Original Article

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Anatomy Section

Morphological Variation of Suprascapular Notch in Population of Eastern India and its Clinical Significance

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ABSTRACT

Introduction: Suprascapular notch is present at the lateral part of the superior border of scapula which is bridged by superior transverse scapular ligament. The suprascapular nerve runs below the ligament and the transverse scapular vessels over it. The ligament sometimes becomes ossified and impinges the underlying nerve which causes paralysis of both supraspinatus and infraspinatus muscles.

Aim: To study the morphological variation of suprascapular notches in dry human scapulae.

Materials and Methods: This observational cross-sectional study was carried out on 102 adult dry human scapulae (62 right, 40 left) collected from the 1st year MBBS students of different Medical colleges of West Bengal from August 2020 to March 2021. The shapes of suprascapular notch, presence of ossified ligaments were observed. Superior Transverse Diameter (STD), Middle Transverse Diameter (MTD), Maximum Depth (MD) of the suprascapular notch, distance from the deepest point of suprascapular notch to supraglenoid tubercle and distance between the spinoglenoid notch to the posterior rim of glenoid cavity were measured and statistically analysed. Classification of the suprascapular notch was done based on Rengachary classification.

Results: Type III notch was most common (n=52). One scapula had small U-shaped notch with lateral part of the ligament ossified and another had U-shaped notch with both medial and lateral part of the ligament ossified but they failed to join. In Type I and Type VI there were no such diameters like STD or MTD but for other types STD was more than MTD. The distance between suprascapular notch and supraglenoid tubercle was variable-type VI had minimum and type I had the maximum distance. The distance between the medial wall of the spinoglenoid notch and the posterior rim of glenoid cavity was least in type I and highest in type III.

Conclusion: This study showed that type III was the most common suprascapular notch. The present study also compared the findings with other previous studies and found that percentage of presence of suprascapular foramen in this eastern Indian population was higher than southern Indian population.

Keywords: Entrapment neuropathy, Morphology, Rengachary classification, Suprascapular nerve

INTRODUCTION

The brachial plexus formed by the ventral primary rami of C5, C6, C7, C8 and T1 innervates all the muscles, joints and skin of the upper limb. It has roots, trunks, divisions and cords. The suprascapular nerve (C5,C6) usually arises as the first branch of the upper trunk but it frequently springs directly from the ventral primary ramus of C5 [1]. The nerve passes backward above the clavicle and disappears beneath the anterior border of trapezius. It enters through suprascapular foramen below the superior transverse scapular ligament and supplies supraspinatus and winds round the spinoglenoid notch below the inferior transverse scapular ligament to supply infraspinatus. Suprascapular nerve entrapment occurs when there is compression of nerve while passing through the bony suprascapular notch [2,3]. Complete ossification of the superior transverse scapular ligament converts the notch into foramen and it is the most important predisposing factor for the compression of the nerve [4].

The famous orthopaedic surgeon Andre Thomas first described the mechanism leading to the development of the suprascapular nerve entrapment syndrome in the year 1936. He depicted that as the suprascapular nerve passed through the two osseo-fibrous openings, the suprascapular and spinoglenoid notches, they represent rings over which the nerve is pulled. So, the concomitant extension and external rotation of the arm had led to traction and friction of the nerve in the narrow tunnel, causing paralysis of that nerve [5].

In arthroscopic shoulder operation the suprascapular notch also acts as important landmark to locate suprascapular nerve [6]. The shape of suprascaular notch plays very important role for compression of this nerve. In the whole population, approximately 1-2% all shoulder pain is caused by the suprascapular nerve entrapment [2]. Suprascapular nerve entrapment was also described in many previous studies. The impingement of suprascapular nerve causes difficulty in external rotation and abduction, and atrophy of the infraspinatus and supraspinatus muscles. This entrapment syndrome is most frequently found in people who do a lot of work requires extreme abduction and external rotation [7].

Depending upon the vertical length, transverse diameter and shape of the notches, various research workers classified them in many ways [8,9]. In current study, suprascapular notch was classified based on classification done by Rengachary SS et al., [2].

Similar studies were also done on the Indian population though they were very few in number [10-14]. They all reported that the most common type was type III except the study done by Gopal K et al., where they got type II as the most common one [14]. But in eastern Indian population similar studies are lacking. So, the present study was conducted to determine whether any variation of suprascapular notch is prevalent among the eastern Indian population.

MATERIALS AND METHODS

An observational cross-sectional study was done on 102 adult dry human scapulae of unknown age and sex. All the bones were collected from different medical colleges of West Bengal so that they represented the eastern Indian population. As the study was conducted on dry scapulae it was suggested by Ethical Clearance

Committee of various colleges to take permission from the head of the department and the verbal permission was received from the Head of the Department of respective colleges. The study was conducted from August 2020 to March 2021.

Inclusion criteria: Human adult undamaged dry scapulae irrespective of gender and side were included in the study.

Exclusion criteria: Bones with any damage or having pathological changes like fracture were excluded in the study.

Study Procedure

The suprascapular notches were identified and they were classified on the basis of classification done by Rengachary SS et al., [2]. The suprascapular notches and the following diameters related to the notches were measured with the help of vernier calipers [Table/Fig-1-4]:

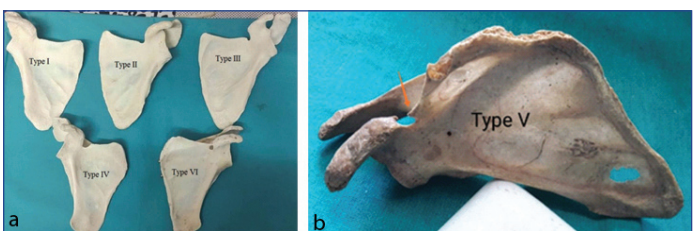
1. Superior Transverse Diameter (STD): The maximum distance between the superior points on the either side of the notch.

2. Middle Transverse Diameter (MTD): The maximum distance between the middle points on the margins of either side of the notch.

3. Maximum Depth (MD): The vertical distance from the deepest point of the notch to the STD.

4. Safe zone distance: [a] Distance of suprascapular notch from the margin of the glenoid cavity; and [b] the distance between the medial wall of the spinoglenoid notch to the posterior margin of the glenoid cavity. In type I and type VI all the measurements could not be taken.

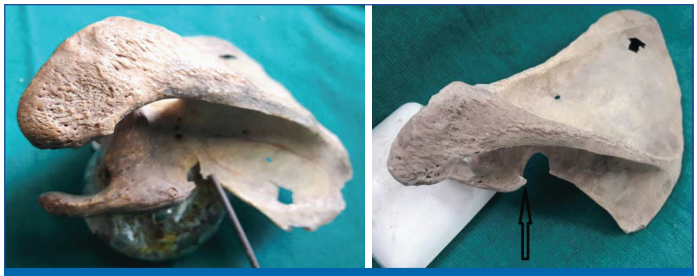
[Table/Fig-1]: Various dimensions of suprascapular notch. Superior Transverse Diameter (STD), Middle Transverse Diameter (MTD), Maximum Depth (MD).



[Table/Fig-2]: a) Various types of suprascapular notches. b) Type V scapula (only medial part of the ligament ossified).

STATISTICAL ANALYSIS

All data were compared and analysed descriptively. The Statistical Package for Social Sciences (SPSS) version 16.0 was used.



[Table/Fig-3]: Both medial and lateral part of the ligament ossified but they fail to join.
[Table/Fig-4]: Only lateral part of the ligament ossified. (Images from left to right)

RESULTS

In the present study, total 102 dry scapulae were observed and measurements were taken. Based on Rengachary classification, the percentage of various types of Suprascapular notches were calculated. The [Table/Fig-5] shows that type III was most common followed by type II.

Shape of the notch	No of specimens (%)
Type I (no notch)	04 (3.92%)
Type II (wide, blunt V shaped)	26 (25.49%)
Type III (symmetrical U shaped)	52 (50.98%)
Type IV (small V shaped)	10 (9.80%)
Type V (U shaped with medial part of the ligament ossified)	04 (3.92%)
Type VI (Ligament completely ossified)	06 (5.88%)

[Table/Fig-5]: Distribution of various shapes of supra scapular notch based on Rengachary classification.

The study found two different types: one scapula had small U-shaped notch with lateral part of the ligament ossified and another had U-shaped notch with both medial and lateral part of the ligament ossified but they failed to join. Both were included in Type V during calculation of percentage [Table/Fig-3,4].

Then various dimensions like STD, MTD and MD of different types of suprascapular notches were measured. In Type I and Type VI there were no such diameters. For other types, STD was more than MTD [Table/Fig-6].

Types of notches	Superior Transverse Diameter (STD) (mm) (Mean±SD)	Middle Transverse Diameter (MTD) (mm) (Mean±SD)	Maximum Depth (MD) (mm) (Mean±SD)
II	16.067±3.519	9.615±2.848	7.963±2.957
III	10.011±3.428	7.1±3.472	6.608±2.780
IV	6.96±4.99	5.26±3.715	5.266±1.021
V	8.3±3.535	5.15±2.899	7.4±1.979

[Table/Fig-6]: Various dimensions of different types of suprascapular notches. They were not present in Type I and Type VI.

The [Table/Fig-7] shows that the distance between suprascapular notch and supraglenoid tubercle was variable. Type VI had minimum distance and it was maximum in type I. Type II and type III showed the maximum range.

Types of notches	Mean (mm)±SD	Range (mm)
I	32.4±0.693	31.9-32.9
II	26.569±4.534	19.4-35.8
III	28.025±3.362	19.4-33.5
IV	25.62±3.307	20.5-29.1
V	26.15±4.171	23.2-29.1
VI	24.97±1.724	23.1-26.5

[Table/Fig-7]: Distance between suprascapular notch and supraglenoid tubercle of various types of scapula.

The distance between the medial wall of the spinoglenoid notch and the posterior rim of glenoid cavity was also measured. It was least in type I. It was highest in type III [Table/Fig-8].

Types of notches	Mean (mm)±SD	Range (mm)
I	12.35±3.1819	10.1-14.6
II	15.8±1.831	13.6-18.2
III	17.185±1.525	14.7-18.5
IV	16.066±1.7009	14.4-17.8
V	13.9±0.424	13.6-14.2
VI	14.1±0.1732	13.9-14.2

[Table/Fig-8]: Distance between posterior rim of glenoid cavity and the medial wall of the spinoglenoid notch.

DISCUSSION

Shapes of suprascapular notches have been studied by different workers among different population. The present study among eastern Indian population, type III was most common type followed by type II, type IV, type VI. Percentage of Type I and Type V was same. The [Table/Fig-9] shows that type III was most common type found in most of the studies done by previous authors [2,9-11,14-21].

Study/Location	Type I	Type II	Type III	Type IV	Type V	Type VI
Rengachary SS et al., (1979) (America) [2]	8%	31%	48%	3%	6%	4%
Iqbal K et al., (2010) (India) [9]	18%	20%	13%	-	-	-
Sangam MR et al., (2013) (India) [10]	21.5%	8.65%	59.61%	2.88%	5.76%	1.93%
Mayuri MVR and Sagar TN, (2020) (India) [11]	10%	16.67%	40%	21.67%	3.33%	8.33%
Gopal K et al., (2015) (India) [14]	6.6%	41.5%	44.3%	-	4.7%	2.8%
Ticker JB et al., (1998) (America) [15]	-	23%	77%	-	-	-
Sinkeet SR (2010) et al., (Kenya) [16]	22%	21%	29%	5%	18%	4%
Soni G et al., (2015) (India) [17]	2%	7%	58%	-	-	3%
Mahdy AA and Shehab AA, (2013) [18]	-	13%	76%	-	-	-
Vandana R and Patil S, (2013) (India) [19]	4.5%	5.2%	35%	-	3%	12.6%
Albino P et al., (2013) (Italy) [20]	12.4%	19.8%	22.8%	3%	10%	31%
Vaidya VK et al., (India) (2018) [21]	20%	15%	26.42%	28.57%	7.14%	2.85%
Present study (eastern India)	3.92%	25.49%	50.98%	9.8%	3.92%	5.88%

[Table/Fig-9]: Comparison of frequencies of various types of suprascapular notches in different population based on Rengachary classification [2,9-11,14-21].

It is known that small notches have greater chance of nerve impingement. As V shaped notches have less area than U shape, these were commonly associated with suprascapular nerve entrapment [22,23].

Complete ossification of transverse scapular ligament converts the notch into foramen. In the present study there were six such scapulae among 102. Previous studies showed that the incidence of foramen was different among different population. Following table [Table/Fig-10] shows the comparative distribution of suprascapular foramen in different population [2,8,10].

Authors	No. of specimens (%)
Rengachary SS et al., (America) [2]	09 (4%)
Natsis K et al., (Greek) [8]	26 (6.1%)
Sangam MR et al., (India) [10]	2 (1.93%)
Present study (India)	06 (5.88%)

[Table/Fig-10]: Distribution of Suprascapular foramen in different population [2,8,10].

The suprascapular nerve may be injured in many surgical procedures. Safe zone is a distance which was very much important to avoid this injury during surgeries involving posterior part of shoulder joint [24]. Two distances are considered as the safe zone distance- the distance from supraglenoid tubercle to suprascapular notch (S1) and the distance between posterior rim of glenoid cavity and the medial wall of the spinoglenoid notch (S2). If the first dimension (S1) is 23 mm and the latter (S2) is 14 mm, it is considered as safe [10], which in present study were 30.3±3 mm and 16.8±2.19 mm, respectively. Among 102 scapulae, 6 (5.88%) fell short than 23 mm and 8 (7.6%) fell short than 14 mm. Similar study done by Sangam MR et al., on South Indian population described that 2.88% scapulae had distance less than 23 mm whereas 8.65% had distance less than 14 mm [10]. Research works done by others on safe zone distance were also studied to get conclusive evidence.

From the [Table/Fig-11], it can be concluded that the number of scapula having S2 distance less than 14 mm was more than the scapulae having S1 distance less than 23 mm [10,16,25,26]. This could be due to morphological variations among the people. More precautions should be taken during surgeries in those cases especially during the open surgical procedures requiring dissection of posterior shoulder joint to avoid injury of the suprascapular nerve [24].

Authors	Percentage of scapulae falling short of S1	Percentage of scapulae falling short of S2
Sangam MR et al., (2013) (India) [10]	2.88%	8.6%
Sinkeet SR et al., (2010) (Kenya) [16]	5.9%	12%
Philip SE and Dakshayani KR, (2017) (South Karnataka) [25]	3%	21%
Chaitra BR et al., (2019) (South India) [26]	1%	10%
Present study	5.88%	7.6%

[Table/Fig-11]: Comparison of safe zone distance in various population [10,16,25,26].

Limitation(s)

For this study, the bones were collected from only a few medical colleges of West Bengal because of the restrictions due to the ongoing pandemic. Moreover, the radiological findings of the type and size of the suprascapular notches during evaluation of the cases of suprascapular nerve entrapment were not correlated with the findings of the osteological studies [27].

CONCLUSION(S)

From the present study, it was found that type III notch was most common in eastern Indian population like most other regions of India. But the percentage of ossification of suprascapular ligament i.e., the formation of suprascapular foramen was more in the eastern part. Two special types were also found where both medial and lateral part of the ligament was ossified but they failed to join and in another type only lateral part of the ligament was ossified. Comparing this study with others, it is suggested that incidence of ossification of suprascapular ligament is more in the eastern part of India. Variations were also observed in respect to safe zone distance. Further studies are recommended with larger number of samples, data on the morphological variations of the suprascapular notches in Eastern India along with associated radiological findings in suprascapular nerve entrapment would help in drawing a conclusion.

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