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Research Article

Variations in suprascapular notch morphology and its clinical importance

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ABSTRACT

Background: Suprascapular notch (SSN) is present towards the medial end of superior border of scapula. The morphometric variations of the SSN have been identified. The suprascapular nerve compression is commonly noted at the site of SSN.
Methods: The study was carried out in the department of anatomy, SRMS-IMS medical college, Bareilly and SGRRIM-HS Dehradun. The 120 dried scapulae were randomly selected. The age, sex and race of the scapulae were not known. The scapulae were observed carefully for the different shapes of the suprascapular notch. The various dimensions of suprascapular notch were taken by using a digital vernier caliper.
Results: In the present study six types of SSN were noted based on the description by Rengachary SS. et al.[22] Type I (15.83%); type II (41.66%); type III (25.00%); type iv (12.50%); type v (1.67%) and type VI (3.33%). We also classified the SSN based on the description by M. Polguj et al. 2011,[28] the frequencies were: type I (MVD>STD), 20%; type II (MVD=STD=MTD), 3.33%; type III (STD >MVD), 55.83%; type IV (bony foramen), 3.33% and type V (Without a discrete notch), 17.5%.
Conclusion: The suprascapular neuropathy may occur at the various anatomical locations of its course and has a variety of causes. Our study is important for clinician because the narrow SSN increase the risk of suprascapular entrapment neuropathy. So the knowledge of these variations should be kept in the mind of clinicians in the diagnosis and treatment of suprascapular neuropathies.

Keywords: Suprascapular notch, Variations, Neuropathy

INTRODUCTION

The scapula (shoulder blade) is a triangular flat bone that lies on the posterolateral aspect of the thorax, overlying the 2nd-7th ribs. The scapula has medial, lateral, and superior borders and superior, lateral, and inferior angles. The superior border is the thinnest and shortest of the three borders, it is marked near the junction of its medial two thirds and lateral third by the suprascapular notch, which is located where the superior border joins the base of the coracoid process.[1] Suprascapular notch has been classified by various workers in different populations on the basis of vertical length, transverse diameter and shape of the notch.[2-4] The suprascapular notch is bridges by the Superior Transverse Scapular Ligament (STSL), which is attached laterally to the root of the coracoids process and medially to the limit of the notch.[5] The superior transverse scapular ligament sometimes ossified and converted the suprascapular notch into a bony foramen through which the suprascapular nerve travels.[6-8] The variations in its thickness and length, and its tendency to ossify, suggest that the ligament responds to changes in

mechanical load.[9] The suprascapular nerve originates from the upper trunk of the brachial plexus, and then it runs posterior under the trapezius passing through the suprascapular notch of the scapula to enter the supraspinous fossa. The suprascapular nerve first supply motor fibres to the supraspinatous muscle, a shoulder abductor, before proceeding laterally to supply deep sensory fibres to the glenoacromial and acromio-clavicular joints, and the coraco-acromial ligament. It then wrap around the spinoglenoid notch of the scapular spine under the spinoglenoid ligament to enter the infraspinous fossa, where it supplies motor fibres to the infraspinatous muscle, an external rotator of the shoulder.[10] The calcification of superior transverse scapular ligament may trap or compress the suprascapular nerve as it passes through the scapular notch under the STSL, affecting functions of supraspinatus and infraspinatus muscles.[11] Kopell and Thompson[12] reported that compression of the suprascapular nerve causes suprascapular nerve entrapment syndrome. He also explains that during abduction or horizontal adduction at the shoulder joint there is traction on the suprascapular nerve and may compress the nerve against STSL. The suprascapular nerve entrapment most commonly occurs at the suprascapular notch under the transverse scapular ligament less frequent, the nerve can also be entrapped distally at the spinoglenoid notch.[12] Various authors have described that the partially or completely ossification of STSL with formation of bony foramina is the most common predisposing factor for the compression of the suprascapular nerve at the suprascapular notch.[10-15] The compression of the suprascapular nerve may occur anywhere along its course but the incidence my increase with the ossification of STSL.[7] The suprascapular nerve is relatively immobile both at its origin at the upper trunk and at the suprascapular notch. Because both the shoulder and scapula are quite mobile, movement, especially repetitive movement, results in stretch and nerve injury. Also like most of the major proximal upper extremity nerves, the suprascapular is often prominently involved in neurological amyotrophy.[10]

METHODS

The present study is based on the observation of 120 dried human scapulae, selected from the stock of bones of department of anatomy, SRMS-IMS medical college, Bareilly and SGRRIM-HS Dehradun. The dried scapulae were randomly selected. The age, sex and race of the scapulae were not known. The scapulae were observed carefully for the different shapes of the suprascapular notch and the presence of partial or complete bony bridges within the suprascapular notch (Table 1/Figure 1). The various dimensions of suprascapular notch were taken with the help of digital vernier caliper as follows (Table 2/Figure 2).

1. Superior Transverse Diameter (STD): i.e. the distance between the superior margins of the SSN.
2. Maximum Vertical Depth (MVD): i.e. vertical plane from middle of the STD to the deepest point of SSN.
3. Middle Transverse Diameter (MTD): i.e. distance in horizontal plane between the opposite margins of the SSN in half dimension of MVD perpendicular to it.

The data analysis of type I, type II, & type III was recorded as mean, minimum, maximum and standard deviation (Table 3).

RESULTS

In the present study six types of suprascapular notch were noted based on the description by Rengachary SS. et al.[22] We observed: type I, 19 (15.83%); type II, 50 (41.66%); type III, 30 (25.00%); type IV, 15 (12.50%); type V, 2 (1.67%) and type VI, 4 (3.33%) (Table 1/Figure 1). We also classified the suprascapular notch based on the description by M. Polguj et al. 2011[28] (Table 2/Figure 2), the frequencies were: type I (MVD>STD), 20%; type II (MVD=STD=MTD), 3.33%; type III (STD >MVD), 55.83%; type IV (Suprascapular foramen), 3.33% and type V (Without a discrete notch), 17.5%. Type I and type III were classified into three subtypes: A, B & C. The frequency of subtypes IA, IB & IC were recorded as 11.66%, 3.30% & 5% respectively and the frequency of subtypes IIIA, IIIB & IIIC were 3.33%, 2.50% and 50% respectively.

Table 1: Results of various types of suprascapular notch on the basis of Rengachary et al.[22]classification.

Suprascapular notch	No. of scapulae		Total	Percentage
	Left	Right		
Type I	7	12	19	15.83
Type II	27	23	50	41.66
Type III	18	12	30	25.00
Type IV	9	6	15	12.50
Type V	1	1	2	1.67
Type VI	3	1	4	3.33
Total	65	55	120	

Table 2: Frequency of each type of suprascapular notch on the basis of Polguj M et al.[28] classification.

Suprascapular notch	No. of scapulae	Total/percentage
Type I A	14 (11.66%)	1A+1B+1C = 24 (20%)
Type I B	4 (3.30%)	
Type I C	6 (5.0%)	
Type II	4 (3.33%)	4 (3.33%)
Type III A	4 (3.33%)	3A+3B+3C = 67 (55.83%)
Type III B	3 (2.50%)	
Type III C	60 (50%)	
Type VI	4 (3.33%)	4 (3.33%)
Type V	21 (17.5%)	21 (17.5%)
Total	120	120

Figure 1: Supero-posterior view of scapula showing the various type of suprascapular notch (SSN). A-type I, B-type II, C-type III, D-type VI, E-type V, F-type VI suprascapular notch. Superior angle (1), coracoids process (2), acromian process (3) and spine of scapula (4). SSF-Suprascapular foramen. OSTSL-Ossified superior transverse scapular ligament.

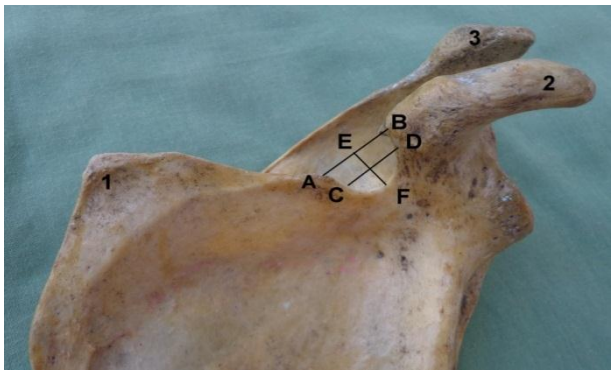

Figure 2: Ventral surface of scapula showing points for measurements of different parameters of SSN. AB-superior transverse diameter (STD), CD-middle transverse diameter (MTD), EF-maximum vertical depth (MVD).

Table 3: Results of various parameter of suprascapular notch.

Suprascapular notch	Maximum depth of SSN Mean ± SD (mm)	Superior transverse diameter of SSN Mean ± SD (mm)	Middle transverse diameter of SSN Mean ± SD (mm)
Type I	12.55 ± 4.07	8.98 ± 2.76	9.08 ± 2.99
Type II	5.92 ± 2.69	5.92 ± 2.69	3.82 ± 1.50
Type III	7.31 ± 2.02	8.50 ± 1.98	8.06 ± 1.78

DISCUSSION

Many anatomical studies have been conducted on the morphometric variations of the SSN and ossification of the superior transverse scapular ligament (STSL).[1-6,22]

Vastamakin et al. 1993,[16] Zehetgruber H et al. 2002,[17] Urguden et al. 2004,[18] Bhatia DN et al. 2006,[19] reported that the morphometric anatomy of the SSN and STSL is the most important factor for suprascapular nerve entrapment. The suprascapular nerve entrapment syndrome is characterized by the shoulder pain and atrophy of the supraspinatus and infraspinatus muscles (Kopell and Thompson 1959).[12]

Hrdicka A 1942[20] and Olivier G 1960[21] reported five types (Type I, type II, type III, type IV and type V) of SSN on the basis of visual observation.

As per Hrdicka A[20] in the type I the suprascapular notch was absent and type V had the suprascapular foramen. Olivier[21] reported that type I having very small notch, type II: shallow notch, type III: deep notch, type IV also have deep notch and in type V, the SSN is converted into a bony foramen by ossification of the STSL.

In 1979 Rengachary SS[22] classify the suprascapular notch into six types as bellow:

- Type I - the superior border forms a wide depression from the medial angle to the coracoids process of scapula.
- Type II - blunted large V- shaped suprascapular notch occupying the middle third of the superior border of scapula.
- Type III - notch is U-shaped with parallel margins.
- Type IV - narrow and very small V-shaped notch. A shallow groove is frequently formed for the suprascapular nerve adjacent to the notch.
- Type V - notch is minimal and U-shaped with a partially ossified superior transverse scapular ligament.
- Type VI - notch is converted into a foramen.

In the present study in Indian population on the basis of the Rengachary SS. et al. (1979)[22] classification, Type II (41.66%) SSN were found most common type, whereas type V was the least observed (1.67%) (Table 1/Figure 1). However in previous studies like Rengachary SS. et al. (1979),[22] Sinkeet SR et al. (2010),[23] S. Muralidhar (2013)[24] and Usha Kannan et al. (2014)[25] observed Type III as the most common type of suprascapular notch (Table 4/Figure 1). In 2013 Paolo Albino et al.[26] examined the five hundred dry human scapulae and

recorded the type VI as most common notch (31.1%), but in other studies it were observed only in 2.88%-5.0% scapulae (Table 4). In our study type III (25.00%) resulted the second most common class and it correlates the finding of Paolo Albino et al. (22.8%).[26]

Table 4: Comparison of previous studies with current based on Rengachary SS et al.[22] classification.

Authors	Population	SSN I	SSN II	SSN III	SSN VI	SSN V	SSN VI
Rengachary SS.et al.[22]	America	8%	31%	48%	3%	6%	4%
Natsis K et al.[2]	Greek	6%	24%	40%	13%	11%	6%
Sinkeet SR et al.[23]	Kenya	22%	21%	29%	5%	18%	4%
Paolo Albino et al.[26]	Italy	12.4%	19.8%	22.8%	31.8%	10.2%	3.6%
Usha Kannan et al.[25]	India	20%	10%	52%	4%	4%	10%
Present study	India	15.83%	41.66%	25.00%	12.50%	1.67%	3.33%

We also noted that the frequency of type I (15.83%) suprascapular notch is less than that recorded by Sinkeet SR et al.,[23] S. Muralidhar[24] and Usha Kannan et al.[25] 2014, but it was found more in frequency than that observed by Rengachary SS.[22] et al. 1979 and Paolo Albino et al. 2013[26] (8.0% & 12.4%) (Table 4/Figure 1). We also found the complete ossified superior transverse scapular ligament in four scapulae (3.33%) (Table 1/Figure 1). It correlates the finding of Vyas KK et al. 2013[27] in Indians, Paolo Albino[26] in Italian and Sinkeet et al[23] in Nairobian population (Table 4). However in our study It was found to be higher in frequency than the earlier reported by S. Muralidhar[24] (1.92%) but lower than that described in many other workers (Table 4). In Indian population the frequency of ossification of superior transverse scapular ligament into a bone resulting conversion of SSN into a foramen varies from 1.92 % to 10% (Table 4). M. Polguj et al. 2011[28] examined the 86 human scapulae of polish community and classified the five types of suprascapular notch based on three morphometrical measurements as follows: (Table 2/Figure 2).

1. Superior Transverse Diameter (STD): i.e. the distance between the superior margins of the SSN.
2. Maximum Vertical Depth (MVD): i.e. vertical plane from middle of the STD to the deepest point of SSN.
3. Middle Transverse Diameter (MTD): i.e. distance in horizontal plane between the opposite margins of the SSN in half dimension of MVD perpendicular to it.

The types of suprascapular notch were also recorded as per the description given by M. Polguj et al.[28] and classified five types of SSN. In type I, Maximum Vertical Depth (MVD) was greater than STD. Type II have equal all three parameters (STD=MVD=MTD). In type III, the MVD <STD. In type VI, a bony foramen and type V had a discrete SSN. The type I and type III SSN were divided into three subtypes: A (MTD >STD), B (MTD=STD) & C (MTD <STD). In our study as per the description given by M. Polguj,[28] type III were recorded as the most common type of SSN (48.33%), also the same result have been reported by the other previous workers (Table 5). We also observed that the Type I is the second most common type of SSN i.e. 20%, similar observation have been made earlier by M. Polguj et al. 2013[29] in Polish population, while Vyas et al.[27]found type VI (30.67%), as the second most common type of SSN in Indian population (Table 5).

Table 5: Comparison of previous studies with current based on Polguj M et al.[28] classification.

Authors	Population	SSN I	SSN II	SSN III	SSN VI	SSN V
M. Polguj et al. 2011[28]	Poland	24.4%	2.3%	54.7%	7%	11.6%
M. Polguj et al. 2013[29]	Poland	24.18%	1.95%	56.16%	4.72%	12.99%
Vyas KK et al. 2013[27]	India	20.33%	2.67%	42.67%	3.67%	30.67%
Present study 2014	India	20%	3.33%	55.83%	4.16%	17.5%

CONCLUSIONS

The suprascapular neuropathy may occur at the various anatomical locations of its course and has a variety of causes. Suprascapular notch is the most studies anatomical location of the suprascapular nerve injury. Our study on the various shapes of the suprascapular notch and presence of suprascapular foramen is important for clinician because it increase the risk of suprascapular entrapment neuropathy by narrowing the SSN notch enough to be considered as a risk factor for the compression and irritation of suprascapular nerve. So the knowledge of these variations should be kept in the mind of clinicians in the diagnosis and treatment of

suprascapular neuropathies and suprascapular nerve decompression.

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