

ANATOMICAL BASICS AND VARIATIONS OF THE SCAPULA IN SOUTH INDIAN POPULATION

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ABSTRACT

Introduction: Morphology of suprascapular notch (SSN) and measurement of safe zone for the approach of suprascapular nerve is associated with suprascapular nerve entrapment neuropathy. For better knowledge about different shape and measurement of safe zone for suprascapular nerve distance is important for the clinicians in understanding the source of the entrapment neuropathy and avoiding the nerve injury during operative procedure.

Aim: The aim of the present study is to find out the morphology of suprascapular notch and measurement of safe zone for the suprascapular nerve distance in Indian dry scapula.

Materials and methods: The present study was carried out in 150 adult dried human scapulae of undetermined sex in Indian population. The following parameters were measured, 1. Shape of suprascapular the notch. 2. Measurement of safe zone for the suprascapular nerve distance.

Results: Out of 150 scapulae, 76 (51%) were shallow U shaped notch, 32 (21%) were deep U shaped notch, 10 (7%) were J shaped notch, 12 (8%) were V shaped notch, 12 (8%) showed absence of notch, 8 (5%) showed complete foramen. The mean value of distance between the suprascapular notch and the supraglenoid tubercle (SGT) were 3.10 ± 0.32 . The mean value of distance between the spinoglenoid notch (SGN) and the posterior rim of glenoid cavity (PGC) were 1.55 ± 0.23 . The mean value of distance between the suprascapular notch and the spinoglenoid notch were 2.09 ± 0.29 .

Conclusion: This study will be useful in understanding the importance of suprascapular notch in causing entrapment neuropathy and safe zone distance is of surgical importance in avoiding injuries to the suprascapular nerve during shoulder surgical procedures.

KEY WORDS: - Supra Scapular Notch, Supra Glenoid Tubercle, Spino Glenoid Notch, Posterior rim of Glenoid Cavity.

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INTRODUCTION

The geometric anatomy of the scapula is of fundamental importance in the pathomechanics

of rotator cuff disease, total shoulder arthroplasty, and recurrent shoulder dislocation [1]. The suprascapular notch is a depression on the

fundamental importance in the pathomechanics superior border of the scapula just medial to the root of coracoid process. Suprascapular notch is converted into suprascapular foramen by the superior transverse scapular ligament. The suprascapular artery passes above the ligament, and the suprascapular nerve passes below the ligament through suprascapular foramen [1].

The superior transverse scapular ligament sometimes ossified and converted into a suprascapular foramen [2-4]. Suprascapular nerve is a mixed nerve which gets originated from upper trunk of brachial plexus (C5, C6). It enters the supraspinous fossa through suprascapular notch and passes deep to supraspinatus muscle and winds around the spinoglenoid notch to reach the infraspinatus fossa and supplies shoulder joint acromioclavicular joint, supraspinatus and infraspinatus which are components of rotator cuff [5,6]. Suprascapular notch has been classified by various authors in different populations on the basis of shape & diameter of the notch [7-9]. Kopell was the first person to describe the suprascapular nerve entrapment in 1959, he also explains that during abduction at horizontal position of shoulder joint leads to traction on the suprascapular nerve and may compress the nerve against superior transverse scapular ligament [10]. The result of suprascapular nerve entrapment is weakness of arm, difficulty in external rotation and abduction and then atrophy of the infraspinatus and supraspinatus muscles [11-15].

Entrapment neuropathy of suprascapular nerve is more commonly seen in males than in females less than 35 years and it is commonly seen in athletes like volley ball players and baseball pitchers [16]. The following factors are involved in the etiology as well as iatrogenic lesions during open or orthoscopic surgical procedures [17-19] - Anterior dislocations of shoulder joint [11] – Injury from direct trauma [11 & 22], ganglionic cyst [20 & 22] – synovial and swing's sarcoma [21] – chondrosarcoma and lipoma [21]. The glenoid cavity provides a vertical axis for the movement of the head of humerus during abduction and when the arm is raised to the shoulder height, the head slides into the smaller upper part of glenoid cavity which is deepened by glenoid labrum. 3 The variations in the shape

and size of glenoid cavity and attachment of glenoid labrum at the glenoid notch are important for normal functioning of this most freely movable joint of the human body [16]. The purpose of this study is to investigate various morphological and morphometric measurements of scapula in south Indian dry scapula.

MATERIALS AND METHODS

The present study was carried out in 150 adult dried human scapula of undetermined sex in Indian population. Bones with pathological changes and damaged bones were excluded.

The following parameters were measured:

Shape of suprascapular notch:

Measurements of safe zone for the suprascapular nerve distance.

a) Distance between the deepest point of suprascapular notch (SSN) and the supraglenoid tubercle (SGT).

b) Distance between spinoglenoid notch (SGN) and middle of posterior rim of glenoid cavity (PGC).

c) Distance between the deepest part of suprascapular notch (SSN) and spinoglenoid notch (SGN).

Maximum scapular length: Distance from the superior angle to the inferior angle of scapula.

Maximum scapular width: The maximum transverse diameter between the medial border of the scapula, where the spine meets the body of the scapula, and the anterior lip of the glenoid.

Measurement of Scapular Index= (Breadth X100)/Length

Superior-Inferior glenoid diameter: Maximum distance measured from the inferior point on the glenoid margin to the most prominent point of the supraglenoid tubercle.

Anterior-Posterior glenoid diameter:

maximum breadth of the articular margin of the glenoid cavity perpendicular to the glenoid cavity height. Shape of suprascapular notch, Measurement of suprascapular nerve safe zone, scapular index and Glenoid cavity index, was analyzed by student's t-test. The values were expressed as Mean \pm SEM (GRAPH PAD PRISM WINDOW 6 VERSION USA).

Fig. 1: showing shapes of suprascapular notch and its incidence. A. Shallow 'U' shape B. Deep 'U' shape C. 'J' shape D. 'V' shape E. Absence of notch F. Complete foramen.

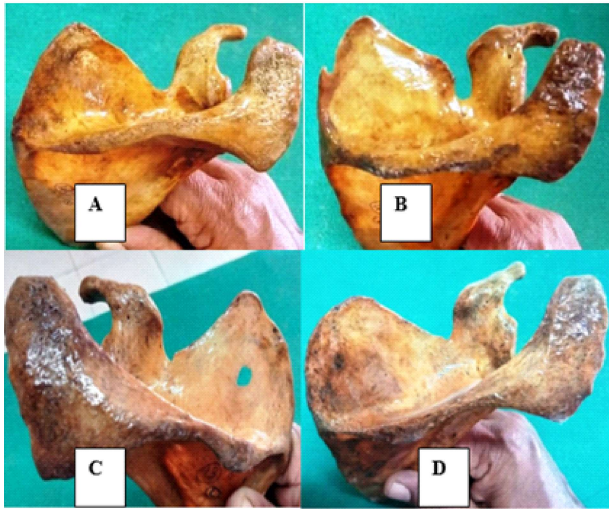
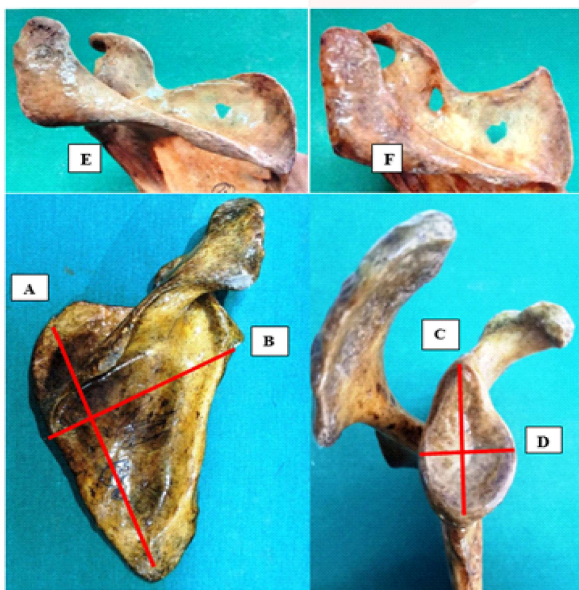


Fig. 2: A. Major Longitudinal Axis of Scapula B. Major transverse axis of scapula C. Major Longitudinal Axis of Glenoid cavity D. Major transverse axis of glenoid cavity.



RESULTS

Out of 150 scapulae, 76 (51%) were shallow 'U' shaped notch, 32 (21%) were deep 'U' shaped notch, 10 (7%) were 'J' shaped notch, 12 (8%) were 'V' shaped notch, 12 (8%) showed absence of notch and 8 (5%) showed complete foramen. Among these all types, Shallow U shape is most common and least common type is the presence of foramen (Table 1).

Measurements of safe zone for the suprascapular nerve distance: the mean value of distance between the suprascapular notch and the supraglenoid tubercle was 3.10 ± 0.32 . The mean value of distance between the spinoglenoid

notch and the posterior rim of glenoid cavity was 1.55 ± 0.23 . The mean value of distance between the suprascapular notch and the spinoglenoid notch was 2.09 ± 0.29 (Table 2).

The mean value of maximum scapular length was 12.5 ± 1.01 . The mean value of maximum scapular width was 10.2 ± 0.81 . Measurements of Glenoid cavity: the mean value of superior-inferior glenoid diameter was 03.4 ± 0.31 . The mean value of anterior-posterior glenoid diameter was 02.49 ± 0.30 (Table 3). Measurements of scapular index: the mean value of scapular index was 74.6 ± 4.18 (Table 4).

Table 1: showing shapes of suprascapular notch and its incidence.

S. No	Shape of the notch	Number of notches	Percentage of notch
1	Shallow 'U' shape	76	51%
2	Deep 'U' shape	32	21%
3	'J' shape	10	7%
4	'V' shape	12	8%
5	Absence of notch	12	8%
6	Complete foramen	8	5%
Total		150	100%

Table 2: Showing measurements of safe zone for the suprascapular nerve.

S. No	Measurements of safe zone	Mean \pm SD
1	Distance between SSN and SGT	3.10 ± 0.32
2	Distance between SGN and PGC	1.55 ± 0.23
3	Distance between SSN and SGN	2.09 ± 0.29

Table 3: Various Morphometric Measurements of Scapula.

S.No	Parameter Values	Average (cm)	Mean (cm) and Standard Deviation
1	Major Longitudinal Axis of Scapula	10.5-15.8	12.5 ± 1.01
2	Major transverse axis of scapula	08.3-11.7	10.2 ± 0.81
3	Major Longitudinal Axis of Glenoid Cavity	03-04.3	03.4 ± 0.31
4	Major transverse Axis of Glenoid cavity	01.8-03.2	02.49 ± 0.30

Table 4: Showing distribution of scapula as per its scapular index (Breadth/length) X100)

S.No	Scapular index	Number of scapula	Percentage (%)
1	65-70	17	11.3
2	70-75	68	45.3
3	75-80	45	30.1
4	80-85	20	13.3

DISCUSSION

In Indian population the frequency of ossification of superior transverse scapular ligament into a bone resulting conversion of suprascapular notch into a foramen varies from 1.92% to 10% krishnagopal et al., [23] and 10% to 12% have been reported by Vandhana et al.,[24]and Jadhve et al.,[25].

The present study showed only 5% of complete ossification of superior transverse scapular ligament converts suprascapular notch into a suprascapular foramen in 150 dry scapulae in Indian population. It was found to be lower in percentage than the earlier reported by Krishna Gopal et al., [23] Vandhana et al., [24], and Jadhve et al., [25].

The present study observation was significant as compared to those of other studies done on various populations it has been reported to be more in Brazilian (30.76%) population, followed by Turkish (12.5%) and American (6.5%) populations. Paolo Albino et al., 2013 [26] reported that, 1.93% - 4% of scapulae showed complete fusion of superior transverse scapular ligament which leads the notch into a foramen. The incidence of complete ossification of the superior transverse scapular ligament was similar with the present study. Iqbal et al.,[27] reported three types of suprascapular notch based on the shapes, 'U', 'V' and 'J' on gross examination. Nafees Fathima et al.,[28] distinguished, the U notch on the basis of depth (shallow and deep) by visual observation. Dunkelgrun et al., [29] reported that the 'U' shaped notch had a large area than the 'V' shaped notch, leading to an assumption that the 'V' shaped notch was more likely to be connected with the nerve entrapment. In the present study, 'U' shaped notch was more common (shallow 'U' – 51%, deep 'U' – 21%) than the 'V' shaped notch (8%). This study findings was not similar to those of various other studies, Ticker et al., [30] ('U' – 77%, 'V' – 23%), Bayramoglu [31] ('U' – 62.5%, 'V' - 25%), Duparc[32] ('U' – 63.3%, 'V' - 36.7%), Muralidharreddysangam et al.,[33] ('U' – 69.23%, 'V' - 26.92%).

Several morphological variations and classification of the suprascapular notch were reported in many populations (Rengachary et al., 1979;

Iqbal and Khan, 2010; [34, 27] Sinkeet et al., 2010; Wang et al., 2011) [35, 36] All the above studies were based on the morphology of the suprascapular notch and few studies are available on the safe zone approach of suprascapular nerve in order to prevent the iatrogenic injury of the nerve. The safe zone approach of suprascapular notch was reported by various authors, Hafezji 2016 [37] in south Gujarat population, Sabreen 2018 [38] in Egyptian population. These authors examined safe zone distance and reported no significant correlation with dimensions of the suprascapular notch. The distance between the suprascapular notch and the margin of the glenoid cavity is critical during open surgical procedures which require dissection of the posterior shoulder joint, as has been described by De Mulder et al.,[39] and Warner et al., [40]. It has been reported that 2.3 cm, from the glenoid rim, at the level of the superior rim of the glenoid and 1.4 cm, from the posterior rim of the glenoid, at the level of the base of the scapular spine are safe. Another study was carried out by Muralidharreddy et al., [33] reported that the safe zone for the approach of suprascapular nerve during surgical procedures has been described, the mean distance from the glenoid rim, at the level of the superior rim of the glenoid were 2.9 cm and from the posterior rim of the glenoid, at the level of the base of the scapular spine 1.6 cm respectively. A similar study were carried out by Sinkeet et al., [35] in the Kenyan population, which described that 5.9 % and 12 % scapulae fell short of the critical distance respectively. In the present study, the mean value of distance between the suprascapular notch and the supraglenoid tubercle was 3.10 ± 0.32 , when compared with above mentioned populations the present study showed higher values in Indian population and the mean value of distance between the spinoglenoid notch and the posterior rim of glenoid cavity was 1.55 ± 0.23 , it was in accordance with the above studies. In the present study this was the first of its kind reported that the mean value of distance between the suprascapular notch and the spinoglenoid notch was 2.09 ± 0.29 in Indian population.

The Scapular breadth was ranging from 83mm to 117mm in present study, while other studies

showed it 83-126 mm [41-44]. The mean scapular breadth in various studies range from 92-104 mm. In present study mean scapular breadth is 102 mm which is nearer to the study by Von Schroeder 2001[45]. The Scapular length in present study was ranging from 105mm to 158mm and mean Scapular length was 125 mm ± 1.01 mm, While Flower WH's study of European race showed mean length to be 155.44mm. Thus, the scapular length of European region and Kashmir region was higher than that of south Indian population (Flower, 1879) [46 & 47]. Mean scapular index observed in present study was 74mm with standard deviation of 4.18mm. In other studies, the mean scapular index ranged from a minimum of 57.3mm in Peruvian population to a maximum of 72mm in the Negroes and Kashmir region. Thus, our study scapular index value is nearer to Negroes and Kashmir population [47].

Previous studies reported that abnormal morphology of the glenoid was associated with severe full thickness tears [48 & 49]. The length and breadth of glenoid cavity is an important factor which should be appropriately matched with the size of prosthesis during total shoulder arthroplasty in order to achieve full congruency [50 & 51]. In the present study the average superior-inferior diameter of the right glenoid was 34 ± 03.2 mm and the average anteroposterior diameter of the glenoid was 24.9 ± 3.0 mm. Iannotti et al., reported that superior-inferior diameter of the glenoid to be 39 ± 3.5 mm value was more than the when compared to the present study[52]. Mallon et al., and Von Schroeder et al., reported that SI diameter to be 35 ± 4.1 mm and 36 ± 4 mm respectively [53 & 54].

ABBREVIATIONS

SSN - Supra Scapular Notch

SGT - Supra Glenoid Tubercle

SGN - Spino Glenoid Notch

PGC - Posterior rim of Glenoid Cavity

CONCLUSION

This study will be useful in understanding the variations of the scapula, morphometry of glenoid cavity and importance of suprascapular

notch in causing entrapment neuropathy; safe zone distance is of surgical importance in avoiding injuries of the suprascapular nerve during shoulder surgical procedures.

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Conflicts of Interests: None

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