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Morphological Study of the Suprascapular Notch and its Clinical Correlation with Suprascapular Nerve Entrapment Syndrome

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ABSTRACT

The suprascapular nerve gets compressed or irritated as it travels through the suprascapular notch in the debilitating disorder known as suprascapular nerve entrapment syndrome. Understanding the anatomy of the suprascapular notch is crucial to recognize the likelihood of developing this syndrome. Nowadays, shoulder discomfort and dysfunction are frequently attributed to damage to the suprascapular nerve. In order to determine its clinical importance and relationship to suprascapular nerve entrapment syndrome, the aim of this study is to undertake a morphological investigation of the suprascapular notch in Indian dry scapulae and compare it with the incidence among other races globally. In this cross-sectional and prospective study, 150 adult scapulae of unknown gender and age were examined. About 75 of them belonged to the right and 75 to the left. We identified five different types of suprascapular notches in the current analysis; Deep U shape: 38%, Shallow U shape: 32%, J shape: 20%, V shape: 8% and Indented: 2%. Among these different types, the Deep U shape was the most common shape found, followed by the Shallow U shape and Indented was the least commonly reported. The suprascapular notch is one of the areas where nerve entrapment usually occurs. Therefore, knowledge of the anatomy of the suprascapular notch is essential to comprehending suprascapular nerve entrapment syndrome. To accurately diagnose a shoulder condition and plan the necessary surgical procedures, clinicians, radiologists, neurosurgeons and orthopaedic surgeons must have a thorough understanding of the morphology of the notch.

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Key Words
Scapula, suprascapular notch, suprascapular nerve entrapment, variations

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INTRODUCTION

The suprascapular nerve gets compressed or irritated as it travels through the suprascapular notch in the debilitating disorder known as suprascapular nerve entrapment syndrome (SNES). This condition can lead to significant pain, weakness and functional impairment of the shoulder joint. Understanding the morphological variations of the suprascapular notch and their clinical correlation in SNES is crucial for accurate diagnosis, effective treatment and improved patient outcomes. The suprascapular notch, located on the superior border of the scapula near the glenoid cavity, serves as a crucial anatomical landmark for the passage of the suprascapular nerve[1]. However, variations in the morphology of the suprascapular notch have been observed, which can influence the susceptibility to nerve entrapment. These morphological variations include the shape, depth, width and presence of a superior transverse scapular ligament. The presence of a bony or fibrous bridge across the suprascapular notch can create a narrowed space through which the nerve passes, potentially leading to compression or entrapment. Moreover, advancements in imaging modalities, such as magnetic resonance imaging (MRI), have facilitated the detailed assessment of the suprascapular notch morphology, allowing for a more comprehensive understanding of its relationship with SNES. These imaging techniques enable clinicians to visualize and evaluate the bony and soft tissue structures within the suprascapular notch, aiding in the identification of potential nerve compression or entrapment. Kopell and Thompson, first of all, described SNES in 1959[2]. They found that the suprascapular nerve was compressed against the transverse scapular ligament by the abduction and adduction of the shoulder joint. Weight lifters, tennis players, dancers, volleyball players and other athletes that need a significant amount of external rotation and severe abduction for overhead activity frequently have this syndrome. One of the causes of SNES is variation in the suprascapular notch's shape[3]. The comprehensive understanding gained from this study will contribute to improved patient care, early intervention and the development of targeted therapeutic strategies for individuals suffering from SNES.

Aim and objectives: In order to determine its clinical importance and relationship to suprascapular nerve entrapment syndrome, the aim of this study is to undertake a morphological investigation of the suprascapular notch in Indian dry scapulae and compare it with the incidence among other races globally.

MATERIALS AND METHODS

In this cross-sectional and prospective study, 150 adult scapulae of unknown gender and age were examined, which were obtained from the Department of Anatomy, Nalanda Medical College and Hospital, Indira Gandhi Institute of Medical Sciences and All India Institute of Medical Sciences, Patna, Bihar. About 75 of them belonged to the right and 75 to the left.

Inclusion criteria: It includes the following:

- **Scapulae with the intact superior border:** Bones should be well-preserved and suitable for accurate morphological observations
- **Age and sex:** Bones belong to adult male and female individuals included in the study.
- **specimen quality:** Bones that are free from significant deformities, fractures, or pathological conditions affecting the superior border of the scapulae

To protect the integrity of the specimens throughout the study, proper handling and care were taken. With the aid of a cell phone camera, representative images of the various suprascapular notch shapes were captured.

Exclusion criteria: It includes the following:

- **Severely damaged or fragmented bones:** Bones that are extensively damaged, fragmented, or show significant deformities affecting the superior border of the scapulae
- **Pathological conditions:** Bones exhibiting pathological conditions such as tumors, infections, or systemic diseases affecting the superior border of the scapulae
  Bones with evidence of previous surgical interventions or orthopedic procedures that may alter the natural morphology of the superior border of the scapulae
- **Non-human specimens:** Exclusion of non-human bones or specimens from the study

RESULTS

The undermentioned observations were obtained as a result of the analysis of adult human scapulae (Table 1 and Fig. 1-6).

We identified five different types of suprascapular notches in the current analysis. Among these different types, the Deep U shape was the most common shape found, followed by the Shallow U shape and Indented was the least commonly reported.

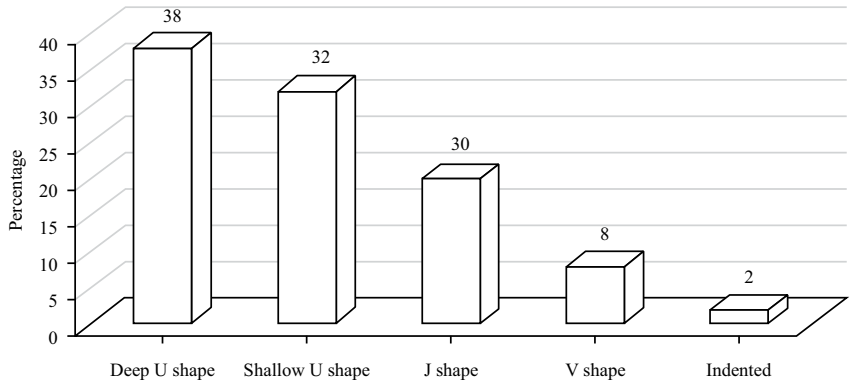

Fig. 1: Comparison of the frequency of the various suprascapular notch shapes

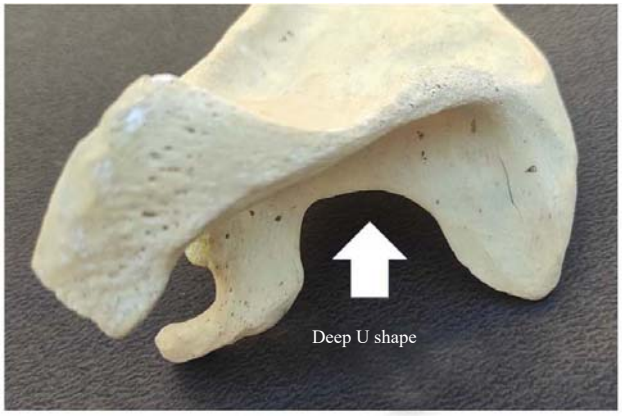

Fig. 2: Scapula showing deep U-shaped suprascapular notch

Fig. 3: Scapula showing shallow U-shaped suprascapular notch

Table 1: Displaying the incidences of the various shape of the suprascapular notch

Shapes	Number	Percentage
Deep U shape	57	38
Shallow U shape	48	32
J shape	30	20
V shape	12	8
Indented	3	2
Total	150	100

DISCUSSIONS

In diverse populations around the world, researchers have looked at distinct physical variations and classifications of the suprascapular notch. We compared the observations of different researchers around the globe with our observations as shown in Table 2.

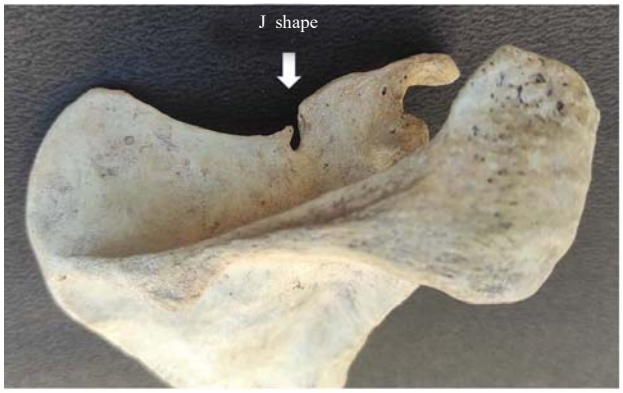

Fig. 4: Scapula showing shallow J-shaped suprascapular notch

Fig. 5: Scapula showing shallow V-shaped suprascapular notch

Fig. 6: Scapula showing Indented suprascapular notch

In 1979, Rangachary *et al*.[4], Rangachary *et al*.[5] and Rangachary *et al*.[6] studied 211 American scapulae and divided the suprascapular notch into six categories (Type I-VI). The following criteria were used to classify these items: (a) The notch's depth, (b) The width at the notch's upper border and (c) The notch's widest point. They explained that a little notch has a higher likelihood of impinging on a nerve than a huge one. Based on the notches' vertical and horizontal widths, Natsis *et al*.[7] divided 423 scapulae into five groups. Type I lacked a clearly defined notch, Type II had the highest transverse diameter, Type III had the largest vertical diameter, Type IV had a bony foramen and Type V had both. In 2010, Sinkeet *et al*.[8] conducted a study on the Kenyan population and divided the suprascapular notch into 6 distinct forms, taking into account the degree of suprascapular ligament ossification. According

Table 2: Comparison of the frequency of various suprascapular notch designs as reported by several authors

	Shape of SSN				
	Deep U shape (%)	Shallow U shape (%)	J shape (%)	V shape (%)	Indented (%)
Rengachary *et al*.[4,5,6]	48	31	-	3	-
Natsis *et al*.[7]	40	24	-	13	-
Sinkeet *et al*.[8]	29	21	-	5	-
Iqbal *et al*.[9]	13.2	-	22	20	26.8
Albino *et al*.[10]	22.8	19.8	-	31.1	-
Vasudha[11]	34.78	6.08	19.13	-	7.82
Udayasree *et al*.[12]	47.6	-	21.4	4.7	-
Akhtar *et al*.[13]	35.8	31.8	21.6	5.75	4.87
Bagoji *et al*.[14]	48.5	-	6.52	21.0	-
Honokiet *al*.[15]	36	10.6	-	29.4	-
Present study	38	32	20	8	2

to them, Type I denotes a broad "U," Type II denotes a "J," Type III denotes a "V," Type IV denotes a "V," and Types V and VI were connected to the degree of STSL ossification. Type III was discovered to be the most prevalent. The Deep U shape of the suprascapular notch is the most frequent in the current study, whereas the Indented shape is the least frequent. Iqbal *et al*.[9] investigation on the Pakistani population in 2010 only uncovered the three notch types U, V and J. Throughout their analysis, the J-shaped form dominated. In 2013, Albino *et al*.[10] used 500 dried scapulae from the Italian population to investigate the relationship between the suprascapular notch and posterior superior limit of the safe zone for the suprascapular nerve. According to Rengachary's technique, they also divided the suprascapular notch into six separate varieties, with Type IV being the most prevalent and Type VI being the least prevalent. Vashudha *et al*.[11] evaluated the suprascapular notch and the level of suprascapular ligament ossification in 115 dried Indian scapulae. They found suprascapular notches in eight distinct patterns, including symmetrical, shallow, J-shaped, wide, indented, hockey stick, deep and grooved. The two most frequent shapes among them were a symmetrical U and a groove. The Deep U shape and Indented are the two suprascapular notch types that are the most and least frequent, respectively, in the current study. The suprascapular notch's various forms and the suprascapular ligament's degree of ossification were also investigated in 42 dried Indian scapulae by Udayasree *et al*.[12]. The only SSN types they discovered were U, J and V shapes, with U shapes being the most prevalent and V shapes being the least. In 11.9% of the cases, the suprascapular notch was absent. In 4.7% of the cases, the suprascapular ligament had partially ossified and in 9.5% of the cases, it had fully ossified. Five different types of suprascapular notches were described by Akhtar *et al*.[13]. Out of 226 scapulae, 49 (21.68%) have shallow U shapes, 72 (31.86%) have deep U shapes and 81 (35.84%) have deep U shapes, scapulae have three different shapes: J-shaped, V-shaped and indentation suprascapular notch in 11 (4.87%) scapulae. The most prevalent and least frequent shapes of suprascapular notches, respectively, were Deep U and Indented, which is the same as our observations. Out of 138 scapulae, 67 (48.55%) had a U-shaped notch, 29 (21.01%) a V-shaped notch and 14 (10.14%) a J-shaped notch, according to research by Bagoji *et al*.[14]. Nine scapulae (6.52%) were deficient by an entire notch. There were two (1.44%) scapulae with wide double foramen. Six (4.34%) of the scapulae were fully notch. The notch was absent in seven (5.07%) of the scapulae. They reported a W-shaped notch in two (1.44%) of the scapulae. Ossification of the STSL was substantially more frequent in older patients, according to Honoko *et al*.[15], suggesting age-related change. Additionally, no link was seen between the development of SSN palsy and the STSL's shallow notch or ossification in their study. In 220 dried scapulae, Akhtar and Madhukar[16] and Akhtar *et al*.[17] observed that the suprascapular notch was absent in 15.46% of instances. On the left side, suprascapular notch absence was more prevalent. In contrast, among 224 scapulae, 12.5% of scapulae had fully ossified STSL and 21.87% had partially ossified STSL. On the right side, both fully and partially ossified STSLs were more prevalent. By Warner *et al*.[18] and de Mulder *et al*.[19], it was found that the distance between the glenoid cavity boundary and the suprascapular notch was crucial during open surgery and necessitated dissection of the posterior shoulder joint. In order to protect the suprascapular nerve during procedures adjacent to this area, they described a safe zone[20]. The glenoid's posterior limit at the base of the scapula was 1.4 cm away, while the upper rim was 2.3 cm away. Surgeons are aware of this safe zone in order to avoid nerve damage while performing surgery on the shoulder joint. Although this nerve does not reach the adjacent skin, it provides the motor supply for the supra and infraspinatus muscles. Therefore, any irritation of the nerve fibers results in severe, poorly localized pain. The muscles had already begun to atrophy by the time the patient presented his complaints to a clinician. Every doctor needs to have in-depth anatomical knowledge of the suprascapular nerve's path and all potential sites of its compression for an early and accurate diagnosis.

While our study contributes to understanding the clinical correlation between the suprascapular notch and SNES, it is essential to acknowledge its limitations. The sample size in our study was relatively small and it consisted of a specific population group. Therefore, caution should be exercised when generalizing our findings to larger and more diverse populations. The validity of our findings and exploration of potential racial or genetic implications on suprascapular notch morphology call for further research with bigger sample sizes and various groups.

Further study avenues could include investigating additional morphological features of the suprascapular notch and their relationship with clinical parameters of SNES, such as pain severity, muscle weakness and functional impairment. Longitudinal studies examining the outcomes of different treatment modalities based on notch morphology could also provide valuable insights into personalized approaches for managing SNES.

CONCLUSION

The suprascapular notch is one of the areas where nerve entrapment usually occurs. Therefore, knowledge of the anatomy of the suprascapular notch is essential to comprehending suprascapular nerve entrapment syndrome. To accurately diagnose a shoulder condition and plan the necessary surgical procedures, clinicians, radiologists, neurosurgeons and orthopaedic surgeons must have a thorough understanding of the morphology of the notch.

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