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A Morphometric Study of the Suprascapular Notch and its Clinical Significance in the Indian Population

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Abstract: ***The suprascapular notch is present in the superior border of the scapula, medial to the root of the coracoid process. The morphology of the suprascapular notch varies significantly. Sometimes it is converted into suprascapular foramen by the transverse scapular ligament. The morphological variations of the suprascapular notch may affect the suprascapular nerve and cause nerve entrapment syndrome. In this study, we have measured the superior transverse diameters and maximum depths of suprascapular notches in 100 scapulae and classified them according to the system proposed by Natsis. We found that in 5% of our samples, the suprascapular notch was absent (Type I). In 72% of the bone samples, the scapulae were of Type II (maximum depth < superior transverse diameter). 17% were of Type III (maximum depth > superior transverse diameter) and 6% of Type IV (presence of suprascapular foramen). Type V scapula (presence of both suprascapular notch and foramen simultaneously) was not found. So, in most scapulae, the suprascapular notches were found to be wider rather than deeper. The findings are mostly at par with similar studies done among the Indian population. The study of morphometric parameters of the suprascapular notch is of utmost clinical importance. Different surgical techniques can be explored in this region of the body, keeping in mind the variations found in the Indian population.***

Keywords: suprascapular notch, suprascapular foramen, scapula, Natsis's classification

1. Introduction

The suprascapular notch is an indentation present in the superior border of the scapula. It lies medial to the root of the coracoid process. The notch is converted into a foramen by the transverse scapular ligament. The suprascapular nerve and vein run through the notch below the ligament. The suprascapular artery, on the other hand, passes above the ligament. The suprascapular nerve is often compressed in the suprascapular notch. This results in "suprascapular nerve entrapment syndrome". This pathology was first described by Kopell and Thompson in 1956.[1]

In suprascapular nerve entrapment syndrome, the patients complain of pain in the posterior and lateral aspects of the shoulder. Tenderness is elicited upon deep palpation over the suprascapular notch.[2] Relative weakness of shoulder abduction and external rotation of the arm may be observed as the supraspinatus and infraspinatus muscles are affected.[3]

Variations in the morphology of the suprascapular notch often play a significant role in the aetiology of the suprascapular nerve entrapment syndrome.[4] Besides, the injury to the suprascapular nerve may sometimes be iatrogenic due to its proximity to the shoulder joint. The nerve may be injured during surgical exploration in such cases.[5] Also, an ossified transverse scapular ligament may pose a difficulty during surgical decompression of an entrapped suprascapular nerve in its foramen.

Therefore, the knowledge of the morphology of the suprascapular region, particularly the suprascapular notch and the transverse scapular ligament, and their variations is important in the clinical management of suprascapular nerve compression. In the present study, we aimed to determine two morphometric parameters of the suprascapular notch, namely, the superior transverse diameter and the maximum depth. We also wanted to classify the notches based on our findings.

2. Materials and methods

For the purpose of this study, we selected 100 dry scapulae which were already in the collection of the Museum of Anatomy at a government medical college in Kolkata, West Bengal. The age and sex of the scapulae were unknown. Scapulae of both right and left sides were selected. Broken bone specimens, bones with obvious congenital anomalies or other defects were excluded from the study. The study was observational in nature and was conducted over a period of twelve months. The following morphometric parameters of the suprascapular notch were recorded:

1) Superior transverse diameter - the horizontal measurement taken between the margins of the suprascapular notch along the superior border of the scapula.
2) Maximum depth - the vertical measurement taken between the midpoint of the superior transverse diameter and the deepest point of the suprascapular notch.

A photographic technique, similar to the ones used in previous similar studies, was used to measure the suprascapular notches. The scapula under observation was held with an adjustable ring and clamp in such a way that its plane lay at right angles to the perpendicular axis of the camera. The digital camera was fixed on a stand. The distance between the camera and the object was always kept at two feet. The scapulae were always photographed from the anterior side at a resolution of 640x480 pixels. The images were then imported into Auto CAD 2014 (Autodesk) software and the measurements of the suprascapular notches were measured digitally. A metric scale was clamped to the stand during photography for reference. The notches were

then classified according to the system proposed by Natsis[6] into:

a) **Type I**: absent suprascapular notch
b) **Type II**: maximum depth < superior transverse diameter
c) **Type III**: maximum depth > superior transverse diameter
d) **Type IV**: presence of suprascapular foramen
e) **Type V**: presence of both suprascapular notch and foramen

3. Results

In our study, we found that in 5% of the scapulae, the suprascapular notches belonged to Type I, in 72% to Type II , in 17% to Type III and in 6% to Type IV **[Table. 1]**. No scapula with Type V notch was found among the sample selected. The superior transverse diameter of the Type II suprascapular notches was found to be higher (1.24 +/- 0.32 cm) as opposed to Type III notches (0.83 +/- 0.30 cm) **[Table. 2]**. On the contrary, the maximum depth of the Type III suprascapular notches were found to be higher (1.03 +/- 0.34 cm) than in those of Type II (0.70 +/- 0.26 cm) **[Table 3]**. The superior transverse diameters and maximum depths of suprascapular notches could not be measured in scapulae with Type I notches (absent notch) and in Type IV, where the notch had been converted into a foramen by the ossified transverse scapular ligament.

Table 1: Distribution of scapular notches

Type of scapula	Right sided	Left sided	Percentage
Type I	4	1	5
Type II	38	34	72
Type III	7	10	17
Type IV	4	2	6
Type V	0	0	0
Total	53	47	100

Table 2: Superior transverse diameters in different types of suprascapular notches (in cm)

Parameters	Type I	Type II	Type III	Type IV
Mean	NA	1.24	0.83	NA
SD	NA	0.32	0.3	NA
Median	NA	1.17	0.85	NA

Table 3: Maximum depth of different types of suprascapular notches (in cm)

Parameters	Type I	Type II	Type III	Type IV
Mean	NA	0.7	1.03	NA
SD	NA	0.26	0.34	NA
Median	NA	0.72	1.02	NA

Figure 1: A Type I scapula from our study

Figure 2: A Type II scapula from our study

Figure 3: A Type III scapula from our study

Figure 4: A Type IV scapula from our study

4. Discussion

A review of existing literature reveals that a number of methods have been used to classify suprascapular notches in different studies. Some of the authors, such as Bayramoglu et al.[7], Hrdricka[8] et al., Olivier et al.[9] and Ticker et al.[10], have classified the notches based on their shapes. These classifications are, however, qualitative and lack specific geometric parameters. Other authors, such as Polguj et al.[11], have used three parameters to measure the suprascapular notch. In addition to the two parameters used by Natsis et al., Polguj used the middle transverse diameter of the notches as well in his classification. In our view, Natsis's classification was simpler to understand as it was clearly described and quantitative, based on fewer parameters. Also, the typing method used by Natsis et al. is not altered by the morphological variations of the transverse scapular ligament. They can also be easily seen in radiographs.

In the present study, 5% of the notches belonged to Type I, i.e. without a discrete notch, 72% belonged to Type II, i.e. the notch widest at its superior transverse diameter, 17% to Type III, i.e. the notch with maximal depth and 6% to Type IV, i.e. a bony foramen. As mentioned earlier, Type V notches were not seen in any of the bones we studied. So, Type II notches were the most common, followed by Type III, Type IV and Type I. Since no uniform classification was followed by all the authors conducting this type of studies, it was difficult to do a reasonable comparative with the reports of other authors. However, we compared our results with the other studies which have also followed Natsis's classification. **[Table 4]**

Table 4: Comparison of frequency of various types of suprascapular notches in different populations (based on Natsis et al. classification

Type	Natsis[6] (Greek)	Wang[12] (Chinese)	G. Soni[13] (Indian)	Present study
I	8.30%	28%	5%	5%
II	41.85%	58.16%	72%	72%
III	41.85%	28.23%	20%	17%
IV	7.30%	3%	3%	6%
V	0.70%	-	-	-

Our findings closely resembled the findings of G. Soni et al., who also conducted their study among the Indian population. In Natsis's original study among the Greek population, Types II and III had equal incidences. However, in the studies of Wang et al. (among the Chinese population) and G. Soni et.al, the incidence of Type II suprascapular notches was higher than that of Type III. Our study has also found higher incidence of Type II over Type III suprascapular notches. The incidence of Type IV notches was reported higher by Natsis (7.2%) than both the above mentioned studies and the findings are reflected by the present study as well (6%).

Rengachary et al.[14] suggested that the absence of suprascapular notch may play a significant role in the compression of the suprascapular notch. Suprascapular nerve entrapment syndrome is also common among people who have a narrow suprascapular notch. This means that people with Type III suprascapular notches are at a higher risk of developing the pathology. Also, we found the presence of suprascapular foramen i.e. an ossified transverse scapular ligament in 6% of the bones we studied. Overall, studies of suprascapular notches in the Indian population show the incidence of suprascapular foramen between 0 and 12.6%. Our findings are well within this range. We have also found one scapula with a partially ossified transverse scapular ligament. Studies by G. Soni and MR Sangam[15] among the Indian population report 6-11% incidence of partially ossified transverse scapular ligament. Reports by

Rengachary and Ticker mention even higher incidences of the same (upto 23%).

5. Conclusion

The study of the morphometric parameters of the suprascapular notch is of clinical significance. In our study, it was found that a wider suprascapular notch is more common among the Indians than a deeper notch. Upon comparison of the current study with the previous studies on this topic among the Indian population and otherwise, it appears that the morphometric values of the suprascapular notch may be influenced by race of the population. Natsis et al. have already stated that radiologists, neurosurgeons and orthopaedic surgeons should bear the possibility of variation of dimensions of the notch in mind. Its identification during preoperative radiological examination and during intraoperative period is important, as altered surgical techniques may be needed to avoid an injury to the suprascapular nerve or during surgical nerve decompression. Since our study was conducted on dry bones at museums, we were limited by the lack of data on the age and sex of the samples. Also, we did not have any data on their medical history, including the possible signs and symptoms of suprascapular nerve entrapment. Further detailed ventures, such as screening of high risk patients by clinicians for the incidence of suprascapular nerve entrapment syndrome and confirmation of the syndrome in relevant cases and its correlation to the anatomy of scapula by radiological modalities such as CT and MRI may bring new information to light. We hope that the present study will enrich the cumulative knowledge for the further progress of medical sciences.

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