Original Article

Evaluation of occlusal groove morphology of primary mandibular second molar in an Indian population

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Abstract

Background: The study of morphology of dentition can provide information on the phylogenetic relationship between species and diversities among population. There is a difference in opinions regarding influence of ethnicity on dental morphology. Using quantitative methods, few studies have shown the associations between these dental features and crown traits in humans. The present study is to find the correlation between the occlusal morphology and forensic anthropological research. **Aim and Objective:** The aim of this study is to determine the prevalence of different types of primary mandibular second molars in South Indian which can be used in forensic anthropological research. **Materials and Methods:** This study was conducted among 276 children in Thiruvallur district, Tamil Nadu. Screening for the number of cusps and groove patterns of primary mandibular second molars was done by direct intraoral examination. **Statistical Analysis:** It was done with the help of IBM. SPSS statistics software 23.0 version. To find the significance in categorical data, Chi-square test was used. $P < 0.05$ was considered as statistically significant. **Results:** Primary mandibular second molars with 5 cusps were observed in 96.4% of population, 4 cusps in 1.8%, and 6 cusps in 1.8% which were noted in the study. Mandibular second molars with "+" groove pattern in 33% of population and "Y" groove pattern in 67% of population were recorded. 5Y pattern was the most frequently observed occlusal pattern in these population, which is a primitive type of occlusal groove pattern. **Conclusion:** The study of dental morphology and odontometry is important in the field of forensic and anthropological research. It helps to understand the phylogenetic relationships among species and also to study the diversities within a population. This study revealed a primitive type of occlusal morphology in the population studied.

Key words: Anthropology, forensic, primary teeth

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Introduction

In living and nonliving populations, teeth can serve as an excellent source of study material in genetic, forensic, and anthropological investigations.[1] Variations and difference in the degrees of expression are observed in the dentitions among different populations.[2,3] Cultural, environmental, and racial factors are known to influence the morphometry of the teeth. Occlusal characteristics of the primary teeth can also be influenced by sucking habits and parafunctional habits like bruxism.[4] The variations in tooth form and groove pattern are frequently encountered which can be studied by measurements.[5] Variations in the occlusal surfaces of the mandibular molars are based on the study by Gregory and Hellman.[6,7] Dental morphological characteristics provide data about the phylogenetic relationships between different species. It also provides information regarding the variations and diversities within a population which can be used in forensic and anthropological research.[8] Like the other biological characters, tooth morphology also forms the heritage of human population.[9] The permanent mandibular molars present with protoconid (mesiobuccal), hypoconid (distobuccal), and mesoconid (hypoconulid) cusps on their buccal aspect and the metaconid (mesiolingual) and entoconid (distolingual) on their lingual aspect. Various groove patterns are formed based on the variation in the contacts of these cusps with each other.[10] If contact of metaconid cusp occurs with the hypoconid cusp, it forms "Y" pattern. If there is no contact of the two cusps, it forms "+" pattern.[11]

A total of six occlusal groove patterns are observed in permanent mandibular molars: 4+, 4Y, 5+, 5Y, 6+, and 6Y, where 4, 5, and 6 represent the number of cusps present and "+" and "Y" represents the groove patterns.[10] A lower molar with Y groove pattern and five to six cusps was observed in *Dryopithecus*. With the evolution, there appears to be decrease in the number of cusps.[12] According to Gregory and Hellman, the basic pattern is the "5Y" type.[6]

The primary second mandibular molar resembles the permanent mandibular first molar except that it is smaller in its dimension.[7] The study of occlusal morphology of the teeth can provide information about the phylogenetic relationships between different species and diversities among the same population. The objective of the present study was to assess the occlusal morphology of the primary mandibular second molar in South Indian population.

Materials and Methods

The study was approved by the Institutional Ethical Committee (STP/SDMDS2017PED42B). This study was a descriptive study conducted in two primary schools in Thiruvallur district, Tamil Nadu, after obtaining permission from the authorities of the schools. Informed consent was obtained from the parents of the children who were included in the study. The study was conducted in 276 children using cluster sampling, who satisfied the inclusion and exclusion criteria [Table 1].

Direct intraoral examination of the children for the number of cusps and the groove patterns along with the age and sex was recorded by two trained dental professionals using mouth mirror under natural illumination. A pilot study was done on 40 children who visited dental college for treatment. The two examiners recorded the data independently under the supervision of a professor so as to avoid any interobserver variation when scoring the study population. Inter-examiner reliability was checked using kappa statistics and the value was found to be 0.8. The criteria for determining the groove patterns given by Hellman and Gregory were used. If the contact of metaconid with the hypoconid occurs, it was considered as Y pattern. If there was no contact of the metaconid with the hypoconid, it was considered as + pattern.

Statistical analysis

The collected data were analyzed with IBM. SPSS statistics software 23.0 version (SPSS 23.0, IBM, Armonk, NY, United States of America). To describe about the data, descriptive statistics, frequency analysis, and percentage analysis were used. To find the significance in categorical data, Chi-square test was used. $P < 0.05$ was considered as statistically significant.

Results

Out of 276 children examined, 144 (52.2%) were males and 132 (47.8%) were females. The mean age of the males and females included in the present study was 7.2 years. In this population, five-cusp pattern was most frequently observed. The predominant groove pattern was "Y."

About 1.8% ($n = 10$) of teeth showed four-cusp pattern, 96.4% ($n = 532$) showed five-cusp pattern, and 1.8% ($n = 10$) showed six-cusp pattern. Almost 33% ($n = 182$) of the teeth showed "+" and 67% ($n = 370$) showed "Y" groove pattern [Table 2]. Table 3 shows occlusal morphology of

Table 1: Demonstrating the inclusion and exclusion criteria of the study

Inclusion criteria	Exclusion criteria
Children between age 5 and 9 years of age	Carious, restored, or broken teeth
Bilaterally fully erupted primary second molars	Children with bruxism are excluded
Molars showing clear occlusal outline with all cusps and groove pattern	Teeth with developmental defects of the structure and shape
Children of Tamil Nadu origin only	-

primary mandibular second molars. About 65.4% (*n* = 361) of teeth showed 5Y pattern followed by 5 + pattern which was observed in 31% (*n* = 171). 6 + pattern was the least observed pattern which was present in 0.7% (*n* = 4). Figure 1 shows that 5Y pattern is the most frequently observed pattern with 65.9% in right primary mandibular second molar and 64.9% in left primary mandibular second molar.

Table 4 shows bilateral symmetry of occlusal morphology. About 50% bilateral symmetry was observed in teeth which exhibited 6 + and 6Y pattern. Nearly 46.3% teeth with 5Y pattern exhibited bilateral symmetry. Table 5 shows occlusal morphology with gender distribution. There was no statistical difference in the distribution of the occlusal morphology between males and females, *P* > 0.05.

Table 2: Distribution of cusps and groove pattern

Tooth*	Left (75), *n* (%)	Right (85), *n* (%)	Total, *n* (%)
4 cusps	5 (1.8)	5 (1.8)	10 (1.8)
5 cusps	266 (96.4)	266 (96.4)	532 (96.4)
6 cusps	5 (1.8)	5 (1.8)	10 (1.8)
+	92 (33.3)	90 (32.6)	182 (33)
Y	184 (66.7)	186 (67.4)	370 (67)

*FDI system is used for notation of teeth. FDI: Federation Dentaire Internationale

Table 3: Occlusal morphology of primary mandibular second molar

Occlusal morphology	Left (75)*, *n* (%)	Right (85)*, *n* (%)	Total, *n* (%)
4+	3 (1.1)	4 (1.4)	7 (1.3)
4y	2 (0.7)	1 (0.4)	3 (0.5)
5+	87 (31.5)	84 (30.4)	171 (31)
5Y	179 (64.9)	182 (65.9)	361 (65.4)
6+	2 (0.7)	2 (0.7)	4 (0.7)
6Y	3 (1.1)	3 (1.1)	6 (1.1)

*FDI system is used for notation of teeth. FDI: Federation Dentaire Internationale

Table 4: Bilateral symmetry of occlusal morphology in primary mandibular second molars

Occlusal morphology	Frequency of bilateral symmetry, *n* (%)	Frequency of bilateral nonsymmetry, *n* (%)	Total, *n* (%)
4+	3 (42.9)	4 (57.1)	7 (100.0)
4Y	1 (33.3)	2 (66.7)	3 (100.0)
5+	72 (42.1)	99 (57.9)	171 (100.0)
5Y	167 (46.3)	194 (53.7)	361 (100.0)
6+	2 (50.0)	2 (50.0)	4 (100.0)
6Y	3 (50.0)	3 (50.0)	6 (100.0)

Discussion

Dental anthropology deals with the study of the origin and variations in the human dentition and can act as a valuable tool to identify the geographic origin of the population.[13] Genetic factors, long-term environmental factors, sucking habits, and other parafunctional habits influence the final form of the tooth.[3,4] Development of teeth is a long-term, progressive process which occurs as a result of molecular and cellular interactions. It has critical stages of development which can be influenced by genetic, epigenetic, and environmental factors.[14] The fissure pattern is independent of the number of cusps and is considered to be polygenic, determined by combinations of alleles at two or more loci.[15] The studies on dental morphology is mostly based on the classification of Gregory and Hellman.[5,6] Such studies have used various methods, such as extracted teeth,[3,13] intraoral examination,[16,17] and dental study casts.[18] In this study, direct intraoral examination of the study subjects was done which has the advantages of accurate recording, proper identification of teeth and follow-up of patients can be done when needed. It also has the advantage that it is less time consuming requiring minimum armamentariumwhich is convenient to both the examiner and the study subjects.[3,19]

The human dentition is changing in its form, size, and number. According to Dahlberg,[20] these changes are not taking place at the same rate among various racial groups and it varies from one geographic location to the other. There are 28 observable dental traits that have been studied in the Mongoloid dentition which include shoveling of the incisor teeth, Carabelli's trait, the number and form of cusps,
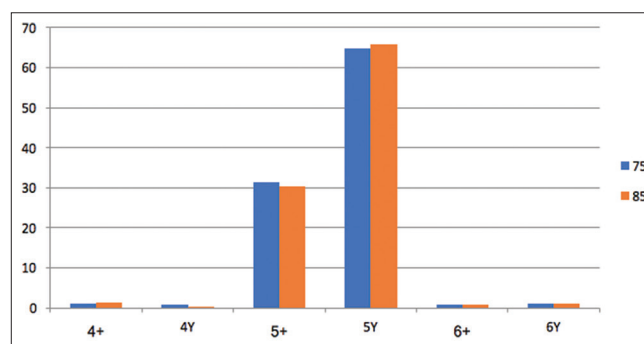

Figure 1: Distribution of occlusal groove pattern and cusp numbers in primary mandibular second molars

Table 5: Cusp numbers and groove pattern with general distribution in primary mandibular and second molar

Tooth*	4		5		6		P	+		Y		P
	Male (144), *n* (%)	Female (132), *n* (%)	Male (144), *n* (%)	Female (132), *n* (%)	Male (144), *n* (%)	Female (132), *n* (%)		Male (144), *n* (%)	Female (132), *n* (%)	Male (144), *n* (%)	Female (132), *n* (%)	
75	3 (2.1)	2 (1.5)	139 (96.5)	127 (88.2)	2 (1.4)	3 (2.1)	0.893	50 (34.7)	42 (29.2)	94 (65.3)	90 (62.5)	0.609
85	3 (2.1)	2 (1.5)	139 (96.5)	127 (88.2)	2 (1.4)	3 (2.1)	0.893	50 (34.7)	40 (27.8)	94 (65.3)	92 (63.9)	0.434

*FDI system is used for notation of teeth. FDI: Federation Dentaire Internationale

ridges and fissure patterns, and presence of three roots on the mandibular first molar.[21-23]

The primary mandibular second molar resembles the permanent mandibular first molar except the fact that the former is smaller in its dimension.[7] This study was carried out based on Hellman's classification of occlusal pattern and number of cusps on permanent mandibular permanent molars. Very few dental anthropology has been carried out in primary teeth.

Morphological study on the occlusal groove of mandibular molar of Chinese population showed "5Y to be the most prevalent pattern in permanent mandibular first molars.[24] This is in concordance with the present study. Morphologic characteristics of the permanent dentition of 63 coastal and 33 inland Alaskan Eskimos showed "5Y" to be the most prevalent pattern for permanent mandibular first molars.[25] The present study also shows similar finding in primary mandibular second molars. Another study conducted in the state of Gujarat, India, also revealed "5Y" pattern to be more prevalent in permanent mandibular first molar.[9]

During human evolution, the occlusal grooves of mandibular molar have changed from the pattern "Y to pattern "+." Six types of occlusal grooves were classified as Y5, Y4, +5, +5, X5, and X4.[16] However, distal cusp is the most variable, and in the evolutionary advanced type, it disappears and therefore leads to a four-cusp form.[3]

Conclusion

In the present study, the presence of high percentage of "Y" pattern shows the primitive nature of the people. The study of dental morphological characteristics and odontometry is important in forensic and anthropological research as it can provide information on the phylogenetic relationship between species and diversities among populations and also in performing dental treatments. Hence, clinicians should have knowledge on the variations seen in the occlusal morphology of the teeth.

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Conflicts of interest
There are no conflicts of interest.

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