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Original Research Article

MORPHOLOGICAL CLASSIFICATION AND PARAMETERS OF SPINE OF SCAPULA AMONG SOUTH INDIAN POPULATION

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ABSTRACT

Introduction: Scapula is a pivotal bone of Shoulder girdle, critical in stabilizing and permitting various sports movements like swimming, rowing and throwing. Isolated fractures of the scapular spine are rare. Usually, they are associated with other fractures of the shoulder girdle or injuries to the head, lungs, ribs, cervical spine and brachial neurovascular structures constituting 6% of scapular fractures.

Objectives: 1) to classify and to obtain the Quantitative morphometric parameters of scapular spine and also to find the asymmetry of the same bilaterally.

Methodology: This study was conducted on 100 dried adult Human Scapula. Spine of scapula were observed and classified morphologically, various morphometric measurements like projection length of spine, thickness and height of spine of scapula were taken using digital vernier caliper and thickness measuring gauge micrometer. The data was analysed statistically using SPSS software version 20.0 and were tabulated.

Results: The commenest type of spine was fusiform (type I) with 46% and the least was "S" shape type V with 0% incidence. Type II (slender) spine showed least measured values related to all the parameters.

Conclusion: Spine of scapula is an important process, provides elegant reinforcement to dorsal surface of scapula. A morphological variation of the same is not a rare entity in our observation. With recent development in surgical approaches towards the clinical conditions of shoulder joint thorough qualitative and quantitative knowledge of the same is necessary for any surgeon which can be an additional aid for the surgeon during surgeries.

KEY WORDS: Spine, Scapula, Classification, Fracture, Morphology.

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INTRODUCTION

Scapular bone fractures are rare injuries which constitutes of 1 % of all the fractures and 5 % of shoulder girdle fractures. Most of the scapular fractures involve the neck and body, and only 6 % of scapular fractures are scapular spine fractures. Fractures of scapular body may cause a weak rotator cuff function and loss of an active arm elevation, named 'pseudo-rupture' of the rotator cuff, probably due to inhibition of the muscle contractions from intramuscular haemorrhage. Also, pseudo-arthrosis of spine of scapula or acromion, like os acromiale, predisposes to sub-acromial impingement syndrome. The pull of the deltoid muscle can tilt the fragment inferiorly, which compromises the function of the rotator cuff. Sagging of the lateral spine projection over acromion effectively produces narrowing of the supraspinatus outlet and secondary impingement of the rotator cuff [1].

As Lambert et al. states in their study, fracture of scapular spine represents a partial failure of the lateral scapular suspension system, leading for failure of scapular postural control, with resulting sub-acromial impingement resultant impingement syndromes of the shoulder. Although scapular spine fractures are rarely seen, they must be considered in differential diagnosis of impingement syndromes of the shoulder [2].

How the trabecular bone density varies within the scapula and how can this may lead to more optimal Reverse Shoulder Arthroplasty (RSA) screw placement has not been addressed in the scientific literature. The three columns of trabecular bone runs within the scapula adjacent to the glenoid fossa, one extending through the base of the coracoid process, a second along the lateral border, and a third extending into the spine of scapula, were hypothesized to be of similar density relatively. The base of the coracoid process was statistically significantly less dense than the spine and the lateral border of the scapulae examined ($P < 0.5$). The higher-quality bone component in the lateral border and spine, compared with the coracoid region, may provide better bone plate for screws when fixing the glenoid baseplate in RSA. AS the studies done related to morphological and morphometric parameters of spine of Scapula is quite rare though the variations is quite common, the present study was done to add into the data of spine of scapula which may be helpful for orthopedicians [3].

Objectives:

· The objective of this study was to classify the SS (scapular spine) morphologically

· To provide baseline data of specific geometrical parameters of scapular spine according to osteologic features.

· To evaluate the asymmetry of parameters bilaterally

METHODOLOGY

The present study was done on one hundred (100) dry an adult human scapula. Age and sex of the donors were unknown. Types of scapula were classified into following five types morphologically, Type 1- Fusiform shape (tapered at both ends and wide in the middle), Type 2- Slender rod shape (thin throughout), Type 3- Thick rod shape (thick throughout), Type 4- Wooden club shape(gradual thickening from medial to lateral edge), Type 5- Horizontal S-shape (“S” shaped spine) . Nine bony landmarks described for their relevance to regions of interest for scapular fixation were chosen and marked (Fig 1, 2).Measurements were taking using digital vernier caliper and thickness of spine was taken using thickness measuring guage digital micrometer.

• **AE (superior border of SS):** length of SS measured from the medial edge of the scapula where it meets with the SS to the lateral midpoint of lateral edge of the acromion.

• **AD:** length of SS measured from the medial edge of the scapula where it meets with the SS to the corner of the acromion.

• **AC (base border of SS):** distance from the medial edge of the scapula where it meets with the SS to the edge of the spinoglenoid notch.

• **BC (lateral border of SS):** height of the spine at the lateral edge.

• **FG and HI:** Height of the spine at point G and I.

• **J, K, L:** midpoints of FG, HI, and BC.

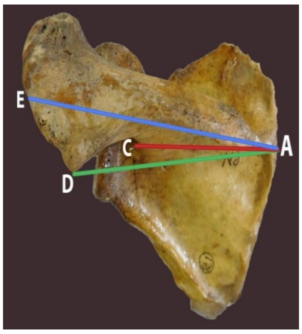


Fig. 1:

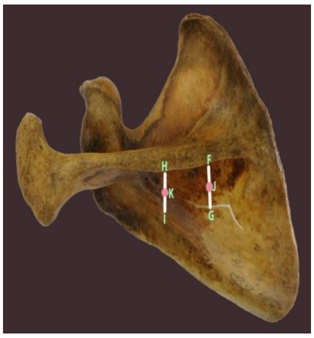


Fig. 2:

Statistical data: All data observed are presented as Mean and standard deviation (SD). Descriptive statistics was used to describe demographics and measurement variables of all scapulae.

Categorical variables are expressed as frequencies and percentages. Unpaired "t" test was used to compare types considering a *P*-value < 0.05 as statistically significant. The Statistical Package for Social Sciences (SPSS version 20.0) was used for the analysis of the data.

RESULTS

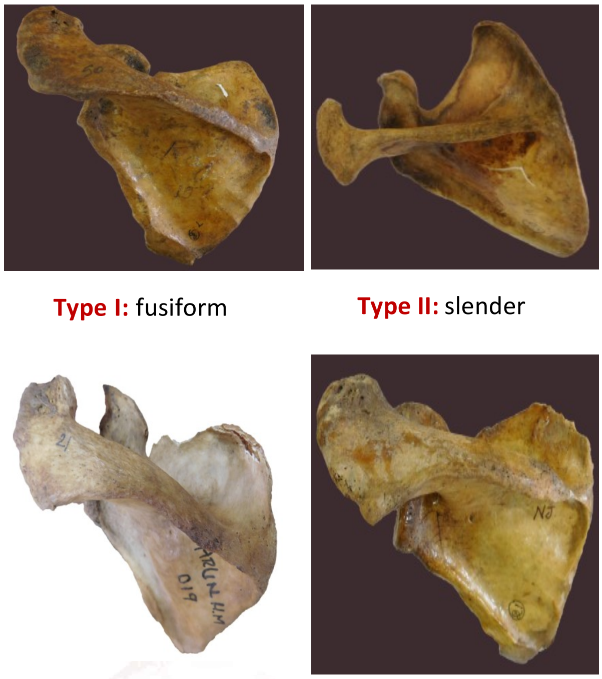
In the present study, the commonest type of spine was fusiform (type I) with 38%, second being the type IV with 28% followed by type III with 24%, Type II with 10% and the least was "S" shape type V with 0% incidence, not much of the difference observed bilaterally (Table 1).

Table 1: Showing percentage of morphological different types of spine of Scapula.

TYPE	Out of 100	Based on side	N (%)
I	35	Right(50)	19(38)
		Left(50)	16(32)
II	16	Right(50)	05(10)
		Left(50)	11(22)
III	21	Right(50)	12(24)
		Left(50)	09(18)
IV	28	Right(50)	14(28)
		Left(50)	14(28
V	NIL	NIL	NIL

The average length of AE, AD, AC and BC on right and left side were 140.6 ± 10.1 to 115.7± 3.3 mm, 124.4 ±7.5 to 107.7± 4.14, 88.6± 7.0 to 69.66 ± 4.8mmand 44.1± 4.5 to 32.8± 6.7mm , 127.9±7.4 to 123.0± 9.8mm, 120.5±7.5 to 114.7± 10.7mm, 82.9±11.6 to 78.9±7.4mm , 38.0±6.9 to 32.8±6.7mm respectively.. A complete description and summary of the results can be observed in Table 2. No significant difference was found between left and right scapulae. A summary of the thickness for the bony landmarks on the SS is shown in (table 3). "L'' representing thickness at midpoint of BC being the thickest in all types , Type II was the thinnest and shed least values. Overall, Type 1, 3, 4 showed thicker values . No statistical difference was found between left and right sides of the body. p value>0.05 was not statistically significant.

Fig. 3: Showing different types of Spine of Scapula.



Type I: fusiform **Type II:** slender **Type III:** thick rod shape **Type IV:** Wooden club shape

Table 2: Distribution and Measurements of the Scapular Spine based on Sides among different types of scapula.

TYPES	SIDE	N (%)	AE	AD	AC	BC	FG	HI
			Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
TYPE 1	RIGHT(50)	19(38)	127.8(8.4)	121.9(7.7)	80.5(4.3)	39.5(4.2)	25.0(2.8)	30.2(3.7)
	LEFT(50)	16(32)	127.9(7.4)	120.5(7.5)	82.7(5.4)	37.4(7.2)	23.9(2.8)	24.3(2.3)
TYPE II	RIGHT(50)	05(10)	115.7(3.3)	107.7(4.14)	69.66(4.8)	36.1(2.3)	26.24(3.3)	28.86(2.2)
	LEFT(50)	11(22)	124.7(12.2)	114.7(10.7)	78.9(7.4)	38.0(6.9)	22.3(2.7)	24.6(2.7)
TYPE III	RIGHT(50)	12(24)	140.6(10.1)	124.4(7.5)	88.6(7.0)	44.1(4.5)	26.2(6.2)	28.6(3.3)
	LEFT(50)	09(18)	126.1(13.9)	119.8(14.9)	82.9(11.6)	37.9(7.4)	23.1(2.9)	24.6(4.3)
TYPE IV	RIGHT(50)	14(28)	120(8.1)	116.7(8.0)	71.1(6.4)	39.9(4.4)	27.6(3.0)	33.5(4.2)
	LEFT(50)	14(28)	123.0(9.8)	115.0(11.2)	79.6(7.3)	32.8(6.7)	22.8(1.9)	23.4(2.9)
TYPE V	RIGHT(50)	0	--	--	--	--	--	--
	LEFT(50)	0	---	---	---	---	---	---

DISCUSSION

Over the past decade, there has been an increased interest in understanding the operative indications and techniques in treating scapular fractures and tracking their outcomes. Multiple studies done over decades have documented poor functional outcomes following non-operative management of displaced scapular fractures. There is a groundswell of recognition that severe deformity from scapular fractures malunion is strongly associated with poor functional consequences among patients. This has lead to a growing recognition that scapular fractures should also be held to the same standards as other bodily fractures with regard to fracture fixation principles, including anatomic articular reduction, proper alignment, and stable internal fixation. Through research, there has been an improved understanding in patterns of scapular fracture and the relevant surgical approaches used for fracture fixation [4].

According to Mohammed AS Sultany reports in his study, Scapular fractures are relatively uncommon and generally represent 0.5–1% of all fractures. Of these, fractures of the body and neck are the most common and account for more than two-thirds of the cases, with intra-articular fractures of the glenoid cavity (rim and fossa) making up approximately 10%. Fractures of the acromial and coracoid processes account for 9% and 7%, respectively, while those of the scapular spine only represent about 6% [5].

In a study done to measure and map scapula osseous thickness to identify the optimal areas for internal fixation, the glenoid fossa (25 mm) displayed the greatest mean osseous thickness, followed by the lateral scapular border (9.7 mm), the scapula spine (8.3 mm), and the central portion of the body of the scapula (3.0 mm). To optimize the screw purchase and strength of internal fixation, the lateral border, the lateral aspect of the base of the scapula spine, and the scapula spine itself should be preferred anatomic sites of internal fixation of scapula fractures [6].

We are currently unaware of any major studies that have specifically focused upon scapular spine fractures, possibly because such fractures are frequently grouped with fractures of the scapular body or acromion. Those fractures that enter the spino-glenoid notch are clearly different from isolated acromial fractures and therefore should be identified and treated differently [7].

Scapular spine fractures, especially those at the base of the acromion, are uncommon. Furthermore, the complex bony anatomy of the scapula sometimes makes accurate classification of fractures on a plain radiograph rather difficult, thus justifying the need to use CT scanning.The use of three-dimensional reconstructed CT images in the current case provided essential and accurate preoperative information about the position and extent of the fracture, thus facilitating preoperative planning [8].

Based on morphological classifications, Hua Jun Wang states that Type 1-Fusiform shape (47.17%) and Type 5-Horizontal S-shape (19.18%) were the most common, followed Type 4-Wooden club shape (13.21%) and Type 3-Thick rod shape (12.58%). Type 2-Slender -rod shape (7.86%) was the least common [9].

In our study the Type 5-S Shape (0%) was the least common, commonest being type 1-fusiform(35%), followed by type IV (28%) and type III(21%). The average length of landmarks AE, AC, and BC of the SS were 135.83 ± 10.33 mm, 83.27 ± 6.22 mm, and 45.60 ± 5.45 mm, respectively, In our study it was observed that AE ranged from 140.6± 10.1 -115.7±3.3mm, highest projection length of the scapula being of type III and least of Type II which is almost correlating with the previous studies done by authors. In a study on Six patients with grade III mandibular ORN who were treated with debridement of lesions, Type IIb soft tissue and type H hemimandible defects after surgery were reconstructed using bilobed trapezius myocutaneous flaps and scapula osteomyocutaneous flaps including the acromion, spine, and part of the medial scapular border based on the transverse cervical vessels showed satisfactorily results without any complications. Thus scapula osteomyocutaneous flap based on transverse cervical vessels may be an effective approach to reconstruct through-and-through defects of the hemimandible and to provide satisfactory or acceptable functional and esthetic outcomes after debridement of advanced mandibular ORN [10].

The most detailed description of the use of the scapular spine pedicled on trapezius is given by Panje and Cutting (1980) in their description of a case history that involved resection of the body of a hemimandible in a jaw previously irradiated for epidermoid carcinoma. Kenyeres (1984) used the medial part of the scapular spine for reconstruction of the maxilla because of the close morphological similarity of this buttressed part of the spine to flat bone. We feel that scapular spine , split sternum pectoralis major osteomusculocutaneous pedicled to trapezius is a valuable addition to the transfer, where previous radiotherapy has made the area relatively avascular or where previous unsuccessful reconstruction requires an alternative approach [11].

CONCLUSION

In conclusion, the present study classified and measured SS morphology on 100 dry adult human scapula. Type 1 was the most common, while Type 5 was the least common. The contours of Types 5 and 1 were more complex than the other 3 types. Types 2 were much thinner than the other types; therefore, we believe this type to be more prone to fracture. The presented data provides precise and well-sorted information about SS variation and localization in South Indian population. This data supplements existing reports which contribute to a thorough understanding of the human SS. With advancement in surgical approaches towards shoulder arthopathies and scapular spine fractures it becomes important to have thorough prior knowledge of morphological and morphometric parameters of SS. Reduce in surgery time, additional aid for the surgeon, decrease the future complications like malunion, tissue irritation. Recently scapular spine is proving as an alternate option as osteomyocutaneous flap but an optimal osteomyocutaneous flap needs to be long and strong for bony union, and contoured to be able to reconstruct complex 3-dimensional skeletal defects. Estimating availability of bone as well as familiarizing with morphological features of the scapular spine is very essential for an appropriate contouring and fitting of the bone graft to the defects to ensure the best functional outcome. Thus this study may serve as baseline data for the same.

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Conflicts of Interests: None

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