

Prevalence of a few variant dental features in children aged 11-16 years in Davangere, a city in Karnataka

Poornima P., Kirthiga M.,
Shilpa Sasalwad,
Nagaveni N. B.

*Department of Pedodontics and
Preventive Dentistry,
College of Dental Sciences,
Davangere, Karnataka, India*

Address for correspondence:

*Dr. Poornima P.,
Room No. 8, Department of
Pedodontics and Preventive
Dentistry, College of Dental
Sciences, Davangere, Karnataka,
India.*

*E-mail: drpoonimas2
@gmail.com*

Abstract

Context: Variations in morphology of shape of teeth have always been of interest to dentists from ancient times. But to our surprise, till date, no studies related to the prevalence of dental features have been conducted in any part of the world. **Aims:** To evaluate the prevalence of a few variant dental features in a group of children aged from 11 to 16 years in the city of Davangere that belongs to the state of Karnataka, India. **Materials and Methods:** A cross-sectional survey was conducted where children aged 11–16 years were selected (both girls and boys) and type III clinical examination was done. They were checked for the following features – Carabelli's cusp, 3-cusped maxillary 2nd molar, 5-cusped maxillary 1st molar, 4-cusped mandibular 1st molar, 5-cusped mandibular 2nd molar, cusp 6 present in mandibular 1st molar, and 7-cusped mandibular 1st molar. **Statistical Analysis Used:** The Chi-square test was used to analyze the categorical data. *P* value of 0.05 or less was considered for statistical significance. **Results:** Around 99.3% of the school children examined had at least one of the dental variations that were examined in relation to the shape of teeth. **Conclusions:** This study definitely provides us with baseline data, but further epidemiological studies are required to determine the prevalence of the above mentioned dental anomalies.

Key words: Cusp variation, dental features, prevalence, school children

Introduction

Variations in the structure of teeth have always been of great interest to the dentist from the scientific as well as practical points of view. The majority of variations in shape affect the crown of the tooth, some of which occur frequently, but a few are specific to a few ethnic groups. There are a few dental

features commonly seen among Indian population, which have been identified lately in the specific permanent maxillary and mandibular molars in order to have a better understanding and knowledge about the population variation and similarity. These are Carabelli's cusp of maxillary 1st molar, 3-cusped maxillary 2nd molar, cusp 5 in maxillary 1st molar, 4-cusped mandibular 1st molar, 5-cusped mandibular 2nd molar, cusp 6 in mandibular 1st molar, and cusp 7 in mandibular 1st molar.

The cusp of Carabelli was first described in 1842 by Carabelli. It has been found in Australopithecus Neanderthal, where it was only a groove. Hence, the Carabelli's cusp seems to have undergone an evolution from a simple groove to a well-developed cusp [Figure 1].

The sixth cusp is also called as the tuberculum accessorium posterio-internum or tuberculum sextum. This accessory

Access this article online

Website:
www.jfds.org

DOI:
10.4103/0975-1475.176948

Quick Response Code



cusps is said to be seen between the distal and distobuccal cusps of the primary and permanent mandibular molars, more common with the permanent ones. This cusp is most commonly seen in the Chinese and Negroes [Figure 2].

The seventh cusp was also identified in the mandibular 1st molar. It was present between the mesiolingual and the distolingual cusps, and was termed as the tuberculum intermedium [Figure 3].

There are no previous clinical research studies other than case reports regarding the prevalence of the dental anomalies mentioned above. There cannot be further research in this field unless we have baseline data about the prevalence of the same. Hence, the aim of this study was to evaluate the prevalence of a few dental anomalies in a group of children aged from 11 to 16 years in the city of Davangere that belongs to the state of Karnataka in India. This data could be useful as a baseline for South Indian population in order to identify a particular tooth and the origin of the person in the field of forensic dentistry. The study of the number of cusps is not only important in anthropology, but also important in the study of dental occlusion, orthodontics, restorative dentistry, and prosthetic dentistry.^[1] It could also be used to assess the etiological factor and treatment for this condition which is still under research.^[2-5]

Materials and Methods

Ethical approval and consent

Prior to the study, ethical clearance was obtained from the Institutional Review Board of College of Dental Sciences. Verbal consent from parents and concerned authorities of schools was sought prior to study commencement.

Sample selection

A cross-sectional study was conducted in a city named Davangere in Karnataka state, India, where 1600 school children (730 boys and 870 girls) aged 11–16 years were screened for normal variations in the shape of teeth. The investigator was trained to diagnose morphological variations of permanent teeth (deciduous teeth were excluded) among the children by a gold standard examiner who visited the Out-patient Department of College of Dental Sciences for duration of 3 months. The intra-examiner reliability was calculated by randomly selecting 100 children and examining them at two different occasions. The kappa statistics was found to be 0.95 which reflected a high degree of conformity in the examination. Two-stage sampling procedure was adopted for selection of the sample. In the first stage, six government schools and six private schools were selected from the total number of schools (190) with the help of simple random sampling. In the second stage, children were selected from the already selected schools with the help of proportionate stratified



Figure 1: Cusp of Carabelli with respect to 16

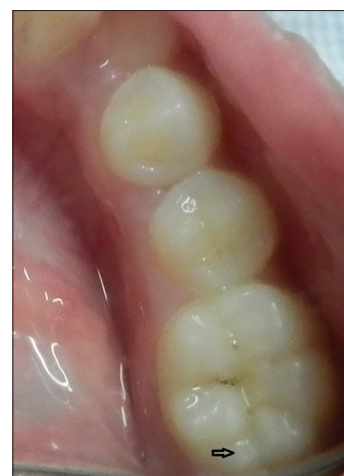


Figure 2: Cusp 6 in mandibular 1st molar with respect to 46



Figure 3: Cusp 7 in mandibular 1st molar with respect to 36

random sampling. The examinations took place in a suitable room at the individual schools with the help of natural light using mouth mirrors, probes, tweezers, and cotton for removing the plaque whenever necessary.

The morphological variations examined were: Carabelli's cusp seen in maxillary 1st molar, 3-cusped maxillary 2nd molar, cusp 5 maxillary 1st molar, 4-cusped mandibular 1st molar, 5-cusped mandibular 2nd molar, presence of cusp 6 in mandibular 1st molar, and cusp 7 mandibular 1st molar.

Statistical analysis

The values are expressed in the form of numbers and percentages. The Chi-square test was used to analyze the categorical data. *P* value of 0.05 or less was considered for statistical significance.

Results and Discussion

A total of 1600 school children were reviewed in whom the various dental features were examined and tabulated [Table 1]. Among them, only 11 (0.9%) children were found with no deviation from the normal shape of teeth. The rest of the children (1589) had one or the other feature that was being checked for. The results in the descending order of their prevalence are discussed below. Among all the observed dental features, cusp 5 seen in the permanent maxillary 1st molar was the most prevalent. Exactly 436 (27.3%) children were found to have the same. This feature was followed by cusp 6 seen in the mandibular 1st molar of 321 school-going children. Their percentage was calculated as 20%. This was followed by the prominent cusp of Carabelli of maxillary 1st molar seen in 313 children (19.5%), and then the 3-cusped maxillary 2nd molar seen in 253 children (15.8%), the 4-cusped mandibular 1st molar seen in 117 children (7.3%), cusp 7 present in mandibular 1st molar of 108 children (6.7%), and lastly the 5-cusped mandibular 2nd molar (2.5%) seen in 41 children.

The prevalence of the various dental features was also assessed separately in girls and boys [Table 2]. All the features were more common in females except 5-cusped mandibular 2nd molar which was common in males, although there was no significant difference between males and females with respect to the features noted except for one which was 6-cusped mandibular 1st molar (*P* < 0.001, HS). The number of males and females with this feature was 123 and 198, respectively.

The world-renowned palaeontologist William King Gregory expressed the view in the early 20th century (1922) that tooth crown morphology varied hardly among the major races of human kind. Exceptions to this generalization are the cusp of Carabelli and the molar cusp pattern and number. This study is the first one of its kind, as there are no previous studies from India regarding the prevalence of morphological variations mentioned above.^[6]

In the normal scenario, with respect to the permanent mandibular molars, there are usually five

cusps – mesiobuccal (protoconid), mesiolingual (metaconid), distobuccal (hypoconid), distolingual (entoconid), and distal (hypoconulid). Variations in the mandibular molars are as follows:

- An extra cusp on the buccal surface of the mesiobuccal cusp or the protostylid
- A sixth cusp called the tuberculum sextum or entoconulid located on the distal marginal ridge between the distal and distolingual cusps
- A seventh cusp known as metaconulid or tuberculum intermedium occurs as a small elevation on the distal ridge of the mesiolingual cusp or as a relatively prominent eminence on the lingual rim of the crown between the mesiolingual and distolingual cusps, found in relatively high frequency among Negroid populations.^[7] A study was conducted by Scott where he found that the prevalence of cusp 7 was found to be 5–10% in the general population.^[8]

The maxillary molars differ from the mandibular molars in many aspects. A few to name would be cusp of Carabelli, 3-cusped maxillary 2nd molar and 5-cusped maxillary 1st molar.

The development of individual teeth involves epithelial mesenchymal interactions that are mediated by signals shared with other organs. Tooth type appears to be determined by epithelial signals and to involve differential activation of homeobox genes in the mesenchyme. This

Table 1: Prevalence of some morphological variant dental features in school-going children aged 11-16 years from Davangere

Feature	No. of cases (1600)	%
Cusp of Carabelli	313	19.5
3-cusp maxillary 2 nd molar	253	15.8
Cusp 5 maxillary 1 st molar	436	27.3
4-cusp mandibular 1 st molar	117	7.3
5-cusp mandibular 2 nd molar	41	2.5
Cusp 6 mandibular 1 st molar	321	20
Cusp 7 mandibular 1 st molar	108	6.7
Total	1589	99.1

Table 2: Prevalence of a few morphological variant dental features among males and females

Feature	No of cases (1600)	No. (%)		<i>P</i>
		Males	Females	
Cusp of Carabelli	313	151 (20.8)	162 (18.7)	0.28
3-cusp maxillary 2 nd molar	253	121 (16.7)	132 (15.2)	0.45
Cusp 5 maxillary 1 st molar	436	204 (28.1)	232 (26.8)	0.54
4-cusp mandibular 1 st molar	117	53 (7.3)	64 (7.3)	0.94
5-cusp mandibular 2 nd molar	41	23 (3.1)	18 (2.0)	0.17
Cusp 6 mandibular 1 st molar	321	123 (16.9)	198 (22.8)	0.003*
Cusp 7 mandibular 1 st molar	108	49 (6.7)	59 (6.8)	0.99
Total	1589	724 (45.5)	865 (54.4)	

*Highly significant

differential signaling could have allowed the evolutionary divergence of tooth shapes among the various tooth types. The advancing tooth morphogenesis punctuated by transient signaling centers in the epithelium corresponds to the initiation of the tooth buds, tooth crowns, and the individual cusps.^[9]

Several members of the fibroblast growth factor (FGF) family, i.e. FGF 4, 8, and 9, have been implicated as epithelial signals regulating mesenchymal gene expression and cell proliferation during epithelial morphogenesis and the establishment of tooth shapes.^[10]

A study was done by Kettunen *et al.* where he analyzed the roles of FGF-3, FGF-7, and FGF-10 in developing mouse teeth. Their result suggested that FGF-3 and FGF-10 have redundant functions as mesenchymal signals regulating epithelial morphogenesis of tooth and that their expressions appeared to be differentially regulated. In addition, FGF-3 may participate in signaling functions of the primary enamel knot.^[9]

Another school of thought for the variations with respect to occlusal surfaces of molars is that they are determined polygenetically and by a combination of allele on two or more sites, and that they occur in one of the final stages of molar growth as a result of the terminal deposition of enamel.^[10] Numerous studies have shown that the genes of the X-chromosome regulate the deposition of enamel, while the genes of the Y-chromosome influence the division of the cell connected with the formation of the dentine–enamel bond and the deposition of enamel.^[11] Dental anomalies are caused by complex multifactorial interactions between genetic, epigenetic, and environmental factors during the long process of dental development.^[12]

The cusp of Carabelli is said to emerge from the lingual surface of the mesiolingual cusp of upper molars and usually begins to form after the four major cusps of the molar have initiated. The trait ranges in expression from a shallow furrow to a cusp with a free apex which rivals the hypocone (distobuccal cusp). The study also suggests that the interaction between enamel knot spacing and the duration of crown morphogenesis best reflects the developmental events promoting late-forming enamel knot formation and thus Carabelli's cusp expression. Once formed, Carabelli's cusp size would be increased either by an earlier onset of formation (resulting in a taller Carabelli's cusp), by delaying the cessation of tooth crown formation (resulting in a broader Carabelli's cusp, especially lingually), or both.^[13] The frequency of Carabelli cusp was reported to be high in Europeans (70–90%), but low in oriental races.^[14] This prevalence was higher when compared to the Hungarian population (65.34%).^[13] In Malaysian children, the frequency of a Carabelli cusp on the maxillary 1st molars was 54.2%^[15] which was comparable to

another study in India where the prevalence was 52.77%.^[16] Compared to all these studies, our study has a much lesser prevalence which is only 19.5%.

A study conducted by Suzuki and Sakai concluded that there are no significant difference in the cusp numbers of 1st and 2nd molars of 392 male and female Japanese.^[17]

The frequency of cusp 6 on the 1st and 2nd molars (65 and 63%, respectively) from Indian crania was found to be about 3 times that of Aleuts (21 and 18%, respectively) and Eskimos (22 and 18%, respectively). But the prevalence of cusp 6 on the mandibular 1st molars of Aleuts and Eskimos was comparable to our study (20%). All three groups (Indian, Aleuts, and Eskimos) showed 5- or 6-cusped 1st lower molars. No 4-cusped molars were found. The 4-cusped 2nd lower molars occurred most often in the Aleuts (9%), less in Indians (3%), and least in the Eskimos (1%).^[18]

Our study is the first of its kind in India or any other part of the world for that matter. Other studies performed by Poornima,^[9] Nagaveni *et al.*,^[20] Anantharaj *et al.*,^[1] Jha *et al.*,^[2] Madhushankari *et al.*,^[3] and Hedge *et al.*^[5] have reported cases pertaining to a particular feature like the presence of a 6-cusped molar or a variation in a particular molar. There is no prevalence study that could give us baseline data of the variations present in the molars.

Forensic importance

All human dentitions are basically the same. The differences between individuals are in the number and extent of the primary and secondary characters of the tooth groups, which in turn are the reflections of the genetic constitution of the individual. From the "blueprint" that characterizes all human dentition, teeth exhibit morphological and metric traits that vary within and between populations. The morphological variations are a secondary type of dental variation, which are of greater evolutionary significance than the rare and idiosyncratic dental anomalies that are mostly induced by environmental factors during development. The paleontological record indicates that dental evolution proceeds by selection of minor variations. There are major differences between trait frequency and expression between populations, and it is this variation that is of special significance to physical anthropology and allied fields. The secondary structural variants of tooth crowns manifest in two primary ways: All or none characters (accessory ridges, supernumerary cusps and roots, furrow patterns) or as difference in form (variation in curves or angles). Within a population, these traits show variation in the degree of expression as often are noted as slight, moderate, or pronounced when present.^[7]

The sixth cusp has been described as a racial characteristic of the Mongoloid population. It is said to show distinct contrast between populations. American Blacks are said

to show the highest frequency, which distinguishes Blacks from other populations. Hence, these dental anomalies can very well be used to find out the origin of a particular person to a certain extent.^[2]

As far as cusp of Carabelli is concerned, the incidence and degree of expression differ among species; therefore, it can be used to detect and to compare different populations. According to Bermúdez De Castro (1989), Carabelli's trait can be useful in establishing the phylogenetic relationships between closely related populations.

There is a variation in the prevalence of cusp 7 in different ethnic groups. A study done by Scott (1973) showed variations in frequency of cusp 7 in lower 1st molars. The study showed low frequency (0–10%) for Western European, Sino-American, and Sunda pacific groups. Finnish-Permian group showed a frequency of 3%. Our study found a prevalence of 6.7% in Davangere children, which is in agreement with the above studies.^[7,8,21]

Conclusion

This is the first study of its kind and provides baseline data about the same in Karnataka. Among the sample size chosen about 99.3% of the school children were found to have at least one dental variant feature with respect to the shape of teeth, which is a very high number. The most common variant seen was the cusp 5 maxillary 1st molar seen in 27.3% of children. As far as gender was concerned, females were more commonly affected with 6-cusped mandibular 1st molar ($P < 0.001$, HS) when compared to males. However, further epidemiological studies are definitely required in individuals of different races showing specific morphological variations.

References

- Anantharaj A, Praveen P, Venkataraghavan K, Pratibha Rani S, Krishnan MB. Bilateral six cusped and three rooted mandibular first molars. *World J Dent* 2011;2:255-8.
- Jha P, Nikhil V, Arora V, Arora A. Tuberculum intermedium in mandibular first molar: A case series. *International Journal of Dental Update* 2011;1:53-6.
- Madhushankari GS, Basavanna RS, Dahiya D, Sonika. Emphasizing a new developmental variation of the mandibular molars-A mermaid in dentistry. *J Clin Diagn Res* 2011;5:402-3.
- Mavrodisz K, Rózsa N, Budai M, Soós A, Pap I, Tarján I. Prevalence of accessory tooth cusps in a contemporary and ancestral Hungarian population. *Eur J Orthod* 2007;29:166-9.
- Hegde S, Nayak UA. Unusual occlusal morphology mandibular first permanent molar: A case report. *Int Chin J Dent* 2003;3:1-6.
- Jernvall J, Thesleff I. Reiterative signaling and patterning during mammalian tooth morphogenesis. *Mech Dev* 2000;92:19-29.
- Scott GR, Turner CG. *The Anthropology of Modern Human Teeth: Dental Morphology and Its Variation*. 1st ed. Cambridge, England: Cambridge University Press; 1997.
- Scott GR. *Dental Morphology: A Genetic Study of American White Families and Variation in Living Southwest Indians*: Arizona State University; 1973.
- Kettunen P, Laurikkala J, Itäranta P, Vainio S, Itoh N, Thesleff I. Associations of FGF-3 and FGF-10 with signaling networks regulating tooth morphogenesis. *Dev Dyn* 2000;219:322-32.
- Moorrees CF. *The Aleut Dentition: A correlative study of dental characteristics in an Eskimoid people*. Cambridge: Harvard University Press; 1957.
- Maćešić M, Kaić Z. Characteristics of the occlusal surfaces of lower molars in a sample of the Croatian population. *Acta Stomat Croat* 2003;37:69-73.
- Brook AH. Multilevel complex interactions between genetic, epigenetic and environmental factors in the aetiology of anomalies of dental development. *Arch Oral Biol* 2009;54(Suppl 1):S3-17.
- Hunter JP, Guatelli-Steinberg D, Weston TC, Durner R, Betsinger TK. Model of tooth morphogenesis predicts carabelli cusp expression, size, and symmetry in humans. *PLoS One* 2010;5:e11844.
- Alvesalo N, Nuutila M, Portin P. The cusp of Carabelli. Occurrence in first upper molars and evaluation of its heritability. *Acta Odontol Scand* 1975;33:191-7.
- Rusmah, Meon. Talon cusp in Malaysia. *Aust Dent J* 1991;36:11-4.
- Kannapan JG, Swaminathan S. A study on a dental morphological variation. Tubercle of Carabelli. *Indian J Dent Res* 2001;12:145-9.
- Suzuki M, Sakai T. Occlusal surface pattern of the lower molars and the second deciduous molar among the living Polynesians. *Am J Phys Anthropol* 1973;39:305-15.
- Turner CG. *The Dentition of the Arctic Peoples*. Madison: Garland Publishing; 1967.
- Poornima P, Shilpa S, Roshan NM, Subba-Reddy VV. Variation in morphology of permanent mandibular first molar: A rare case report in India and review. *Inter J Dental Anthropol* 2013;23:43-51.
- Nagaveni NB. Occurrence of cusp 7 (Metaconulid) in permanent lower first molars- Report of 4 cases and review of literature. *Int J Dent Anthropol* 2008;13:22-7.
- Palomino H, Chakraborty R, Rothhammer F. Dental morphology and population diversity. *Hum Biol* 1977;49:61-70.

How to cite this article: Poornima P, Kirthiga M, Sasalwad S, Nagaveni NB. Prevalence of a few variant dental features in children aged 11–16 years in Davangere, a city in Karnataka. *J Forensic Dent Sci* 2016;8:13-7.

Source of Support: Nil, **Conflict of Interest:** None declared