Original Article

Indian Journal of Anatomy
Volume 8 Number 3, July - September 2019
DOI: http://dx.doi.org/10.21088/ija.2320.0022.8319.17

Morphological Study of Anterior Coracoscapular Ligament

Dandekar Usha K[1], Dandekar KN[2]

Abstract

Suprascapular notch harboring the two ligaments, namely superior transverse scapular ligament and anterior coracoscapular ligament is a potential site contributing in causation of suprascapular nerve entrapment syndrome. The etiological role of superior transverse scapular ligament in suprascapular nerve entrapment syndrome is established and it needs to be excised in the treatment of suprascapular nerve entrapment syndrome. The anterior coracoscapular ligament is recently introduced as a new risk factor. The mystery about the role of this ligament in suprascapular nerve entrapment syndrome attracted us to undertake morphological study of this ligament. In this study, anterior coracoscapular ligament was found as a separate fibrous band in 41.2%. According to the distal attachment of the ligament as suggested by Piyawinijwong, we found three types of anterior coracoscapular ligament: type I (52.4%), type II (40.5%) and type III (7.1%). According to the shape of ligament, we found anterior coracoscapular ligament as– Fan shaped (47.6%), band shaped (42.9%), bifid (2.4%) and vestigial type (7.1%). The mean cross sectional area of suprascapular opening with anterior coracoscapular ligament was estimated as 29.86 mm^2 and without anterior coracoscapular ligament it was 29.35 mm^2. The mean middle width of suprascapular opening with anterior coracoscapular ligament was 3.8 mm and without anterior coracoscapular ligament it was 4 *mm*. The suprascapular nerve as the only structure passing through suprascapular opening was seen in 50%. The suprascapular nerve along with suprascapular vein passing through suprascapular opening was seen in 20.6% whereas suprascapular nerve and suprascapular vessels passed through suprascapular opening in 17.6%. Accessory suprascapular veins were found in 11.8%. The anterior coracoscapular ligament apparently contributes to reduce the area of suprascapular opening leading to compression of suprascapular nerve which may cause suprascapular nerve entrapment syndrome. The anterior coracoscapular ligament if present is one of the equally important predisposing factors as superior transverse scapular ligament. Variations in morphology of anterior coracoscapular ligament may influence the area of suprascapular opening through which suprascapular nerve passes. Therefore one should not underestimate the importance of anterior coracoscapular ligament.

Keywords: Anterior coracoscapular ligament; Suprascapular nerve entrapment syndrome.

How to cite this article:
Dandekar Usha K, Dandekar KN. Morphological Study of Anterior Coracoscapular Ligament. Indian J Anat. 2019;8(3):233-238.

Introduction

The Suprascapular Notch (SSN) is a potential site contributing in causation of Suprascapular Nerve Entrapment Syndrome (SNES). The reduction in space in SSN through which the suprascapular nerve passes may lead to its compression causing SNES whose symptoms include nagging pain over the posterolateral region of shoulder and severe cases may show atrophy of the supraspinatus and infraspinatus muscles along with weakness of abduction and external rotation of upper limb.[1-3]

The SSN harbors two ligaments: Superior Transverse Scapular Ligament (STSL) and Anterior Coracoscapular Ligament (ACSL). The STSL is a constant ligament while ACSL is infrequent. Both are incriminated as predisposing factors in causation of SNES by various authorities. André

Author's Affiliation: [1]Associate Professor, Department of Anatomy [2]Professor, Department of Surgery, Rural Medical College, Pravara Institute of Medical Sciences Deemed to be University Loni, Maharashtra 413736, India.

Corresponding Author: Dandekar Usha K, Associate Professor, Department of Anatomy, Rural Medical College, Pravara Institute of Medical Sciences Deemed to be University Loni, Maharashtra 413736, India.

E-mail: drushadandekar@yahoo.co.in
Received 15.06.2019 | **Accepted** 24.07.2019

Thomas (1936) was the first to describe mechanisms leading to the development of SNES[4]. In 1959 Kopell and Thompson stated that abduction or horizontal adduction of the shoulder exert traction on the suprascapular nerve causing its compression.[5] Rengachary[6] suggested a "sling effect" by STSL causing traumatic kinking of the suprascapular nerve. These reports established STSL as a predisposing factor contributing injury and compression of suprascapular nerve causing SNES. In 2002, Avery *et al.*[7] introduced another independent ligament, "ACSL", as a new risk factor. ACSL is a fibrous band extending anterior to the suprascapular notch and inferior to STSL. Thus the suprascapular nerve passes through the foramen bounded superiorly by the inferior border of STSL, inferiorly by superior border of ACSL if present or inferior border of SSN in absence of ACSL and bony margins of SSN on each side[8]. The incidence of ACSL varies from 18.8% to 60% of population.[7-14]

Since the introduction of ACSL, its role in causation of SNES has remained controversial. Some authors held it (ACSL) as predisposing factor in SNES while some considered it to provide protective cushioning effect. The mystery about the role of this ligament in SNES and lack of description in standard textbook attracted us to undertake morphological study of ACSL.

Materials and Methods

The study was carried out on 102 embalmed adult human shoulders in the Department of Anatomy, Rural Medical College, Loni. Institutional Ethical clearance was obtained from the IEC of Pravara Institute of Medical Sciences Deemed University to which the Rural Medical College is affiliated. [Letter PIMS/IEC-DR/2018/288dated 11/12/2018 Reg.No: PIMS/DR/ RMC/2018/273].

Exclusion criteria consisted of presence of any operative interventional procedure in suprascapular region and congenital anomalies of shoulder. Dissection of the suprascapular region was carefully performed by incising and reflecting the skin and soft tissues layer wise. The scapular muscles were demonstrated and then reflected to expose the superior border of scapula and SSN. The STSL, ACSL and suprascapular nerve and vessels were identified and skeletonized. The morphometry of ACSL, the relationship of the suprascapular nerve and vessels to ACSL and presence of any abnormal mass in this area were carefully recorded. The Cross sectional area of suprascapular opening was calculated by using the formula for an ellipse: Area = $\pi \times D1/2 \times D2/2$ where D1 is vertical diameter of suprascapular foramen and D2 is transverse diameter of the suprascapular foramen.[15] Digital Vernier caliper was used to record measurements and multiple photographs obtained. Data obtained in the present study was compared with that of available literature in different populations.

Results

ACSL was found as a fibrous band in 42 shoulders (41.2%). The ligament was situated below the STSL and attached laterally to the root of coracoid process and extended to anterior surface of the scapula or to the inferior margin of SSN. According to the distal attachment of the ligament, as suggested by Piyawinijwong classification [11], we found three types of ACSL as type I (52.4%) (**Fig. 1**),

Fig. 1. Type I: ACSL extending to anterior surface of scapula further away from SSN

Fig.2. Type II: ACSL sub-dividing the SSN into two foramen

type II (40.5%) (**Fig. 2**) and type III (7.1%) (**Fig. 3**). According to the shape, ACSL was found as–Fan shaped (47.6%) (**Fig. 4**), band shaped (42.9%) (**Fig. 5**), bifid ACSL (2.4) (**Fig. 6**) and vestigial type (7.1%).

In the present study, the mean cross sectional area of suprascapular opening with ACSL was estimated as 29.86 mm^2 and without ACSL it was 29.35 mm^2. The mean middle width of suprascapular opening with ACSL was estimated as 3.8 *mm* and without ACSL it was 4 *mm*. we also demonstrated the mean cross sectional area and mean middle width of suprascapular opening in different types of STSL with and without ACSL.

In our study, the suprascapular nerve as the only structure passing through suprascapular opening was seen in 50%. The suprascapular nerve along with suprascapular vein passing through suprascapular opening was seen in 20.6% whereas suprascapular nerve and suprascapular vessels passed through suprascapular opening in 17.6%.

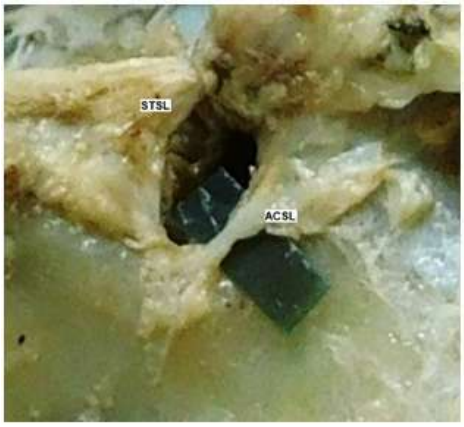

Fig. 3. Type III: ACSL extending up to inferior border of SSN

Fig. 4. Band shaped ACSL

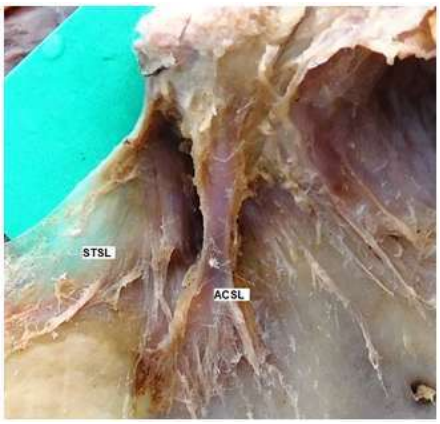

Fig. 5. Fan shaped ACSL

Fig. 6. Bifid ACSL

Accessory suprascapular veins were found in 11.8%.

Discussion

ACSL is one of the important factors in the causation of SNES as it may reduce the area of suprascapular opening leading to compression of suprascapular nerve. However, Polguj[1] in 2013 postulated that the presence of ACSL may prevent the development of suprascapular neuropathy, unless it does not significantly reduce the space under the STSL. In that case, the ligament supports the nerve to prevent its excessive movement and forms a canal which enables direct passage of the nerve from the front side of the scapula to the supraspinous fossa. Thus, by supporting the nerve, ACSL can protect against its injury. Podgorski[8] postulated

that mechanically efficient ACSL is more common in the deep and narrow type of suprascapular notch which is more prone to SNES.

In our study the incidence of the ACSL was 41.2%. It was higher than that seen by Piyawinijwong[11]. Bayramoglu[13], and Gurses[14] but was lower than that described by Avery[7]. Polguj[9] Polguj[10], Polguj[12], Podgorski[16], Polguj[17]. Polguj[12] in 2012 classified the ACSL into 4 types based on specific geometrical parameters and morphology. In type I the ligament is uniformly fan shaped. In this type the ratio of Maximal Proximal Width (MPW) to Maximal Distal Width (MDW) is equal or more than two. The type II is band shaped. The ratio between MPW and MDW is less than two. The type III is bifid in which two independent bands are present at the medial edge of the SSN. Type IV is vestigial where the ligament is presented as a small band running in the area of the inferior border of the SSN. Gurses[14]

Table 1: Comparison of types of ACSL according to shape

Shape of ACSL	Michal Polguj[12]	Gurses[14]	Present study
Fan shaped	7	25	47.6
Band shaped	62.8	68.7	42.9
Bifid	11.6	0	2.4
Vestigial	18.6	6.3	7.1

found above mentioned three types. They did not get bifid ACSL (Type III). In our study, we found all four types but the findings are not corresponding with Polguj[12] and Gurses[14] study (**Table 1**).

According to distal attachment of the ACSL, Piyawinijwong[11] distinguished three types as follows: In Type I (15.79%), the distal attachment extended to the anterior surface of the scapula further away from inferior border of the SSN. In Type II (63.16%) the distal attachment extended across the SSN and subdivided the notch into two foramina. In Type III (21.05%), the distal attachment extended near the bottom of the SSN. Type II and III were the most vulnerable types as they reduced the space for the passage of suprascapular nerve through suprascapular opening[11]. We found these types in 52.4%, 40.5% and 7.1% respectively which are not corresponding to the study done by Piyawinijwong.[11] Polguj[12] found difficulty to compare their method of classification of ACSL to Piyawinijwong's classification. They considered vestigial ACSL as type III and other shaped ACSL together as type I and II.

The mean cross sectional area of suprascapular opening with ACSL was estimated as 29.86 mm^2 and without ACSL it was 29.35 mm^2. Polguj[12] reported these findings as 29 ±18.4 mm^2 and 33.06 ±18.93 mm^2. Polguj[10] emphasized the alteration in mean area and mean middle width of suprascapular opening in different types of STSL with ACSL as well as without ACSL. They reported mean area and mean middle width of suprascapular opening in cases of band shaped STSL with ACSL were lower than without ACSL. In cases of fan shaped STSL they found similar values in specimens with ACSL and without ACSL. Bifid STSL had similar findings as band shaped STSL. Our findings are corresponding with Polguj[10] study in case of band shaped STSL but not with fan shaped and bifid STSL.

The relationship of ACSL to suprascapular nerve and vessels has clinical importance with regards to entrapment of suprascapular nerve. In the present study, in all cases the suprascapular nerve passed through suprascapular opening formed by STSL and ACSL in specimens having ACSL or STSL and inferior border of SSN in specimens without ACSL. Podgorski[8] found the same findings. In Polguj[12] study the suprascapular nerve passed inferior to ACSL in 2 specimens and superior to it in 41 specimens. Polguj[9] reported the suprascapular nerve passing superior to ACSL through the suprascapular foramen in 91 cases and inferior to the ACSL in two specimens. Polguj[17] found 2.8% cases in which suprascapular nerve passed under the ACSL and in 49.1% cases it passed above the ligament.

The chances of SNES increase if structures passing through suprascapular opening are more in number. The structures that surround the suprascapular nerve can cause its compression and damage[18]. Podgorski[19] mentioned that the SSN vein and ACSL may support a cushion mechanism for the suprascapular nerve protecting it against repeated microtrauma. Standard textbooks mentioned that the suprascapular nerve passed below STSL through suprascapular opening and the suprascapular vessels passed above the STSL[20]. The relation of suprascapular vessels and suprascapular nerve was described by Polguj[10,17]. Polguj[10] classified these relations into 2 types as: First Type-the suprascapular artery ran above the STSL and the suprascapular vein and nerve ran below it. Second type-the suprascapular vessels

were above the STSL and the suprascapular nerve was below it. Polguj[17] further classified these relations into 4 types. First 2 types are same as above. In type III the suprascapular vessels and nerve passed through suprascapular opening. Type IV comprised the other variants of these structures as the occurrence of the accessory suprascapular veins and the cases in which the analyzed structures pass under the ACSL. Gurses[14] proposed another threefold classification of relations of suprascapular structures to ACSL. Type I is typified by single suprascapular nerve passing between the STSL and ACSL (18%). Type II is subdivided into IIa and IIb: Type IIa possessing single suprascapular vein with suprascapular nerve passing between the STSL and ACSL (12%) and Type IIb possessing single suprascapular vein passing under the ACSL and suprascapular nerve passing between the STSL and ACSL (2%). In Type III, the whole suprascapular triad (suprascapular artery, vein, and nerve) passes between the STSL and ACSL (4%). In my previous study on STSL[21] I have reported first 3 types whereas Podgorski[16] reported first and third types. In the present study we found all 4 types but the findings are not corresponding to other's study (**Table 2**).

Double suprascapular foramen have been demonstrated by Serghei[18] and Polguj[22] probably caused by ossification of both STSL and ACSL. Saritha[23] found co-existence of SSN and suprascapular foramen. These reports indicate that the presence of two bony bridges may be a factor in the increased risk of occurrence of suprascapular neuropathy.

Table 2: Comparison showing relations of neurovascular structures to ACSL and STSL according to Polguj classification.[17]

	Polguj[10] %	Podgorski[16] %	Polguj[17] %	Gurses[14] %	Usha [21] %	Present study %
Type I	72.1	96	61.3	12	29.03	20.6
Type II	27.9	0	17	18	54.84	50
Type III	-	4	12.3	4	16.13	17.6
Type IV	-	-	9.4	2	-	11.8

Conclusion

It has been suggested that reduction in the space available for the passage of suprascapular nerve may predispose its compression and injury leading to the SNES. The ACSL if present is one of the equally important predisposing factors as STSL. Variations in morphology of ACSL may influence the area of suprascapular opening through which suprascapular nerve passes. Therefore, one should not underestimate the importance of ACSL.

Conflict of Interest: Nil

References

1. Polguj M, Synder M, Borowski A, *et al.* "Anterior coracoscapular ligament as a factor predisposing to or protective for suprascapular neuropathy." Bio Med Research International. 2016;6
2. Zehetgruber H, Noske H, Lang T, *et al.* Suprascapular nerve entrapment, A meta-analysis International Orthopedics (SICOT). 2002;26:339–43.
3. Aly El Sayed, Metwally M, Elshenety RM, *et al.* Suprascapular nerve: Anatomical and Clinical Study. International Journal of Clinical and Experimental Medical Sciences. 2016;2(3):31–39.
4. Pecina M. Who really first described and explained the suprascapular nerve entrapment syndrome. J Bone Joint Surg Am. 2001;83-A(8):1273–7.
5. Thompson WAL, Kopell HP. Peripheral entrapment neuropathies of the upper extremity. New Engl J Med. 1959;260:1261–65.
6. Rengachary SS, Burr D, Lucas S, *et al.* Suprascapular entrapment neuropathy: A clinical, anatomical, and comparative study. II: Anatomical study, Neurosurg. 1979;5(4): 447–51.
7. Avery BW, Pilon FM, and Barclay JK. Anterior coracoscapular ligament and suprascapular nerve entrapment. Clinical Anatomy. 2002;15(6):383–86.
8. Podgorski M, Topol M, Sibiński M, *et al.* What is the function of the anterior coracoscapular ligament?–A morphological study on the newest potential risk factor for suprascapular nerve entrapment. Annals of Anatomy. 2015;201:38–42,
9. Polguj M, Jędrzejewski K, Majos A, *et al.* Variations in bifid superior transverse scapular ligament as a possible factor of suprascapular

entrapment: An Anatomical Study. Int Orthop. 2012;36:2095–100.

10. Polguj M, Jedrezwski K, Podgorski M, *et al.* A proposal for classification of the superior transverse scapular ligament: Variable morphology and its potential influence on suprascapular nerve entrapment. J Shoulder Elbow Surg. 2013; 22:1265–73.
11. Piyawinijwong and S, Tantipoon P. The anterior coracoscapular ligament in Thais: Possible etiological factor of suprascapular nerve entrapment. Siriraj Medical Journal. 2012;64:S12–S14.
12. Polguj M, Jędrzejewski K, and Topol M. Variable morphology of the anterior coracoscapular ligament: A proposal of classification. Annals of Anatomy. 951;8(1): 77–81.
13. Bayramoglu A, Demiryurek D, Tuccaretal E. Variations in anatomy at the suprascapular notch possibly causing suprascapular nerve entrapment: An Anatomical Study. Knee Surgery, Sports Traumatology, Arthroscopy. 2003;11(6):393–98.
14. Gurses IA, Gayretli O, Coskun O, *et al.* Anatomical relations between anterior coracoscapular ligament and suprascapular neurovascular structures and a proposal for classification. Acta Orthopaedica et Traumatologica Turcica. 2015;49(4):433–37.
15. Mitchell J. The incidence and dimensions of the retroarticular canal of the atlas vertebra. Acta Anatomica. 1988a;163:113–20.
16. Podgórski M, Topol M, Sibiński M, *et al.* New parameters describing Morphological variations in the suprascapular notch region as potential predictors of suprascapular nerve entrapment. BMC Musculoskeletal Disord. 2014;15:396.
17. Polguj M, Rozniecki J, Sibiński M, *et al.* The variable morphology of suprascapular nerve and vessels at suprascapular notch: A proposal for classification and its potential clinical implications. Knee Surgery, Sports Traumatology, Arthroscopy. 2015;23(5):1542–548.
18. Covantev S, Belic O, Mazuruc N. Double suprascapular foramen: A rare scapular notch variation. Russian Open Medical Journal. 2016;5(3):1–3.
19. Podgórski M, Sibinski M, A. Majos, *et al.* The suprascapular vein: A possible etiology for suprascapular nerve entrapment and risk of complication during procedures around the suprascapular foramen region. Orthopaedics and traumatology, surgery and research: OTSR. 2014;100(5):515–19.
20. Grays Standring S. Gray's Anatomy: The Anatomical Basis of Clinical Practice, 40th edition. New York, USA: Churchill Livingstone Elsevier; 2008.
21. Dandekar U, Dandekar K. Cadaveric morphological study of superior transverse scapular ligament and its clinical correlation. Indian J Clin Anat Physiol. 2019;6(2).
22. Michał P, Michał P, Kazimierz J, Miroslav T, The double suprascapular foramen: Unique anatomical variation and the new hypothesis of its formation. Skeletal Radiol. 2012;41:1631–636.
23. Saritha S. Co-existence of suprascapular notch and suprascapular foramen. A rare anatomical variation and its clinical correlation: A Case Report. International journal of medical science and clinical Invention. 2014;1(2):65–8.