Indonesian Dental Association

Journal of Indonesian Dental Association

http://jurnal.pdgi.or.id/index.php/jida
ISSN: 2621-6183 (Print); ISSN: 2621-6175 (Online)

Case Report

A 3-in-1 Treatment of Traumatized Tooth with Open Apex and Discoloration

Fadil Abdillah Arifin[1§]

[1] *Department of Conservative Dentistry, Faculty of Dentistry, Universitas Muslim Indonesia, Makassar, Indonesia*

Received date: February 25, 2021. **Accepted date:** September 3, 2021. **Published date:** October 31, 2021.

KEYWORDS

bleaching;
discoloration;
MTA;
open apex;
retreatment;
walking bleach

ABSTRACT

Introduction: The most common etiology of pulp necrosis is dental trauma. Pulp necrosis that seemed to be young had incomplete apical anatomy, remaining as tooth discoloration. **Case Report:** A 25-year-old male without a compromised medical history was referred for endodontic retreatment in the left maxillary central incisor after a trauma that occurred 17 years before. The primary complaints were unpleasant esthetic features with a dark gray appearance and discomfort during the chewing process. A left maxillary first incisor with wide-open apical and periapical lesions was shown in the radiographic. Gutta-percha removal and debridement of the root canal were performed with K-file. The root canal was irrigated with saline solution, and the calcium hydroxide paste was left for one week as intracanal dressing. At the next appointment, the apical portion of the canal was filled with a Mineral Trioxide Aggregate (MTA) apical plug, which was then obturated with the thermoplastic gutta-percha. Then, a walking bleach procedure was performed in two cycles using 35% hydrogen peroxide gel, resulting in a satisfactory tooth color. In the follow-up periods of three and eight months, favorable clinical and radiographic appearance responses were observed, and none of the previous symptoms were detected. **Conclusion:** The use of MTA as an apical plug material is shown to be one of the best materials for exposed apical teeth. The walking bleach technique was also shown to be effective for discoloration after trauma.

§ Corresponding Author
E-mail address: fadilabdillaharifin@umi.ac.id (Arifin FA)

DOI: 10.32793/jida.v4i2.648

INTRODUCTION

Endodontic treatment of traumatized immature permanent teeth is challenging regarding to the apical closure. Pulp necrosis appears in incomplete root formation, resulting in interrupted dentin formation and root development. Consequently, the root canal is large with thin and fragile walls, and the apex remains open.[1] The proper root canal sealing is the most challenging procedure in the endodontic treatment of infected immature teeth. Lack of control of working length are factors responsible for an open apex. The loss of an apical stop in the apex also remains problematic in the obturation procedure.[2]

Mineral trioxide aggregate (MTA) has an adequate sealing ability, with excellent results in long-term prognosis. This material is easy to be manipulated, having an outstanding biocompatibility. The barrier at the end of the root canal in teeth with necrotic pulp and open apex, permitting vertical condensation of warm gutta-percha, is offered by using MTA.[2–4] In in vivo studies of MTA, the biocompatibility and inductive effect of hard tissue have been demonstrated by providing satisfactory antibacterial activity.[2,3] On the other hand, MTA has many favorable properties, such as radiopacity and moisture resistance.[2] Therefore, MTA is a potential material for apical sealing of infected immature teeth. It prevents overfilling material and also decreases leakage problems in the apical.[2,3,5] According to these features, effective results have been shown using MTA on the apical of infected immature teeth. Also, to these effects, pulp necrosis can result in tooth discoloration, caused by blood penetration into dentinal tubules followed by red blood cell hemolysis. Then, the release of hemoglobin and its breakdown products results in a yellowish-brown appearance.[6] Dental bleaching is a solution for conservative and esthetic problems instead of invasive treatments, such as crowns or porcelain veneers. Bleaching techniques for nonvital teeth, using an oxidizing agent stored in the pulp chamber that can be in direct contact with the dentin, can be used in cases of tooth discoloration.[7]

CASE REPORT

A 25-year-old male patient was referred to Dentamedica Care Center, Makassar, Indonesia with a primary complaint in his left maxillary central incisor, which became discolored and felt uncomfortable during the chewing process. Based on the anamnesis of the patient, no contributory medical history was detected. The patient had trauma on his maxillary central incisor at eight years of age. However, the patient had never received any dental treatment until a year ago. Based on a clinical examination, a fracture and a dark gray tooth-colored area were detected in the left maxillary first incisor (Fig. 1). Therefore, the patient was in discomfort with his physical appearance. Additionally, the affected tooth had a more labial position than the other teeth, with the appearance of maxillary and mandibular teeth crowding. The teeth felt tender to percussion. Based on a radiographic examination, gutta-percha was not hermetic in its wide root canals. The apical third of the tooth was also wide open, with a periapical lesion (Fig. 1). Therefore, the tooth was diagnosed with pulp necrosis.

Figure 1. Clinical and radiographic appearance of the tooth before treatment

Treatment

The first procedure was performed to prepare the rubber dam isolator. Then, the endo access bur (Dentsply Maillefer, Switzerland) was used to open the pulp cavity on the maxillary surface of the tooth. After successfully removing all the gutta-percha using retreatment files (Dentsply Maillefer, Switzerland) (Fig. 2), the next step was to use the Propex II apex locator (Dentsply Maillefer, Switzerland) to determine the working length. Then, the working length was then confirmed using a periapical radiograph. The obtained tooth working length was 19 mm (Fig. 3). K-file 70 (Dentsply Maillefer, Switzerland) was used to prepare and clean the root canal wall in a circumferential movement, but the root canal was not widened again, and saline solution was used as the irrigation solution. Afterward, paper points were used to dry the root canal, and then the calcium hydroxide paste (Ultracal XS, Ultradent, USA) was applied along the working length of the root canal as a medicine. Finally, the cavity was covered with cotton and a temporary filling.

After one week, the patient returned with no complaints during the chewing process. Consequently, the calcium hydroxide paste was removed, and the root canal was irrigated using saline solution. The root canal was then dried using paper points. Afterward, ProRoot

MTA (Dentsply Maillefer, Switzerland) powder was mixed with the liquid at an appropriate dose rate. Then, the exposed root was placed using an MTA carrier through a 3–4 mm length. Next, it was confirmed with periapical radiographs that the root tip seemed to be covered entirely with MTA (Fig. 4). After the MTA was correctly set, the root canal filling was performed using the BeeFill thermoplastic obturation technique (VDW, Germany). After that, the filling was confirmed to be hermetic with periapical radiographs. Finally, the patient was instructed to return one week later.

The patient returned without any complaint. As a result, internal tooth bleaching was performed. Before bleaching, the original color of the tooth was determined. The initial color was assessed using the Vita Classical shade guide (VITA, Germany). The initial tooth color was C4 (or even darker). Therefore, the pulp chamber was slightly widened to ensure that all of the pulp roof was removed. After that, the gutta-percha was reduced by 2 mm below the orifice. Then, the pulp chamber was cleaned and dried. Next, Glass Ionomer Cement (GC Fuji IX, GC, Japan) was applied to the cervical area under the teeth at a 45° angle facing the labial aspect. The bleaching material used was 35% hydrogen peroxide gel (Opalescence Endo Hydrogen Peroxide Gel, Ultradent, USA). The material had to be filled in the entire space of the pulp cavity, which was sealed with cotton and temporary fillings. The tooth whitening technique used was referred to the walking bleach technique.[8]

After the first five days, the tooth color was rechecked. There was a significant change from C4 to A4, but the obtained color was still not quite in harmony with the color of the surrounding teeth. Thus, the bleaching agent was reapplied and left for five days. On the next visit, the tooth bleaching was similar to the others, and the color was quite harmonious with the surrounding teeth, which had the A3 color. The rest of the bleaching agent within the cavity was then thoroughly cleaned and dried. Next, the tooth was restored with Z350 XT resin composite (3M ESPE, USA), and etching and bonding procedures were performed after that. The etching material was applied for 20 s and then rinsed and dried properly. The bonding material was also applied using a micro brush. Later, the composite was applied layer by layer, and the polymerization was completed using a light-curing device. After the finishing procedure was carried out using a fine finishing bur, the restoration was polished with a polishing paste (Fig. 5).

Follow-up

Afterward, the treatment results were reexamined three and eight months after the procedures (Figure 6). The patient began orthodontic treatment for crowded teeth, and there was no complaint regarding the treated tooth. The lesion decreased in size, as shown in the periapical radiographs obtained (Fig. 6).

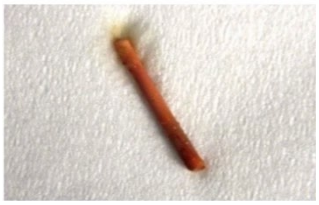

Figure 2. The removed gutta-percha from the affected tooth

Figure 3. The radiographic where the working length in the affected tooth was confirmed

Figure 4. A radiograph used to confirm the MTA filling of the affected tooth

Figure 5. The clinical and radiographic appearance of the tooth after the treatment procedures

Figure 6. The clinical and radiographic appearance of the treated tooth after the 8-months follow up

DISCUSSION

Trauma is the most common etiology of pulp necrosis. This process results in bacterial invasion and pulpal inflammation, followed by infection necrosis and periapical inflammation. It was shown in laboratory results, bacteria could penetrate enamel and dentin through minor cracks after trauma. Furthermore, if the periodontium is traumatized, bacteria from the gingival crevice or pocket may reach the pulp through severed blood vessels.[9]

In this case report, the patient had trauma on his maxillary central incisor at eight years of age. At the time, the root growth of his maxillary central incisor was still not perfect. The root was not fully formed at the time of tooth eruption, and root growth continued for several years after tooth eruption in the oral cavity. Adequate root growth can be achieved at the age of 11.[10]

Apexification is a process of hard tissue formation in the apical portion of the teeth. Cohen et al. reported that during the apexification process, the closure of the third apical canal of the open apical tooth portion was induced to perform obturation. Traditional approaches using calcium hydroxide for apexification and apical barrier techniques using MTA have been used to treat immature teeth with pulp necrosis. Usually, there is no further root development when that technique is used.[11] There are several problems related to pulpal and periradicular diseases that are associated with immature roots and divergent canals: (1) the difficulty of debridement procedure at the canal with larger apical and smaller coronal canal diameters, (2) the absence of an apical stop leads to inadequate obturation, and (3) fractured teeth are often at high risk of fracture to the root canal area.[12]

Although calcium hydroxide paste was popular for apexification treatment, it has some disadvantages. Kakani et al. explained that the duration of calcium hydroxide (1–2 years) is too long. Therefore, MTA is used for "one-visit apexification" to overcome the negative effect of calcium hydroxide as an apical sealing agent.[5]

MTA is the best material for sealing the iatrogenic and pathological communication between endodontic and periodontal spaces. Kakani et al. explained that MTA has the feature of inducing hard tissue, such as cementum, when in direct contact with periradicular tissue.[5] This substance can affect the production of interleukins and cytokines, resulting in hard tissue formation. Repair in the apical portion of teeth might be promoted by the MTA plug, preventing extrusion filling and raising the resistance of fracture risk in immature teeth.[5]

Holland et al. described a study regarding the response of the periapical tissue of a dog after using MTA as a root canal filling. They showed the biological activity of apical foramen closure and noticed free periapical tissue inflammation after MTA use. These responses occur due to cell adhesion and differentiation, resulting in hard tissue deposition in the periapical. In the current case, the periapical lesion was healing after three months of treatment when the open apex narrowed, without any reinfection symptoms.[13]

The significant etiologies of discoloration are the composition of the pulp tissue, hemorrhage after pulp extirpation, drugs, and obturation materials.[10] Due to the penetration of blood into the dentinal tubules, followed by hemolysis of red blood cells, the release of hemoglobin, and its breakdown products, a yellowish-brown tooth appearance results from this process. The degradation of iron pigments to iron sulfide has a role in the appearance of color changes.[6]

Discoloration occurs due to the formation of chromogenic products, as they are chemically stable.[14] Baba et al. explained that during the bleaching process, hydrogen peroxide penetrates enamel and dentin. In this process, free radicals react with pigment molecules that change color and break the double bonds of chromophore molecules. The change of optical properties in pigment molecules results from the change of configuration and size of molecules, resulting in a lighter tooth color perception by human eyes.[15] During bleaching, the long formation of organic molecule chains is transformed into carbon and water while releasing nascent oxygen.

The use of heat or light as an additional application in the bleaching technique is recommended by some manufacturers. Nonetheless, Zimmerli et al. mentioned that using heat directly into the pulpal cavity induces root resorption formation.[8] Koçak et al. concluded that LED

light source and diode laser similarly and successfully bleached discolored treated teeth endodontically.[16] Internal bleaching is a conservative, simple, effective, and low-cost procedure, with good esthetic results during the treatment of nonvital tooth discolorations. Therefore, regarding the outstanding outcomes, the concentrations used and the biocompatibility of the bleaching agent were more critical; the combined technique should be adopted in preference to the walking bleach technique.[13]

When the walking bleach technique was first introduced in 1961, a mixture of sodium perborate and water was placed into the pulp chamber sealed off between appointments.[15] In the modification method that was later performed, hydrogen peroxide (30–35%) replaced water with better whitening results.[6] Before placing the bleaching agents, remove the root canal filling material in about 2–3 mm subgingival, controlling the depth using a periodontal probe. The whitening gel is injected into the pulp chamber and closes the cavity with sealing material and provisory filling.[15] The bleaching procedure has been reported to potentially result in root resorption. The gap between cementum and enamel is reported in 10% of teeth, resulting in the pH of peroxide material that can damage surrounding bone and cellular.[10] The mechanism of cervical root resorption and internal coronal bleaching is not yet fully understood. It has been mentioned that the bleaching agent can be diffused through dentinal tubules, contacting periodontal tissues and causing cementum necrotic, periodontal ligament inflammation, and, eventually, cervical root resorption.

CONCLUSION

In conclusion, MTA can be considered as an appropriate material for an apical plug for an open apical tooth. The walking bleach technique using 35% hydrogen peroxide was effective in bleaching nonvital tooth material with discoloration.

Declaration of The Patient Consent

Written informed consent was obtained from the patient for the publication of this study.

Acknowledgment

The author would like to thank the Dentamedica Care Center for its support.

Conflict of Interest

The author discloses any financial and personal relationships with other people or organizations that could appropriately influence the work of the author.

REFERENCES

1. Iqbal N, Farooq S. Mineral trioxide aggregate apexification: a case report. Int J Dent Sci Innovat Res. 2019;2(6):437-40.
2. Gupta S, Sodhi SP, Brar G, Bansal R. Endodontic treatment of immature tooth – a challenge. J Pre-Clin Clin Res. 2020;14(3):73–79.
3. Nosrat A, Bolhari B, Saber Tahan S, Dianat O, Dummer PMH. Revitalizing previously treated teeth with open apices: A case report and a literature review. Int Endod J. 2021;54(10):1782-93.
4. Raldi DP, Mello I, Habitante SM, Lage-Marques JL, Coil J. Treatment options for teeth with open apices and apical periodontitis. J Can Dent Assoc. 2009;75(8): 591-6.
5. Kakani AK, Chandrasekhar V, Muralidhar T, Chandrakanth M, Rakesh D. Mineral trioxide aggregate as an apical plug material in tooth with open apex: a case report. Int J Sci Study. 2015;2(11):218-21.
6. Özlek E, Neelakantan P, Akkol E, Gündüz H, Uçar AY, Belli S. Dentinal tubule penetration and dislocation resistance of a new bioactive root canal sealer following root canal medicament removal using sonic agitation or laser-activated irrigation. Eur Endod J. 2020;5(3):264-270.
7. Claudia Santos de Azevedo Izidoro A, Cristine Martins G, Higashi C, Zander-Grande C, Tay LY, Gomes JC, et al. Combined technique for bleaching non-vital teeth with 6-month clinical follow-up: case report. Int J Oral Dent Health. 2015;1(2):1-4.
8. Zimmerli B, Jeger F, Lussi A. Bleaching of nonvital teeth: a clinically relevant literature review. Schweiz Monatsschr Zahnmed. 2010;120:306-13.
9. Torabinejad M, Fouad AF, Shabahang S. Endodontics : principles and practice. 6th Ed. Cambridge: Elsevier Inc; 2021.
10. Damle SG. Textbook of pediatric dentistry. 3rd Ed. New Delhi: Arya (Medi) Publishing House; 2010.
11. Berman LH, Hargreaves KM. Cohen's pathways of the pulp. 12th Ed. Cambridge: Elsevier Inc; 2020.
12. Ingle JI, Rotstein I. Ingle's endodontics. 7th Ed. North Carolina: PMPH USA; 2019.
13. Holland R, Sant A, Júnior A, de Souza V, Junior ED, Filho JAO, et al. Apical patency and filling material. Braz Dent J. 2005;16:9-16.
14. Coelho AS, Garrido L, Mota M, Marto CM, Amaro I, Carrilho E, et al. Non-vital tooth bleaching techniques: A systematic review. Coatings. 2020;10:1-10.
15. Baba NZ. Contemporary restoration of endodontically treated teeth: evidence-based

diagnosis and treatment planning. Illinois: Quintessence Publishing Co Inc; 2013.
16. Koçak S, Koçak MM, Sağlam BC. Clinical comparison between the bleaching efficacy of light-emitting diode and diode laser with sodium perborate. Australian Endo J. 2014;40:17-20.