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Research Article

AN OBSERVATIONAL STUDY OF ENTHESOPATHY IN DRIED HUMAN SCAPULAE

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ABSTRACT

Objectives: An abnormal ossification process in soft tissues at the attachment site to a bone is called enthesopathy due to biomechanical movements of bone. The present study aimed to observe the calcification of the transverse scapular ligament (TSL) with complete or partial ossification, the presence of the triangular bony growth at the lateral border of scapula and to observe vascular foramen/foramina piercing at the bases of the spine of scapulae.

Methods: An observational study was conducted on dried human scapulae 140 in number (70 right and 70 left) of unknown sex and age, procured from the Department of Anatomy, People's College of Medical Science and Research Center, Bhopal, and Government Doon Medical College, Dehradun, India. These scapulae were studied to observe enthesopathic changes in them. Measurements were taken with Vernier calipers.

Results: In the present study, we observed the presence of completely ossified TSL with formation of complete suprascapular foramina in 8.57% scapulae. The incidence of triangular bony growth at the lateral border of scapula was found in 40% scapulae of the right side and 32.85% of the left. The incidence of vascular foramina piercing at the bases of the spine of scapulae was 17.14% on the right side and 21.42% on the left side scapulae.

Conclusion: The study provides the descriptive knowledge of enthesopathy in scapulae. The study is of great significance for neurosurgeons and orthosurgeons to carry out various reconstructive surgeries.

Keywords: Enthesis, Enthesopathy, Scapulae, Transverse scapular ligament, Neurovascular foramina.

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INTRODUCTION

The usual attachment or insertion site of a tendon, muscle, capsule, or ligament to a bone is called the enthesis which is very active metabolically. Any disruption from the normal at these sites called enthesopathy having multifactorial causes such as inflammatory changes along with diseases of bone followed by bone erosions and is slowly replaced by endochondral ossification as the healing process (Enthesitis), degenerative (prone in old age) changes as hyperostosis (e.g., Diffuse Idiopathic Skeletal Hyperostosis [DISH]), endocrine disorders such as diabetes mellitus, hypo- and hyperparathyroidism, deposition of calcium pyrophosphate dehydrate (CPPD) crystals, trauma, and its related factors and diseases such as fluorosis, plasma cell dyscrasia with polyneuropathy, organomegaly, endocrinopathy, monoclonal gammopathy (POEM syndrome), and skin changes [1].

These sites when undergo abrasions, stress, or stain due to biomechanical movements of bones act as focal site of abnormal calcification and ossification of bones involving disorders in calcium metabolism, degeneration process, as well as systemic disorders act as an additional predisposing factor, leading to abnormal ossification process in the soft tissues.

These abnormal bony growths may impinge on surrounding structures and blood vessels, leading to bulk of clinical or physical manifestations. The variations in the ossification of transverse scapular ligament (TSL) with the formation of suprascapular foramen of varying shape and size may act as a predisposing factor in compressing the suprascapular nerve (SN), leading to its neuropathy. Similarly, the lateral border gives attachment to teres minor muscle in upper 2/3rd and teres major muscle in lower 1/3rd portion and is also related to the lower subscapular and thoracodorsal nerves and the circumflex scapular artery branch of subscapular artery passes through groove present both muscles may be damaged or impinged by the triangular bony projection causing pain, numbness, and spasm during various movements of the scapula. Thus, the knowledge of enthesopathy will be of great help to anatomists, clinicians, surgeons, orthopedicians, and radiologists during further course of application. The present study was an observational study on dried human scapulae aimed to study the calcification of the TSL with complete or partial ossification, the presence of the triangular bony growth at the lateral border of the scapula and to observe vascular foramen/foramina piercing at the bases of the spine of scapulae.

METHODS

The study was carried out on dried human scapulae of unknown age and sex, 140 in number (70 right and 70 left), procured from the Department of Anatomy, People's College of Medical Sciences and Research Centre, Bhopal, India, and at Government Doon Medical College, Dehradun, India. Fractured and damaged scapulae were excluded from the study. These scapulae were closely analyzed to observe the following variations as follows:

- The ossification of TSL (right, left, or bilateral), extent of ossification (complete/incomplete), and measurements of completely ossified ligaments with dimensions of suprascapular foramina was taken using Vernier calipers.
- The triangular bony projections at the lateral border of the scapula. The distance of this bony growth from the infra glenoid tubercle (maximum length) and that from an inferior angle (minimum length) was measured using Vernier calipers.
- Presence of vascular foramen/foramina at the base of spine of the scapula and their incidence was recorded.

All measurements were taken by a single observer twice to avoid intraobserver error of precision in measurement. If difference of more than 0.4 cm was found in both the measurements, the measures of

precision were calculated. The data were tabulated and subjected to statistical analysis using Microsoft Excel 2007.

RESULTS

The present study showed the presence of complete TSL in 12 (five right sided and seven left sided) scapulae with the formation of suprascapular foramina (Fig. 1) of maximum and minimum lengths of foramen as 1.3 cm and 0.1cm, respectively, while 0.8 cm maximum width and 0.1 cm minimum width (Table 1).

The presence of a completely ossified TSL with formation of completes suprascapular foramina was seen in 8.57% cases that may compress SN passing through them.

The presence of triangular bony projection out growing from the lateral border of the scapula seen in 23 scapulae of the left side and 28 of the right side with the maximum distance of 9.9 cm measured from the infraglenoid tubercle and the maximum distance of 4.2 cm measured from the inferior angle of the scapula. The incidence of bony growth was found as 40% on the right side scapula (Fig. 2) and on the left as 32.85% (Fig. 3). Neurovascular structures such as lower subscapular and thoracodorsal nerves and the circumflex scapular artery branch of subscapular artery passes through groove present both teres muscles may be impinged by the bony projection causing pain, numbness, and spasm during various movements of the scapula.

The bases of the spine of 12 right and 15 left scapulae were pierced by vascular foramen (Fig. 4) with the incidence of 17.14% of the right side and 21.42% of the left side scapulae.

These scapular ossifications manifesting as various clinical conditions are of immense help and significance to the anthropologists, clinicians, operating surgeons, and radiologists to diagnose the diseases of the shoulder joint at its earliest as well as to accurately interpret the Computed tomography (CT) and magnetic resonance imaging (MRI) scans.

DISCUSSION

Ossified TSL bridging the suprascapular notch (SSN) providing the passage for the SN presents on the superior border of the scapula has been reported in Gray's Anatomy Text book [2], Frazer's Anatomy [3], as well as Hrdlicka's Anthropometry text books [4]. There are two major sites of SN entrapment, that is, at the level of the SSN and at the base of the scapular spine [5]. Past researches reported the two different shapes of the SSN as a "U" shaped in 77% and a "V" shaped notch in 23% incidence [6], but in the present study observed formation of a foramen with the completely ossified ligament. In present study, the incidence of complete ossification of the ligament is 8.57% much higher than the previous studies except the study of Jadhav *et al*. and Silva *et al*. (Table 2).

Tubbs *et al*. [7] showed the higher significant presence of scapular foramen on the right side scapula and in male cadavers. They also supported that artery close to nerve might exert ischemia to the nerve causing neuropathy as a result of microtrauma to the nerve while according to Mariggl *et al*. [8] theory of a bony nodule in the central part of the ligament comparable to the ossification center supported by Polguj *et al*. [9]. Nerve entrapment neuropathy may cause pain

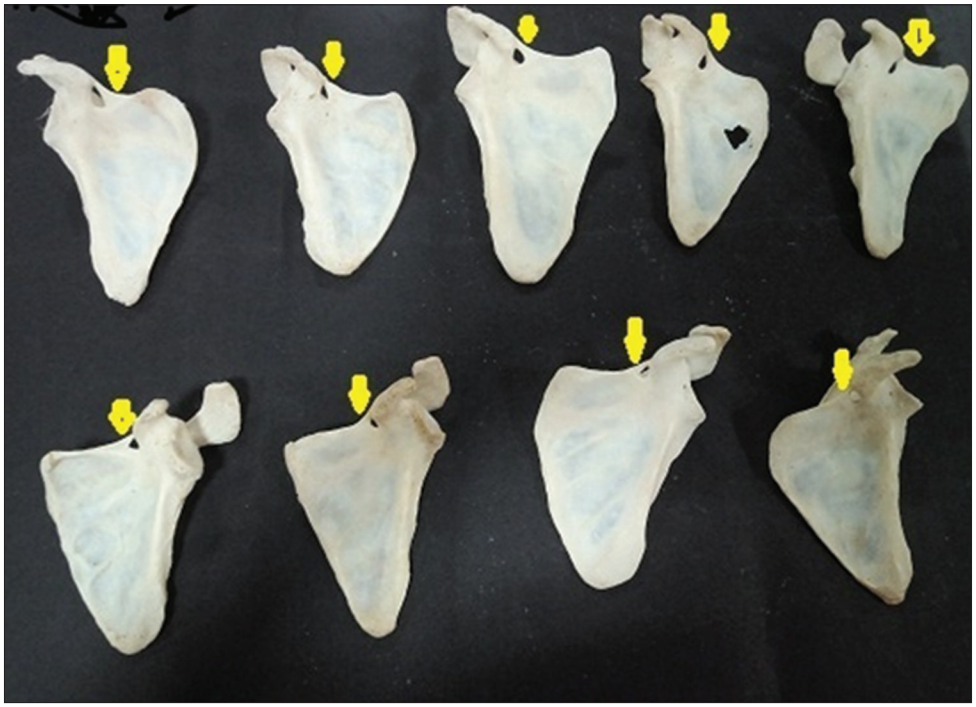

Fig. 1: Arrows showing complete ossified transverse scapular ligament with the formation of suprascapular notch

Table 1: Ossified ligaments and muscles of scapulae with their measurements

Ligament/muscle ossified	Number of cases measurements of complete ossified ligaments (in cms)			
	Complete ossification	Partial ossification	Maximum (L×B)	Minimum (L×B)
TSL	12 (5 right and 7 left)	–	1.3×0.6	0.7×0.1
Teres major muscle	51 (28 right and 23 left)	-	Maximum length from infraglenoid tubercle=9.9 and from inferior angle = 4.2	Minimum length from infraglenoid tubercle=7.2 and from inferior angle = 2.2

TSL: Transverse scapular ligament

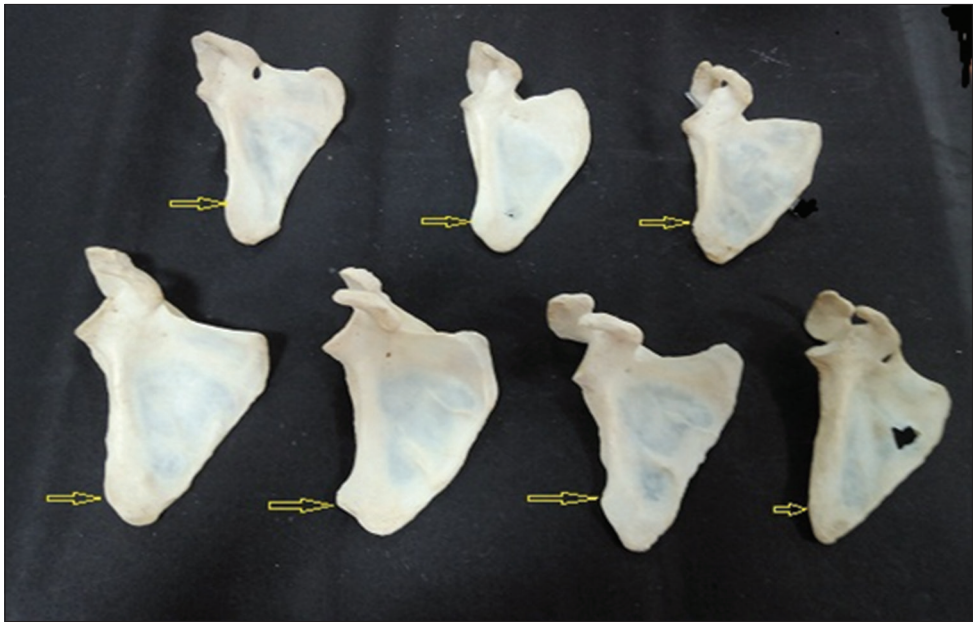

Fig. 2: Arrows showing bony triangular projections at the lateral border of the right scapula

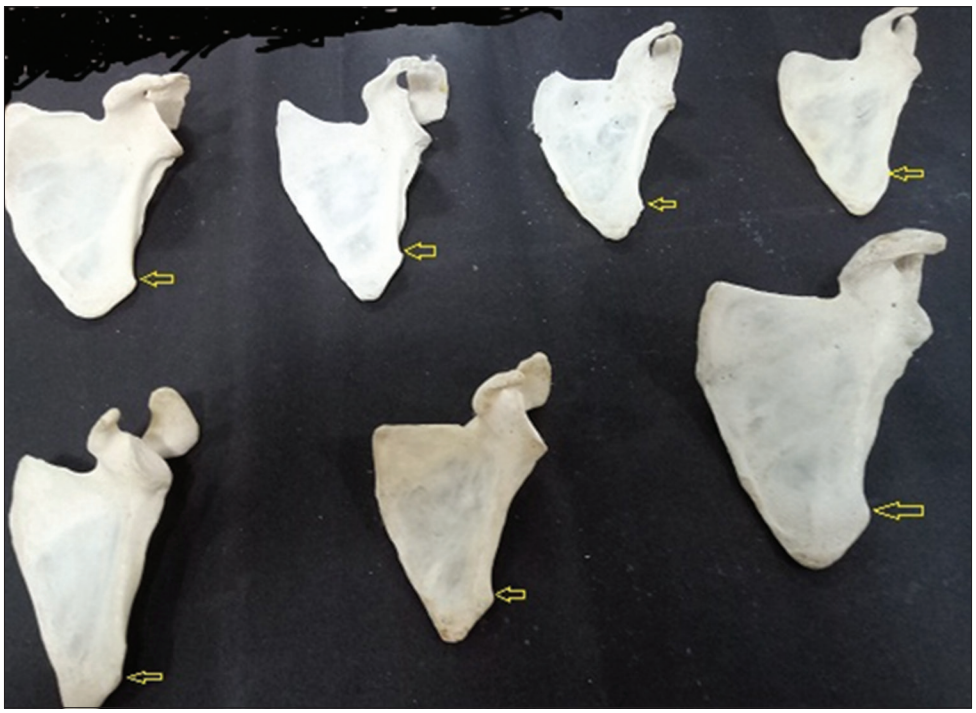

Fig. 3: Arrows showing bony triangular projections at the lateral border of the left scapula

in shoulder, weakness in rotator cuff muscles restricting various movements of the shoulder joint. Abnormal calcifications of various soft tissues such as ligaments, tendons, muscles, and fibrous capsule of joints are the contrecoup reaction of pathology, followed by repair process.

Clinically, they manifest as pain, stiffness, swelling, or tenderness involving the joints and the bones [10]. Thus, knowledge of anatomical variations occurring in the supra scapular ligament will be of immense help to arthroscopic surgeons to perform nerve decompression surgeries.

In the present study, a triangular bony projection at the lateral border of the scapula was seen in 51 scapulae with incidence of 36.42%. Bony growth has been classified under three categories as arising at joint margins as osteophytes, those arising at the sites of attachments of tendons and ligaments known as enthesophytes [1] and others as bony tumors, but bony growths seen in present case may be due enthesophytes or bony tumors excluding osteophytes as these growth are not seen at joint margins.

Singh [17] presented a case report of a triangular bony growth protruding from the lateral border of the scapula with incidence of 3% that may occurred due to excessive strain during biomechanical movements of scapula involving teres major and teres minor muscles or due to calcium metabolism disorder. Similar finding presented as a case report by Goswami and Yadav [18].

In the present study, incidence of vascular foramen at the base of spine of the scapula was seen in 19.28% scapulae while in Text book

Fig. 4: Arrows showing vascular foramen present at the base of spine of scapula

Table 2: Comparison of the present study with the previous studies on complete ossification of TSL

Authors	Incidence (%)
Thounaojam *et al*., Imphal [11]	2
Jadhav *et al*., Maharashtra [12]	10.57
Das *et al*., New Delhi [13]	5
Poirier and Charpy, Paris [14]	5
Gray, California [15]	6.35
Silva *et al*., Brazil [16]	30.76
Present study	8.57

TSL: Transverse scapular ligament

of Quain's Elements of Anatomy mentioned about 10–15% of scapulae, the base of the spine is pierced by a vascular foramen [14].

CONCLUSION

The present study provides the descriptive knowledge of enthesopathy of scapulae which immensely helps clinicians, radiologists, and surgeons to diagnose the disease and comes to differential diagnosis with better and accurate interpretation of CT and MRI scans. Awareness of modifications involved in bones, leading to compression of neurovascular structures in the vicinity, is of great significance for neurosurgeons and orthosurgeons to carry out various reconstructive surgeries and thus relieving symptoms.

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AUTHORS CONTRIBUTIONS

Sumita Agarwal–collected data and wrote manuscript while other authors read and approved the final manuscript.

CONFLICTS OF INTEREST

Nil.

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