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Original Article

# Morfometrical and morphological analysis of the suprascapular notch with multidetector computerized tomography

*Musa Acar* [a,*], *Tuba Şimşek* [a], *Serpil Acar* [b], *Duran Efe* [c], *Mahinur Ulusoy* [d]

[a] *Mevlana University, Department of Physical Therapy and Rehabilitation, Konya, Turkey*
[b] *Konya Numune Hospital, Department of Physical Therapy and Rehabilitation, Konya, Turkey*
[c] *Mevlana Üniversity, Faculty of Medicine, Department of Radiology, Konya, Turkey*
[d] *Mevlana Üniversity, Faculty of Medicine, Department of Anatomy, Konya, Turkey*

ARTICLE INFO

*Article history:*
Received 22 February 2014
Accepted 18 May 2014
Available online 11 June 2014

*Keywords:*
Morphology
Shoulder
Suprascapular notch
Variation

ABSTRACT

*Introduction:* Suprascapular notch is situated in lateral section of margo superior of scapula as adjacent to substratum of processus coracoideus. Suprascapular nerve compression is characterized with chronic localized pain spreading to shoulder posterior and/or lateral areas, to under brachion and into the neck; and with weakness in shoulder abduction, and also atrophy of supraspinatus and infraspinatus muscles. In our study, we aimed to exhibit notch suprascapularis morphology and the variations of this structure which creates an important passage for suprascapular nerve.
*Methods:* This study was conducted on 100 patients (35 females–65 males). Average age of individuals included into the study was 17–87 years.
*Results:* The morphological study of the suprascapular notch revealed six different types of notches.
*Discussion:* The data we have obtained in our study are important to constitute a reference space of Turkish society. Furthermore, the fact that the differences between genders and right-left are exhibited will be helpful for surgeons who perform surgery in this region. Therefore, we conclude that the exhibited results will provide a better detail of information regarding morphometry of suprascapular notch and will aid in diagnosing and surgical treatment for shoulder pain.


## 1. Introduction

Suprascapular notch is situated in lateral section of superior margin of scapula as adjacent to substratum of coracoid process. This notch is closed, from top by, superior transverse scapular ligament; and converted into a holeforme; and creates a passage for suprascapular nerve. The suprascapular nerve and veins move forward and backward within the structure.[1,2]

* *Corresponding author*. Tel.: +90 5054348893; fax: +90 3322411111.
E-mail address: macar@mevlana.edu.tr (M. Acar).
http://dx.doi.org/10.1016/j.jasi.2014.05.005

Suprascapular nerve is a peripheric nerve that ascends from C5–C6 nerve roots, and separates from the upper truncus of brachial plexus, and has motor and sensory sarcostyles. It passes from suprascapular notch to back of scapula; and goes-ahead in fossa supraspinatus; and provides motor innervation of supraspinatus muscle and infraspinatus muscle.[3] The sense branch of the supraspinatus nerve takes the sense of shoulder joint and acromioclavicular joint.[4]

Suprascapular nerve compression is characterized with chronic localized pain spreading to shoulder posterior and/or lateral areas, to under brachion and into the neck; and with weakness in shoulder abduction, and also atrophy of supraspinatus muscle and infraspinatus muscle.[2] It is stated, in literature, that entrapment neuropathies of suprascapular nerve occur in two points such as suprascapular notch and supraglenoid notch.[5] Suprascapular notch is the most important point along with suprascapular nerve; because this region is the main place of suprascapular nerve compression and pain.[2] Reasons of approximately 1–2% of all shoulder pains depend on neuropathy of suprascapular nerve, and for this reason, it may be overlooked in differential diagnosis of shoulder ailments. Supraspinatus nerve compression was described by Kopel and Thomson, at first. They reported that traction is applied on suprascapular nerve at shoulder abduction and horizontal abduction, and superior transverse scapular ligament compresses on the nerve.[6] Furthermore, the fact that the region anatomy is well known is an important factor to prevent possible neurological complications during the surgical intervention applied on shoulder region.[7]

In our study, we aimed to exhibit suprascapular notch morphology and the variations of this structure which creates an important passage for suprascapular nerve. Furthermore, by carrying out some morphometric measurements for suprascapular notch, we aimed to determine better its localization. Thus, we think that the data that we are exhibiting here may be useful for radiology, orthopedics and neurology specialists in diagnostic and treatment of shoulder pains.

## 2. Material and methods

This study was conducted on 100 patients (35 females–65 males) who were referred to Radiology Department of Mevlana (Rumi) University, Faculty of Medicine for thorax computed tomography (CT) in the year 2013. Images were obtained from the patients with no shoulder pain and whose scapulas could be imaged completely through multidetector computed tomography (MDCT). Totally 200 scapulas including 100 right and 100 left scapulae were examined. Average age of female individuals included into the study was 17–87 years and age average of male individuals included into the study was 17–85 years.

In first stage of the study; patients who previously consulted the hospital and underwent MDCT of scapula by using 64 slice-MDCT system (Siemens Somatom Sensation, Erlanger, Almanya, 2005) were identified.

Then, after the morphological evaluations on suprascapular notch typologies were registered. The measurement was performed on suprascapular notch. Measurements were designed as follows:

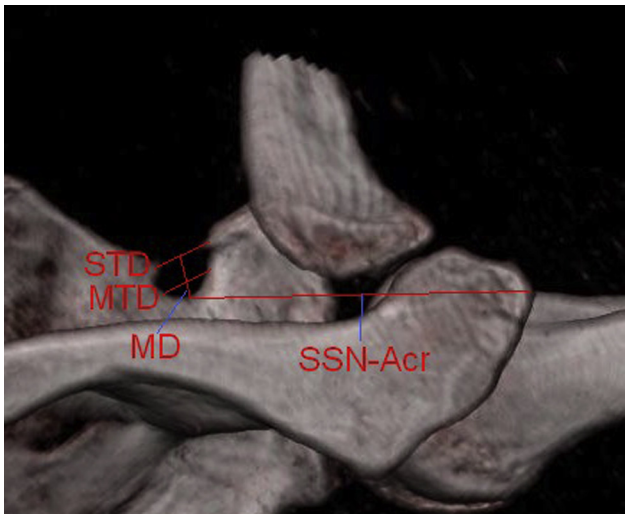


**Fig. 1 – Measurements of the suprascapular notch: STD: superior transverse diameter; MTD: middle transverse diameter; MD: maximal depth; SSN-Acr: distance between suprascapular notch and the acromion.**

The superior transverse diameter (STD): The maximum dimension of the horizontal measurements taken in the horizontal plane between corners of the SSN on the superior border of the scapula (Fig. 1).

The middle transverse diameter (MTD): The dimension of the horizontal measurements taken in the horizontal plane between opposite walls of the SSN at half the dimension of MD, perpendicular to it (Fig. 1).

The maximal depth (MD): The maximum dimension of the longitudinal measurements taken in the vertical plane from an imaginary line between superior corners of the notch to the deepest point of the suprascapular notch (Fig. 1).

The distance between suprascapular notch and the supraglenoid tubercle (SSN-ST): The distance between deep-middle point of suprascapular notch and the beginning point of supraglenoid tubercle was measured on the vertical plane (Fig. 2).

The distance between suprascapular notch and the acromion (SSN-Acr): The distance between deep-middle point of suprascapular notch and the front-lateral corner of acromion was measured on the vertical plane (Fig. 1).

In the third stage of our study, the obtained data were analyzed with S.P.S.S. 14.0 (Statistical Package for the Social Sciences) packed programme. The obtained data are expressed as mean ± SD and percentage. Normal distribution assumption was evaluated by using Kolmogorov–Smirnov test. Student-t test was used to compare groups, Pearson correlation test was used for relation between parameters.

## 3. Results

The morphological study of the suprascapular notch revealed six different types of notches. The intensity facts named (1) type A1 (Fig. 3) – in which MD is bigger than STD and MTD is


**Fig. 2 – Measurements of the suprascapular notch: SSN-ST: distance between suprascapular notch and the supraglenoid tubercle.**

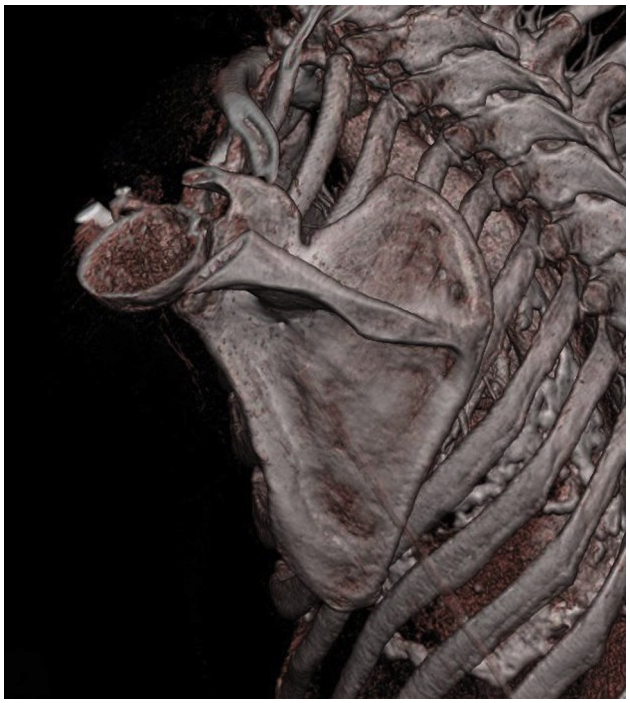

**Fig. 4 – Classification of the suprascapular notch; Type A2.**

bigger than MD – was recorded as 5.5%; (2) type A2 (Fig. 4) – in which MD is bigger than STD and MD is bigger than MTD – was recorded as 6.5%; (3) type B1 (Fig. 5) – in which STD is bigger than MD and MTD is bigger than MD – was recorded as 1%; (4) type B2 (Fig. 6) – in which STD is bigger than MD and MD is bigger than MTD - was recorded as 72.5%; (5) type C (Fig. 7) – in which the facts of suprascapular transverse ligamentum is ossified, and also the suprascapular notch is converted into a hole – was detected as 10%; (6) Type D (Fig. 8) – in which no suprascapular notch was observed – was recorded 4.5%. Distribution of morphological classification belonging to suprascapular notch as per genders and lateralization is given, in detail, in Table 1.

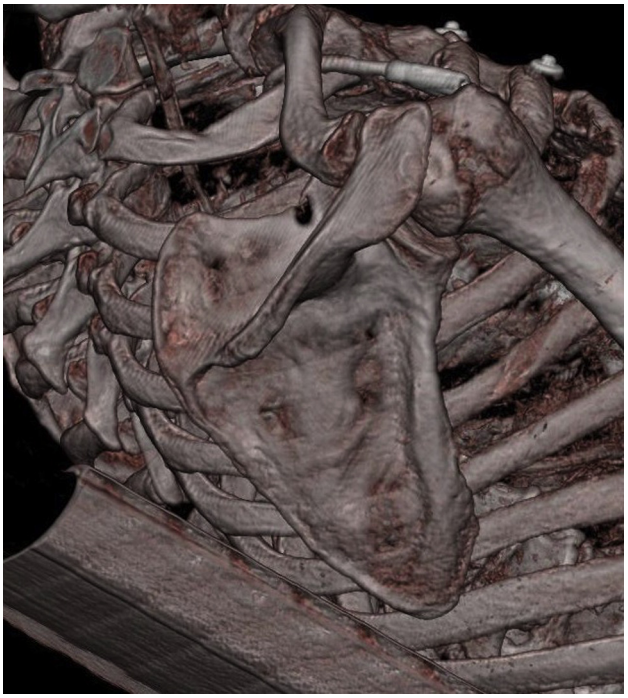

**Fig. 3 – Classification of the suprascapular notch; Type A1.**

**Fig. 5 – Classification of the suprascapular notch; Type B1.**

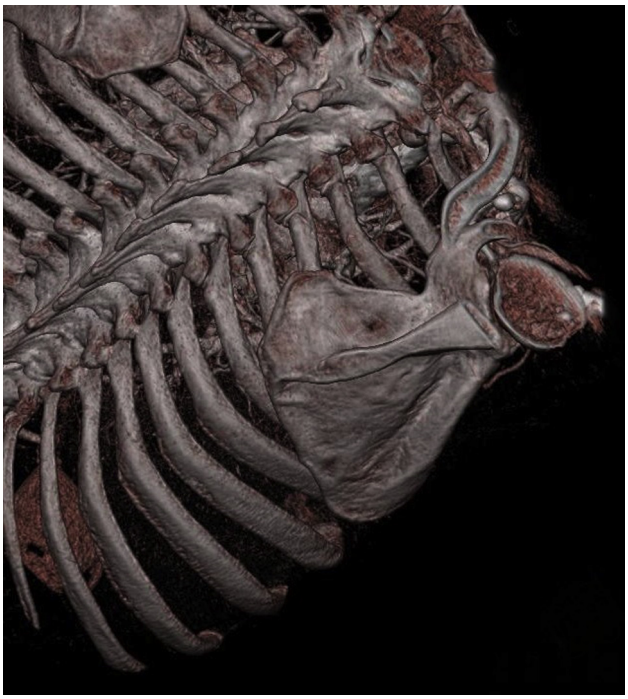

**Fig. 6 – Classification of the suprascapular notch; Type B2.**

**Fig. 8 – Classification of the suprascapular notch; Type D.**

Right-hand and/or left-hand scapulas of 19 of 100 patients included into the study take place in type III or type IV classification. 81 patients taking place in other classes were included into the morphometric measurements because of parameters of suprascapular notch were not observed on these patients. As a result of morphometric measurements we carried out, STD was detected at women as 11.24 ± 3.58 mm; as for at men it was detected as 12.74 ± 4.46 mm. While MTD in women as 8.00 ± 2.15 mm, and in men as 9.11 ± 2.26 mm are detected, MD in women was recorded as 7.14 ± 1.84 mm, and in men as 8.14 ± 2.21 mm. SSN-ST in women as 29.72 ± 2.70 mm, and in men as 32.16 ± 4.39 mm were found. As for SSN-ACR in women as 54.97 ± 6.85 mm, and in men as 59.40 ± 5.77 were recorded. Difference between average values of genders was found statistically significant ($p < 0.05$) in also all of parameters (Table 2). Values of these parameters were recorded in right-hand and left-hand separately (Table 3); and detected that the difference, in respect of statistics, between these values is significant in STD only, but not significant for other parameters ($p > 0.05$).

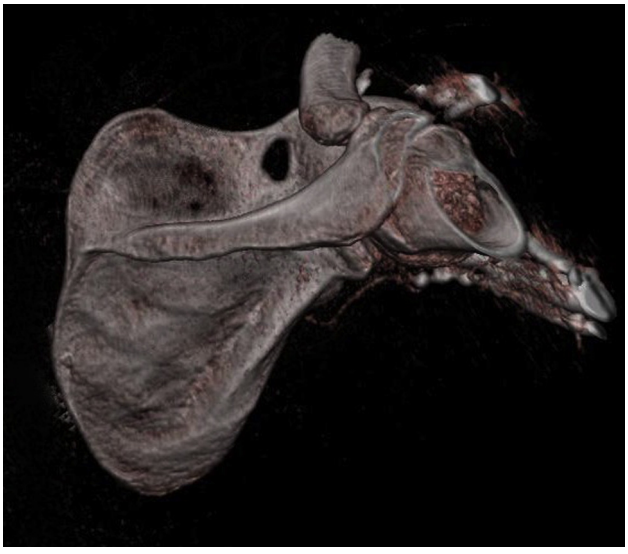

**Fig. 7 – Classification of the suprascapular notch; Type C.**

## 4. Discussion

The most important passage in which suprascapular nerve is compressed is suprascapular notch. For that reason, anatomical variations of suprascapular notch play a major role in suprascapular nerve compressions.[6] Because of this, its clinical significance, suprascapular notch typing was made, in the literature, by many researchers.[1,2,4,5,8] Suprascapular

**Table 1 – The distribution of types of scapular notch.**

| | Female ($n = 88$) | | Male ($n = 112$) | | Total |
|---|---|---|---|---|---|
| | Right | Left | Right | Left | |
| Type A1 | 2 | 3 | 3 | 3 | 11 |
| Type A2 | 1 | 3 | 5 | 4 | 13 |
| Type B1 | – | 1 | – | 1 | 2 |
| Type B2 | 35 | 32 | 38 | 40 | 145 |
| Type C | 4 | 3 | 7 | 6 | 20 |
| Type D | 2 | 2 | 3 | 2 | 9 |
| Total | 44 | 44 | 56 | 56 | 200 |

**Table 2 – Comparison of the obtained data according to gender (mean ± SD) (mm).**

| Parameters | Female ($n = 35$) | Male ($n = 46$) | P |
|---|---|---|---|
| STD | 11.24 ± 3.58 | 12.74 ± 4.46 | <0.05 |
| MTD | 8.00 ± 2.15 | 9.11 ± 2.26 | <0.05 |
| MD | 7.14 ± 1.84 | 8.14 ± 2.21 | <0.05 |
| SSN-ST | 29.72 ± 2.70 | 32.16 ± 4.39 | <0.05 |
| SSN-Acr | 54.97 ± 6.85 | 59.40 ± 5.77 | <0.05 |

**STD:** superior transverse diameter; **MTD:** middle transverse diameter; **MD:** maximal depth; **SSN-ST:** distance between suprascapular notch and the supraglenoid tubercle; **SSN-Acr:** distance between suprascapular notch and the acromion.

notch was divided into 3 types in 1942, at first, as shallow, medium and deep depending on observation.[2] Ticker[9] et al divided suprascapular notch into 3 types as V shaped type and U shaped type and superior transverse scapular ligament was ossified type. Ticker[9] et al who explained that this classification is subjective divided suprascapular notch into its types by carrying out a lot of measurements. In this study, the type of which MD is bigger than STD is named as type I; and the type of which STD, MTD and MD are equal is named as type II; and the type of which MD is lesser than STD is named as type III, and the type of which superior transverse scapular ligament was ossified and its suprascapular notch turned into foramen is named as type IV; and also the type of which suprascapular notch could not be detected is named as type V. Furthermore, those shapes as type I and type III were divided into subgroups. According to this, those of which STD is lesser than its MDT separated as subgroup A; and those with equal STD and MDT separated as subgroup B; and those STD is bigger than its MDT separated as subgroup C. In the same study, while type III became the most encountered group with 56.16%; the type II became the least encountered group with 1.95%. In this study, type I has been detected as 24.18%; and type IV has been detected as 4.72%; and type V has been detected as 12.99%. No fact of any two or three of STD, MTD and MD values are equal was encountered in our study. The intensity of facts we named as type A1 in our study was recorded as 5.5%; and the intensity of facts we named as type A2 was recorded as 6.5%; and the intensity of facts we named as type B1 was recorded as 1%; and the intensity of facts we named as type B2 was recorded as 72.5%. The intensity of facts we named as type C was recorded as 10%; and the intensity of facts we named as type D was recorded as 4.5%. While type B which is the most encountered in our study similar to Polguj[6] et al detected as 73.5%; no type of STD, MTD and MD values are equal was encountered in our study. Type A has been detected as 12%; and type C has been detected as 10%; and type D has been detected as 4.5%.

**Table 3 – Comparison of the obtained data according to lateralization (mean ± SD) (mm).**

| Parameters | Right ($n = 81$) | Left ($n = 81$) | P |
|---|---|---|---|
| STD | 12.78 ± 4.39 | 11.40 ± 3.83 | <0.05 |
| MTD | 8.87 ± 2.28 | 8.39 ± 2.70 | >0.05 |
| MD | 7.98 ± 2.20 | 7.44 ± 1.98 | >0.05 |
| SSN-ST | 31.20 ± 4.36 | 31.01 ± 3.47 | >0.05 |
| SSN-Acr | 58.4 ± 6.24 | 56.57 ± 6.88 | >0.05 |

**STD:** superior transverse diameter; **MTD:** middle transverse diameter; **MD:** maximal depth; **SSN-ST:** distance between suprascapular notch and the supraglenoid tubercle; **SSN-Acr:** distance between suprascapular notch and the acromion.

It is said that suprascapular nerve entrapments are related to suprascapular notch. Notch depth and diameter are important in suprascapular nerve compressions. Small suprascapular notch creates more risk than big notches during forming of suprascapular nerve entrapments.[5] The second important factor in formation of entrapment neuropathy is geometry of suprascapular nerve motion area. Because the microtraumas that may occur in each motion may cause to nerve neuropathy.[2]

Polguj[6] et al measured STD, MTD and MD parameters in their study; and recorded these values as 7.48 ± 1.99 mm, 6.91 ± 1.62 mm and 5.91 ± 2.13 mm respectively. Albino[8] et al recorded the STD value as 9.3 mm in men, and as 9.4 mm in women; and also the MD value as 6.1 mm in men, and as 5.8 mm in women; and reported that the difference between these averages is not significant statistically. Polguj[2] et al detected, in their study, that STD value is 8.74 ± 1.87 mm in women, and 8.5 ± 3.11 mm in men; and MTD value is 10.06 ± 3.63 mm in women, and 10 ± 4.02 mm in men; and also MD value is 6.75 ± 2.23 mm in women, and 8.31 ± 3.29 mm in men. When they compared these results between genders, they reported that average difference between MD value is statistically significant only. In our study, STD was detected as 11.24 ± 3.58 mm in women, and as 12.74 ± 4.46 mm in men. While MTD in women as 8.00 ± 2.15 mm, and in men as 9.11 ± 2.26 mm are detected, MD in women was recorded as 7.14 ± 1.84 mm, and in man as 8.14 ± 2.21 mm. The findings we have found are not in harmony with the results in the literature. The difference between genders belong to values we have found is significant in respect of statistics.

Suprascapular notch is an important reference point for suprascapular nerve during arthroscopic shoulder operations. The distance between suprascapular notch and glenoidal cavity has critical importance during operations to be applied to posterior of shoulder joint. Known of anatomic details of the present structures along with the suprascapular nerve is important for more understanding of entrapment neuropathies.[1,10] Sangam[1] et al recorded that the distance between glenoid cavity and suprascapular notch is 29.06 ± 2.9 mm. Sinkeet[10] et al recorded this value as 28.74 ± 3.8 mm. In our study, SSN-ST has been found in women as 29.72 ± 2.70 mm, and as 32.16 ± 4.39 mm in men. The results we have obtained are in harmony with the results stated in the literature.

This nerve may be affected during the operations in relation to the posterior of shoulder joint, not withstanding suprascapular nerve lacerations are encountered rarely. Therefore, localizing of the place of suprascapular nerve is significantly important in order to prevent surgical complications. Knowing the average distance of some facial anatomic landmarks belong to shoulder to suprascapular notch which is passage place of the nerve gives great advantage to localize the place of the nerve.[11] Terra[11] et al recorded, in their study, that the distance of suprascapular notch to acromion anterolateral edge is 61 mm. Our study, this distance has been recorded as 54.97 ± 6.85 mm in women, and 59.40 ± 5.77 mm in men. It has been recorded that the fact that

the difference between two genders is statistically significant. The results we have obtained in our study are in harmony with the results of Terra[11] et al.

## 5. Conclusion

One of the most important ways of preventing nerve injuring which is too serious surgical complication is to be able to estimate the places where the nerve passes by knowing anatomic details of the region. The data we have obtained in our study are important to constitute a reference space of Turkish society. Furthermore, the fact that the differences between genders and right-left are exhibited will be helpful for surgeons who are interested in the region. Therefore, we believe in that the data we have exhibited in our study are guiding data in medical education, in diagnosis and in surgical treatment.

## Conflicts of interest

All authors have none to declare.

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