Scapular morphometry- A study in West Bengal population with literature review

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Abstract: *Background*: Scapula is a bone of interest for anatomists as it has a considerable evolutionary modification from quadruped to biped. It is the link bone between axial and appendicular skeleton of upper limb. Its different morphometric parameters were found to be associated with different diseases of the shoulder girdle. Till date no anthropometric data is available from the eastern India specifically from Bengalee population. *Objective:* Measurement of different morphometric parameters of dry human scapulae including its indices to elicit data from West Bengal. *Methods*: In the present study authors measured different parameters in 200 available dry human scapulae; preserved in Anatomy departments of different medical colleges of Kolkata over last one year. Measurement of length, breadth, infraspinous length, projection length and were taken by slide callipers, with calculation of scapular and infraspinous indices. *Result*: In the present study mean values of the parameters of scapula were: length 132.97±18.07mm, breadth 97.96±9.38mm, infra-spinous length 103.57±11.05mm, projection length 124.93±7.41mm, scapular index 75.56±17.67 and infra-spinous index 95.35±11.21. *Conclusion:* Measurement of different parameters of scapula and indices of scapula can be useful for surgical intervention, prosthetic invention, medico-legal aspect and in comparative study. In addition to the anthropometric data available for population from other zones of India, this study adds the data from Eastern India.

Keyword: Infraspinous Index, Projection Length, Scapular Length, Scapular Breadth, Scapular Index.

Introduction

Scapula, a triangular shaped flat bone, is one of the components of pectoral girdle, present on postero-lateral aspect of thoracic cage extending from level of second to seventh thoracic vertebral spine [1]. Thislink bone between axial and appendicular skeleton of upper limbhas three fossae; one on ventral aspect- subscapular fossa and two on dorsal aspect - supra and infraspinous fossae, divided by a triangular spinous process of scapula [1]. Considering evolution, development of scapula is by fusion of two bones- dorsally scapula proper and coracoid process ventrally [2].

Peculiar shaped scapula, which is a mammalian character, with attachment of fifteen muscles has been the point of attraction for the anatomist for years [3]. Different studies reflected evolutionary changes from pronograde to orthograde due to

freeness of forelimb, where there is progressive increase of breadth of the scapula [4]. Long, narrow shape of scapula has modified to broad shaped scapula, due to changes in the infraspinous segment predominantly [5].

In anthropometry scapular 'length' is described as its maximum cranio-caudal distance i.e. the distance between the most projected summit of superior angle to the summit of inferior angle; whereas the scapular 'breadth' is described as maximum width i.e. distance between most distant point in outer arc of glenoid to the angle where the spine meets the body. The 'scapular index' is described as 'scapular breadth x 100 / scapular length'. The 'infraspinous length' is the distance of inferior angle summit to the medial most projected point where spine

meets. And the infraspinous index depicts as of 'scapular breadth x 100/ infraspinous length' (Fig. 1) [6-14].

Fig-1: Concepts of different morphometric measurements in scapula
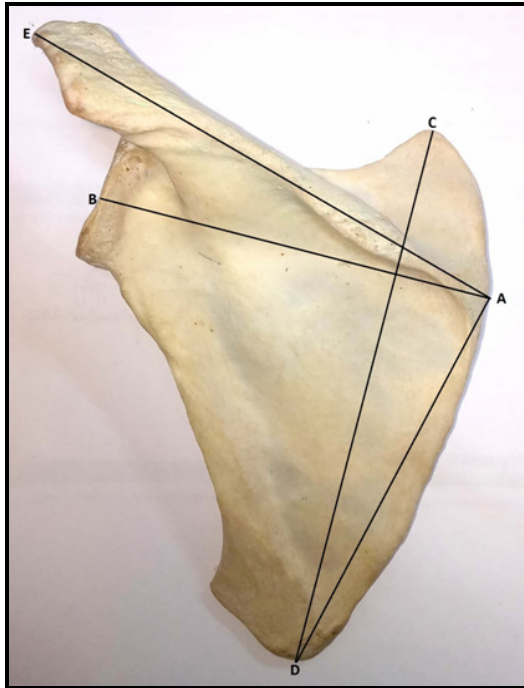
The line C-D represents the scapular length; the line A-B represents the scapular breadth; the line A-D represents the scapular infraspinous length; and the line A-E represents the projection length of scapula.

These morphometric parameters of scapula are important for rotator cuff disease, shoulder arthroplasty, recurrent dislocation of shoulder, prosthesis manufacturing as well as from medico-legal point of view, comparative anatomy [15-17].

So far the literature has been searched for, till date though data available for different scapular morphometrics in northern, western and southern India population; but no data is found in the eastern Indian population.

The present study aimed to describe bilateral morphological and morphometric variations of differentparameters of scapula like its length, breadth, infraspinous length, projection length, scapular index, infraspinous index; in the population of West Bengal for both understanding of shoulder pathology, shoulder arthroplasty and to the anthropologist during working on evolution from pronograde to orthograde.

Material and Methods

With due permission from Institutional Ethics Committee and the Director of the institution, under guidance of the Head of the department, this institution based cross-sectional observational study was undertaken in the Department of Anatomy of IPGME&R Kolkata for six months duration from March 2020 to August 2020. The dry adult human scapulae of unknown age and sex were collected from the museums of Anatomy departments.

Head of the Departments of Anatomy of other four medical teaching institutes of Kolkata were also approached for their kind permission to access the scapulae kept in the respective departmental museums; presuming the bones were disarticulated from the skeletons of donated cadavers belonging to population of West Bengal. Thus in 100 scapulae of right side and 100 scapulae of left side, in total 200 specimens were included in study by the convenient method of non-randomised sampling. We discarded malformed, non-ossified or broken bones.

Measurements were taken in millimetre with the help of Vernier calliper (with precision 0.02 mm), osteometric board, white paper, lead pencil. We took measurement of each data three times by two observers and finally took the mean value of each data to avoid observational bias (Fig 2- 5).

Fig-2: Scapular length measurement by Vernier caliper.

Fig-3: Scapular breadth measurement by Vernier caliper

Fig-4: Scapular Projection length measurement by Vernier caliper

Fig-5: Scapular 'infraspinous length' measurement by Vernier caliper

Parameters measured were:

(i) *length of scapula* (distance between the summit of superior angle and inferior angle) [Fig 2]

(ii) *breadth of scapula*(distance between the point where the spine intersects the medial border of scapula and the middle of the outer border of glenoid cavity) [Fig 3]

(iii) *projection length* (medial edge of the scapular spine to the lateral edge of the acromion process) [Fig 4]

(iv) *Infraspinous length* of scapula(distance between the point where the spine intersects the medial border of scapula and the summit of the inferior angle of scapula) [Fig 5]

(v) *scapular index* (breadth of scapula X 100/ length of scapula),

(vi) *infraspinous index* (breadth of scapula X 100/ infraspinous length of scapula).

The mean, standard deviation (SD), range of each parameter were calculated with SPSS version 16 and compared with previous studies.

Results

Mean, SD and p values of different parameters are given in table no 1. Student t test was done between the right and left values of each data to note whether the difference was significant or not. The p-value we got for length, breath, infraspinous length, projection length of the scapular spine was 0.0594, 0.3665, 0.0369 and 0.7483 respectively; showing difference between right and left side is insignificant. The co-relation between breath and length of scapula was expressed as scapular index and breath with the infraspinous length of scapula was expressed as infraspinous index.

As a whole, 'scapular length' was found to be 132.97 ±18 mm, with no significant variation in laterality. Similarly, the 'scapular breadth' in average found to be 97.96 ± 9.38 mm with no significant variation in left to right side. The 'projection length' was also found to have insignificant variation to laterality with average value of 124.93± 7.41 mm. On the otherhand, the 'infraspinous length' in average found to be 103.57 ± 11.05 mm with

statisticallysignificant variation with laterality (p value 0.0369). So far, the indices concerned, as a whole, the 'scapular index' in average was found to be 75.61 ± 17.6 with highly significant

variation on left or right (p value 0.0071); but the 'infraspinous index' was found to vary insignificantly from right to left side with mean value 95.42 ± 11.2 [Table 1].

Table-1: Morphometric parameters of adult dry human scapulae in Bengalee population [N=200]					
Serial no	Parameters	Side	Mean	SD	Students' t test p value for laterality comparison
1	Length (mm)	Right	130.61	21.51	0.0594
		Left	135.40	13.05	
		As a whole	132.97	18.00	
2	Breadth (mm)	Right	98.56	9.48	0.3665
		Left	97.45	9.40	
		As a whole	97.96	9.38	
3	Infraspinous length (mm)	Right	105.22	11.60	**0.0369**
		Left	101.97	10.22	
		As a whole	103.57	11.05	
4	Projection length (mm)	Right	124.83	6.24	0.7483
		Left	125.17	8.53	
		As a whole	124.93	7.41	
5	Scapular Index	Right	78.91	23.5	**0.0071**
		Left	72.28	6.53	
		As a whole	75.61	17.6	
6	Infraspinous index	Right	94.56	10.98	0.276
		Left	96.28	11.33	
		As a whole	95.42	11.2	

Discussion

We measured the parameters and indices of scapula from the population of West Bengal, with the help of vernier callipers and mean of each measurement were taken to avoid interobserver bias. The available dry human scapulae in Anatomy departments of medical colleges of Kolkata can be presumed to be out of the donated cadavers of Bengali population.

In our study we have found statistically significant bilateral variations in scapular index and infraspinous length, whereas other parameters were statistically insignificant bilateral variations. This variation might be due to belongingness to different persons with different statures. As in the museum available specimens it could not be decided that whether the right and

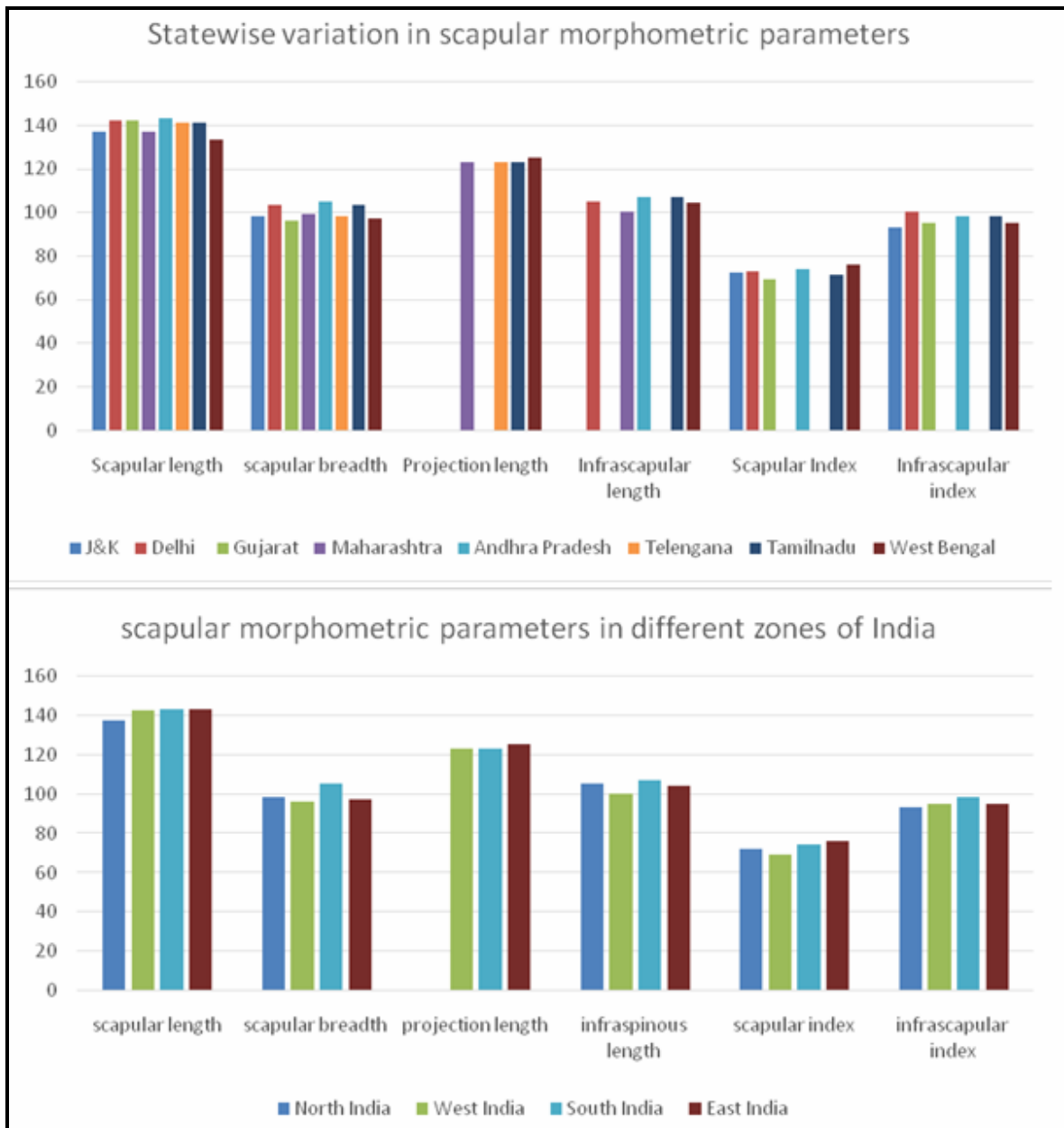left scapulae are paired for a single person, so this variation might be obvious.

Previously in many studies from different zones of India, the researchers well established the morphometric parameters of scapulae in different populations; but this endeavour to measure in Bengali population has not been found earlier documented. Comparing with different studies, it could be extrapolated that overall mean and SD values of breath, infraspinous length, scapular index and infraspinous index of scapula done in our study corresponded with the values of the study done over North Indian populations by Maheen et al [8] and Neeta et al [11] for all parameters except length and projection length.

The values got by several authors in different studies done over South Indian population differed largely from that of Bengali.

Scapular length was found to be less in Bengali population compared to other states of India; whereas, higher scapular breadth is found in Delhi, Andhra Pradesh and Tamilnadu population. [Table 2, Fig 6] [7-13].In the available studies no data have been found regarding the projection length of scapulae in north Indian population [8,11]; where as in this study in Bengali population, the projection length was found maximum compared to the other zones of India. [Table 2, Fig 6] [7,9,10,12,13]. Infraspinous length as well as the scapular index were found low in Western Indian population compared to the other zones in India; whereas the infraspinous index was found high in south Indian population except Delhi (99.60 ± 7.26 mm) [Table 2, Fig 6] [7-13]. Highest infraspinous index of Delhi, capital of India, might be due to diversity of ethnicity.

Fig-6: Graphical representation of morphometric parameters (average values) of scapula; observed in different studies in different zones of India

	States	authors	scapular length (mm)	scapular breadth (mm)	projection length (mm)	Infraspino us length (mm)	scapular index	infraspino us index
North India	J&K	Nazir M et al. [8]	137 ± 20.09	98.16 ± 11.60	-	-	72 ± 11.41	92.83
	Delhi	Chhabra N et al. [11]	141.94 ± 12.76	103.65 ± 6.82	-	104.58 ± 9.97	73.32 ± 4.80	99.60 ± 7.26
West India	Gujarat	Singal G et al. [7]	141.7± 8.9	96.4 ± 7	-	-	68.5 ± 4	94.6
	Maharashtra	Chavan S et al. [10]	137± 13.67	99.32 ± 10.11	123.02 ± 11.29	99.12 ± 9.02 (avg)	-	-
South India	Andhra Pradesh	Krishnaiah et al. [13]	143.25± 11.44	105.59	-	107.71± 7.6	73.99 ± 4.63	98.33 ± 5.86
	Telengana	Lingandenne PE et al. [12]	141.49	98.69 ± 6.98	123.35	-	-	-
	Tamilnadu	Rajeswari K et al. [9]	141.34± 8.5	103.3 ± 6.9	122.53 ± 4.3	106.7± 3.5	71.24 ± 3.1	98.30 ± 4.58
East India	West Bengal	**Present study**	**132.97± 18.00**	**97.96 ± 9.38**	**124.93 ± 7.41**	**103.57± 11.05**	**75.56 ± 17.67**	**95.35 ± 11.21**

Table-2: Comparison data sheet for different studies till date available in literature, in different zones of India; for scapular morphometric parameters:

This present study states the data for scapular morphometry in Bengali populationfor the first time as found in literature, although the limitation is understood for its procedure done on available human scapulae in Anatomy departments. This limitation gives the way of further sequel study on the living population based on surface anatomy and skiagram.

Conclusion

Knowledge of measurements of different parameters of scapula in Bengali population is important for surgeons as well as general practitioners to understand and treat different pathologies of shoulder joint. This data can also be used in forensic medicine from medicolegal point of view, also for demographic studies, rehabilitation of players during sports injuries, prosthetic positioning.

Comparison of parameters in different parts of India may attribute to racial and ethnic variations

and/or different methods by which data were collected in different studies.

In our study we did not include sexual dimorphism of scapula, and we did not compare our result with that found by different authors done on different countries. So, further studies can be carried out to explore such different measurements and indices.

Conflicts of interest: There are no conflicts of interest.

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