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ORIGINAL ARTICLE

Sex identification and reconstruction of length of humerus from its fragments: An Egyptian study

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Abstract: The aim of this study was to calculate the total length of the humerus and identify the sex from its fragments in Egyptians. One hundred and fifty dry adult right humeri (75 male and 75 female) were studied. The humeri were divided into seven fragments according to specific anatomical landmarks. Data obtained was subjected to descriptive statistical analysis. The longest fragmentary portion revealed a good result with closest proximity to the total length of humerus. All fragments showed significant sexual differences ($P < 0.001$) between males and females except H2. Total length of humerus revealed the highest percentage of accuracy (93.3%) followed by H4 (86.7%) and H7 (83.3%) for sex identification. Finally, from measurements of different humeral fragments in Egyptian population; the length of the humerus can be estimated and the sex can be identified.

1. Introduction

Several factors are essential for forensic experts to be able to identify an unknown dead body in many anthropological cases and traumatic events. Identifying the sex of a body and estimating the body's stature are considered the most important factors in establishing the identity of indefinite dead bodies, parts of bodies, or even skeletal fragments.[1]

In forensic examinations, sex determination is considered the simplest assignment because the external and internal genitalia can directly assert the sex of the deceased.[2] On the other hand, in cases of severely decomposed, commingled, and dismembered dead bodies, determining the sex of the deceased is a challenging task. In addition, sex determination is important to evaluate other parameters of a biological profile, such as stature and age.[3]

There are many techniques to determine the demographics (e.g., sex and race) from skeletal remains in the field of forensic anthropology. A qualitative morphological examination (non-metrical method) is the simplest and fastest method with 95–100% accuracy if the whole skeleton is available and the observer is an expert. This method depends on visual inspection of the sexual and physical characteristics of the bones, which are distinctive to the elements of the human skeleton.[4]

A second technique, a morphometric method, relies on measurements and statistical techniques. These methods are considered more advantageous for data evaluation and its application to the skeleton.[5] However, many indices depend on direct distances between two bony landmarks, and the complicated pattern of an osseous curve cannot be studied.[6,7]

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Later, a combination of morphometric and meristic characteristics is used as a new technique. Geometric morphometrics is a method that can compute the differences of the shape of bones in a two- or three-dimensional (2D or 3D) coordinate system by obtaining the mean.[8] Recent advances in geometric morphometrics allow analyses of bone configurations and sex determination.[9,10]

It was difficult to estimate a body's stature from available bone fragments following mass disasters or even from archeological remains. Some forensic experts neglected fragments of bones, thinking that no benefit could be gained from such fragments; however, in 1935, Müller recorded a scientific basis for estimating long bone length from fragments.[11]

It has been reported that the stature of an individual can be estimated from the length of the long bones of the limbs.[1] The femur was considered the most ideal bone to estimate stature in the majority of past studies.[12,13] However, populations differ in the relationship between stature and lengths of limb bones. Therefore, specific equations for stature estimation are required for each population.[14]

Many researchers studied the sexual dimorphism of adult skeletons[15–17] using the dimensions of the skull, face[18,19], long bones[20,21], hands, feet[22–24], and pelvis.[25,26] Scholars proved that a specific study is needed for each population to gain accurate results for the sexual identification of a skeleton.[27] Discriminant function analysis had been used to estimate the sex from bones if they are suspected to be sexually dimorphic.[28,29] The pelvis was considered to be the most accurate bone for sex determination, as it allows for parturition in females.[30]

The humerus is one of the important long bones of the skeleton due to its strength, even in a fragmented state, and it is possible to be recovered in a forensic case. Classical osteometric techniques have been used to realize the value of estimating the humerus length from its fragments[31,32] and confirming the existence of sexual dimorphism in the humerus.[33,34] In anthropometric studies, the humerus is a moderately studied bone. It plays an essential role in sex identification, stature estimation of the individual, forensic studies, etc.[35]

The aim of this study was to derive regression equations for establishing the total length of the humerus and discriminant function equations for sexual identification using different humerus fragmentary measurements in Egyptian populations.

2. Materials and methods

The humerus bone collection used in this study was obtained from the dissected cadavers of Egyptians in the Forensic Medicine Department of the Justice Office in Minia Governates-Egypt and also from the Anatomy Department of Minia and Cairo universities. These bones were selected in a dried and fully ossified state. The deformed, atrophied, or pathological bones were not included in this study. The age and sex of the cadavers were recorded; however, full information about the individuals was unavailable.

By a simple random sampling technique, 150 humeri (75 males, 75 females) of an Egyptian population were chosen. The age for both sexes at death ranged between 20 and 60 years. The period of human history from which the bones have been collected is not recorded in the archives of the anatomy department of Minia and Cairo Universities. The right humeri only were used in this study because both humeri of the same individual were unavailable and the right side was the dominant side.

Eight measurements were taken from each humerus. Each humerus was fragmented by drawing imaginary lines at different anatomical landmarks (Fig. 1).

The anatomical landmarks are:

a: is the most proximal point on the head
b: is the most inferior point on the margin of the articular surface on the head
c: is at the convergence of two areas of muscle attachment just below the major tubercle
d: is at the upper margin of the olecranon fossa
e: is at the lower margin of the olecranon fossa
f: is at the most distal point on the trochlea
g: is the most lateral protruding point on the lateral epicondyle
h: is the most medial protruding point on the medial epicondyle
i: is the most superior point on the margin of the articular surface of the head

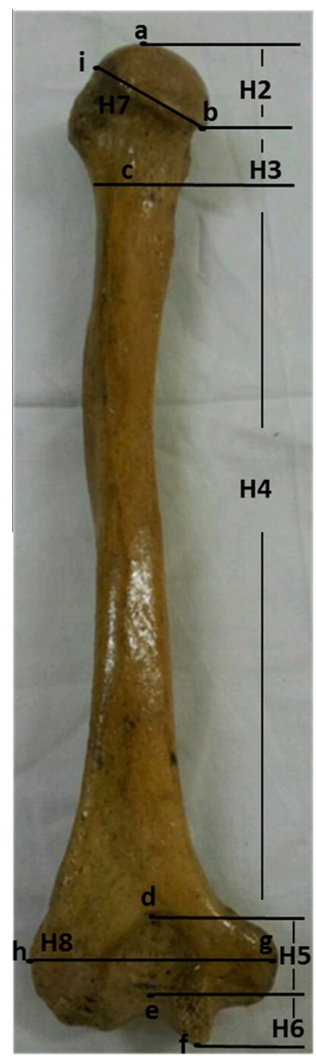

Figure 1 Humerus with anatomical landmarks in relation to different fragments.