**Endodontic Management of Taurodontic Teeth: Case Reports**

**Keywords:** Anatomic variation, Cone-beam computed tomography, C-shaped canal, Root canal, Taurodontism

**Introduction**

Taurodontism is a dental anomaly with apical migration of pulp chamber floor resulting in an elongated pulp chamber with short bi/trifurcated root canals and no cementoenamel junction constriction.1 It can occur in primary or permanent dentition, unilaterally or bilaterally, and can be syndromic or non-syndromic. The anomaly is seen mostly in molars, especially second molars, but there are also reports of taurodontic premolars and anterior teeth in the literature.1-3 The exact etiology is unknown but it is assumed that a failure in the invagination of Hertwig’s epithelial sheath might be the reason.4 Taurodontism can be accompanied with other anomalies associated with Hertwig’s epithelial sheath abnormalities like C-shape configuration of root canal system or extra root canals2, 5-7 which makes the endodontic management more challenging. The purpose of this report is to represent the endodontic management of taurodontic teeth with different configurations.

**Case Presentation**

**Case 1 (A Hypertaurodontic First Molar)**

A 24-year-old systemically healthy male patient was referred to the endodontic department of … university of medical sciences from his general dentist who was unable to complete the root canal treatment of the left maxillary first molar due to its complex anatomy. In clinical examination, a temporized tooth was observed which was unresponsive to pulpoperiapical tests. Preoperative radiograph showed a taurodontic anatomy (figure 1A). In accordance with the Shifman and Chanannel classification, the tooth was classified as Hypertaurodontic (TI ≈ 50).3 With the diagnosis of previous treatment with asymptomatic apical periodontitis, the patient was scheduled for a non-surgical root canal retreatment. After a local anesthesia infiltration with 2% lidocaine and epinephrine 1:100,000 (Daroupakhsh, Tehran, Iran), the tooth was isolated with rubber dam and the access cavity was reopened with high-speed diamond round bur No. 2 (Jota AG, Rüthi, Switzerland) and continuous water spray under a dental operating microscope (Carl Zeiss, Meditec Inc., Dublin, CA, USA). The orifices were negotiated with #8 and #10 K-files (Mani Inc., Utsunomiya, Japan). Working length was determined as 18 mm for the mesiobuccal, 22 mm distobuccal, 22 mm and palatal canals by an electronic apex locator (Dempex, DEM Ltd., Barnstaple, Devon, England), respectively and confirmed with radiography (figure 1B). Chemomechanical cleaning and shaping was completed by crown-down technique with M3 rotary files (UDG, Changzhou, China) up to size 25/04 under copious irrigation with 5.25% sodium hypochlorite and normal saline, alternately. After taking cone-fitting confirmation radiograph (figure 1C), all canals were dried with sterile paper points (META, Chugbuk, South Korea) and obturated with gutta-percha (META, Chugbuk, South Korea) and AH plus sealer (Dentsply DeTrey, Konstanz, Germany) using warm vertical technique by FastFill warm obturator (Fast Fill Obturation System, Eighteeth, china). Finally, Cavit (Cavisol, Tehran, Iran) was applied as a temporary restoration (figure 1D) and the patient was referred to his dentist for permanent restoration. A follow-up visit was conducted 12 months later. Patient reported no pain or discomfort. Clinical and radiographic examination (figure 1E) showed an asymptomatic tooth with a successful endodontic treatment.

**Case 2 (A Mesotaurodontic First Molar)**

A 12-year-old systemically healthy male patient was admitted in the endodontic department of … university of medical sciences with a chief complaint of pain in the left posterior region of the lower jaw. Clinical examination, revealed a deep and extensive carious lesion in left mandibular first molar with no pain on pulpoperiapical tests. In radiographic examination a mesotaurodontic molar (TI = 30-40) with possible C-shaped anatomy was observed (figure 1A). With the diagnosis of chronic irreversible pulpitis and chronic apical periodontitis, the patient was scheduled for a root canal treatment. After mandibular nerve block with 2% lidocaine and epinephrine 1:100,000 (Daroupakhsh, Tehran, Iran), the tooth was isolated with rubber dam and an access cavity was achieved with high-speed diamond round bur No. 2 (Jota AG, Rüthi, Switzerland) and continuous water spray under a dental operating microscope (Zumax Medical Co., Suzhou New District, China). The orifices were negotiated with #8 and #10 K-files (Mani Inc., Utsunomiya, Japan). Working length was determined as 21 mm for mesial and distal canals by an electronic apex locator (Dempex, DEM Ltd., Barnstaple, Devon, England), which was confirmed radiographically (figure 1B). Cleaning and shaping were completed by crown-down technique with M3 rotary files (UDG, Changzhou, China) up to size 20/04 under active copious irrigation with 5.25% sodium hypochlorite and normal saline, alternately. After taking cone-fitting confirmation radiograph (figure 1C), all canals were dried with sterile paper points (META, Chugbuk, South Korea) and obturated with gutta-percha (META, Chugbuk, South Korea) and AH plus sealer (Dentsply DeTrey, Konstanz, Germany) using warm vertical technique by FastFill warm obturator (Fast Fill Obturation System, Eighteeth, china). Finally, Cavit (Cavisol, Tehran, Iran) was applied as a temporary restoration (figure 1D) and the patient was referred to the department of esthetic and restorative for permanent restoration. A follow-up visit was conducted 10 months later. Patient was clinically and radiographically asymptomatic (figure 1E).

**Case 3 (A Mesotaurodontic First Molar)**

A 43-year-old systemically healthy female patient was referred to the endodontic department of … university of medical sciences with a chief complaint of pain on chewing in the left posterior region of maxilla. Clinical examination, revealed a left maxillary first molar with a defective amalgam restoration which was tender on percussion. Preoperative radiograph showed a mesotaurodontic anatomy (TI = 30-40) with a poor-quality root canal therapy (figure 1A). A diagnosis of previous treatment with symptomatic apical periodontitis was made and the patient was scheduled for a non-surgical root canal retreatment. After a local anesthesia infiltration with 2% lidocaine and epinephrine 1:100,000 (Daroupakhsh, Tehran, Iran), the old restoration was removed with high-speed diamond round bur No. 2 (Jota AG, Rüthi, Switzerland) and continuous water spray. The whole treatment process was undertaken under isolation with rubber dam and a dental operating microscope (Zumax Medical Co., Suzhou New District, China). Gutta-percha was removed with chloroform (Morvabon, Tehran, Iran), gates drills No. 1, 2, 3 (Mani Inc., Utsunomiya, Japan) and M3 retreatment rotary files (UDG, Changzhou, China). Working length was determined as 16 mm for MB1 canal, 14 mm for MB2 canal, 19 mm for DB and P canals by an electronic apex locator (Dempex, DEM Ltd., Barnstaple, Devon, England) and confirmed with radiography (figure 1B). Root canals were chemomechanically prepared by crown-down technique with M3 rotary files (UDG, Changzhou, China) up to size 25/04 except for the MB2 canal which was shaped up to size 20/04 under copious irrigation with 5.25% sodium hypochlorite and normal saline, alternately. After taking cone-fitting confirmation radiograph (figure 1C), all canals were dried with sterile paper points (META, Chugbuk, South Korea) and obturated with gutta-percha (META, Chugbuk, South Korea) and AH plus sealer (Dentsply DeTrey, Konstanz, Germany) using warm vertical technique by FastFill warm obturator (Fast Fill Obturation System, Eighteeth, china). Cavit (Cavisol, Tehran, Iran) was applied as a temporary restoration (figure 1D) and the patient was referred to the department of prosthetics for permanent restoration. A follow-up visit was conducted 6 months later in which the patient reported no pain or discomfort. Clinical and radiographic examination (figure 1E) showed an asymptomatic tooth with a successful endodontic retreatment.

**Case 4 (A Hypertaurodontic Second Premolar)**

A 39-year-old systemically healthy female patient was referred to the endodontic department of … university of medical sciences with a chief complaint of pain on chewing in the left posterior region of mandible. In clinical examination, a restored left mandibular second premolar with defective margins which was tender on percussion and palpation was observed. Preoperative radiograph showed a hypertaurodontic anatomy (TI ≈ 50) with a poor-quality root canal therapy (figure 1A). A diagnosis of previous treatment with symptomatic apical periodontitis was made and the patient was scheduled for a non-surgical root canal retreatment. Local anesthesia was achieved by a mandibular nerve block with 2% lidocaine and epinephrine 1:100,000 (Daroupakhsh, Tehran, Iran). After isolation with rubber dam, the restoration was removed with high-speed diamond round bur No. 2 (Jota AG, Rüthi, Switzerland) and continuous water spray under a dental operating microscope (Zumax Medical Co., Suzhou New District, China). Gutta-percha was removed with chloroform (Morvabon, Tehran, Iran), gates drills No. 1, 2, 3 (Mani Inc., Utsunomiya, Japan) and M3 retreatment rotary files (UDG, Changzhou, China) and the root canals were negotiated with #8 and #10 K-files (Mani Inc., Utsunomiya, Japan). Working length was determined as 20 mm for all three canals by an electronic apex locator (Dempex, DEM Ltd., Barnstaple, Devon, England). Root canals were prepared by crown-down technique with M3 rotary files (UDG, Changzhou, China) up to size 25/04 under copious irrigation with 5.25% sodium hypochlorite and normal saline, alternately. After taking cone-fitting confirmation radiograph (figure 1B), all canals were dried with sterile paper points (META, Chugbuk, South Korea) and obturated with gutta-percha (META, Chugbuk, South Korea) and AH plus sealer (Dentsply DeTrey, Konstanz, Germany) using warm vertical technique by FastFill warm obturator (Fast Fill Obturation System, Eighteeth, china). Cavit (Cavisol, Tehran, Iran) was applied as a temporary restoration (figure 1C) and the patient was referred to the department of prosthetics for permanent restoration. At 6-month follow-up visit, the patient reported no pain or discomfort and was clinically and radiographically asymptomatic (figure 1D).

**Discussion**

Taurodontism is defined by apical displacement of pulp chamber floor resulting in an elongated root trunk with shortened root canals 1. Due to clinically normal shaped tooth crown, the taurodontism diagnosis is only through radiographic examination.3 Deeply located orifices, large pulp chamber and bulky pulpal tissue reduce the clinician’s visibility, making the endodontic management very challenging. According to American Association of Endodontists (AAE) guidelines, root canal management of the taurodontic tooth is of moderate difficulty.8 It’s probable etiology, which is Hertwig’s epithelial root sheath invagination failure, increases the possibility of accompanying this anomaly with other anomalies related to Hertwig’s epithelial root sheath abnormalities, such as C-shaped configuration of the root canal system and extra root(s)/root canal(s).9, 10 This makes the endodontic management of a taurodontic tooth even more challenging. Parupalli *et al.*11 suggested that the most difficult stage during root canal treatment of a taurodontic tooth is instrumentation. Deeply located root canal orifices and short root canals cause only the apical part of the instrument to be in contact with the canal walls. Inadequate instrumentation leads to incomplete cleaning and shaping followed by inadequate obturation and poor apical sealing which hinders long term treatment success. Magnification and illumination plus careful exploring the pulp chamber floor with a DG-16 explorer, troughing, dying and champagne test may be of in locating the orifices.11, 12 Irrigation with NaOCl is beneficial not only in extirpation of bulky pulpal tissue in the chamber, but also for improving the cleaning process of the complex root canal system. Especially, when there are accompanied anomalies e.g., C-type anatomy. Because of the thin dentinal walls in such cases, it is recommended to focus more on debridement with cautious active irrigation with NaOCl rather than mechanical shaping in order to avoid strip perforations and other iatrogenic accidents.6, 13 As in the present study, the preparation size in the second mesiobuccal root canal in Case No. 3 and the C-shaped root canal system in Case No. 2 did not exceed the size of 20/04. In order to improve the 3D filling the complex root canal system of taurodontic teeth, thermomechanical obturation techniques are recommended 14. Warm vertical compaction followed by a proper restoration with adequate coronal seal would improve the treatment outcome.

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