IEJ Iranian Endodontic Journal

Advanced Endodontic Techniques for Treating Root Perforation in a Hypertaurodont Molar: A Case Report

Ali Chamani [a], Maryam Forghani [a], Mina Zarei [a], Pouria Soltaninezhad [a*]

[a] Department of Endodontics, Faculty of Dentistry; Dental Research Center, Mashad, Iran

Article Type: **Case Report**

Received: 18 Nov 2024
Accepted: 25 Dec 2024
Published: 29 Jan 2025
Doi: *10.22037/iej.v20i1.46431*

****Corresponding author***: Pouria Soltaninezhad, Park Square, Vakilabad Blvd, School of Dentistry, Mashhad, Iran, Postal code: 1461965381.

E-mail: soltaninezhadpouria@gmail.com

Taurodontism is a dental anomaly characterized by an enlarged pulp chamber and apically displaced pulpal floor. This disorder poses significant challenges in endodontic treatment, especially when perforations occur. The present case study details the endodontic retreatment of a hypertaurodont maxillary second molar in a 36-year-old female patient with a mesial canal perforation. The procedure employed a dental operating microscope for enhanced visualization and precision. Canals were prepared using a crown-down technique, with the perforation site managed using MTA and bioceramic material applied via the second mesiobuccal canal. The remaining canals were obturated using gutta-percha and bioceramic sealer. At the 1-year follow-up, the tooth was functional and asymptomatic, with radiographic evidence of a normal periodontal ligament space. This case demonstrates the efficacy of contemporary endodontic techniques, including bioceramic materials and advanced magnification, in managing the unique challenges posed by taurodontism.

Keywords: Anatomic Variation; Perforation; Root Canal; Taurodontism

Introduction

Taurodontism is a dental anomaly characterized by an enlarged pulp chamber, apical displacement of the pulpal floor, and the absence of cervical constriction at the cementoenamel junction (CEJ) level. According to Witkop, taurodontism is characterized by teeth with large pulp chambers with apical displacement of the bifurcation or trifurcation, resulting in a larger apicoocclusal height of the chamber than in normal teeth [1-4].

The etiology of taurodontism is multifactorial and unclear, often associated with inadequate invagination of the epithelial root sheath at an early stage, leading to the formation of the cynodont [3, 5]. Other proposed etiological factors include odontoblastic deficiency during root dentin formation [6] and disruptive developmental homeostasis [7].

The prevalence of taurodontism ranges from 2.5% to 11.3% of the population [8, 9]. It may be unilateral or bilateral, with no sex predilection, and affects permanent teeth more frequently than primary teeth. Mandibular molars are more commonly affected than maxillary molars, with the mandibular second molar being the most frequently involved tooth in the dentition [10-12].

Diagnosis of taurodontism is typically made through diagnostic radiographs, as taurodonts appear normal in the oral cavity [13]. Shifman and Chanannel proposed the taurodont index (TI) as a quantitative measure to identify taurodontism from radiographs. The TI is calculated by dividing the height of the pulp chamber by the distance between the occlusal end of the pulp chamber and the root apex and multiplying the result by 100. A tooth is diagnosed with taurodontism if the TI is equal to or greater than 20 (hypotaurodontism TI 20-30, mesotaurodontism TI 30-40, and hypertaurodontism TI 40-75) [14].

From an endodontic perspective, taurodontic teeth present several challenges, including difficult coronal access, initial exploration, preparation, and root canal filling [15, 16]. The enlarged pulp chamber volume can lead to increased blood flow during access preparation, which may be mistaken for perforation. Additionally, the short roots and apical displacement of the pulpal floor increase the risk of actual perforation during treatment [15, 17].

Root perforation, defined as a communication between the root canal walls and the periodontal space, can significantly impact the prognosis of endodontic treatment [18]. The management

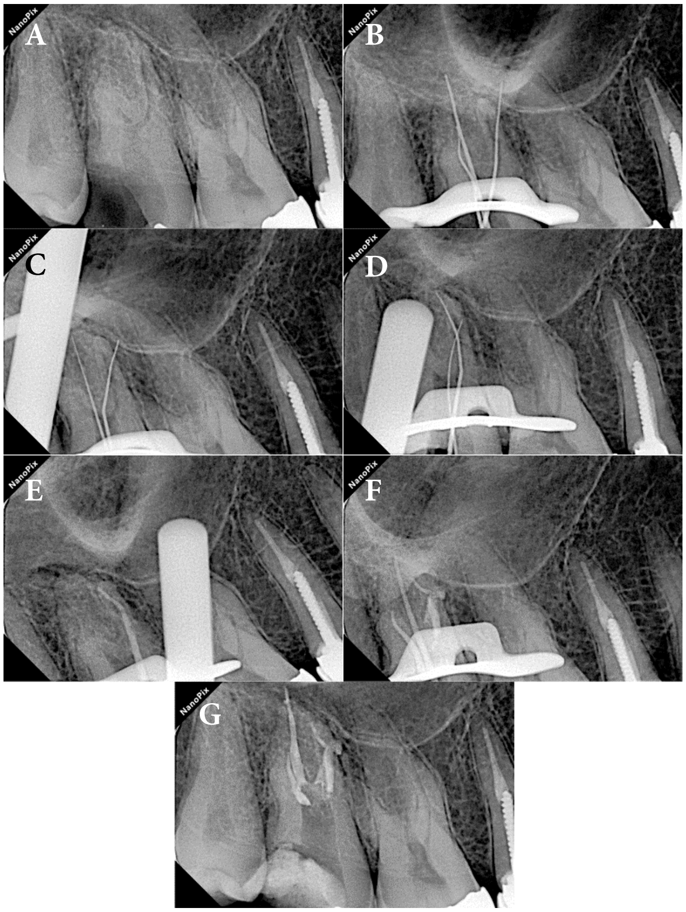

Figure 1. Maxillary second molar; *A*) Preoperative radiograph; *B*) Perforation in the first mesiobuccal (MB1), working length confirmation radiograph; *C*)Perforation in MB2; *D*) Finding the main canals path of MB1 and MB2; *E&F*) Master cone confirmation radiograph; *G*) Postoperative radiograph

of perforations requires careful consideration of various factors, including the time of occurrence, location, size, and choice of repair material [19, 20].

This paper aims to discuss the management of perforation in a taurodontic tooth, focusing on the application of contemporary materials and techniques to overcome the unique challenges presented by this dental anomaly. By exploring current evidence and clinical strategies, we seek to provide insights into optimizing treatment outcomes for patients with taurodontism complicated by perforation.

Case Report

A 36-year-old female patient was referred to the Department of Endodontics at Mashhad University of Medical Sciences with a chief complaint of incomplete root canal treatment on her right maxillary second molar. The patient was in good general health with no significant medical conditions. Dental history revealed that initial endodontic treatment had been previously initiated by a general dental practitioner, during which an iatrogenic perforation occurred in the mesiobuccal (MB) canal.

Clinical examination revealed a tooth unresponsive to sensibility tests. In the clinical examination, no swelling or sinus tract was found, and the tooth was sensitive to percussion. However, the tooth showed no response to sensibility tests, including cold testing (Luber cold spray, Tolu Taravat Tabiat Tebb, Tabriz, Iran) and electrical pulp testing (Parkell, Edgewood, New York, USA). Furthermore, no periodontal pockets were identified.

Preoperative radiography indicated hypertaurodont anatomy (TI≈50) according to the Shifman and Chanannel classification (Figure 1A). The diagnosis was previous treatment with no sign of infection and symptomatic apical periodontitis.

Non-surgical root canal treatment was performed under local anesthesia (2% lidocaine with 1:100,000 epinephrine). The tooth was isolated with a rubber dam, and access was reopened using a high-speed diamond round bur (No. 2, Jota AG, Rüthi, Switzerland)) under a dental operating microscope (OMS2380; Zumax, Suzhou, China). After modification of the access cavity, 3 separate root canal orifices (MB1, distobuccal (DB), and palatal (P)) were detected under a dental operating microscope. They were negotiated with #8 K-file (Mani, Utsunomiya, Japan).

In this stage, the presence of a perforation in the mid-root of the MB canal, which had occurred during the initial endodontic treatment, was confirmed using an apex locator (Dempex, DEM, Barnstaple, Devon, England) and radiography (Figure 1B).
The orifice of the MB2 canal was located using various ultrasonic tips and conservative dentin removal near MB1 and was negotiated with a #10 K-file. The anatomy of the MB root was identified as Vertucci type II, and the MB2 Canal also led to the perforation area (Figures 1C and 1D).

The main pathway of the MB canals was located by inserting a #8 K-file and performing a pecking motion. The pathway was then negotiated and instrumented up to a #15 K file (Mani Inc, Utsunomiya, Japan) (Figure 1D).

The working length was determined by an electronic apex locator (Dempex, DEM, Barnstaple, Devon, England), respectively, and confirmed with radiography. Further shaping of the canal was done using rotary files. A #15 K-file (Mani, Utsunomiya, Japan) was placed through the MB2 canal into the perforation to block the artificial pathway. Then, instrumentation of the main canal was carefully completed up to a 25/0.04 (M3, Shenzhen, China) rotary file under copious irrigation with 5.25% sodium hypochlorite and normal saline.

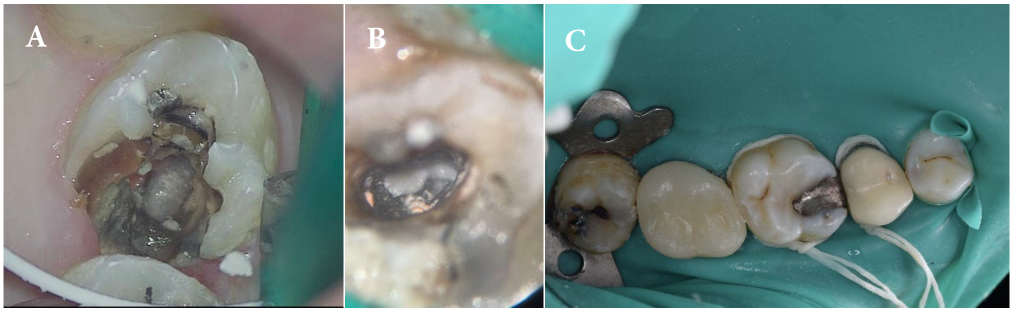

Figure 2. Maxillary second molar; *A)* Preoperative photograph; *B)* Sealing the coronal halves of the MB1 and MB2 canals using MTA followed by a layer of glass ionomer; *C)* After cemetation of ceramic onlay restoration

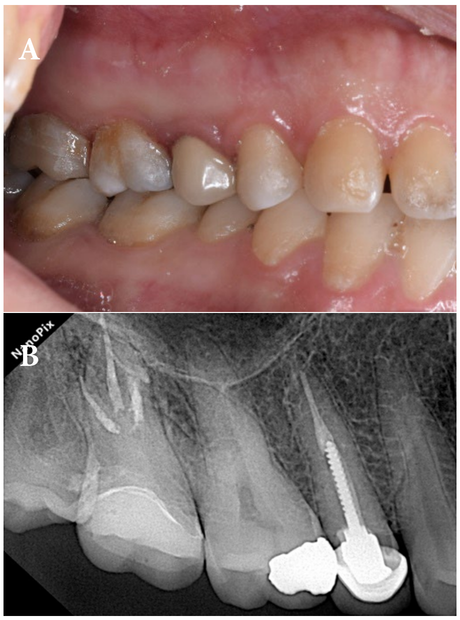

Figure 3. Maxillary second molar; *A)* Clinical view of the crown restored with ceramic onlay restoration after 12-month; *B)* 12-month follow-up radiography

The shaping and cleansing of the remaining canals were done up to N0. 30 master apical file (Flexofile, Dentsply Maillefer, Ballaigues, Switzerland) and followed by M3 silver rotary files up to 25/0.04 (M3, Shenzhen, China) with profuse irrigation with 2.5% sodium hypochlorite and normal saline. The ultimate irrigation was done with 17% EDTA (Morvabon, Tehran, Iran), 2.5% sodium hypochlorite, and a final rinse with normal saline. The canal irrigation was done with an ultrasonic activator (Ultra-X ultrasonic activator; Eighteenth, Changzhou, China). Next, the root canals were dried with sterile paper points (META, Chugbuk, South Korea).

For obturation, the MB1 canal was obturated using gutta-percha (META, South Korea) in conjunction with a bioceramic sealer (NeoSealer Flo, Avalon Biomed, Houston, TX, USA). A warm vertical technique was employed using the Fastpack Obturation System (Eighteenth, Hangzhou City, China), maintaining a 3-mm distance from the apex. For the MB2 canal, which exhibited perforation, bioceramic sealer (NeoSealer Flo, Avalon Biomed, Houston, TX, USA) was directly injected. The coronal portions of both MB1 and MB2 canals were sealed using mineral trioxide aggregate (MTA; Avalon Biomed, Houston, TX, USA) to ensure optimal coronal seal (Figures 1F and 2B).

Following radiographic confirmation of cone fit (Figure 1F), the remaining canals were dried with sterile paper points and obturated using gutta-percha and bioceramic sealer (NeoSealer Flo, Avalon Biomed, Houston, TX, USA) *via* warm vertical compaction (FastFill Obturation System) and the patient was referred for permanent ceramic onlay restoration (Figures 1G and 2C).

A 12-month follow-up appointment was scheduled to assess treatment outcomes.

At the 12-month follow-up session, it was clinically and radiographically asymptomatic (Figure 3).

Discussion

The management of root perforation in a hypertaurodont presents unique challenges due to the anatomical variations associated with taurodontism. This case report highlights the successful treatment of a perforation in the mesial canal of a hypertaurodont maxillary second molar using contemporary endodontic techniques and bioceramic materials. Taurodontism, characterized by large pulp chambers and short roots, is thought to result from the failure of Hertwig's epithelial root sheath to invaginate at the proper time [21] The diagnosis of hypertaurodontism in this case, with a taurodont index (TI) of approximately 50, is consistent with the classification proposed by Shifman and Chanannel [14] This severe form of taurodontism significantly complicates endodontic treatment, increasing the risk of procedural errors such as perforations [15]

From an endodontic perspective, taurodontism presents challenges during negotiation, instrumentation, and obturation. In this case, the MB and DB canal orifices were narrow and in close proximity, making negotiation difficult. The short canals necessitated instrumentation with only the apical third of the file, rendering the process time-consuming. The deeply placed canal orifices further complicated the procedure. The use of a dental operating microscope was crucial for precise visualization and management of the perforation site. This result aligns with current evidence suggesting that magnification aids enhance the accuracy of endodontic procedures and potentially reduce iatrogenic errors [22]. The microscope's role was particularly important given the complex anatomy of the hypertaurodont tooth, allowing for better navigation of the canal system and perforation repair. Initial negotiation of the orifices was performed carefully with #8 and #10 K-files under microscopic guidance. To ensure complete removal of the pulp, 5.25% sodium hypochlorite and normal saline were used initially to digest the voluminous pulp tissue characteristic of taurodont teeth [23, 24]. In this study, the obturation procedure differed from conventional methods due to the complexity of the root canal anatomy and the proximity of buccal orifices [25]. A modified filling technique was employed, consisting of bioceramic sealer (NEO ceramic sealer) and AH-Plus sealer (Dentsply DeTrey, Konstanz, Germany) with vertical compaction of the elongated pulp chamber. The decision to use bioceramic materials, specifically MTA, for sealing the perforation site is supported by literature highlighting the advantages of these biomaterials in endodontic applications [26-28]. The biocompatibility, bioactivity, and excellent sealing properties of bioceramics make them ideal for perforation repair [29, 30]. The use of the MAP One carrier (Maillefer, Dentsply, Switzerland) for MTA placement allowed for precise application in the confined space of the MB2 canal, demonstrating the importance of specialized delivery systems in complex cases [31]. The goal of a perforation repair is to mechanically and biologically seal the communication between the periradicular tissues and the access cavity space using a biocompatible material that promotes a favorable tissue healing response [32]. In the present case, the postoperative radiograph showed that this sealing had been achieved, although there was some extrusion of the material into the tissues (Figure 3B). However, MTA has been shown to have minimum adverse effects on hard tissue, and this was confirmed in this case [27, 33]. The decision to seal the coronal portions of the mesial canals with MTA and a glass ionomer overlay provides additional protection against potential reinfection. This protection is particularly relevant in taurodontic teeth, where the enlarged pulp chamber may increase the risk of coronal leakage [34]. The warm vertical compaction technique with AH-Plus sealer used for obturation of palatal and distobuccal canals is well-suited for the irregular anatomy of a taurodontic tooth, allowing for better adaptation of the filling material to the canal walls [35].

The 12-month follow-up appointment scheduled for this case is crucial for assessing the long-term success of the treatment. Factors such as the resolution of periapical pathology, absence of clinical symptoms, and maintenance of tooth function will be key indicators of treatment success. This case report underscores the importance of thorough preoperative assessment, including careful radiographic analysis, in identifying anatomical variations that may complicate endodontic treatment. The successful management of the perforation in this hypertaurodont tooth demonstrates that with appropriate techniques and materials, even complex cases can be treated effectively.

Conclusion

This case report illustrates that while taurodontism, particularly hypertaurodontism, presents significant challenges in endodontic treatment, these can be overcome through careful planning, the use of advanced imaging and magnification techniques, and the application of contemporary endodontic materials and methods. The successful management of root perforation, in this case, provides valuable insights for clinicians facing similar complex scenarios in endodontic practice.

Acknowledgments
The authors would like to thank Mashhad University of Medical Sciences for the support.

Conflict of interest
None.

Funding support
None.

Author contributions
Conceptualization: AC, Methodology: AC/MF/PS, Formal analysis and investigation: AC/PS, Writing-original draft preparation: AC/MF/PS, Writing-review and editing: AC/MF/MZ/PS, Supervision: MF/MZ. All authors read and approved the final manuscript.

References

1. Bafna Y, Kambalimath H, Khandelwal V, Nayak P. Taurodontism in deciduous molars. BMJ Case Rep. 2013;2013:bcr2013010079.
2. Mohan RPS, Verma S, Agarwal N, Singh U. Case Report: Taurodontism. BMJ Case Reports. 2013;2013.
3. Mohammadi M, Zarei M. Endodontic Management of a Mandibular Second Premolar with Three Root Canals and Taurodontism: A Case Report. Iranian Endodontic Journal. 2024;19(3):228.
4. Mokhtari H, Niknami M, Zand V. Managing a mandibular second premolar with three-canal and taurodontism: a case report. Iran Endod J. 2013;8(1):25.
5. Toure B, Kane A, Sarr M, Wone M, Fall F. Prevalence of taurodontism at the level of the molar in the black Senegalese population 15 to 19 years of age. Odontostomatol Trop. 2000;23(89):36-9.
6. Mangion JJ. Two cases of taurodontism in modern human jaws. 1962.
7. Witkop Jr CJ, Keenan KM, Červenka J, Jaspers MT, Opitz JM, Reynolds JF, Gorlin RJ. Taurodontism: an anomaly of teeth reflecting disruptive developmental homeostasis. Am J Med Genet. 1988;31(S4):85-97.
8. Joseph M. Endodontic treatment in three taurodontic teeth associated with 48, XXXY Klinefelter syndrome: a review and case report. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2008;105(5):670-7.
9. Sert S, Bayırlı G. Taurodontism in six molars: a case report. J Endod. 2004;30(8):601-2.
10. MacDonald-Jankowski D, Li T. Taurodontism in a young adult Chinese population. Dentomaxillofacial Radiology. 1993;22(3):140-4.
11. Rao A, Arathi R. Taurodontism of deciduous and permanent molars: report of two cases. J Indian Soc Pedod Prev Dent. 2006;24(1):42-4.
12. Jamshidi D, Tofangchiha M, Pozve NJ, Mohammadpour M, Nouri B, Hosseinzadeh K. Prevalence of taurodont molars in a selected Iranian adult population. Iran Endod J. 2017;12(3):282.
13. Shaw JM. Taurodont teeth in South African races. J Anat. 1928;62(Pt 4):476.
14. Shifman A, Chanannel I. Prevalence of taurodontism found in radiographic dental examination of 1,200 young adult Israeli patients. Community dentistry and oral epidemiology. 1978;6(4):200-3.
15. Parolia A, Khosla M, Kundabala M. Endodontic management of hypo-, meso-and hypertaurodontism. Aust Endod J. 2012;38(1):36-41.
16. Chamani A, Azizi V, Karimpour S. Endodontic management of taurodontic teeth: A case series. Clin Case Rep. 2024;12(7):e9101.
17. Demiryürek EÖ, Gönülol N, Bulucu B. Endodontic treatment of a taurodontic premolar with five canals. Aust Endod J. 2013;39(2):81-4.
18. Alves de Melo PH, Machado AG, Barbosa Machado AL, Carvalho FN, de Melo JB, Jochims Schneider LF. Evaluation of Root Perforation Treatments with Mineral Trioxide Aggregate: A Retrospective Case Series Study. Iran Endod J. 2019;14(2):144-51.
19. Estrela C, Decurcio DdA, Rossi-Fedele G, Silva JA, Guedes OA, Borges ÁH. Root perforations: a review of diagnosis, prognosis and materials. Braz Oral Res. 2018;32:e73.
20. Shekarchizade N, Farhad A, Khalifezade S. The accuracy of three apex locators in determining the location of strip root perforation in different environments. Iran Endod J. 2021;16(3):184.
21. Radwan A, Kim SG. Treatment of a hypertaurodontic maxillary second molar in a patient with 10 taurodonts: a case report. J Endod. 2014;40(1):140-4.
22. Singla MG, Girdhar D, Tanwar U. Magnification in Endodontics: A review. IP Indian J Conserv Endod. 2018;3(1):1-5.
23. Mohammadi Z, Soltani MK, Shalavi S. An update on the management of endodontic biofilms using root canal irrigants and medicaments. Iran Endod J. 2014;9(2):89-97.
24. Mohammadi Z, Shalavi S, Giardino L, Palazzi F, Asgary S. Impact of Ultrasonic Activation on the Effectiveness of Sodium Hypochlorite: A Review. Iran Endod J. 2015;10(4):216-20.
25. Tsesis I, Shifman A, Kaufman AY. Taurodontism: an endodontic challenge. Report of a case. J Endod. 2003;29(5):353-5.
26. Akhavan A, Rad ES, Mehdizadeh M, Mousavi SB, Modaresi J. Radiopacity evaluation of a new root-end filling material (NREFM) with two types of radiopacifiers in comparison to pro-root MTA and Portland cement. J Isfahan Dent Sch. 2012:221-8.
27. Akhavan A, Parashos P, Razavi SM, Davoudi A, Shadmehr E. Hard tissue reaction to mineral trioxide aggregate and experimental root-end filling material in guinea pig mandibles. J Dent Sci. 2017;12(2):107-11.
28. Haghgoo R, Arfa S, Asgary S. Microleakage of CEM Cement and ProRoot MTA as Furcal Perforation Repair Materials in Primary Teeth. Iran Endod J. 2013;8(4):187-90.
29. Kakani AK, Veeramachaneni C, Majeti C, Tummala M, Khiyani L. A review on perforation repair materials. J Clin Diagn Res. 2015;9(9):ZE09.
30. Eghbal MJ, Fazlyab M, Asgary S. Repair of a strip perforation with calcium-enriched mixture cement: a case report. Iran Endod J. 2014;9(3):225-8.
31. Clauder T, SHIN SJ. Repair of perforations with MTA: clinical applications and mechanisms of action. Endod Topics. 2006;15(1):32-55.
32. Pace R, Giuliani V, Pagavino G. Mineral trioxide aggregate as repair material for furcal perforation: case series. J Endod. 2008;34(9):1130-3.
33. Rahimi S, Mokhtari H, Shahi S, Kazemi A, Asgary S, Eghbal MJ, Mesgariabbasi M, Mohajeri D. Osseous reaction to implantation of two endodontic cements: Mineral trioxide aggregate (MTA) and calcium enriched mixture (CEM). Med Oral Patol Oral Cir Bucal. 2012;17(5):e907-11.
34. Faraj BM, Mohammed HM, Mohammed KM. Coronal sealing ability of copalite varnish with different intermediate restorations as an intra-orifice barrier in endodontically treated teeth. A comparative in-vitro study. JSMC. 2013;3(2):89-95.
35. do Nascimento AC, Marques AA, Sponchiado-Júnior EC, Garcia LF, de Carvalho FM. Endodontic treatment of hypertaurodontic mandibular molar using reciprocating single-file system: A case report. The Bulletin of Tokyo Dental College. 2016;57(2):83-9.

Please cite this paper as: Chamani A, Forghani M, Zarei M, Soltaninezhad P. Innovation Management of Root Perforation in a Hypertaurodont Molar: A Case Report. Iran Endod J. 2025;20(1): e14. Doi: 10.22037/iej.v20i1.46431.