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Mandible in Forensic Anthropology

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Forensic anthropology is defined as the field of study, which focused on examination of human bone systematically in order to get the identification of remains in medico-legal case [1]. The thorough examination in assessing the skeletal remains by the forensic anthropologists can lead to the time and the cause of death [2]. In a forensic case, anthropologists as well as pathologists deal with the human body. The pathologists perform the post mortem with the intact body, while the anthropologist focus in cases of degraded skeletonized, decomposed and burnt bodies [1].

The huge knowledge of human bone, dental anthropology, taphonomy, archaeology and genomics are significant for the forensic anthropologists to estimate age, race, sex and stature of skeletal remains [3]. The procedures to estimate age, sex, stature as well as ethnic background are vital in order to establish the biological profile of the remains, and particularly influential in criminal cases [2]. The study of bones and their anatomical measurements not only gives information regarding their origin but also ancestry, sex, stature, and age at death [4].

In forensic anthropology, both qualitative and quantitative methods have been used for distinguishing the biological profile of skeletal remains [5]. The methods in forensic anthropology are further divided into conventional morphometric and geometric morphometric analysis [2]. In traditional morphometric analysis, calipers were used to measure bones, and were digital mapped by modern digital software for calculation of linear metric distances [6]. In this method, the patterns of variation between individuals can be explored by using the statistical method. Both shape and size of the bone can be reflected by the measurements [7]. In the case of massive data, the analyses are very difficult if conventional morphometric analysis is used [6]. Traditional morphometric could allow one to visualize Statistical relationships either numerical or as scatter plots, not as estimates of the shapes themselves [8].

In recent years, in the development of the technological advances, researchers changed their method into the more sophisticated analysis, which are geometric morphometric methods [9]. The geometric morphometric analysis used anatomical landmark data to quantify the biological form [10]. It involves a very advanced statistical analysis with visualization of shape as end product [11]. The geometric morphometric analysis is a new method that study shapes and forms. Various studies used geometric morphometric methods to study variation in bones, and were able to determine the nature of previously identified anatomical variations in the population [12]. In recent years, geometric morphometric methods have become increasingly common for studying human skeletal biology in both physical and forensic anthropology [13]. These methods were used to a greater extent because they allow detail assessment of shape differences among specimens compared to the traditional method [14].

Geometric morphometric approach can represent each specimen by the relative positions of morphological landmarks that can be located precisely, and establish a one-to-one correspondence among all specimens, which were included into the analysis [10]. Procrustes superimposition procedure is the core of geometric morphometrics that extract shape information and remove variation in size, position and orientation from the data on landmarks coordinates [15]. The multivariate regression analysis used the coordinates of the superimposed landmarks to address a wider range of biological questions [16].

Forensic anthropologists deal with the cranial as well as post cranial bone in the identification of human remains. Recent research has focused on using various skeletal elements to quantify variation related to sex, age and race to facilitate forensic identification [17]. The pelvis and skull are the most reliable bone elements for sex determination in human bone. Mandible becomes the important element for sex confirmation in the absence of a complete pelvis. The mandible is the strongest and durable facial bone that retains its shape better than others [18]. It is morphological features show changes concerning age, sex and race [19]. Many researchers proved that many parts of mandible show variation in identification parameters. Gonial angle and antegonial region are important landmarks in the mandible, which were influenced by sex, age, and dental status [20]. Mandibular ramus also showed strong evidence that it can be used for sex determination in forensic analysis [21].

The sexual dimorphism varies between populations [22]. Although, population differences were more pronounced than sex differences in the sub-adult human mandible [23], results showed that significant morphological differences were present between samples. Cross-validation showed 70% accuracy in the identification of unknown individuals using complete mandible [13]. Franklin et al. [17] showed highly significant size and shape dimorphism in the samples examined, whereby the condyle and ramus were consistently the most dimorphic regions. It was stated that the mandible is a suitable element in terms of sex classification [17].

Among the various methods used for sex, ancestry and age estimation in individuals, the radiological method has certain advantages over histological and biochemical methods [24]. Radiographic method is a simple, quick, economic and non-invasive method for identification of the remains [25]. Radiographic scan was utilized for individual identification to determine age, sex, race, stature and cause of death [26]. Conventional radiographs allow observation of anatomical characteristics such as coronal shape and size, pulp anatomy, positioning and shape of the alveolar bone crest, and help in comparative identification of ante-mortem and post-mortem treatment [27]. Advanced imaging modalities like Computed Tomography (CT) helped in image segmentation, and avoids superimposition of anatomic structures. In addition, 3D CT images can be applied for facial recreation in reconstructive identification [25].

In conclusion, out of 206 bones of the body, mandible is selected due its important in mastication, smiling and speaking. The mandible is one of the important bones that can help in identification of human remains. The study of this important bone is very important in different population in order to identify the variation among the groups. Future research focus on every segment of the mandible in different method is required for in advanced research.

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