MORPHOMETRICANALYSIS AND SEX DETERMINATION OF AXIAL BORDER AND CORACOID PROCESS OF HUMAN DRY SCAPULA

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Abstract: The scapula is a slender and big triangular flat bone placed on the thoracic wall poster lateral side. The scapula connects the axial skeleton to the upper bipeds' appendicular skeleton. The Sri Venkateswara institute of medical science and svmc medical college in Tirupati conducted this investigation on 106 dry adult human scapulae of undetermined sex. In this study, scapular measures such as the length of the axial border, the length of the supraspinous line, and the width of the Coracoid process of the scapula were taken and parameters were estimated.

Keywords: sex estimation; vernier caliper; human dry scapula

Introduction

The scapula is a long, slender triangular flat bone located on the posterolateral side of the thoracic wall.[1]. The scapula connects the axial skeleton to the upper limb's appendicular skeleton. There are three angles, three borders, three surfaces, and three processes on the scapula. The thickest lateral border spans from above the glenoid cavity to below the inferior angle. The spinous process is a triangular plate of bone that runs down the dorsal aspect of the scapula and connects laterally to the acromion process. The assessment of a person's gender is crucial for establishing identity from skeletal remains. [2] David Gonçalves (2011) Sex determination is critical for establishing identity from skeletal remains. David Gonçalves (2011) [2]. The assessment of the sex of unidentified human skeletal remains is crucial for establishing a biological profile and is a critical stage in the identification process [1, 2].
Traditionally, assessing a biological profile (sex, population affinity, age at death, and stature) begins with assessing sex, because the age at death and stature are sex-dependent [3, 4]. The assessment of biological sex on skeletal remains is predicated on the existence of morphological variations between female and male people [1, 5]. The two most similar procedures for determining sex are morphological and geometrical methods. As a result, sex can be determined using measurements of dimorphic dimensions and observations of physical features. Morphological approaches rely on the visual assessment of dry bones and are observer-dependent, resulting in subjective conclusions [7, 26, 30, 32]. Metric approaches compare male and female size differences, assuming that males are larger than females [1, 2, 33].
The first stage in creating individual identification using the pelvis and skeleton is determining the precise sex from the skeleton. [4]. One of the most important medical issues is determining sex, and it is also used extensively in archaeological explorations to establish identity. It is an attempt to link information flow with human evaluation. Ancestry identification is important in forensic contexts as well as bioarchaeological research on skeletal remains from archaeological sites. [5]. Adult males and females have different shape and size characteristics across the entire human population. Anatomists have used known and unknownto perform various measurements to differentiate the scapula's sex. [6]

II. Aims and Objectives

The current study's goal is [1] To measure the anthropometric measurements of the dry scapula. [ii] To calculate the axial border and coracoid process, use the supraspinous line of the scapula. [iii] To assist orthopaedic and prosthetic surgeons in better understanding shoulder pathology as well as in designing and fitting glenoid components for total shoulder arthroplasty.

III. Material and Methods

The experiment involved 106 dry, unpaired adult human scapulae of unknown sex. The right side had 58 scapulae and the left side had 57. The research was carried out at Tirupati's Sri Venkateswara Institute of Medical Sciences. The collected bones are in good condition and free of pathological lesions or fractures.Morphological sexing.

The following morphological characteristics were used to determine sex: I. Glenoid fossa depth II. Muscular ridges on the costal surface and scapular borders III.Inferior angle IV. Glenoid cavity length

Based on the morphological characteristics listed above, each scapular bone was classified as male or female for sexing purposes.

Imeasured the scapula parameter with vernier callipers, taking measurements from each individual's right and left sides. The supraspinous line's length is measured from the superior angle to the spinal axis on the medial border. The axial border is measured from the most inferior point of the glenoid fossa to the inferior angle's bottom. The superior and medial borders of the Coracoid process are used to calculate the width of the Coracoid process.

Results

Results In the present study, 106 scapular bones from both sides and both sexes were utilized. Sexing of the bone was done by using the following four morphological features, which were tabulated sex-wise and side-wise (Table 1).

SIDE	MALE	FEMALE	TOTAL
Right	31	25	56
Left	30	20	50
Total	61	45	106

The current study's findings could be categorized as right male vs. right female and left male vs. left female, as shown below.

Right male and Right female (scapula)

[1] Lengthof the supraspinous line (LSSL): In the present study, the lengths of the supraspinous line were the mean and an SD value for the length of the supraspinous line was found to be 4.82±0.60 and 12.6±0.67 in the right male and female and the difference-value and to be statistically significant with a p-value of 0.01 [Table1].

[2] Length of Axial Border (LAB): The mean and standard deviation of the length of the axial border of the scapula in the right male and right female were 12.51.09 and 11.01.40, respectively, and the difference was statistically significant with a p-value of 0.001[Table1].

[3]Width of the Coracoid process (WCP): The mean and standard deviation of the width of the Coracoid process scapula in the right male and right female were 1.360.13 and 1.290.14, respectively, and the difference was not statistically significant with a p-value of 0.001[Table1].

Table1 Mean±SD Values of parameters and significance test between right male and right female

S.no	Side & sex wise	LSSL Mean ± SD	LAB Mean ± SD	WAP Mean ± SD
1.	Right male	4.82±0.60	12.5±1.09	3.15±0.60
	Right female	4.15±0.79	11.0±1.40	2.58±0.57
(p-value)		0.004**	0.01**	0.01*

* (Pvalue<0.05, statistically significant)

Left male and Left female (scapula)

[1]Length of the supraspinous line (LSSL): In the present study, the lengths of the supraspinous line were the mean and an SD value for the length of the supraspinous line was found to be 5.00±1.20 and 4.50±0.47 in left male and left female and the difference was found to be not statistically with-valuable of 0.05 [Table2].

[2]Length of Axial Border (LAB): The mean and SD values of the length the of Axial border of the scapula were found to be 12.5±0.84 and 11.2±0.62 in left male and left female respectively and the difference was found to be statistically significant with a p-value of 0.02 [Table2].

[3]Width of the Coracoid process (WCP): The mean and SD values of the width of the Coracoid process scrap were found to be 1.36±0.13 and 1.29±0.14 in left male and left female respectively and the difference was not statistically significant with a p-value of 0.80[Table2].

Table2 Mean±SD Values of parameters and significance test between Left male and Left female

2.	Side & sex wise	LSSL Mean ± SD	LAB Mean ± SD	WCP Mean ± SD
	Left male	5.00±1.20	12.5±0.84	1.32±0.16
	Left female	4.50±0.47	11.2±0.62	1.29±0.51
(p-value)		0.5	0.02**	0.80

* (Pvalue<0.05, statistically significant)

Males (right and left dry scapula)

[1] Length of the supraspinous line (LSSL): In the present study, the lengths of the supraspinous line were the mean and an SD value for the length of the supraspinous line was found to be 4.82±0.60 and 5.00±1.20 the in right male and left male and the difference was found to be statistically not significant with a p-value of 0.55 [Table3].

[2] Length of Axial Border (LAB): The mean and SD values of the length of the Axial border of the scapula were found to be 12.5±1.09 and 12.5±0.84 in right male and left male respectively and the difference was found to be statistically not significant with a p-value of 1.00 [Table3].

[3]Width of the Coracoid process (WCP): The mean and SD values of the width of the Coracoid process scapula were found to be 1.36±0.13 and 1.32±0.16 in right male and left male respectively and the difference was not statistically significant with a p-value of 0.38[Table3].

Table 3 Mean±SD Values of parameters and significance test between Right Male and Left Male

3.	Side & sex wise	LSSL Mean ± SD	LAB Mean ± SD	WCP Mean ± SD
	Right male	4.82±0.60	12.5±1.09	1.36±0.13
	Left male	5.00±1.20	12.5±0.84	1.32±0.16
	(p-value)	0.55	1.0	0.38

* (Pvalue<0.05, statistically significant)

Right Female and Left female (scapula)

[1] Length of the supraspinous line (LSSL): In the present study, the lengths of the supraspinous line were the mean and an SD value for the length of the supraspinous line was found to be 4.82±0.60 and 4.50±0.47 in Right Female and Left female and the difference was found to be statistically not significant with a p-value of 0.23[Table4].

[2]Length of Axial Border (LAB): The mean and SD values of the length of the Axial border of the scapula were found to be 11.0±1.40 and 11.2±0.62 in Right Female and Left female respectively and the difference was found to be statistically not significant with a p-value of 0.68[Table4].

[3]Width of the Coracoid process (WCP): The mean and SD values of the width of the Coracoid process scapula were found to be 1.29±0.14 and 1.29±0.51 in Right Female and Left female respectively and the difference was not statistically significant with a p-value of 1.00[Table4].

Table 4 Mean±SD Values of parameters and significance test between Right Male and Left Male

4	Side & sex wise	LSSL Mean ± SD	LAB Mean ± SD	WCP Mean ± SD
	Right female	4.15±0.79	11.0±1.40	1.29±0.14
	Left female	4.50±0.47	11.2±0.62	1.29±0.51
	(p-value)	0.23	0.68	1.00

⁎ (Pvalue<0.05, statistically significant)

Male and Female (Scapula)

[1]Length of the supraspinous line (LSSL): In the present study, the lengths of the supraspinous line were the means, and an SD value for the length of the supraspinous line was found to be 4.92±0.99 and 4.31±0.70 in males and females, and the difference was found to be statistically significant with a p-value of 0.01[Table5].

[2] Length of Axial Border (LAB): The mean and SD values of the length of the axial border of the scapula were found to be12.53±0.99 and 11.12±1.15 in males and females, respectively, and the difference was found to be statistically significant with a p-value of 0.00[Table5].

[3] Width of the Coracoid process (WCP): The mean and SD values of the width of the coracoid process scapula were found to be1.34±0.15 and 1.34±0.15in Males and females, and the difference was found to be statistically insignificant with a p-value of 0.21[Table5].

Table 5: Mean±SD parameter values and significance test for male and female

5.	sex wise	LSSL Mean ± SD	LAB Mean ± SD	WCP Mean ± SD
	Male	4.92±0.99	12.53±0.99	1.34±0.15
	Female	4.31±0.70	11.12±1.15	1.34±0.15
	(p-value)	0.01⁎⁎	0.00⁎⁎	0.21

⁎ (Pvalue<0.05, statistically significant)

Fig1

Fig2

Fig3

Fig1 Length of Axial Border (LAB) **Fig2**Length of supraspinous line (LSSL) **Fig3**Width of Coracoid process

DISCUSSION

In the present study, six morphometric parameters have been used the length of the supraspinous line, the length of the axial border, and the width of the coracoid process of the scapula. The morphometric variables were statistically analysed sex-wise and side-wise [5].

Length of the supraspinous line (LSSL): Campobassoet.al. (1998) reported a Mean±SD Value of 5.32±0.6 (in cm) for the maximum length of the supraspinous line in a total of 223 scapulas. Gretchen R Dabbset.al. (2010) found 57.47±5.87 (in mm) in males and 48.94±5.20 in females,

The value obtained in the present study was a mean ± SD value of 12.79±0.99 (cm) that were low, which might be due to less sample size compared to that of Campobassoet.al. (1998) for the length of the supraspinous line in a total of 106 scapulas. The low mean ± SD values 13.11±0.85 in males and 12.20±0.99 in females with a low sexual dimorphic value is 0.49, comparable with the findings of Gretchen R Dabbset.al. (2010).

In the present study, a p-value of 0.001 for was LSSL observed when male data were compared with female data, and LSSL data in the present study is also compared about different sides (right Vs left)within gender and also between different genders (male VS female. Out of these comparisons, significant changes in for right male Vs right female (0.01) for LSSL were noted. Insignificant p values for left male Vs left female (0.5), right female Vs left female (0.23) and right male Vs left male (0.55) for LSSL observed.

Length of Axial Border (LAB): Campobassoet.al. (1998) reported a Mean±SD Value of 5.32±0.6 (in cm) for the maximum length of the supraspinous line in a total of 223 scapulas.

The value obtained in the present study was a mean ± SD value of 12.79±0.99 (cm) that were low, which might be due to less sample size compared to that of Campobassoet.al. (1998) for the length of the supraspinous line in a total of 106 scapulas.

In the present study, a p-value of 0.001 for was LSSL observed when male data were compared with female data, and LAB data in the present study is also compared about different sides (right Vs left) within gender and also between different genders (male VS female). Out of these comparisons, significant changes in right male Vs right female (0.001) and left male Vs left female (0.02) for LAB were noted. Insignificant p values for left male Vs left male (1.0), and right female Vs left female (0.68) were observed.

Width of the Coracoid process (WCP): There are no similar studies not found for the width of the Coracoid process. In the study, a p-value of 0.21 for WCP when male data were compared with female data. WCP data about different sides (right Vs left) within gender and also between different genders (male Vs female). Out of these comparisons, an insignificant p-value for right male Vs right female (0.16) and left male Vs left female (0.80) right male Vs left male (0.38) and right female Vs Left female (1.00) for WCP. The sexual dimorphic value is 0.17 for the width of the Coracoid process.

Conclusions

This article summarizes and presents the morphometric measurements of various scapula parameters taken in the Andhra Pradesh region of India. The use of this study's data in demographic studies and forensic science benefited this study. Anatomists face numerous challenges when analyzing the isolated scapula of an unknown group (or) diseased person for sex determination. The sexual determination parameters may also be useful to forensic and orthopaedic surgeons for prosthetic implants. Males had higher mean values in the variables when compared to females. The inclusion of a large number of scapulae in this study could shed light on the variation in sexual dimorphism across geographic regions.

An application with a large number of variables may result in the selection of variables for establishing standard parameters for determining sex in this population.

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