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Ossification of Superior Transverse Scapular Ligament in an Indian Population

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Abstract

The scapula is a flat bone, situated on the posterolateral aspect of the chest wall. Its superior border is thin and extends between superior and lateral angles. It presents suprascapular notch which is converted into a foramen called suprascapular foramen by superior transverse scapular ligament [STSL] [suprascapular ligament; a fibrous band]. The suprascapular vessels pass above STSL and suprascapular nerve passes below it, through the suprascapular foramen. Complete ossification of STSL converts suprascapular foramen into bony foramen & Suprascapular nerve is commonly entrapped in it. *Aims:* Aim of this study is to calculate & compare the incidence with other studies of the ossified superior transverse scapular ligament [STSL] in dry scapulae and to discuss its clinical significance. *Materials and Methods*: Ninty seven dried human scapulae of Indian population of Marathwada region of Maharashtra, 67 of male and 30 of female i.e. of known sex from the Anatomy Department of Government Medical College, Aurangabad were closely examined for the presence of ossified superior transverse scapular ligament. *Results*: It was found that complete ossification of STSL was 12 out of 97 scapulae of which 11 were males and one was female. 12.37% scapulae of known sex had completely ossified STSL, including nine scapulae of right side and three scapulae of left side. *Conclusions*: The present study showed 12.37% incidence of ossified STSL in Maharashtrian [Indian] population. Incidence of ossification of STSL varies in different populations. It may be influenced by mechanical stress on ligament, age, sex & genetic factors. The knowledge of STSL ossification may be helpful for anatomists, orthopedicians, radiologists, neurosurgeons & clinicians in diagnosis and treatment of suprascapular nerve entrapment syndrome.

Keywords: Superior Transverse Scapular Ligament [STSL]; Ossification; Suprascapular Notch; Suprascapular Foramen; Suprascapular Nerve.

Introduction

The shoulder blade [scapula] is a flat bone, situated on the posterolateral aspect of the chest wall [1]. Its superior border is thin and extends between superior and lateral angles. It presents suprascapular notch which is converted into a foramen called suprascapular foramen by superior transverse scapular ligament [STSL] [suprascapular ligament; a fibrous band]. The suprascapular vessels pass above the STSL [2,3] and the suprascapular nerve passes below it, through the suprascapular foramen [4]. Suprascapular nerve is a large branch of superior trunk of brachial plexus at Erb's point. It runs laterally deep to trapezius and omohyoid, enters the supraspinous fossa, through the suprascapular notch inferior to superior transverse scapular ligament [3,5]. The Suprascapular nerve [SSN] gives motor innervations to the supraspinatus and infraspinatus muscles and sensory innervations to the rotator cuff muscles, to the shoulder and acromioclavicular joint [5,6]. The STSL is a thin flat substantial band that bridges the suprascapular notch and is attached in between the base of the coracoid process and the lateral wall of the suprascapular notch [3]. Suprascapular foramen is the most common location of supra scapular nerve compression & injury. In some animals [7] the suprascapular notch is frequently bridged by bone converting it into a bony foramen, but in human beings , the STSL is sometimes ossified [3,8]. Studies on variations of the superior transverse scapular ligament include calcification,

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partial or complete ossification and multiple bands [9]. Complete ossification of STSL converts suprascapular foramen into bony foramen & Suprascapular nerve is commonly entrapped in it [10,11]. Most important predisposing factor of supra scapular neuropathy is an ossified STSL [12]. Often the ossified STSL produces compression of the suprascapular nerves which result in symptoms like pain in the shoulder region, wasting and weakness of the supraspinatus and infraspinatus muscles [13]. Many studies on incidence of ossification of STSL with associated suprascapular nerve entrapment ,are seen published without reasoning the cause . So, purpose of this study was to compare the incidence of ossification of STSL in dry scapulae, to elucidate the reasons of ossification of STSL with its clinical importance.

Material and Method

The present study was carried out on 97 dried human scapulae of known sex obtained from the Department of Anatomy, Government Medical College, Aurangabad , Maharashtra. The scapulae included in this study were 67 of male and 30 of female. Each bone was closely observed for the presence of suprascapular foramen and the presence of complete ossification of the superior transverse scapular ligament. The bones showing suprascapular foramen [ossified superior transverse scapular ligament] were photographed. The scapulae with damaged superior margin were excluded from the study.

Results

Twelve (12) out of 97 [12.37%] scapulae of known sex had completely ossified STSL [Fig. 1] , including nine scapulae of right side [Fig. 2] and three scapulae of left side [Fig. 3]. Among 12 ossified STSL 11 out of 67 male scapulae [16.41%] & 1 out of 30 female scapulae showed ossification STSL [3.33%]. Nine scapulae [9.27%] of right side [Male=9 & Female=0] & three scapulae [3.09%] of left side[Male=2& Female=1] showed ossified STSL. Eighty five [87.62 %] scapulae were found with no ossified STSL.

Table 1: Shows the numbers of completely ossified STSL

Completely ossified STSL	**Right**	**Left**	**Total 12 out of 97** (12.37%)
Male (67)	9	2	11 (16.41%) Out of Male
Female (30)	0	1	01 (03.33%) Out of Female

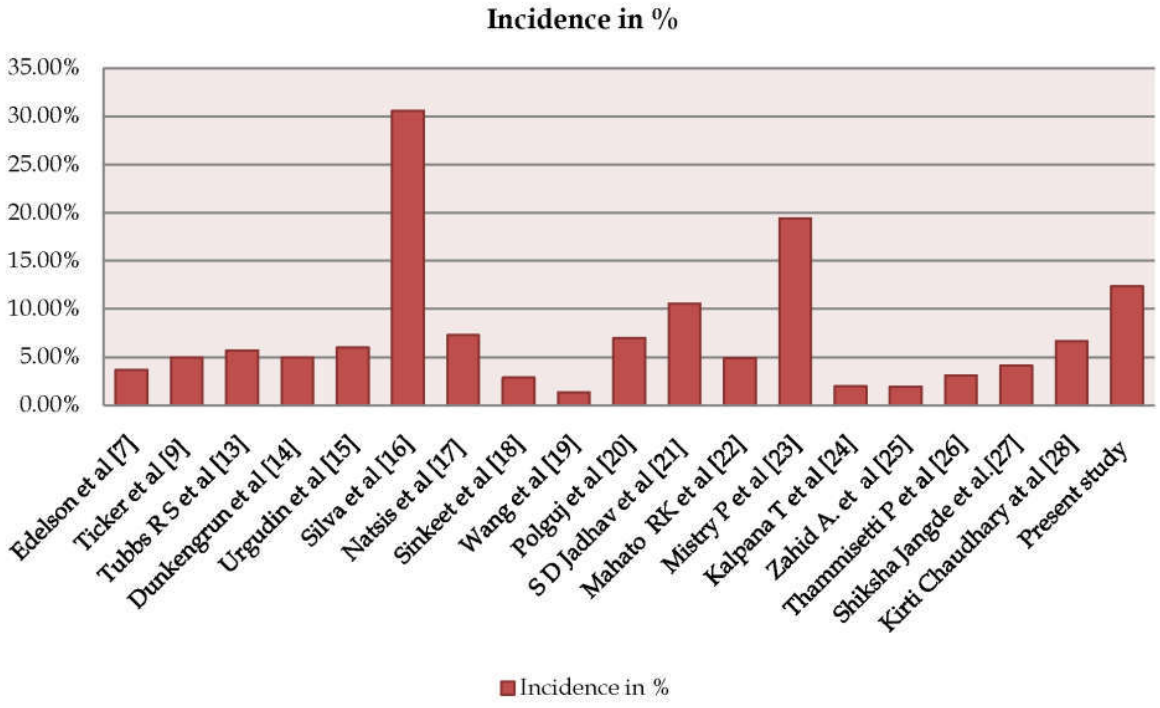
Table 2: Incidence of completely ossified STSL in different populations

Sr. No.	**Study**	**Country**	**Year**	**No. of studied specimens**	**Incidence in %**
1	Edelson et al [7]	America [Washington, NY]	1995	1000	3.7%
2	Ticker et al [9]	America [Massapequa , NY]	1998	79	5%
3	Tubbs R S et al [13]	America [Birmingham,Alabama]	2013	104	5.7%
4	Dunkengrun et al [14]	America [New York]	2003	623	5%
5	Urgudin et al [15]	Turkish	2004	20	6%
6	Silva et al [16]	Brazil	2007	221	30.6%
7	Natsis et al [17]	Germany	2007	423	7.3%
8	Sinkeet et al [18]	Kenya	2010	138	2.9%
9	Wang et al [19]	China	2011	295	1.35%
10	Polguj et al [20]	Poland	2011	86	7%
11	S D Jadhav et al [21]	India [Maharashtra]	2012	350	10.57%
12	Mahato RK et al [22]	India[Andhra Pradesh]	2013	122	4.92%
13	Mistry P et al [23]	India [Surat]	2013	180	19.44%
14	Kalpana T et al [24]	India [Manipur]	2013	100	2%
15	Zahid A. et al [25]	Pakistan	2014	204	1.96%
16	Thammisetti P et al [26]	India [Madhya Pradesh]	2015	96	3.1%
17	Shiksha Jangde et al.[27]	India [C.G.]	2015	73	4.1%
18	Kirti Chaudhary at al [28]	India [Maharashtra]	2016	90	6.66%
19	Present study	India [Maharashtra]	2016	97	12.37%

Fig. 1: Showing all completely ossified STSL
12 Scapulae of ossified STSL, 11 of male & 1 of female

Fig. 2: Right sided scapula with completely ossified STSL
Nine Scapulae of ossified STSL of male & none of female

Fig. 3: Left sided scapula with completely ossified STSL.
Two Male Scapulae One Female Scapulae



Graph 1: Studies of different workers showing incidence of completely ossified STSL

Discussion

Incidence of ossification of STSL varies in different populations as shown in Table 1 and it may be influenced by many factors. Mechanical stress on ligament, age , sex & genetic factors may influence in formation of ossification of STSL [22].

The fractional area of calcified fibrocartilage increases with age [29]. Thus it can be considered that incidence of ossification of STSL is more in advanced aged people. This is supported by the fact that bony bridges [complete ossification of STSL] are more often seen with increasing age suggesting its relation to enthesopathic changes [30].

The quantity of uncalcified fibrocartilage at an enthesis [site of attachment] is well correlated to the extent of movement that occurs between ligament/ tendon and bone. Movement is the mechanical stimulus that triggers the metaplasia of fibroblasts to fibrocartilage cells [31]. So during shoulder and upper extremity movements the muscles [specially supraspinatus and its fascia which is attached with STSL] contraction is likely to cause torsion of the upper part of the scapula. Such twisting movements can create significant stress concentrations at the STSL entheses and even lead to small changes in insertional angle at both ends of the ligament. Near the medial margin of suprascapular notch, superior border of scapula also gives origin to omohyoid muscle which though weak, on contraction contributes to stress concentration at STSL due to its closeness to the ligament. The lateral end of STSL is also blends with the conoid part of coracoclavicular ligament, so force acting on coracoclavicular ligament is transmitted to STSL. Even in the absence of any connection between these two ligaments forces acting on the coracoid process are indirectly transmitted to the STSL due to its attachment to the base of coracoid process. This also adds to stress concentration at the STSL lateral enthesis [2,3].

The bony spurs are bony outgrowths that extend from bone to soft tissue of a ligament/tendon at its enthesis and represent a skeletal response to stress. They can occur in association with high levels of physical activity, are more common with increasing age and are more frequently found in males than in females [2,32]. Rasmussen [33] et al. reported that fibrocartilage developed from fibrous tissue in the os penis of rat, calcified with age under the influence of androgens. Glucksmann & Cherry [34] have shown that testosterone administered to female rats induces the development of an os clitoridis containing fibrocartilage. Hrdlicka [30] in his work has mentioned that bony bridges are found more in Caucasian males. These findings indicate that male predominance in ossification of ligaments may have some endocrinal basis and application of same for STSL ossification can be the topic for further research.

Some individuals have greater tendency to form bone than others, both at the margins of joints and at the entheses. Such individuals form bone at the levels of mechanical stress that do not trigger comparable osteogenesis in others due to their genetic predisposition to more bone formation [32]. Cohen [35] et al. have described a familial case of calcification of STSL causing entrapment neuropathy of the suprascapular nerve affecting both father and son, suggesting that the ossification of STSL may have a genetic basis.

Suprascapular nerve [c5, c6] arises at the Erb's point, which is present on superior trunk of brachial plexus. It goes towards the suprascapular notch through the posterior cervical triangle, under cover of trapezius and omohyoid and finally passes through the suprascapular foramen and enters the supraspinous fossa [3]. Suprascapular nerve entrapment neuropathy has also been described in clinical scenario without a visible ossification of STSL[11]. This is characterised by weakness of abduction and external rotation of the arm due to supraspinatus and infraspinatus muscle denervation, atrophy of these muscles and is frequently accompanied by ill-defined dull or burning pain on the posterolateral aspect of shoulder which exaggerate on activity. In some cases the pain radiates to the ipsilateral extremity, the side of the neck or the front of the chest.

The present study [Fig.1] reported 12.37% incidence of completely ossified STSL, which is slightly higher than S D Jadhav et al. 2012 [10.57%] [21]. The incidence of our study is significantly lower than Mistry P et al. 2013 [19.44 %] [23] & Silva et al. 2007 [30.6%] [16]. Silva et al. studied the prevalence of the ossified superior transverse scapular ligament on dry scapulae in Brazilian population. Complete ossification of superior transverse scapular ligament was rare in some population such as in Kenya [18], China [19], India [Manipur] [24] & Pakistan [25] native as 2.9%, 1.35%, 2% & 1.96% respectively. Sinkeet et al observed the incidence of completely ossified ligament in Keniyan while Wang et al in chinese population . Kalpana T et al. & Zahid A. et al. studied the incidence of ossified ligament is Indian & Pakistani population respectively . Tubbs R S et al 2013 [13] reported incidence of complete ossification of the ligament as 5.7% in American

population and according to study of Polugi et al in Poland population incidence to be 7% . Coexistence of suprascapular notch and suprascapular foramen a rare anatomical variation was found during radiological and anatomical investigations by Micha Polguj et al. [20]. In American population the incidence of complete ossification of the ligament was reported as 3.7 % by Edelson et al. [7], 5% each by Ticker et al. [9] and Dunkengrun et al [14]. Urgudin et al. [15] have been described complete ossification of superior transverse scapular ligament in Turkish population as 6%. While Natsis et al. [17] 2007 in German population as 7.3%. According to Raj Kishore Mahato 2013 [22] complete ossification of the ligament is 4.92% and also he describes that ossification may be influenced by age, mechanical load on ligament, sex and genetic factors and can be one of the risk factors for suprascapular entrapment neuropathy. In Indian population the incidence of complete ossification of the ligament was reported as 3.1% by Thammisetti P et al. [26] , Shiksha Jangde et al [27] & Kirti Chaudhary et al. [28] observed the incidence as 4.1% & 6.66% respectively.

Although anatomical knowledge of the course of the nerve and its possible sites of entrapment is essential for an early and correct diagnosis and management of the nerve entrapment syndrome; certain habits of life [abduction at shoulder] at utilization of the upper limb; the muscles, supraspinatus and levator scapulae transit in this region can be related to the STSL calcification. Also abduction associated external rotation predispose to neuropraxis due to suprascapular nerve compression [36]. It is hypothesized that repetitive overhead motion or trauma contributes to ossification of the ligament as the incidence of entrapment of the suprascapular ligament is largely increased with strenuous overhead motion [e.g., volleyball, baseball]. Cohen et al. [35] have described a familial case of calcification of superior transverse scapular ligament affecting a 58 year old man and his son, who had STSL calcification causing entrapment neuropathy of the suprascapular nerve, clinical symptoms of pain, weakness of the external rotation and abduction, and atrophy of the supraspinatus muscle . Treatment for compression of the suprascapular nerve begins with physical therapy to strengthen the rotator cuff musculature. If conservative treatment fails, surgical decompression of the suprascapular ligament is recommended. Arthroscopic decompression may facilitate a more rapid recovery especially when the entrapment is caused solely by the ossified ligament [37].

There are few limitations to this study. Because of the use of dry scapulae, clinical history of patients was not available as well as the effects of other soft tissue structures on suprascapular nerve could not be evaluated. Therefore the patient with ossified STSL might have suprascapular nerve entrapment neuropathy but without these details, it is hard to say that patient had suprascapular nerve entrapment neuropathy. Since the present study was performed with a limited number of dry bones, more clinical, radiological, surgical, histological and cadaveric studies need to be done.

Conclusion

The present study was performed with dry scapulae and showed 12.37 % incidence of ossified STSL in Maharashtrian [Indian] population . Incidence of ossification of STSL varies in different populations. So more clinical, radiological and cadaveric studies need to be done. The study provides precise data in diagnosis of the suprascapular nerve entrapment. So these facts should be in the mind of clinicians, radiologists and surgeons while dealing with a case of shoulder pain.

Conflict of Interest: Nil

Acknowledement

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