

# Frequency of Complete Absence of Suprascapular Notch in Dry Scapulae - An Osteological Study with Clinical Significance

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## ABSTRACT

### BACKGROUND

Suprascapular notch is a depression located in the superior border of the scapula near its lateral part, close to the root of the coracoid process. It is bridged by the superior transverse scapular ligament & serves as a path for the suprascapular nerve. The notch is commonly seen in all the scapulae with variable morphology. Sometimes, it is associated with ossified transverse scapular ligament which plays an important role for the suprascapular neuropathies which has been suggested in many previous literatures. But, its absence can also be a reason for nerve entrapment which has been mentioned less frequently. The purpose of this study was to find out the incidence of completely absent suprascapular notch among dry scapulae of north India, especially Gurugram region along with a morphometric evaluation of superior border of scapular where the notch is situated.

### METHODS

One hundred & ten adult dry scapulae of unknown sex from the osteology museum of SGT Medical College, Gurugram, were obtained for evaluation of absence of suprascapular notch in the superior border of the scapulae near the root of the coracoid process by subjective evaluation (visual inspection). We have also done a morphometric evaluation (length) of the superior border of all the scapulae irrespective of the suprascapular notch. Our observations were compared with other osteological studies performed on other population groups.

### RESULTS

Of the 110 scapulae studied, 43 belonged to right side & 67 scapulae of left side. By visual inspection, 13 scapulae (11.8%) were devoid of suprascapular notch on the upper border & rest 88 scapulae (88.81%) had different variety of suprascapular notch. Among the 13 scapulae without suprascapular notch, 8 scapulae (61.5%) were of right side and 5 scapulae (38.46%) were of left sided bone. Apart from this, the average length of the superior border of the scapulae was 42.73 mm.

### CONCLUSIONS

Incidence of completely absent suprascapular notch in our study is 11.8% which will act as a reference point among Gurugram population in north India. Clinicians should keep in mind about complete absence of suprascapular notch which can be a probable reason for the suprascapular nerve entrapment.

### KEY WORDS

Scapula, Superior Border, Suprascapular Notch, Absent Suprascapular Notch, Morphology, Entrapment Neuropathy

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## BACKGROUND

Scapulae is a triangular flat bone which lies on the posterolateral aspect of the chest wall extending from second to seventh rib and articulates with the clavicle & the head of the humerus with many soft tissue attachments.<sup>(1)</sup> Numerous major clinical conditions are related to this bone like impingement syndrome, entrapment neuropathies & glenohumeral dislocations with disabilities.<sup>(1)</sup> The bone is also known as shoulder blade; two in either sides of the thoracic wall which link the appendicular skeleton of the upper limb with the axial skeleton with the help of the clavicle.<sup>(2)</sup> The bone is having a body with 2 surfaces; costal or subscapular fossa and a dorsal surface which is further divided into supraspinous & infraspinous fossa as it contains a spinous process. It also bears 3 angles, superior; inferior & lateral which actually possess the glenoid cavity to form the shoulder joint.<sup>(2)</sup> So, scapula plays an important role in the movements of the glenohumeral joint.<sup>(3)</sup> Scapula also contains three borders; superior, medial & lateral. Among the three borders, the superior one is the thinnest & shortest which extending from the root of the coracoid process to the superior angle of the scapula.<sup>(4)</sup> The superior border is mostly interrupted by the presence of suprascapular notch near the junction of medial two third & lateral one third very close to the coracoid process.<sup>(5)</sup> Normally the suprascapular notch of different variety is located in the lateral part of the superior border.<sup>(5,6)</sup> Sometimes the notch is bridged by the ossified superior transverse scapular ligament converting the notch into a foramen.<sup>(4)</sup> The suprascapular nerve arising from the upper trunk of the brachial plexus traverses under the superior transverse scapular ligament to supply the supraspinatus muscle, then runs along the lateral border in the spinoglenoid notch to enter into the infraspinous fossa to innervate the infraspinatus muscle.<sup>(4)</sup> So, entrapment of the nerve is very common whenever there is ossified superior transverse scapular ligament leading to a foramen & this condition was first described by Koppel & Thompson.<sup>(7)</sup> The morphological variation regarding the suprascapular notch is one of the causative factors for suprascapular neuropathies which is seen mostly in athletes.<sup>(8)</sup> Most frequent clinical manifestations are inability to abduct the arm not only in athletes but also fencers, dancers, hunters & individual performing lot of overhead abduction as a part of their occupation.<sup>(9,10,11)</sup> The most popular classifications for suprascapular notch is the one by Rengachary et al. described in 1979 where six types of suprascapular notches were defined.<sup>(12,13)</sup> Among the six types, the first variety of scapulae showed small indentation or no notch near the coracoid process of scapula.<sup>(12)</sup> Ticker et al. categorized the suprascapular notch of scapulae into 'U' & 'V' shaped variety.<sup>(13)</sup> But, other authors have also described the morphological variations of the notch according to their shape like U shaped; V shaped; foramen or absent notch means totally straight superior border.<sup>(14,15,16)</sup> Though normally the notch is present in the scapula with various morphological features with many clinical implications, but its absence is also seen in some of the scapulae.<sup>(17)</sup> So, complete absence of suprascapular notch is also thought to be a reason for nerve entrapment as compression of the suprascapular nerve is possible by the superior transverse scapular ligament characterized by diffuse pain in the

posterolateral aspect of the shoulder causing weak abduction.<sup>(18)</sup> Very few studies have been performed to determine the incidence of absent suprascapular notch in Indian population, so keeping this in mind the study have been undertaken among the dry scapulae of north Indian zone.

## METHODS

In the present anatomical study, 110 adult dry scapulae (this was the sample size available in the department; was more than 30 which is the minimum no for the sample size in any osteological study) of unknown sex obtained from the osteology museum of Department of Anatomy, SGT Medical College, Gurugram were evaluated for the incidence of absent suprascapular notch. Scapulae were segregated & broken scapulae especially the superior border was excluded for the evaluation. General morphological parameter like the side of the bone was also mentioned. Each bone was studied for the presence or absence of any types of notch in the superior border near the root of the coracoid process like U shaped; V shaped, ossified suprascapular ligament which convert the notch into foramen by subjective evaluation (visual inspection). Then the incidence of completely absent suprascapular notch was calculated according to the side of the scapulae. Apart from this, we have also measured the length of the superior border of all the scapulae irrespective to the presence or absence of notch by a digital vernier caliper in mm which extends from the root of the coracoid process to the superior angle of the scapula. Scapulae with absent suprascapular notch were segregated for photography & proper documentation was done. We have also done photography for 'U' shaped notch & scapula with suprascapular foramen for the differentiation of absent notch in the superior border.

### Statistical Analysis

All the data obtained were tabulated in Microsoft excel 2007 version & maximum; minimum; mean & standard deviation was calculated. Though it was a descriptive type of analysis, so test of significance was not applied.

## RESULTS

In the present osteological evaluation, 110 adult dry intact scapulae were examined for the incidence of absent suprascapular notch on the superior border of the scapulae by visual inspection. Out of the 110 scapulae studied, 43 belonged to right side and 67 belonged to left side. By subjective evaluation (visual inspection) method we have obtained 13 scapulae (11.8%) were devoid of suprascapular notch on the superior border of scapulae; rest 88 scapulae (88.81%) with different types of notches like little indentation, U shaped, V shaped or suprascapular foramen on the superior border of scapulae which has been displayed in the Table along with the graphical representation in Table. It was also observed that, among the 13 scapulae with absent suprascapular notch, 8 scapulae (61.5 %) were belonged to the right side & 5 scapulae (38.46%) were of the left side. The

incidence of morphological evaluation of absence suprascapular notch according to the side has been displayed in Table 1. Among all the dry specimens where suprascapular notch was absent, it was observed that there was no lateral confluent near the root of the coracoid process thus to confirm its absence. Mostly the superior border was straight in our observation among the scapulae with absent suprascapular notch.

Side of the Scapulae	No. of Bones without Notch n (%)	No. of Bones with Notch N (%)	Total n
Right	8(61.5%)	35(36.08%)	43(39.09%)
Left	5(38.4%)	62(63.91%)	67(60.9%)
<b>Total</b>	<b>13(11.8%)</b>	<b>97(88.18%)</b>	<b>110</b>

**Table 1. The Incidence of Morphological Evaluation of Absence of Suprascapular Notch According to the Side**

Along with this, the morphometric evaluation (Length) of the superior border of all scapulae was also measured. We observed the mean length of superior border of scapula was 57.83 mm irrespective to the side or presence or absence of the notch. The minimum, maximum, mean and standard deviation of the length is shown in Table 2. Though the results are of descriptive statistics type, so application of test for significance was not required.

Total No. of Scapulae (n)	Parameters Measured	Maximum (mm)	Minimum (mm)	Mean (mm)	Std. Deviation
110	Length of superior border of scapula	57.83	30.18	42.73	5.5501

**Table 2. Morphometric Parameters (Length) of Superior Border of the Scapula**

**DISCUSSION**

The suprascapular notch is very commonly seen in the superior border of almost all scapulae at its anterolateral end separating the superior border from the root of the coracoid process.<sup>(1,2)</sup> The notch is bridged by the superior transverse scapular ligament which extends from the medial end of the notch up to the root of the coracoid process converting it into a foramen.<sup>(2)</sup> Though the notch shows variable morphological features but it acts as a common cause for the entrapment neuropathy because it transmits suprascapular nerve to enter into the supraspinous fossa.<sup>(2)</sup> Its position is an important anatomical landmark for the suprascapular nerve during different arthroscopic surgical procedure in relation to glenohumeral joint.<sup>(19)</sup> So, this morphological feature clinically plays a major role like other parts of the scapula which becomes a area of choice for osteological investigations by the researchers. The suprascapular nerve is a large branch coming from the upper trunk of the brachial plexus follows an oblique course through the posterior cervical triangle to go towards the suprascapular notch.<sup>(2,20)</sup> Movements like overhead abduction of the shoulder joint can result traction force on the suprascapular nerve leading to its compression against the upper border.<sup>(20)</sup> Rengachary et al. in 1979, had described six different types of suprascapular notches which was one of the most popular classification regarding variable morphology of suprascapular notch.<sup>(12,13)</sup> In his classification, type I was the category for the absent suprascapular notch among the scapulae. The risk of entrapment neuropathy increases in many folds when absent suprascapular notch seen along with the ossified superior transverse scapular

ligament.<sup>(2,20,21)</sup> Many authors have followed Rengachary's classification for the morphological variations of suprascapular notch as well as for the incidence of ossified superior transverse scapular ligament converting the notch into foramen.<sup>(12)</sup> Some of the authors Vedha et al., Kour et al., Fatima et al. also described suprascapular notch according to different alphabetical symbol like shallow U, deep U, V shaped, J shaped & slightly indented notch among Indian population.<sup>(14,15,16)</sup> Wang et al. described the notch by measuring different diameters like vertical & transverse; to classify the different variety of notches.<sup>(22)</sup> Several authors have also reported about variations such as calcification, bifurcation or trifurcation & hypertrophy of transverse scapular ligament which was also a directly associated with entrapment neuropathy.<sup>(23,24,25)</sup> But incidence of complete absence of suprascapular notch with clinical implications was mentioned in very few studies which have been displayed in Table 3 & 4.

Authors	Year	Population Group	No. of Scapulae	Incidence of Absent Suprascapular Notch (%)
Rengachary et al. <sup>(12)</sup>	1979	American	211	8
Natsis et al. <sup>(26)</sup>	2007	Greek	423	6
Ofusori et al. <sup>(6)</sup>	2008	Nigerian		Single Case Report
Sinkeet et al. <sup>(27)</sup>	2010	Kenyan	138	22
Iqbal et al. <sup>(28)</sup>	2010	Rawalpindi	250	18
Wang et al. <sup>(22)</sup>	2011	Chinese	295	28
Polgus et al. <sup>(29)</sup>	2013	Poland	81	6
Albino et al. <sup>(30)</sup>	2013	Italian	500	12.4
Present study	2019	India	110	11.8

**Table 3. Meta-Analysis of the Incidence of Absent Suprascapular Notch in the Scapula among Different Population Groups**

In few of the studies, authors like Ofusori et al. & Rekha et al. have mentioned about single case regarding the incidence of absence suprascapular notch in Nigerian and Indian population respectively.<sup>(6,18)</sup> They suggested that, the absence of suprascapular notch is a possible reason of compression of the suprascapular nerve by the superior transverse ligament on the upper border of the scapula which can be pronounced if the ligament becomes ossified. This can further lead to paralysis, weakness, numbness etc as well as weakness while abduction of the shoulder joint causing disability in shoulder movements.<sup>(6,18)</sup> So, this type of morphological variations play great role for the nerve entrapment because its injury can cause severe rotator cuff dysfunction. The incidence of complete absence of suprascapular notch in our study is almost similar studies performed by Kour et al., Varghese et al., Mahato et al., Vaidya et al. among Indian population though sample size as well as regional variation still present.<sup>(15,31,32,33)</sup> Apart from this, our observation for the incidence was almost similar with work done by Albino et al. in Italian population but the sample size was very high in their case.<sup>(30)</sup> Similar results for the incidence were seen in studied performed by Natsis et al. & Polgus et al. among population of Greek & Poland.<sup>(26,29)</sup> Their result was also similar with the research performed by Pragna et al., Kour et al., Varghese et al. among Indian population.<sup>(34,15,32)</sup> It was observed that, except researches done by Rubi et al., Rekha et al. & Jawed et al. where only incidence of absent suprascapular notch was reported,<sup>(17,18,35)</sup> rest of the studies by other authors were performed to determine the incidence of all the morphological variations of suprascapular notch

among Indian population including absent suprascapular notch in dry scapulae.

Authors	Year	Population (Different Regions in India)	No. of Scapulae	Incidence of Absent Suprascapular Notch (%)
Soni et al. <sup>(36)</sup>	2012	Agroha	100	2%
Rekha et al. <sup>(18)</sup>	2013	Karnataka	Single Case Report	
Vasudha et al. <sup>(37)</sup>	2013	Karnataka	115	6%
Reddy et al. <sup>(38)</sup>	2013	Andhra Pradesh	104	21.15%
Pragna et al. <sup>(34)</sup>	2013	Gujarat	80	6.25%
Jawed et al. <sup>(35)</sup>	2014	Patna	220	34(15.46%)
Kannan et al. <sup>(39)</sup>	2014	Pondicherry	415	80(20%)
Desai et al. <sup>(40)</sup>	2014	Gujarat	200	16%
Kour et al. <sup>(15)</sup>	2016	Jammu	60	8(13.3%)
Rubi et al. <sup>(17)</sup>	2016	Assam	236	42(17.79%)
Varghese et al. <sup>(32)</sup>	2017	Kerala	50	7(14%)
Mahato et al. <sup>(31)</sup>	2017	Tamil Nadu	250	23(9.2%)
Vaidya et al. <sup>(33)</sup>	2018	Uttar Pradesh	140	13(9.28%)
Present study	2019	Gurugram	110	13(11.8%)

**Table 4. Comparative Analysis of Incidence of Scapulae without Suprascapular Notch among Populations of Different Regions in India**

Scapula is an interesting bone for the researchers regarding different morphometrical investigations as to help the surgeons to perform surgical procedure. So, we have measured the length of superior border of all the scapulae which was 42.37 in average expecting a normal baseline data for the population of North India. In studies done by Rekha et al. & Ofusori et al. it was almost same around 6 cm which was different from our study, but both were measured in a single bone among South Indian & Nigerian population respectively.<sup>(6,18)</sup>

Authors	Year	Population (Different Regions in India)	No. of Scapulae	Length of the Superior Border of Scapula
Ofusori et al. <sup>(6)</sup>	2008	Nigerian	Single case report	6.5 cm
Rekha et al. <sup>(18)</sup>	2013	Indian	Single case report	6 cm
Present study	2019	Indian	110	42.37 mm

**Table 5. Morphometric Analysis (Length) of the Superior Border of Scapulae Performed in Other Studies**

**CONCLUSIONS**

Suprascapular notch shows remarkable variations in the scapula which has been reported by many authors among different population groups with different sample sizes. But, very few studies have been undertaken to evaluate the frequency of complete absence of suprascapular notch among Indian population especially north zone. Complete absence of suprascapular notch is an important cause of suprascapular nerve entrapment syndrome. Apart from this, morphological data regarding completely absent suprascapular notch will provide an anatomical baseline to correlate the radiologic findings with clinical presentations which is expected to be of great help to the orthopaedic surgeon to devise appropriate surgical interventions to restore the normal function of the shoulder joint.

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