

## Occurrence of Complete Ossification of the Superior Transverse Scapular Ligament

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**Abstract:** The lateral end of the upper border of the scapula is characterised by a notch which is bridged by the superior transverse scapular ligament (STSL), converting it into a foramen the 'suprascapular foramen' which gives passage to the suprascapular nerve through the foramen and the suprascapular vessels pass above the STSL. Sometimes the STSL may undergo ossification resulting in a bony foramen. The bony suprascapular foramen can be very narrow at times leading to compression of the suprascapular nerve resulting in the 'suprascapular nerve entrapment syndrome'. The ossification STSL has been reported in literature in varying frequency. In the present study a collection of 208 scapulae were examined for the frequency of occurrence in the local population. Ossification of the STSL was found in 03.85% of the scapulae. The knowledge of the occurrence of STSL is important for the orthopaedician while dealing with cases presenting with pain in the shoulder region.

**Key words:** shoulder joint, scapula, suprascapular nerve, nerve compression

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### I. Introduction:

The upper border of the scapula is notched at its lateral end which is called as 'suprascapular notch'. In fresh state the superior transverse scapular ligament (STSL) bridges the suprascapular notch, converting it into a foramen the 'suprascapular foramen' which gives passage to the suprascapular nerve through the foramen and the suprascapular vessels pass above the STSL [1]. The suprascapular nerve supplies supra and infraspinatus muscles. Quite often the STSL may undergo ossification resulting in a bony foramen which may vary in size [1]. The bony suprascapular foramen can be very narrow at times. A narrow suprascapular foramen may lead to compression of the suprascapular nerve resulting in a clinical condition called the 'suprascapular nerve entrapment syndrome' characterised by weakness of the upper arm, difficulty in abduction and external rotation of the shoulder joint and then atrophy of the supraspinatus and infraspinatus muscles. This clinical condition is quite common in sports persons who play volleyball, tennis and badminton where extreme abduction and external rotation of shoulder joint is required. The size of suprascapular notch is an important factor to cause suprascapular nerve entrapment syndrome because narrow suprascapular notch was encountered in those patients with this syndrome. Thus, morphological variation of the suprascapular notch is predisposing factors for suprascapular nerve entrapment syndrome [1,2,3,4,5,6,7]. The present study was undertaken to find out the frequency of occurrence of complete ossification of STSL in a collection of south Indian scapulae.

### II. Material and Methods:

The study was carried out on 208 adult dry scapulae (94 of right side and 114 of left side) of unknown sex accessed from collections of scapulae available in a number of medical colleges of Tamil Nadu. Only those scapulae which were not damaged near the upper border were used for the study. The upper border of the scapula was examined for the presence of ossification of the suprascapular ligament. Wherever the suprascapular ligament was ossified converting the suprascapular notch into a foramen following measurements were taken with a digital vernier calliper to the nearest mm:

- (1) The middle vertical diameter of the suprascapular foramen-the maximum value of the longitudinal measurements taken in the vertical plane from a point half way along the length of the bony bridge and the deepest point of the suprascapular notch (Figure 1(a));
- (2) The middle transverse diameter of the suprascapular foramen-the maximal distance between the proximal and distal margins of the SSN, taken in the horizontal plane in half dimension of MVD, perpendicular to it (figure 1(a)).
- 3) Width of the bony bar spanning the foramen in the middle.

4) Thickness of the bony bar spanning the foramen

### III. Observations:

Complete ossification of STSL was observed in eight scapulae (03.85% -two of right and six of left side).

The mean middle vertical diameter of the suprascapular foramen was  $8.785 \pm 3.41$  (Rt- $9.16 \pm 4.73$ ; Lt- $8.41 \pm 2.084$ ); the mean middle transverse diameter of the suprascapular foramen was  $7.48 \pm 2.55$  (Rt- $8.82 \pm 3.083$ ; Lt- $6.14 \pm 2.008$ )

Width of the bony bar-  $4.96 \pm 1.732$  (Rt-  $5.7 \pm 1.58$ ; Lt- $4.22 \pm 0.304$ )

Thickness of the bony bar-  $3.945 \pm 1.285$  (Rt- $3.42 \pm 0.82$ ; Lt- $4.47 \pm 1.75$ )

### IV. Discussion:

Bony bridging of the suprascapular notch is a common feature in some animals when compared to human beings. Gray [5] examined 1151 scapulae from various sources, which included 87 Indian scapulae, but he did not find even a single instance of suprascapular ligament ossification among the Indian scapulae. Keshav Kumar [8] in his study found STSL ossification only in one out of 200 Indian scapulae (0.5%). The resulting suprascapular foramen was of very large size (13mmx7mm). Familial occurrence of ossification of STSL has also been reported: Cohen et al., [9] have described a case of calcification of suprascapular ligament in a 58 years old man and his son resulting in entrapment neuropathy of the suprascapular nerve, associated with pain, weakness, atrophy of supraspinatus muscle. Osuagwu, et. al., [10] have also reported a case of complete ossification of the suprascapular ligament in a Nigerian male adult.

Instances of suprascapular ligament ossification resulting in bifid [11] and trifid [12] apertures have also been reported.

One can see from tables 1 [3,5,13-26] and 2 [27-39] that the occurrence of ossification of STSL shows wide variation. Brazilian study quotes highest occurrence of ossification of STSL (30.76%), followed by Egyptians (13.6%).

Indian studies show a range of 1.5-10.57% of occurrence of STSL ossification. A study of 76 scapulae from Jarkahand [38] has reported 0.0% of occurrence. Among Indians highest occurrence of ossification of STSL (10.57%) has been reported from Maharashtra [27] followed by Pondicherry (10.0%) [30]. But another study from Maharashtra [39] using 31 cadavers has reported only 1.61% of occurrence of STSL ossification (see table-2). This indicates there can be inter ethnic variation with an geographical area.

There are many causes of suprascapular nerve dysfunction. These include trauma like scapular fractures, clavicular fractures, shoulder dislocations. Reduction in the space due to crowding in the suprascapular foramen may lead to suprascapular nerve entrapment syndrome (SNES). Around 1% to 2% of the total shoulder girdle pain are considered to be due to SNES [40]. André Thomas [6] was the first to describe the mechanisms leading to the development of suprascapular nerve entrapment syndrome. In his report, Thomas described a case of a young patient who came with a complaint of weakness in the left shoulder during certain activities. Occurrence of suprascapular entrapment neuropathy is well known among athletes, especially volleyball players. Ravindran [41] has reported a case of a brother and sister who were volleyball players for over six years. They presented with right shoulder pain and wasting of the scapular muscles, particularly the infraspinatus. On examination involvement of the rhomboid muscles also, was noticed suggesting involvement of other nerves in the region such as the dorsal scapular nerve.

A method of classifying the suprascapular notch, using measurements was introduced by Natsis et al. [42]. In his study, five types were proposed, of which complete foramen of the suprascapular notch is the fourth type. Polguj et al. [43] have improved this classification by a new quantitative method based on geometrical parameters, which includes five types.

The anatomical and morphological variations of the bones forming the shoulder joint are of clinical importance. The data presented here will be useful for interpretation of the radiological images, of patients presenting with pain and weakness of shoulder joint. The data may be used for comparison with other studies of Indian scapulae and with those studies of different population groups. The Orthopaedic surgeon may find it useful during surgery of shoulder joint for suprascapular nerve entrapment to avoid accidental injuries to suprascapular nerve.

**TABLE 1: FREQUENCY OF OSSIFICATIONS OF THE SUPERIOR TRANSVERSE SCAPULAR LIGAMENT IN DIFFERENT POPULATION GROUPS AROUND THE WORLD.**

Author /Year	Population group studied	Number of scapulae studied	Percentage of scapulae with ossified STSL
Kajava [13] 1924	Finland	133	1.5
Vallois [14, 15] 1925, 1926	Italy	200; 152	6.5; 6.1

Gray [5] 1942	USA	1151	6.34
Hrdicka [16] 1942	Egypt	511	13.6
Olivier [17] 1960	France	100	5.0
Rengachary et al. [3] 1979	USA	211	4.0
Edelson [18] 1995	USA	1000	3.7
Ticker et al. [12] 1998	USA	79	5.0
Bayramoglu et al. [19] 2003	Turkey	32	12.5
Tubbs et al. [20] 2003	USA	120	3.7
Dunkelgrun et al. [21] 2003	USA	623	5.0
Urg'uden et al. [22] 2004	Turkey	100	6.0
Silva et al. [23] 2007	Brazil	221	30.76
Sinkeet et al. [24] 2010	Kenya	138	3.0
Wang et al. [25] 2011	China	295	4.08
Polguy et al. [26] 2013.	Poland	616	4.72
Present study	South India	208	03.85

**TABLE 2: FREQUENCY OF OSSIFICATIONS OF THE SUPERIOR TRANSVERSE SCAPULAR LIGAMENT AMONG DIFFERENT POPULATION GROUPS IN INDIA.**

Author /Year	Population group	Number of scapulae studied	Percentage of scapulae with ossified STSL
Jadhav et al/2012[27]	Maharashtra	350	10.57
Soni, Malik, Shukla, Chhabra, Gaur/2012[28]	Haryana	100	3.0
Thounaojam, Karam, Singh/2013[29]	North-Eastern	100	2.0
Kannan , Kannan , Anbalagan , Sudha Rao/2014[30]	Pondicherry	400	10.0
Jangde , Singh Arya , Paikra , Basan 4/2015[31]	Central Indian	73	4.1
Basha , Sugavasi/2015[32]	Andhra	200	1.5
Pawar , Manoranjitham/2016[33]	Maharashtra	105	2.85
Manmeet Kour, Sangeeta Gupta/2016[34]	Jammu	60	3.33
Vedha, Vidulatha/2017[35]	Tamilnadu	250	9.2
Desai, Rathwa, Chavda/2018[36]	Gujarat	200	3.5
Bhandari,Acharya,Parveen,Sah/2018[37]	Himachal Pradesh	200	5.7
Rita Kumari, Renu Prasad /2019[38]	Jarkhand	76	0.0
Dandekar,and Dandekar/2019[39]	Maharashtra	62 (31cadavers)	1.61
Present study	South India	208	03.85

**Legends for the figures:**

**Figures showing measurement of suprascapular foramen.**

**Fig-1a:**

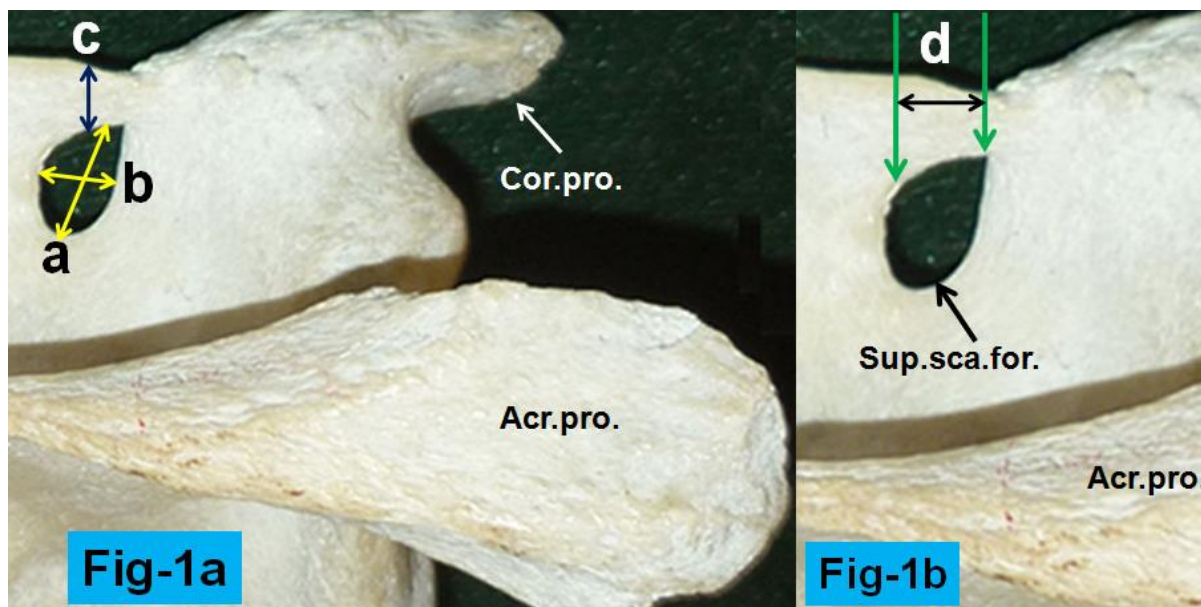
- a**-vertical diameter of the suprascapular foramen
- b**-transverse diameter of the suprascapular foramen
- c**-width of the bony bar bridging the suprascapular foramen

**Fig-1b:**

- d**-length of the bony bar bridging the suprascapular foramen

**Abbreviations used:**

**Acr.Pro:**acromion process;**Cor.pro:**coracoid process;**Sup.sca.for:**suprascapular foramen



## V. Conclusions:

During interpretation of the radiological images, of patients presenting with pain and weakness of shoulder joint the morphological variations of the bones forming the shoulder joint are of clinical importance. The data presented here will be useful for comparison with other studies of Indian scapulae and with those studies of different population groups. The Orthopaedic surgeon should be aware of the occurrence of ossification of STSL during surgery of shoulder joint for suprascapular nerve entrapment to avoid accidental injuries to suprascapular nerve.

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