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Analysis of Non - Metric Dental Crown Traits in the Population of Mahabubnagar District, Telangana

Running title: Analysis of Non- Metric Dental Crown Traits in the Population of Mahabubnagar District, Telangana

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Abstract: <u>Introduction</u>: Human identification is one of the most challenging subject that man has been confronted with. Forensic science helps in human identification by the application of science and technology to the detection and investigation of crime and administration of justice. Non - metric dental traits are used primarily to determine identify, gender and origin of a person. <u>Aim and Objective</u>: To study non - metric dental crown traits in the population of Mahabubnagar district, Telangana by using dental casts. <u>Materials and Methods</u>: A total of 400 subjects, 200 males and 200 females were selected 15 from schools, colleges in and around Mahabubnagar district. Impressions of maxillary and mandibular dental arches were taken and Non metric dental crown traits were examined to evaluate the presence or absence of a trait. <u>Results</u>: Out of the 15 non - metric dental crown traits, shovelling (41%), winging (21%), metacone (99.8%), hypocone (82.3%), cusp 5 (68.5%), cusp of carabelli (72%), interruption groove (39%), peg lateral (5%), cusp 6 (4.8%), dental tubercle (3%), distal accessory ridge (1%), mesial accessory ridge (0.3%) were found to be prevalent in the study population. <u>Conclusion</u>: Nonmetric dental traits of the human dentition can be a valuable diagnostic tool for anthropological studies in classifying and characterizing different ethnic groups. It is important to recognize that, population identification or differentiation is undertaken based on the presence or absence of multiple nonmetric traits, and not through the use of a single trait.

Keywords: Shovelling, winging, metacone, hypocone, distal and mesial accessory ridges

1. Introduction

Human beings are the most specialized, diversified and versatile creations in this nature.1 Human identification is one of the most challenging subject that man has been confronted with. Forensic science helps in human identification by the application of science and technology to the detection and investigation of crime and administration of justice, requiring the coordinated efforts of a multidisciplinary team.2 Tooth is a highly stable structure of human body which has high state of preservation compared to bone. Since 20th century, various studies on dental traits have exhibited significant differences in frequencies among different geographic areas around the world.3 Non - metric dental crown traits (NDCT) are phenotypic forms of the tooth crown that are succeed and administered in their orientation, location and growth. These tooth traits are inheritable and show major variations in their expression both within and between the populations.4 Till date, there are more than 135 non - metric dental traits described in human dentition.5 The present study is performed to observe and interpret NDCT such as carabelli cusp, shovelling, peg laterals, interruption groove, dental tubercle, winging, cusp 5, cusp 6, distal accessory ridge, mesial accessory ridge, hypocone, tricuspid premolars, parastyle, metacone, protostylid in the population of Mahabubnagar district, Telangana.

Aim and Objectives

To study non - metric dental crown traits in the population of Mahabubnagar district, Telangana 49 by using dental casts.

2. Materials and Methods

A total of 400 subjects, 200 males and 200 females were selected from SVS Institute of Dental Sciences, schools, colleges in and around Mahabubnagar district. Subjects who met the inclusion criteria were taken for the study. Impressions of both upper and lower arches of study subjects were taken with alginate impression material and study casts were made using type II Dental stone. Finally, required parameters such as cusp of carabelli, shovelling, peg laterals, interruption groove, dental tubercle, winging, cusp 5, cusp 6, distal accessory ridge, mesial accessory ridge, hypocone, tricuspid premolars, parastyle, metacone, protostylid were examined using a magnifying lens to evaluate the frequency of a trait. According to odontoscopic system developed from ASUDAS, the traits are identified and scored. All the study

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casts were checked by three observers independently to avoid inter observer bias.

3. Results and Observations

Out of the 15 traits which were assessed in this study, except for tricuspid premolars, parastyle and protostylid traits all the other traits were prevalent in the current population. On examination, the frequency distribution of different traits in the study population was noted as shovelling (41%), winging (21%), metacone (99.8%), hypocone (82.3%), cusp 5 (68.5), carabelli cusp (72%), interruption groove (39%), peg lateral (5%), cusp 6 (4.8%), dental tubercle (3%), distal accessory ridge (1%), mesial accessory ridge (0.3%). (Table 1)

Table 1: Frequency distribution of non - metric traits			
Traits	Male	Female	Total
Cusp of Carabelli	151 (75.5%)	137 (68.5%)	288 (72%)
Shovelling	87 (43.5%)	77 (38.5%)	164 (41%)
Peg laterals	11 (5.5%)	9 (4.5%)	20 (5%)
Interruption groove	78 (39%)	78 (39%)	156 (39%)
Dental tubercle	9 (4.5%)	3 (1.5%)	12 (3%)
Winging	45 (22.5%)	39 (19.5)	84 (21%)
Cusp5	139 (69.5%)	135 (67.5%)	274 (68.5%)
Cusp6	8 (4%)	11 (5.5%)	19 (4.8%)
Distal accessory ridge	1 (0.5%)	3 (1.5%)	4 (1%)
Mesial accessory ridge	0	1 (0.5%)	1 (0.3%)
Hypocone	155 (77.5%)	174 (87%)	329 (82.3%)
Metacone	199 (99.5%)	200 (100%)	399 (99.8%)
Parastyle	0	0	0
Protostylid	0	0	0
Tricuspid premolar	0	0	0



Graph 1: Distribution of non - metric traits among study population

There was no presence of tricuspid premolars, protostylid and parastyle traits among males and females in the study population. (Graph 1)

4. Discussion

Human dentition varies in its form, size, and number from person to person. Hence, these unique features of human dentition help to identify individuals whose death makes it difficult to distinguish by visual recognition, fingerprints, and documents. Teeth exhibits large variation in morphological features and their form may not be easily altered; thus, human dentition can be a valuable diagnostic tool for anthropological studies in classifying and characterizing different ethnic groups.³

The dental traits are heritable, are caused by multiple genes, and are also influenced by environmental factors which are relatively free of sex and age. The dental nonmetric traits exhibit historical, cultural, and biological variations which help to understand displacement, migration paths, and ethnic variation of humanity.⁶

Tooth is one of the hardest tissues of human body and has a high capacity to preserve itself even in extreme conditions of pH, moisture, salinity and high temperature. Due to its genetically unique nature and unrepeatable dental morphology and its resistance to change and 84 remodel itself, except in attrition and secondary dentin accumulation, tooth can provide biological and cultural information of an individual or a population.⁷ Teeth can maintain their form for long periods and makeup about 90% of the fossil record. Therefore, the morphology of the human mouth is very important to anthropologists.

The evaluation of dental traits is done through various methods, among those ASUDAS method is commonly and successfully used standardized method for scoring dental traits of human teeth. This system was developed by A. Dahlberg in 1940 from standard dental plaques and later this was modified by C. G. Turner II in 1981 at the Department of Anthropology of the Arizona State University.⁸

The present study was conducted to evaluate 15 nonmetric dental crown traits among the Mahabubnagar population of Telangana state using dental casts.

Cusp of carabelli is a nonfunctional cusp located on mesiopalatal cusp in maxillary first permanent molar. It is a heritable feature. The etiology is unknown, but it might be due to over activity of dental lamina. The frequency of occurrence

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is high in Europeans than in Asians. Males are more commonly affected than females at the ratio 1.2: 1.3 Saravanan R et al., conducted a study on 800 subjects of three different ethnic groups and found a frequency of 72% for the cusp of carabelli trait among the study population. These results are in accordance with this study which is also exhibiting 72% frequency.⁹

Shovelling trait is a combination of a concave lingual surface and elevated marginal ridges enclosing a central fossa in the upper central incisor teeth. High prevalence of shovelling trait has been reported in Eskimos, Pima Indians, North American Indians. The lower frequencies of shovelling trait have been found for Europeans and Negroids.³ The results of the present study (41%) are not in correlation with Hsu JW et al., who noted a higher prevalence (81%) of shovelling trait among Chinese population in southern Taiwan.¹⁰

Scott and Turner relate the **winging trait** feature with the absence of the space in the dental arch that prevents the proper alignment of the incisors. In some cases, however, the distal margins of the incisors are rotated in a labial or lingual direction. Lingual rotation has been termed counter winging by Dahlberg (1963). Venkatesh D et al., observed the frequency of winging in 400 subjects of racially mixed population of Bengaluru and found a higher expression of this trait in Iranians and Christian sub - groups (20%). These are in correlation with the present study results where 21% of the study population showed the expression of winging trait.³

Severe reduction and absence of distolingual cusp (**hypocone**) is a valued trend from the upper first molar to the upper second molar and is associated with a simplification of the dental morphology and reduced size. Compared to first molar, hypocone of second molar generally shows reduction in size. In the present study, the frequency of hypocone trait is 82.3% among the study population. These results are in agreement with a study conducted by Scott GR et al., who observed the dental morphology of Pima Indians and reported that 89% of the study population showed expression of hypocone trait.⁸

Metacone is the major cusp of the upper molars that can show size reduction and it is rarely absent. Rosenzweig KA et al., conducted a study on Jewish adolescents from Yemen and Cochin population and observed that metacone trait expression in all the individuals. In this grade 4 pattern was higher among Yemen population. Likewise, the present study also showed grade 4 pattern of metacone trait among the study population.¹¹

Cusp 5 is a distal cusp of lower molar tooth. In the present study the expression of cusp 5 trait was found to be 68.5% among study population. These results are not in agreement with a study conducted by Tinoco RL et al., who observed the frequency of cusp 5 trait as 24.8% in 130 individuals of southeast Brazil population.¹²

Interruption groove is the groove on incisor that meets or crosses the cingulum and may continue on to the root. In the present study the frequency of interruption groove is 39%, whereas it was just 2% in a study by Srivastav M et al., ¹³

Peg shaped lateral incisor is a condition in which the lateral incisor is small cone shaped and does not develop correctly. In the present study the expression of peg lateral trait was found to be 5% among study population. These results are in accordance with the study conducted by Pacelli CS et al., who noted a 3.17% expression of the trait among Medieval population from Ibiza.¹⁴

Cusp 6 is a supernumerary cusp which is a derivative of entoconulid. This supernumerary cusp is manifest between the hypoconulid and the entoconulid. In a study conducted by Townsend G et al., on 399 subjects of Australian aboriginal population, the expression of cusp 6 trait was 50 - 80% in permanent molar teeth, which is not in accordance with the results of the present study, showing 4.8% expression.¹⁵

Dental tubercle is also known as lingual tubercle. In a study conducted by Venkatesh D et al., the prevalence of dental tubercle trait among population of Bengaluru was 6% in Hindu group. Their results are in close association with the present study.³

Mesial accessory ridge is a small ridge present towards mesial aspect of sagittal grooves and a **distal accessory ridge** is located toward distal aspect of buccal cusp of the maxillary premolars which is homologous to the mesial accessory crest. S. E. Burnett et al., observed the prevalence of accessory ridges in maxillary premolars and noticed that 18% of south African white population had mesial accessory ridge and 50% of the south African Indian and south African population showed expression of distal accessory ridge trait. Whereas in the present study only 1% of the study population showed distal accessory ridge and 0.3% showed mesial accessory ridge trait.¹⁶

In the present study the expression of tricuspid premolar, parastyle and protostylid traits was not observed.

In the present study nonmetric dental traits such as cusp of carabelli, peg laterals, interruption groove, cusp 5 and metacone showed higher frequencies and traits like shovelling, dental tubercle, winging, cusp 6, distal accessory ridge, mesial accessory ridge and hypocone exhibited lower frequencies compared to other studies. These varied expressions of traits may be due to environmental factors, geographical, genetical factors and also due to difference in sample type, size and observer bias.

5. Conclusion

Present research work concludes that, nonmetric dental traits of the human dentition can be a valuable diagnostic tool for anthropological studies in classifying and characterizing different ethnic groups. It is important to recognize that, population identification or differentiation is undertaken based on the presence or absence of multiple nonmetric traits, and not through the use of a single trait. However, studies considering larger sample size are needed to corroborate with the present results.

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