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COMPLETE OSSIFICATION OF SUPERIOR TRANSVERSE SCAPULAR LIGAMENT: INCIDENCE AND ITS CLINICAL IMPLICATIONS

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ABSTRACT

Introduction and Aims- The ossified superior transverse scapular ligament is one of the risk factor for the suprascapular nerve entrapment neuropathy and poses a challenge during suprascapular nerve decompression. This study has been done to understand the various mechanisms of neural injury leading to suprascapular entrapment neuropathy and to compare its incidence in different populations.

Materials and Methods- 131 dry Indian human scapulae (64-right and 67-left) were examined and analysed. **Results-** 6.1% (8 in 131) scapulae presented with completely ossified STSL of which 3 on right side and 5 on left side. **Conclusion-** The anatomical knowledge of ossified STSL may be helpful for clinician dealing with suprascapular nerve entrapment neuropathy and the knowledge of underlying mechanism of injury to nerve may be helpful in planning the appropriate treatment strategy.

Keywords- Scapula, Superior transverse scapular ligament, Suprascapular notch, Suprascapular neuropathy, ossification.

INTRODUCTION

The superior transverse scapular (suprascapular) ligament is a thin flat fibro-fasciculus band attached laterally to the base of the coracoid process and medially to the medial (inner) side of the suprascapular notch.^{1,2} The ligament and the notch together form a sharp edged inelastic osteofibrous foramen through which suprascapular nerve travels.^{3,4} Suprascapular artery and vein usually pass over the ligament.^{1,5} The classic description of superior transverse scapular ligament (STSL) is a completely non-ossified single band and should be expected on average, in three-fourth of cases.⁶ The documented variation of STSL includes calcification, partial or complete ossification and multiple bands.⁶ The ossification of the STSL was considered anomalous by Harris et al.⁷ The size and shape of suprascapular notch may be a

factor in suprascapular nerve entrapment neuropathy because narrow notch has been found in patient with this neuropathy.^{8,9}

Suprascapular nerve entrapment neuropathy has also been described in clinical scenario without a visible ossification of STSL.¹⁰ This is characterised by weakness of abduction and external rotation of the arm due to supraspinatus and infraspinatus muscle denervation and frequently accompanied by ill-defined shoulder pain.¹¹

Variable incidence of complete ossification of STSL has been reported by research workers which vary in different population. In Indian scenario paucity of data on complete ossification are available. Hence this study has been reported to compare the incidence of ossified STSL in different population, to explain its various mechanism and to discuss its clinical implications.

MATERIALS AND METHODS

The present study was carried out on 131 (Right-64, Left-67) dried human scapulae of unknown sex obtained from Department of Anatomy, SVS Medical College, Mahabubnagar, Andhra Pradesh and Raichur Institute of Medical Sciences, Raichur, Karnataka. Each scapula was observed to see the presence of completely ossified STSL. Representative photographs of STSL were taken using digital camera (Sony 16 megapixel). Quantitative data pertaining to the dimensions of STSL were recorded in millimeters. Dimensions of STSL (Superior maximal length, inferior maximal length, thickness at medial and lateral end) has been measured with divider and meter scale. The scapula with bilaterally damaged superior margin were excluded from the study.

RESULTS

Macroscopic examination revealed that 8 (3-right side, 5-left side) out of 131 (6.1%) scapulae had completely ossified STSL. Dimensions measured are given in Table-2.

DISCUSSION

The completely ossified STSL is one of the most important factors of suprascapular nerve entrapment neuropathy and may pose a challenge at surgical exploration during a suprascapular nerve decompression.^{6,12} Incidence of complete ossification of STSL differs from population to population as shown in table-1. In the present study we observed 6.1% incidence of completely ossified STSL which is close to Polguez¹² (6.25%). Silva *et al.*¹³ have reported 30.76% incidence which is quite high as compared to our study (6.1%). Gray D J¹⁴ found 6.34% (73 in 1151) suprascapular foramen but no foramen in 87 Indian scapulae. In some population complete ossification of STSL was very rare for eg. in Alaskan Eskimos-0.3%, native American- 2.1-2.9%.¹⁵ Osuagwu *et al.*¹⁰ reported a case of complete ossification of STSL in Nigerian male

adult. Khan¹⁶ & Das *et al.*¹⁷ also have reported cases of complete ossification of STSL in Indian population. Cohen¹⁸ *et al* described a familial case of calcification of STSL affecting a 58 year old man and his son who had STSL calcification causing entrapment neuropathy of suprascapular nerve and its attendant clinical symptoms of pain, weakness and atrophy of supraspinatus muscle.

Usually cases of Suprascapular nerve entrapment neuropathy due to ossified STSL complain of deep and diffuse, poorly localized dull or burning pain in the posterolateral aspect of shoulder, which exaggerate on activity and often can be elicited by palpation over the region of the scapular notch. In some cases the pain radiates to the ipsilateral extremity, the side of the neck or the front of the chest. The pain is accompanied by weakness on abduction and external rotation of the shoulder and atrophy of supraspinatus and infraspinatus muscle.^{19,20} Muscle atrophy usually begins before the clinical signs & symptoms and patient's complaints.^{19,20,21} The thorough understanding of anatomy of suprascapular nerve is of paramount importance for an early diagnosis & proper treatment.

Suprascapular nerve, a long mixed sensorimotor peripheral nerve originates from the lateral aspect of superior trunk of the brachial plexus with contribution from the 5th and 6th anterior cervical roots, occasionally from 4th root as well. The nerve then travels down to reach the upper border of the scapula and enters the supraspinatus fossa through the suprascapular notch below the STSL (suprascapular vessels usually above the STSL). The nerve travels obliquely along the floor of the supraspinatus fossa under supraspinatus muscle, supplies it and takes a sharp turn around the lateral margin of the base of the scapular spine with the suprascapular vessels passing below a debated (60.8%)²² spinoglenoid ligament to enter the infraspinatus fossa. Here it supplies the infraspinatus muscle.^{1,4,5,11,19,23}

The suprascapular nerve entrapment neuropathy may be of chronic type (compression, traction,

friction leading to repetitive microtrauma) or acute type (direct trauma eg. fracture of scapula, dislocation of shoulder, fracture neck of humerus, fracture of the clavicle).^{11,20,21} Suprascapular nerve is commonly susceptible to compression mainly at two major sites, suprascapular notch and spinoglenoid notch. Suprascapular nerve injury at suprascapular notch may occur as a result of compression by the overlying superior transverse scapular ligament, specially if it is ossified,^{12,17} calcified,¹⁸ bifid,²⁴ trifid,⁶ hypertrophied²⁵ and/or presence of anterior coracoscapular ligament just below the STSL as reported by Avery 60% (16 in 27)²⁶, Bayramoglu 18.8% (6 in 32)²³, Piyawinijwong 28% (19 in 127)²⁷, Polguez 50% (47 in 93)¹² and/or presence of space occupying lesion eg. ganglionic cyst reported by Ticker⁶, might be due to reduction in available space for the suprascapular nerve passage.

The shape of suprascapular notch has been associated with the risk of nerve injury as well. Rangachary⁹ *et al.* examined 211 cadaveric scapulae and categorized the notch shape into 6 different types – Type I – no discrete notch, Type II – wide V-shaped notch, Type III – wide U-shaped notch, Type IV – narrow V-shaped notch with impression of nerve, Type V – U-shaped notch with partial ossification, Type VI – bony foramen. Our study is concerned to Type VI. Ticker⁶ classified the notch into two types ‘U’ & ‘V’ shaped. Although it has been hypothesized that suprascapular nerve entrapment is more likely to be associated with narrow V-shaped notch, no direct correlation between notch type and suprascapular nerve injury has been demonstrated.²⁸

The suprascapular nerve entrapment neuropathy without visible ossification of STSL can be explained by another mechanism of nerve injury ie. traction (mechanical stretching) with or without friction (rubbing) of suprascapular nerve. The nerve courses through several areas of critical nerve fixation (like at the

site of emergence and termination of the nerve, at the suprascapular notch and spinoglenoid notch, on the floor of supraspinatus fossa under the hypertrophied supraspinatus muscle) and areas of sharp turns. Due to repetitive overhead activities and forceful rotational movements during sports such as volleyball,²⁹ baseball,³⁰ the suprascapular nerve is subjected to traction and kinking specially at suprascapular and spinoglenoid notches as the nerve is within a notch and held by a overlying ligament.^{6,24,25,31} Rangachary⁹ *et al.* found that nerve become closely opposed to the STSL with depression, retraction and hyperabduction of shoulder and hypothesized that mechanism of nerve injury might involve kinking of the nerve against the STSL (sling effect). The stretching of the nerve may also be exacerbated by scapular protraction which move the scapula (and its base of the spine) laterally. It has been hypothesized that this stretching of nerve can be further exacerbated by simultaneous contraction of infraspinatus muscle in which contracted infraspinatus muscle pulls the nerve medially while it is tethered laterally by the base of the spine of the scapula.²⁹

It has been shown that spinoglenoid ligament inserts into posterior glenohumeral capsule, so during cross body adduction and internal rotation, ligament is tightened and nerve is compressed.^{22,32} Sandow *et al.* reported that during extreme abduction and full external rotation medial tendinous margin of the supraspinatus and infraspinatus can impinge strongly against the lateral edge of spine, compressing the infraspinatus branch of suprascapular nerve.³³ Hypertrophied spinoglenoid ligament also causes compression of suprascapular nerve at spinoglenoid notch leading to suprascapular nerve entrapment neuropathy as described by Aeillo *et al.*³². Most paralabral cysts compress the suprascapular nerve only at spinoglenoid notch as it passes within 21 mm from the glenoid rim.³⁴ The enlarged spinoglenoid notch vein has

been identified as cause of suprascapular nerve compression.³⁵

Another hypothesis of injury is that the intimal damage of axillary or suprascapular artery due to direct trauma or friction can result in microemboli of the vasa nervorum which can result in ischaemic injury to the nerve.³¹

The best method to prevent permanent muscle atrophy is the early diagnosis and treatment. While dealing a case of shoulder pain and weakness, along with the natural history of suprascapular nerve injury, family history of such complaints and related treatment should be taken into consideration which may help in diagnosis. Most of the authors have agreed that electromyography (EMG) study is essential to confirm suprascapular nerve entrapment neuropathy. The nerve conduction velocity (NCV) is helpful but not essential for the diagnosis.¹⁹ Radiograph and CT-scan may be useful in assessing the shape of notch, calcified ligament or fracture callus. MRI is particularly helpful in identifying course of nerve, presence of soft tissue lesion (usually cyst) and also in ruling out the other causes of shoulder pain such as rotator cuff tear.^{20,21}

The treatment of suprascapular entrapment neuropathy depends on the duration of the symptoms and the location and cause of entrapment.³⁶ If the neuropathy is of acute onset or secondary to a traction injury rather than to a compressive neuropathy, it should respond to non-operative treatment consisting of relative rest and pain control followed by progressive range of motion and controlled strengthening exercises. However, residual atrophy may persist regardless of the type of treatment.^{21,37} If the nerve lesion is proximal and both the supraspinatus and infraspinatus muscles are involved, the entire nerve should be decompressed but most importantly the superior transverse scapular ligament should be released or sectioned from its medial attachment to minimize the risk of injury to the more laterally located suprascapular nerve

and vessels.²¹ The ossified STSL is a relative contraindication to the arthroscopic release of STSL. So it should be evaluated preoperatively when considering arthroscopic neurolysis.³⁷ A quarter-inch osteotomy can be used to resect the ossified STSL.³⁸ But if only the infraspinatus muscle is involved or there is a structural lesion at the spinoglenoid notch such as paralabral cyst, the nerve may be simply decompressed at the notch. Some surgeons recommend release or section of both the suprascapular and spinoglenoid ligaments even if lesion is at spinoglenoid notch.^{20,34} Surgical exploration with release of compression or traction does not help in regeneration of the nerve or resolution of the atrophy.²¹

Limitation of the study is that the person with ossified STSL might have suprascapular nerve entrapment neuropathy, but the work was done on dry bone so without clinical history it is hard to say that person had suprascapular nerve entrapment neuropathy. Since the present study was performed with a limited number of dry scapulae, more clinical, radiological and cadaveric studies need to be done.

CONCLUSIONS

The present study revealed that incidence of complete ossification of STSL varied in different populations and it can be one of the risk factors for suprascapular entrapment neuropathy. The anatomical knowledge of understanding of the mechanism of this neuropathy may be helpful in planning the appropriate treatment strategy and thus avoiding the poor treatment outcome or treatment failure.

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Table-1 Incidence of complete ossification of superior transverse scapular ligament in different populations

S no.	Authors	Incidence in %	Ossified specimen/No. of specimen studied	Place
1	Natsis ³⁹	7.3	31/ 423	Germany
2	Edelons ⁴⁰	3.7	37/ 1000	America
3	Polguez ¹²	6.25	6/ 96	Poland
4	Sinkeet ⁴¹	2.9	4/ 138	Kenya
5	Silva ¹³	30.76	68/ 221	Brazil
6	S D Jadhav ⁴²	10.57	37/ 350	India (Maharashtra)
7	Kalpana T ⁴³	2	2/ 100	India (Manipur)
8	Present study	6.1	8/ 131	India (Andhra Pradesh)

Table-2 Dimensions of ossified superior transverse scapular ligament

Parameters	1 Left	2 Left	3 Left	4 Left	5 Left	6 Right	7 Right	8 Right
Superior maximal length	9mm	9mm	10mm	12mm	11mm	8mm	10mm	7mm
Inferior maximal length	6mm	6mm	8mm	10mm	10mm	6mm	9mm	6mm
Width at lateral end	4mm	6mm	3mm	3mm	4mm	6mm	8mm	2mm
Width at medial end	6mm	7mm	7mm	5mm	9mm	7mm	8mm	5mm



Fig.-1. Right scapula anterior view showing ossified STSL (arrow).



Fig.-2. Left scapula anterior view showing ossified STSL(arrow).