*Original Article*

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# Morphometric Study of Suprascapular Notch in Adult Dried Human Scapula: A Cross-Sectional Study in South Karnataka

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**Abstract**

*Introduction:* The suprascapular notch is the major site for suprascapular nerve compression. *Objective:* To study morphological variations of suprascapular notch in South Karnataka population and to determine posteriosuperior and posterior limits of safe zones for shoulder arthroscopic procedures from posterior approach. *Materials and Methods:* 100 dried adult human scapulae of unknown sex, obtained from Department of Anatomy, Kodagu Institute of Medical Sciences, Madikeri, Karnataka, India. Information regarding various forms of the suprascapular notch was noted. *Results:* Suprascapular notch was present in all Scapula. Based on Rengachary classification, most prevalent was Type III (33%) and least was type VI (1%). Superior Transverse Diameter (STD) =12.19±4.83, Mid Transverse Diameter (STD) =8.22±2.98 , Maximum Depth (MD) =8.46±3.35. The mean distance from SSN to Supraglenoid tubercle was 29.82±4.06 and the distance between the medial wall of the spinoglenoid notch and the posterior margin of the glenoid cavity was 15.19±2.64 respectively. *Conclusions:* Knowing about the morphological variations of suprascapular notch will assist the clinicians in order to understand the concepts of suprascapular nerve entrapment which will help the outcome of the treatment.

**Keywords:** Suprascapular Notch; Suprascapular Ligament; Suprascapular Nerve Entrapment.

## Introduction

Scapula is a flat triangular bone which is also known as the shoulder blade and is situated in the posteriolateral aspect of the thorax, opposite to the 2nd to 7th ribs [1]. The suprascapular notch (SSN) is a depression on the lateral part of the superior border of the scapula, medial to the coracoid process. This notch is bridged by the superior transverse scapular ligament, which will be sometimes ossified and converting it to a foramen which transmits the suprascapular nerve to the supraspinatus fossa. Suprascapular nerve supplies motor branches and ligamentous structures of the shoulder and acromioclavicular joints [2]. Accordingly, this notch is an important landmark of the suprascapular nerve during arthroscopic shoulder operations [3].

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The reduction in the area below the ossified ligament leads to Suprascapular nerve entrapment. The first description of Suprascapular nerve entrapment syndrome had given by Kopell & Thompson in 1959 and opined it as one of the cause for shoulder pain & dysfunction [4]. The nerve entrapment commonly occurs at suprascapular & spinoglenoid notches where nerve excursion is limited by bony & ligamentous constraints. Excessive nerve excursion during overhead sports can cause traction neuropathy [5].

The shape of suprascapular notch may vary in each scapula which may alter the distance between it and the supraglenoid tubercle. This distance is important for the determination of a potential safe zone to minimize the risk of iatrogenic injury of the suprascapular nerve during arthroscopic procedures and other open procedures requiring dissection of the posterior glenoid neck [6].

The aim of present study is to study morphological variations of the suprascapular notch in the south Indian population, classify the suprascapular notch into various types as per Rengachary et al. [7] classification and to determine posteriosuperior and posterior limits of safe zones for shoulder arthroscopic procedures from posterior approach and also to compare our results with the studies done by

previous authors. This study will furnish morphological and morphometric data providing an anatomical baseline which will facilitate to devise appropriate surgery of shoulder joint. So, it is of immense help to anatomists, osteologists, anthropologists and orthopaedicians.

## Materials & Methods

The present study was conducted for a period of 3 months from June 2017 to August 2017 on 100 dried adult human scapulae of unknown age and sex, obtained from Department of Anatomy, Kodagu Institute of Medical Sciences, Madikeri. Deformed & damaged superior border of Scapulae were excluded from the study. Morphological variations in the shape of suprascapular notch were observed and were classified based on the description of Rengachary et al. [7]. The following dimensions were measured in mm using digital vernier callipers (Fig. 1). The data was analysed statistically.

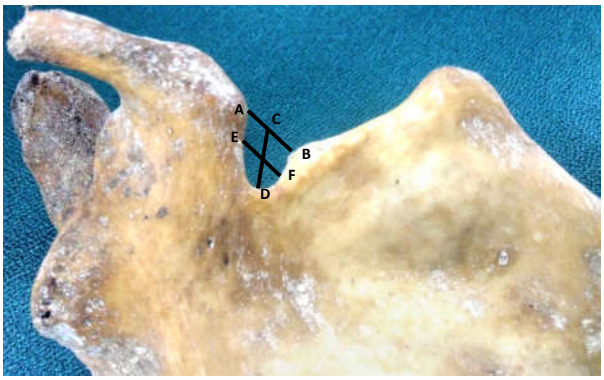


**Fig. 1:** Showing the procedure to measure Superior Transverse diameter, Mid transverse diameter, Maximum depth.
AB- Superior Transverse diameter, EF- Mid transverse diameter, CD- Maximum depth

*Superior Transverse diameter (STD)*: It is the horizontal distance between superior corners of SSN on the superior border of the scapula.

*Maximum depth (MD)*: It is the distance between the superior corners of the notch to the deepest point of the suprascapular notch.

*Mid transverse diameter (MTD)*: It is the horizontal distance between the opposite walls of SSN at a midpoint of MD and perpendicular to it.

Distance from the base of the suprascapular notch to the supraglenoid tubercle (SGT) and the distance between the medial wall of the spinoglenoid notch (SPGN) at the base of scapular spine and the posterior rim of the glenoid cavity (GC) were measured [8].(Figure 2A , 2B)

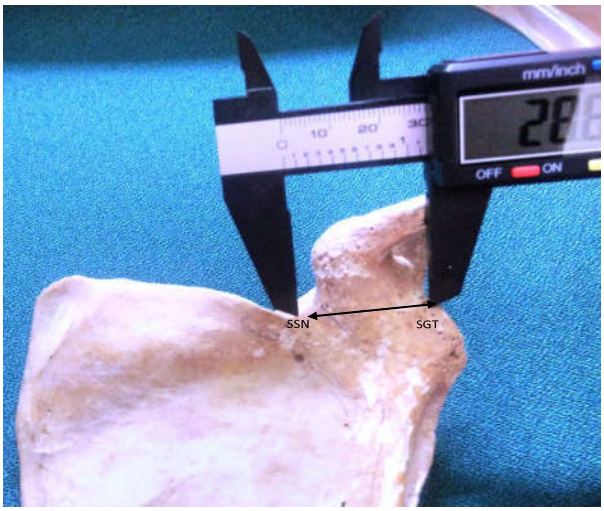


**Fig. 2A:** Showing the distance between SSN and SGT
SSN- Suprascapular notch, SGT- Supraglenoid tubercle


**Fig. 2B:** Showing the distance between SPGN and GC
SPGN-Spinoglenoid notch , GC-Glenoid cavity

## Results

In present study, the suprascapular notch was observed and classified into 6 types as per the classification given by Rengachary et al. [7] It is as follows:

Type I: wide depression in the superior border of scapula

Type II: wide blunt V shape

Type III: symmetric U shape with nearly parallel lateral margins

Type IV: very small V shape, often with a shallow groove for the suprascapular nerve

Type V: partial ossified medial portion of suprascapular ligament

Type VI: completely ossified suprascapular ligament

According to this classification following types were observed. (Fig. 3)

Out of 100 scapulae studied, the highest number of SSN were of Type III which showed 33% followed by Type I which showed 24% of the total number of scapulae (Table 1).

The highest dimension of Superior Transverse Diameter (STD) and Mid Transverse Diameter (MTD) of SSN were found in Type II which showed 14.28±3.86 and 8.88±3.26 followed by type II which showed 12.05±4.1 and 8.65±2.65 respectively. The Maximum Depth (MD) were highest in Type V which showed 10.46±3.15 followed by Type III which showed 9.72±3.15 (Table 2).

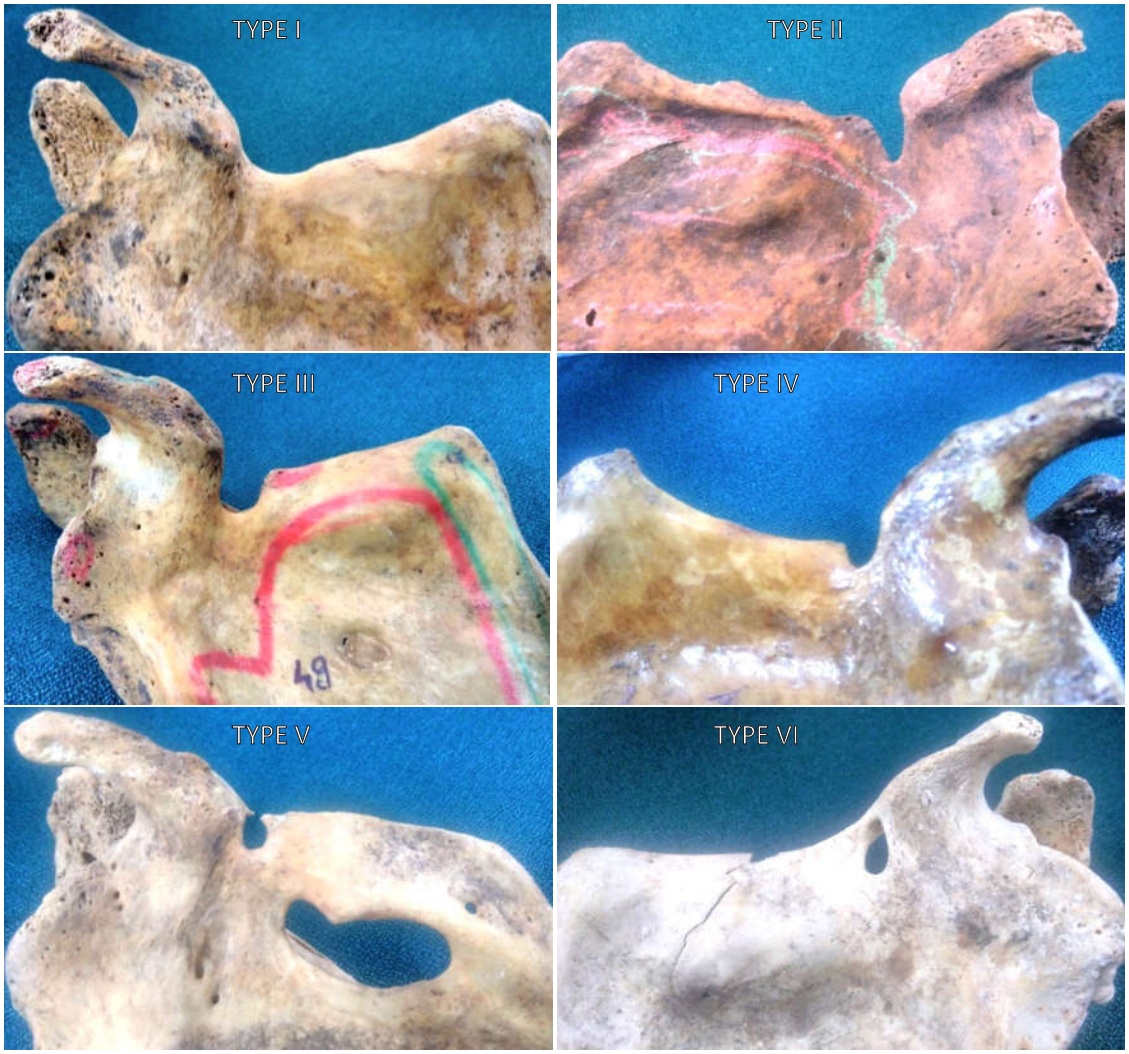


**Fig. 3:** Showing the Classification of Suprascapular notches

**Table 1:** Shows the incidence of various types of suprascapular notch

| Sl. No. | Types | Total |
|---|---|---|
| 1 | I | 24% |
| 2 | II | 18% |
| 3 | III | 33% |
| 4 | IV | 13% |
| 5 | V | 11% |
| 6 | VI | 1% |

**Table 2:** Showing dimensions of Suprascapular notch

| Sl. No. | Type of notch | STD Mean± SD | MTD Mean±SD | MD Mean±SD |
|---|---|---|---|---|
| 1 | I | - | - | - |
| 2 | II | 14.28±3.86 | 8.88±3.26 | 9.24±3.69 |
| 3 | III | 12.05±4.1 | 8.65±2.65 | 9.72±3.15 |
| 4 | IV | 8.6±2.45 | 5.12±1.46 | 5.10±1.68 |
| 5 | V | 6.5±5.05 | 7.51±3.19 | 10.46±3.15 |
| 6 | VI | - | - | - |

**Table 3:** Shows the distance between the suprascapular notch (SSN) and the supraglenoid tubercle (SGT) and the distance between the medial wall of the spinoglenoid notch(SPGN) and the posterior margin of the glenoid cavity (GC) respectively

| Sl. No. | Type of Notch | Mean ±SD (mm) | Mean ±SD (mm) |
|---|---|---|---|
| 1. | Type I | 29.32 ± 3.42 | 14.79 ± 2.46 |
| 2. | Type II | 29.96 ± 4.36 | 14.96 ± 3.06 |
| 3. | Type III | 30.24 ± 4.69 | 15.68 ± 2.83 |
| 4. | Type IV | 29.09 ± 3.8 | 14.47 ± 1.18 |
| 5. | Type V | 30.08 ± 3.7 | 15.68 ± 3.00 |
| 6. | Type VI | 32.36 | 17.39 |

The distance between the suprascapular notch (SSN) and the supraglenoid tubercle (SGT) and the distance between the medial wall of the spinoglenoid notch (SPGN) and the posterior margin of the glenoid cavity (GC) were highest in Type VI which showed 32.36 and 17.36 respectively (Table 3).

## Discussion

The anatomical structure of scapula is complicated because of its own unique features. Surgeons involved in treatment and arthroscopic procedures on shoulder joint should have a thorough anatomical knowledge of scapula. SSN variations have been studied by various authors in different populations. Based on the morphological appearance, Ticker et al. [9] classified suprascapular notch as 'U' and 'V' types. Assessment of V shape suprascapular notch using geometrical parameters was done by Polguj et al. [10]. Based on the dimensions of notch, Natsis et al. [11], had classified into 6 types as follows; Type I – with no notch, Type II- notch with greater transverse diameter, Type III- notch with greater vertical diameter or depth, Type IV- notch converted into bony foramen and Type V – notch with bony foramen. Based on gross features, Iqbal et al. [12] had classified SSN into 3 types J, U and V.

In our present study, based on the shape of SSN, we classified suprascapular notch into six types, which was stated by Rengachary et al. [7]. We observed that type III was common showed 33% which was similar to the observation of most of the other studies. Next common was type I, showed 24% which was similar to the findings of Sinkeet et al. [13], Muralidhar [14] and Usha kannan et al. [15] and it differed from the studies of Rengachary et al. [7], Natsis et al. [11]. and Philip SE et al. [8], which showed type II as prevalent. The incidence of completely ossified transverse scapular ligament (Type VI) in our present study was least (1%) which was similar to the studies of Murulidhar et al. [14], Kalpana et al. [16], showed 1.93% and 2% respectively. However, Vandana and Sudha et al. [5], Usha kannan et al. [15] have reported 12.6% and 10% respectively. We have compared our results with other studies in Table 4. This variability in the shapes of suprascapular notch can be explained by the fact that the shape of the notch is influenced by ossification of coracoid process [17].

In the present study, dimensions of various types of SSN showed that, in 18% of the scapulae STD was less than MD which is comparatively less that of other studies and in 81% of scapulae, STD was greater than MD where the findings were of a greater value than that of Rengachary et al. [7], and Natsis et al. [11].

Dunkelgren et al. [18] have opined that V shaped notches which are having STD more than MD are more likely to be related to suprascapular nerve entrapment because of its smaller area than U shaped notches where depth is more than height . A reduction in the height of the suprascapular foramen may predispose to entrapment of suprascapular nerve and it should be considered as a possible etiologic factor.

**Table 4:** Comparison of types of SSN with other studies

| Authors Studies | Type I | Type II | Type III | Type IV | Type V | Type VI |
|---|---|---|---|---|---|---|
| Rengachary et al [7] | 8% | 31% | 48% | 3% | 6% | 4% |
| Natsis et al[11] | 8.3% | 41.85% | 41.85% | 31% | 3% | -- |
| Sinkeet et al[13] | 22% | 21% | 29% | 5% | 18% | 4% |
| Muralidhar RS[14] | 21.15% | 8.65% | 59.61% | 2.88% | 5.76% | 1.93% |
| Usha kannan et al[15] | 20% | 10% | 52% | 4% | 4% | 10% |
| Philip SE et al[8] | 9% | 36% | 38% | 8% | 6% | 3% |
| Present study | 24% | 18% | 33% | 13% | 11% | 1% |

**Table 5:** Comparison of the distance between the suprascapular notch and the supraglenoid tubercle (SGT) and the distance between the medial wall of the spinoglenoid notch(SGN) and the posterior margin of the glenoid cavity (GC) respectively

| Sl. No. | Authors study | Distance between SSN and SGT(cm) | Distance between SGN and GC (cm) |
|---|---|---|---|
| 1 | Shishido et al [3] | 2.3 | 1.4 |
| 2 | Sinkeet et al[13] | 2.87 | 1.58 |
| 3 | Vandana and Sudha et al[5] | 2.73 | 1.3 |
| 4 | Philip S E et al[8] | 2.9 | 1.6 |
| 5 | Present study | 2.9 | 1.5 |

Suprascapular nerve entrapment is an acquired neuropathy secondary to compression of the nerve in the bony suprascapular notch. The signs and symptoms of suprascapular nerve entrapment are weakness of the arm, difficulty in external rotation and abduction, and then, atrophy of the infraspinatus and supraspinatus muscles. This entrapment syndrome is most frequently found in individuals who repeatedly experience stress on their shoulder and those with occupations which require a lot of overhead work involving extreme abduction and external rotation. These include baseball players, weight lifters, tennis players, fencers, hunters using bows, dancers, and figure skaters [6].

The distance between SSN and supraglenoid tubercle is critical during open surgical procedures requiring dissection of shoulder joint from posterior approach. 'Safe zone' is the critical distance within which these procedures are done safely without causing much injury to the suprascapular nerve [5]. Shishido et al. [3], and Sinkeet et al. [13], have reported the mean distance between SSN and supraglenoid tubercle as 23 mm and 28 mm respectively. In the present study the corresponding distance was 29.8mm ± 4.06 mm .The largest distance was observed in type III (30.24±4.69) and least in type IV (29.09±3.8) which is similar to the studies done by Vandana and Sudha et al. [5] study but different from Sinkeet et al. [13], study which showed type IV having longest distance (30.1mm) and type III having least (27.3mm).

Shishido et al. [4], and Sinkeet et al. [13], have reported the average distance between posterior rim of glenoid cavity and medial wall of spinoglenoid notch at the base of scapular spine as 14 mm and 15.8 mm respectively. Corresponding distance in our study is 15.19±2.64 mm. We have compared our results with other authors in Table 5.

According to De Mulder et al. [19], and Warner et al. [20], it has been reported that 23mm from the glenoid rim at the level of the superior rim of the glenoid and 14 mm from the posterior rim of the glenoid at the level of the base of the scapular spine are safe. In the present study the mean distances were 29 mm and 15 mm respectively. Regarding notch and safe zone dimensions, It was commonly noted in type IV followed by type II has the less safe zone distance. Thus, it calls for an extra caution in carrying out shoulder procedures in the above mentioned types of suprascapular notch.

## Conclusion

The anatomical knowledge about the variations in the types and different measurements of suprascapular notch and its safe zone is essential for surgeons, for making a proper diagnosis and for planning the most appropriate surgical interventions.

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*Conflict of interest:* Nil

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