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Endodontic Management of Taurodontism in Maxillary Molars: A Report of Two Cases

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Abstract

Background

Taurodontism is an uncommon developmental anomaly characterized by an enlarged pulp chamber, apical displacement of the pulpal floor, and shortened roots resulting from abnormal invagination of Hertwig's epithelial root sheath during odontogenesis. Although the external morphology of affected teeth appears clinically normal, the altered internal anatomy poses significant challenges during endodontic treatment. Canal calcification further increases treatment complexity by making canal negotiation and instrumentation difficult. The use of Cone-Beam Computed Tomography (CBCT) has considerably improved the diagnosis and management of such anatomically complex cases.

Case Presentation

Case report no. 1 A 38-year-old female presented with severe nocturnal pain associated with the maxillary right first molar. Clinical examination revealed deep caries involving tooth #16 with tenderness on percussion. Radiographic examination demonstrated deep caries approaching the pulp and features suggestive of Mesotaurodontism. Owing to difficulty in canal identification, CBCT imaging was performed, which confirmed Mesotaurodont morphology and revealed calcification of all three root canals. Nonsurgical root canal treatment was successfully completed using CBCT-guided canal localization, rotary instrumentation, irrigation with 5.25% Sodium Hypochlorite and 17% Ethylenediaminetetraacetic Acid (EDTA), obturation with a Bioceramic sealer using a single-cone technique supplemented by Thermoplasticized gutta-percha, followed by Composite resin restoration. At the two-month follow-up, the patient remained asymptomatic, and the tooth was clinically functional.

Case report no. 2 A 28 year old female presented with severe spontaneous pain associated with the maxillary right first molar. Clinical examination revealed deep distal caries involving tooth #16 with tenderness on percussion. Radiographic examination demonstrated deep caries approaching the pulp and features suggestive of Hypotaurodontism. Nonsurgical root canal treatment was successfully completed similar to case report no. 1

Conclusion

Taurodont teeth with calcified canals present significant diagnostic and therapeutic challenges. Careful radiographic assessment, three-dimensional imaging using CBCT, meticulous canal negotiation, effective irrigation, and contemporary obturation techniques can facilitate predictable endodontic outcomes. This case highlights the indispensable role of CBCT in identifying calcified canals and guiding successful endodontic treatment in teeth with complex anatomical variations.

Keywords: Taurodontism; Mesotaurodontism; Hypotaurodontism Cone-beam computed tomography; Calcified canals; Root canal treatment

Introduction

Taurodontism is a developmental anomaly of tooth morphology characterized by an elongated pulp chamber, apical displacement of the pulpal floor and furcation, and shortened roots while maintaining a clinically normal crown morphology. The anomaly results from incomplete or delayed invagination of Hertwig's epithelial root sheath during root development, leading to altered root formation without affecting enamel morphology. Consequently, Taurodont teeth are often diagnosed incidentally during radiographic examination rather than clinical inspection.[1,2]

The term Taurodontism was first introduced by Sir Arthur Keith in 1913 to describe teeth resembling those of cud-chewing animals because of their enlarged pulp chambers and shortened roots.[3] Later, Shaw classified Taurodontism into Hypotaurodontism, Mesotaurodontism, and Hypertaurodontism according to the degree of apical displacement of the pulpal floor, a classification that continues to be widely accepted in clinical practice.[4]

The reported prevalence of Taurodontism varies considerably among different populations, ranging from less than 1% to over 10%, depending on ethnicity and diagnostic criteria.[5] It most frequently affects permanent molars, particularly the maxillary molars, and may occur either as an isolated developmental anomaly or in association with several syndromic conditions, including Amelogenesis Imperfecta, Klinefelter Syndrome, Tricho-Dento-Osseous Syndrome, And Down Syndrome.[2,6]

From an endodontic perspective, Taurodont teeth present considerable challenges because of their atypical internal anatomy. The enlarged pulp chamber and apically displaced canal orifices complicate access cavity preparation and increase the difficulty of locating root canals. Furthermore, the root canal system often exhibits significant anatomical variability, including additional canals, fins, isthmuses, and unusual canal configurations, which increase the risk of missed canals and inadequate debridement.[7]

Canal calcification further compounds the complexity of endodontic treatment in Taurodont teeth. Calcified canals may result from aging, trauma, restorative procedures, or chronic pulpal irritation, leading to narrowing or complete obliteration of the canal space. Negotiating these canals without causing procedural errors such as perforation, ledging, or instrument separation is particularly challenging. Conventional periapical radiographs frequently provide insufficient information because of the superimposition of anatomical structures and their inherent two-dimensional limitations.[8]

Cone-beam computed tomography (CBCT) has emerged as an invaluable diagnostic adjunct in the management of complex endodontic cases. Unlike conventional radiography, CBCT provides three-dimensional visualization of root morphology, canal configuration, canal calcification, and surrounding periapical structures.[9]

Recent advances in endodontic technology, including enhanced Magnification, Ultrasonic tips, Nickel–Titanium rotary instrumentation, activated irrigation techniques, and Bioceramic sealers, have significantly improved the management of teeth with complex canal anatomy. Bioceramic sealers, used in conjunction with minimally tapered gutta-percha cones and Thermoplasticized obturation techniques, offer excellent sealing ability, dimensional stability, and bioactivity, making them particularly advantageous in irregular canal systems commonly encountered in Taurodont teeth.[10,11]

The present case reports describes the successful nonsurgical endodontic management of a Mesotaurodont maxillary first molar with calcified root canals diagnosed using CBCT and management of a Hypotaurodont maxillary first molar .The report highlights the diagnostic value of three-dimensional imaging and discusses contemporary clinical strategies that facilitate successful treatment of anatomically challenging teeth.

Case Presentation

Case no. 1

A 38-year-old female patient reported to the Department of Conservative Dentistry and Endodontics with the chief complaint of severe spontaneous pain in the upper right posterior region for one week. The pain was continuous, aggravated during the night, and severe enough to disturb sleep. The patient did not report any relevant medical history, previous dental trauma, or systemic conditions associated with developmental dental anomalies.

Case No. 2

A 28 year old female presented with severe spontaneous pain associated with the maxillary right first molar. Clinical examination revealed deep distal caries involving tooth #16 with tenderness on percussion. Radiographic examination demonstrated deep caries approaching the pulp and features suggestive of Hypotaurodontism. Nonsurgical root canal treatment was successfully completed similar to case report no. 1.

Clinical Examination

Intraoral examination revealed deep proximal caries involving the maxillary right first molar (tooth #16). The tooth exhibited tenderness on vertical percussion, while palpation of the buccal and palatal vestibules elicited no tenderness. Periodontal examination demonstrated healthy gingival tissues with physiologic probing depths, and the tooth exhibited no abnormal mobility. No swelling or sinus tract was present.

Based on the patient's history and clinical findings, pulpal and periapical diagnostic tests were performed. The clinical diagnosis was symptomatic irreversible pulpitis associated with normal apical tissues, warranting nonsurgical root canal treatment.

Radiographic Examination

A preoperative intraoral periapical radiograph demonstrated deep carious involvement extending close to the pulp chamber. In addition, the tooth exhibited an enlarged pulp chamber with an apically displaced pulpal floor and shortened roots, suggestive of Mesotaurodontism according to Shaw's classification.

Considering the anticipated anatomical complexity, Cone-Beam Computed Tomography (CBCT) was prescribed to obtain a three-dimensional assessment of the root canal system. Axial, sagittal, and coronal CBCT sections confirmed Mesotaurodont morphology characterized by an elongated pulp chamber, apical displacement of the pulpal floor, and shortened roots. The scan further demonstrated significant calcification of all three principal canals, making conventional radiographic interpretation inadequate for precise canal localization. The additional anatomical information obtained from CBCT facilitated accurate treatment planning and minimized the risk of excessive dentin removal during canal exploration.

Endodontic Procedure

Case No. 1

After obtaining informed consent, local anesthesia was administered using 2% lidocaine with 1:100,000 epinephrine, and the tooth was isolated under rubber dam, an endodontic access cavity was prepared using a high-speed diamond bur under copious water irrigation. On entering the pulp chamber, the characteristic features of Mesotaurodontism, including an enlarged pulp chamber and apically displaced pulpal floor, became evident.

A Dental Operating Microscope (DOM) was employed throughout the procedure to enhance visualization of the pulpal floor and facilitate identification of the canal orifices. Owing to extensive calcification of the canal system, localization of the canals was challenging. The CBCT images were carefully correlated with the clinical findings, and under microscopic magnification, the pulpal floor was meticulously explored. Guided by the three-dimensional CBCT anatomy and enhanced visualization provided by the DOM, the mesiobuccal, distobuccal, and palatal canals were successfully identified and negotiated while preserving tooth structure and minimizing the risk of iatrogenic perforation.

Working lengths were established using an Electronic Apex Locator and confirmed radiographically. Canal patency was carefully negotiated using small

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Stainless-Steel hand files before biomechanical preparation was completed using Nickel-Titanium rotary instruments in a Crown-down sequence while maintaining the original canal curvature.

Copious irrigation was performed throughout instrumentation using 5.25% Sodium Hypochlorite to achieve effective dissolution of organic tissue and microbial reduction. Following completion of canal preparation, 17% Ethylenediaminetetraacetic Acid (EDTA) was used for one minute to remove the smear layer, followed by a final rinse with Sodium Hypochlorite to maximize canal cleanliness.

The canals were subsequently dried using sterile paper points. Obturation was performed using a Bioceramic sealer in conjunction with a single-cone gutta-percha technique. To enhance adaptation within the enlarged canal space and improve three-dimensional sealing, the coronal portion of the canals and pulp chamber was backfilled using Thermoplasticized gutta-percha. A postoperative radiograph confirmed dense and homogeneous obturation with satisfactory adaptation of the filling material throughout the canal system. Following obturation, the access cavity was restored with a direct Nanohybrid Composite resin restoration, thereby providing an immediate coronal seal and reinforcing the remaining tooth structure.

Case No. 2

A second patient underwent nonsurgical root canal treatment following the same clinical protocol as described in Case 1. The diagnostic work-up, including clinical examination, radiographic assessment, CBCT evaluation, access cavity preparation, canal negotiation under a dental operating microscope (DOM), working length determination, biomechanical preparation, irrigation protocol, obturation technique, and final coronal restoration were performed using the same materials and methodology.

The distinguishing feature of this case was the root canal anatomy. CBCT examination revealed a five-canal configuration comprising two Mesiobuccal canals (MB1 and MB2), two Distobuccal canals (DB1 and DB2), and one Palatal canal. The additional mesiobuccal and distobuccal canals were successfully identified and negotiated with the aid of CBCT-guided three-dimensional assessment and enhanced magnification provided by the DOM. All five canals were instrumented using the same biomechanical preparation protocol and irrigated with 5.25% sodium hypochlorite followed by 17% Ethylenediaminetetraacetic acid (EDTA) and a final rinse with Sodium Hypochlorite.

Following complete canal preparation, the canals were dried with sterile paper points and obturated using a Bioceramic sealer with a single-cone gutta-percha technique. The coronal portion of the canals and the enlarged pulp chamber were subsequently backfilled with Thermoplasticized gutta-percha to ensure optimal three-dimensional adaptation and sealing. A postoperative radiograph confirmed dense, homogeneous obturation of all five canals with satisfactory adaptation of the filling material. The access cavity was restored with a direct Nanohybrid Composite resin restoration to provide an effective coronal seal and reinforce the remaining tooth structure.

Both patients were recalled after two months for clinical evaluation. At the follow-up visit, she reported complete resolution of symptoms and satisfactory masticatory function. Clinical examination revealed absence of tenderness to percussion or palpation, normal periodontal findings, and no evidence of swelling or sinus tract formation.

Discussion

Taurodontism is an uncommon developmental anomaly characterized by an enlarged pulp chamber, apical displacement of the pulpal floor, and shortened roots resulting from the failure of Hertwig's epithelial root sheath to invaginate at the appropriate stage of root development.[1] The anomaly primarily affects permanent molars and usually remains clinically undetected because the external crown morphology is normal. Consequently, diagnosis relies predominantly on radiographic examination, with Cone-beam computed tomography (CBCT) providing superior visualization of the altered internal anatomy.[2,3]

According to Shaw's classification, Taurodontism is categorized into Hypotaurodontism, Mesotaurodontism, and Hypertaurodontism

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depending on the degree of apical displacement of the pulpal floor.[4] The present case was diagnosed as Mesotaurodontism, in which the pulp chamber extends significantly into the root while maintaining distinguishable root trunks. Although Mesotaurodont teeth are less anatomically complex than Hypertaurodont teeth, their endodontic management remains challenging because of the increased distance between the chamber roof and canal orifices, the altered position of the pulpal floor, and frequent variations in canal morphology.[1]

Successful endodontic treatment depends on complete debridement, disinfection, and obturation of the entire root canal system. These objectives become considerably more difficult to achieve in Taurodont teeth because the elongated pulp chamber and apically displaced furcation alter conventional anatomical landmarks used during access cavity preparation. Failure to recognize these anatomical variations may result in excessive dentin removal, missed canals, perforation of the chamber floor, or incomplete canal instrumentation.[5]

The present case was further complicated by calcification of all three root canals. Canal calcification is frequently associated with aging, chronic pulpal inflammation, restorative procedures, or trauma and may obscure canal anatomy, thereby increasing the likelihood of procedural errors during treatment.[6] Conventional intraoral periapical radiographs provide only two-dimensional information and may be insufficient to accurately determine the location and course of calcified canals, particularly in teeth exhibiting developmental anomalies.

For this reason, CBCT was employed as an adjunctive diagnostic tool after the initial radiographic examination suggested unusual pulp chamber morphology and difficulty in canal identification. Three-dimensional imaging enabled confirmation of Mesotaurodont morphology, demonstrated the extent of canal calcification, and provided valuable information regarding the spatial relationship of the canals before instrumentation. The European Society of Endodontology recommends the selective use of CBCT in cases where conventional radiographs fail to provide adequate diagnostic information or when complex canal anatomy is suspected.[7] In the present case, CBCT significantly improved treatment planning and facilitated safe canal negotiation while minimizing unnecessary removal of tooth structure.

The Dental Operating Microscope (DOM) also played a pivotal role during treatment. Magnification and coaxial illumination substantially improve visualization of the pulpal floor, developmental grooves, and calcified canal orifices. Previous studies have demonstrated that the use of magnification significantly increases the detection of additional or calcified canals while reducing the incidence of iatrogenic complications.[8,9]

Adequate irrigation assumes even greater importance in Taurodont teeth because the enlarged pulp chamber and anatomical irregularities limit the effectiveness of mechanical instrumentation alone. Sodium hypochlorite remains the irrigant of choice because of its antimicrobial activity and ability to dissolve organic tissue, whereas EDTA facilitates removal of the inorganic smear layer and improves penetration of irrigants into dentinal tubules.[10] In the present case, 5.25% Sodium Hypochlorite and 17% EDTA were activated using ultrasonic irrigation, thereby enhancing irrigant penetration, acoustic streaming, and cavitation within the canal system. Numerous investigations have demonstrated that passive ultrasonic irrigation improves smear layer removal, disrupts bacterial biofilms, and enhances disinfection compared with conventional syringe irrigation, particularly in anatomically complex root canal systems.[11,12]

The obturation technique selected for Taurodont teeth should account for the enlarged pulp chamber and irregular canal morphology. Conventional lateral compaction may inadequately adapt gutta-percha to the walls of the elongated pulp chamber, leaving voids that may compromise the long-term seal. In the present case, obturation was performed using a Bioceramic sealer with a single-cone technique followed by Thermoplasticized gutta-percha backfill. Bioceramic sealers exhibit excellent flow characteristics, dimensional stability, alkaline pH, calcium ion release, and bioactivity, allowing intimate adaptation to dentinal walls and accessory anatomical irregularities.[13] Supplementing the apical single-cone obturation with Thermoplasticized gutta-percha provided improved adaptation within the enlarged pulp chamber while maintaining a conservative and predictable obturation strategy.

This case reinforces the importance of integrating three-dimensional imaging, magnification, enhanced irrigation protocols, and contemporary obturation materials when managing teeth with developmental anomalies.

Conclusion

Taurodontism presents a unique endodontic challenge because of its altered internal anatomy, characterized by an enlarged pulp chamber, apically displaced pulpal floor, and shortened roots. The presence of calcified canals further increases treatment complexity by complicating canal localization and negotiation. This case demonstrates that successful nonsurgical endodontic management of a Mesotaurodont maxillary first molar with calcified canals is achievable through meticulous treatment planning and the integration of contemporary endodontic technologies.

Cone-beam computed tomography proved invaluable in confirming the diagnosis, assessing canal calcification, and guiding access preparation. The use of a dental operating microscope facilitated precise canal identification, while ultrasonic activation of sodium hypochlorite and EDTA enhanced canal disinfection. Obturation using a Bioceramic sealer in conjunction with a single-cone technique and Thermoplasticized gutta-percha provided a predictable three-dimensional seal despite the enlarged pulp chamber. The favorable short-term clinical outcome emphasizes the importance of combining advanced diagnostic imaging with biologically driven endodontic principles for managing anatomically challenging teeth.

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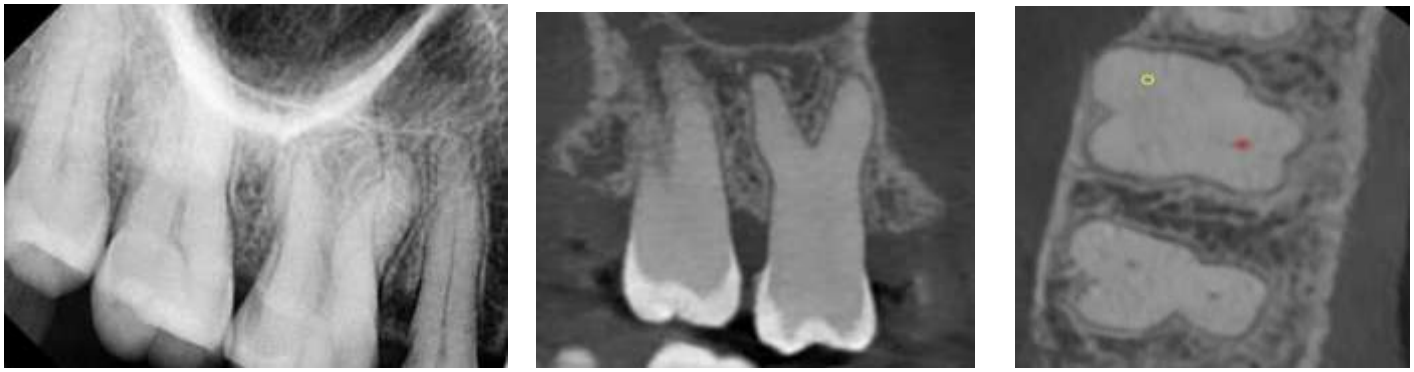
Case no. 1

Figure 1. Preoperative IOPA radiograph (1a) and CBCT scan (1b, 1C) with tooth #16



1a **1b.** **1C**

Figure 2. Working length determination with tooth #16

Figure 3. Master cone IOPA X-ray with tooth #16.

Figure 4. Post-obturation IOPA X-ray with tooth #16

Figure 5. 2month follow up IOPA X-ray with tooth #26

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Case no. 2

Figure 1. Preoperative IOPA radiograph tooth #26

Figure 2. Working length determination with tooth #26.

Figure 3. Master cone IOPA X-ray with tooth #26.

Figure 4. Post-obturation IOPA X-ray with tooth #26.

Figure 5. 2month follow up IOPA X-ray with tooth #26.

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