A Study on Morphometry and Morphological Variation of Suprascapular Notch in Dried Human Scapula

SUDARSHAN GUPTA, ZARNA PATEL, DEEPAK HOWALE

ABSTRACT

Introduction: The Suprascapular Notch (SSN) is located at the superior border of the scapula, just medial to the base of the coracoid process. The knowledge of variations in shapes and dimensions can be helpful to clinicians to correlate the suprascapular nerve entrapment with a specific type of notch.

Aim: This study was carried out to observe morphological variation in shapes of SSN and morphometric analysis of SSN.

Materials and Methods: A total of 120 adult scapulae of unknown age and sex will be obtained from Department of Anatomy, GMERS Medical College, Gandhinagar and Sola, Gujarat, India. The shapes of SSN were observed and dimensions were taken by digital Vernier caliper.

Results: The most common type of SSN observed was Type 2, a notch that was longest in its transverse diameter. The least common type was Type 4. Type 5 SSN was absent. The most common shape was ‘J’ and least common was ‘V’. Partial and complete ossification was also noted.

Conclusion: Knowledge of anatomical variations of suprascapular notch is better for understanding location and source of entrapment syndrome. Since, the present study is performed with a limited number of dry scapulae, so there is need of further clinical, radiological and cadaveric studies.

Keywords: Ossified suprascapular ligament, Rotator cuff, Suprascapular nerve entrapment syndrome

INTRODUCTION

The scapula in humans is located between second to seventh ribs in the post lateral part of the chest. It is a flat bone which is triangular in shape. At the superior border of scapula, a notch is present medially to coracoid process base. This notch is called the SSN. Suprascapular nerve passes through SSN which is motor nerve to supraspinatus and infraspinatus muscles, and sensory to rotator cuff muscles, ligamentous structures of shoulder and acromio-clavicular joint [1]. The suprascapular nerve passes through the suprascapular foramen which is created by the attachment of superior transverse scapular ligament to the notch [2].

Kopell and Thompson were the first to describe suprascapular nerve entrapment syndrome at SSN [3]. Over the years, many studies have investigated anatomical variations in the SSN and found out that ossified suprascapular ligament is one of the possible cause for development of suprascapular neuropathy [4]. It is characterized by shoulder pain, weakness in arm, difficulty in external rotation and abduction, and atrophy of supraspinatus and infraspinatus muscles. This syndrome is commonly seen in those who are involved in overhead heavy work, athletes such as baseball players, volleyball players, weight lifters etc., [4]. The SSN was classified into six types by Rengachary et al., [5-7], based on the shape of notch. This study has been planned with the following objectives:

1) To find out the prevalence of the various shapes of SSN.
2) Morphometric analysis of different shape of SSN and to find out the any difference in measurements of different shape and on right and left side scapulae.

MATERIALS AND METHODS

This is an observational analytical type of study to determine the morphological variations and morphometric analysis of SSN in dried human scapulae conducted at Department of Anatomy of GMERS Medical College, Gandhinagar, Gujarat, India during September 2016 to December 2016 (4 Months). Using Epi Info 7 by CDC Atlanta [8], and considering a prevalence rate of variation in shape of SSN as 26.9% from previous studies [9], confidence level as 95%, acceptable margin of error as 8% and design effect of 1, the provisional sample size was calculated to be 120. These 120 human dried scapula of unknown age and sex were obtained.


from Department of Anatomy, GMERS Medical College of Gandhinagar and GMERS Medical College Sola (Ahmedabad) after obtaining proper administrative and ethical clearance. Only bones that were intact and free from any pathological or congenital anomalies were used. The shape of SSN was observed on gross examination. According to the shape, the notch was classified as ‘J’, ‘U’, ‘V’ having indentation or notch completely absent. Partial/ complete ossification of suprascapular ligament was also taken into account.

Anatomic measurements accurate to 0.1 mm were measured by a digital Vernier caliper. Vertical Length (VL), Transverse Diameter (TD) and distance from the base of SSN to the superior rim of glenoid cavity were measured [Table/Fig-1]. VL was the length between the midpoint of imaginary line joining the superior corners of the notch and maximal depth of the notch. The line perpendicular to the midpoint of VL was take as the TD.

Nasis K et al., classified the SSN into five different types [3]:
1) Type 1: Without any discrete notch,
2) Type 2: The notch that had longest transverse diameter,
3) Type 3: The notch that had longest vertical length,
4) Type 4: With a bony foramen, and
5) Type 5: With a notch and a bony foramen.

Photographs of different types of SSNes were also taken for record keeping purpose.

**RESULTS**

[Table/Fig-2] shows the classification of SSN according to Natsis K et al., [3]. In this study, the most common type of SSN was Type 2 (66%), followed by Type 3 (18%) and Type 1 (13%). Least common type of SSN was Type 4 (3%). Type 5 SSN i.e., notch with bony foramen was not observed in any scapula.

Classification of SSN according to its shape is shown in [Table/Fig-3]. The most common type was ‘J’ (44%), followed by ‘U’ (22%), and ‘V’ (7%). Notch with indentation was found in 11%, whereas notch was completely absent in 8% of the scapula. Partial ossification was observed in 5% while complete ossification was observed in 3% of the scapula [Table/Fig-4].

[Table/Fig-5] shows the morphometric analysis of the SSN. The mean and standard deviation of vertical length, transverse diameter and distance from base of SSN to supraglenoid tubercle are noted. The mean of vertical length and transverse diameter of left scapula is significantly more than that of right scapula.

Morphometric measurements (vertical length, transverse diameter and distance from base of SN to supraglenoid tubercle) in ‘U’, ‘V’ and ‘J’ shaped scapula are shown in
In this study, according to Natsis K et al., classification [3], we observed four different types of SSN with varying percentages. Type 5 notch was not observed. Hardliska, 1942 [4] was first to separate the SSNes into 5 types. Rengachary et al., [5-7] classified the SN into 6 types. Type 6 is complete ossification of ligament resulting in a bony foramen of variable size. This classification was modified by Ticker JB et al., [10] and Bayramoglu A et al., [11] and included the ‘U’, ‘V’ shape and notch with ossification.

Polguj M et al., [12] elaborated a different classification in which 3 distances were measured: the maximal depth, superior and middle transverse diameter. The prevalence of completely ossified superior transverse scapular ligament was 10% as found in a study by Kannan U et al., [13]. Chabra N et al., [14] in their study did not found any Type 5 notch whereas, Type 2 was most common. Similar observations were found in present study. Wang HJ et al., [15] found proportion of completely ossified suprascapular ligament was 2.4%. Iqubal K et al., [16] reported ‘J’ shaped notch as most common type (22%). Agrawal D et al., Patel P et al., and Sutaria L et al., found ‘U’ shaped notch at respectively 45%, 47.5%, 38% (22%). Agrawal D et al., Patel P et al., and Sutaria L et al., found ‘U’ shaped notch at respectively 45%, 47.5%, 38% (22%).

Table/Fig-7: Classification of suprascapular notch on the basis of its shape (n=120).

### DISCUSSION
In this study, according to Natsis K et al., classification [3], we

<table>
<thead>
<tr>
<th>Type of Shape</th>
<th>Right (%)</th>
<th>Left (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td>16 (27.6)</td>
<td>13 (21.0)</td>
<td>29 (42.2)</td>
</tr>
<tr>
<td>J</td>
<td>19 (32.8)</td>
<td>31 (50.0)</td>
<td>50 (41.7)</td>
</tr>
<tr>
<td>V</td>
<td>06 (10.3)</td>
<td>03 (04.8)</td>
<td>09 (07.5)</td>
</tr>
</tbody>
</table>

Table/Fig-4: Classification of suprascapular notch on the basis of its shape (n=120).

| Shape wise morphometric differences in right and left scapula (n=120). |
|--------------------|------------------|------------------|----|
| Vertical length (VL) | U 7.75           | 8.25             | 0.02 |
|                     | V 6.11           | 7.35             | 0.01 |
| Transverse Diameter (TD) | U 9.24         | 10.00            | 0.04 |
|                     | V 7.11           | 7.99             | 0.04 |
| Distance from Base of SSN to Supraglenoid Tubercle | U 30.40 | 28.66 | 0.19 |
|                     | V 28.48          | 27.56            | 0.21 |
|                     | J 29.83          | 28.57            | 0.20 |

Table/Fig-5: Morphometric analysis of suprascapular notch (n=120).

Table/Fig-6: The mean vertical length was significantly higher in ‘U’ shape and lower in ‘J’ shape. Similarly, mean transverse diameter was significantly higher in ‘U’ shape than ‘V’ shape. Post-hoc-test determined significant difference in mean vertical length between all three shapes. However, there was no significant difference in mean transverse diameter between ‘V’ and ‘J’ shaped scapula.

Table/Fig-7: Shape wise morphometric differences in right and left scapula (n=120).

Table/Fig-8,9: Comparison of morphological variations in SN in present study viz-a-viz other previous studies. However, the present study takes a step further in comparing morphometry of scapula with various shapes, and their differences in left and right scapula.

Table/Fig-6: Comparison of morphometry of scapula with various shapes (n=120).

Table/Fig-8,9: Comparison of morphological variations in SN in present study viz-a-viz other previous studies. However, the present study takes a step further in comparing morphometry of scapula with various shapes, and their differences in left and right scapula.

Shape of bone is determined by morphogenetic factors and effect of strain also plays a major role in it. When mechanical or gravitational stresses are reduced or bone subjected to constant pressure bone resorption occurs. On the other hand constant tension favors bone deposition. If force is applied to skeletal tissues they are able to adapt their mechanical properties to match with the applied force. In case of increased strain cells detect it and respond by deposition of more...
extracellular matrix by which stiffness of the tissue increases and strain level returns to normal. In similar way reduced strain leads to decrease production of extracellular matrix, decrease stiffness, so strains increases to normal level [23].

Scapula develops from a cartilaginous model. It ossified from eight or more ossification centers: one in the body, two in the coracoid process, two in the acromion, one each in the medial border, inferior angle and lower part of the rim of the glenoid cavity. The center for the body appears in the eighth intrauterine week. In most persons, ossification starts in the coracoid process in the first year of life. The coracoid process joins the rest of the scapula at about the 15th year. At or after puberty, ossification also occurs in sub coracoid part, lower part of glenoid cavity, in the acromion process and medial border. The upper third of glenoid cavity is ossified from sub coracoid center. In males this unites with rest of scapula at 17th year and in females at 14th year. By 20th year, the various epiphyses have all joined the scapula [23].

Scapula is a flat bone. Near it superior border it provide attachment to levator scapulae, supraspinatus, inferior belly of omohyoid and subscapularis muscle. Scapular attachment of levator scapulae on medial border extend from superior angle to medial end of scapular spine. Subscapularis arises from medial two third of the costal surface of the scapula.

Scapula provides attachment of various muscles that act on the shoulder girdle and shoulder joint. Traction and forced applied by these muscle near the superior border may modify the shape of SSN. That lies near the junction of subcoracoid epiphysis and body of the scapula and this area completely ossified in 14th year in the female and the 17th year in the male [23].

CONCLUSION

Knowledge about anatomical variations of SSN is helpful for considering the location and source of entrapment syndrome. Variation in morphometry in left and right sided scapula as well as in different shapes of scapula could be expected. As scapula is a flat bone and various muscles are attached to it, traction force applied by these muscles during movement of shoulder girdle and shoulder joint may lead to some variation in the morphology of scapula. The knowledge of this variations would be helpful during surgical and arthroscopic shoulder procedures. The sample size of human scapula was relatively limited in the present study, so there is scope for further studies focusing on clinical and radiological correlations.

ACKNOWLEDGEMENTS

We sincerely thank the Heads of Department of Anatomy of GMERS Medical College, Sola and Gandhinagar for granting permission to carry out this study.

REFERENCES


