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Taurodontism: An anatomical challenge to clinical endodontics

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Abstract

While considering the various developmental anomalies of tooth, taurodontism is one of the morpho-anatomical anomalies which is rarely seen. The lack of constriction at the level of cemento-enamel junction with elongated pulp chambers and apical shift of bifurcation or trifurcation of roots, gives the tooth a rectangular or cylindrical appearance. The root canal system complexity, changed configuration and sometimes, the presence of additional root canals offer a big clinical challenge while performing the endodontic therapy. Till date, most of dental practitioners are having little awareness about such condition and its endodontic management.

Therefore, this paper reviews about the details of taurodontism including its etiology, pathogenesis, diagnosis, types, categorization and difficulties produced during endodontic management along with their solutions.

Keywords: Taurodontism, Tooth anomaly, Enlarged pulp chamber, Bi-furcation, Tri-furcation, Cyanodont, Mandibular molar.

Introduction

The term taurodontism comes from the Latin term tauros, which means 'bull' and the Greek term -odus, which means 'tooth' or 'bull tooth'.[1,2] Taurodontism is the tooth anomaly showing change in the tooth shape with enlarged tooth body on the expense of roots which are reduced in size. Such cases may have enlarged pulp chamber which may reach close to the root apex and apically displaced furcation areas.[3] Sometimes, these furcal areas may be only a few millimeters above the roots apices. Permanent molar teeth are most commonly involved, but this can also affect the deciduous dentition. The occurrence may be unilaterally or bilaterally, and in any combination of teeth or quadrants.

Taurodontism was first explained by Gorjanovic - Kramberger (1908)[4] in a 70,000 year old pre-Neanderthal fossil, discovered in Kaprina, Croatia.[5] Taurodontism was very common in early humans and occurs very frequently today in Eskimos.[6,7]

Taurodontism has been seen in the dentition of modern races. The incidence of it was reported to be as high as 30% in hybrids of Australoids and the Bush people of South Africa.[8] Taurodontism has been reported in mongoloid and negroid populations.[3] It assumes that taurodontism is more prevalent than it was previously expected. In a study by Seow and Lai (1989), it was reported that 38.4% of 66 patients with hypodontia involved at least one permanent mandibular first molar with taurodontism compared to only 7.5% of a control group without hypodontia.[9]

Etiology and Pathogenesis

The etiology behind the taurodontism anomaly is supposed to be a primitive pattern, a mutation, a specialized or retrograde character, an atavistic feature, an X-linked trait, familial or an autosomal dominant trait as per various theories reported earlier. Various syndromes and genetic defects have shown their association with taurodontism but still, the real significance of it is not very clear.[10] Taurodontism occurs mostly as an isolated anomaly, but some developmental syndromes and anomalies like amelogenesis imperfecta (AI), Down's syndrome, Ectodermal dysplasia, Klinefelter syndrome, Tricho-dento-osseous syndrome, Mohr syndrome, Wolf-Hirschhorn syndrome and Lowe syndrome have shown their association with it.[11] In some rare syndromes like Williams syndrome,[12] McCune-Albright syndrome,[13] Smith-Magenis syndrome,[14] and Van der Woude syndrome[15] taurodontism has also been found.

Several theories of pathogenesis of such anamoly have also been proposed: an unusual developmental pattern, a delay in pulpal chamber calcification, Hertwig's epithelial root sheath (HERS) alteration, an odontoblastic deficiency.[16] Some authors have also supported the theory of disrupted developmental homeostasis resulting in taurodontism.[17]

Classification

Based on the relative displacement of pulp chamber floor, taurodontism can be of three types - hypotaurodontism, mesotaurodontism and hypertaurodontism (Shaw, 1928)[8] [Fig. 1 – Image showing various types of taurodontism]. Later on, Feichfnger and Rossiwall (1977) clearly confirmed that a tooth to be categorized as taurodontic tooth, the distance from the bifurcation or trifurcation of the root to the cemento-enamel junction (CEJ) should be greater than the occluso-cervical height.[18] In the current time, there are various classification systems to confirm the status of taurodontism, but a new classification as introduced by Shifman and Chanannel (1978), is the most commonly used system till date.[19]

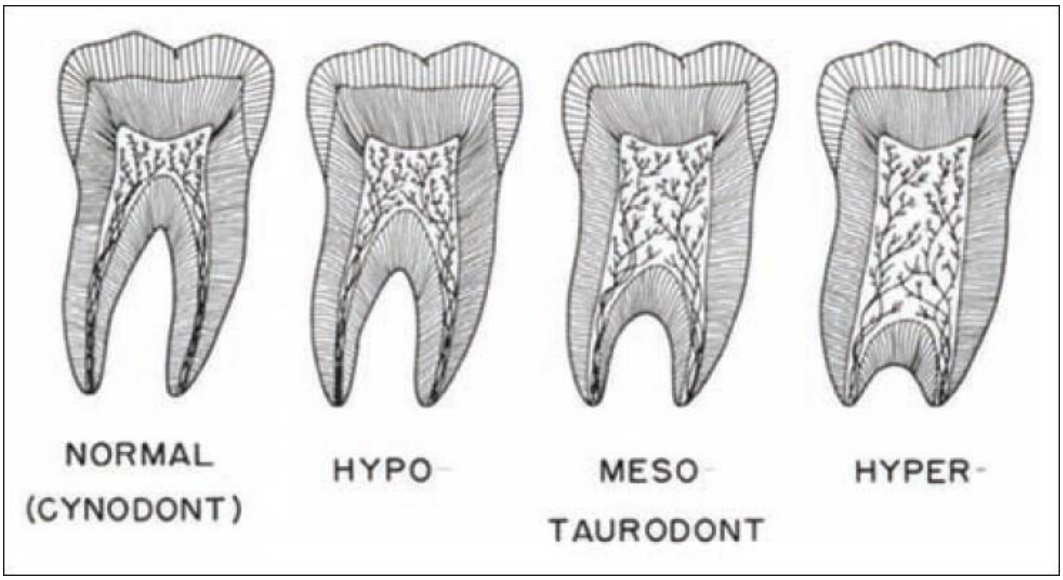


Fig. 1: Image showing various types of taurodontism

Diagnosis

Anatomic Features: There is elongated and enlarged pulp chamber having greater occluso-cervical height than normal[20,21] that results in its apical extension below the CEJ.[1,2] It also generates a rectangular shape of tooth as the CEJ constriction is less marked than that of the normal tooth. Also, the bifurcation or trifurcation of molars is apically displaced, resulting in shorter roots than normal one whilst enlarging the body of the tooth.[1,2,20,21,22] [Fig. 2: Image showing taurodontic teeth]

Fig. 2: Image showing taurodontic teeth

Clinical Features: Clinically, a taurodont seems as a normal tooth. Since the body and roots of a taurodont tooth is found to be below the alveolar margin, it is very difficult to recognize it clinically.[2,23] Therefore, the taurodontism is usually distinguished from well developed diagnostic and/or digital radiographs.[24,25]

Radiographic features: The radiographic characteristics of taurodont tooth include: Extremely large pulp chamber with a greater apico-occlusal height than normal and lacks the usual constriction at the cervical region of the teeth with exceedingly short roots and root canals,[26] location of bifurcation or trifurcation (near the root apices), despite a normal crown size[2,23,27] [Fig. 3: Radiographic image showing Taurodontic teeth]. Also, one should be very alert about diagnosing taurodontism in heavily worn molars as the taurodontism may be masked by wear-induced secondary dentine deposition.[28]

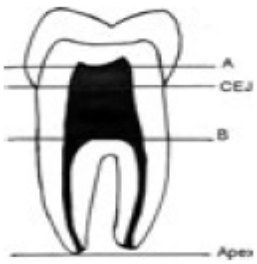
Fig. 3: Radiographic image showing Taurodontic teeth

Finally, for the endodontic management of such taurodontic tooth, it becomes very important to have high-quality diagnostic radiographs. Cone Beam Computed Tomogaphy (CBCT) is a new diagnostic imaging method that is very useful for effective evaluation of root canal morphology.[29] It has proved its importance in locating and identifying root canals, especially in case of anatomic variations and difficulties.[30,31]

Categorization: There are several schools of thoughts which differ about the extent of displacement and/or morphologic change representing taurodontism. Apart from the size of the pulp chamber and roots, it also becomes very important to consider the position of the body of the tooth in relation to the alveolar margin.[3]

Different proposed categorizations for taurodontism have been listed in **Table 1.**

Table 1: Different proposed categorizations for Taurodontism

Proposed by	Criteria	Categories	Remarks
Shaw 1928	External morphological criteria (based on the relative amount of apical displacement of the pulp chamber floor) a. Cynodont b. Hypotaurodont c. Mesotaurodont d. Hypertaurodont	Hypotaurodont: Moderate enlargement of the pulp chamber at the expense of the roots Mesotaurodont: Quite large pulp and short roots but still separate Hypertaurodont: Pulp chamber nearly reaches the apex giving prismatic or cylindrical forms and then breaks up into 2 or 4 channels Single or pyramidal root (cuneiform): usually in the lower second molar where the pulp is involving whole root without cervical constriction and open via a single wide apical foramen	First quantitative analysis of taurodontism Included second molar as a standard tooth for determining the degree of taurodontism
Keene 1966	'Taurodont Index' (related the height of the pulp chamber to the length of the longest root)	Cynodont: Index value of 0–24.9% Hypo-T: Index value of 25–49.9% Meso-T: Index value of 50–74.9% Hyper-T: Index value of 75–100%	Relative method Disadvantages: 1. Use of landmarks in biologic structures which undergo changes 2. Arbitrary selection and grading the index from 0 to 100 into 4 groups appears to be unrealistic
Shifman & Chanannel 1978	Point A: lowest point at the occlusal end of the pulp chamber Point B: highest point at the apical end of the chamber (distance from A to B)/(distance from A to the apex of the longest root) $\geq$ 0.2 Distance from B to CEJ $\geq$ 2.5 mm 	Hypo-T:20–20.9% Meso-T:30–39.9% Hyper-T: 40–75%	Advantage: overcome Keene's index problem by using radiographs of teeth excluding the reparative dentin deposition or roots which differed morphologically Disadvantage: range of measurement of 'the distance from B to the CEJ' is small and thus subjected to error

Differential diagnosis

- Certain metabolic conditions like pseudo-hypoparthyroidism, hypophosphatasia, and hypophosphatemic vitamin D-resistant and dependent rickets (Enlarged pulp chamber but with normal tooth form.[2,32,33]
- Early stages of dentinogenesis imperfecta (Appearance may resemble the large pulp chambers).[27]
- The developing molars may appear similar to taurodonts (but they differ with wide apical foramina and incompletely formed roots).[23]

Endodontic Management

Access cavity design and preparation: Access to the root canal orifices can easily obtained as the pulpal chamber floor cannot be affected by reactionary dentine formation as in normal teeth (Shifman & Buchner, 1976).[26] On the other hand, Durr et al. (1980)[24] proposed that morphology can affect the location of the orifices and can have difficulty in instrumentation and filling.

Location of canal orifice and/or additional canals: Each taurodont tooth may contain extraordinary root canals differing in shape and number. There was a case reported where a mandibular taurodont tooth had five canals, but only three of which could be instrumented till the apical end.[34] Therefore, careful exploration of the grooves between all orifices under magnification,[35] becomes very important to identify additional orifices and canals.[20]

Chemo-mechanical Preparation: Being voluminous nature of the pulp in taurodontic tooth, complete removal of the necrotic pulp should be confirmed. For this, 2.5% sodium hypochlorite has been suggested initially as an irrigant to dissolve pulp tissue completely.[5] Moreover, as proper instrumentation of the irregular root canals cannot be performed, extra efforts should be made by irrigating the canals with 2.5% sodium hypochlorite in order to dissolve as much necrotic material as possible.[36] Also, the addition of final ultrasonic irrigation may help complete pulp tissue removal.[5]

Obturation of root canal system: Proper and complete obturation of the root canal system in taurodontism is challenging. A modified obturating method has been proposed, which include combined lateral compaction in the apical region with vertical compaction of the elongated pulp chamber, using the system B device.[35] The radiographic image of an obturated taurodontic tooth has been shown in Fig. 4.

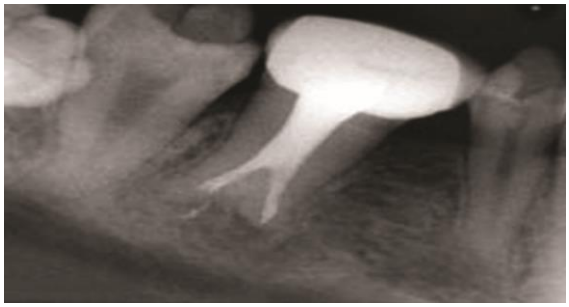


Fig. 4: Radiographic image showing obturated taurodontic tooth

Other Challenges associated with taurodontism: Intentional replantation can be another endodontic challenge related to taurodontism. Because of dilated apical region, the extraction of a taurodont tooth is quite difficult.[20] In contrast, it has also been suggested that because of its large body and little surface area embedded in the alveolus, extraction becomes less difficult as long as the roots are not very much divergent.[24]

Finally, it should also be considered that in hypertaurodontism cases (where the pulp chamber nearly reaches the apex and then breaks up into two or four channels), the vital pulpotomy will be the preferred treatment of choice rather than pulpectomy procedure.[25,26]

Post-endodontic consideration: It has been suggested that post-placement should be avoided for tooth reconstruction.[35] A taurodont tooth may not have as much stability as a cynodont when used as an abutment for either prosthetic or orthodontic purposes, since less surface area of the tooth is embedded in the alveolus.[24]

Also, there is a very interesting point to be noted that when periodontal pocketing or gingival recession occurs, the chances of furcation involvement are considerably less than those in normal teeth because taurodont teeth have to show significant periodontal destruction before furcation involvement occurs.[25,26]

Conclusion

Taurodont teeth have wide range of anatomic variations including the size and shape of pulp chambers, varying degrees of obliteration and canal complexity, apical displacement of canal orifices, and the potential for additional root canal systems. The dental practitioners should be well aware about these significant changes. While managing such tooth endodontically, careful exploration of the grooves between all orifices, particularly with magnification; ultrasonic irrigation; and a modified obturating technique are recommended.

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