

Assessing the association of taurodontism with numeric dentition anomalies in an adult central Indian population

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Abstract

Aim: To study the association between taurodontism and numeric anomalies in adult population. **Materials and Methods:** Out of 1,012; 946 panoramic radiographs and dental records were retrospectively assessed to determine the presence of dental agenesis and supernumerary and taurodont teeth. **Results:** Taurodontism of one or more teeth was observed in 164 cases (97 females and 67 males). Hypodontia was observed in 148 patients (84 females and 64 males) with 62 patients having associated taurodontism (38 females, 24 males), oligodontia in 12 patients (five females and seven males) of whom nine patients also had taurodontism of one or more teeth (five females and four males). Forty-five patients (32 females and 13 males) presented with 57 supernumerary teeth (ST) with 12 patients having simultaneous presence of taurodontic tooth (seven females and five males). **Conclusion:** Our study suggests a preferential association between tooth agenesis and taurodontism; however, such association was not observed in individuals with hyperdontia. Understanding the nature of this preferential association may be of importance in determining the etiology of both conditions. This association may also define a subphenotype for future genetic studies on dental development. Further molecular studies are necessary to verify the etiology and mechanism of taurodontism associated with tooth agenesis.

Key words: Hypodontia, oligodontia, supernumerary teeth, taurodontism, tooth agenesis

INTRODUCTION

Developmental anomalies of the dentition are not frequently observed in the dental clinic.^[1] Abnormalities in tooth number constitute the most common craniofacial anomalies.^[2] Dental anomalies involving the number of teeth include hypodontia (one or more missing teeth), oligodontia (six or more missing teeth), anodontia (complete absence of teeth), and hyperdontia (one or more

extra teeth, also known as supernumeraries).^[3] Prevalence of developmentally missing teeth is 6-8% (excluding missing third molars), and that of supernumerary teeth (ST) is 1.5-3.5%, which appears to be on rise.^[2]

Dental morphological traits are of particular importance in the study of phylogenetic relationships and population affinities. One of the most important abnormalities in tooth morphology is taurodontism. This abnormality is a developmental disturbance of a tooth resulting in lack of constriction at the level of the cemento-enamel junction (CEJ) and is characterized by vertically elongated pulp chambers, apical displacement of the pulpal floor, and bifurcation or trifurcation of the roots.^[4] It appears most frequently as an isolated anomaly, the expression of which displays a rather wide variation and is often associated with several syndromes and abnormalities.^[5] It is likely that tooth number polymorphisms may bear a fundamental

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relation to the size, development, and calcification timing of the dentition as a whole.^[6] Moreover, certain dental anomalies appear associated in the same patient, more than expected by chance, most likely because genetic defect can determine different manifestations or phenotypes. One classic example is the association between the unilateral agenesis of the maxillary lateral incisor and the microdontia of its antimere. However, the associations between the dental anomalies are not restricted to this classic example.^[7]

Teeth adjacent to missing or ST sometimes show abnormal development and an altered morphology, suggesting a link between the causes of hypodontia and ST and the determinants of tooth size and shape in affected individuals.^[8] Understanding the nature of this association may be of importance in determining the etiology of both conditions. This association could define a subphenotype for future genetic studies on dental development. It may also aid in the understanding of underlying causes leading to various craniofacial defects.^[9] Although previous studies have shown such association in non-Indian pediatric population, to our best knowledge this is the first study of its kind to be carried out on adult central Indian population. We hypothesize that hypodontia is associated with general change in dental development and supernumerary tooth are an isolated abnormality. Based on this hypothesis, it is proposed that hypodontia is more likely to be associated with taurodontism, whereas ST are not. Therefore, the aim of this study was to examine the prevalence of taurodontism in adults with numeric anomalies of dentition.

MATERIALS AND METHODS

This study comprises data from 1,012 orthopantomogram (OPG) of patients who attended the Department of Oral Medicine and Radiology. Patient's dental records and radiographs were examined retrospectively in order to detect prevalence of dental agenesis, supernumerary, and taurodontism [Figures 1 and 2]. All OPG evaluation



Figure 1: Hypodontia with taurodontism

was carried out in a dark room using X-ray viewer by experienced specialists of oral medicine and radiology. Patients <18 years of age at the time of radiographic examination (44 subjects) and if the OPG was not of high quality (22 subjects). A total of 66 dental records were excluded and final samples of 946 records were included in this study (520 females and 426 males).

Tooth agenesis was registered when a tooth was absent on the panoramic radiograph, excluding a history of loss due to trauma or extraction. All permanent teeth were investigated, excluding third molars. Hypodontia was diagnosed when one to six teeth were absent, excluding the third molars. Oligodontia was diagnosed if more than six teeth were absent, excluding the third molars. Dental and medical records of patients with hypodontia were checked to exclude incidences of caries or trauma or any medical condition or treatment affecting their dental development. Medical history of patients with ST was assessed to rule out the possibility of systemic conditions or syndromes.

Taurodontism was analyzed on permanent mandibular first molars according to the criteria previously described.^[10] The tooth was considered as taurodontic when the crown body-root ratio (CB:R) was equal or greater than 1:1.10.^[9] The mandibular first molars were employed for study because previous studies have established that these teeth are minimally distorted on the OPG.^[10] In addition, the permanent first molars are considered the most stable teeth in the arch and are usually present in hypodontia subjects.^[11]

The data was statistically analyzed using chi-square test.

RESULTS

Of the total 946 panoramic radiographs examined, taurodontism of one or more teeth was observed in 164 cases (97 females and 67 males). Hypodontia was seen in 148 patients (84 females and 64 males) with 62 patients



Figure 2: Oligodontia with taurodontism

having associated taurodontism (38 females and 24 males). Oligodontia was observed in 12 patients (five females and seven males) of whom nine also had taurodontism of one or more teeth (five females and four males). Forty-five patients (32 females and 13 males) presented with 57 ST with 12 [Tables 1 and 2] patients having simultaneous presence of taurodontic tooth (seven females and five males).

DISCUSSION

In the present study the prevalence of hypodontia and oligodontia was found to be 15.6 and 1.2% respectively. Previous studies have found the prevalence of hypodontia to be between 2.310% in the world population.^[12] Population studies have revealed less than 1% population to be affected by oligodontia. One or more ST were encountered in 6% of the cases with a prevalence range of 0.1-3.8%.^[12] Taurodontism was encountered in 17.3% of the subjects

which is within the range noted in other populations (7.1-46.4%).^[13] The variations in prevalence between different populations may be due to ethnic differences in addition to differences in sampling techniques and diagnostic criteria.

The prevalence of ST was higher in females than males, while gender difference was not observed in the prevalence of taurodontism or hypodontia. The gender distribution reported by most authors show a male predisposition in cases of ST^[14,15] and female predisposition in cases of hypodontia in the permanent dentition.^[16,17] Except for a higher prevalence of taurodontism amongst females in a Chinese ethnic group, no study has found a gender difference for this abnormality.^[4] However, the lack of gender difference in the incidence of taurodontism and hypodontia may also be due to the smaller sample size.

Our study suggests a statistically significant tendency in the association between tooth agenesis and taurodontism. A prevalence of 7.5 % was observed in the population studied. Previous studies support our findings, but were carried out in pediatric population, in relatives of individuals with hypodontia and adults of different ethnic origin [Table 3].^[18,19] Two Brazilian pediatric population studies [Table 3]^[19,20] did not find such association probably because sporadic cases of hypodontia were used as study samples. Moreover, there is stronger association of taurodontism in cases affected with oligodontia concurrent to previous studies [Table 3].^[18,21] Interestingly a variable magnitude of association between tooth agenesis and taurodontism was observed despite the studies using gene mutations segregating in families failing to observe such associated taurodontism. Nevertheless identification of families with specific associated dental anomalies would allow testing of the specific hypothesis that certain genetic factors contribute to that specific association.^[9]

Table 1: Association of taurodontism with hypodontia, oligodontia, and supernumerary teeth

	Hypodontia	Oligodontia	Supernumerary
Taurodontism	62	09	12
P value	0.000	0.000	0.445

Table 2: Prevalence of taurodontism, hypodontia, oligodontia, and supernumerary teeth

Dental anomaly	Total (n = 946) (%)		Prevalence		
			Male	Female	P value
Taurodontism	164	17.33	67	97	0.445
Hypodontia	148	15.6	64	84	0.634
Oligodontia	12	1.26	07	05	0.351
Supernumerary	45	4.7	13	32	0.026
Not present	577	61	229	348	—

Table 3: Review of studies done by various authors on different populations to assess association between taurodontism and numeric anomalies of the dentition

Authors	Sample size	Population and year of the study	Result
Seow and Lai	66 children (hypodontia)	Queensland, 1989	34.8% of subjects had associated taurodontism
Schalk van der Weide <i>et al.</i>	117 (oligodontia)	Netherland, 1993	28.9% of subjects had associated taurodontism
Calvano Kuchler <i>et al.</i>	975 children, 45 (hypodontia), 16 (taurodontism)	Brazil, 2008	No association between taurodontism and hypodontia
Gomes <i>et al.</i>	1,049 66 hypodontia	Brazil, 2010	21.2% of subjects had associated taurodontism
Kan <i>et al.</i>	83 children hypodontia, 37 children supernumerary teeth	Queensland, 2010	Only girls showed a significant higher tendency for taurodontism (P 0.003). Oligodontia significantly more susceptible to taurodontism (P 0.004). Not significant in cases of supernumerary teeth
Kuchler, <i>et al.</i>	1,167; 56 hypodontia, 51 taurodontism	Brazil, 2008	No association between tooth agenesis and taurodontism
Arte, <i>et al.</i>	214 family members	Finland, 2001	Taurodontism associated with hypodontia and oligodontia. However, the results were not statistically significant in separate groups of relatives

Root abnormalities (taurodontism and short root anomaly) have been attributed to an epithelial defect and more specifically to a defect of the function of the Hertwig's epithelial root sheath. The association between root abnormalities and tooth agenesis suggests the existence of a common primary defect. It may exert its effect independently on different processes or root abnormalities may follow secondarily from an earlier defective event.^[22] The occurrence of taurodontism is considered as an indicator of developmental instability and tooth agenesis is suggested as an expression of a general abnormality of dental development. Genes expressed in the early stages of tooth development, such as *MSX1*, *PAX9*, *AXIN2*, and *EDA* have been linked to tooth agenesis, whereas the gene *DLX3* that was identified in taurodontism associated with syndromes is expressed later during root morphogenesis. These genes, which are expressed at two distinctly different points in time during the entire tooth formation process, are likely to provide the link between tooth agenesis and taurodontism.^[9] However, no gene mutation responsible for the appearance of non-syndromic ST has been identified as yet.^[12] Although taurodontism has been noted with ST in several case reports,^[23,24] in our study it did not show any statistically significant association with taurodontism. They appear to be a separate pathologic entity. Etiologic mechanisms leading to its formation are probably different from those responsible for the onset of an intensely intercorrelated group of dental anomalies.^[25]

Several studies have investigated the association of other tooth anomalies in patients with tooth agenesis, however extensive PubMed search revealed meager number of published data more specifically studying its association with taurodontism. To the best of our knowledge, this is the first study that reporting prevalence of taurodontism in adults with hypodontia and ST in the Indian subcontinent. Clinicians should be alerted to the possibility of taurodontism with its accompanying clinical difficulties in patients with hypodontia and ST. Alterations in crown root ratio are probably followed by other subtle morphological differences that hamper the successful conclusion of orthodontic treatment. Moreover, the tendency to root resorption is greater in dentitions in which hypodontia and taurodontism occurs.^[26]

CONCLUSION

This study suggests that there is preferential association between dental agenesis and taurodontism in the adult population studied, but did not find similar association in individuals with hyperdontia. Understanding the nature of this preferential association may be of importance

in determining the etiology of both conditions. This association could also define a subphenotype for future genetic studies of dental development. Additional larger population studies in different ethnic groups are needed to confirm such association. Further molecular studies are also necessary to corroborate the etiology of taurodontism associated with tooth agenesis.

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