Review Article

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Determination of Race and Ethinicity on the Basis of Human Dentition: A New Paradigm in Forensic Dentistry

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Abstract

A race is defined as a morphologically recognizable subset of a species. From time to time many authors have used dental characteristics to determine ancestry and ethnicity. Morphological characteristics of teeth on the basis of which it is possible to differentiate the races were determined by numerous dental anthropological studies involving Carabelli's trait, *Shovel-shaped incisors etc. This article highlights the different methods and morphological variations of teeth and their role in race and ethnicity determination both antimortem and postmortem.*

Keywords: Forensic Identification; Ethnicity; Human Race; Dental Anthropology.

Introduction

The dentition is usually well preserved postmortem even when bony structures of the body are destroyed. The use of dental morphology to determine race and ethinicity relationships is an established procedure in biological and anthropological studies. The identiûcation of the race is an important factor in individualizing human remains, limiting the pool of missing persons for identification of unidentiûed human remains [1]. According to Skinner and Lazenby [2] in the field of forensic anthropology, the term 'race' is used very broadly. Racial affinity is identified for the purpose of identifying human skeletal remains. Shipman et al [3] defined race as a morphologically recognizable subset of a species. According to Dyer [4] the term race describes populations or group of populations that is sufficiently different from all others in the species and it is separately recognized. Dyer [4] discussed the early racial classification of Linnaeus who recognized four human racial subspecies: Homo sapiens europaeus, Homo sapiens asiaticus, Homo sapiens ajer, and Homo sapiens americanus. Based on blood group studies, Dyer [4] also mentioned the six classifications proposed by W.C. Boyd in 1950 that includes early european, european (caucasoid), african (negroid), asiatic (mongoloid), amerindian and australoid. Lasker and Lee [5] were ûrst to conduct surveys to determine ancestry in a forensic science by use of dental characteristics. They concluded that shovel-shaped incisors are most common in mongoloids and carabelli's trait is most common in whites. However they did not identified any dental traits which were more common in Africans. Shovel-shaped incisors and carabelli's trait remain the most common dental traits used in forensic analyses [6]. However in some recent researches [7] it was found that frequency of carabelli's trait is highly variable in all world-wide populations. carabelli's trait was ûrst described in 1842 by von carabelli. It is most studied dental morphological characteristic .The carabelli's trait consists of a pit, Y-shaped ûssure, bump or a cusp on the mesio lingual side of the maxillary deciduous posterior pre-molars and permanent molars [8]. In a recent survey, Correia and Pina [7] reported frequencies of ûrst molar carabelli's trait in populations ranging from 13.5% up to 85% from alaskan natives to american whites. Shovel-shaped incisors are those with ridges on the mesial and distal margins of the lingual surfaces [9]. Shoveling is usually studied as a qualitative variable however some researchers have studied it as a quantiûable metric trait by measuring the depth of the shoveling from the center of the lingual surface [10]. The frequency of shovel shaped incisors range from 0.0% up to 91.9% in a wide range of geographic

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areas [11].The western eurasia, africa and paciûc groups have the lowest frequencies while eastern asian, northern asian and native american have highest frequencies and greatest expression of shovel shaped incisors . In north america, incisor's shoveling is most commonly used in determination that a forensic skeleton is native american or hispanic. The recognition of inherited racial characteristics in a deceased individual is difficult due to effect of environmental factors during growth period. However differential tooth morphology can distinguish racial groups such as caucasoid, negroid, and mongoloid to certain extent. In mongoloids the incisors have deep lingual fossa formed by accentuated marginal ridges and prominent cingulum. The teeth are shovel or scoop shaped. Usually the premolars have tubercle on the buccal cusp. This tooth is known as Leong's premolar and this condition is known as den's evaginatus [12]. Taurodontism and absence of bifurcations or cusp of carabelli is also characteristic tooth morphology of mongoloids[13]. Mongoloid teeth are the largest in size in comparison to negroids, caucasoids. The protostylids are accessory cusps / tubercles that occur in the mesiobuccal surface of mandibular molars. The protostylids have highest frequency in Caucasoid group. The anterior teeth of Caucasoids are chisel-shaped and smaller in size with a smooth lingual surface. The maxillary lateral incisor are usually peg-shaped[14]. In negroid group cusp of carabelli is present in maxillary molars. Negroids have an increased tendency for the prevalence of supernumerary teeth. Tuberculum intermedium which is an extra lingual cusp between the distolingual and mesiolingual cusp of mandibular first molar is also very commonly seen in negroids [14].

Morphological and Anatomical Variation in the Teeth and Skull

The racial differentiation on the basis of morphological characteristics of teeth is determined by dental anthropological studies. The caucasians have a characteristically high prevalence of carabelli cusp, reduced number of dental cusps and simplification of the fissure system. Asians have a high prevalence of shovelled incisors, the fissure system of the teeth is complex and there is no reduction of the number of dental cusps. The negroids have neither have a high degree of carabelli cusp prevalence, nor the shovelled incisors however they have a complex fissure system and the usual number of cusps on the teeth [11]. The caucasoid cranium is long in length, narrow in breadth and high in height. The sagittal contour is round and it exhibits sloping forehead in comparison to negroid or mongoloid crania. The occipital profile is rounded and it exhibits strong nuchal muscle markings [2]. A negroid cranium is long in length, narrow in breadth and low in height. The sagittal contour is flat and the occipital profile is quite rounded [2]. The mongoloid cranium is long in length [2] but can frequently appear round instead of long [15]. The mongoloid cranium is broad in breadth and average in height, categorised between the high caucasoid cranium and the low negroid cranium. The occipital profile is angular and the nuchal muscle markings are moderate [2]. Ubelaker [16] observed that the anterior alveolus in negroid mandible is quite projecting in comparison with caucasoid and mongoloid mandibles. This is due to the pronounced prognathism or alveolar projection seen in negroid skulls. Krogman and Iscan [6] concluded that dental roots of caucasoid are shorter, straighter and less splayed than negroid or mongoloid dental roots. They also observed that enamel extensions are more common in caucasoid teeth. The negroid dentition is characterized by 2-3 lingual cusps on the mandibular fIrst molar, wide, hyperbolic arches with a narrow palatal vault, both maxillary and mandibular prognathism and a tuberculum intermedium. A tuberculum intermedium is an extra lingual cusp between the disto-lingual and mesio-lingual on mandibular first molar [17]. The mongoloid dentition has an edge-to-edge bite that occurs when the mandible and maxilla are occluded. The incisor teeth will occlude edge-to-edge without showing the overbite that is commonly found in Caucasoid dentition. Occlusal wear on the incisors is usually found in Mongoloid skull [18]. The diagnostic morphological dental trait of Mongoloid dentition is shovel-shaped incisors. Shovel-shaped incisors have prominent marginal ridges on the lingual surface [16] and occurs with high frequency in mongoloid populations. An incidence rate of 85-99% have been reported for shovel-shaped incisors in mongoloid dentitions [17]. However shovel-shaped incisors can occur in negroid and caucasoid dentitions but it is rarely found in these populations [15].

Methods for Racial Identification on the Basis of Skull and Teeth

Krogman and Iscan [6] describe an anthroposcopic method used by Todd and Tracy in 1930 to determine racial affinity from negroid and caucasoid skulls. Todd and Tracy focused on five descriptive traits as supraorbital ridges, upper orbital margins, glabella, frontonasal suture and the interorbital distance. Under each of these five descriptive traits, Todd and Tracy looked for two contrasting variations which

they believed to be racially connected. The supraorbital ridges were either mesa-like or undulating, the upper orbital margins were either sharp or blunt, glabella was either rounded or depressed, the frontonasal suture was either plain or beetling and the interorbital distance was either narrow or wide. On the basis of descriptive traits Todd and Tracy classified skulls in two types, U-type and M type which are distributed throughout the two races. Brooks et al [19] conducted an anthroposcopic analysis of alveolar prognathism and its usefulness in determining race from a skull and concluded that there are racially distinct differentiations in the morphological appearance of maxillary alveolar prognathism. Anthropometric methods of determining racial affinity in the skull have been conducted through the use of discriminant function statistics. One of the first methods using discriminant function statistics to determine race was carried out by Giles and Elliot in 1962. Giles and Elliot [20] studied american caucasoid and negroid skulls from the Hamann-Todd and Terry collections and american indian skulls from the indian knoll collections, the gulf states and the southwestern united states. Using this method, eight cranial measurements are taken and multiplied by a determined factor. The results are then added or subtracted to produce a score that can be assessed for racial affiliation. In 1984, Gill [22] developed an anthropometric method to determine race which involves six measurements of the midfacial skeleton and the computation of three indices: the maxillofrontal index, the zygo-orbital index and the alpha index. Krogman and Iscan [21] further concluded that this method worked adequately to distinguish caucasoids from negroids and mongoloids but it was not useful in distinguishing between negroids and mongoloids. However Gill [22] further stated that no other methods seems to show such stable and dependable results. He insisted further that Gill's anthropometric method require the use of a simometer which is an instrument that was rarely found and /or used at the time of his publication.The forensic anthropology databank (FDB) was established to address the poor performance of various race and sex-determination methods and to address the problems with the older reference collections by providing an alternative source of data for the development of forensic methods [23]. The FDB consists of data collected in forensic cases and submitted by various anthropologists as well as a sample of individuals [23]. Although an electronic database is not a substitute for a skeletal collection however the FDB has enormous research potential [23]. FORDISC is a computer electronic database can be used to determine race or sex. FORDISC has several features that make it more useful than all other previous discriminant function approaches. First, unique discriminant functions are calculated based on what measurements can be collected from an unknown individual. Second, posterior and typicality probabilities are calculated in addition to the discriminant function score. The posterior probability is a measure of group membership assuming that the unknown individual is in fact one of the options selected. The typicality probability is a measure of whether the unknown individual could belong to any of the groups selected in the analysis. This statistic addresses one of the major problems with all discriminant function approaches. Although the discriminant function score may force a placement into one of the selected groups, a typicality score of 0.05 or lower indicates that the unknown is not typical of any of the selected groups [23].

Conclusion

Race determination is an important diagnostic criterion in forensic sciences. Certain variation of morphological features are specific to particular ethnic race and can be used to relate the deceased to that race. With increasing database and more advance diagnostic tools race determination can be predicted more accurately.

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