Morphometric study of suprascapular notch

Vandana R, Sudha Patil

Assistant Professor, Associate Professor, Department of Anatomy, Navodaya Medical College, Raichur, Karnataka

Abstract

**Background and aims:** Suprascapular nerve may be compressed anywhere along its course but most commonly at the level of SSN (suprascapular notch) and spinoglenoid notch. The variation in the morphological and morphometric features of SSN, spinoglenoid notch, therefore plays a crucial role in the suprascapular nerve entrapment syndrome. The purpose of present study was to determine the variation in morphology and dimensions of SSN and to determine posterosuperior and posterior limits of safe zone for shoulder joint procedures from posterior approach. **Material & methods:** We conducted study on 134 dry scapulae of north Karnataka region and classified the SSN into various shapes according to Iqbal et al and I-VI types based on description by Natsis et al, along with this, the mean distance from the SSN to supraglenoid tubercle and the mean distance between posterior rim of glenoid cavity and medial wall of spinoglenoid notch at the base of scapular spine were also measured. **Results:** Based on Iqbal et al classification, 'U' shaped notch found to be most common (35%) whereas least common was W shaped (0.7%). The incidence of complete ossification of STSL was 12.6%. Based on Natsis classification most common was type II (TD>VL) seen in 69% and least common was type VI (notch & foramen) 0%. The mean distance from SSN to supraglenoid tubercle was 27.3 mms ± 1.7 and mean distance between posterior rim of glenoid cavity and medial wall of spinoglenoid notch at the base of scapular spine was 13mms ± 0.2 which are comparatively less than the other population studies which are mentioned in the article. **Conclusions:** There are variations in the shape and size of SSN and safe zone critical distance in different populations so it requires still more population specific studies on suprascapular notch.

**Key-words:** nerve entrapment, superior transverse scapular ligament.

Introduction

Suprascapular nerve entrapment syndrome is relatively uncommon but significant cause of shoulder pain and dysfunction which was first described by Kopell and Thompson in 1959. There are several potential causes of nerve entrapment along its path particularly at the vulnerable suprascapular and spinoglenoid notches, where nerve excursion is limited by bony and ligamentous constraints. Traction neuropathy may occur following excessive nerve excursion during overhead sports.

However the literature focusing on suprascapular notch and suprascapular nerve entrapment in Indian population is scarce. So the study is undertaken to enlighten our knowledge regarding suprascapular notch.

**Material and methods**

Present study was conducted on 134 dry scapulae in the Department of Anatomy of Navodaya Medical College, Raichur, Karnataka. The following parameters were used:

1. Shape of suprascapular notch on visual observation
2. Dimensions of notch-superior transverse diameter & vertical length
3. Distance between SSN and supraglenoid tubercle
4. Distance between posterior rim of glenoid cavity & medial wall of spinoglenoid notch at the base of scapular spine.

Shape of suprascapular notch was recorded on gross examination and classified into various types as proposed by Iqbal et al. Representative photographs of various...
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notch types were taken using digital camera (Fig.1, a-h).

Dimensions of SSN like superior transverse diameter & vertical length of notch were measured in millimeters (mms) using sliding Vernier caliper & SSN were classified into 5 types based on Natis classification⁴. Scapulae with indentation, absence of notch and complete ossification of STSL were excluded from measurement (Fig.2).

Distance between deepest point of SSN & supraglenoid tubercle were taken in millimeters but scapulae with absence SSN were excluded from this measurement (Fig.3-1).

Distance between posterior rim of glenoid cavity & medial wall of spinoglenoid notch at the base of scapular spine was measured in millimeters (Fig.3-II).

Results
In present study 134 scapulae were analyzed for various parameters as mentioned.

Table 1 shows classification of shapes of SSN according to Iqbal et al to which we added partial and complete ossification of STSL. One scapula with W shaped notch which has not been mentioned in literature previously was noticed in the present study. (Fig.1-h).

Table-2 shows classification of SSN according to Natis et al. For these measurements scapulae with indentation and partial ossification of SSN were excluded.

Table-3 shows the distances between SSN and supraglenoid tubercle & distance between the posterior rim of glenoid cavity and the base of scapular spine in mms.

Discussion
Scapula has complicated anatomy because of its own unique structure. Knowledge of detail anatomy of scapula is necessary for surgical treatment of shoulder joint disorders and arthroscopic procedures on shoulder joint⁴. However there are very limited studies for quantitative anatomy of scapula in the literature. In the present study we have made an effort to classify SSN based on its shape and dimensions.

Various authors have reported about different shapes of SSN. Ticker et al in 1998, Bayramoglu et al in 2003, Sinkeet et al in 2010 have classified SSN into only two types - U & V. All of them have found 'U' shaped SSN as most common type ⁴.⁷.⁸.

Iqbal et al in 2010 & Gargi et al in 2012 have classified SSN into five types namely U, V, J, Indentation

<table>
<thead>
<tr>
<th>Shape</th>
<th>No. of Scapulae</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td>47(35.5%)</td>
</tr>
<tr>
<td>J</td>
<td>46(34.3%)</td>
</tr>
<tr>
<td>V</td>
<td>7(5.2%)</td>
</tr>
<tr>
<td>W</td>
<td>1(0.7%)</td>
</tr>
<tr>
<td>Indentation</td>
<td>6(4.5%)</td>
</tr>
<tr>
<td>Absent</td>
<td>6(4.5%)</td>
</tr>
<tr>
<td>Partial Ossification</td>
<td>4(3%)</td>
</tr>
<tr>
<td>Complete Ossification</td>
<td>17(12.6%)</td>
</tr>
<tr>
<td>Total</td>
<td>134</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>No. of Scapulae</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (Absence)</td>
<td>6(4.8%)</td>
</tr>
<tr>
<td>II (Td&gt;Vi)</td>
<td>87(70.1%)</td>
</tr>
<tr>
<td>III (Vb&gt;Td)</td>
<td>10(8%)</td>
</tr>
<tr>
<td>IV (Td=Vi)</td>
<td>4(3.2%)</td>
</tr>
<tr>
<td>V (Bony Foramen)</td>
<td>17(13.7%)</td>
</tr>
<tr>
<td>VI (Notch And Foramen)</td>
<td>0(0%)</td>
</tr>
<tr>
<td>Total</td>
<td>124</td>
</tr>
</tbody>
</table>
Table 3: Showing the distances between SSN and supracleoid tubercle & distance between the posterior rim of glenoid cavity and the base of scapular spine in mm.

<table>
<thead>
<tr>
<th>Shape</th>
<th>Frequency</th>
<th>Mean Length ± SD (AB)</th>
<th>Range</th>
<th>Mean Length ± SD (CD)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td>47</td>
<td>28.7 ± 2.8</td>
<td>24-38</td>
<td>13.3 ± 1.8</td>
<td>9-17</td>
</tr>
<tr>
<td>J</td>
<td>46</td>
<td>28.9 ± 3.3</td>
<td>19-34</td>
<td>13.2 ± 2</td>
<td>8-18</td>
</tr>
<tr>
<td>V</td>
<td>7</td>
<td>26.6 ± 2</td>
<td>24-30</td>
<td>13.1 ± 2.2</td>
<td>11-18</td>
</tr>
<tr>
<td>Indentation</td>
<td>6</td>
<td>-</td>
<td>-</td>
<td>12.8 ± 2</td>
<td>9-15</td>
</tr>
<tr>
<td>W</td>
<td>1</td>
<td>24 ± 0</td>
<td>-</td>
<td>13 ± 0</td>
<td>-</td>
</tr>
<tr>
<td>PO</td>
<td>4</td>
<td>28.2 ± 2.2</td>
<td>25-31</td>
<td>13 ± 0.7</td>
<td>12-14</td>
</tr>
<tr>
<td>CO</td>
<td>17</td>
<td>27.4 ± 2</td>
<td>23-31</td>
<td>13 ± 2.3</td>
<td>9-17</td>
</tr>
<tr>
<td>ABSENCE</td>
<td>6</td>
<td>-</td>
<td>-</td>
<td>12.5 ± 1.9</td>
<td>10-15</td>
</tr>
</tbody>
</table>

**Abbreviations: AB - Distance between deepest point of SSN and supracleoid tubercle. CD - Distance between the posterior rim of glenoid cavity and the base of scapular spine. SD - Standard deviation.**

Fig. 1 showing various shapes of SSN: a- U Shape; b- J Shape; c- V Shape; d- Indentation; e- Absence of notch; f- Partial ossification of STSL; g- Complete ossification of STSL; h- W shape.

**Abbreviations: CO- Complete ossification; PO- Partial ossification; SSN- Supracleoid notch; STSL- Superior transverse scapular ligament; TD- Transverse diameter; VL- Vertical length.**

and Absence. Iqbal et al have found 'T' shaped as most frequent type (22%) and indentation as least common type (2.6%) among 200 scapulae. Gargi found 'U' shaped as most frequent type (58%) and absence notch as least frequent type (2%) among 100 scapulae. In present study, 'U' shaped SSN was commonest type (35%) whereas scapulae with indentation (4.5%) and absence of SSN (4.5%) were least common. We found one scapula with 'W' shaped SSN during our study (Fig. 1-h). This type of SSN has not been mentioned in the literature previously. Dunkelgrun et al have opined that the 'U' shaped notches are of larger area than the V shaped notches, leading to the assumption that a 'V' shaped notch is more likely to be related with nerve entrapment. The variability in the shapes of SSN can
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Fig. 2: Measurements of dimensions of SSN. a. Superior Transverse Diametre of SSN b. Vertical length of SSN

Fig. 3: I - Distance between deepest point of SSN and supragnoid tubercle. II - Distance between posterior rim of glenoid cavity and medial wall spinoglenoid notch at base of sapular spine

be explained by the fact that the shape of the notch is influenced by ossification of coracoid process.

Variation in morphology of STSL which includes its partial or complete ossification is one of the predisposing factors for suprascapular nerve entrapment syndrome. The incidence of complete ossification of STSL varies widely in different populations, in French population it was found in 5 to 6% of scapulae, American population it was 4% and 5%, 7.3% among Greek population, 4% in Kenyan population, 7% in Polish population and 3% among Chinese population.

In 2012, Gargi et al found complete ossification of STSL in 3% of north west Indian population. Present study carried out on South Indian (North Karnataka) sample showed much higher incidence of complete ossification of STSL amounting to 12.6%. This indicates that there are differences in different population, therefore population specific studies are required to know the incidence of complete ossification of STSL. Incidence of partial ossification was 18% in Kenyan population, 18% in North American population, 11% in Greek population and 15% in North West Indian population.

In the present study it was 3% which is much lower compared to above studies.

SSN were also classified into various types by many authors depending on the dimensions. Natsis et al described 5(five) types where type II (TD > VL) and type III (VL > TD) were commonest both having equal frequency i.e. 41.8% whereas least common type was type VI (Notch & foramen) 0.75%. Ticker et al, Gargi et al and Wang et al have found most common type was type II (TD > VL) having incidence 33%, 72% & 58.16% respectively and least common was type VI (Notch & foramen) having incidence of 1.27%, 0% & 0% respectively.

Polguy et al in his classification has included one more type i.e. SSN with TD = VL and excluded type VI (notch & foramen). The most common type he found was type II (57.7%) and least common was type IV (2.3%). Rengachary et al found most common notch having VL > TD (48%) and least common was bony foramen (4%). In present study we have classified SSN into 6(six) types (table-2) where we found the most common being type II (69%) and least common was type VI (0%).

The distance between SSN and margin of glenoid cavity is critical during open surgical procedures requiring dissection of shoulder joint from posterior approach. An effort to avoid injury to suprascapular nerve during procedures has lead to the descriptions of "safe zone" critical distance within which these procedures can be done safely. Shishido et al in 2001 and Sinkeet al in 2010 have reported the mean distance between SSN and supragnoid tubercle as 23 mm and 28.7 mm respectively. In the present study the corresponding distance was 27.3 mm ± 1.7. Sinkeet observed longest distance in 'V' shaped notch (30.1 mm) and shortest distance in symmetrical 'U' shaped notch (27.3 mm). In present study the largest distance was observed in 'T' shaped notch (28.9 mm ± 3.3) and least in 'V' shaped notch (26.6 mm ± 2).
Shishido et al\textsuperscript{2} and Sinkeet et al\textsuperscript{9} have reported the average distance between posterior rim of glenoid cavity and medial wall of spinoğlenoid notch at the base of scapular spine as 14 mm and 15.8 mm respectively. Corresponding distance in our study is 13 mm ± 0.2. Regarding notch and safe zone dimensions, 'V' shaped notch is having less safe zone distance. So one has to be cautious of possibility of suprascapular nerve injury during shoulder procedures in dealing scapula with 'V' shaped SSN. Sinkeet et al\textsuperscript{9} have found posterior superior (distance between deepest point of SSN to suprascapeni tubercle) and posteri(om)distance between posterior rim of glenoid cavity & medial wall of spinoğlenoid notch at the base of scapular spine) safe zone distances for shoulder surgery as 28.7 mm and 15.8 mm in Kenyan population but in our study the corresponding distances were 27.3 mm ± 1.7 and 13 mm ± 0.2, which are comparatively less than the above studies. Our findings call for extra caution for surgeons operating on shoulder joint in our population.

Conclusion

There are variations in the shape and size of SSN and safe zone critical distance in different populations so it requires still more population specific studies on suprascapular notch.

References


Address for communication :
Dr. Vandana R.
Assistant Professor of Anatomy
Navodaya Medical College, Mantralayam Road,
Raichur - 584 103. Karnataka.
e-mail ID : drvandanar@gmail.com
Mobile : 09880328506.