Application of cone-beam computed tomography in the analysis and management of intricate internal anatomy of hyper- and mesotaurodontic teeth

Karunakar Parupalli, Raji Viola Solomon, Basa Srinivas Karteek, Sravan Polasa

Department of Conservative Dentistry and Endodontics, Panineeya Institute of Dental Sciences and Research Centre, KNR University of Health Sciences, Telangana, India

Abstract

Developmental anomalies are marked deviations from normal size, shape, contour, and various other parameters. An understanding of these anomalies and its application has been a clinical challenge. With the advances in diagnostic technology, the field of endodontics has been evolving with new treatment protocols, which gives promising results. The aim of this article is to present a case report on tooth anomaly that is taurodontism and its management in a patient with multiple taurodont teeth. This article brings discussion on anatomical variations of the taurodont teeth and the techniques related to the endodontic treatment of the same and how it differs from normal teeth.

Keywords: Anomaly; apical displacement; bull tooth; hypertaurodontism; mesotaurodontism; taurodontism

INTRODUCTION

Taurodontism is a developmental anomaly of teeth, resulting in enlargement of the body of the tooth, which shows as large pulp chamber and small roots with the apical displacement of furcation.[1]

De Terra in 1903 was the first to report on this type of teeth in prehistoric hominids and in 1907 by Gorjanovic, Kramberger, and Aldoff, and in 1909, Pickeril identified this in the modern population. However, the term was actually coined by Sir Arthur Keith in 1913.[2]

Shaw (1928) was the first to conduct a study on this anomaly and identified three variants and named them as hypotaurodontism (moderate enlargement of the pulp chamber at the expense of the roots), mesotaurodontism (pulp is quite large and the roots short but still separate), and hypertaurodontism (prismatic or cylindrical forms where the pulp chamber nearly reaches the apex and then breaks up into two or four channels). He also gave a report that 30% of incidence exists in hybrids of Australoids and the Bush people of South Africa.[3,4]

Literature also supports the existence of these types of teeth in Eskimos, Mongoloid, and Negroid population, which is also not an uncommon feature in the modern population.[5]

Seow and Lai reported about 38.4% of 66 patients having hypodontia contained at least one taurodont tooth, most probably the mandibular first molars compared to the control group, which had only 7.5%.[5]

Bharti et al. considered the etiology of taurodont is probably due to the failure of Hertwig’s epithelial sheath to invaginate at the defined horizontal level.[6]
There are many reports on the incidence of taurodont teeth in patients with Klinefelter syndrome, but the association is not always there. Now, it is considered just an anatomical variation with the prevalence of 2.5%–11.3%.\(^{7-9}\)

Literature also gives many etiological predispositions related to as mutations, a specialized or retrograde character, an atavistic feature, X-linked trait, and familial or autosomal dominant trait.\(^{10}\)

Anomaly also has an association with several syndromes such as Klinefelter syndrome, trisomy 21 or Down’s syndrome, and certain diseases such as hypophosphatasia, tricho-dento-osseous syndrome, otodental syndrome, X-chromosome aneuploidy syndrome, XXX chromosome syndrome, XYY syndrome, hereditary ectodermal dysplasia, tricho-onycho-dental syndrome, orofacial digital syndrome, or Mohr syndrome.\(^{10}\)

Root canal treatment of taurodont tooth presents a challenge during biomechanical preparation and obturation.\(^{1-3}\)
CASE REPORT

A 23-year-old male patient reported to the department of endodontics with the chief complaint of pain arising from the upper left and lower left back tooth region.

The pain was sharp, spontaneous, sudden in onset, and continuous. Extraoral examination revealed no abnormality indicating no relation to any syndromic condition. On oral examination, there were deep carious lesions in relation to 27 and 36 with tender on percussion.

On radiographic examination, teeth showed different anatomical details such as enlarged pulp chamber and short roots. For further anatomic details, the patient was advised to take panoramic radiograph and cone-beam computed tomography (CBCT) (90KV, 5.00 mA, 8.01 s., HDX WILL by DENTRI).

On the basis of clinical and radiographic examination, the diagnosis was confirmed as symptomatic irreversible pulpitis with symptomatic apical periodontitis with mesotaurodontism in relation to 36 and hypertaurodontism in relation to 27. Treatment plan was decided as nonsurgical endodontic therapy in relation to 27 and 36.

Upon administration of 2% lignocaine with 1:100,000 epinephrine, occlusal caries was excavated, and access opening was made under rubber dam isolation using a dental operating microscope (Seiler).

Copious irrigation was done using 5% sodium hypochlorite agitated with ultrasonic (BioSonic by COLTENE, E4 ultrasonic tip by Woodpecker) to remove the pulp tissue in the elongated pulp chamber. It was noted that orifices were located at a much lower level, and careful exploration (using DG-16 explorer) was done to locate all the orifices following which working length was estimated using apex locator (ProPex Pixi, Dentsply) and confirmed radiographically (RadioVisioGraphy).

Four canals were identified at a much lower level than the usual for 27, i.e., mesiobuccal, distobuccal, mesiopalatal, and distopalatal and for 36, mesiobuccal, mesiolingual, distobuccal, and distolingual. The canals were prepared using the step-back technique up to 25 size (ISO) K-file followed by hand ProTaper F2. Calcium hydroxide dressing was given for 1 week. In the next appointment, the canals were irrigated with 5% sodium hypochlorite, saline followed by 17% EDTA, and final rinse by 2% chlorhexidine, and the master cone (size F2) radiograph was taken [Figures 1 and 2, f].

Obturation was done using lateral condensation technique for the apical region and thermoplastized gutta-percha (using Obtura II) for elongated pulp chamber using AH Plus sealer (Dentsply) under operating microscope (Seiler) [Figures 1 and 2].

DISCUSSION

Taurodont teeth always and almost show up anatomical complexity in the form of abnormal location of orifices, number of canals, etc.\(^1\)

Clinically, a taurodont appears as a normal tooth, but it is difficult to recognize as the body of the tooth lies below the alveolus. Therefore, the diagnosis of taurodontism is usually made from diagnostic radiographs. Radiographically, the pulp chamber is rectangular in appearance with an elongated body and short roots, and location of furcation is near the root apices, despite a normal crown size.\(^1\)\(^2\)\(^3\)

Shiftman and Channel advocated criteria for the identification of taurodont tooth that the ratio of distance between pulpal floor and roof (a) to the distance between root apex and the pulpal roof (b) should be ≥0.2 and the distance from point b (pulpal floor) to cementoenamel junction (CEJ) should be >2.5 mm. They classified as hypotaurodont: 20%–20.9%, mesotaurodont: 30%–39.9%, and hypertaurodont: 40%–75.9%\(^4\)\(^5\)\(^6\)\(^7\)\(^8\).\(^9\)\(^10\)\(^11\)\(^12\)\(^13\)\(^14\)\(^15\)

Taurodont teeth show enlarged pulp chamber and lack of constriction at CEJ which give a rectangular appearance to them, unlike cynodont teeth which show small pulp chamber and constriction at CEJ. Hence, the distance from the bifurcation of roots to the CEJ is greater than the occluso-cervical distance.\(^14\)\(^16\)

Although permanent mandibular molars are most commonly affected, taurodontism can be found both in primary and permanent dentition.\(^2\)\(^17\)

Endodontic therapy is reported as complicated due to alteration of canal orifice location, as suggested by Y. Schalk-van der Weide et al.\(^16\)

Hence, to better understand the internal canal aberrations, a diagnostic CBCT (90KV, 5.00 mA, 8.01 s., HDX WILL by DENTRI) was advised [Figures 1 and 2, a,b], and the details such as the number of canals, location of the orifices, and root canal configuration were clearly observed.\(^2\)

The challenges faced during the management of this case were removal of pulp tissue, complete deroofing of the pulp chamber, location of orifices, instrumentation, and obturation.

Removal of pulp tissue was difficult as there was a lot of pulp tissue in elongated pulp chamber, which required copious irrigation of 5.25% sodium hypochlorite with ultrasonic activation (BioSonic by COLTENE, E4 ultrasonic tip by Woodpecker).\(^2\)
With the conventional burs, it is difficult to remove or deroof the pulp chamber completely. Long shank bur (Mueller bur no. 191R) was used in this case to achieve the deroofing. It is almost impossible to locate the canal orifices without magnification as they are located at a much deeper level (6–8 mm from CEJ). Hence, dental operating microscope ($\times 12.5$) was used to identify all the orifices.

Instrumentation is the major problem in taurodont cases and difficult to accomplish as the pulp chamber divides into canals at a lower level with a lesser length of root canals, which mandates the instrumentation with apical part of the file.$^{[6,7,18]}$

After the instrumentation with 25 K-file, canals were instrumented with ProTaper hand files 8% taper up to F2. As there are elongated pulp chamber and short root canals, conventional obturation techniques do not work in these taurodont teeth. Hence, a modified obturation technique$^{[5-7]}$ was used, that is, the apical part was obturated with lateral condensation technique, followed by thermoplasticized gutta-percha for elongated pulp chamber. One can also use composite resin to reinforce the walls of pulp chamber when remaining dentin thickness is less.$^{[10,19]}$

There was sufficient dentin thickness, so the pulp chamber was obturated with gutta-percha. One advantage of obturation with gutta-percha in pulp chamber is easy retrievability in cases of retreatment.$^{[10]}$

Taurodont teeth offer favorable prognosis in periodontal point of view as even in case of periodontal pockets, the chances of furcation involvement would be low.$^{[18,20]}$

For the prosthetic treatment of a taurodont tooth, it has been recommended that postplacement is avoided for tooth reconstruction.$^{[14]}$

Taurodont teeth do not serve as ideal abutments for orthodontic or prosthodontic treatment because of less embedded tooth surface in alveolar bone. The lack of a cervical constriction would deprive the tooth of the buttressing effect against the excessive loading of the crown.$^{[21-23]}$

**CONCLUSION**

Taurodont teeth present an endodontic challenge as conventional methods are inappropriate for the management of these cases. Success is mainly accomplished by the use of magnification, ultrasonic irrigation along with the modified instrumentation and obturation techniques. It is essential for an endodontist to have an understanding of complexity and variations in the taurodont teeth and should also be familiar with the use of advanced equipment and armamentarium, all of which play a major role in successful management.

**Declaration of patient consent**

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

**REFERENCES**

1. Tsisis I, Shifman A, Kaufman AY. Taurodontism: An endodontic challenge. Report of a case. J Endod 2003;29:353-5.
2. Sahu YR, Jain A. Endodontic management of taurodontism in maxillary molar: A case report. Int J Sci Stud 2016;4:271-4.
3. Tyagi P, Gupta S. Bilateral taurodontism in deciduous molars: A case report. People’s J Sci Res 2010;3:21-3.
4. Rao A, Arathi R. Taurodontism of deciduous and permanent molars: Report of two cases. J Indian Soc Pedod Prev Dent 2006;24:42-4.
5. Manjunath BS, Kovuru SK. Taurodontism: A review on its etiology, prevalence and clinical considerations. J Clin Exp Dent 2010;2:e187-90.
6. Bharti R, Chandra A, Tikku AP, Wadhwani KK. “Taurodontism” an endodontic challenge: A case report. J Oral Sci 2009;51:471-4.
7. Rainir M, Mashalkar S, Saraf V. Taurodontism: A case Report. Pravara Medical Review 2013;5:22-4.
8. Hata S, Maruyama Y, Fujita Y, Mayanagi H. The dentofacial manifestations of XXXY syndrome: A case report. Int J Paediatr Dent 2001;11:138-42.
9. Jafarzadeh H, Azarpazhooh A, Mayhall JT. Taurodontism: A review of the condition and endodontic treatment challenges. Int Endod J 2008;41:375-88.
10. Prakash R, Vishnu C, Suma B, Velmurugan N, Kandaswamy D. Endodontic management of taurodontic teeth. Indian J Dent Res 2005;16:177-81.
11. Metgud S, Metgud R, Rani K. Management of a patient with a taurodont, single-rooted molars associated with multiple dental anomalies: A spiral computerized tomography evaluation. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2009;108:e81-6.
12. Casamassimo PS, Nowak AJ, Ettinger RL, Schlenker DJ. An unusual triad: microodontia, taurodontia, and dens invaginatus. Oral Surg Oral Med Oral Pathol 1978;45:107-12.
13. Goldstein E, Gottlieb MA. Taurodontism: familial tendencies demonstrated in eleven of fourteen case reports. Oral Surg Oral Med Oral Pathol 1973;36:131-44.
14. Nazari S, Mirmotelebi F. Endodontic treatment of a taurodontism tooth: Report of a case. Iran Endod J 2006;1:114-6.
15. Ruprecht A, Batniji S, el-Newehi E. The incidence of taurodontism in dental patients. Oral Surg Oral Med Oral Pathol 1987;63:743-7.
16. Schalk-van der Weide Y, Steen WH, Bosman F. Taurodontism and length of teeth in patients with oligodontia. J Oral Rehabil 1993;20:401-12.
17. Subramaniam E, Muthu M, Sivakumar N. Non-syndromic taurodontism. Pak Oral Dent J 2004; 24:2004.
18. Bell J, Civil CR, Townsend GC, Brown RH. The prevalence of taurodontism in Down’s syndrome. J Ment Defic Res 1989;33(Plt 6):467-76.
19. Shifman I, Channanel I. Prevalence of taurodontism found in radiographic dental examination of 1,200 young adult Israeli patients. Community Dent Oral Epidemiol 1978;6:200-3.
20. Radwan A, Kim SG. Treatment of a hypertaurodontic maxillary second molar in a patient with 10 taurodonts: A case report. J Endod 2014;40:140-4.
21. Sert S, Bayat G. Taurodontism in six molars: A case report. J Endod 2004;30:601-2.
22. Krishnamoorthy S, Gopikrishna V. Endodontic management of a hypertaurodontic tooth associated with 48, XXXY syndrome: A review and case report. J Conserv Dent 2015;18:265-8.
23. Simsek N, Keles A, Ocakı MS. Endodontic treatment of hypertaurodontism with multiple bilateral taurodontism. J Conserv Dent 2013;16:477-9.