

Prevalence of Dental Morphology Anomalies in Greater Noida Population

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ABSTRACT

Human teeth of both dentitions may show changes and variations in morphological structures. Such variations can be found on the crown either in the form of an increased number of roots or in anomalous cusps. In this study, our aim is to find the incidence of dental morphological anomalies in Greater Noida population, distribution according to teeth and Gender

Materials and Methods: The study was carried out on 2250 women and men, visiting Oral Medicine department from August 2019 to January 2020 were screened for the presence of any dental morphological anomalies namely, cusp of Carabelli in permanent maxillary first molar, shoveling and double shoveling, supernumerary teeth and talon cusp and four-five- six cusped mandibular permanent first molar in population of Greater Noida. The results were analyzed with Chi-square test.

Results: The study was carried out on 2250 women and men. About 68.26% of the studied population had one or more deviant morphological features of permanent teeth.

The variation most commonly seen was double shoveling (34.93%) followed by shoveling (28.17%). Non-significant results were observed in any trait with respect to gender.

Conclusion: This study is the first of its kind, providing a baseline data of the prevalence of morphological details in the Greater Noida population

Keywords: Dental morphological anomalies, Dental anatomy, Greater Noida

INTRODUCTION

Teeth are vertebrate organs that arise from progressive and complex interactions between the oral epithelium, an underlying mesenchyme, and an ectoderm. A plethora of research has focused on determining the processes that initiate tooth development. There are many factors (multiple signaling molecules, including BMPs, FGFs, Wnt and Shh proteins) within the tissues of the first branchial arch which is necessary for the development of teeth. ^[1]

Dental anatomic features are used mainly to determine a person's origin, gender and identity. The importance of a dental anatomical trait depends on its distinctiveness and frequency of occurrence in a given population. Morphological details are important to understand the variations among species and also it adds information for phylogenetic and genetic studies. Investigation of racial differences in dental morphology has led to the belief that the common origins of people are reflected to a certain degree in their related phenotypic patterns. ^[2]

Dental morphological anomalies are caused by complex interactions between epigenetic, genetic and environmental factors during the dental development. Understanding the variations in the outcomes and the process of morphogenesis is a significant contribution to the multidisciplinary clinical team approach to

treatment [3]. Timely diagnosis allows optimal patient management and treatment planning and can significantly reduce complications and the amount and complexity of the planned treatment. If such associations of hereditary origin occur, they may be worth diagnosing and studying, as early recognition of one tooth developmental disturbance may reveal a possible risk of future eruption or other teeth position disturbances. However, various dental anomalies are commonly observed together in clinical practice.

TALON CUSP

A rare dental anomaly, Talon cusp, first described by Mitchell in 1892, with a distinct morphologically altered cusp-like structure projects from the cingulum area of the anterior teeth. A talon cusp (dens evaginatus of anterior tooth) is a well-defined supplementary cusp located on the surface of an anterior tooth and extends at least half the distance from the incisal edge to the cemento-enamel junction (CEJ) [4]. The name reveals the resemblance of the utmost extreme cases to an eagle's talon as viewed from the occlusal edge. It is composed of normal enamel and dentin, has extensions of pulp tissue, or maybe devoid of pulp tissue. The etiology of the talon cusp is still unidentified.

According to degree of the cusp formation and extension, Hattab et al classified talon cusp into three types [5]. Type 1 (talon) is a morphologically well-defined additional cusp that projects from the palatal surface to at least half the distance between incisal edge and CEJ. Type 2 (semitalon) refers to an additional cusp ($\leq 1\text{mm}$) that may blend with the palatal surface or stand away from the rest of crown. It extends less than halfway between incisal edge and CEJ. Type 3 (trace talon) is the enlarged cingula that may have a bifid, conical, or tubercle-like appearance.

MANDIBULAR FIRST MOLAR SHAPES ACCORDING TO GROOVE AND CUSP CONFIGURATION

The permanent first mandibular molar is situated 6th from the midline of the mandible and is usually the largest mandibular tooth. The occlusal surface of the tooth appears as roughly oblong outline with the distal and mesial surfaces converging toward the lingual surface. There are 5 cusps [Figure 1] - three buccal (the mesiobuccal, the distobuccal and the distal) and two lingual (the mesiolingual and the distolingual) cusps. The distal cusp or the hypoconulus is the smallest cusp and the mesiolingual cusp is the largest cusp. Several discrepancies have been reported in the location and number of cusps in the first mandibular permanent molar. There may be 4 cusps [Figure 2] instead of 5 because of reduction of the distal cusp giving a more circular outline as that of the permanent second molar. The 4-cusp type has only 1 buccal groove. An accessory cusp or paramolar cusp may sometimes be seen on the buccal surface of the mesiobuccal cusp, about in the middle third of the crown. Some mandibular first permanent molars have a 6th cusp which is termed tuberculum septum when located on the distal ridge between the distolingual cusp and distal cusp and tuberculum intermedium when located between the two lingual cusps. [6]

The sixth cusp is common in the Chinese population. In 90% of cases, the mesiolingual cusp is joined to the distobuccal cusp across the floor of the central fossa. This feature and the five-cusped pattern is termed as the dryopithecus pattern and is characteristic of all the lower molars of the anthropoid apes and their early ancestors, the dryopithecines. [7]

Because of the Y-shaped fissure pattern and the 5 cusps, the dryopithecus pattern is sometimes referred to as a Y5 pattern. In 10% of cases where the distolingual cusps and mesiobuccal meet, a more cruciate system of fissures is formed. This is sometimes referred to as a +5 pattern. The principal grooves of the mandibular first permanent molar are the central, lingual, mesiobuccal and the distobuccal grooves. The distobuccal groove

is unique to this tooth. The pattern of the grooves on the occlusal surface of the mandibular first molars shows considerable distinction. Three principal types of occlusal groove patterns have been described: type Y, in which the central groove forms a Y figure with the lingual groove; type +, in which the central groove forms a + figure with the buccal and lingual grooves (common in four-cusp type of molars); and type X, in which the occlusal grooves are somewhat in the form of an X. [8]

According to the **number of cusps**, a tooth may be classified as follows:

1. The presence of cusps 1-4 (1-protoconid; 2-metaconid; 3-hypoconid; 4-entoconid).
2. The presence of five cusps (hypoconulid)
3. The presence of six cusps (entoconulid).

The permanent mandibular molars are more variable than the permanent maxillary molars in the number of different patterns and in the frequency of such patterns.



Figure 1: Mandibular First Molar showing 4 cusps



Figure 2: Mandibular First Molar showing 5 cusps

Cusp of Carabelli Trait

The Cusp of Carabelli is a distinctive morphological trait often seen on the palatal surface of the mesiopalatal cusp of maxillary permanent molars and maxillary second deciduous molars [9]. First described by Carabelli in the year 1842 and since then it has been identified as a significant trait in forensic, anthropological and ethnic studies. Various terminologies have been given to it which includes accessory cusp, fifth lobe, supplemental cusp, mesiolingual elevation, Carabelli's tubercle, etc. The classification of Cusp of Carabelli [Figure 3] according to Dahlberg [10] was considered over Kraus [11] as the former had more precise grading

| Degree | Expression |
|--------|--|
| 0 | Smooth mesiobuccal crown surface |
| 1 | Small vertical ridge and groove |
| 2 | Small pit with minor grooves diverging from depression |
| 3 | Double vertical ridges or slight and incomplete cusp outline |
| 4 | Y form |
| 5 | Small tubercle |
| 6 | Broad cusp outline with a moderate tubercle |
| 7 | Large tubercle with a free apex |

Figure 3: Classification of cusp of carabelli according to Dahlberg (1903)



Figure 4: Maxillary First Molar showing Cusp of Carabelli

According to Dahlberg, the Cusp of Carabelli [Figure 4] could be an adaptation to enlarge the occlusal surface buccolingually compensating for the evolutionary reduction in mesiodistal dimension [12]. One more study has reported that larger first molars and Carabelli's cusp

are interrelated large but not based on increase in buccolingual diameter alone [13]. The Cusp of Carabelli is advocated to be a primitive structure that would gradually vanish in line with human evolution [14]

SHOVELING

Shovel-shaped Incisors (SSIs) are the teeth with deep lingual fossa surrounded by thick marginal ridges.

Shovel-shaping [Figure 5] is one of the most common morphologies associated with human upper incisors. Scoring the expression of shovel shaping in the central and lateral upper incisors, from absent (0) to extremely shoveled (7). Variations in the distribution of incisor enamel related to shoveling are likely the product of the growth process and is genetically determined. [15]

Hrdliucka A [16] classified shoveling as follows: (a) shovel-enamel rim distinct with an enclosed well-developed fossa, (b) semishovel-enamel rim distinct but enclosed fossa shallow, (c) trace shovel-traces of enamel rim which cannot be classed as semishovel, and (d) no shovel-no perceptible trace of rim or fossa. Further, these categories were classified as existence or non-existence of shovel trait. The trait was considered present whenever there was a rim or fossa present.



Figure 5: Double Shovelling

Shovel-shaped incisors (SSIs) are characterized by a pronounced hollow area on the palatal surface of the teeth surrounded with a well-defined elevated enamel border. Because this condition

resembles an ordinary coal shovel, teeth with that extraordinary condition are termed “shovel-shaped incisors”. The affected incisors demonstrate a hollowed lingual surface bounded with pronounced lateral margins, thus resembling the scoop of a shovel.

SUPERNUMERARY TEETH

Supernumerary teeth are considered as one of the most noteworthy dental anomalies during the primary and early mixed dentition stage.

A hyperdontia or supernumerary tooth [Figure 6] describes an excess in teeth number which can occur in both the permanent and the primary dentition. [17] Hyperactivity of the dental lamina is the most usually accepted theory. [18] Commonly, supernumerary teeth can erupt in any part of the dental arch, but they most frequently occur in the midline maxillary region, i.e. mesiodens, that are nearly 80% of all supernumerary teeth. The second common supernumerary tooth is distomolar i.e. the maxillary fourth molar and is positioned distal to the third molar. Other supernumerary teeth seen with varied frequencies are maxillary paramolars situated lingually, buccally, or interproximally in molar areas, mandibular premolar, and maxillary lateral incisors. The frequency of occurrence of supernumerary teeth in primary dentition is five times lower in comparison to permanent dentition. Supernumerary teeth are generally coincidentally diagnosed during either radiograph or intraoral examination.



Figure 6: Supernumerary Tooth

Supernumerary teeth can cause different local disorders, including disturbed eruption, crowding, or retention of teeth, delayed or abnormal root formation in permanent teeth, and cyst [19]. The extraction of these teeth is a generally recommended for avoiding complications.

CLINICAL IMPLICATIONS

- A careful assessment and thorough knowledge of such traits are required to increase efficiency and effectiveness of treatment procedures, identification of incipient caries /deep fissures, extension of fissures during cavity preparation, application of pit and fissure sealants, etc.
- Every patient's Ante mortem dental record should be recorded and maintained, that could be of forensic significance for the identification of an individual or to identify the population to which the person belongs.

Literature search revealed that no studies have been performed regarding the prevalence of the known morphological details in Greater Noida. Hence, the present study was undertaken to evaluate the prevalence of aberrant dental morphological details namely, cusp of Carabelli in permanent maxillary first molar, shoveling and double shoveling, supernumerary teeth and talon cusp and four, five, six cusped mandibular permanent first molar in population of Greater Noida

MATERIALS AND METHODS

The study was carried out on 2250 women and men, attending Oral Medicine department from August 2019 to January 2020 were screened for the presence of any dental morphological anomalies namely, cusp of Carabelli in permanent maxillary first molar, shoveling and double shoveling, supernumerary teeth and talon cusp and four- five- six cusped mandibular permanent first molar in population of Greater Noida. The results were analyzed with Chi-square test.

Participant information form was sent to all parents/guardians of the selected children explaining the purpose, procedure, and significance of the study in the local language. Only those children were included whose parents or guardians signed the consent form

Selection criteria

The subjects with orthodontic treatment, traumatic injuries to teeth, with special health care needs, teeth with extensive caries/restorations/developmental anomalies, attrited cusps and having non-eruption/partial eruption of the desired tooth unilaterally/bilaterally were not included in the study

Clinical Examination

Type III clinical examination was conducted in the clinical department using a mouth mirror and probe under natural light. Cotton rolls were used to clean the teeth off food debris and to dry them. A special performa was designed to note the required data.

Statistical analysis

Descriptive summary statistics were obtained for all independent variables. The Chi-square test was applied to see the frequency of different developmental anomalies across genders. All significant differences were detected at 95% of confidence level. Statistical analyses were carried out using SPSS (Statistical Package for the Social Sciences) Version 17

RESULTS

The study was carried out on 2250 women and men. About 68.26% of the studied population had one or more deviant morphological features of permanent teeth.

Shovel-shaped incisors were detected in 634 individuals. [Table-1] Photographic images of the palatal surfaces were obtained and after the examination of high resolution digitalized images by observers. Double shoveling was observed in 786 cases. Cusp of Carabelli in 463 individuals.[Table-2]

The mandibular molar cuspal number varied in prevalence- 5 cusp in 252 individuals, 6 cusps in 164 cases, 7 cusps in 184 individuals and 4 cusps in 54 cases.

Talon cusps were seen in 351 cases and supernumerary teeth in 302 individuals, in which mesiodens were the most frequent finding.

Table 1: Prevalence of deviant morphological features according to gender

| Feature | Total cases | Males | Females | P value |
|---------------------------------|-------------|-------|---------|---------|
| Shovelling | 634 | 332 | 302 | 0.665 |
| Double shoveling | 786 | 402 | 384 | 0.89 |
| Cusp of carebelli | 463 | 220 | 243 | 0.89 |
| 5 cusp – first mandibular molar | 252 | 134 | 118 | 0.88 |
| 6 cusp – first mandibular molar | 164 | 84 | 80 | 0.96 |
| 7 cusp – first mandibular molar | 184 | 92 | 92 | 0.999 |
| 4 cusp – first mandibular molar | 54 | 23 | 31 | 0.86 |
| Talon cusp | 351 | 178 | 173 | 0.97 |
| Supernumerary teeth | 302 | 160 | 142 | 0.87 |

Table 2: Prevalance of deviant morphological features and their unilateral and bilateral occurrence

| Feature | Present | percentage | unilateral | percentage | Bilateral | Percentage |
|---------------------------------|---------|------------|------------|------------|-----------|------------|
| Shovelling | 634 | 28.17 | 23 | 3.62 | 611 | 96.3 |
| Double shoveling | 786 | 34.93 | 15 | 1.90 | 771 | 98.09 |
| Cusp of carebelli | 463 | 20.57 | 83 | 17.92 | 380 | 82.07 |
| 5 cusp – first mandibular molar | 252 | 11.2 | 45 | 17.85 | 207 | 82.14 |
| 6 cusp – first mandibular molar | 164 | 7.28 | 32 | 19.51 | 132 | 80.48 |
| 7 cusp – first mandibular molar | 184 | 8.17 | 15 | 8.15 | 169 | 91.84 |
| 4 cusp – first mandibular molar | 54 | 2.4 | 13 | 24.07 | 41 | 75.92 |
| Talon cusp | 351 | 15.6 | 102 | 29.05 | 249 | 70.94 |
| Supernumerary teeth | 302 | 13.42 | 152 | 50.33 | 150 | 49.66 |

DISCUSSION

The world renowned paleontologist Williamking Gregory (1922) opined that tooth crown morphology varied scarcely among the major races of mankind. Exceptions to this overview are the cusp of Carabelli and the molar cusp pattern and number. [20]

The prevalence of talon cusp in our study (351/2250; 15.6%) was found to be comparable to that in the study conducted by Hegde in 1999. [21] The reported prevalence of talon cusp in the literature is most commonly seen in maxillary lateral incisors followed by maxillary central incisor and maxillary canine (8.3%). However, the permanent maxillary central incisor was the most commonly involved tooth in our study. Type I talon cusp and type II talon cusp were the most prevalent types in our study.

No significant trend of sex predilection for specific types of talon cusp could be observed in our study. The future studies on types of talon cusp can probably identify the sex predilection of each specific type of talon cusp. Talon cusp has been reported in patients with Sturgeweber

syndrome, Rubinstein-taybi syndrome, Mohr syndrome, Ellis van-creveld syndrome, and Alagille syndrome [22]

None of the cases observed during the study had any clinical signs/symptoms of these syndromes. In our study, we could not observe any familial history for talon cusp. Various known complications associated with talon cusp are altered esthetics, accidental cusp fracture, attrition, and breast feeding problems, irritation of tongue during speech, periodontal problems due to occlusal interference, and caries susceptibility because of developmental grooves on tongue. None of these complications could be observed in our Patients.

In the present study, the mandibular molar cuspal number varied in prevalence- 5 cusp in 252 individuals, 6 cusps in 164 cases, 7 cusps in 184 individuals and 4 cusps in 54 cases. In the present study, 5 cusps are more prevalent than others. The sixth cusp is common in the Chinese population. In 90% of cases, the mesiolingual cusp is joined to the distobuccal cusp across the floor of the central fossa.

The finding is comparable to a previous study carried out in Indian population revealing a prevalence rate of 18%.^[6] Another study was conducted by Turner, where Indians, Aleuts, and Eskimos (1%) were compared. Results showed the absence of four cusped permanent first molar^[23] four cusped pattern.

A feature unnoticed till date is the five cusped maxillary first molar. In the present study, a prevalence rate of 17.8% was found with respect to permanent teeth.

Another interesting trait recorded in the mixed dentition is the six cusped mandibular first molar. The prevalence percentage was 7.28 in permanent teeth. The prevalence was quite less when compared to the study by Turner. The outcome showed a prevalence rate of 65% with Indians, 21% with Aleuts, and 22% with Eskimos when the permanent teeth were considered.^[23]

The last deviant feature checked for is the seven cusped mandibular first molar which showed a prevalence of 8.17% with permanent teeth were taken into account. The results of the present study are comparatively less to a study done in the Indian population where a prevalence of 11.2% was observed.^[24]

The incidence of the shovel-shaped incisors was 28.17% in our study group; (2) SSI affected the lateral incisors more than central incisors; (3) the number of men reflecting SSI was higher than women (women -302, men - 332); and Incisor edges of the shovel-shaped incisors are broader and thicker than normal teeth. This situation was supposed to reinforce the tooth structure.^[25] Additionally, shovel-shaped incisors should be inspected for surface defects at the point where the marginal ridges converge. Any deep fissures or invaginations should be restored.

Based on the study findings, the prevalence of supernumerary teeth in 2250 patient was 13.42%, which is inconsistent with the other studies, with a range of 0.1-3.8%.^[26] In terms of location, most commonly, the supernumerary teeth occur in the maxillary anterior region.^[27]

Regarding gender distribution, most of the supernumeraries in this study showed that the prevalence was almost equal in both males and females. Considering the mechanical and pathological changes induced by supernumerary teeth, displacement of adjacent teeth is higher.

Dental anomalies are caused by complex multifactorial interactions between genetic, epigenetic, and environmental factors during the long process of dental development.^[28] Tooth type is determined by epithelial signals which involve differential activation of homeobox genes in the mesenchyme. This differential signaling could have been the possible reason for variation in the tooth type.

Various fibroblast growth factors such as 4, 8, and 9 have been regarded as epithelial signals regulating mesenchymal gene expression and cell proliferation in concern with epithelial morphogenesis.^[29]

Forensic implication

The morphological variation could be a useful tool to categorize and identify populations to which the person belongs. For example, the sixth cusp has been labelled as a racial characteristic trait of the Caucasians and mongoloids are surveyed to have a high prevalence rate of cusp of Carabelli

A thorough knowledge and careful assessment of such traits is required for clinical applications that includes identification of deep fissures/incipient caries, application of pit and fissure sealants, extending to the fissures during cavity preparation, etc

Antemortem dental profile of every patient should be recorded and maintained for the forensic value, i.e., identification of an individual

CONCLUSION

About 64.6% of the studied population had one or more deviant morphological features of permanent teeth. The most common feature present was

double shoveling followed by shoveling and the cusp of Carabelli

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