meticulous technical steps to perform the procedure.

Keywords: *immature permanent tooth, open apex, regenerative endodontics, revascularization*

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Introduction

Revascularization was first put forward by two authors in 2004 describing a new technique for the management of immature permanent teeth with apical periodontitis (Banchs & Trope, 2004). The principle of revascularization is to provide a sterile root canal that allows new cells to populate with the objective of restoring pulp vitality (Caruso *et al.*, 2014; Simon *et al.*, 2014).

Contrary to apexification, revascularization allows the continuation of root development to minimize the risk of tooth fracture. Necrotic dental pulp in immature permanent teeth causes disruption of root development which reduces dentin thickness particularly at the apical third of the root, making these teeth more prone to fractures (Albuquerque *et al.*, 2014; Raddall & Leung, 2019).

An alternative treatment was developed to overcome the aforementioned drawback (Alghamdi & Alqurashi, 2020; Lv *et al.*, 2018) which has been shown to induce root

extension and radicular reinforcement (Albuquerque *et al.*, 2014). A standardized protocol for this technique was formulated by the American Association of Endodontics (AAE) (AAE, 2016) and European Society of Endodontology (ESE) (Galler *et al.*, 2016). According to the AAE guidelines, the primary goal of regenerative endodontics is healing of the apical periodontitis, the secondary goal is increased root wall thickness and/or root length, and the tertiary goal is to regain positive response to pulp testing. Both the secondary and tertiary goals are desirable, but not essential in determining clinical success.

The application of mineral trioxide aggregate (MTA) over the blood clot without utilization of a matrix or scaffold was demonstrated in previous case reports (Machado *et al.*, 2016; Neelamurthy *et al.*, 2018) although a direct placement of a glass ionomer cement over the blood clot was also reported (Kanaparthy *et al.*, 2011). In current practice, the selection of bioactive material is more appropriate due to its properties and favorable outcomes (Machado *et al.*, 2016, Neelamurthy *et al.*, 2018, Yu *et al.*, 2022).

This case discusses the technique and outcomes of revascularization on an immature upper anterior tooth with symptomatic apical periodontitis.

Case Report

A healthy 18-year-old female patient was referred to the 'Unit Pakar Pergigian Restoratif, Klinik Pergigian Jalan Gambut, Kuantan, Pahang' for the management of an immature upper anterior tooth with symptomatic apical periodontitis. Patient had history of dental trauma about 10 years ago, with sustained tooth fracture involving the incisal edge of tooth 21. The tooth was restored following the incident. On presentation, patient could not recall the episodes of pain or swelling in the area. An extraoral examination revealed no abnormalities. Intraoral examination revealed a light-yellow discoloration with a Class IV composite restoration associated with tooth 21, no carious lesion, Grade 1 tooth mobility, tenderness to percussion, and probing depths within normal limit. The tooth did not show any response to pulp sensitivity tests (Digitest 2, Parkell Inc, USA). A panoramic radiograph revealed the overall dentition and good bone level (Figure 1). Periapical radiograph revealed a periapical lesion in relation to tooth 21 with root of normal length but thin root dentin, fragile walls and an open apex (Figure 2).

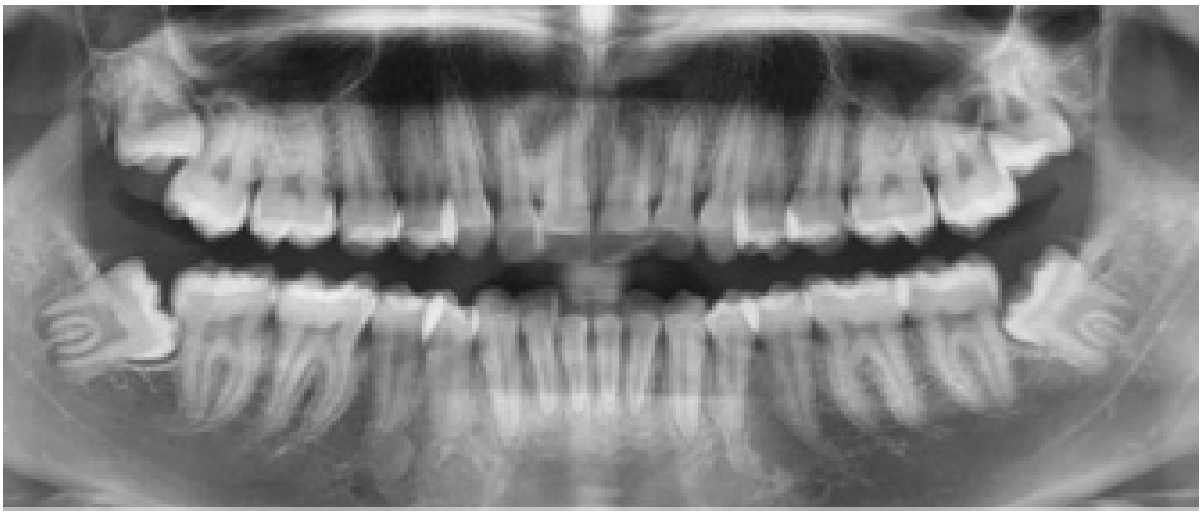

Figure 1. Panoramic radiograph.

Figure 2. Preoperative radiograph.

During the first visit, informed consent was given outlining the treatment options, risks and benefits of each option, and the likely prognosis. Following the discussion with patient, revascularization of tooth 21 was decided and the clinical procedure was carried out. Local anesthesia (2% lidocaine, 1:100000 epinephrine) was administered at the labial aspect of tooth 21. Effective tooth isolation with a rubber dam was achieved and an access cavity was prepared to gain access to the pulp chamber. Irrigation with 3% sodium hypochlorite (CanalPro, Coltene, USA) and 17% EDTA (CanalPro, Coltene, USA) was carried out and the root canal was dried with sterile paper points. The working length was determined with an electronic apex locator (Dentaport ZX, Morita MFG Corp, Japan) and confirmed with a working length radiograph (Hatela Instant Film, Hanshin Technical Lab LTD, Japan) at 22.5mm. The tip of an endodontic file was at the radiographic apex, suggesting at the appropriate position and length.

Triple antibiotic paste (TAP) containing ciprofloxacin, metronidazole and cefaclor in a 1:1:1 ratio was mixed with sterile distilled water to form a thick consistency paste. Then, the TAP was placed gently in the root canal by using a lentulo spiral until below the cementoenamel junction and the excess TAP at the root canal entrance was cleaned with cotton pellets. The access cavity was temporarily restored with glass ionomer cement (GC Fuji 7, GC Corporation, Japan).

During the second visit 3 weeks later, patient did not report of any pain or discomfort following the procedure and the clinical examination revealed no significant findings. Local anesthesia (2% mepivacaine without vasoconstrictor) was administered at the labial aspect of tooth 21, followed by tooth isolation with a rubber dam. The temporary restoration was removed, intracanal medicament in the root canal was irrigated with 3% sodium hypochlorite (CanalPro, Coltene, USA) and 17% EDTA (CanalPro, Coltene, USA), and the root canal was dried with paper points.

A #40 Hedstrom file (Dentsply Maillefer, Switzerland) was used to penetrate the periapical tissue, confirmed with the periapical radiograph (Figure 3). Bleeding from the periapical region gradually filled into the root canal and reached the cementoenamel junction in a semicoagulated form. A Rootdent MTA (TehnoDent, Belgorod region, Russia) approximately 3mm thick was placed over the blood clot and a moist cotton pellet was placed over the Rootdent MTA (TehnoDent, Belgorod region, Russia). Access cavity was temporarily restored with glass ionomer cement (GC Fuji 7, GC Corporation, Japan). A periapical radiograph was taken immediately after the procedure to assess the placement of Rootdent MTA (TehnoDent, Belgorod region, Russia) (Figure 4).

Figure 3. #40 Hedstrom file was used to penetrate the periapical tissue.

Figure 4. MTA placement over the blood clot.

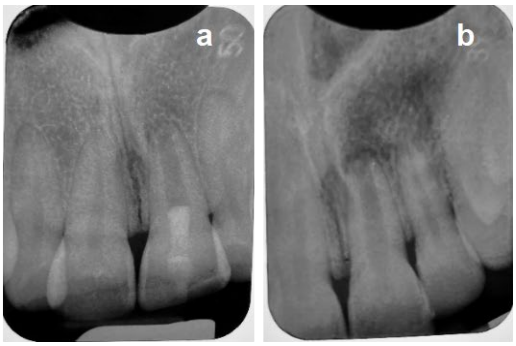

Figure 5. a) Periapical radiograph at 6-month follow-up in comparison with the b) Preoperative radiograph.

During the third visit 1 week later, patient did not report of any pain or discomfort following the procedure and clinical examination revealed no significant findings. The temporary restoration and cotton pellet were removed and the access cavity was restored with a light-curing composite resin (G-aenial Anterior, 3M ESPE, USA) as a definitive restoration.

At the 6-month follow-up visit, patient did not report of any pain or discomfort following the procedure and clinical examination revealed no significant findings. A periapical radiograph revealed decreased size of periapical lesion, however, thickening of the root canal walls could not be observed (Figure 5). At the 24-month follow-up visit, clinical aspect remained the same with no significant findings (Figure 6), however, the improvement on the root canal walls could not be observed (Figure 7). The tooth was not responsive to pulp sensitivity test at any of the follow-up visits.

Figure 6. Front clinical view at 24-month follow up.

Figure 7. a) Periapical radiograph at 24-month follow-up in comparison with the b) Preoperative radiograph.

Discussion

This case documented revascularization on an immature upper anterior tooth with symptomatic apical periodontitis using blood clot as a scaffold. The primary goal of eliminating the symptoms was achieved uneventfully. However, the secondary goal of increased dentin thickness and/or increased root length, including the tertiary goal of regaining positive response to pulp sensitivity test were not achieved. The biggest challenge encountered in revascularization is successful induction of bleeding into the root canal space for the sources of viable cells, which can be derived from non-pulpal origins, namely circulating cells, cementum, periodontal ligament and alveolar bone (Simon *et al.*, 2014). Revascularization could resolve the apical inflammation, but is unable to support dentin-pulp regeneration (Cao *et al.*, 2015). This might explain the reason of not achieving the thickening of root dentin and/or increased root length, and negative response to pulp sensitivity test during all follow-up visits in this case. Although revascularization may be successful in resolving apical periodontitis and revitalization in some cases, it is unknown whether the revascularized tissues truly represent dentin-pulp regeneration (Cao *et al.*, 2015).

Prerequisites for successful revascularization include disinfection of the root canal, placement of a suitable matrix or scaffold for tissue ingrowth, and achieving a bacteria-tight coronal seal (Law, 2013). The inability to achieve these aspects could lead to a treatment failure. Disinfection in the root canal is carried out using an antimicrobial root canal irrigant namely sodium hypochlorite and an intracanal medicament namely TAP. The disadvantage of TAP use is tooth discoloration due to its minocycline composition. In this light, double antibiotic paste can be opted which excludes the minocycline, or replaced with clindamycin, amoxicillin, or cefaclor (a member of the second-generation

cephalosporins) (Valverde *et al.*, 2017; Lee, 2019). The TAP was used in this case but surprisingly no apparent tooth discoloration afterwards. Perhaps, careful application of TAP by using the lentulo spiral until below the cementoenamel junction could contribute to this outcome.

The placement of a matrix or scaffold for tissue ingrowth was not possible in this case due to a delicate and time-consuming procedure, costly, requiring highly trained and skilled personnel to perform the procedure. Hence, a 3mm thickness of MTA was placed over the blood clot instead. Even though the blood clot in the root canal space was used as a matrix or scaffold, the treatment outcome observed in this case was favorable, suggesting its suitability as an alternative when access to another matrix or scaffold is restricted. The resolution of periapical lesion observed in this case report corroborated with other case report in which the MTA was placed over the blood clot without the utilization of a matrix or scaffold (Machado *et al.*, 2016; Neelamurthy *et al*., 2018). In a case report when the induction of bleeding into the root canal space was unsuccessful, a concentrated growth factor (CGF) was utilized as an alternative scaffold followed by MTA placement on the thrombus of the CGF (Yu *et al.*, 2022). Regarding a bacteria-tight coronal seal in this case, it was achieved using a composite resin, which was bonded effectively to the remaining coronal tooth structure.

Despite favorable treatment outcomes, challenges associated with the clinical procedures are still present. The matrix or scaffold with the highest success rate is platelet-rich plasma (PRP) (Bezgin *et al*., 2015; Alagl *et al.*, 2017; Shivashankar *et al.,* 2017), however, the process for obtaining PRP needs to be considered when deciding on use of this matrix or scaffold. The PRP and platelet-rich fibrin (PRF) require blood samples from the patients, which can be traumatic in young children (Rizk *et al.,* 2020). The procedure also requires other specialized equipment and materials, causing the technique to be less accessible to the dental clinic. Additionally, the process of stimulating bleeding at the periodontal tissue past the root apex to obtain the blood clot in the root canal space has the disadvantage of being more difficult to control (Shivashankar *et al.*, 2017) where sometimes it is impossible to generate the bleeding into the root canal space (Rizk *et al.*, 2020). In this case, bleeding into the root canal space can be achieved effectively, could be attributed to an appropriate case selection and the clinical procedure is performed by an experienced clinician under standard protocol.

The utilization of cone-beam computed tomography (CBCT) is beneficial because the true nature of the lesion and improvement on the root dentin following revascularization procedure can be observed effectively. However, in this case report, the use of CBCT was not possible due to unavailability of this method at the dental setting. Perhaps, for future consideration, CBCT can be used not only as one of diagnostic tools but for monitoring purposes related to the revascularization procedure.

Conclusion

The outcome of revascularization on an immature upper anterior tooth with symptomatic apical periodontitis is favorable after 24-month follow-up, with the evidence of insignificant clinical findings, and absence of periapical lesion. However, increased dentin thickness on the root canal wall could not be observed, including negative response to pulp sensitivity test. The outcome of this case fulfilled the essential requirement according to AAE guidelines, and is considered a successful treatment clinically, despite not observing the secondary and tertiary outcomes. An appropriate case selection taking into consideration various factors, combined with the skills and experience of the clinician are of upmost importance in ensuring the predictability of the treatment provided.

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Conflict of interest

None

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