Morphometric study of Suprascapular Notch and its relation to scapular dimensions with assessment of the safe zone in Egyptian dry scapulae

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ABSTRACT

Background: limited knowledge about anatomical variations is one of the causes of unexplained symptoms and under or maltreated conditions. The suprascapular nerve may be trapped in the suprascapular notch(SSN) causing a disabled limb. Studying the variations and the dimensions of the suprascapular notch is crucial clinically regarding the diagnosis and management of suprascapular nerve injuries.
Aim: Determination of the variation in the morphology of the suprascapular notch in Egyptian dry scapulae.
Material and Methods: The study was carried out on 55 dry adult scapulae of unknown sex. Suprascapular notch measurements and scapular dimensions morphometry were carried out.
Results: Type II is the most prevalent (47.3%) among the examined Egyptian scapulae, followed by type III (29.1%).
Conclusion: The present study delivers data about the type, morphology, and dimensions of the suprascapular notch in Egyptian dry scapulae along with the safe zone and the scapular dimensions.
Keywords: Suprascapular notch, SSN safe zone, SSN measurements, Scapular measurements.

INTRODUCTION

The upper border of the scapula contains a notch (SSN) which gives a bath for the suprascapular nerve, adjacent to the base of the coracoid process. The transverse scapular ligament is attached to the corners of the notch converting it into a foramen. The suprascapular nerve passes under the ligament; while suprascapular vessels pass superficial to the ligament (1)

Entrapment could affect the suprascapular nerve leading to its affection; this can occur at the suprascapular notch or through the spinoglenoid notch, causing suprascapular nerve entrapment syndrome. Shoulder pain with supraspinatus and infraspinatus atrophy occur as a result of nerve entrapment (2). Knowing the anatomical variations of SSN, will help in reaching the diagnosis of shoulder pain cause and help surgeons to achieve the best surgery results by considering the safe zone for avoiding suprascapular nerve injuries during surgeries (3,4,5). Suprascapular nerve entrapment syndrome could be missed by clinicians due to the failure of imaging techniques to find positive findings (6).

The present study aimed to determine the variation in the morphology of the suprascapular notch in Egyptian dry scapulae. This study also provides data on the safe zone distance of the suprascapular notch and the root of scapulae from the margin of the glenoid cavity.

MATERIAL AND METHOD

Study design

The present study was carried out on 55 dried adult scapulae of unknown sex that were obtained from The Bone Bank, Department of Anatomy, Kasr Al-Ainy Medical School, Cairo, Egypt. Broken scapulae were excluded from the study. Suprascapular notch type and dimensions, safe zone for suprascapular nerve passage and the scapular dimensions were determined.

The SSN was classified into six types according to Rengachary’s classification (1) as follows: Type I, wide depression in the superior border of the scapula; Type II, wide blunted V shape; Type III, symmetric U shape; Type IV, very small V shape; Type V, partially ossified suprascapular ligament; Type VI, completely ossified suprascapular ligament (Fig.1). the number of different notch types was documented.

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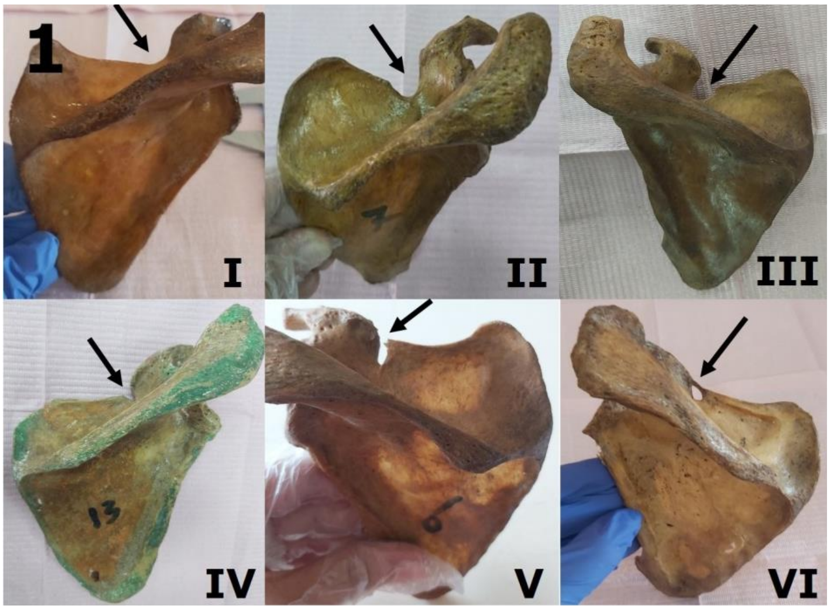

Fig. 1: Different types of Suprascapular notch according to Rengachary's classification.

The suprascapular notch of each scapula was measured for the following details according to Kachlik et al.(7) as shown in figure 2: **1) superior transverse diameter (STD)** – the horizontal distance between superior corners of the SSN; **2) lateral length (LL)** - the length between the deepest point in SSN and the lateral upper corner of the notch; **3) Medial length (ML)-** the length between the deepest point in SSN and the medial upper corner of the notch**; 4) Total circumferential diameter (TCD)-** the sum of the medial length, lateral length, and the STD of the notch; **5) middle transverse diameter (MTD)-** the distance between the side walls of the SSN at a mid-point of the maximal depth; **6) maximum depth (MD)** – the depth between the middle point of the STD and the deepest point of the suprascapular notch.

Fig. 2: Measurements of suprascapular notch: ***MTD: maximum transverse diameter, MD: maximum depth; ML: medial legth, LL: lateral length.***

Suprascapular notch measurements were measured in cm, using the Vernier caliper,then the date were tabulated (table 1).

Table (1): suprascapular notch dimensions measured in cm using the Vernier caliper

		STD	L.L	M.L	TCD	MTD	MD
type	II	1.29±0.4	0.86±0.31	0.58±0.28	2.72±0.7	0.84±0.33	0.63±0.27
	III	0.98±0.22	0.99±0.22	0.78±0.28	2.75±0.62	0.78±0.22	0.81±0.22
	IV	0.74±0.22	0.89±0.19	0.73±0.2	2.37±0.58	0.5±0.15	0.76±0.2
	V	0.22±0	1.21±0	0.97±0	2.4±0	0.71±0	0.9±0
	VI	0±0	0.66±0	0.34±0	1±0	0.59±0	0.51±0
P value		<0.001	0.328	0.103	0.103	0.123	0.162

Values are presented as mean ±SD; P-value ≤0.05 is significant

The scapular measurements were measured according to Gumina et al. (8) as shown in Figure 3, and the results were tabulated in Table 2, these measurements include:

(A) the safe zone for the passage of the suprascapular nerve; two safe limits are important:

- The posterior limit (M1) –measured distance lies between 2 points; the supraglenoid tubercle and the deepest point of the SSNe
- The posterosuperior limit (M2) – measured distance lies between the the posterior margin of the glenoid cavity and the medial extremity of the spino-glenoid notch.

(B) The scapular dimensions:

- The length of the scapula (M3) – the distance between the upper and lower angles of the scapula
- The width of the scapula (M4) – the distance between the lower margin of the glenoid cavity and the root of the spine of the scapula at the medial border.

Statistical analysis:

Data were coded and entered using the statistical package for the Social Sciences (SPSS) version 28 (IBM Corp., Armonk, NY, USA). Data was summarized using mean and standard deviation for quantitative variables and frequencies (number of cases) and relative frequencies (percentages) for categorical variables. Normality was double checked for using Shapiro-Wilk test and normality plots. Comparisons between groups were done using analysis of variance (ANOVA) with multiple comparisons Bonferroni post hoc test in normally distributed quantitative variables while the non-parametric Kruskal-Wallis test and Mann-Whitney test were used for non-normally distributed quantitative variables (7). Correlations between quantitative variables were done using Spearman correlation coefficient. P-values less than 0.05 were considered statistically significant (8).

Fig. 3: Measurements of scapular parameters: ***M1: posterior limit of safe zone; M2: posterosuperior limit of safe zone; M3: scapular length; M4: scapular width***

RESULTS

Prevalence of SSN types in Egyptian dry scapulae sample:

In the present study, by examining the frequencies and percentages of SSN types, type II is the most prevalent type (47.3%) among the examined Egyptian scapulae, followed by type III (29.1%). SSN is absent in 9.1% (type I). The superior transverse scapular ligament is completely ossified in 1.8% of cases with an absence of the notch (type VI) (Fig. 4).

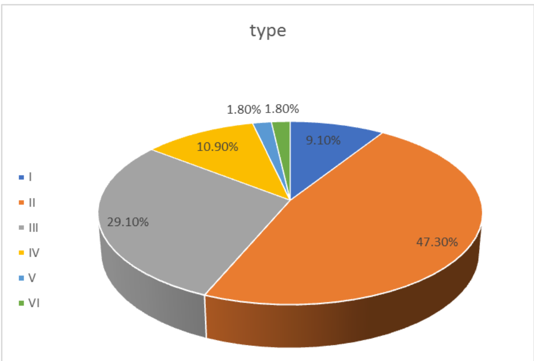

Fig. 4: A chart showing percentages of the different Suprascapular notch types

Relation of SSN dimensions with its type

- ***SSN type II showed the greatest superior transverse and middle transverse diameters:*** SSN type II showed the greatest superior transverse diameter (STD) which showed a highly significant difference between the various SSN types (p-value<0.001) where type II had the greatest measurement (1.29±0.4 cm) and type IV the least (0.74±0.22 cm); type V STD is not taken into consideration due to partial ossification of the ligament. Regarding the mean transverse diameter (MTD) type II also showed the highest record (0.84±0.33 cm) while type IV showed the least (0.5±0.15 cm); with no significant difference between groups. SSN type V showed the highest depth (MD) (0.9 cm) followed by type III (0.81±0.22 cm), type IV (0.76±0.2 cm), type II (0.63±0.27cm). TCD was greatest in type III and type II (2.75±0.62 cm, 2.72±0.7 cm respectively) and least in type VI (1 cm). Mean± SD of each parameter of SSN are shown in Table (1) and Fig. (5); it was found that type II and III notches have the greatest dimensions with a lower chance of nerve entrapment compared to type IV, V and VI.

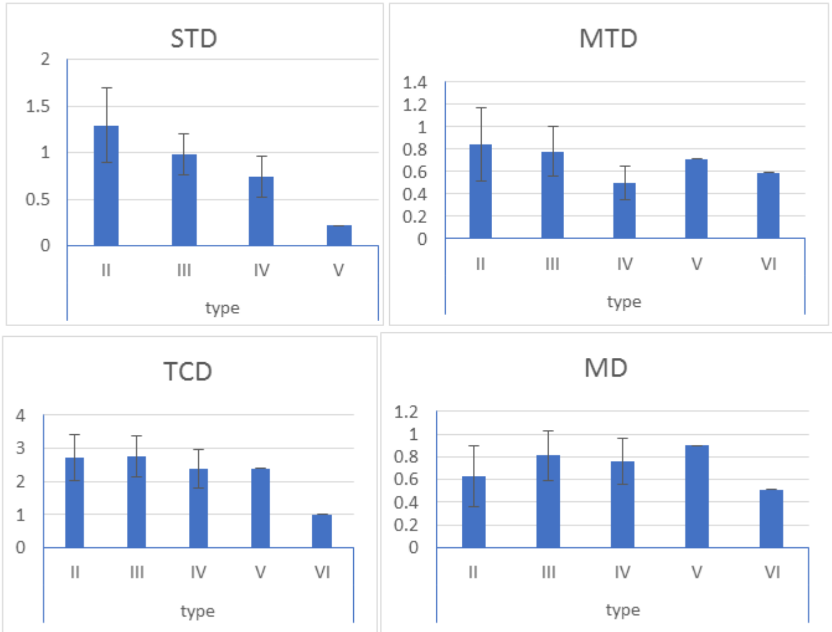

Fig. 5: Bar charts showing differences between Suprascapular notch types regarding STD, MTD, TCD &MD

- ***SSN type III has the greatest MD and glenoid length and Type VI showed the greatest M1 and greatest scapular width M4:*** The mean distance of the posterior limit (M1) for type VI SSN is 3.45±0 cm displaying the greatest measurement while for type I is 2.73±0.72 cm presenting the least with no significant difference between groups. The mean distance posterosuperior limit (M2) is 1.88±0.47 cm for type IV, 1.57±0 cm for type V and 1.58±0 cm for type VI with no significant difference between groups. Type III is shown to have the maximum scapular length of 14.91±1 cm and type I showed the minimal (12.95±1.05 cm) with a significant difference between groups (p=0.019). Type VI has the greatest scapular width (M4= 10.88±0) followed by type III (M4=3.81±0.31). glenoid width shows a significant difference between groups with the greatest for type VI followed by type III the type IV (p=0.030). Measurements of ‘safe zone’ distances and scapular in various types of notches are shown in Table 2.

Table (2): safe zone and scapular dimensions

		M1	M2	M3	M4	glenoid h.	glenoid w.
type	I	2.73±0.72	1.81±0.67	12.95±1.05	9.9±0.52	3.42±0.19	2.32±0.16
	II	3.16±0.29	1.67±0.21	14.59±1.05	10.61±0.96	3.74±0.31	2.64±0.24
	III	3.15±0.29	1.77±0.3	14.91±1	10.65±0.7	3.81±0.31	2.72±0.22
	IV	3.05±0.37	1.88±0.47	14.75±0.68	10.54±0.74	3.63±0.15	2.67±0.22
	V	2.8±0	1.57±0	14.6±0	9.5±0	3.8±0	2.42±0
	VI	3.45±0	1.58±0	14.58±0	10.88±0	3.85±0	2.79±0
P value		0.163	0.747	0.019	0.423	0.163	0.030

Values are presented as mean ±SD. P-value ≤0.05 is significant

- ***Correlations between M4 and other parameters (M1, M2, STD,MTD) in each SNN type (p-value and r-value)*** as shown in table (3) and fig. (6): There is a positive correlation between scapular width M4 and safe zone limit M1, and M2 in all SSN types. A strong positive correlation is found between M4 and M1 in types II and III (r=0.833 and 0.763 respectively) and a moderate correlation in type III (r=0.5) as shown in Table 3 and Figure 6.

Table (3): Correlations between M4 and other parameters (M1,M2,STD,MTD) in each SSN type

		M4					
		I	**II**	**III**	**IV**	**V**	**VI**
M1	**r**	0.022	0.500	0.763	0.833	.	.
	P value	0.973	0.009	0.001	0.039	.	.
	N	5	26	16	6	1	1
M2	**r**	0.279	0.392	0.317	-0.268-	.	.
	P value	0.650	0.048	0.232	0.662	.	.
	N	5	26	16	5	1	1
STD	**r**	.	-0.113-	0.219	-0.385-	.	.
	P value	.	0.583	0.416	0.451	.	.
	N	0	26	16	6	1	1
MTD	**r**	.	-0.102-	0.007	-0.229-	.	.
	P value	.	0.620	0.979	0.662	.	.
	N	0	26	16	6	1	1

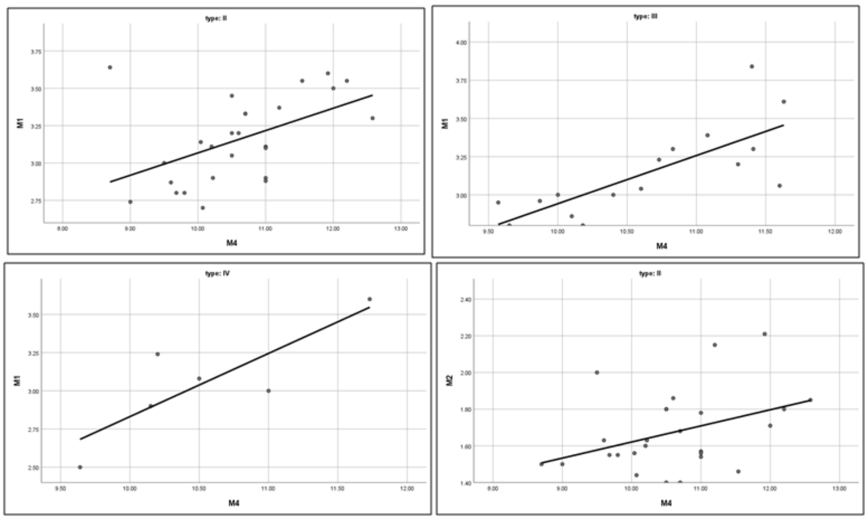

Fig. 6: Showing the strength of positive correlations between M4 and other parameters (M1,M2,STD,MTD) in each Suprascapular notch type

DISCUSSION

Several variations were described concerning morphology and morphometric measurement in different populations. SNN type II suprascapular notch (SSN) were the most prevalent in our study (47.3%). This comes in accordance with kumar et al. (11) who stated that 50% of the Indian scapulae studied were of type II. The second prevalent SSN type in the current study is type III (29.1%). These results are different from American (1) and Kenyan (12) scapulae where the percentage of type III SSN was greater than type II, but still, these two types are the most common types.

In the present study, partial and complete ossification of the supra-scapular ligament (1.8% for each) was noticed. Different studies recorded different percentages; a study on Greek population showed 0.7% of partial ossification with no ossification was recorded in and Greek (13) and Polish (14) scapulae. In the Indian (11) and Ugandan (15) populations, the prevalence of complete ossification of the suprascapular ligament was about 5 fold that of the Egyptian population studied in the current work. Also, partial ossification was high in the Kenyan (12) and Italian (16) populations (19% and 10.2% respectively) compared to 1.8% in the Egyptian population.

No suprascapular notch was found in 9.1% of the studied scapulae with near results in American (1) and Greek (13) populations; while it was 24.2 %,22%, and 21.4% in Polish (14), Kenyan (12), and Italian (16) populations respectively. It was revealed that the incidence of the suprascapular foramen was different in different populations.

The size and TCD of SSN plays are fundamental in the predisposition of SN entrapment, as narrow notches provide more chances of nerve entrapment than wider notches (17)

In the present study, we found a Strong positive correlation between the posterior limit of the safe zone and width of the scapula in types II and IV. We also found a moderate correlation between M1 and M4 in type II, this comes in similarity to the study conducted by Duparc et al. (17) and Polguji et al. (18).

The distance between the suprascapular notch and the margin of the glenoid cavity is critical during open surgical procedures which require dissection of the posterior shoulder joint, as has been described by De Mulder et al., (1٨) and Warner et al. (١٩). In order to avoid injuries to the suprascapular nerve during these procedures, a safe zone has been described, based on the critical distance within which they can be done safely (٢٠). It has been reported that 2.3 cm. from the glenoid rim, at the level of the superior rim of the glenoid and 1.4 cm. from the posterior rim of the glenoid, at the level of the base of the scapular spine are safe. In the present study, the mean distances were 3.05 cm. and 1.71 cm respectively. None of the scapulae fell short of the respective critical distances which have been mentioned for the safe zones. While a study was carried out by Sinkeet et al.(١2) in the Kenyan population, described that 5.9% and 12% of scapulae fell short of the critical distances respectively.

CONCLUSION

The present study delivers data about the morphology, type and dimensions of the suprascapular notch in Egyptian dry scapulae along with the safe zone and the scapular dimensions. These data are important in diagnosis and proper intervention in sport medicine, orthopaedics, radiology and general surgery. SSN is a common site of suprascapular nerve compression, and by knowing precise morphometric information and population variation of notch, we can help surgeons avoid iatrogenic nerve injuries and highlight the use of clinical screening in high-risk populations before any surgical shoulder procedures using either open- or endoscopic techniques.

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