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Original Article

Forensic Section

Evaluation of Dental Non-Metric Traits in Ethnic Tamil Population: An Aid in Forensic Profiling

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ABSTRACT

Introduction: Non-metric dental traits are features of dental morphology that show alteration in their appearance both within and between the populations. These traits seem to be controlled in part by genetics so these can be successfully used in the description of the ethnicity which can be helpful in identification of the person through the dental records.

Aim: The analysis aimed at assessing the frequency of dental non-metric traits in the ethnic Tamil Population as some dental variants are constant within a given geographical area, which suggests that the frequency of the trait can be mapped within a population.

Materials and Methods: An observational study was conducted in SRM dental college from July 2017 to December 2017 (over a period of five months). The study sample included 1000 participants, (500 males, 500 females). The non-metric dental traits which were assessed were cusp of carabelli, talon's cusp, shovelled incisor, and peg shaped lateral incisor, protostylid, dryopithecus groove pattern, hypoconulid, parastyle, paracone, bushman canine, interruption grooves, tuberculum dentale. The participants were subjected to visual examination and photographic records. Descriptive analysis was done in this study.

Results: Out of the 12 non-metric dental traits which were assessed in the present study, only 5 non-metric dental traits were found to be prevalent among this population. The frequencies were cusp of carabelli 230 out of 1000 (23%){male (90 out of 500) female (140 out of 500)}, shovelled incisor 80 out of 1000 (8%){male (50 out of 500) female (30 out of 500)}, peg lateral 50 out of 1000 (5%) {male (20 out of 500) female (30 out of 500)}, interruption groove 20 out of 1000 (2%) {male 20 out of 500)}, dryopethicus groove 20 out of 1000 (2%) {male (10 out of 500) female (10 out of 500)}among the ethnic Tamil population.

Conclusion: The present study highlights the fact that two non-metric traits i.e., cusp of carabelli and shovelled incisor found to be more common in males and females of ethnic Tamil population. This fact represents that these traits are the most common in ethnic Tamil Population which could be used as one of the validation tools for Human identification.

Keywords: Cusp of carabelli, Gender identification, Shovel incisor, Talon's cusp

INTRODUCTION

The anatomy of an individual's tooth has been employed in determining the origin, identity and gender of a person in the previous years. Non-metric dental traits are inheritable characteristics of teeth that show variations in their expression both within and between the populations [1]. The significance of these traits are their occurrence as a pattern in a particular population and their frequency in particular ethnicity. Various studies in Dental Anthropology have proven that variations in teeth have cogent hereditary relationship which may be characteristic of the ethnicity of a population, their incidence and degree of expression providing important data for phylogenic and/or genetic studies. Some non-metric dental traits are constant within a particular population which may be indicative of their heritage [1]. The advantage of these non-metric dental traits is that these morphological features remain stable unless acted upon by an external agent (especially dental caries or other wasting disease) owing to the high mineralised content of the tooth which makes it stead fast [2]. So these can be successfully used in the description of the ethnicity which can be helpful in identification of the person through the dental record. The cusp of carabelli is a small additional cusp which is present at the mesiopalatal line angle of maxillary first molar. This extra cusp is usually found on the first molar and becomes gradually less which likely in the second and third molars. This cusp is completely absent in some individuals and present in others in a variety of forms. Shovel-shaped incisors are those whose lingual surfaces are gouged as a consequence of lingual marginal ridges [3]. These traits have been used to differentiate between the Caucasian and Mongoloid populations in earlier studies [4,5]. Although dental non-metric trait studies have been done before, a very small number of studies have been conducted to comprehend the existence of all traits extensively in an ethnic population and the distribution of one trait to another [3]. To the best of our knowledge this is the first study to include the Tamil ethnic population in an extensive study. Most of the present data on tooth morphology are from European and American studies, hence their results might not reflect upon the Tamil ethnic population which has roots from the Dravidian era and indigenous studies are the need of the hour.

MATERIALS AND METHODS

Ethical approval: The study was approved by the ethical committee of SRM Dental College and Hospital, Ramapuram and informed and written consent was obtained from each patient prior to their participation in the study.

Study setting: An observational study was carried out between July to December 2017 in Department of Oral Medicine And Radiology, SRM Dental college, Chennai, Tamil nadu, India. The study sample include 1000 sample (500 male and 500 female) and age group was 18-40 years. Sample size was determined using Cochran's formula. Ethnicity was determined based on accurate history of ancestors, homeland, religion, language or dialect and subjects with likelihood of cross ethnicity were excluded from the study. Descriptive analysis was done for the present study.

Inclusion criteria: The subjects included in study have fully erupted set of teeth, well aligned, non-attrited and intact tooth. If a tooth was missing or measuring points were not defined due to caries or restorations, the patient was excluded from the study. Twelve

different non-metric dental traits were observed for all permanent teeth by the set mentioned diagnostic criteria [Table/Fig-1,2]. The participants were subjected to complete oral examination. Examination was carried out by two observers to overcome the observational errors and photographs were clicked if any positive trait was present for the maintenance of record. Frequencies were recorded for the following dental non-metric traits [Table/Fig-1].

Traits	Features
Cusp of Carabelli	Small additional cusp which is present at the mesiopalatal line angle of maxillary first molar.
Talon's Cusp	Cusp like projections located on the palatal surface of maxillary anterior tooth.
Shovelled Incisor	Incisor whose lingual surface is gouged as an after-effect of lingual marginal ridges, crown curvature or basal tubercles.
Peg Shaped Lateral Incisor	Condition in which the lateral incisor does not develop correctly and is small and often cone shaped.
Protostylid	A supernumerary cusp located on the mesial half of the buccal surface on the maxillary and mandibular incisor.
Dryopethicus Groove Pattern	The mesiolingual and distobuccal are joined across the floor of central fossa and form a five cusped pattern.
Hypoconulid	The distal or fifth cusp of lower molar tooth.
Parastyle	A small cusp lying anterior to the paracone on the buccal surface of a molar tooth.
Paracone	A cusp in the buccal corner of a maxillary molar tooth.
Bushman Canine	Mesial ridge on the lingual surface of canine.
Interruption Groove	The groove on incisor that meets or crosses the cingulum and may continue on to the root.
Tuberculum Dentale	Cingular prominence seen on the lingual surface of maxillary anterior teeth, presents as a projection resembling cingulum.

[Table/Fig-1]: Features of non-metric dental traits.

Traits Observed	Teeth Evaluated
Shovelling	UI1,UI2,LI1,LI2
Tuberculum Dentale	UI1,UI2,UC
Interruption groove	UI1,UI2
Peg shaped	UI2
Bushman canine	UC
Paracone	UP1,UP2,LP1,LP2
Cusp of Carabelli	UM1
Parastyle	UM1,2,3
Dryopethicus groove	LM2
Protostylid	LM1
Talon's cusp	UI1,2,3
Hypoconulid	LM1

[Table/Fig-2]: Non-metric traits observed and teeth evaluated for each [1].
UI: Upper incisor; LI: Lower incisor; UC: Upper canine; UP: Upper premolar; LP: Lower premolar; UM: Upper molar; LM: Lower molar

STATISTICAL ANALYSIS

All raw data was entered into Microsoft excel and descriptive statistics was performed using SPSS software version 17.

RESULTS

Out of the 12 defined non-metric dental traits which were assessed in the present study, only five non-metric dental traits were found to be prevalent in the current population. In the present study 1000 subjects were included with the mean age of 18-40 years. On examination the most significant frequencies were cusp of carabelli (23%) shovelled incisor (8%), Peg lateral (5%), dryopethicus groove (2%) interruption groove (2%).

Among all the traits, 18% males and 28% females had cusp of carabelli, 10% males and 6% females had shovelled incisor, 4% males and 6% females had peg lateral, 4% males had interruption groove and 2% males and females had dryopethicus groove.

From the present study it was inferred that in Ethnic Tamil population, cusp of carabelli and shovelled incisor were more common [Table/Fig-3].

Traits	Male	Female	Total
Shovelling	50 (10%)	30 (6%)	80 (8%)
Peg Lateral	20 (4%)	30 (6%)	50 (5%)
Cusp of Carabelli	90 (18%)	140 (28%)	230 (23%)
Dryopethicus Groove	10 (2%)	10 (2%)	10 (2%)
Interruption Groove	20 (4%)	0	20 (2%)
Protostylid	0	0	0
Talon's Cusp	0	0	0
Hypoconulid	0	0	0
Parastyle	0	0	0
Paracone	0	0	0
Bushman Canine	0	0	0
Tuberculum Dentale	0	0	0

[Table/Fig-3]: Frequency distribution of non-metric traits.

DISCUSSION

The hypothesis that heritability of dental traits may provide knowledge on reconstituting migration patterns of past and also significantly influence the understanding of human evolution [6,7].

The alteration of tooth morphological features does not change across a span of time without cause. Several theories elucidate the differences in trait expression among different races; there is debate in the literature with respect to the degree of genetic control in the occurrence and countenance of these traits. Theories have been placed forward to explain these differences among different races. Field theory proposes that the trait is brought and is therefore subjected to environmental stress. Clonal model theory suggests that the trait is inherent and therefore, less reactive to environmental factors. Traits are the result of interaction between genetic and environmental factors [1]. It has been suggested that the frequency of the trait can be plotted within the population [2]. In analysing non-metric traits, many researchers opted for visual examination and few studied dental casts while some studies use a combination of both [8,9]. The clear advantage of using visual examination is that it is an accurate method of recording and patient can be recalled for follow up when required along with proper identification of feature [10]. It also ensured racial history recording and gender accuracy which cannot be determined by previous casts to a reliable measure. The most significant traits were cusp of carabelli, shovel led incisor, peg lateral, dryopethicus groove and interruption grooves. In a study on non-metric traits of permanent posterior teeth in Kerala population Cusp of carabelli traits were 17.78%, dryopethicus groove for "y" pattern is 100% [2]. In a study, 40.5% cusp of carabelli, 68.2% shovelling was revealed in a native of Bangalore city, Karnataka [1]. Ethnic dental analysis of shovel and Carabelli's traits in a Chinese population, 49.7% cusp of carabelli were present [11]. The Prevalence of Fifth Cusp (Cusp of Carabelli) in the Upper Molars in Saudi Arabian School Students was 41.7% cusp of carabelli [12].

Shovelling of incisors and canines is a prominent trait that varies between geographical populations and appears stable within a population [13]. In a study done in Australian population, the expression of Carabelli trait was more on the primary molars than the permanent molars. Kieser observed the expression of Carabelli trait on primary and permanent molars and reported a high mark of uniformity of appearance of Carabelli trait in primary and permanent dentition. He conjectured that this result was consistent with low epigenetic but high genetic influence on Carabelli trait expression. Previous studies have shown that shovelling is a prominent trait among the Asian and American

people [14]. A study done on Saudi Arabian population shows that the differences in the phenotypic countenance of the trait in the various dentitions type and sexes, as stated by some workers may suggest that the trait is under a polygenic effect [15]. Studies by Kharat DU et al., have shown that shovelling frequencies in range of 20-25% in population of Sudan and Egypt [16]. In the present study, Ethnic Tamil population has shovelled incisor in the frequency of 8%, this is comparable to the study by Uthaman C et al., who deduced the shovelling frequency among Malayalee population in Coorg to be 6.7% as opposed to the Tibetan population which was 40% [17]. Thus, the South-Indian ethnic population has reported lower prevalence of shovelling compared to the Mongoloids and Caucasian-Americans [18]. In our study, we reported that dryopethicus groove is present in 2% and Interruption groove in 2% of the population. The dryopethicus grove was least characterised occlusal morphology in Chinese studies by Guo L et al., [19]. While Alaskan Eskimo studies by Hasund A et al., showed that the dryopethicus groove was the most predominant in first mandibular molars [20], our study results are consistent with previous studies in Kerala population which proves that presence of dryopethicus groove occlusal pattern is characteristic in south-Indian ethnic population. Peg shaped laterals are most commonly associated with microdontia. Developmentally a disturbance during odontogenesis mainly injury to developing tooth can give rise to this type of tooth morphology [2,17]. In a study involving Greek ethnic population the prevalence of peg laterals was 0.4% but this could be attributed to the small number of population assessed in the study [21]. In a meta-analysis by Hua F et al., the prevalence of peg laterals was highest in mongoloid population being 3.1% while the data on general population reflects the same as our study being close to 1.8% in Asian population [22]. Peg laterals also showed characteristic gender predilection to female being greater (6%) than male as comparable to previous studies. Thus, we conclude that peg laterals vary with race, ethnicity and gender.

LIMITATION

This study is unique because as far our knowledge, there has been no study done on population of Tamil Nadu. The strength of the study is its feasibility as it can be done anywhere, does not require any special instruments and it does not create any discomfort to the patients.

This study was done in hospital which is a drawback in the study as it includes cases only from a confined area. The further recommendation is that this study should be done in a different part of Tamil Nadu so that we will be able to get more precise result.

CONCLUSION

The present study highlights the fact that two non-metric traits i.e., cusp of carabelli and shovelled incisor was found to be more common in males and females of ethnic Tamil population. This fact represents that these traits are the most common in ethnic Tamil Population which could be used as one of the validation tools for Human identification.

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