

# DENTAL ANTHROPOLOGY-A REVOLUTIONARY TOOL IN FORENSIC SCIENCE

## **ABSTRACT:**

Dental anthropology is a field of physical anthropology that studies the origin, development, and evolution of anthropoid dentitions, as well as their relationship to social, physical, and cultural factors. Teeth have their own distinct morphology and physiology, which is in stark contrast to the body's genetic structure. Teeth are also unique among the resistant elements of archaeological and fossil remains in that they have been exposed on the body's surface throughout their lives. As a result, dental anthropology may be assessed in the mouth cavity of living humans using similar methods to those used for prehistoric relics. As a result, it's no surprise that practising dental surgeons have historically ranked well among dental anthropologists.

This review's initial purpose is to provide an overview of the morphological and non-morphological properties of animate dentitions that aid in the indirect identification of prehistoric remains and the understanding of their cultural, social, and physical relationships, as well as to assist forensic odontologists with craniofacial identification and skull bone reconstruction.

**KEYWORDS**-Dental Anthropology, Metric tooth traits, Forensic anthropologists, Snaggletooth, Tooth wear.

## **INTRODUCTION:**

Anthropology, sometimes known as "human science," is the study of humans in all aspects of their existence, from their biology and evolutionary history to the social and cultural qualities that separate humans from other animals. Archaeology, physical anthropology, linguistic anthropology, social and/or cultural anthropology, and psychological anthropology were the diverse topics of research that separated anthropologists into specialisations(1). Physical anthropology includes a subdiscipline called dental anthropology(1). It is a crucial method of investigation that enables access to information that would otherwise be unavailable through other types of study. To determine and evaluate the era of existence of the species carrying those teeth, the topic entails analysing dental metrics and non-metric features similar to numerous cultural groups, tooth wear trends, and eating or other behaviors.

Because osseous remnants have a more delicate microscopic structure than teeth, they are more easily deteriorated. As a result, both in archaeological instances and in the sad rising number of mass tragedies, such as airline accidents, natural disasters, or terrorist acts, the latter frequently represent a significant component of the data accessible(2). If police officers discover undocumented human remnants such as teeth, for instance, this crucial bit of evidence could be the only resource investigators have to match to dental records of reported missing individuals in order to ascertain the identity of the individual(3). Because tooth material does not alter throughout a lifetime, it may be used to learn about past cultures' social and biological processes, as well as forensic anthropological methods for locating missing people. Modern Dental Anthropology is the outcome of years of systematic efforts by academic researchers to deepen the discipline's scientific nature and attempt to justify the tremendous biological variety of human groups(2).

## **HISTORY OF DENTAL ANTHROPOLOGY:**

The physical or biological anthropologist's job is to explain biological variety in terms of adaptation, evolution, and history. Anthropologists in the pre-Darwinian era concentrated mostly on racial diversity and classification. Blumenbach, Cuvier, and others concentrated on externally evident physical traits including skin, hair, and eye colour and form, as well as skull kinds, in their early classifications(4). A small group of anthropologists began investigating the utility of teeth and their significance in understanding human health, behaviour, and variation in the nineteenth century(4).

More academics started paying attention to tooth size and morphology in primates, the still restricted variety of ancient hominins, and modern human populations after the post-Darwinian assumption that humans were primates and their closest relatives were apes(4).

## **SIGNIFICANCE OF DENTAL ANTHROPOLOGY:**

- It is significant in tracing historic trends in tooth size, shape, and number, genetically regulated variables such as tooth and crown size and morphology are used(2).
- Dental pathology and crown wear reveal dietary and cultural habits.
- It helps in defect analysis, both gross and microscopic, reflects disease and dietary stress.
- The intentional cultural changes of teeth (dental scarification) reflect people's past and present societies and cultures.
- Bite marks, specific occlusion and wear patterns, missing and filled teeth, and radiographic markers make teeth crucial in many forensic investigations.
- The comparative anatomy of teeth is important for identifying biology and systematics.

## **OBJECTIVES OF DENTAL ANTHROPOLOGY:**

- To be able to clearly identify all aspects of the human jaws and dentition(5)
- To be able to label the primary features of each tooth
- To have a knowledge of dentition size and form variation, as well as how to interpret it in terms of sexual dimorphism, evolution, migration, and growth.
- To have a knowledge of the developmental mechanisms that lead to the construction of the jaws and teeth
- To have a better understanding of the many forms of wear and how they change with age
- To be able to recognise the essential microscopic characteristics in the histology of enamel, dentine, and cement, as well as to comprehend the primary methods in which they may be utilized in anthropological study.
- To identify and define the most common forms of dental pathological lesions, as well as understand how they are assessed.

- To have a firm grasp on the significance of dentition in determining age.

## **STEPS OF DENTAL ANTHROPOLOGY IMPLEMENTATION:**

### **1.COLLECTION& HANDLING:**

Following proper collection and recording of the remains of a skeleton with teeth, as well as thorough and gradual analyses of the sediment around it for disintegrated teeth or bones, the collected specimen must be transported with extreme caution to avoid fragmentation of fragile parts such as the mandible, and metric and non-metric analysis in the laboratory(2).

### **2.METRIC ANALYSIS METHODS:**

Various methods for measuring teeth have been presented by researchers. The size of the teeth is generally determined by characteristics such as height and length, also measured are the diameter, width, and area. Characteristics such as height, for example, are not measured since the teeth of ancient humans are heavily worn, making the height useless and incomparable to other specimens. Because it uses commonly defined measuring points and methodologies, metric analysis is an effective method for facilitating specimen comparison. Each tooth size falls into a certain ethnic group's typical size category. As a result, a suitably sized sample can disclose the metric size of one group. Digital callipers must be used to measure teeth, and four attributes must be measured. By measuring one object twice and re-measuring pairs of measurements with considerable discrepancies, an average value in millimetres (mm) is determined(2).

**a. Crown length-**

It is determined by measuring the distance between the tooth's facial surface, bend ridge, and cutting edge (front tooth) or protoconid cusp top (molar).

**b. Mesio-distal diameter-**

The longest distance between the bend ridge inside the crown and the distal surface bend ridge parallel to the face surface of the teeth is used to determine the crown's diameter.

**c. Crown cervix mesio-distal diameter-**

This is the shortest distance between the inner surface of the crown and the tooth root boundary, as well as the distal surface parallel to the teeth's face surface.

**d. Diameter of the facio-lingual canal-**

The longest distance between the bend ridge of the face surface and the metaconid bend ridge is measured perpendicular to the surface where the mesio-distal diameter of the teeth was measured(6).

**e. Crown module (mcor)-**

This is the head's relative size, which may be computed using the average of the facio-lingual and mesio-distal diameters. The complete size is normally only estimated when crown height

is taken into account, despite the fact that the height value that may be determined by wearing of the tooth is limiting.

As a result, the mcor is utilised in order to make a comparative or informative comparison. For today's individuals, consider the following:

- Southern Europeans have a little tooth type of 10.20 mm.
- Mongoloids and Northern Europeans have a middle tooth type of 10.20-10.49 mm.
- Groups primarily residing in tropical locations and the South Pacific have enormous tooth types (> 10.50 mm).

**f. Index of the crown (I cor)-**

This is the ratio of the molar crown's mesio-distal diameter to the facio-lingual diameter. When viewed from the top, the crown seems longer in the facio-lingual direction because the index is greater.

**g. Crown absolute size (robustness, Rb)-**

This is a paleoanthropological metric that measures the overall crown size in relation to the crown module.

**h. Crown size in relation to others (canine index, incisor index)-**

This includes the ratio of mesial incisor mesio-distal diameter to maxillary lateral incisor mesio-distal diameter, as well as the ratio of mesial canine length to mandibular lateral mesio-distal diameter.

- Over the course of human evolution, the first molar is thought to be the tooth that has had the least amount of change (Selmer-Olsen 1949). Because it is the least affected tooth, the mesiodistal width retains its genetic characteristics the best among metric qualities.
- The step-index is determined as the proportion between the first molar's mesio-distal diameter to that of canines, second, and third molars based on these parameters. When compared to the first molar, the deterioration of those teeth can be estimated.

### **3. NON-METRIC ANALYSIS METHODS-**

Non-metric dental traits are morphological aspects of the teeth that vary in appearance both within and between populations. These characteristics appear to be influenced by genetics in part, therefore they can be successfully employed in the description of ethnicity, which can aid in the identification of a person through dental data. The majority of them are found in the crowns of incisors and molars in both dentitions. Teeth non-metric features are useful for identifying modern human groupings and determining their genetic ties with ancestral populations(7). The number and position of teeth, as well as the diversity of tooth shape, are used to classify non-metric features(8). The tooth trait's diversity provides crucial identifying information that distincts genetic recombination, and establishing links between small populations(9). Non-metric traits that are frequently reported include:

**a. Congenitally missing teeth:**

- The third molar and maxillary lateral incisors are two teeth that are frequently absent.
- In many situations, the incisors next to the eye tooth (canine) look identical when lateral incisors are congenitally lacking.
- This phenomena has been more common during the previous millennium, with some groups reporting a frequency of up to 20% in some cases.

## **b. Snaggletooth**

- It might be an incisor or a molar, and its form might or might not be the same as a regular tooth.
- It can affect both permanent and deciduous teeth, but the latter is far less common.

### **i. Bi-laterally rotated incisors (winging) –**

- The 'twisting' of the mesial side of the incisors toward the cheek is more typical in the lateral incisors. V-shaped or wing-shaped teeth are other names for them.
- The Mongoloid group has an expression rate of up to 45 percent, however this is uncommon among Europeans.

### **ii .Peg-shaped teeth –**

- These teeth are disproportionately tiny and resemble pegs; these are most common in the maxillary lateral incisors and may be caused by a congenital abnormality.
- In hominid populations, the expression frequency is around 3%, and it is somewhat greater in Europeans.

### **iii. Crowding of teeth —**

- When teeth that are permanent become overcrowded, one or two are usually forced out of their normal locations. Because the tooth sizes remain constant while the jaw size decreases, this results in crowding.
- As a result, the alveolus shrinks, preventing teeth from erupting correctly and causing them to spin. This condition is more common in maxillary incisors.

### **iv. Shovel-shaped incisors (shovelling) –**

- Among the morphological qualities of teeth, this genetic characteristic is the most widely investigated. Shovelling is the stretching of the enamel of the mesial and distal incisors' edges toward the tongue.
- The border of enamel is formed by this lingual edge ridge, which creates a fossa in the lingual centre(10).

### **v. Double-shoveling, labial marginal ridges (double-shoveling, labial marginal ridges) –**

- The enamel on the mesial and distal edge ridges of maxillary incisors that reach toward the cheek and tongue is referred to as double shovelling.

## **c. Canine distal accessory ridge –**

- This characteristic refers to the supplementary ridge on the lingual side of the mandibular canine's distal surface.

**d. Terra's tubercle –**

- This extra tubercle can be found on the edge ridge of the maxillary first canine's inner surface.

**e. Carabelli's cusp –**

- Tubercle with an unusual shape. The lingual surface of the protoconid of the maxillary first molar is where Carabelli's cusp is located. The fifth cusp is also a name for it.

**f. Protostylid cusp –**

- A protostylid cusp is an auxiliary cusp that forms in front of the mandibular molar's buccal side.

**g. Premolar groove patterns –**

- The number and form of lingual cusps in maxillary and mandibular premolars are studied.

**h. Cusp patterns of molars –**

- Molar cusp form and grooves have been used to characterise traits among modern human groupings, such as ties between ancestors and descendants.

**i. Mandibular molar occlusal cusp type –**

- The number of cusps and grooves determine the occlusal cusp type of mandibular molar.
- Depending on the groove type, there are usually 4-5 cusps.
- Grooves are divided into three categories: T, Y, and X.

**j. Mandibular molar distal trigonid crest –**

- The existence of the crest linking the protoconidmetaconid of the trigonid of mandibular molars is noted.

**k. Deflecting the wrinkle of the mandibular molar lingual front cusp –**

- The metaconidsocclusal ridge on mandibular molars usually runs straight from the cusp top into the developing groove. This ridge can be straight and refracted by being slanted toward the central fossa in some circumstances. This is an unusual occurrence in the third molar.

**l. LEH-**

- Due to the limits of dental asymmetry as a large scale predictor of comparative stress levels, dental anthropologists have moved their focus to the study of abnormalities in the tooth crown that occur during amelogenesis (enamel development) and dentinogenesis (dentine production) (dentine formation).(11)

## **SIGNIFICANCE OF DENTAL ANTHROPOLOGY IN FORENSICS**

Without a doubt, forensic odontologists all around the world have positively identified a huge majority of the victims discovered at crime scenes throughout the years. They did so by dissecting/resecting jaws from scarred and decomposing victims, comparing ante-mortem and post-mortem dental radiographs, and investigating bite marks inflicted on one individual by another. Although forensic anthropologic tests seldom result in a direct identification, they can substantially aid in narrowing the search field, which may lead to an identification. Odontology is one area of forensic investigation that rarely requires non-clinical assistance, except in situations when teeth are severely fractured and commingled(12). Forensic dental anthropologists use their experience in the recovery and reconstruction of human remains to identify and recreate dentitions, making them more suitable to examination by forensic odontologists.

## **TOOTH WEAR PATTERNS IN DENTAL ANTHROPOLOGY**

Tooth wear is a natural physiological phenomena in which teeth remain effective while being worn. Differences in the abrasiveness of the food and the usage of teeth as tools are linked to the intensity and type of tooth wear among civilizations(13). Tooth loss is inextricably linked to survival in species that utilise teeth to digest food - lose your teeth, and you lose your life. In the latter phases of human development, cultural buffering helped to remove this major link, although dental problems are still governed by long-term evolution, not current cultural improvements(14). As a result, human teeth, like the teeth of other vertebrates, were created under the influence of the environment. Anthropologists have long focused their understanding of tooth wear in premodern civilizations on the abrasiveness of the diet, sociocultural behaviours, as well as the usage of teeth as a means to cut, tear and grind the food. Because due to the use of processed and softer foods, modern people have less abrasive wear. As a result, erosion and attrition account for a large portion of the wear in our modern civilizations. Dental occlusions are fluid and change throughout time. The principal factor that affected the morphology of teeth through time was tooth wear, notably abrasion in pre-modern hunter-gatherer groups. Since the reptilian-mammalian transition, tooth wear mechanisms, particularly abrasion, have been prevalent. In contrast to the anthropological perspective(15). It's plausible to say that dentistry developed as a science during the preceding century, when dental caries, periodontal disease, and damaged dentitions were wreaking havoc on communities. As a result, dentistry has advanced in its ability to restore and rehabilitate dentitions to their original morphology, based on the underlying assumption that the newly erupted tooth was the most useful form. Despite the fact that dental thought is shifting away from strict geometric notions, there was a time when any sort of tooth wear was deemed problematic(16). There is little doubt that dental anthropology and dentistry are becoming more intertwined. Dentists are shifting away from static concepts, affirming significant changes as an implacable progression throughout life. Anthropologists have widely accepted attrition, abrasion, and erosion as distinct mechanisms.

## **CONCLUSION-**

The state of one's teeth may reveal a lot about one's diet and overall health. The evidence of food texture may be seen in macroscopic wear and dental microwear studies. Trace element biomonitoring aids in determining a person's nutritional and environmental state. It's critical to develop Dental Anthropology's varied spirit. Dentists, physicians, bioarchaeologists, forensic anthropologists, biochemists, biologists, historians, and social anthropologists all have knowledge and abilities that can help broaden the spectrum of interpretations within the subject. It is clear that the metric and non-metric characteristics of teeth may play a

significant influence in anthropology. Thus, modern dental anthropology is the result of decades of planned and continuous efforts by research teams to develop the discipline's scientific nature and seek to explain the tremendous biological variety of human communities.

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