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Research Article

# What is the function of the anterior coracoscapular ligament?–A morphological study on the newest potential risk factor for suprascapular nerve entrapment

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ABSTRACT

*Background:* The suprascapular notch (SSN) is the most common site of suprascapular nerve neuropathy, which may be brought on by the presence of a deep, narrow SSN and structures restricting the space for the nerve. The anterior coracoscapular ligament (ACSL) is a fibrous band extending on the anterior side of the suprascapular notch. As it may tighten the osteo-fibrous tunnel for the nerve, it has been proposed as a new anatomical risk factor in its entrapment. However, this structure occurs in up to 60% of patients, many of whom do not demonstrate any nerve injury.

The aim of this work is to evaluate the association between the occurrence of the ACSL and SSN morphology.

*Materials and methods:* The suprascapular notch region was dissected in 100 formalin-fixed, cadaveric shoulders. The ACSL (if present) and the SSN were assigned to a classification based on their morphology and diameters. Statistical analysis was performed.

*Results:* The ACSL was present in 52 scapulae (52%) and in all cases, the suprascapular nerve travelled superior to the ACSL. Mechanically relevant types of ACSL were found to occur significantly more often when deeper notches were present ($p = 0.0018$).

*Conclusions:* The mechanically efficient ACSL is more common in deep and narrow SSNs, which are associated with suprascapular nerve neuropathy. Thus, by supporting the nerve, the ACSL can protect against its injury.



## 1. Introduction

In 2002, Avery et al. (2002) first reported a new risk factor in suprascapular nerve entrapment: a separate, singular fibrous band named the Anterior Coracoscapular Ligament (ACSL), extending below the superior transverse scapular ligament (STSL), on the anterior side of the suprascapular notch (SSN). It was proposed that this ligament might reduce the space available for the passage of the suprascapular nerve, predisposing the patient to its compression and injury (Avery et al., 2002; Bayramoğlu et al., 2003; Piyawinijwong and Tantipoon, 2012). However, their observations were only qualitative and conclusions were not supported by statistical analysis. Moreover, Polguj et al. (2013a) later demonstrated that the mean area of the opening for the suprascapular nerve passage did not significantly differ between specimens with an ACSL and those without. Finally, although the occurrence of the ACSL ranges from 18.8% (Bayramoğlu et al., 2003) to 60% (Avery et al., 2002), the frequency of shoulder pain due to the suprascapular neuropathy is less than 2% of the general population (Gosk et al., 2007). All the above suggests that the ACSL may play a protective role against this particular neuropathy (Fig. 1). It can support the suprascapular nerve, preventing its excessive movement and creating a "flume" that smoothly guides the nerve from the anterior side of the scapula to the supraspinatus fossa.

On the other hand, the size and shape of the SSN are the most well-defined and important anatomical factors in the etiopathology

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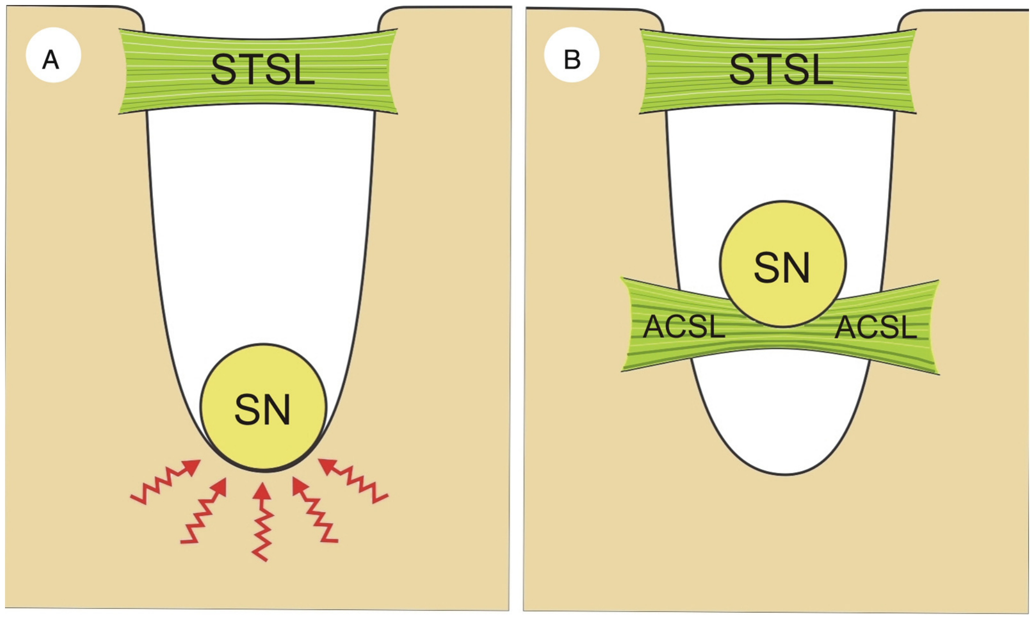


**Fig. 1.** Schema presenting protective role of the ACSL. In "deep and narrow" SSN (A) the nerve might be irritated by bony borders (red zigzag), but when the ACSL is present (B) the nerve receives additional space to move freely. ACSL—anterior coracoscapular ligament, SN—suprascapular nerve, STSL—superior transverse scapular ligament.

of suprascapular nerve entrapment (Natsis et al., 2007; Dunkelgrun et al., 2003). A "deep and narrow" type of suprascapular notch is associated with suprascapular nerve neuropathy (Avery et al., 2002; Polguj et al., 2013b; Rengachary et al., 1979a,b).

The aim of the present study is to evaluate the relationship between the presence of the ACSL with particular types of SSN, as well as its morphology. It is foreseen that the ACSL will co-occur more often with deep and narrow notches, protecting against irritation and trauma of the suprascapular nerve. This is the first study to investigate the protective function of the ACSL.

## 2. Materials and methods

The suprascapular notch was dissected in 100 formalin-fixed, cadaveric shoulders (41 left and 59 right). Only limbs having no deformations or scars around the shoulder region were included. Donors were Caucasians from the Polish population who gave their informed consent for their bodies to be utilized for scientific purposes. The study protocol was accepted by the Bioethics Commission of the Medical University of Lodz (protocol no. RNN/580/13/KE).

An anterior approach was used. The subscapular muscle was bluntly detached from the subscapular fossa and retracted laterally, revealing the anterior side of the scapula. The arrangement of the suprascapular nerve and vessels was recorded and the structures were removed.

If the ACSL was present, it was classified according to Polguj et al. (2013a) as bifid (type III) or vestigial (type IV), based on its morphology (Fig. 2). Fan-shaped or band-shaped types of the ACSL (type I and II, respectively (Fig. 2)) were recognised based on the following measurements (Fig. 3):

(1) Maximal proximal width (MPW) of the ACSL—the maximal distance between the superior and inferior borders of the proximal attachment of the ACSL, taken in a plane parallel to the axis of the ligament.
(2) Maximal distal width (MDW) of the ACSL—the maximal distance between the superior and inferior borders of the distal attachment of the ACSL, taken in a plane parallel to the axis of the ligament.

In a fan-shaped type of ACSL, the diameters of the MPW and the MDW varied by more than 2 times and in a band-shaped type the difference was less.

Afterwards all ligaments were removed to reveal the bony border of the SSN. To assign the SSN to the five-fold classification given by Polguj et al. (2013b), type 4 (a bony foramen created by the ossified STSL) and type 5 (a discreet notch) were selected based on the morphology of the SSN (Fig. 4). For further differentiations of SSN types in remaining notches, the following parameters were measured:

(1) The superior transverse diameter (STD) of the SSN—distance between uppermost points of the medial and lateral edge (corners) of the SSN.
(2) The maximal depth (MD) of the SSN - the shortest distance from the STD to the deepest point of the SSN.

In type I, the MD was bigger than the STD; in type II they were equal; and in type III the STD was bigger than the MD (Fig. 4). All measurements were performed with a Digimatic caliper (Mitutoyo Company, Kawasaki-shi, Kanagawa, Japan).

Statistica 12.0 (StatSoft Polska, Crakow, Poland) was employed for all statistical analyses. The normality of data distribution was checked with the Shapiro-Wilk test. The Student's t-test was used to compare the SSN dimensions between shoulders with and without the ACSL. A p-value <0.05 was concerned significant.

## 3. Results

In all cases, the suprascapular nerve travelled to the supraspinatus fossa between the STSL and ACSL (Fig. 3).

The ACSL was present in 52 scapulae (52% of all samples). The most common type was a band-shaped (type II), which occurred in 33 shoulders (63.5% of all identified ACSLs). In 10 shoulders (19.2% of ACSLs) the ACSL was vestigial (type IV) and in 5 shoulders (9.6% of ACSLs) it was bifid (type III). The rarest type was a fan-shaped (type I), found in 4 shoulders (7.7% of ACSLs) (Fig. 2). The types of