ORIGINAL ARTICLE

Occlusal morphology of permanent mandibular first and second molars in Gujarati population

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Abstract

Background: Dental identification has been used since long time for disaster victim identification protocol. There is a difference of opinion regarding whether ethnicity influences dental morphology or not. Few studies have shown the associations between these dental features and crown traits in humans using quantitative methods. The present study is an attempt to find correlation of occlusal morphology of Gujarati population with forensic Odontology. **Aim:** To study different occlusal morphology of permanent mandibular first and second molars in Gujarati Population. **Materials and Methods:** This study comprised of a total of 100 participants of Gujarati origin, selected by random sampling method. Total number of cusps and groove patterns of mandibular first and second molar were examined clinically and photographs of the same were taken. A descriptive statistics, Chi-square test and Student *t*-test were used for analysis of data. **Results:** Mandibular first molar with 5 cusps in 71%, 4 cusps in 18% and 6 cusps in 11% were noted in the study. Mandibular first molars with "+" groove pattern in 39.5% and "Y" groove pattern in 60.5% were recorded. Mandibular second molar with 5 cusps in 6.5% and 4 cusps in 93.5% were recorded in the study. Mandibular second molars with "+" groove pattern in 93.5% and "Y" groove pattern in 6.5% were recorded. **Conclusion:** The most common occlusal morphology in permanent mandibular first molar is "5 cusp" and "Y" groove pattern in about 47% and for second molar is "4 cusp" and "+" groove pattern in 88.5% of Gujarati population. It may be concluded that variation in degree of expression and frequency of teeth in dentitions of different populations is different, which may help in forensic identification.

Key words: Cusp numbers, groove patterns, occlusal morphology, permanent mandibular first and second molars

Introduction

The large variation in morphological features and their form may not be easily altered; thus, a trait of the human dentition can be a valuable diagnostic tool for anthropological studies in classifying and characterizing different ethnic group.[1] The cusps, ridges, and grooves that decorate the crown surface also vary within different species of primates, together with the number and form of tooth roots. Various authors have different opinion regarding whether ethnicity influences dental morphology or not. However, it is observed that there are different degrees of expression and frequency in variation of teeth in dentitions of different populations.[2] Investigations into racial differences in dental morphology have led to the hypothesis that the common origins of peoples are reflected to a certain degree in their similar phenotypic patterns.[1]

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It is generally believed that the numerous morphologic characteristics of the teeth are generally determined.[3] Detailed description and study of these traits could provide valuable information regarding phylogeny of man and distinctions between races and subraces.[4]

Various studies attempt to relate the prevalence of dental morphology with different factors. Hsu *et al*., investigated the association between the shovel and the Carabelli's trait in a Chinese population.[5] Although tooth morphology may be indicator of genetic distances between populations it should be viewed with caution. The cusps and grooves on mandibular molars were subsequently investigated by Gregory and Hellman.[6] Gregory and Hellman[6] and Hellman[7] described variations in occlusal surfaces of the mandibular molars and developed morphological categories as "5 Y," "5+," "4Y" and "4+." And Takeshi Matsuda has used "6Y," "5Y," "4Y," "6+," "5+," "4+," "6X," "5X," "4X" pattern for mandibular molars. Al most all dental anatomy textbooks describes permanent mandibular first molar as "Y" groove pattern with 5 cusp numbers and permanent mandibular second molar as "+" groove pattern and 4 cusps.[8-10]

Unusual anomalous morphological features were mistakenly regarded by some early observers as aberrations and not considered to represent normal biological variation. Since only limited data are available on the prevalence of the dental characteristics of the Gujarati population, there seems to be a need to investigate the major dental traits in this population. The aims of this study were to determine the prevalence of occlusal morphology of permanent mandibular first and second molar in Gujarati population and its importance for Forensic Odontology.

Materials and Methods

A total 100 participants of Gujarati origin were introduced. Blinding of sampling was done and participants' identification number, gender and date of birth are recorded. The inclusion and exclusion criteria are as follows:

Inclusion criteria

- Teeth free from occlusal/proximal caries
- Presence of bilaterally completely erupted permanent mandibular first and second molars
- Molars showing clear occlusal outline with all cups and groove pattern
- Participant of only Gujarati origin.

Exclusion criteria

- Any pathology involving teeth including age-related changes
- Traumatic injuries of jaws/teeth
- Participants with cusp grinding, restorations and prosthesis
- Molars clinically showing hypoplastic features.

A 14 megapixel digital camera is used to for taking the photograph of the teeth. Teeth showing clear occlusal outline with all cusps and groove pattern of permanent mandibular first and second molars in the photograph are included in the study.

All the participants were first clinically examined and later intraoral occlusal photographs were taken to record the occlusal morphology without any error. To evaluate the groove pattern "Y," "+" or "X," if contact of metaconid (mesioligual cusp) with the hypoconid (distobuccal cusp) have been checked. If contact occurs the pattern resembles a "Y" form and if no contact occurs then pattern resembles "+" form and if entoconoid (distoligual cusp) contacts with protoconoid (mesiobuccal cusp) pattern resembles "X" form.[8-10] From the photograph and clinical examination cusp numbers and groove patterns of mandibular molars of 100 participants recorded [Figures 1-4]. The data thus collected subjected to statistical analysis. The SPSS software package version 20 has been used for statistical analysis. Descriptive statistics and Student *t*-test and Chi-square tests were used for data analysis.

Results

About 71.5% (143 teeth) mandibular first molar showed 5 cusps pattern, 18% (36 teeth) shows 4 cusps pattern and 10.5% (21 teeth) shows 6 cusps pattern. 93.5% (187 teeth) mandibular second molars shows 4 cusps pattern and 6.5% (13 teeth) shows 5 cusps pattern. 39.5% (79 teeth) of the mandibular first molar shows "+" and 60.5% (121 teeth) shows "Y" groove pattern. 93.5% (187 teeth) shows "+" and 6.5% (13 teeth) shows "Y" groove pattern [Table 1] [Figures 5 and 6]. We don't found "X" groove pattern and 7 cusps in any of the molars. Table 2

Figure 1: Mandibular right first molar showing "5Y," right second molar showing "4+" groove pattern. Mandibular left first molar showing "5+," left second molar showing "4+" groove pattern

Figure 2: Mandibular right first molar showing "4+," right second molar showing "4+" groove pattern. Mandibular left first molar showing "4Y," left second molar showing "4+" groove pattern

Figure 3: Mandibular right first molar showing "4Y," right second molar showing "4+" groove pattern. Mandibular left first molar showing "4Y," left second molar showing "4+" groove pattern

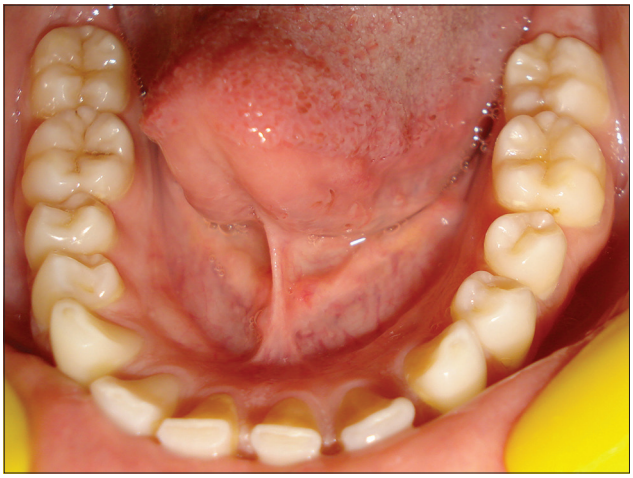

Figure 4: Mandibular right first molar showing "6+," right second molar showing "5+" groove pattern. Mandibular left first molar showing "6Y," left second molar showing "5+" groove pattern

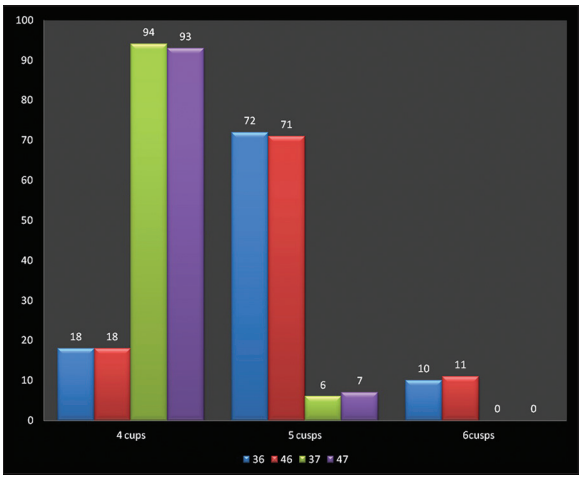

Figure 5: Distribution of cusp numbers in mandibular molars

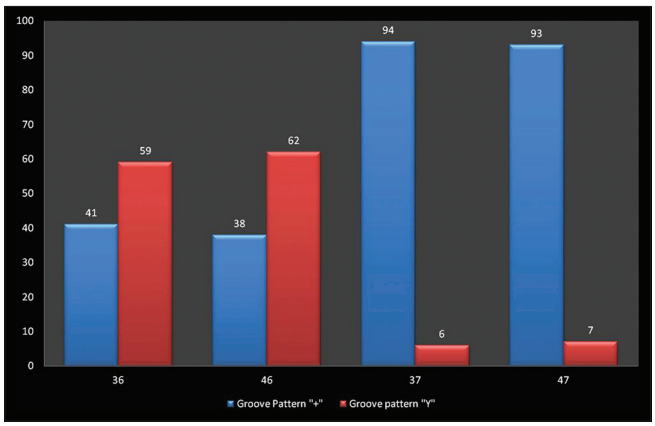

Figure 6: Distribution of groove pattern in mandibular molars

is showing gender-wise distribution of cusps and groove pattern of permanent mandibular molar [Figure 7].

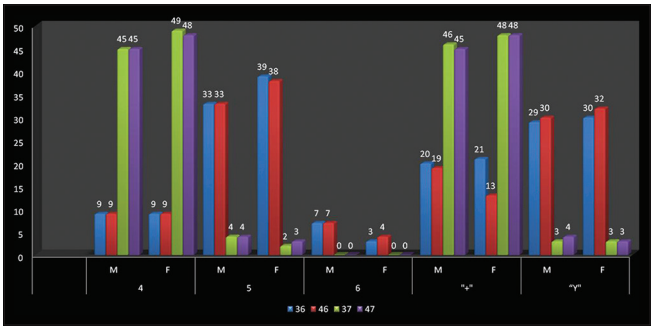

Figure 7: Gender distribution

Table 3 is suggesting the comparison of prevalence of occlusal morphology of mandibular first and second molars in Guajarati population by Student *t*-test and revels that 4 cusps pattern and "+" groove pattern are highly significant for permanent mandibular second molars where 5 cusps

pattern and 6 cusps pattern and "Y" groove pattern are statistically significant in mandibular first molars [Table 3]. The most common occlusal configuration for mandibular first molar is "5Y" in about 47% (94) and for second molar was "4+" in 88.5% (177).

Chi-square test revels that, there is no significant difference noted between male and female in occlusal pattern of "4+," "5+," "4Y," "5Y," "6Y." However "6+" pattern is significant in male ($P = 0.05$) as compared to females [Table 4].

Discussion

The term "trait" has been defined as a distinguishing feature, or characteristic of an individual. The frequency of occurrence of a trait may be low in a specific population because that trait is becoming progressively more, or less well developed in that population. Hence, it is not inconceivable that a trait could inadvertently be considered to be an anomaly, even though it may be a characteristic feature of that population. Thus, an anomaly which is considered in one population may be a trait in another population. Furthermore, the dentition of man is changing in form, size and number. Studies have, according to Dahlberg,[11] revealed that these changes are not taking place at the same rate in the various geographic and racial groups. This evolutionary tendency is probably the reason why there is so much variation in the number of cusps exhibited by the maxillary first primary molar of Japanese children.[12] The 28 observable dental traits that have been studied in the Mongoloid dentition include shoveling of the incisors teeth, Carabelli's trait, the number and form of cusps, ridges and fissure patterns, and three roots on the mandibular first molar.[13-15]

Table 1: Distribution of cusps and groove pattern in permanent mandibular molars

Tooth*	Cusp numbers			Groove pattern	
	4 cusps	5 cusps	6 cusps	"+"	"Y'
36	18	72	10	41	59
46	18	71	11	38	62
37	94	6	0	94	6
47	93	7	0	93	7

*FDI system is used for notation of teeth

Table 2: Cusp numbers and groove pattern with gender distribution in permanent mandibular molars*

Tooth*	Cusp numbers						Groove pattern			
	4		5		6		"+"		"Y"	
	M	F	M	F	M	F	M	F	M	F
36	9	9	33	39	7	3	20	21	29	30
46	9	9	33	38	7	4	19	13	30	32
37	45	49	4	2	0	0	46	48	3	3
47	45	48	4	3	0	0	45	48	4	3

*FDI system is used for notation of teeth, M: Male, F: Female

Table 3: Comparison of prevalence of occlusal morphology of mandibular first and second molars in Gujarati population*

Student-t test	Cusp numbers			Groove pattern	
	4	5	6	"+"	"Y"
36-46	0.004	0.01	0.03	0.012	0.012
37-47					

*FDI system is used for notation of teeth

Table 4: Statistical test for occlusal morphology using Chi-square test*

	P					
	"4+"	"4Y"	"5+"	"5Y"	"6+"	"6Y"
First molars	0.07	0.0869	0.91045	0.24987	0.0525	0.96032
Second molars	0.746187	0.559144	0.948252	0.07503	-	-

*FDI system is used for notation of teeth

The accumulation of data on the morphological traits of the teeth in different populations has led anthropologists to become more concerned with the evolutionary significance of these data, and to consider the mode of inheritance. The various morphological traits of the dentition are likely to be inherited; however, the mode of inheritance, of most traits, is at present poorly understood, and may well remain so for a long time.

For permanent mandibular molars cups such as protoconid (mesiobuccal), hypoconid (distobuccal) and mesoconid or (hypoconulid) present on the buccal side and metaconid (mesioligual) and entoconid (distoligual) on the lingual side. Based on contacts of these cusps various groove patterns have been identified in permanent mandibular molars such as "Y," "+," "X."

Sex determination using dental features is primarily based upon the comparison of tooth dimensions or using non-metric dental traits, like Carabelli's trait of upper molars, deflecting distal accessory ridge of the upper and lower canines or shoveling of the upper central incisors. But many dental researchers found low level of sexual dimorphism in human crown dimension.[16] Very few studies have been done in forensic odontology based on occlusal morphology of permanent mandibular first and second molars.

In the present study after visual clinical examination, direct intraoral photographs of permanent mandibular first and second molars with clear cusp outline and groove pattern were taken. Age, sex and cusp numbers and groove patterns were noted. Previously, many similar studies have used impression and dental cast for data collection. In the present study we have used the photographic method with intraoral examination which has advantages as following:

- Requires minimum armamentarium
- Less time consuming
- Preservation and longevity of digitalized data is convenient and easy

- Convenient to both examiner and subjects
- Transfer of material/data is easy.

The study showed that 71.5% (143) mandibular first molars showed 5 cusps pattern and 60.5% (121) showed "Y" groove pattern. And 47% of them showed "5Y" pattern. 93.5% (187) mandibular second molars showed 4 cusps pattern, 93.5% (187) showed "+" groove pattern and 88.5% showed "4+" occlusal morphology. No "X" groove pattern was noted in the present study.

Mosharraf *et al*.,[17] has studied occlusal morphology of permanent mandibular second molar in Iranian adolescent by using hydrocolloid impressions of subjects and found that most frequent occlusal configuration was 4+ pattern that is coinciding with the present study.

Guo *et al*.,[18] have done morphological study on occlusal grove of mandibular molar of Chinese adults using computer analysis and found that the rate of "5Y" in first mandibular molar is the highest. The rate of "+4" in second mandibular molar is the highest suggesting evolutionary changes in groove pattern molars correlating with the present study.

Hasund and Bang[19] have studied morphologic characteristics of the Alaskan Eskimo dentition and noted cusp number and groove patterns of mandibular molars. The predominant pattern of the lower first molars was 5Y, while for the second molar the dominating patterns were +5 and +4. So, for the second molar results are not completely correlating the present study.

Result of the study in not showing any significance to use for gender determination but defiantly further studies with larger sample size may give some favorable results regarding forensic odontology. Present results can be helpful in knowing normal variation in morphology of permanent mandibular molars which ultimately helps in routine dental practice, such as restorative, prosthodontics, orthodontics etc., as well as in anthropology.

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