

THE SPINOGLENOID LIGAMENT

ANATOMY, MORPHOLOGY, AND HISTOLOGICAL FINDINGS

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Background: Dysfunction of the distal branch of the suprascapular nerve has been reported in athletes involved in throwing or overhead sports. The consistent presence of a dynamic anatomic structure, the spinoglenoid ligament, overlying the nerve in the spinoglenoid notch may be a contributing factor to the dysfunction of this nerve. The purpose of this study was to report the anatomy, morphology, and histological characteristics of the spinoglenoid ligament.

Methods: The spinoglenoid ligaments of fifty-eight fresh-frozen cadaver shoulders were dissected to evaluate their anatomic dimensions, histological characteristics, and relationship to the suprascapular nerve, the posterior part of the capsule, and the glenoid rim. The spinoglenoid ligament was harvested, with its insertions on the scapular spine and on the capsule and glenoid left intact, for the histological analysis.

Results: Dissection revealed that a spinoglenoid ligament was present in all specimens. The ligament was found to form an irregular quadrangular shape. On gross examination, the deep fibers of the ligament extended from the lateral aspect of the scapular spine to the posterior part of the glenoid and the superficial fibers blended with the posterior aspect of the shoulder capsule. Histological sections demonstrated Sharpey fibers inserting into bone at the scapular spine and blending with the posterior aspect of the shoulder capsule to insert into the posterior surface of the glenoid, findings that confirmed the ligamentous nature of this structure.

Conclusions: This study revealed the presence of the spinoglenoid ligament in all of the shoulders that were examined, with some variation in the size of the ligament.

Clinical Relevance: In this study, we identified a complex, multilayer, distinct spinoglenoid ligament with superficial and deep attachments to the glenoid. These findings support a possible relationship between this ligament and entrapment neuropathy of the distal suprascapular nerve.

The existence and importance of the spinoglenoid (inferior transverse scapular) ligament has been debated in the literature¹⁻¹⁰. Anatomic dissections have shown a wide variation in the prevalence of the spinoglenoid ligament^{1,4,5,7,8,10,11}. Some investigators have omitted commentary on this ligament because it has been thought that the structure is indistinct^{11,12} or that its clinical relevance has not yet been defined.

The null hypothesis for this study was that the spinoglenoid ligament is an anatomic variant, as other authors have not agreed on its presence or prevalence^{1,7,8,11,12}. The purpose of this study was to define the prevalence, anatomy, morphology, and histological characteristics of the spinoglenoid ligament in fresh-frozen cadaveric shoulders.

Materials and Methods

Fifty-eight shoulders of thirty fresh-frozen cadavers were dissected. Fifty-six of the fifty-eight specimens were paired. Two shoulders were not included in the study because previous shoulder surgery prevented appropriate dissection. There were sixteen male and fourteen female donors, with an

average age at the time of death of sixty years (range, twenty-eight to ninety-six years). There was no significant difference between the ages of the male and female donors ($p = 0.179$).

Anatomy

The fresh-frozen shoulder specimens were thawed overnight before dissection. The trapezius and deltoid muscles were reflected from the scapular spine and the acromion process to expose the supraspinatus and infraspinatus muscles. The supraspinatus and infraspinatus muscles were carefully elevated from their respective fossae, and the structures of the spinoglenoid notch were evaluated and dissected. The suprascapular nerve was identified, and it remained in its anatomic position as the spinoglenoid ligament was exposed for complete examination.

Morphology

Fine calipers (Starrett, Athol, Massachusetts), accurate to 0.02 mm, were used to measure the dimensions of the spinoglenoid ligament. The lengths (from the lateral aspect of the scapular spine to the posterior aspect of the glenoid) of the superior and

TABLE I Measured Dimensions of the Spinoglenoid Ligament

	No. of Specimens	Average Age* (yr)	Measurement* (mm)					
			Ligament to Nerve (A)	Ligament to Bone (B)	Scapular Spine Insertion (C)	Glenoid Insertion (D)	Superior Border (E)	Inferior Border (F)
All	58	60	4.63	6.61	14.36	13.76	15.84	14.21
Male	30	55	4.40	6.43	17.04	16.25	17.78	15.40
Female	28	66	4.89	6.81	11.30	10.92	13.63	12.86
P value		0.179	0.302	0.431	<0.01	<0.01	<0.01	0.019

*The letters correspond to those in Figure 1.

inferior borders of the ligament as well as the widths of the insertions on the scapular spine and the posterior aspect of the glenoid were measured in all specimens. The distance from the midpoint of the inferior border of the ligament to the base of the spinoglenoid notch was measured. Then the distance from the midpoint of the inferior border of the ligament to the superior aspect of the nerve was measured (Fig. 1).

Histological Analysis

The spinoglenoid ligament was removed, with the insertions intact, from eight specimens. A segment of the scapular spine and a segment of the posterior aspect of the glenoid, including the capsule and attached soft tissues, were preserved with each ligament. The specimens were fixed in 10% buffered formalin. Following decalcification in ethylenediaminetetraacetic acid (EDTA), all specimens were embedded in paraffin. The ligament was sectioned in an axial direction and was stained with hematoxylin and eosin as well as Masson trichrome stain. Histological examination was performed under light microscopy, and photomicrographs were made at four and ten times magnification.

Statistical Methods

The mean values for all anatomic measurements were calculated for the whole group and for each gender, and the significance of any differences between genders was determined with use of the Student t test. Values of $p < 0.05$ were considered to be significant.

Results

Anatomy

Dissection revealed a spinoglenoid ligament in all fifty-eight specimens. The sizes and thicknesses varied, but all specimens contained a ligament that had distinct insertions on the scapular spine and the posterior aspect of the glenoid with definite superior and inferior borders (Figs. 2-A and 2-B). On gross examination, the spinoglenoid ligament was seen to have an irregular quadrangular shape, thinnest in its midportion and fanning out to its insertions superomedially and inferolaterally. The inferolateral portion of the ligament had distinct superficial and deep layers inserting into the posterior aspect of the shoulder capsule and the posterior aspect of the glenoid neck, respectively. The distal branch of the suprascapular

nerve and the branches of the suprascapular artery and vein passed along the base of the scapular spine. The nerve to the infraspinatus and the suprascapular artery and vein also were noted to course below the ligament in all specimens.

The mean lengths, corresponding to the letters in Figure 1, are shown in Table I. Although there was a significant difference in the overall size of the spinoglenoid ligament between the men and the women, there was no significant difference in the distance between the nerve and the ligament (A in Fig. 1).

Histological Findings

Histologically, the ligament was composed of bundles of collagen fibrils with similar orientation. Sharpey fibers were seen

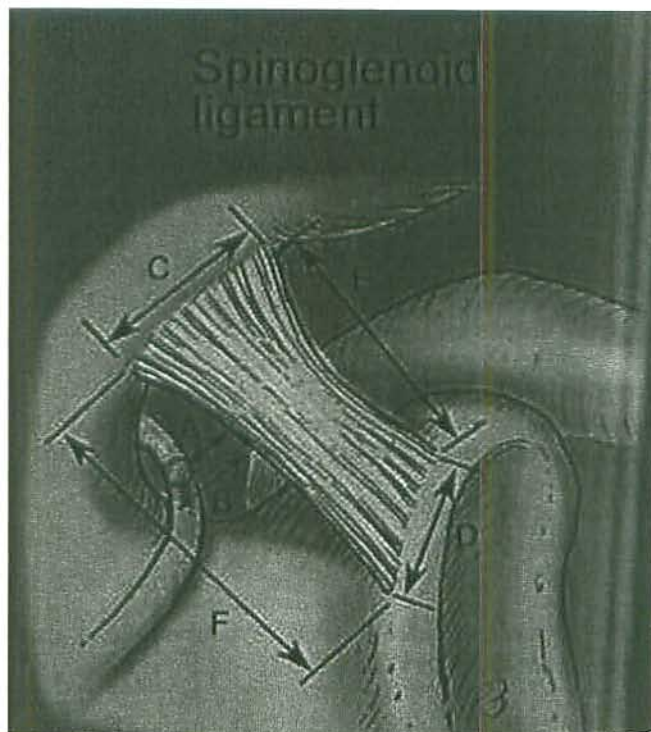


Fig. 1
Illustration of the measurements performed for this study. A = minimal distance from the ligament to the nerve, B = maximal distance from the ligament to bone, C = scapular spine insertion, D = glenoid insertion, E = superior border, and F = inferior border.



Fig. 2-A

Figs. 2-A and 2-B Anatomy of the spinoglenoid ligament. The ligament is noted centrally, spanning the spinoglenoid notch from the scapular spine to the posterior part of the glenoid rim. The distal branch of the suprascapular nerve and the branches of the suprascapular artery and vein are seen at the base of the scapular spine and below the ligament. **Fig. 2-A** The spinoglenoid ligament is shown with the overlying trapezius and deltoid removed from the scapular spine and the acromion process to demonstrate the intricate relationship between the suprascapular nerve and the spinoglenoid ligament. The infraspinatus is retracted inferiorly.

inserting into bone at the scapular spine. Sharpey fibers are defined as bundles of collagen fibers known to extend from the periosteum to underlying bone. The periosteum is often united to bone at sites where muscle, ligament, and even tendon are attached. The deep layer of the spinoglenoid ligament fit this definition and had Sharpey fibers that extended on the scapular spine to the glenoid. The superior (proximal) aspect of the ligament inserted directly into bone on the scapular spine (Fig. 3-A). The inferior (distal) aspect of the ligament inserted into bone at the posterior aspect of the glenoid neck (Fig. 3-B).

Discussion

According to Gray¹³, Thomas¹⁴, and Snell¹⁵, a ligament is a cord or band of connective tissue uniting two structures, commonly found in association with joints. Ligaments are of two varieties: the majority are of the first type, which is composed of dense bundles of collagen fibers that are inelastic under normal conditions. The second type of ligament is composed of elastic tissue, which regains its original length after stretching. The spinoglenoid ligament is a complex ligament composed of both of these variations, which helps to explain its dynamic function.

Since the first description of suprascapular nerve entrapment by Kopell and Thompson¹⁶, in 1959, several authors have reported suprascapular nerve entrapment associated with transverse ligament anomalies^{17,18}, ganglia^{19,20}, tumors²¹, trauma^{22,23}, fractures of the scapula²⁴, anterior shoulder dislocations²⁵, and rotator cuff ruptures²⁶. The reported prevalence of the spinoglenoid ligament has varied greatly in the literature, from 3% (two of seventy-two) to 80% (ninety of 112)^{1,3,4,7,8,10}. We believe that this tremendous variation is directly related to the preparation of the specimens being studied. Tissue that was not preserved with the fresh-frozen technique tends to become friable, making meticulous cadaveric dissection difficult.

The spinoglenoid ligament was an identifiable structure in 100% of the specimens in this study. Its size and thickness did vary, with men having a larger ligament than women, on the av-

erage. However, the linear space available for the suprascapular nerve to pass through did not differ between men and women. The histological analysis showed a proximal ligamentous insertion into the scapular spine as well as a distal insertion into the posterior aspect of the glenoid neck and the shoulder capsule.

The strengths of this study are the use of fresh-frozen



Fig. 2-B

Close-up view of the spinoglenoid ligament with the acromion resected and the suprascapular and infraspinatus muscles removed to demonstrate the relationship of the ligament to the posterior aspect of the shoulder capsule.



Fig. 3-A

Figs. 3-A and 3-B Histological appearance of the spinoglenoid ligament. **Fig. 3-A** The spinoglenoid ligament (superior) with its typical collagen bundles inserts directly into the bone (inferior) of the scapular spine (hematoxylin and eosin, $\times 10$).

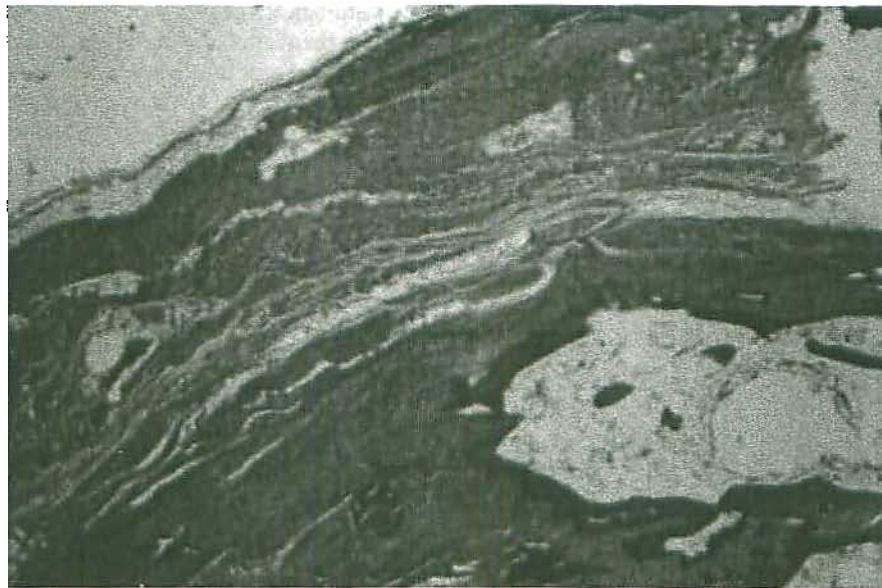


Fig. 3-B

The posterior glenoid insertion of the spinoglenoid ligament shows the dense, parallel bundles of collagen of the spinoglenoid ligament (superiorly) inserting into the bone of the glenoid neck inferiorly. The superficial and deep layers of the spinoglenoid ligament are demonstrated in this slide (Masson trichrome, $\times 4$).

human cadavers, the number of specimens dissected, and the histological analysis. To our knowledge, we are the first to report the histological characteristics of this ligament. The weaknesses of this study are the limited correlation between its results and the clinical situation and the wide variance in the ages of the subjects.

A dynamic study evaluating the pressure exerted on the suprascapular nerve by compression of the spinoglenoid ligament during the glenohumeral range of motion will help to clarify the nature of entrapment neuropathy of this nerve. The

anatomic description detailed above will hopefully lead to a safe, minimally invasive technique to release the spinoglenoid ligament when clinically indicated. ■

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