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Research Article

Morphometric analysis of Humerus bone in Indian population

S.Lokanadham[1], N.Khaleel[2] , P.Arun Raj[3]
[1]Department of Anatomy, ESI Medical College& PGIMSR, Chennai, Tamilnadu.
[2]Department of Anatomy, St. John's Medical College, Bangalore, Karnataka.
[3]Department of Anatomy, Sri Venkateswara Institute of Medical Sciences, Tirupati, AndhraPradesh

Corresponding author
Sadhu Lokanadh
E-mail: loka.anatomy@yahoo.com

Abstract: The examination of the upper and lower limb asymmetries can be useful to medical anthropologists, archeologists, forensic experts and for medico legal studies. We were collected 100 dry human humeri of unknown sex from department of SVIMS University & SVMC, Tirupati. Each humerus was measured for 14 parameters by using Osteometric board and sliding caliper. The parameters and their values are statistically verified and analyzed. The results revealed that values of the parameters were higher in males than those of females with mere significant ($p<0.001$). Every parameter was independent of others and contributes certain percentage of certainty to decide the sex of unknown humerus. The present study reveals that humeri of unknown gender can be sexed to the extent of 75-80% with above measured parameters which gives knowledge about the sex determination of unknown.
Keywords: humerus, morphometry, sex determination.

INTRODUCTION

Almost all bones of the human skeleton show some degree of sexual dimorphism. It is recognized that long bone cross-sectional area is greater in males compared to females, which is tough to reflect more rapid periosteal bone growth in boys [1]. However, it is currently unclear whether these findings reflect gender differences in bone size or shape. Previous studies tried to confirm the factors that affect the long bone dimensions and to explain the phenomenon of the different lengths between the right and left humeri [2, 3]. In the present study we are taking one of the long bones (humerus) either individually or in combination, has been subjected to statistical and morphometric analysis for the purpose of determination of sex. Earlier studies concluded that the right upper limb bone dimensions were greater especially in length when compared with the lower limb [4]. The humerus offers important advantages over other long bones in that its entire outline can readily be traced on total body X-ray absorptiometry (DXA) images, and its shape can be modeled as a cylinder with reasonable accuracy [5].

MATERIALS AND METHODS

In the present study 100 adult humerus bones were collected from the department of Anatomy, Sri Venkateswara Medical College and also from department of Anatomy, Sri Venkateswara Institute of Medical Sciences, Tirupati. We measured 14 different parameters of the humerus to study the morphometric analysis by using Metal sliding caliper, Osteometric board, and Tape. All parameters were recorded and statistically analyzed.

RESULTS

Each humerus was measured for 14 parameters which were already described in materials and methods. Based on parameter differences out of hundred humeri we got 71 male humeri and 29 female humeri. In the present study we are discussing about all these 71 male and 29 female humeri. The mean maximum length in male was: 31.97±0.155; female it was: 28.65±0.153. The mean total length in male was: 31.532±0.154.In female it was: 28.35±0.153.The mean breadth of proximal epiphysis in male was: 4.719±0.034 and in female was: 4.167±0.049.The mean breadth of distal epiphysis in male was: 5.974±0.054, in female was: 5.537±0.325. The mean maximum diameter in middle in male was: 1.953±0.027, in female was: 1.75±0.030. The mean minimum diameter in middle in male was: 1.657±0.0211, in female was: 1.485±0.026. The mean least girth of the shaft in male was: 5.871±0.060, in female was: 5.339±0.090. The mean girth in the middle of the shaft in male was: 6.391±0.068, in female was: 5.782±0.090. The mean maximum transverse diameter of head in male was: 4.378±0.420, in female was: 3.492±0.042.The mean maximum vertical diameter of head in male was: 3.266±0.031, in female was: 2.96±0.0416. The mean girth of head in male was: 12.96±0.091, in female was: 11.521±0.1190. The mean breadth of trochlea in male was: 2.339±0.022, in female was: 2.092±0.034. The mean breadth of capitulum in male was: 1.638±0.017, in female was: 1.521±0.022. The mean depth of trochlea in male was: 2.39±0.023, in female was: 2.089±0.036.

Table 1: 14 Parameters measured for 100 humeri

Parameters	Mean ± SEM (males) n=71	Mean ± SEM (females) n=21	t value	P value
Maximum length	31.97±0.155	28.65±0.153	12.406	<0.0001*
Total length	31.532±0.154	28.35±0.153	12.168	<0.0001*
Breadth of proximal epiphysis	4.719±0.034	4.167±0.049	8.733	<0.0001*
Breadth of distal epiphysis	5.974±0.054	5.357±0.325	2.761	0.0069*
Maximum diameter in the middle	1.953±0.027	1.75±0.030	4.362	<0.0001*
Minimum diameter in the middle	1.657±0.0211	1.485±0.026	4.64	<0.0001*
Least girth of shaft	5.871±0.060	5.339±0.090	4.79	<0.0001*
Girth in the middle of the shaft	6.391±0.068	5.782±0.090	4.987	<0.0001*
Maximum transverse diameter of head	4.378±0.420	3.492±0.042	1.343	0.182**
Maximum vertical diameter of head	3.266±0.031	2.96±0.0416	5.492	<0.0001*
Girth of head	12.96±0.091	11.521±0.1190	8.897	<0.0001*
Breadth of trochlea	2.339±0.022	2.092±0.034	5.913	<0.0001*
Breadth of capitulum	1.638±0.017	1.521±0.022	3.718	0.0003*
Depth of trochlea	2.39±0.023	2.089±0.036	6.947	<0.0001*

P*<0.01 (Significant); P**>0.01 (no significant)

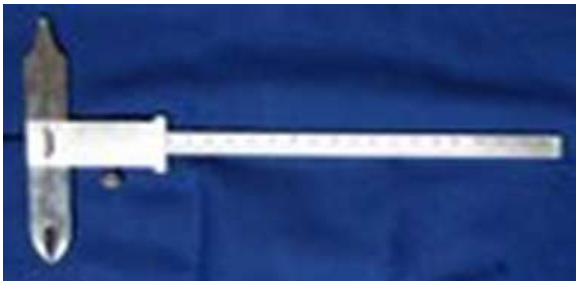

Fig. 1: Sliding Caliper

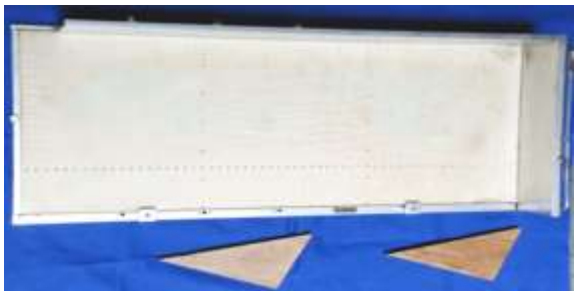

Fig. 2: Osteometric board

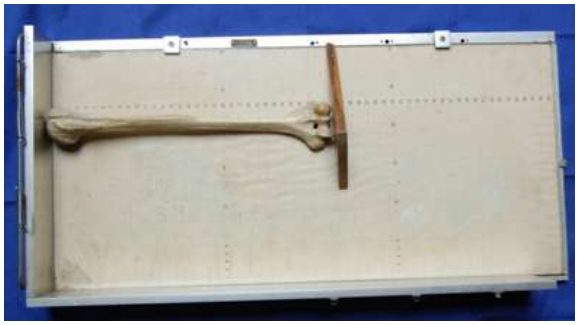

Fig. 3: Measuring maximum length of the Humerus by using Osteometric board

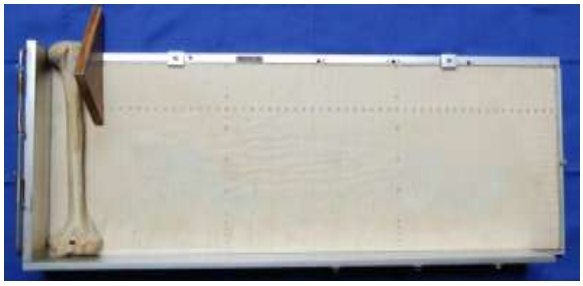

Fig. 4: Measuring Breadth of proximal epiphysis of the Humerus by using Osteometric board

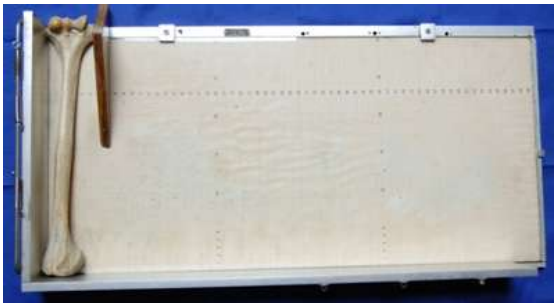

Fig. 5: Measuring Breadth of distal epiphysis of the Humerus by using Osteometric board

Fig. 6: Measuring Maximum Transverse diameter of head of humerus by Sliding caliper.

DISCUSSION

We collected 100 humerus bones from the department of anatomy and measured maximum length, total length, breadth of proximal epiphysis, maximum diameter in middle, minimum diameter in middle, least girth of shaft, girth in the middle of the shaft, maximum vertical diameter of head, girth of head, breadth of trochlea and depth of trochlea which are analyzed respectively ($P<0.0001$).Tanner&Hughes found that humerus is wider in males compared to females from age 3 years until the time of pubertal growth acceleration in females[6]. Boys have a higher fracture risk than girls in childhood [7]. Gender differences in humeral shape are established prior to puberty is supported by various studies in which greater humeral width was seen in prepubertal boys compared to girls [8].The observation of an 8% gender difference in lean mass and 27% difference in fat mass, compared to the 1% gender difference in humeral length and 2% of difference in width, perhaps reflects the strength of association between fat or lean mass and bone area [9].According Kranito et al study of Cretan population data is concludes that proximal epiphysis is the most dimorphic part with classification accuracy of 89.9% while the distal epiphysis is ranked third among with length 85.1% and same study proved that men have shorter humerus shaft than women humerus shaft[10].morphometry of distal segments of humerus is very important because of its sexual dimorphism and humerus is subjected to greater functional stress [11]. Is'can et al.found that the most effective single dimension, as determined by the direct discriminate analysis, was the vertical head diameter in the Chinese (81%) and epicondylar breadth in the Japanese and the Thai populations 90% and 93% respectively[12]. Robinson MS and Bidmos got 72-95.5% accuracy in their study on the skulls and humeri of South Africans [13]. The humeral head diameter was the most common sex discriminator [14]. Kranioti et .al studied 168 left humeri by the Osteometric method and they found 92.3% accuracy in determining the sex and found that the single most effective (89.9%) dimension was the vertical head diameter of the humerus [15].

CONCLUSION

In the previous studies authors did not analyze relationship between total humeral length and the measurements of their segments related to possible differences among population.

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