CASE REPORT OLGU SUNUMU

DOI: 10.5336/dentalsci.2025-108181

One-Visit Apexification Using Mineral Trioxide Aggregate in an Immature Permanent Tooth with Open Apex and Periapical Lesion

Açık Apeksli ve Periapikal Lezyonlu İmmatür Daimi Dişte Tek Seans Apeksifikasyon Tedavisinde Mineral Trioksit Agregat Kullanımı

Selman SEVTEKİN[a], Esin ÖZLEK[a]

[a]Van Yüzüncü Yıl University Faculty of Dentistry, Department of Endodontics, Van, Türkiye

ABSTRACT This case report evaluates the clinical and radiographic prognosis of an immature permanent tooth with a periapical lesion treated by one-visit apexification using mineral trioxide aggregate (MTA). A 20-year-old patient with pain in the maxillary anterior region. Radiographic examination revealed incomplete root development and a periapical radiolucency associated with the maxillary left central incisor. A 5 mm thick MTA plug was placed in the apical region, and the canal was obturated using the warm filling technique. At the 18-month follow-up, radiographic healing was observed. Although no clinical symptoms were detected, discoloration of the tooth crown was noted and managed with non-vital bleaching, resulting in an aesthetic outcome.

Keywords: Mineral trioxide aggregate; apexification; tooth discoloration

ÖZET Bu olgu sunumu, periapikal lezyonlu immatür bir daimi dişte mineral trioksit agregat (MTA) kullanılarak tek seanslı apeksifikasyonun klinik ve radyografik sonuçlarını değerlendirmektedir. Yirmi yaşında bir bayan hasta, maksillar ön bölgedeki ağrı şikâyetiyle başvurmuştur. Radyografik incelemede, maksillar sol santral dişte kök gelişiminin tamamlanmadığı ve periapikal bölgede radyolüsensi olduğu gözlemlenmiştir. Apikal bölgeye 5 mm kalınlıkta MTA bariyeri yerleştirilmiş ve kanal, sıcak dolgu tekniği ile doldurulmuştur. On sekizinci ay takip randevusunda, klinik semptomların ortadan kalktığı ve radyografik iyileşmenin sağlandığı tespit edilmiştir. Ancak kronda koyu renklenme meydana gelmiştir. Devital beyazlatma yöntemiyle diş başarılı bir şekilde ağartılmış ve estetik bir sonuç elde edilmiştir.

Anahtar Kelimeler: Mineral trioksit agregat; apeksifikasyon; dişte renk değişikliği

Pulpal diseases caused by caries, trauma, or treatment interventions can lead to pulp necrosis, allowing microorganisms to accumulate within the root canals. This process triggers an immune response in the periapical region, leading to the formation of periapical lesions and halted root development in immature teeth.[1]

Endodontic treatment of immature teeth with necrotic pulp is challenging, as creating a hermetic apical plug is essential to prevent microleakage and ensure treatment success. Traditionally, calcium hydroxide [$Ca(OH)_2$] has been used for apexification, promoting hard tissue formation at the root apex. However, its prolonged treatment duration and increased fracture risk have necessitated alternative approaches.[2] Mineral trioxide aggregate (MTA), a tricalcium silicate cement, has gained preference for one-visit apexification. MTA facilitates hard tissue formation at the apex by releasing calcium ions, ensuring biocompatibility and apical sealing.[3] This case

Correspondence: Esin ÖZLEK
Van Yüzüncü Yıl University Faculty of Dentistry, Department of Endodontics, Van, Türkiye
E-mail: esin_ozlek@hotmail.com

Peer review under responsibility of Turkiye Klinikleri Journal of Dental Sciences.

Received: 02 Jan 2025 ***Received in revised form:*** 11 Mar 2025 ***Accepted:*** 13 Mar 2025 ***Available online:*** 30 May 2025

report evaluates the clinical effectiveness of one-visit apexification using MTA in a maxillary central incisor with incomplete root development and a periapical lesion.

CASE REPORT

A 20-year-old, systemically healthy female patient was referred to our clinic complaining pain in the maxillary anterior region. Intraoral examination revealed a fractured filling and percussion sensitivity involving tooth #21, without mobility, sinus tract, or discoloration. The tooth response was negative to electric pulp and cold tests. Radiographic examination showed incomplete root development and a periapical radiolucency associated with tooth #21, leading to a diagnosis of symptomatic apical periodontitis (Figure 1A). Due to the inability to achieve a hermetic apical seal with traditional methods, an apical plug with MTA was planned, followed by warm vertical compaction for canal obturation.

Under rubber dam isolation, the working length was determined using a #70 K-file (VDW Anteaos, Munich, Germany). The canal was shaped and enlarged with #80 and #90 H-type files to remove infected tissue. Irrigation with 5.25% NaOCl (Microvem, İstanbul, Türkiye) was performed after each file use, approximately 15 mL 5.25% NaOCl solution was used in total. The canal was dried, and $Ca(OH)_2$ was placed as an intracanal medicament. An appointment was scheduled for 2 weeks later.

After 2 weeks, the patient reported no complaints. $Ca(OH)_2$ was removed with a #90 H-file, and final irrigation was performed with 17% EDTA, NaOCl, and distilled water. After drying using paper points, a 5 mm MTA (ProRoot MTA White, Dentsply, Tulsa, OK, USA) plug was placed in the apical 3rd using an MTA carrier (Angelus, Londrina, PR, Brazil) and condensed with a plugger. The next day, root canal was backfilled with thermoplastic gutta-percha and AH Plus sealer (Figure 1B). The tooth was then restored with OptiShade MD composite (Kerr Dental, Orange, USA).

At 12-18-month follow-ups, no clinical symptoms were recorded, and healing of the periapical lesion was observed radiographically (Figure 1C, Figure 1D). At the 18-month follow-up, crown dis-

FIGURE 1: A) Initial radiograph showing a wide periapical radiolucency and incomplete root development in the maxillary left central incisor. **B)** Radiograph demonstrating of the MTA apical plug and root canal obturation using thermoplastic gutta-percha **C and D)** Follow-up radiograph at 12-18 months showing progressive healing of the periapical lesion. **E)** 12-month follow-up showing discoloration and multiple diastemata in the maxillary anterior region prior to aesthetic treatment. **F)** 18-month follow-up showing the results after devital bleaching, composite restorations, and closure of the diastema.

coloration and fracture of the restoration in tooth #21 were detected, along with diastema in the maxillary anterior region (Figure 1E). It was decided to first perform non-vital bleaching on tooth number 21, followed by restoration renewal and diastema closure in the maxillary anterior region. An access cavity was prepared, and 35% hydrogen peroxide bleaching agent (Opalescence Endo, Ultradent Products Inc., South Jordan, USA) was applied and sealed with light-curing glass ionomer cement. The following day, after achieving adequate whitening, the bleaching agent was removed, and $Ca(OH)_2$ was placed into the cavity for 1 week. In the next session, using rubber dam isolation, aesthetic restoration procedure was completed with the closure of the diastema using Harmonize A2D, and Harmonize A1E (Kerr Dental, Orange, USA). At the 18-month follow-up, clinical and radiographic evaluations revealed no symptoms, restoration stability, and complete periapical healing (Figure 1D, Figure 1F).

Informed consent was obtained from the patient prior to the initiation of treatment.

DISCUSSION

The treatment of immature permanent teeth offers several options, including long-term apexification with calcium hydroxide, placement of an apical MTA plug, or root revascularization as a regenerative approach. Calcium hydroxide apexification requires prolonged treatment and carries a great risk of root fracture, whereas MTA provides one-visit application, biocompatibility, and effective apical sealing, making MTA the preferred treatment material in many cases.[3,4] In present case, an apical MTA plug was chosen owing to an open apex diameter not exceeding 1 mm and the favourable root morphology observed in radiographic analysis.

Achieving a hermetic apical plug in teeth with open apices is challenging. MTA's hydrophilic nature allows it to set in a moist environment, while ensuring a reliable apical seal. MTA's ability to induce hard tissue formation further enhances recovery.[5] High success rates were demonstrated in a long-term study, supporting MTA's efficacy in apical sealing over extended follow-up periods.[6]

However, there are alternative materials with biocompatible properties other than MTA. One of these materials, Biodentine™ (Septodont, Saint-Maur-des-Fosses, France), has a similar hydrophilic structure to MTA and stands out for its ability to withstand oral environments while preserving its integrity. Biodentine promoting hard tissue formation was reported to provide successful results in apical sealing.[7,8] However, the fact that MTA has a larger database supported by long-term clinical studies, a higher success rate in apical adaptation, and a proven capacity to induce hard tissue formation were made MTA the first line material of choice in this case.

In present case, $Ca(OH)_2$ was used as an intracanal medicament for two weeks. Its high pH effectively reduces bacterial contamination, promotes dentin remineralization, and supports periapical healing.[7] However, leaving $Ca(OH)_2$ in the canal for more than 30 days can lead to the dissolution of the organic components of the dentin tissue, resulting in structural weakening.[9] Therefore, in this case, $Ca(OH)_2$ was kept in the canal for 2 weeks, maintaining both antibacterial activity and root resistance.

The apical MTA plug was applied 5 mm thick, complying with the recommendations found in contemporary dental literature. Studies suggest that plugs thinner than 3 mm may fail to provide adequate sealing, whereas 4-5 mm plugs create a durable barrier, preventing leakage while reducing fracture risk.[10,11]

One noteworthy drawback of MTA is tooth discoloration, particularly with the use gray MTA. High FeO ion content penetrated dentinal tubules, leading to aesthetic challenges in anterior teeth.[12] For devital teeth affected by MTA-induced discoloration, intracoronal bleaching is an effective solution.[13] In this case, 35% hydrogen peroxide was used for non-vital bleaching, achieving satisfactory whitening within one day. The walking bleach technique, employed in this case, is minimally invasive and avoids risks associated with thermocatalytic methods, such as cervical resorption.[14] Subsequent restoration and diastema closure provided an aesthetic and functional outcome.

In this case report, successful recovery was achieved through one-visit apexification with MTA in a permanent immature tooth with open apex and a

periapical lesion. At the 12-month follow-up, MTA-induced discoloration was effectively managed using walking bleach technique. Over the subsequent 18 months, the patient exhibited no clinical signs or symptoms, and radiographic evaluations confirmed progressive healing of the periapical lesion. Over 18 months follow-up will provide further insights into the long-term outcomes of one-visit MTA apexification protocol.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Esin Özlek, Selman Sevtekin;* ***Design:*** *Selman Sevtekin;* ***Control/Supervision:*** *Esin Özlek;* ***Data Collection and/or Processing:*** *Selman Sevtekin;* ***Analysis and/or Interpretation:*** *Esin Özlek, Selman Sevtekin;* ***Literature Review:*** *Esin Özlek;* ***Writing the Article:*** *Esin Özlek, Selman Sevtekin;* ***Critical Review:*** *Esin Özlek;* ***References and Fundings:*** *Esin Özlek, Selman Sevtekin;* ***Materials:*** *Selman Sevtekin.*

REFERENCES

1. Estrela C, Guedes OA, Rabelo LE, Decurcio DA, Alencar AH, Estrela CR, et al. Detection of apical inflammatory root resorption associated with periapical lesion using different methods. Braz Dent J. 2014;25(5):404-8. PMID: 25517775.
2. Al Ansary MA, Day PF, Duggal MS, Brunton PA. Interventions for treating traumatized necrotic immature permanent anterior teeth: inducing a calcific barrier&root strengthening. Dent Traumatol. 2009;25(4):367-79. PMID: 19614737.
3. Cintra LTA, Benetti F, de Azevedo Queiroz ÍO, de Araújo Lopes JM, Penha de Oliveira SH, Sivieri Araújo G, et al. Cytotoxicity, Biocompatibility, and Biomineralization of the New High-plasticity MTA Material. J Endod. 2017;43(5):774-8. PMID: 28320539.
4. Torabinejad M, Watson TF, Pitt Ford TR. Sealing ability of a mineral trioxide aggregate when used as a root end filling material. J Endod. 1993;19(12):591-5. PMID: 8151252.
5. Pace R, Giuliani V, Pini Prato L, Baccetti T, Pagavino G. Apical plug technique using mineral trioxide aggregate: results from a case series. Int Endod J. 2007;40(6):478-84. PMID: 17403040.
6. Pace R, Giuliani V, Nieri M, Di Nasso L, Pagavino G. Mineral trioxide aggregate as apical plug in teeth with necrotic pulp and immature apices: a 10-year case series. J Endod. 2014;40(8):1250-4. PMID: 25069943.
7. Youssef AR, Emara R, Taher MM, Al-Allaf FA, Almalki M, Almasri MA, et al. Effects of mineral trioxide aggregate, calcium hydroxide, biodentine and Emdogain on osteogenesis, Odontogenesis, angiogenesis and cell viability of dental pulp stem cells. BMC Oral Health. 2019;19(1):133. PMID: 31266498; PMCID: PMC6604301.
8. Vidal K, Martin G, Lozano O, Salas M, Trigueros J, Aguilar G. Apical closure in apexification: a review and case report of apexification treatment of an immature permanent tooth with biodentine. J Endod. 2016;42(5):730-4. PMID: 26994597.
9. Alhajj MN, Daud F, Al-Maweri SA, Johari Y, Ab-Ghani Z, Jaafar M, et al. Effects of calcium hydroxide intracanal medicament on push-out bond strength of endodontic sealers: a systematic review and meta-analysis. J Esthet Restor Dent. 2022;34(8):1166-78. PMID: 36239133.
10. D'Arcangelo C, D'Amario M. Use of MTA for orthograde obturation of nonvital teeth with open apices: report of two cases. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2007;104(4):e98-101. PMID: 17625928.
11. Grayli E, Dashtban A, Shadan L, Behnampour N, Afshari E. Effect of MTA versus CEM apical plugs on fracture resistance of endodontically treated simulated immature teeth restored with cast metal posts: an in-vitro study. BMC Oral Health. 2021;21(1):280. PMID: 34049533; PMCID: PMC8164227.
12. Asgary S, Parirokh M, Eghbal MJ, Brink F. Chemical differences between white and gray mineral trioxide aggregate. J Endod. 2005;31(2):101-3. PMID: 15671818.
13. Attin T, Paqué F, Ajam F, Lennon AM. Review of the current status of tooth whitening with the walking bleach technique. Int Endod J. 2003;36(5):313-29. PMID: 12752645.
14. Nathoo SA. The chemistry and mechanisms of extrinsic and intrinsic discoloration. J Am Dent Assoc. 1997;128: Suppl:6-10. https://www.sciencedirect.com/science/article/abs/pii/S0002817715300544