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Taurodontism teeth: A literature review

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Abstract:

Taurodontism is a rare developmental dental anomaly marked by apical displacement of the pulpal floor, enlarged pulp chambers, and root bifurcation or trifurcation near the apex. Its etiology involves genetic mutations, syndromic associations, or developmental disturbances of Hertwig's epithelial root sheath. Diagnosis relies mainly on radiographic assessment, with CBCT offering superior accuracy, and indices such as Shaw's and Shifman's aiding classification. Clinically, taurodontism complicates endodontic, surgical, orthodontic, and restorative procedures and may indicate underlying systemic disorders. Early recognition and interdisciplinary planning are crucial to optimizing patient outcomes.

Keywords: Taurodontism, Dental anomalies, Hertwig's epithelial root sheath (HERS), Radiographic diagnosis

Introduction:

A tooth's development is a complicated process influenced by several variables. Thus, this process can be disturbed, and a range of abnormalities can result from infections, dietary or hormonal imbalances, genetic control flaws, or modifications to the local environment where tooth development occurs. Teeth development abnormalities can be divided into those that impact tooth number, size, form, structure, and position. Taurodontism is regarded of the most significant abnormalities in tooth morphology. Large pulp chambers with the trifurcation or bifurcation pushed apically, creating a chamber higher apically than healthy teeth and free of pang at the cemento-enamel junction (CEJ), are the hallmark of taurodontism, according to Witkop. The occlusal-cervical distance is significantly smaller than the distance between the root's trifurcation or bifurcation and the CEJ. Bi/Trifurcation of the roots, apical displacement of the pulpal floor, and vertically enlarged pulp chambers are its most distinctive features.

Taurodontism was first described by Gorjanovic-Kramberger in a pre-Neanderthal fossil found in Krapina, Croatia, in 1908. The fossil was 70,000 years old. Pickerill stated the first evidence of taurodontism in the modern human teeth in 1909, referring to the disease as "radicular dentinoma".

Arthur Keith was the first to use the term "taurodontism" in 1913. "Odontoid" means "tooth," and "taurus" means "bull" in Greek. This is because the morphology of the affected tooth resembles that of hoof-bearing animals, especially bulls.

Keith proposed in 1913 that one of the Neanderthals' distinguishing features was taurodontism. He made the argument that such taurodont teeth could not have evolved into the contemporary dentitions he dubbed "cynodonts" (dog-like teeth with normal-sized pulp chambers that are approximately located at the center of the crown and have a narrowing in the chambers' outline form at about the CEJ.

Etiology and pathogenesis:

Oral health status and its variations due to anatomical, pathological, or environmental factors remain a major concern in dentistry (Alyaseen & Aldhaher, 2024). Many explanations have been proposed to explain the genesis of taurodontism. Some of the theorized origins of taurodontism include a primitive pattern, atavistic characteristic mutation, specialized or retrograde character X-linked trait, family trait, or autosomal dominant trait. Although it can be linked to multiple developmental syndromes and abnormalities, this anomaly most commonly manifests as a single aberration (Manjunatha and Kovvuru, 2010). It has been discovered to be a component of numerous other uncommon disorders, including Down syndrome. Cleft palate, dwarfism, and other dental abnormalities, like dens invaginatus, hypodontia, amelogenesis imperfecta, microdontia, and ectodermal dysplasia, have also been related to taurodontism. Those with further uncommon syndromes, including Mohr syndrome, Van der Woude syndrome, McCune-Albright syndrome, Williams syndrome, Smith-Magenis syndrome, and Klinefelter's syndrome (Hemalatha and Attavar, 2015). Dental Practitioners may be the first to notice these conditions since many of them have oral symptoms that show up on dental x-ray as changes in the shape or chemistry. Jafarzadeh and coworker (2008). X-chromosomal aneuploidy is generally more common in people with more severe triat types (meso or hyper). According to Jayashankara et al. (2013), since the incidence of taurodontism increases with the count of X chromosomes, there may be a positive relationship between the trait's expression and the count of X chromosomes.

Regarding the pathophysiology of taurodontism, there are numerous theories:

a) The developmental pattern was atypical

b) The pulp chamber floor's calcification was postponed

c) An odontoblast reduction

d) There was a delay or incomplete fusion of the epithelial diaphragm's horizontal flaps.

e) The most widely recognized change is that which occurs in Hertwig's epithelial root sheath, which is the obvious inability of the epithelial diaphragm to invade at the normal horizontal levels. Hertwig's epithelial root sheath (HERS) is created when the inner and outer enamel epithelia fuse to form the cervical loop, and the stellate reticulum within the enamel organ vanishes after enamel has formed. The root contour is created by the HERS enclosing the dental papilla as it extends downward, as seen in Figure 1. The surrounding dental papilla mesenchyme is subsequently stimulated by HERS to develop into odontoblasts and release the root dentin. The subdivision

establishes whether a tooth has roots or not (Bains et al., 2010; Hemalatha and Attavar, 2015; Chetty et al., 2021).

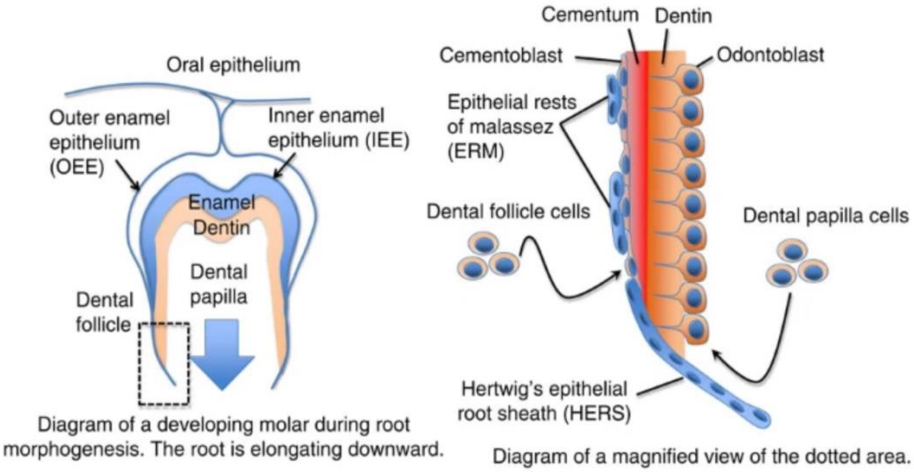

Figure 1: Root morphogenesis of a developing molar (Ono *et al*., 2016).

Numerous transcription and growth factors were expressed by HERS. A delay or failure of HERS to invade the mesenchyme results in the apical displacement of the root furcation and subsequently in the development of taurodontism. The development of teeth, especially the formation of the roots, depends critically on the ectodysplasin A (EDA)/EDA receptor signaling system. As illustrated in Figure 2, the Eda pathway component Edar is expressed during root development with a highly selective expression in the developing HERS. The upper second molars are the most susceptible to the loss of this pathway, which results in a taurodont phenotype when Eda or Edar is lost.

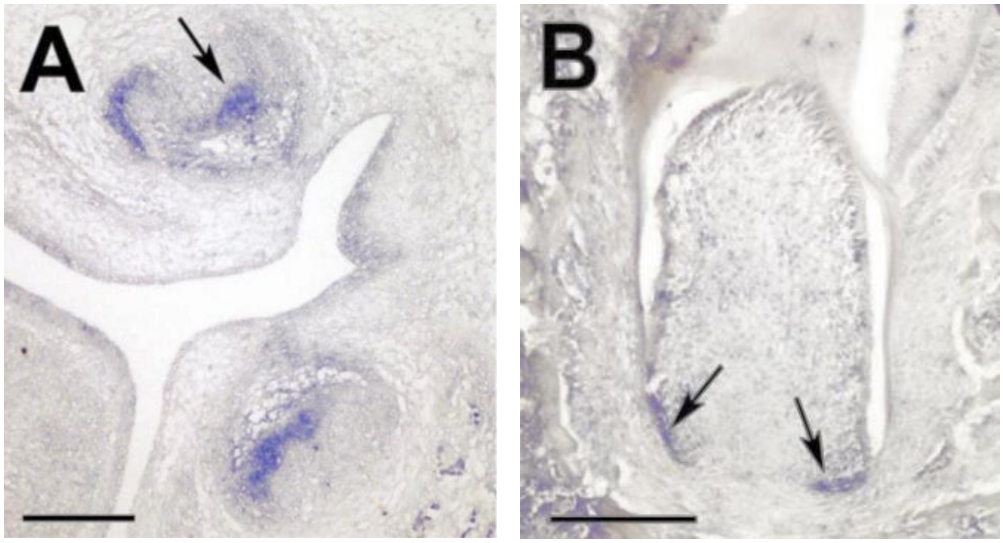

Figure 2: Edar expression in Hertwig's epithelial root sheath (HERS) during root development. (A) late cap stage. (B) At the postnatal stage, Edar is expressed in the HERS (arrows) at the apical end of the tooth (Fons Romero *et al*., 2017).

Given that Edar was expressed in the HERS, it is possible that the lack of active Eda signaling changed another signaling factor that the HERS produces. One potential candidate is a member of the Wnt signaling system; mice and patients with mutations in Wnt10a have a taurodont phenotype, and deletion of Wnt10a results in cusp pattern deficits and hypodontia, which are similar to many features of the phenotype of the Eda pathway mutant (Fons Romero et al., 2017).

At different phases of tooth formation, Wnt signaling is essential. Beginning in the embryonic stage, Wnt signaling activity is seen in the dental epithelium and mesenchyme. An adequate amount of Wnt signaling is necessary for the normal development of tooth roots and periodontal tissue after birth. (Tokavanich and colleagues, 2021).

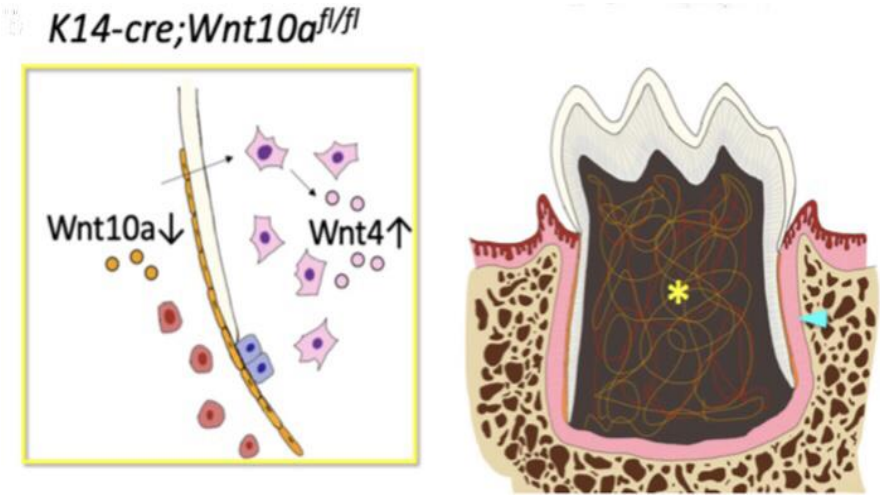

Figure 3: Wnt signaling loss in the phenotype of epithelial cells. The yellow box shows that Wnt4 expression in the dental papilla is increased when Wnt10a in HERS is deleted; a yellow asterisk indicates the absence of a pulpal floor chamber, and a blue arrowhead indicates short and thin root dentin (Tokavanich et al., 2021).

Diagnosis and classification:

Clinical identification of taurodont teeth is impossible since their roots and CEJ are situated beneath the alveolar margin; instead, diagnostic radiographs are typically used to diagnose taurodontism (Azzaldeen et al., 2016). Established on the proportional displacement of the pulp chamber floor apically, Shaw (1928) divided this disorder into three categories: hypotaurodontism, mesotaurodontism, and hypertaurodontism as shown in Table 1. Due to this arbitrary and subjective classification, normal teeth were mistakenly identified as having this abnormality, see the figure below (Dineshshankar et al., 2014). So, Advances in diagnostic approaches, whether radiographic or biochemical, help clinicians identify variations such as taurodontism at an early stage (Husham & T.A.M.H.O., 2024).

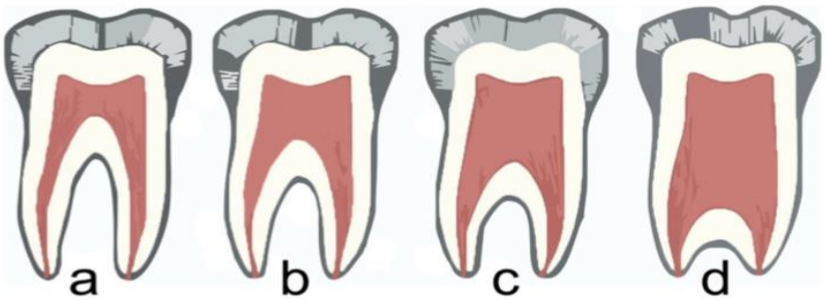

Figure 4: Teeth with taurodontism: Cynodont, hypotaurodontism, mesotaurodontism, and hypertaurodontism are shown in (A), (B), and (C), respectively (Chetty *et al*., 2021).

Table 1: Classification of Taurodontism (Azzaldeen *et al*., 2016).

Type	Severity	Definition
Hypotaurodontism	Mild	Moderate pulp chamber elongation at the root's expense.
Mesotaurodontism	Moderate	Short roots but still distinct, and the moderate pulp is very substantial.
Hypertaurodontism	Severe	Severe prismatic or cylindrical shapes in which the pulp chamber splits into two or four channels after almost reaching the peak.

This imprecise and subjective classification frequently results in taurodontism being misdiagnosed. It is not considered an objective analysis, although it is desired (Jafarzadeh et al., 2008). Instead of depending on a subjective visual radiography assessment, it is crucial to use metric analysis to identify taurodontism. Teeth with attrition and wear-induced secondary dentine formation in the pulp chambers may be misinterpreted as having taurodontism. Therefore, in cases of extreme attrition, taurodontism should be interpreted with caution (Azzaldeen et al., 2016).

Table 2: Keene (1966) classified the pulp chamber's height according to the longest root's length in this order: (Attavar and Hemalatha, 2015).

Type	Index value
Cynodont	0-24.9%
Hypo-taurodontism	25-49.9%
Meso-taurodontism	50-74.9%
Hyper-taurodontism	75-100%

Since the pulp chamber varies as age increases and the root length is susceptible to variations, like external root resorption, the use of landmarks that are regarded as biologically variable structures is a drawback of the Keene index (Azzaldeen et al., 2016). As seen in Figure 5, Blumberg et al.'s 1971 biometric study included five characteristics to identify taurodontism without specifically referring to any categorization. The author believed that taurodontism could not be strictly classified because it is a continual oddity.

The first variable: The mesio-distal distance between the crown's contact points.

The second variable: The mesio-distal dimension, which is measured at the CEJ.
Third Variable: The distance measured perpendicularly from the pulp chamber floor's highest point to the baseline.
Fourth Variable: The distance measured perpendicularly between the longest root's apex and baseline.
Fifth Variable: The distance measured perpendicularly from the pulp chamber roof's lowest point to the baseline (Benzahya, 2015).

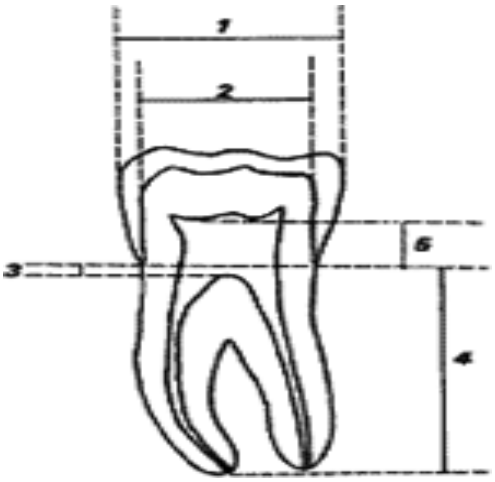

Figure 5: taurodontism classification by Blumberg (Jafarzadeh *et al*., 2008).

The distance between the cemento-enamel junction and the root's bifurcation or trifurcation should be larger than the occluso-cervical distance; this fact was discovered by Feichfnger and Rossiwall in 1977(Bains et al., 2010). Despite the fact that there are numerous classification schemes for assessing the severity of taurodontism, the most popular one to date was put forth by Shifman and Chanannel in 1978 (Dineshshankar et al., 2014). They created a radiographic technique to assess taurodontism, employ objective measures and variables, and provide a schematic representation of their anatomical features in Figure 6.

Two variables were measured: The height of the pulp chamber between the highest point of the floor and the lowest point of the roof is variable 1, and the distance between the lowest roof point of the pulp chamber and the apex of the longest root is variable 2.

Additionally, Shipman and Chanannel created the "taurodont index" (TI), which is determined by dividing the length of the longest root by the height of the pulp chamber. TI= Variable 1 x Variable 2x100

Table 3: According to increasing severity, the following taurodontism symptoms are displayed:(Einy et al.,2022).

Type	TI value
hypotaurodontism	20-30
mesotaurodontism	30-40
hypertarodontism	40-70

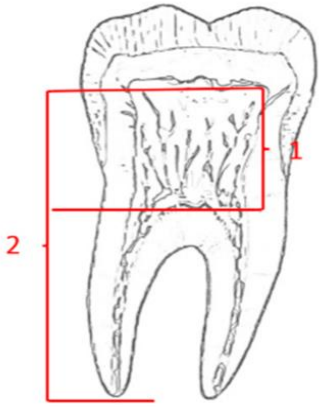

Figure 6: Shifman and Chanannel (1978) variables (Einy *et al*., 2022).

The crown-body length (CB) and root length (R) ratios were calculated using the biometric method recommended by Seow and Lai to diagnose taurodontism on panoramic radiographs that was in 1989. According to this ratio, teeth with a CB: R ratio between 1.10 and 1.29 were classified as hypotaurodontic, while normal teeth ratio less than 1.10. As seen in the image below, mesotaurodont teeth exhibited a ratio of 1.30 to 2.00, while hypertaurodontic teeth had a ratio greater than 2.0 (Benzahya, 2015; Azzaldeen et al., 2016).

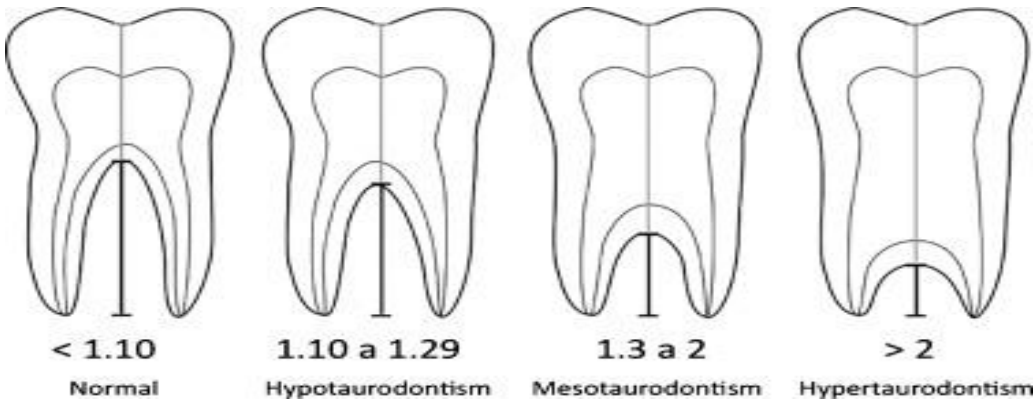

Figure 7: Classification based on crown body-root ratio (Gomes *et al.,* 2012).

In addition to all of these techniques, Tulensalo and associates discovered a straightforward method of evaluating taurodontism using an orthopantomogram (OPG) in 1989. This method involves measuring the distance between the highest point of the pulp chamber floor and the baseline, which is a line that connects the mesial and distal points of the CEJ. When such a distance was 3.5 mm or more, a tooth was identified as taurodontic. They came to the conclusion that this approach is trustworthy for evaluating taurodontism in a developing dentition in epidemiological studies (Jafarzadeh et al., 2008; Benzahya, 2015). Figures 8 and 9 illustrate the precise classification of the primary taurodont teeth using Daito's approach. Because it can be applied in situations where the root is a or where the root growth is not complete, this technique helps assess deciduous molars (Lim et al., 2020).

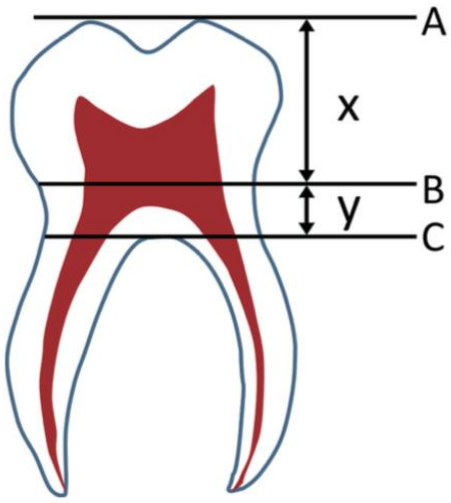

Figure 8: Identification of a taurodontism using the standards Daito outlined. x is the vertical distance between A and B, y is the vertical distance between B and C, (A) is the crown's highest portion, (B) is the CEJ, and (C) is the furcation (Lim *et al*., 2020).

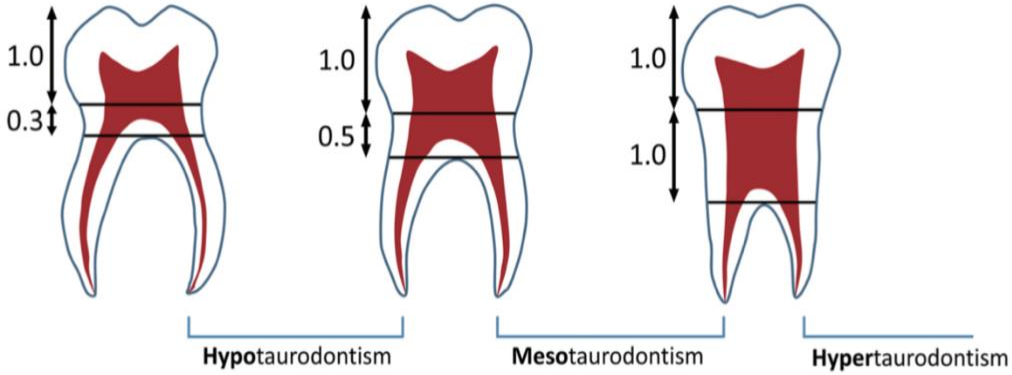

Figure 9: Using Daito's technique, taurodontic deciduous teeth are categorized based on their severity (Lim *et al*., 2020).

Clinical and radiographical features

Both primary and permanent dentition molars and premolars are impacted by taurodontism. As seen in Figure 10, it might impact one tooth or several teeth, unilaterally or bilaterally. According to Gomes et al. (2012), the teeth themselves don't exhibit any clear or unusual morphological or clinical traits. Radiographs provide the best visual representation of this condition's peculiar character. Instead of tapering toward the roots, the involved teeth usually have a rectangular shape. With a somewhat higher apicoocclusal height than usual, the pulp chamber was incredibly big. Furthermore, the roots are too short and the pulp is not constricted at the tooth cervix. Just a few millimeters above the root apices may be the bifurcation or trifurcation. This radiography image is distinctive and eye-catching. Metric analysis was used to diagnose a characteristic that was overlooked in certain radiographs during clinical evaluation. Since

taurodontism is a risk factor for orthodontic therapy and a complicating factor for endodontic treatment, therefore, metric analysis is clinically required to identify taurodontism, even in its most moderate form, instead of depending just on visual radiography evaluation. Additionally, it might help identify additional related medical disorders (HegDe et al., 2013; Sivapathasundharam, 2020). Figure 10: Taurodontism could affect many bilateral teeth in both jaws and impacts both the permanent and primary teeth (Bharath et al., 2015).

Figure 10: Taurodontism could affect many bilateral teeth in both jaws and impacts both the permanent and primary teeth (Bharath et al., 2015).

Differential diagnosis:

Although the pulp chamber may be expanded in metabolic disorders such as pseudohypoparathyroidism, hypophosphatasia, and hypophosphatemic vitamin D-resistant and dependent rickets, the teeth nonetheless have a comparatively typical shape. The look may mimic the vast pulp chambers of dentinogenesis imperfecta, especially in the early stages. Furthermore, growing molars may look like taurodonts in appearance; nevertheless, partially developed roots and broad apical foramina can additionally be taken into consideration (ML and Bhayya, 2018).

Prevalence:

In certain populations, various taurodontisms spread among the population. Globally, research on the prevalence of taurodontism has found that it ranges from 2 to 48%. The variety of social systems and ethnic differences, particularly in expanding populations, may be the cause of these disparities in prevalence. According to the research, the prevalence of taurodontism varies between males and females, maxillary and mandibular teeth, and premolar and molar teeth. Turkey, Senegal, and China were found to have the highest prevalence. Racial and genetic variations, sample selection, and research methods could all be responsible for this heterogeneity (Shah et al., 2015; Benzahya, 2015).

Clinical considerations:

Many dental treatments of taurodontism teeth, such as extraction, endodontic, orthodontic, and prosthetic treatments, will become challenging. In order to avoid complex treatment through early detection, we should take care of these teeth in a preventive manner. Therefore, diagnostic X-rays should be given a high priority. In addition to understanding clinical difficulties, a dentist must be knowledgeable about managing taurodontism (Mohan et al., 2013; Dineshshankar et al., 2014; Einy et al., 2022).

Endodontic considerations:

The danger of pulp exposure from decay or during tooth preparation is increased by an expanded pulp chamber. Due to the intricacy of the root canal system and the proximity of buccal orifices, endodontists were uncomfortable with complete root canal fillings during the negotiating, instrumentation, and obturation processes. (Jadhav et al., 2016; Sambandam and Ramesh, 2017; Majunatha and Kovvuru, 2010). When treating these teeth endodontically, high-quality diagnostic radiographs are crucial Figure 11 (A). An emerging new diagnostic imaging technique that has proven crucial in precisely detecting the root canal system, CBCT can be used in certain situations where anatomic variation and difficulties are discovered. When the occlusal surface is being prepared for endodontic access. It was easy to locate a sizable pulp chamber, but it was challenging to find the canal orifices and identify the root furcation. Because of the pulp chamber's big central opening, it was accomplished by cutting more concentratedly in the middle. The working length was calculated using a K-file, and at this stage, a 2.5% sodium hypochlorite irrigation solution has been recommended to disintegrate organic tissue. Figure 11 (B) (Azzaldeen et al., 2017; Marques-da-Silva et al., 2010). The use of illumination and magnification, such as surgical loupes with LED lights, surgical operating microscopes, and ultrasonic endodontic tips, greatly improves the visualization of the pulpal floor by better displaying the depths of the cavity, which facilitates the identification of root canal orifices (Simsek et al.2013; Unni and Kundabala, 2017).

The extensive nature of the pulp in a taurodontic tooth necessitates chemo-mechanical preparation; total removal of the necrotic pulp must be verified. In order to fully disintegrate pulp tissue, 2.5% sodium hypochlorite was first recommended as an irrigant. Furthermore, as it is impossible to properly instrument uneven root canals, extra effort should be taken to dissolve as well as necrotic material could by irrigating the canals with 2.5% sodium hypochlorite. Additionally, adding a final ultrasonic irrigation could aid in the removal of all pulp tissue (Baranwal, 2016).

Because of the intricate tooth structure and numerous irregularities in the canals, the instrumentation stage is the most challenging in the endodontic treatment of taurodontic teeth. Stripping perforation and other iatrogenic hazards might result from using excessive canal instruments to obtain thorough canal cleaning; therefore, the attempt to achieve successful canal cleaning.The root canal system cannot be exceptionally cleaned with a typical irrigation syringe alone. For this reason, passive ultrasonic irrigation may be a useful addition to the root canal cleaning process. It can clear the root canal of more organic tissue, dentin debris, and planktonic

bacteria.Compared to ultrasonic irrigation and ultrasonic equipment, PUI is a more effective met hod of cleaning the canal.

It has been demonstrated that ultrasonic files have trouble controlling the cutting of dentine d uring ultrasonic preparation. As a result, it is difficult to control the shape of the prepared root ca nal, and irregular shapes and apical holes are generated.

Therefore, after the root canal has been formed, it can be cleared with PUI or a last flush of s yringe irrigation. A well-shaped root canal facilitates better file oscillation and irrigant penetration into the apical region of the root canal system (Simsek et al., 2013). A modified filling strategy that combines lateral compaction in the apical area with warm vertical compaction of the elongated pulp chamber has been proposed using system B or other modern backfill devices Figure 11 (D) (Mohan et al., 2013). A mechanically active bioceramic sealer is employed to get excellent sealing and enhance outcomes (Mohan et al., 2013 and Chamani et al., 2024). Endodontists face challenges due to the potential for taurodont teeth to have an exceptional root canal system, in addition to the difficulties of the endodontic operation (Bharti et al., 2009). Finally, vital pulpotomy can be used instead of pulpectomy, especially in cases of hypertaurodont teeth (Azzaldeen *et al*., 2016).

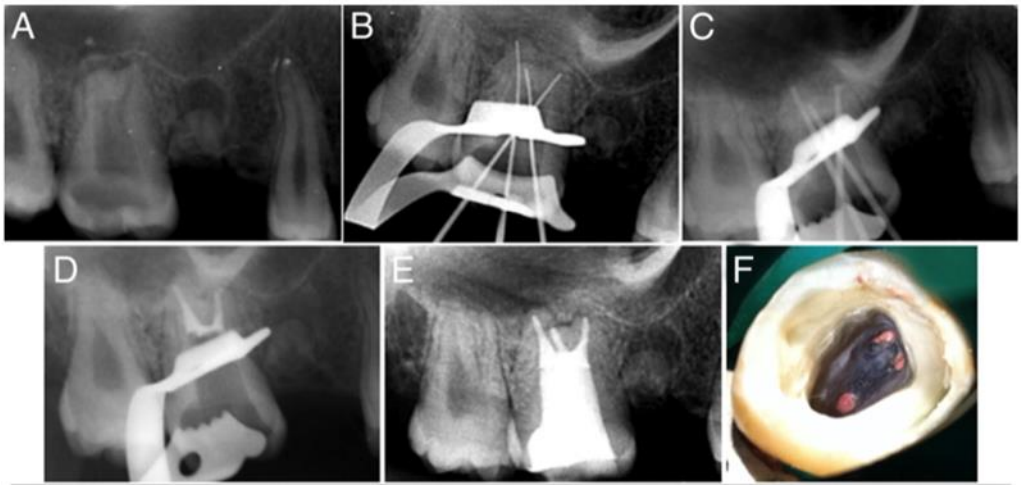

Figure 11: The right maxillary second molar was treated with a root canal. An initial radiograph, a working length estimation, a master cone verification, warm vertical compaction for root canal filling, a postobturation radiograph, composite core buildup, and an intraoral photograph of final obturation are shown in (A), (B), (C), (D), (E), and (F), respectively.

Surgical construction:

Because of the apical shift in the bifurcation or trifurcation, which makes it challenging to position forceps beaks, extracting a taurodont tooth is typically challenging. When surgical teeth elevators are used properly, this issue can be resolved. Additionally, some findings indicated that, unless the roots are much divergent, the evacuation of such teeth might not be an issue because the alveolus includes a huge mass with a limited surface area of a taurodont tooth (Thimmegowda et al., 2015).

Particularly when the length of the tooth reaches the basilar bone in cases of taurodontic third molars. A mandible fracture could occur right away or even during the first four weeks. As

illustrated in Figure 12, several authors proposed the coronectomy as a less traumatic alternative treatment by removing only the crown and keeping the roots in place to prevent bone extension (Mendes et al., 2018).

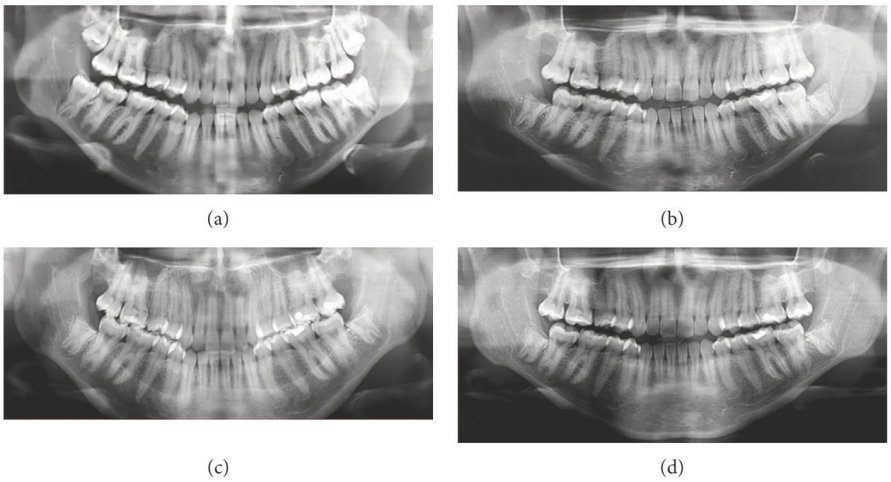

Figure 12: the diagnostic OPG (a). The follow-up was done at seven days, six months, and twelve months, respectively (b, c, and d) (Mendes *et al*., 2018).

Prosthetic consideration:

A taurodont tooth may be less stable as an abutment for prosthetic purposes because of its reduced surface area within the bone (ML and Bhayya, 2018).

Periodontal considerations:

In certain situations, a positive prognosis may be offered by dental implants. Because taurodont teeth must exhibit substantial periodontal deterioration before furcation involvement, the likelihood of furcation involvement is significantly lower in cases of periodontal pocketing or gingival recession than in normal teeth (Baranwal, 2016; ML and Bhayya, 2018).

Conservative consideration:

Dental decay requires conservative cavity preparation techniques, such as minimally invasive treatments, during restorative cavity preparation in bull teeth. Due to an improper crown/root ratio, post-placement was not advised; however, other methods of tooth reconstruction are now accessible, particularly with the advent of adhesive dentistry, which enables the use of fiber-reinforced composite. EverX posterior is regarded as a dentine substitute in big cavities of teeth that have undergone endodontic treatment since it strengthens the restoration with fiber and improves its resistance to breakage (Thimmegowda et al., 2015; Einy et al., 2022; Bavaria et al., 2017; Nazari and MirMotalebi, 2006). The tooth would lose the buttressing action against high crown loading if there were no cervical constriction. Additionally, these roots have less residual dentin thickness, which increases the risk of root fracture, which is particularly significant in these situations. Therefore, it was determined to use a combination of light-cured composite resin and glass ionomer repair to strengthen the root canal walls (Thaha et al., 2015).

Orthodontic consecration:

A short and thin root might result in root resorption as a result of orthodontic movement. Therefore, any orthodontic movement of teeth with taurodontia should be precluded (Datana et al., 2021; Yordanova et al., 2011). Because the damaged tooth's root is short and has a tiny surface area, its anchoring value is reduced. Adding more teeth to the anchored unit or employing orthodontic implants for indirect anchorage are two ways to increase the anchorage value of a taurodont molar tooth. Due to the decreased root support, headgear is not recommended for taurodont molars.Long-term orthodontic treatment can have certain negative effects; one of the most frequent issues with extended treatment is apical blunting or root resorption (Datana et al, 2021).

For both general dentists and orthodontists, the significant prevalence of taurodontism in hypodontic patients poses a clinical difficulty. To get excellent outcomes, the orthodontist should determine which teeth are taurodontic and incorporate them into the treatment plan.In these situations, it is advised to restrict orthodontic tooth movement to preparation operations only in order to make any future prosthetic rehabilitation with fixed constructions easier. Alternatively, spontaneous gap closure is the better option when the treatment plan calls for employing the teeth that are already present to close the gaps. Early primary molar extraction (8–9 years old) is how this is accomplished (Yordanova et al., 2011). Functional and anatomical variations, such as crossbite or taurodontism, may influence dental treatment planning and outcomes (Oudah, M.G., 2023).

Pedodontics consideration:

It is advised that post placement be avoided for tooth restoration when treating a primary taurodont tooth, that is, a severely deteriorated tooth (loss of crown), and no permanent replacement. When utilized as a prosthetic abutment, a taurodont tooth might not be as stable as a healthy tooth; therefore, extraction and a functional space maintainer should be the preferred course of action.

The structure and morphology of the crown, as well as the loss narrowing at the Cementoenamel junction that extends to the bi/trifurcation of the root, make it challenging to place a crown or space maintainer. The architecture and shape of the crown in a taurodont tooth make crown retention challenging. Therefore, a custom-made crown might be recommended in certain situations. Prefabricated bands might not fit properly when space maintainers are placed in primary teeth due to the changing morphology of the tooth; therefore, custom-made bands must be utilized suitably. (2015) Thimmegowda et al.Access is easily obtained for endodontic treatment, although it can be challenging to locate the canals' orifices. It is possible to confuse increased bleeding during access preparation as a perforation of the pulpal floor (Simsek *et al*., 2013; Bafna *et al.*, 2013).

The dentin of primary teeth is thinner than that of permanent teeth from an anatomical perspective. Therefore, we advise using profuse irrigation with 2.5% sodium hypochlorite (NaOCl) instead of ultrasonic irrigation. Because full-strength sodium hypochlorite (5.25%) contains chlorine, which could cause an allergic reaction, it was also avoided. To avoid any leaks,

the entire process was also carried out completely isolated by a rubber barrier (Kamareh et al., 2019).

The natural root resorption of the primary tooth may be delayed if zinc oxide eugenol alone takes longer to resorb. Because of its resorption rate, calcium hydroxide can be a great substance in certain situations. Endoflas, a mixture of calcium hydroxide, eugenol, zinc oxide, barium sulfate, and iodoform, is advised as an obturating agent. The combination of iodoform and calcium hydroxide gives this substance the added benefit of a faster rate of resorption.For complete pulpotomy of carious deciduous molars, biomaterials such as mineral trioxide aggregate (MTA) and calcium-enriched mixture (CEM) have shown positive treatment outcomes; CEM may be a cost-effective and efficient pulp dressing biomaterial (Hemalatha and Attavar, 2015; Kamareh et al., 2019).As the intensity rises, Pulpotomy could be the initial course of treatment as the severity rises (Lim and others, 2020).

Conclusion:

Taurodontism, though often considered a developmental anomaly of minor significance, carries considerable clinical and diagnostic implications. Its unique anatomical configuration demands a multidisciplinary awareness, particularly in cases where conventional treatment protocols may not be directly applicable. This condition challenges routine endodontic, orthodontic, and surgical procedures, requiring modified approaches and enhanced diagnostic vigilance.

Beyond its clinical implications, taurodontism serves as a window into complex developmental processes and genetic signaling pathways involved in root morphogenesis, such as the EDA and Wnt pathways. The recognition of taurodontism as a phenotypic expression in various syndromic conditions further underscores its potential as an indicator of broader systemic health concerns.

Despite the availability of several classification systems, there remains a lack of consensus on a standardized diagnostic approach. This review highlights the importance of moving toward objective, metric-based assessment tools in both research and clinical practice to ensure accurate diagnosis and avoid overtreatment or mismanagement.

Future research should investigate the predictive usefulness of syndromic diagnoses and elucidate their molecular basis. Clinicians, in turn, must adopt a vigilant and individualized approach when managing taurodont teeth, ensuring that anatomical variation does not become a source of therapeutic complication.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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