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RACE IDENTIFICATION USING CRANIOFACIAL STRUCTURES AND SKELETAL AND DENTAL TRAITS- A REVIEW

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ABSTRACT: Typically, forensic anthropologists are the most knowledgeable sources about bone studies. It is possible to infer sex and ancestry from the structure and shape of the skull, especially from its outward appearance. Forensic dentists are able to distinguish three key racial categories: Negroid, Mongoloid, and Caucasoid. A person's racial identity can be determined by both their skeletal and dental characteristics.

Keywords: Race Identification, Craniofacial Structures, Skeletal Traits, Dental Traits

INTRODUCTION:

Forensic odontology refers to a branch of dentistry concerned with proper management and study of dental evidence in order to aid in the identification of individuals and the presentation of dental results[1]. It deals with the use of science and technology in numerous fields. The collaboration of a varied team is required for human identification. It is true that deciding a person's racial affiliation from identifying dentition is a challenging task. There are, nevertheless, certain dental characteristics which occur more commonly in a particular race group.
Forensic anthropologists are the most knowledgeable source person about bone studies. Forensic dentists can also assist with the treatment. It is possible to infer sex and ancestry from the structure and shape of the skull, especially from its outward appearance. These are referred to as Skeletal traits. Forensic dentists are able to distinguish three key racial categories: Negroid, Mongoloid, and Caucasoid. Other tooth traits, such as Cusp of Carabelli, shovel-shaped incisors, and multicuspid premolars, can also help determine ancestry[2]. (Table 3)
Race was described by Shipman et al. (1985) as "a morphologically identifiable subset of a species." Dyer (1974) defined "race" as a term that refers to populations rather than individuals. Additionally, it indicates that a population or group of populations differs enough from every other population in the species[3].

HISTORICAL BACKGROUND OF CLASSIFICATION OF RACE:

The racial classification necessitated both genetic and biological research which are more fascinating and rewarding debated topics[4]. Biological racial classification has long been linked to a list of races for genocide (such as the Nazi-led Holocaust), imperialism, enslavement, as well as other social justice issues injustices[5]. Linnaeus classified human species into natural taxonomic families for race classification in 1758[6]. He introduced four geographical groups of humans namely red Americans, white Europeans, black Africans and yellow Asians[7].

Blumenbach classified humans into five "races" in 1775, equivalent to Linnaeus' classifications[8]. In 1962, Coon refined classification into five races based on physical phenotypic features namely Mongoloid, Caucasoid, Negroid, Australoid, and Capoid[9]. Despite dispute between anthropologists, many scholars and lay people continue to use this classification. The world's four primary groups are Caucasoids, Mongoloids, Negroids, and Australoids (Australian aborigines). Malays, Indian and Chinese are the three primary ethnic groups of Peninsular Malaya. All others belong to the Mongoloid race, which includes the Caucasoid subgroup known as Indo-Dravidian (Indo-European)[2,9].

A thorough examination of person's physical, skeletal, and dental traits may reveal his or her racial identity. It is impossible otherwise to attribute any identifiable anatomical feature to a certain race. In the study of races, skin, head shape, hair, facial type, nose, eyes, skeletal stature, and teeth are all distinguishing characteristics. Racial characteristics, on the other hand, are not diagnostic; they are regarded characteristics that may help determine a person's racial origin. During racial differentiations, the most essential and effective information sources are teeth. Dental attributes include ridges, bulges, crowns, roots, individual tooth sizes, as well as the number of teeth, occlusion and bony relations[10]. Teeth are one of the few parts of the body where measurements from live humans and dead persons or fossils are comparable. Odontometry is the term for the measurement of these characteristics. These dento-anthropologic structures, according to Dhalberg in 1963, are the most essential and dependable relevant information for detecting racial affinities[11].

In 1985, Mizoguchi, a Japanese dental morphologist, identified three incisor variations based on marginal ridge expression and connection to the lingual tubercle[12]. In 1982, Korenhof described three trigonid crests, one of which is part of the lower molar trigonid ridge system[13]. The current Mongoloid race can be identified by its distal crest[14].

CAUCASOIDS:

SKELETAL FEATURES:

A Caucasoid's cranium is long and slender in width, and lofty in height. The sagittal shape is round, with a slightly slanted forehead. The nuchal muscle is prominent, and the occipital contour is rounded (Skinner & Lazenby). According to Alsoleiha, Caucasoids have a tall dolichocephalic head, receding zygomas, a pronounced brow ridge, and nasal apertures that protrude narrowly.[15] According to Durbar et al, Caucasian (or white) people lack prognathism, or a minimum protrusion of the alveolar ridge and an expansion of the lower jaw. With a tear-shaped nasal cavity and tower-shaped nasal bones, their facial features are typically reduced. The palate is triangular, and the eye orbital structure on the skull is sloped, with a prominent forehead and cranium[16]. The frontal bones of white males were found to be thicker than those of black males in a 1975 study by Bass that examined the thickness of the cranium at four distinct locations on the sagittal plane[3]. (Table 2)

DENTITION:

Caucasoid arches are typically narrow "v" shaped, providing limited room for teeth to form properly. As a result, crowding of teeth is a distinguishing trait that can be used to identify members of the aforementioned race. Caucasoids' anterior teeth are known as "chisel-shaped," with a lingual surface that is smaller and smoother. The cusp of Carabelli is a distinctive feature found in about 37% of Caucasoid people[17]. In some Central Europeans, a wide-based pronounced cingulum is more commonly present than a cingulum of rolled smooth continuity.

Shovel-shaped incisors have been noticed in 30%–36% of Swedish and Danish people, 46% of Palestinian Arabs, and 51% of Indians[18]. The maxillary lateral incisors of Europeans show shovel-shaped more commonly, according to Lunt[19]. Additionally, in this race, overbites are common in which teeth on the upper jaw protrude over those on the lower jaw [20]. In addition, this race features a low ratio of cusps 6 and 7, deflective wringles, and protostylids, according to Scott and Turner[21]. (Table 1,3)

NEGROID:

SKELETAL FEATURES:

According to Alsoleihat, Negroids have a short dolichocephalic head, recessed zygomas, and large nasal apertures. A Negroid's cranium is represented as being long, narrower in width and shorter in height. Negroids, or blacks, have a big cranium with a circular nasal cavity and a rectangular palate. The orbit is either rectangular or squarish in shape. The ramus is wider, lower, and more vertical. Negroids have a long U-shaped dental arch; a smaller breadth; and a less dominant chin[22,23]. (Table 2)

DENTITION:

The Negroids have small teeth with midline diastema and spacing. Supernumerary teeth are becoming more prevalent. There are two different cusps on the lower first premolar, and possibly three. In Negroids, it's unusual to see the Carabelli cusp and shovel-shaped incisor together. Third molars are rarely impacted, and the majority of them are visible clinically. Negroids are prone to malocclusions such as Class III malocclusion, open bite, and bimaxillary protrusion. Both maxillary and mandibular alveolar bone protrusion with labial slanted incisors is seen[24]. A mesial ridge is claimed to appear commonly in Sub-Saharan African canines. Turner et al. termed this characteristic as the "Bushman canine" since it was seen in the Bushmen of Africa[25,26]. (Table 1,3)

MONGOLOIDS:

SKELETAL FEATURES:

Mongoloids, sometimes known as Asians, have long, broad, and medium-height skulls that fall in-between the high-heighted Caucasoid skulls and the low heighted Negroid skulls. Mongoloids have a more angular occipital form, and their nuchal muscle marks are more noticeable[22,23]. (Table 2)

DENTITION:

The shovel-shaped incisors are the most characteristic feature of Mongoloids. It is noticed on the palatal surface of incisors. The confluence of the marginal ridges with an elevated cingulum and a deep lingual depression gives the shovel shape. Around 90% of Mongoloids, including Eskimos and American Indians, have this trait[19,27].

The Incisors in Mongoloids are more curved than those of Caucasoids. Dens evaginatus is the condition that occurs in Mongoloids premolars when a buccal cusp develops a tubercle. Upper third molars and 43% of second molars in Singaporean Chinese had bilateral five cusp types. The distal cusp in lower molars is more lingually placed in Mongoloids than in Caucasoids. The lower first and third molars have extra distolingual roots[28].

Mongoloids have thinner root trunks but shorter anatomical roots. Increased root trunk growth causes taurodontism. Furthermore, the enamel contour runs between the root's bifurcation in Mongoloids. The buccal surface of the mandibular molars is more commonly involved[29].

Mongoloids frequently lack the Cusp of Carabelli, which is one of the race's notable features. If it is present, then it is in a reduced form. Mongoloids usually have parabolic arch in general, with big incisors and canines, short premolars, and massive molars, especially in the lower arch[30]. The prevalence of three cusp maxillary first molars in the Indian Malwa community has previously been noted[31].

In 1993 research on Malay adolescents, Yaacob and Talib identified the central incisors of men were only 17 percent larger mesiodistally than the lateral incisors, whereas females were 13 percent bigger[32]. In the lower first and third molars, root size and length decrease laterally[33]. (Table 1,3)

AUSTRALOIDS:

Australoids typically have a large arch size that allows for bigger teeth. Molars of australoids are termed as megadont, as they are several times the size of any other living thing. The mesiodistal diameter of first molar in Norwegian Lapps and White Americans is 10% higher[34,35]. They also have large premolars, although their anterior teeth are modest. In this race, severe attrition and mesial drift of teeth are typical. Attrition has resulted in an edge-to-edge bite and typical spatulate anterior teeth[36]. Shovel-shaped incisors and Cusp / Tubercle of Carabelli are uncommon. According to Campbell, enamel pearls may be seen between the roots in Australoids. The third molars may be missing[37]. (Table 1)

CONCLUSION:

All Human beings belong to the same species (Homo sapiens). All human groups have a large degree of genetic variability. Human genetic variation should be thought of as a continuum rather than as discrete groupings. However, in the realm of forensic osteology, defining race from a skull can help with the identification of human remains. The morphology of each person's teeth is unique. The use of dentition to identify the racial affinities of an unidentified person is extremely challenging. However, there are some dental traits that are more prevalent in one of ethnic groupings and aid in racial identification. It is evident that determining a person's race based on dental traits is a difficult task. As a result, the forensic odontologist must exercise caution when concluding a person's racial character.

TABLE 1: Table showing distinguishing Dental traits of various races[28]:

MONGOLOID	CAUCASOID	NEGROID	AUSTRALOID
incisors shaped like shovels	Narrow arch and crowded teeth	Cusp of carabelli	Enamel pearls between roots
Greater incisor curvature	Chisel shaped anterior teeth	Large molar teeth (Megadont)	Supernumerary teeth

Dens evaginatus	Cusp of carabelli	Severe attrition	Rarely impacted third molars
Five cusp-upper molars		Edge to edge bite	Class III malocclusion
Extra distolingual root in lower molars		Mesial drift of teeth	Open bite
Taurodontism		Enamel pearls between roots	Bimaxillary protrusion
Enamel extensions to the furcation area			
Parabolic arch form			

Table 2: Table showing craniofacial trait variations (modified from gill 1986)[3]

	CAUCASOID	**MONGOLOID**	**NEGROID**
Cranial form	Medium	Broad	Long
Sagittal outline	High, rounded	High, globular	Highly variable
Nasal bone size	Large	Small	Medium/small
Nose form	Narrow	Medium	Broad
Nasal sill	Sharp	Medium	Dull
Nasal spine	Prominent, straight	Medium	Reduced
Incisor form	Blade	Shovelled	Blade
Facial prognathism	Reduced	Moderate	Extreme
Alveolar prognathism	Reduced	Moderate	Extreme
Palatal form	Parabolic	Parabolic	Hyperbolic
Malar form	Reduced	Projecting	Reduced
Orbital form	Rhomboid	Round	Round
Mandible	Medium	Robust	Oblique gonial angle
Chin projection and form	Prominent and bilateral	Moderate and median	Reduced and median

Table 3: Table showing features of non-metric traits:

TRAITS	**FEATURES**
Cusp of Carabelli	Additional cusp or tubercle on the mesiopalatal cusp of the maxillary first molar
Talon's Cusp	The palatal surface of the maxillary anterior tooth has cusp-like projections.
Shovelled Incisor	Incisor with a gouged lingual surface caused by crown curvature, marked lingual marginal ridges, and deep lingual fossa
Peg Shaped Lateral Incisors	Small cone-shaped lateral incisor because of inadequate development.
Protostylid	On the maxillary and mandibular incisors, a supernumerary cusp is positioned on the mesial half of the buccal surface.
Dryopethicus Groove Pattern	The mesiolingual and distobuccal form a five-cusped pattern over the floor of the central fossa.
Parastyle	A small cusp lies anterior to the paracone, found on buccal surface of a molar tooth
Hypoconulid	The fifth or the distal cusp seen on the lower molar tooth
Paracone	A cusp in the buccal corner of a maxillary molar tooth
Interruption Groove	The incisor groove which meets or crosses the cingulum and may extend to the root.
Bushman Canine	Mesial ridge found on the lingual or palatal surface of canine.

Tuberculum Dentale	Cingular prominence, which is a projection on the lingual surface of maxillary anterior teeth that appears like a cingulum.

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