

# Anatomical study of the suprascapular notch: quantitative analysis and clinical considerations for suprascapular nerve entrapment

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**INTRODUCTION** Detailed anatomical knowledge of the suprascapular notch (SSN) is important for the management of entrapment neuropathy and interventional procedures. The objective of the present study was to collect data on the morphological features and anatomical variations of the SSN in an Indian population.

**METHODS** We studied 268 human scapulae of unknown sex (126 right-sided, 142 left-sided) taken from the Department of Anatomy, Dayanand Medical College and Hospital, India. SSNs were classified as either type I, II, III, IV or V, based on the shape of the inferior border of the incisura, and comparison of the SSN's vertical and transverse diameters. The shape of the SSN (i.e V- or U-shaped), if present, was also recorded.

**RESULTS** Type II SSN was the most common (50.00%), followed by type I, type IV and type III (32.46%, 9.70% and 7.84%, respectively). For right-sided type II SSNs, the transverse and vertical diameters were  $9.1 \pm 3.2$  mm and  $5.2 \pm 1.9$  mm, respectively, while those for left-sided type II SSNs were  $9.2 \pm 2.4$  mm and  $5.1 \pm 1.8$  mm, respectively. Generally, the transverse diameter of type II SSN was found to be greater than that of type III SSN. The incidence of U-shaped SSN was 51.49%, while that of V-shaped SSN was 2.99%.

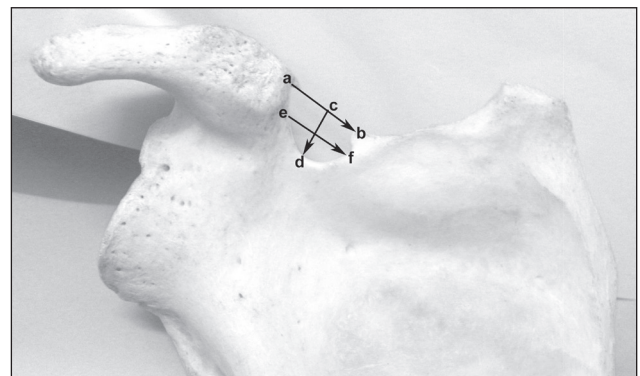
**CONCLUSION** This study of the morphometrical characteristics and anatomical variations of SSN provides an anatomical database of SSN in the Indian context. This database will be of use in surgical procedures, as the information can be used to ensure adequate access to and complete decompression of the suprascapular nerve.

Keywords: scapula, suprascapular nerve entrapment, suprascapular notch

## INTRODUCTION

The suprascapular notch (SSN) is a depression in the lateral part of the superior border of the scapula, which runs medial to the coracoid process (Fig. 1). The suprascapular nerve (SN) is a large branch of the superior trunk that runs laterally deep to the trapezius and omohyoid, and enters the suprascapular fossa through the SSN, inferior to the superior transverse scapular ligament (STSL). It then runs deep to the supraspinatus and curves around the lateral border of the scapular spine with the suprascapular artery to reach the infraspinous fossa, where it branches to the supraspinatus and articular rami of the shoulder, and the acromioclavicular joint.<sup>(1)</sup> The SN is liable to compression when crossing the osteofibrous canal at the SSN. Anatomical variations of the SSN are a possible cause of SN entrapment, especially in individuals involved in repetitive and forceful overhead activities (e.g. volleyball players and baseball pitchers).<sup>(2-5)</sup> While aberrant course of the suprascapular artery through the SSN can lead to SN compression,<sup>(6)</sup> anomalous STSL is the most recognised predisposing factor for SN compression at the SSN; this has been demonstrated in both anatomy dissections and the clinical setting.<sup>(7-9)</sup>

Clinically, SN entrapment is characterised by pain in the posterolateral region of the shoulder, and atrophy of the infraspinatus and supraspinatus muscles. While SN



**Fig. 1** Photograph shows the suprascapular notch of a human scapula. a-b: imaginary line that joins the superior corners of the incisura; c-d: maximal vertical diameter of the incisura; e-f: maximal transverse diameter of the incisura

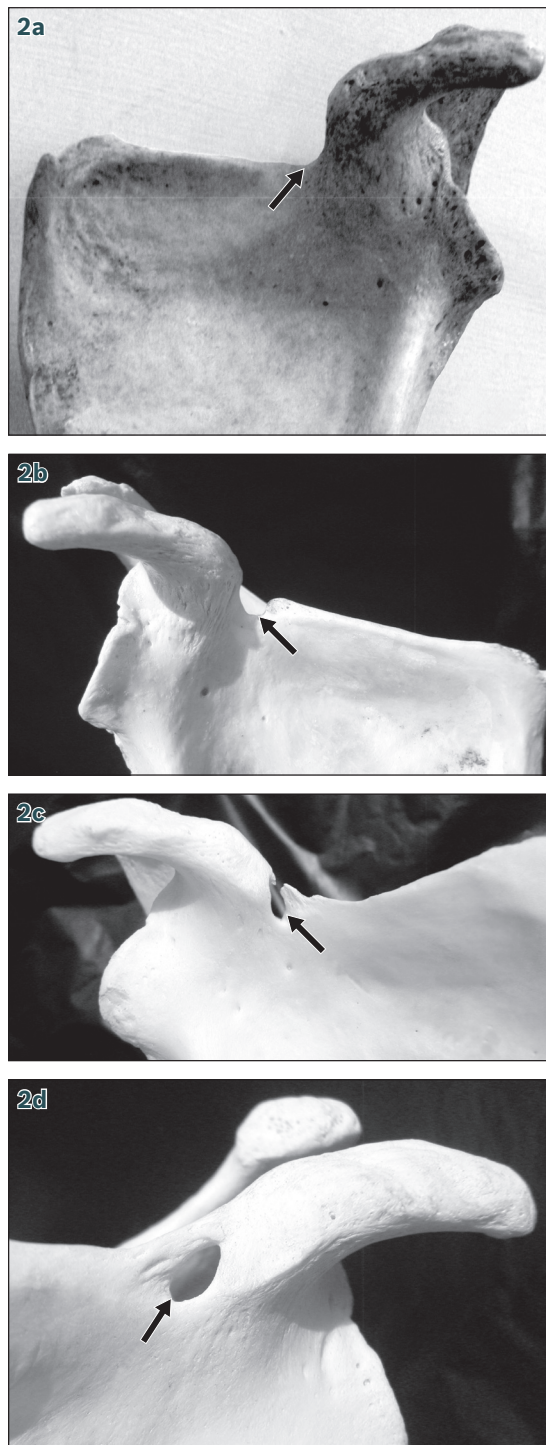
entrapment plays a crucial role in shoulder pain, its possible role is often overlooked in the differential diagnosis of shoulder discomfort.<sup>(10)</sup> The SSN is bridged by the STSL, which is sometimes ossified, transforming the SSN into a foramen. The SN passes through this foramen to the suprascapular fossa.<sup>(11)</sup>

## METHODS

The present study was conducted over a period of one year. It included the analysis of 126 right-sided and 142 left-sided dry adult human scapulae of unknown sex belonging to an Indian

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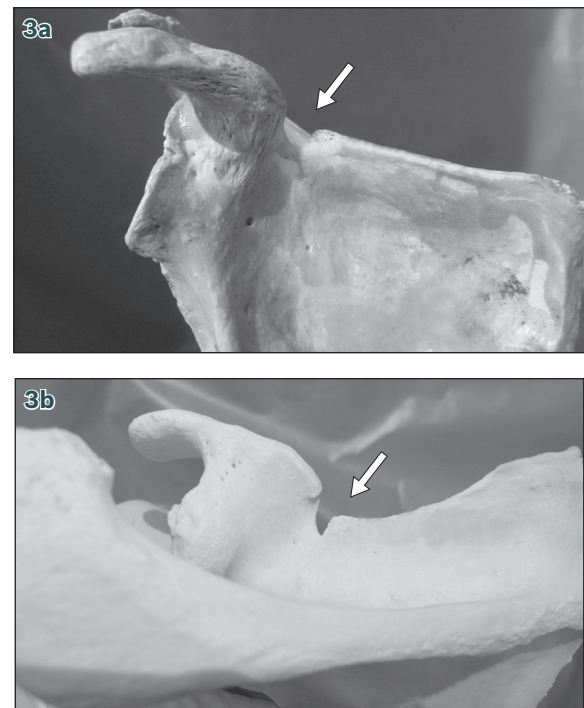
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**Fig. 2** Photographs of human scapulae show (a) type I; (b) type II; (c) type III; and (d) type IV suprascapular notches (arrows). Note the completely formed bony suprascapular foramen in type IV.

population. Only bones that were intact and free from any pathological or congenital anomalies were used. Anatomic measurements accurate to 0.1 mm were taken using a vernier calliper. Appropriate statistical analysis was done whenever applicable.

The SSNs were classified into five groups based on the shape of the inferior border of the incisura, as well as comparison of the vertical and transverse diameters of the SSN (Fig. 1).<sup>(12)</sup> The five groups were as follows: (a) type I: no discrete SSN (Fig. 2a); (b) type II: SSN has a greater transverse diameter than



**Fig. 3** Photographs of human scapulae show (a) a U-shaped suprascapular notch (arrow); and (b) a V-shaped suprascapular notch (arrow).

vertical diameter (Fig. 2b); (c) type III: SSN has a greater vertical diameter than transverse diameter (Fig. 2c); (d) type IV: SSN with a completely formed bony suprascapular foramen (Fig. 2d); and (e) type V: SSN with foramen and incisura. The diameters could not be measured in types IV and V SSNs due to the ossified STSL. The SSNs were also classified according to shape, as either (a) U-shaped: SSN with approximately parallel sides and a rounded base (Fig. 3a); or (b) V-shaped: SSN with medial and lateral sides that converge toward a narrow base (Fig. 3b).

## RESULTS

A total of 268 scapulae were analysed in the present study. SSNs were classified into five groups, of which the most prevalent was type II (50.00%), followed by type I (32.46%), type IV (9.70%) and type III (7.84%) (Table I). Quantitative measurements of types II and III SSNs were taken and tabulated. Metric measurements of types I and IV SSNs could not be taken because type I SSN does not have a discrete notch and type IV SSN has a completely formed bony suprascapular foramen. Type V SSN was not found in our study. The mean  $\pm$  standard deviation of each parameter, and the shape of each SSN are shown in Tables I and II, respectively.

In our study, 32.46% of the scapulae were classified as type I SSN (Fig. 2a). These SSNs did not appear to have a notch, as their superior border presented with a somewhat concave pattern that is without depth, at the midsection where the SSN should have been, thus confirming its absence. The measurements of the transverse and vertical diameters of the right- and left-sided scapulae with types II and III SSNs

**Table I. Type and measurements of the suprascapular notches (SSNs) (n = 268).**

Type of SSN	Proportion (%)	Mean $\pm$ SD (mm)	
		Transverse diameter	Vertical diameter
<b>Type I</b>			
Right-sided	39/126 (30.95)	NA	NA
Left-sided	48/142 (33.80)	NA	NA
Total	87/268 (32.46)	–	–
<b>Type II</b>			
Right-sided	60/126 (47.62)	9.1 $\pm$ 3.2	5.2 $\pm$ 1.9
Left-sided	74/142 (52.11)	9.2 $\pm$ 2.4	5.1 $\pm$ 1.8
Total	134/268 (50.00)	–	–
<b>Type III</b>			
Right-sided	13/126 (10.32)	5.9 $\pm$ 3.2	7.1 $\pm$ 1.9
Left-sided	8/142 (5.63)	7.4 $\pm$ 2.4	9.1 $\pm$ 1.8
Total	21/268 (7.84)	–	–
<b>Type IV</b>			
Right-sided	14/126 (11.11)	NA	NA
Left-sided	12/142 (8.45)	NA	NA
Total	26/268 (9.70)	–	–

NA: not available; SD: standard deviation

**Table II. Shape of the suprascapular notches (n = 268).**

Shape	Proportion (%)		
	Right-sided	Left-sided	Total
U-shaped	63/126 (50.00)	75/142 (52.82)	138/268 (51.49)
V-shaped	4/126 (3.17)	4/142 (2.82)	8/268 (2.99)

are shown in Table I. For right-sided type II SSNs, the mean transverse and vertical diameters were 9.1  $\pm$  3.2 mm and 5.2  $\pm$  1.9 mm, respectively, while those for left-sided type II SSNs were 9.2  $\pm$  2.4 mm and 5.1  $\pm$  1.8 mm, respectively. For right-sided type III SSNs, the mean transverse and vertical diameters were 5.9  $\pm$  3.2 mm and 7.1  $\pm$  1.9 mm, respectively, while the corresponding measurements for the left-sided type III SSNs were 7.4  $\pm$  2.4 mm and 9.1  $\pm$  1.8 mm, respectively. The transverse diameters of type II SSNs were found to be greater than those of type III SSNs in our study. Of all the scapulae examined, 51.49% were U-shaped and 2.99% were V-shaped (Table II).

## DISCUSSION

Complete absence of the SSN has been suggested as a predisposing factor for suprascapular entrapment neuropathy (i.e. SN entrapment).<sup>(13)</sup> The various shapes and sizes of the SSN may also play a role in SN entrapment,<sup>(14)</sup> as narrow SSNs have been found in patients with SN entrapment.<sup>(15)</sup> While previous studies have classified the shapes of SSN using certain mathematical formulas,<sup>(8,12,15)</sup> in this study, we used a simple and reproducible classification system<sup>(12)</sup> to document the various types of SSN. This system uses specific geometrical parameters that distinguish one type of SSN from another. Furthermore, this system for quantitative measurements is easier to comprehend than other classification systems.<sup>(12)</sup>

In the present study, we observed a total of 87 (32.46%) type I SSNs among the 268 specimens. Scapulae with type I SSN

can be considered as having no SSN or SSN-absent.<sup>(12)</sup> At the location where the SSN should have been present, the bone appeared thinner and more translucent than in other parts. This was different from that seen in scapulae with SSNs that were located at the junction of medial two-thirds and the lateral third, just medial to the base of the coracoid process. The number of type I SSNs in our study of Indian scapulae is greater than that reported in studies of Nigerian<sup>(16)</sup> and Chinese<sup>(17)</sup> populations. This observation can be explained by racial differences.

The incidence of type II SSN was 50.00% in our study. Type II SSN was also found to be the most common type of SSN in previous studies.<sup>(16,17)</sup> In the present study, the incidence of type III SSN was 7.84%, which is lower than that reported in Chinese and Western populations.<sup>(17)</sup> This difference may be grounded in ethnic and racial differences. Type IV SSN was present in 9.70% of the scapulae in the present study. The literature shows that the incidence of type IV SSN varies between 3.7% and 12.5%.<sup>(8,9,12,15)</sup> This variability may be related to the different methods of classification and the genetic differences between the populations studied. There was total absence of type V SSN in our sample of scapulae, which is contrary to that reported in previous studies.<sup>(8,12,18)</sup> In animals, the SSN is frequently bridged by a bone rather than a ligament. In humans, however, if the conversion of SSN into foramina occurs, it is due to the ossification of the STSL.<sup>(13)</sup> We observed both U- and V-shaped SSNs in our study, with U-shaped SSNs being more common (51.49%) than V-shaped SSNs (2.99%). While SN entrapment is more likely to be associated with the narrow V-shaped notch,<sup>(19)</sup> no direct correlation between notch-shape and SN entrapment has been advocated by clinicians.<sup>(20)</sup>

In conclusion, our quantitative and qualitative study on the morphology of SSN provides well-sorted data regarding the incidence of various types of SSN in an Indian population. The size of the SSN is considered to play a part in the predisposition for SN entrapment. A small notch gives rise to a larger chance of nerve impingement than a large notch.<sup>(15)</sup> In the present study, the most common type of SSN observed was type II SSN, which has a lower chance of SN entrapment compared to the other types of SSN (i.e. types III, IV and V). No scapula with type V SSN was found in our study. The metrical values and precise localisation of the SSN, as well as information on the anatomical variants of the SSN, are important in understanding SN entrapment syndrome and surgical decompression of SN. Therefore, the present study on SSNs of scapulae from an Indian population may be of interest to both clinicians and anatomists.

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