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Research Article

A STUDY OF INCIDENCE OF OSSIFICATION OF SUPERIOR TRANSVERSE SCAPULAR LIGAMENT OF SCAPULA AND ITS CLINICAL IMPLICATIONS

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ABSTRACT
The aim of this study was to know the incidence of the ossified superior transverse scapular ligament (STSL) on dry adult scapula. Total 180 dry bones (95 right and 85 left) were examined in the Department of Anatomy Government Medical College, Surat for presence of ossified STSL and its thickness. After examination, 19.44% (35/180) of the scapula, presented the ossified STSL of which, 60% (21/35) were ossified in right scapula and 40% (14/35) in left scapula. The 145 scapula that did not present the ossified STSL, it was observed that in 45(31%) of these bones, there was incompletely ossified STSL. This is by far the most common reason for suprascapular nerve entrapment. This anatomical variation should be kept in mind by the clinicians that approaches painful syndrome of the shoulder and suprascapular nerve neuropathy.

Key Words: *Scapula, Superior Transverse Scapular Ligament, Entrapment, Ossification*

INTRODUCTION
A precise knowledge of the shoulder-girdle region is of great importance in order to avoid neurological complications and while performing procedures via open, arthroscopic, or arthroscopically assisted methods. Nerve injury involving suprascapular nerve following shoulder surgery is common due to proximity of the nerve resulting in suprascapular nerve neuropathy. Suprascapular nerve is a branch from upper trunk of brachial plexus. It passes through suprascapular notch which is converted into foramen by superior transverse scapular ligament to supply the motor branches to supraspinatus and infraspinatus muscles and sensory branches to rotator cuff muscles and ligaments of shoulder girdle. It passes through this narrow foramen which not flexible and some time it is having sharp edges (Williams *et al.,* 2004). It is converted to foramen in some species[2] while in humans; this is a result of the ossification of the STSL (Williams *et al.,* 2004; Khan, 2006; Gardner *et al.,* 1988). Testut (1904) and Poirier & Charpy (1911) also reported variation on STSL Ticker *et al.,* (1998) and Osuagwu *et al.,* (2005). Khan (2006) wrote on calcification, partial or complete ossification and multiple bands. Kajava (1924).Vallois (1925), Vallois (1926), Gray (1942), Lewis (1959) have reported difference in ossification of STSL. The suprascapular artery and vein lie superior to the STSL (Antoniadis *et al.,* 1996; Weinfeld *et al.,* 2006). The suprascapular nerve becomes fixed in Osseo fibrous foramen of the notch and STSL (Antoniadis *et al.,* 1996; Weinfeld *et al.,* 2006; Gelmers *et al.,* 1977). Sometimes mechanical irritation can occur at this particular point e.g. during cross body abduction, during a variety of activities involving movement of the upper extremity (Antoniadis *et al.,* 1996; Weinfeld *et al.,* 2006; Gelmers *et al.,* 1977). (Lewis, 1959; Harris *et al.,* 2001) told that ossification of STSL was anomalous saying one more contributory factor to calcification of ligament and nerve entrapment syndrome. In the diagnosis of suprascapular nerve entrapment syndrome, anatomical variations of the STSL sometimes may be possible etiologic factors.

MATERIALS AND METHODS
180 dry adult human scapulas (95 right and 85 left) were examined for presence of ossified STSL in the Anatomy Department of Government Medical College, Surat. Vertical diameter, transverse diameter and thickness of ossified STSL were measured using standard sliding vernier calliper. Scapulas with incomplete ossified STSL were also taken into consideration because of its sharp edge and angulations.

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Observation

Examination showed that 35 out of 180 (19.44%) of examined scapula presented the ossified STSL creating suprascapular foramen (Figurs 1 and 2). In this group, it was observed that 21 out of 35 (60%) were ossified on the right side and 14 out of 35 (40%) on the left side. The 145 scapula that did not present the ossified STSL, it was observed that in 45 out of 180 (25%) of these bones, there was incompletely ossified STSL (Figure 3). Out of them 30 were of right side and 15 were of left side. Out of all, one of the scapulas showed the additional suprascapular foramen along with the suprascapular notch (Figure 4). Mean vertical diameter of suprascapular foramen was found to be 9.3±3.4mm. Mean transverse diameter of foramen was 6±1.8mm. Thickness of ossified STSL was found to be 2.8 ±0.96mm.

Figure 1: Shows right scapula with large suprascapular foramen

Figure 2: shows the measurement of vertical diameter of left suprascapular foramen

Table 1: Shows the numbers of completely ossified STSL, partially ossified STSL and normal suprascapular notch of scapula

	Right	Left	Total out of 180
Completely ossified STSL	21(60%)	14(40%)	35(19.4%)
Incompletely ossified STSL	30(66.6%)	15(33.3%)	45(25%)

Table 2: Shows the mean vertical diameter, mean transverse diameter and thickness of ossified STSL.

Diameter of suprascapular foramen		Thickness of ossified STSL
Mean vertical diameter	Mean transverse diameter	
9.3 ± 3.4 mm	6 ±1.8 mm	2.8 ±0.96 mm

Figure 3: Showing partially ossified STSL of left scapula

Figure 4: Showing suprascapular foramen with normal suprascapular notch

DISCUSSION

The suprascapular nerve gives motor innervations to the supraspinatus and the infraspinatus muscles, but it doesn't innervate the skin. So irritation of the nerve produces deep pain which is poorly localized and that is why the cause of the pain and tenderness is difficult to localize in an individual (Thompson *et al.*, 1959). When the patient visits the clinician with complaints, the muscles atrophy will have already begun (Thompson *et al.*, 1959). Early and correct diagnosis requires a thorough anatomical knowledge of the course of the nerve and its possible sites of compression which may be due to traumatic or some other causes. The suprascapular nerve is commonly compressed mainly at two major sites i.e. at the level of the suprascapular notch and at the base of the scapular spine. The suprascapular nerve passes through the suprascapular notch which is converted into foramen by STSL and there is every chance of compression of nerve if STSL is ossified and possibility of suprascapular neuropathy (Williams *et al.*, 2004). Compression of the suprascapular nerve at the suprascapular notch was first described by Kopell and Thompson *et al.*, (1959). They said that the movement of abduction or horizontal adduction of the shoulder resulted in compression of the nerve against the STSL. (Cohen *et al.*, 1997) reported a familial case of calcification of STSL affecting a 58 years old man and his son suffering from suprascapular nerve entrapment neuropathy. This ossified STSL can be a risk factor during surgery of suprascapular nerve decompression (Ticker *et al.*, 1998). The complete suprascapular foramen was found in 3 of 60 (5%) scapulae by (Poirier & Charpy, 1911). (Kajava, 1924) found the foramen only in 2 of 133 (1.5%) scapulas. (Vallois, 1925) found the foramina in 13 of 200 (6.5%) scapulae of French men. In a second study (Vallois, 1926) reported 6.1 % of foramina in Italian scapula and from a series of studies of same from various sources; the incidence was found from 0% to 3.3 %. Gray (1942) found foramen in 73 of 1151 (6.34%) scapula. Silva *et al.*, (2007) found the ossified STSL in 68 0f 221(30.76%) dry scapula in Brazilians. Comparing with other studies, we documented significant percentage (19.44%) of frequency of ossified STSL in our study (Poirier & Charpy, 1911; Kajava, 1924; Vallois, 1925; Vallois, 1926; Gray, 1942; Silva *et al.*, 2007). About the incompletely ossified superior edge and sharp angulations, we can relate this to shortening or adaptation for muscular overuse that fix at superior edge during the life. Some studies try to show the alterations in the anatomy the human skeleton, in special at sports (Ringel *et al.*, 1990; Tengan *et al.*, 1993; Wang & Koehler, 1996). The partial ossification of the STSL in this study was found in 45 out of 180 (25%). Past studies have reported a 3.7% - 4% incidence of partial ossification of STSL (Hrdlicka, 1942; Rangachary *et al.*, 1979). In the study done by Silva *et al.*, (2007) he found

incompletely ossified STSL in 19.6% of scapula. In the present study, we also included the thickness of ossified STSL as this is also an important factor for the compression of suprascapular nerve. This parameter is not considered until now in all the studies. Sandow & Ilic (1998) discussed about the specific movements in volleyball and their implications at suprascapular nerve compression. The characteristically positions e.g. of volleyball players as abduction associate lateral (external) rotation are factors that predispose the neuropathy. Above data justify our results and the anatomical exploration of the scapular notch region and the STSL. The most recent papers do not elaborate reasons for the STSL ossification, they only analyze that this condition leads to the suprascapular nerve syndrome. There are some articles about bifid and trifid STSL, with the former mostly producing suprascapular nerve entrapment. Rengachary *et al.,* (1979) mentioned six different types of anatomical variations in the suprascapular notch area. These variations of the suprascapular notch and the STSL constitute potential predisposing factors to suprascapular nerve entrapment. Harris *et al.,* (2001) showed that conoid ligament has accessory fascicle at the lateral border of the scapular notch at the junction of the conoid and STLS. This variation is considered anomalous by Harris *et al.*, 2001 but it is mentioned by Testut (1904); Lewis (1959) suggesting one more factor to calcification of STSL and suprascapular nerve entrapment. Although this possible relationship between suprascapular nerve entrapment syndrome and the morphological differences and variations in the STSL, we were unable to correlate all the data due the poor documentation. The present study shows that complete ossification of STSL is common and can occur frequently.

Conclusion

Present study showed 19.44% incidence of ossified STSL which is very much alarming and is a potential risk factor for the suprascapular nerve entrapment syndrome. The anatomical and radiological knowledge of the ossification of the STSL are of extreme importance for clinicians, radiologists and surgeons dealing with suprascapular nerve entrapment conditions. Considering the higher incidence of ossified STSL, further detailed study using the cadaveric dissection, radiology, MRI and dry bones may highlight this topic which opens the door for further research on the ossification of STSL.

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