Case Report

Apexification treatment of immature permanent maxillary first molar with taurodontism: a case report

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ABSTRACT

Introduction: Taurodontism is a rare developmental abnormality affecting the permanent molars, resulting from incomplete invagination of Hertwig's epithelial root sheath at the proper horizontal level. Apexification treatment of a taurodont tooth is challenging and requires special attention due to the difficulty in locating the canal orifices, as well as the complexity involved in the preparation and obturation of the root canals.This case report aims to outline the clinical approach, treatment protocol, and outcome of apexification in an immature taurodontic molar, offering insights into the management of anatomically challenging pediatric endodontic cases. **Case Reports**: The apexification treatment with calcium hydroxide was performed on the immature maxillary left first molar (tooth 26) of an 11-year-old girl diagnosed with symptomatic irreversible pulpitis and mesotaurodontism. After six months, no subjective or clinical symptoms were reported. Although apical closure was not clearly evident on radiographs, an apical stop was detected during clinical examination. Following this evaluation, tooth 26 was obturated with gutta-percha combined with a bioceramic sealer, and subsequently restored using direct composite restoration. An evaluation was performed three months post-treatment, incorporating clinical examination and radiographic and cone-beam computed tomography (CBCT) imaging. **Conclusion**:This case report highlights the successful apexification of a maxillary first molar with taurodontism using calcium hydroxide. The patient remained asymptomatic throughout treatment, with radiographic evaluations indicating conditions within normal limits. CBCT confirmed adequate obturation extending to the apical region and demonstrated definitive apical closure after six months follow-up.

KEYWORDS

Apexification, taurodontism, calcium hydroxide

INTRODUCTION

Pulp exposure caused by caries or trauma in young permanent teeth can trigger the loss of pulpal vitality, which directly impacts root development. Root development and apical closure typically occur over a period of approximately three years following the eruption of the tooth. Early pulpal damage in young permanent teeth can lead to the cessation of root growth, resulting in an open apex and widened root canals.[1-3]

Apexification is a procedure aimed at stimulating closure or calcification at the root apex of immature permanent teeth by removing the infected pulp near the apex and subsequently placing a biocompatible material to seal the root end. This procedure is designed to promote apical closure in teeth that have ceased root development and growth due to pulp damage caused by irreversible pulpitis or pulp necrosis .[4-8] Apexification using calcium hydroxide, commonly referred to as

conventional apexification, is expected to stimulate the formation of an apical barrier while also controlling periapical inflammation due to its antibacterial properties.[4,6]

Apexification can be performed on immature permanent teeth with pulp damage, whether the pulp morphology is normal or altered by anomalies such as taurodontism. Taurodontism is a developmental anomaly in dental morphology, with a global prevalence ranging from 2% to 48%.[9-13]

Root canal treatment and apexification in teeth with taurodontism present substantial challenges in the phases of access, instrumentation, and obturation. These difficulties arise from the complex anatomical configuration of the root canal, which hinders the comprehensive filling of the root canal system in taurodontic teeth.[11-15]

The novelty of this case lies in the clinical management of apexification performed on an immature maxillary first molar with mesotaurodontism in a pediatric patient. Although apexification is a well-established procedure, its application in taurodont molars is relatively uncommon due to their anatomical complexity. The choice of calcium hydroxide over MTA further highlights a procedural distinction, based on considerations such as cost-effectiveness, ease of handling, and biological response. This case report aims to outline the clinical approach, treatment protocol, and outcome of apexification in an immature taurodont molar, offering insights into the management of anatomically complex pediatric endodontic cases.

CASE REPORT

An 11-year-old female patient was referred from a private dental clinic to the Pediatric Dentistry Clinic at Universitas Padjadjaran Dental Hospital with chief complaints of sensitivity and pain in response to cold, hot, sweet stimuli and biting pessure. She had reported experiencing spontaneous throbbing pain during sleep and discomfort while eating for the past three days. The patient also mentioned a history of similar pain two months earlier that had subsided, but she subsequently experienced a worsening of the pain intensity. Clinical and radiographic examinations (Figure 1) were conducted.

Intraoral examination revealed a normal shape of crown with deep caries on the left first maxillary molar (tooth 26). The tooth had a positive response to the electric pulp test and was not tender to percussion and palpation. Radiographic examination of the affected tooth revealed an abnormal tooth with a big occlusal lesion with an involvement of pulp chamber. Other radiographic findings of the affected tooth showed apical displacement of the pulp chamber floor, lack of constriction at the CEJ, and an elongated pulp chamber, all of which indicate taurodontism. The mesial root exhibited a notably open apex. Based on the subjective and objective clinical findings, a diagnosis of symptomatic irreversible pulpitis associated with mesotaurodontism was established.

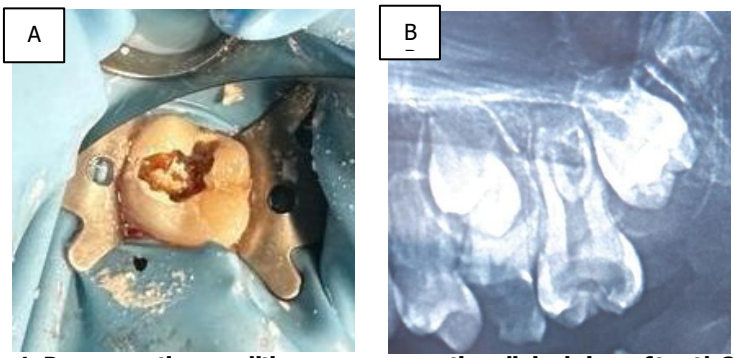

Figure 1. Pre-operative condition; a. pre-operative clinical view of tooth 26, b. pre-operative radiograph of tooth 26

After obtaining informed written consent, local anesthesia was administered using the inferior alveolar nerve block technique with lidocaine containing 1:100.000 epinephrine, followed by the placement of a rubber dam. Once the tooth was properly isolated, an access cavity was prepared on the occlusal surface, and all carious lesions were thoroughly removed (Figure 2a). At the furcation area, the first mesiobuccal, second mesiobuccal, palatal, and distal canal orifices were identified. An electronic apex locator (Eighteenth, Changzou Sifary Medical Technology, China) was used to determine the initial working lengths. Initial files were placed into root canals, and a baseline radiograph was obtained. A rotary system (X-Smart Plus, Dentsply Sirona, New York City, USA) was used for canal preparation.

The Reciproc R25 file system (VDW GmbH, Munich, Germany) was utilized exclusively in a brushing motion to eliminate any remaining tissue from the dentinal walls. To ensure complete removal of infected pulp tissue, 2.5% sodium hypochlorite was employed as the irrigant. Additionally, 17% ethylenediaminetetraacetic acid (EDTA) (Dentonics, North Carolina, USA) was applied multiple times throughout the procedure to effectively eliminate the smear layer. After proper preparation, irrigation, and activation, each canal was dried by using sterile paper points. The canals were filled with calcium hydroxide paste in a premixed syringe (Calcipex II, Nishika, Japan) into the apical third, and a moistened sterile cotton pellet was placed in pulp chamber, and a temporary filling was placed using Cavit (3M, Seefeld, Germany).

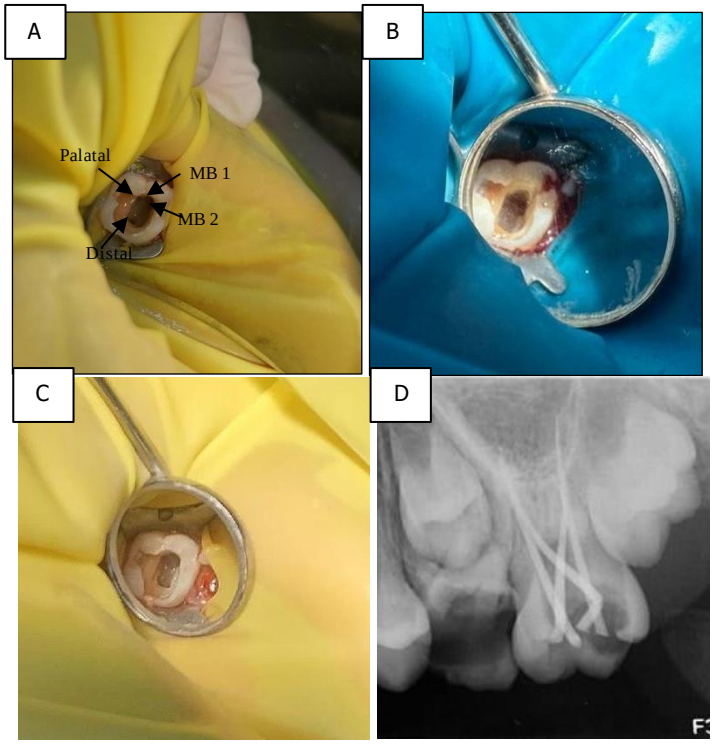

Figure 2. Clinical condition; A. clinical view of access preparation B. clinical view of 3 month during treatment, C. clinical view of 6 month during treatment, D. radiograph view of gutta percha trial.

The patient was scheduled for monthly follow-up appointments to monitor the progression of apical closure. During each visit, apexification was repeated by replacing the calcium hydroxide medication, and radiographic imaging was conducted to assess treatment progress. Clinical assessments were performed at the three-month and six-month follow-up visits (Figure 2b and 2c). At the six-month follow-up, radiographic imaging provided poor visualization of the apical area; however, based on clinical examination a hard apical barrier was confirmed through

tactile sensation using a size 15 K-file. A gutta-percha trial was conducted and confirmed radiographically (Figure 2d). Canal obturation was completed with gutta-percha combined with a bioceramic root canal sealer (AH Plus, Dentsply, Dentsply Sirona, New York City), applied using an endodontic pressure syringe. The pulp chamber floor was then lined with a glass ionomer cement, and the final post-endodontic restoration was achieved using a direct resin composite (Figure 3a and 3b). A follow-up evaluation was performed three months postoperatively, including clinical examination, intraoral periapical radiography, and cone-beam computed tomography (CBCT) imaging (Figure 4). The patient was asymptomatic; radiographic evaluation showed conditions within normal limits, and CBCT confirmed proper obturation up to the apex with clear evidence of apical closure.

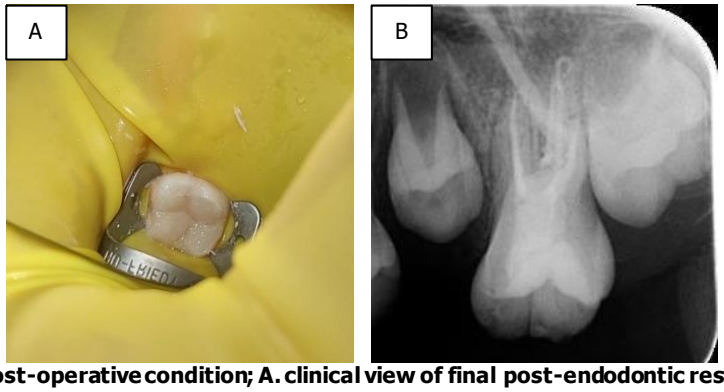

Figure 3. Post-operative condition; A. clinical view of final post-endodontic restoration using direct resin composite, B. post-operative radiograph of tooth 26

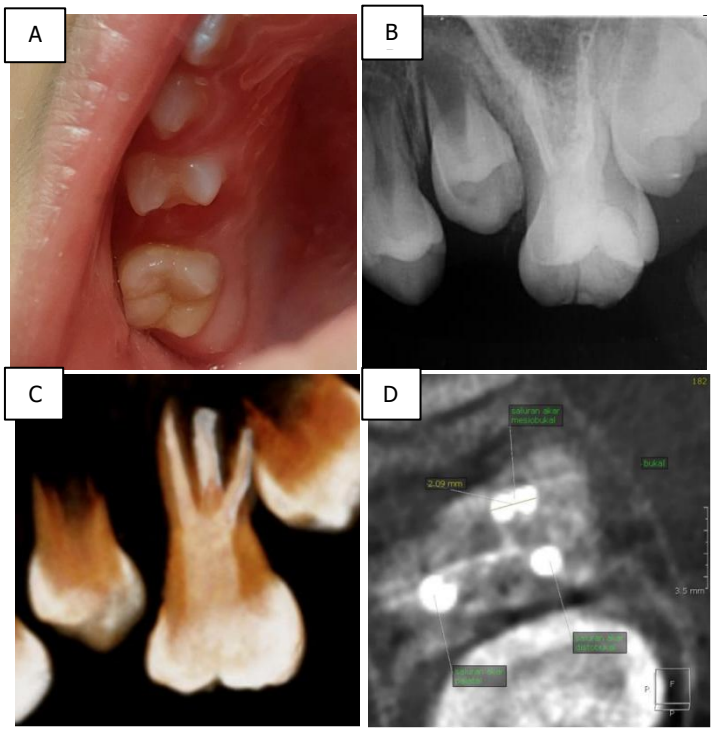

Figure 4. 3rd Follow-up; A. clinical view of 3rd months follow-up B. radiograph view of 3rd months follow-up, C. cbct (3d buccal view), D. cbct (axial view)

DISCUSSION

Apexification is a treatment option for immature permanent teeth with open apices. It is an endodontic procedure aimed at stimulating the formation of a calcified barrier at the apex of non-vital, immature teeth.[4-8] In teeth with taurodontism, this procedure becomes more challenging due to atypical root canal morphology and a tendency for thinner root walls. The primary challenge in performing apexification

lies in achieving thorough cleaning, appropriate shaping, and complete filling of the root canal, despite the extreme variations in tooth anatomy.[9-12]

The complex navigation of root canals often presents a significant challenge in the apexification of taurodont teeth. The unpredictable canal anatomy can make it difficult to locate and access the root canals, thereby complicating effective cleaning and shaping. Additionally, instrumentation becomes more complicated due to the unusual length, volume, and taper of the canals, increasing the risk of perforation or over-instrumentation, especially in areas where the canal walls are particularly thin.[10-15]

This case report identified that the maxillary left first molar presented with pulp damage and a taurodont pulp chamber morphology. Based on the measurements, the tooth was classified as mesotaurodontic. The treatment of choice in this case was apexification using calcium hydroxide.[16,17]

Apexification procedures using calcium hydroxide are commonly employed to stimulate the formation of hard tissue at the root apex. However, this process requires a prolonged period, often taking several months, with monthly follow-up visits to evaluate progress. In this case, apexification treatment and evaluation were conducted over a period of six months, during which the patient remained clinically asymptomatic.

Radiographic and cone-beam computed tomography (CBCT) analyses revealed adequate apical obturation with distinct evidence of apical barrier formation and closure. Continuous radiographic monitoring is crucial to assess both root canal wall thickness and the development of apical closure. Although the final outcome often shows irregular apical closure and atypical root morphology, it is generally sufficient to support conventional obturation.[17-20]

Davood et al. suggest that despite the anatomical challenges posed by taurodontic teeth—such as irregular root canal morphology and thin root walls—calcium hydroxide remains effective when meticulous cleaning, shaping, and monitoring are performed.[18] This case supports previous findings emphasizing the importance of long-term follow-up—often extending over several months, to observe the gradual formation of a calcified barrier, which was evident at the six-month evaluation through both radiographic and CBCT imaging.

The obturation stages of the root canal in taurodontic teeth present significant challenges. Complete filling of the root canal is crucial to prevent the presence of voids that could serve as niches for bacterial growth. In this case, gutta-percha was employed as the obturation material, accompanied by a bioceramic sealer. The use of the bioceramic sealer is anticipated to provide adequate sealing at the apical end, which may be irregularly formed as a result of the apexification procedure.[19-23] The use of bioceramic sealers in conjunction with gutta-percha in this case reflects a growing consensus favoring bioactive materials that enhance sealing efficacy in irregularly shaped apices.[8]

The initial long-term prognosis for apexification treatment in maxillary first molars with taurodontism is generally favorable, provided the procedure is performed meticulously and under strict sterile conditions. However, the risk of long-term failure persists due to the anatomical complexity of the root canal system, particularly in cases involving residual infection or incomplete root canal filling. Therefore, careful and continuous long-term follow-up is essential to ensure optimal treatment outcomes.[17,24,25]

Challenges in radiographic assessment in taurodontism arise because the morphology complicates the evaluation of apical closure and periapical healing, potentially leading to difficulty in accurately assessing treatment success. CBCT imaging is required to confirm an adequate obturation and the presence of apical barrier. Taurodontism is relatively rare, and there is limited research on the long-term outcomes of apexification in such cases, making it difficult to predict long-term success.

The limitations of this case included the six-month follow-up period, which may not be sufficient to evaluate the long-term success and stability of the treatment.

Additionally, the complex root anatomy of taurodontic teeth can vary significantly, and this variability may affect treatment outcomes, thus requiring further studies with larger samples to establish more reliable protocols.

CONCLUSION

Apexification treatment in maxillary first molars exhibiting taurodontism presents notable clinical challenges due to the atypical anatomical characteristics of the root canal. Apexification with calcium hydroxide in an immature first molar with taurodontism can be successful, provided that the procedure is conducted with meticulous cleaning, shaping, monitoring, and strict adherence to sterility. The unique anatomy of taurodont teeth complicates radiographic interpretation of apical closure and periapical healing, highlighting the need for advanced imaging techniques and careful monitoring using CBCT. The implication of this case is that, with meticulous management, favorable outcomes are achievable despite the anatomical challenges posed by taurodontism.

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