

Multiple taurodontism: the challenge of endodontic treatment

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Abstract: This article describe a rare case of multiple taurodontism involving all molars in a 17-year-old male. Volumetric cone-beam computed tomography was used to investigate internal and external root morphology, including that of a maxillary first molar which required endodontic treatment and retreatment. Medical history was not contributory; however, Klinefelter syndrome was the diagnostic hypothesis in this case. (*J Oral Sci* 52, 653-658, 2010)

Keywords: taurodontism; pulp chamber; endodontic treatment; Klinefelter syndrome.

Introduction

Dental anomalies are formative defects caused by genetic disturbances during tooth morphogenesis. Taurodontism was identified in the teeth of Neanderthal specimens and, for a time, was thought to be absent in modern populations (1,2). Although the condition was first described by Gorjanovic-Kramberger in 1908, the term taurodontism was proposed by Sir Arthur Keith in 1913 to describe the "bull-like" condition of the teeth (3).

Taurodontism leads to constriction of the cemento-enamel junction, which results in vertically elongated pulp chambers, apical displacement of the pulpal floor, and bi- or trifurcation of the root (2,4,5). This trait can be seen in permanent and primary teeth, in a single tooth, or in several molars in the same quadrant, and can be unilateral or bilateral (1,4). Taurodontism is defined as a change in

tooth shape caused by failure of the Hertwig's epithelial sheath diaphragm to invaginate at the proper horizontal level. It has also been suggested that taurodontism is genetically transmitted and that it is associated with various syndromes (6-11).

The condition is classified as hypo-, meso-, or hyper-taurodontism, based on the degree of apical displacement of the pulp chamber floor (2). Hypotaurodontism is the least pronounced form, in which the pulp chamber is enlarged; mesotaurodontism is the moderate form, in which the tooth roots are divided only at the middle third; and hypertaurodontism is the most severe form, in which bifurcation or trifurcation occurs near the root apices (2).

Treatment of dental anomalies is a potential endodontic challenge. Taurodontism complicates endodontic procedures due to irregular tooth morphology, which may disturb the location of the root orifices, thereby increasing the difficulty of instrumentation and obturation. The number of root canals varies, with some reports describing 5 to 6 canals (1,3). Improvements in image quality have aided in the analysis of root and canal morphology, particularly with respect to canal identification and length, and have also enhanced postoperative evaluation of endodontic treatment (12). Computerized tomography can be useful for the diagnosis and treatment of taurodontism because the taurodontic tooth roots can be visualized separately (13).

There are few reports of multiple taurodontism not related to syndromes (14). We report a rare case of multiple taurodontism diagnosed with the aid of volumetric tomography and highlight the difficulties of conventional treatment and retreatment of a left maxillary first molar.

Case Report

The present report was approved by the institutional

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ethics committee of Positivo University. A 17-year-old male was referred by his dentist to the Dental School of Positivo University for endodontic treatment of the left maxillary first molar. Contributory diseases were not reported, except

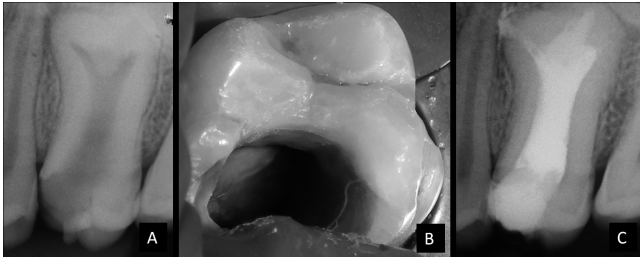


Fig. 1 A: Initial periapical radiograph shows the maxillary left first molar with extensive carious lesion and taurodontism; B: Endodontic access view; C: Final radiograph.



Fig. 2 Panoramic view on cone-beam computed tomography after endodontic treatment shows taurodontism of varying severity in all upper and lower molars.



Fig. 3 Maxillary axial view on cone-beam computed tomography.

for poor performance at school, which resulted in a 5-year period of non-attendance. On oral and periapical radiography, a mesio-occlusal carious lesion was found on the left maxillary first molar, with endodontic involvement. A vitality test of the tooth was negative, and a diagnosis of pulp necrosis was made. A periapical radiograph revealed hypertaurodontism (Fig. 1A).

Endodontic access to the cavity was prepared on the occlusal surface. A huge pulp chamber was found, but the root furcation was difficult to identify (Fig. 1B). At the furcation area, palatal, mesiobuccal, and distobuccal canal orifices were observed. Pulp extirpation was performed, and the canal was thoroughly debrided by irrigation with 5 ml of 2.5% sodium hypochlorite solution. The distobuccal canal was difficult to negotiate. The root canal was prepared by using crown-down technique with Profile 0.04 instruments (Dentsply-Maillefer, Ballaigues, Switzerland) up to size #45, in all canals. However, cleaning and shaping of the distobuccal canal remained difficult due to loss of working length. A final irrigation with 17% EDTA was performed. Thermomechanical root canal obturation was performed (Gutta Condensers, Dentsply-Maillefer) with AH Plus cement (Dentsply-Maillefer). Final radiographic analysis showed a shorter distobuccal root canal obturation (Fig. 1C). All endodontic treatment was performed in a single session.

Due to obturation failure at the distobuccal root and the expectation that other teeth would also present with taurodontism, cone-beam computed tomography (CBCT) was requested. Axial, coronal, and sagittal images were retrieved from CBCT analysis (i-CAT, Imaging Sciences International, Hatfield, PA, USA). The CBCT unit in this study used a 14-bit grayscale and had a voxel size of 0.2 mm. After the initial analysis, CBCT revealed taurodontism in all upper and lower molars (Fig. 2). Because multiple taurodontism is associated with several syndromes, the patient was referred to a medical doctor. After clinical examination, the physician advised that the patient undergo genetic testing; however, this was declined by the patient's parents.

All molars were studied and classified according to the taurodontic classification; severity varied (2). In addition, the number of roots and root canals was also determined (Figs. 3 and 4). Table 1 shows the internal and external morphology of the molars. Figure 5 shows a CBCT image of the left maxillary first molar (Fig. 5A) and the 3-dimensional reconstruction (Fig. 5B). The roots of this tooth were measured (Figs. 6A and 6B), which led to the decision to attempt endodontic retreatment.

This anatomic variation was a challenge, especially in a case of retreatment. The endodontic filling was difficult

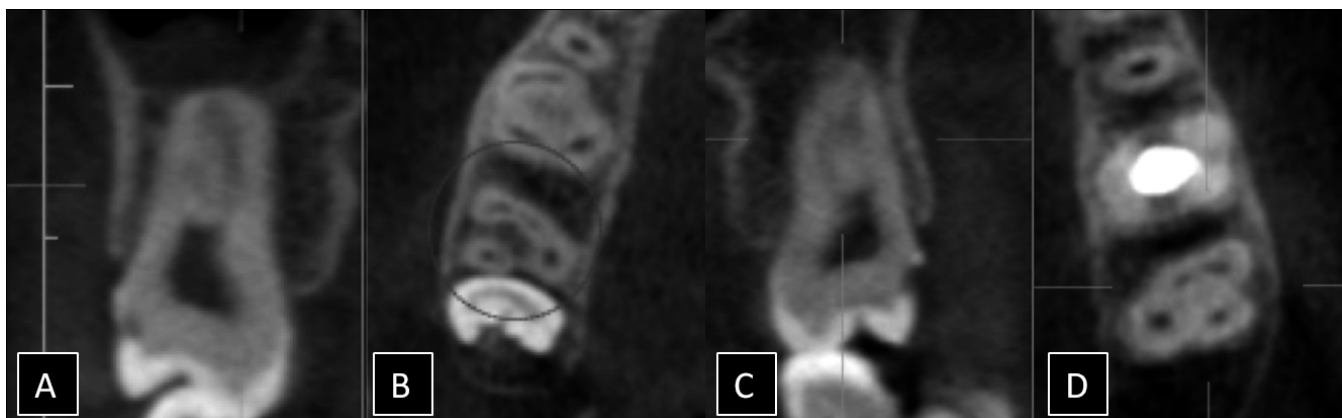


Fig. 4 A and B: Transverse and axial cuts on cone-beam computed tomography show the right maxillary second molar with 2 canals at the mesial root. C and D: Transverse and axial cuts on cone-beam computed tomography show the left maxillary second molar with 2 canals at the mesial root.

Table 1 Classification and number of roots and root canals in taurodontic molars

Tooth no.	Taurodontic classification	No. of roots	No. of canals
16	hyper-	3	3
17	hypo-	3	4 (2 mesiobuccal)
26	hyper-	3	3
27	hypo-	3	4 (2 mesiobuccal)
46	meso-	3	3
47	hypo-	3	3
36	meso-	3	3
37	hypo-	3	3

16 = right maxillary first molar, 17 = right maxillary second molar, 26 = left maxillary first molar, 27 = left maxillary second molar, 46 = right mandibular first molar, 47 = right mandibular second molar, 36 = left mandibular first molar, 37 = left mandibular second molar

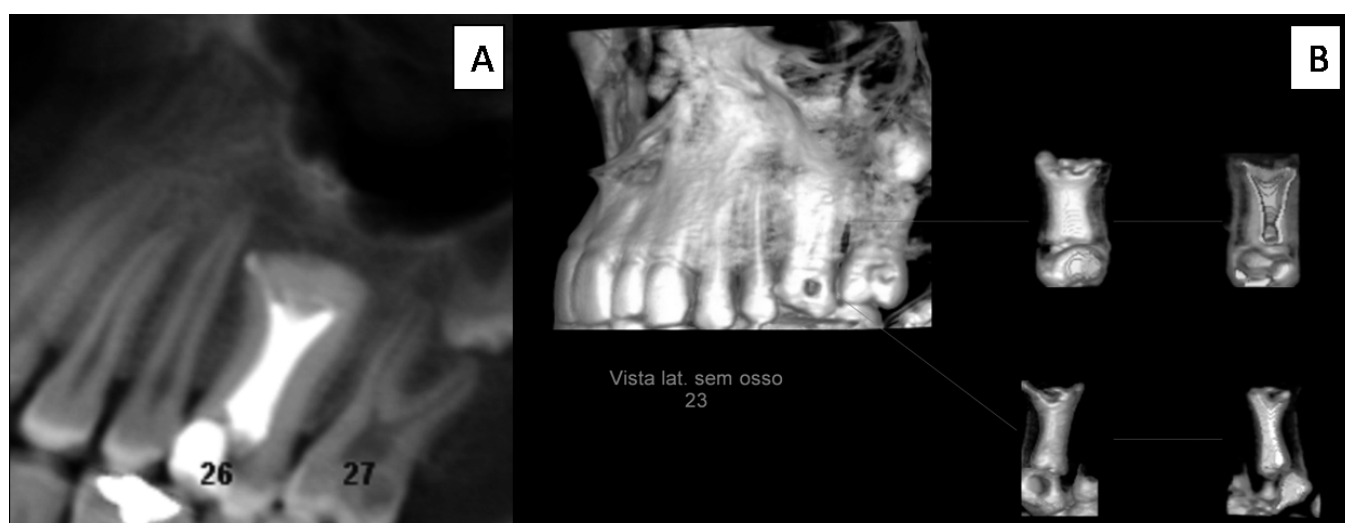


Fig. 5 Sagittal view (A) and 3-dimensional reconstruction (B) of the left maxillary first molar (hypertaurodontism). Partial root canal filling is visible.

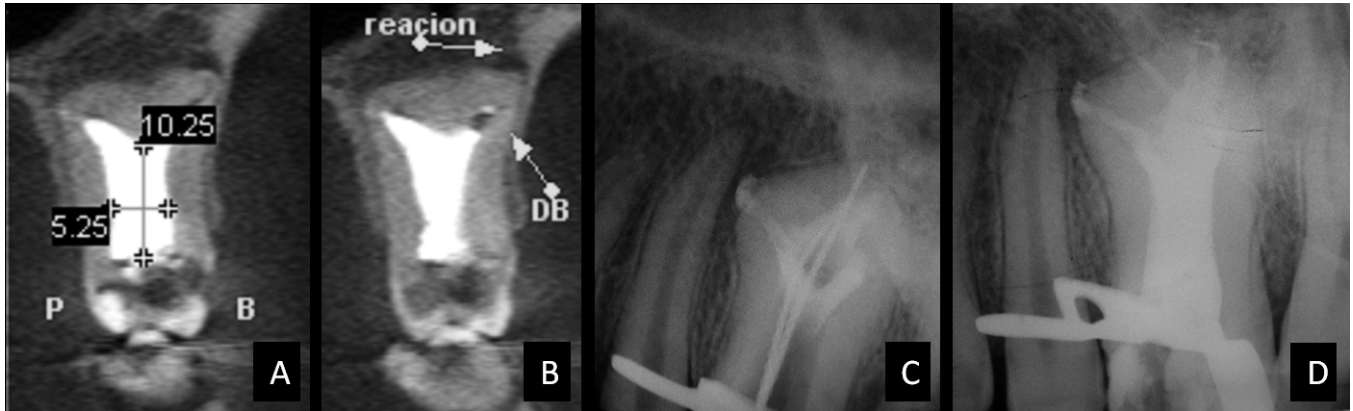


Fig. 6 A and B: Transverse cuts on cone-beam computed tomography show partial endodontic filling and periapical lesion at the distobuccal apex; C and D: Periapical radiographs show the results of endodontic retreatment..

to remove and, as before, working length could not be established in the distobuccal root canal. The main reason for this clinical difficulty was that the apical third of the distobuccal root was calcified, and the apical trifurcation denied the access necessary to establish working length and perform subsequent total cleaning and shaping of the root canal, even though the CBCT image clearly showed the distance required to complete the instrumentation. The crown-down technique was again performed with the Profile system (Dentsply-Maillefer), using files #90, #60, and #45 (Fig. 6C). Size #60 was used as the master apical file in all canals. Then, a final irrigation with 5 ml of 17% EDTA was performed, and a calcium hydroxide dressing was inserted and kept in place for 15 days. The tooth remained asymptomatic during this period, after which thermomechanical root filling was performed (Gutta Condensers, Dentsply-Maillefer), also using AH Plus cement (Dentsply-Maillefer) (Fig. 6D). The results of the endodontic retreatment showed that the distobuccal root canal obturation was still shorter; however, the palatal root filling was better than it had been after the initial treatment.

Discussion

Taurodontism occurs in 2.5% to 3.5% of chromosomally normal Caucasians. Usually, it is an isolated anomaly, but can occur in several well-known syndromes, due to alterations of the sex chromosomes. These syndromes include Klinefelter syndrome (5) and trisomy 21, or Down syndrome (9). Taurodontism is more strongly associated with syndromes involving an ectodermic defect (15).

Endodontic treatment of a taurodontic tooth requires special management because the tooth morphology can make it difficult to identify the location of the orifice.

Thus, endodontic treatment may be complicated, especially the cleaning and shaping of the root canals, and root canal obturation, as was the case with our patient, in whom we observed tri- and bifurcated roots at a low level. The number of root canals in taurodontic teeth varies. Mandibular molars with 5 canals and maxillary molars with 4 or 5 canals have been reported (3,7). In this study, the mandibular molars and the maxillary first molars each had 3 roots and 3 canals. Maxillary second molars each had 3 roots and 4 canals, with 2 mesiobuccal canals. Hypertaurodontism was observed in maxillary first molars, mesotaurodontism in mandibular first molars, and hypotaurodontism in both maxillary and mandibular second molars.

Multiple taurodontism, as in this case, probably indicates the presence of an unknown genetic factor. However, the patient did not present with genetic signs indicating alterations in sex chromosomes. Nevertheless, the 5-year gap in his education and the presence of multiple taurodontism suggest a genetic etiology. Because Klinefelter syndrome sometimes results in only mild physical manifestations that may go unnoticed, we consider it the main diagnostic hypothesis for this patient. Klinefelter syndrome is a form of male hypogonadism resulting from the presence of either 2 or more X chromosomes or 1 or more Y chromosomes. It is the most common chromosomal abnormality in humans, with an incidence of 1 in 500 live births (4, XXY variant), (16) and is the leading cause of reduced spermatogenesis, androgen deficiency, and male infertility. Because physical testicular abnormalities do not develop before early puberty, many cases remain undiagnosed. Before puberty, a child with Klinefelter syndrome may not differ in physical appearance from a healthy prepubertal boy. Androgen deficiency leads to

physical manifestations such as increased leg length, an arm span greater than height, sparse or absent facial and body hair, decreased muscle mass, and feminine distribution of adipose tissue, including gynecomastia (4). Taurodontism is one of many dentofacial manifestations of Klinefelter syndrome and is detectable before puberty. Identification of patients with multiple taurodontic teeth could lead to early recognition of a systemic disorder and improve quality of life. In our patient, a final diagnosis was not possible because the patient's parents declined genetic testing.

Finally, high-quality diagnostic radiographs are very important during the endodontic treatment of such teeth. CBCT is a relatively new diagnostic imaging modality that has been used in endodontics for effective evaluation of root canal morphology. (17) It has been important in locating and identifying root canals, mainly when anatomic variations and difficulties are found (18,19). However, in this case, CBCT did not reduce the difficulty of endodontic retreatment.

There are many factors associated with treatment failure and retreatment. Overfilling the canal space seems to be much less problematic than incomplete or poor obturation (20). Inadequate obturation appears to be associated with difficult or incomplete instrumentation of the root canal system, as in the present case. The lack of appropriate canal shaping only increases the clinical difficulty of subsequent cleaning and obturation procedures. Studies have reported treatment failure in patients with taurodontism, even with "all tools at hand", including good initial radiographic assessment, a well-prepared team, a rotary system, and CBCT. The endodontic treatment of a tooth with taurodontism is clearly a challenge. Even though CBCT provided detailed knowledge of the internal and external anatomy of the tooth in the present case, the clinical difficulty was high and complete filling of the distobuccal root canal was not possible. Vigorous cleaning and shaping, calcium hydroxide, and a good seal provided sufficient cleaning of the canals in this case; however, clinical and radiographic follow-up will continue, and endodontic surgery may be necessary if there are signs of periapical infection.

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