PERMANENT MANDIBULAR SECOND MOLARS;
OCCLUSAL MORPHOLOGICAL CHARACTERISTICS OF PERMANENT MANDIBULAR SECOND MOLARS IN A SAMPLE OF PAKISTANI POPULATION

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ABSTRACT… Objectives: Tooth morphology plays an important role in dental anthropology & forensic odontology. This study was conducted to determine the frequencies of variations in occlusal surface patterns in permanent mandibular second molars in a subset of Pakistani population. **Data Source:** 500 medical and dental students of Dow University of Health Sciences and healthy volunteers visiting the dental OPD with age range from 17 to 25 years. **Design of Study:** Cross-sectional analytical Study. **Setting:** Department of Oral Biology, Dr. Ishratullbad Khan Institute of Oral Health Sciences, Dow University of Health Sciences. **Period:** May 2017 till August 2017. **Materials & Methods:** This analytical study was conducted in the department of Oral Biology at Dr Ishratul Ibad Khan Institute of Oral Health Science. Five hundred dental casts after interoral exam and impression taking were studied for the variations in the frequency of of cusps and their relative groove and fissure pattern. Statistical analysis was performed by Descriptive analysis and Chi Square. **Results:** Out of the fivbe hundred casts that were analysed, 51% were of males and 49% were of females. The four-cusped variety of mandibular molars with presence of distal fovea and distal marginal ridge was the most frequent (95.4%) while the most prevalent occlusal groove form was "+" shape (88.4%). Frequently present occlusal pattern was the "+4" form (85.4%). **Conclusion:** The occlusal configurations of mandibular molars showed high degree of variability. The most frequently occurring pattern of occlusal surface of mandibular second molars in this subset of Pakistani population was determined to be "+4" form. These findings can be used for forensic, teaching & clinical purposes by providing a Pakistani database for morphological characteristic of mandibular molars.

Key words: Occlusal Morphology, Mandibular Molars, Forensic Odontology, Pakistani Population.

INTRODUCTION

No two dentitions are alike ! Dentitions with their spatial arrangement of teeth of any individual are as unique as their finger prints.[1] Accurate antemortem dental records serve as excellent resources for dental identifications in forensic odontology & dental anthropological studies due to the inherent variability in human dentitions.[2,3] Teeth have importance not only for esthetics, mastication and function but they have a pivotal role in forensic odontology, dental anthropology, paleontology, age determination and for ethnic and racial identification. The occlusal characteristics of mandibular molars such as the frequency and morphology of the cusps and the developmental primary and supplementary groove pattern are

used by palaeontologists, forensic odontologists and comparative anatomists to study the human populations due to their evolutionary impact.[4-7]

A strong body of tooth morphology literature suggests that mandibular second molars present with characteristic morphological variations in structure, shape and groove pattern comprising of four cusps with alternating groove patterns representing the plus sign.[8,9] Racial and ethnic variations in the dimensions of mandibular molars alongwith their occlusal patterns present as identifying and distinguishing characteristics in forensic odontology and paleontology.[10] The multiple occlusal characteristics of mandibular second molars are evident as "5 – Y," " 4 – Y " , "

+5 " and " +4 "s.[11-13]

The future occlusal groove patterns is determined by the coalescence of hypocone with metacone resulting in either "Y" or a "+".

Fusion of lobes or primary parts of the tooth results in "Y" occlusal groove configuration, while occlusal surfaces devoid of this coalescence present with a plus sign.[14] Fissures and the "Y" occlusal pattern develop on the occlusal surface during tooth development without any relation to the frequency of cusps of mandibular second molars.[15] Five cuspal variety of mandibular second molars is characteristic of Negroid and Mongloid populations while its absence of five cuspal variety in Caucasians suggests possible racial and ethnic differences that can be pivotal for dental anthropological use.[16-18]

Six and even seven cusps have been identified in physical anthropological studies in mandibular molars of the Polynesians.[19] The location of the sixth cusp is considered to be in between entoconid and the hypocnulid of the mandibular molars in Hominidea.[19]

Dental traits can be effectively used to differentiate between ethnicities of any given population but genetic and molecular basis for the subtle variations in occlusal configurations has yet to be elucidated.[1,14] The frequencies of different traits and their relative expression were observed to be variable in dentitions of different populations.[20] The compilation of environmental and epigenetic factors commonly known as epigenetic factors determine the final shape of the tooth.[21] Some aspects of cultural and biological heritage can also be ascertained through morphological characteristics of teeth and its enclosed pulpal remnants such as their food, climate and migratory patterns in geographical areas.

Therefore the objectives of this study was to determine the most frequently presenting occlusal configuration in mandibular molars in a subset of Pakistani population. No relevant local study was found through searching the local databases of Pakmedinet.com and Google Scholar.

MATERIALS AND METHOD

This analytical cross sectional study was conducted in department of Oral Biology at Dr. Ishrat ul Ebad khan institute of oral health sciences, Dow University of Health Sciences from May 2017 till August 2017. The study sample comprised of five hundred dental, medical and paramedical students of Dow University of Health Sciences and healthy volunteers visiting the dental OPD with age ranging from 17 to 25 years after taking informed consent. Convenience sampling was used to select the participants.

The careful intraoral examination was undertaken after acquiring medical and dental history. Then impression of the oral cavity were taken to prepare dental casts. Dental casts are an inherent component of antemortem dental records. Dental casts were selected rather than visual examination to increase objectivity and reliability in this study. The occlusal configurations of the permanent molars were recorded from the poured casts including the bilateral frequency of cusps and their relative groove and fissure configurations.

The study was performed bilaterally to include all the mandibular molars. Decayed, crowned and heavily restored and extracted mandibulars molars were excluded from this study. In this study, cusps were defined as positive anatomical landmark that appears as a rounded gothic pyramid presenting with triangular ridge, mesial and distal ridge and a lingual ridge accompanied by a groove that is presented as a centrally placed negative anatomical landmark or concavity. Six predominant forms of occlusal grooves and fissures (4 - y, +4, 5 - y, +5, 6 - y and +6) were identified in this study involving five hundred stone casts of mandibular second molars. SPSS version 21 was used to perform statistical analysis for this analytical study. Standard deviation and mean were calculated for descriptive statistics. Chi Square test was used for statistical correlation of qualitative variables.

RESULTS

Of the five hundred casts that were analysed, 51% were of males and 49% of females. Most frequent form i,e 95.4% of occlusal configuration was

determined to be four-cusped form bilaterally b; category 3 as per Biggerstaff classification while only 4.6 % of casts showed 5-cusped form with distal marginal ridge and distal fovea bilaterally; category 1 as per Biggerstaff as shown in Figure-1.

Mandibular molars with occlusal groove configuration presenting with a plus sign (88.4%) was recorded the highest amongst all occlusion variations. "Y" pattern of occlusal groove configuration was identified in lesser number of casts (11.6%).

The most frequent occlusal pattern identified was "+4" form (85.4%) only few casts demonstrated the "+5" form (3%). 10% of the stone casts displayed "4-Y" pattern while "5-Y" was determined only in few casts (1.6%) as depicted in Figure-1.

Bilateral presentation of molars was predominantly found in this study population presenting with plus four occlusal configuration (71.4%).

Occlusal configurations in males and females did not present with any statistical correlation amongst the most commonly presenting six configurations (Table-I).

Males presented with a statistically significant plus five occlusal configuration in comparison with girls.

The statistically significant occlusal groove pattern determined by Chi-square test was determined to be four Y ($P < 0.005$). No statistical correlation of occlusal configurations of mandibular molars belonging to the right and left quadrants was determined by Pearson correlations ($P > 0.05$) as shown in Table-I.

Occlusal Configuration	Male	Female	Total
4-Y	27*	23	50
+4	212	215	427
5-Y	4	4	8
+5	7	8	15
6-y	0	0	0
+6	0	0	0
Table-I. Gender distribution of occlusal patterns *Sig >0.05			

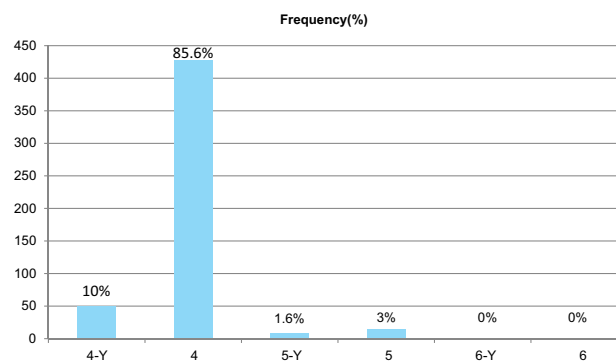| Occlusal Configuration	Right side	Left side	Total
4-Y	52	48	100
+4	427	427	854
5-Y	8	8	16
+5	14	16	30
6-y	0	0	0
+6	0	0	0
Table-II. Bilateral distribution of sample on right and left side *Sig >0.05++			

Figure-1. Frequency distribution of occlusal characteristics

DISCUSSION

The tooth form in adults comprising of both its positive and negative anatomical landmarks is a result of genetic and environmental influences.[22] The boundaries of cusp are represented by multiple set of grooves thereby relating the cusp to the contiguous structures.[15] Grooves are formed during tooth development when lobes or centres of calcification coalesce.[22] These grooves can be either primary grooves that delineate the primary parts of the tooth and supplemental grooves that demarcate the boundaries of subordinate crown components.[23] It has been established from various studies that the relative size and position of cusps and grooves are genetically determined, phenotypically expressed, time linked and cusps, ridges and all positive anatomical landmarks are morphodifferentiated based on the growth rate differences.[24,25] Cusp number and size are manifested by true coronal polymorphism since fully developed structure of crown represents a species specific expression of all resulting from the ontogenetic processes.[26] Grooves are a manifestation of terminal boundaries of positive anatomical landmarks such as cusps and ridges

and are determined primarily by positioning of these landmarks and are thus not genetically determined.[27] Since the forms of grooves vary in depth and width significantly and are considered to be manifestations of the inability of ameloblasts to continue enamel deposition in the constricted space between the two contiguous lobes or positive anatomical landmarks, it can be argued that they are not under the influence of any epigenetic control and thus do not determine any evolutionary changes.[6]

Phenotypically, the mandibular occlusal groove pattern and the number of cusps were classified by Gregory and Hellman.[11] The key occlusal groove form "+4" was explained as four cusps with + shaped occlusal groove pattern, corresponding to Hellman's classification.[11] Among the five cuspal occlusal configuration the distobuccal cusp or the hypoconulid is the most evolved type and the fifth cusp disappears leading to a four-cusp form.[12,28] Almost all of the studies relating to morphology of mandibular molars have used Hellman's classification. Due to grooves not being related to epigenetic and evolutionary pathways in its development and expression, Biggerstaff classified the mandibular molars on the basis of cusps, grooves, distal marginal ridges and distal fovea into three categories.[6] The first category has five cusped mandibulars molars with a distal marginal ridge & distal fovea, second category comprises of five cusped mandibular molars without a distal fovea and distal marginal ridge and the third cagtegory has four cusped molars.[6] Five cusped molars may have accessory cusps namely the tuberculum sexta and the tuberculum intermedium. Five cusped mandibular molars having a distal marginal ridge and distal foveae usually possess tuberculum sexta while the tuberculum intermedia can be present in any of the three categories.

In the present study of variations in occlusal configuration of mandibular second molars from a subset of Pakistani population was determined in which, majority of casts i.e 95.4% showed four numbers of cusps namely mesiobuccal, distobuccal, mesiolingal and distobuccal cusp. The results of this study are comparable to other population based researches conducted in Iran, India and Saudi Arabia with similar results.[8,9,29]

The four cuspal variety of mandibular second molars is characterized by the typical absence of the distal cusp owing to absence of growth of lobes or centres of calcification emanating from lack the inner enamel epithelium during tooth development.[21,30]

Five cuspal variant of mandibular second molar was observed in highest number in Singaporean, main land Chinese & Alaskan Eskimo population,[5,31,32] which is contrary to the present study that showed only 4.5% of the total sample with five cusps. But the results of our study are consistent with the observations of new population of China, which rated the four cuspal variant of second mandibular molars to be in abundance as compared to five cuspal variety of second mandibular molars.[31] The prevalence of four cuspal variety of mandibular second molar as opposed to five cuspal variety could be attributed to epigenetic and evolutionary trends in morphological characteristics of mandibular second molars.

As for the presence of prevalent groove pattern, the predominant pattern in this study was "+" form (88.4%), which is similar to other reports.[6,8,9,20,29,33]

When the complete occlusal configuration was studied that included both the occlusal groove pattern and the frequency of cusps, the bilateral "+4" form (85.4%) was most frequently present in our study sample, that was analogous to studies conducted on the Indian and Saudi population.[20,29,33]

Majority of the dental casts presented with groove shaped "+" and lesser number showed the primitive "Y" form in present finding. These occlusal characteristics showed persistently high evolutionary trend in permanent mandibular second molars. There are studies that indicate sexual dimorphism in men to have the "y - 5".[6,32,34] In our report, no statistical difference was appreciated based on gender. Our finding is in agreement with another study in which the

frequency of each type of groove between gender also presented with no significant variance.[35] Occurrence of morphological characteristics in our study showed bilateral correlation. This finding proposes that there could be epigenetic factors responsible for variation rather than a casual occurrence resulting in diversity in this sample of Pakistani population.[36]

Tooth morphology is taught in dental education as an integral component of the subject of Oral Biology and standard textbooks on this subject are based on dentitions of North American descent.[37] It is therefore recommended that tooth morphology be taught on the basis of morphological aspects of teeth belonging to Pakistani population as racial and ethnic differences are apparent in these studies. This study is a step towards establishing a national database of tooth morphological characteristics that can be used for forensic odontology and dental anthropological studies. There is a need to establish forensic odontology as an undergraduate and postgraduate discipline in dentistry as identification using dental findings can be non-invasive and more accurately performed than other means currently employed in forensics. Forensic odontology relies heavily on national database on tooth morphological characteristics.

CONCLUSION

Odontometeric study of tooth morphological features and their comparisons amongst populations is of outmost important for establishing phylogenetic connection within a population. Population specific identifying and distinguishing tooth characterstics contribute towards establishing population specific forensic odontology and dental anthropology. There is a need to recognize forensic odontology at a national level by the Pakistan Medical & Dental Council and establish a national database of tooth morphological characteristics of the Pakistani population by requiring all dentists to ensure that dental records of their pateints are up to date, accurate and contemporaneous.

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> *The only impossible journey is the one you never begin.*
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> **– Anthony Robbins –**
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AUTHORSHIP AND CONTRIBUTION DECLARATION

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