

# Resection of the medial end of the clavicle: An anatomic study

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*The biomechanical importance of the costoclavicular ligament is well known; however, an extensive debate still exists regarding the amount of the medial clavicle that can be removed without injuring the ligament. The goal of this anatomic study in fresh cadavers is to measure the distance between the inferior articular surface of the medial clavicle and the most medial clavicular insertion of the costoclavicular ligament, as well as to verify whether there is a relationship between this measurement and the length of the clavicle. Dissection of 100 shoulders from 50 fresh cadavers was performed. All specimens were from male cadavers ranging in age from 17 to 65 years (mean, 37 years). Variation in clavicular length did not alter the distance between the inferior articular surface of the medial clavicle and the most medial clavicular insertion of the costoclavicular ligament, which in our study measured 1.26 cm. The costoclavicular ligament can extend as far as the inferior articular surface of the medial clavicle. We recommend identification of this ligament during surgeries for resection of the clavicle's proximal extremity. (J Shoulder Elbow Surg 2007;16: 112-114.)*

**A**bbott and Lucas<sup>1</sup> described the importance of the costoclavicular ligament, also known as the rhomboid ligament, as a stabilizer of the medial clavicle. Since the publication of their study, we have learned that there is no cephalic dislocation of the medial clavicle when this ligament is preserved in operations done on the sternoclavicular articulation. The costoclavicular ligament is short and strong, consisting of anterior

and posterior fasciculi, separated by a bursa. The inferior insertion occurs on the upper surface of the first rib and in the junction with the sternum and above on the inferior surface of the medial extremity of the clavicle, sometimes referred to as the rhomboid fossa.<sup>6</sup>

Resection of the proximal clavicle is used for treatment of instability and degenerative diseases of the sternoclavicular joint resistant to nonoperative management. Preservation, repair, or reconstruction of the costoclavicular ligament is essential for maintaining stability of this segment. The amount of the medial clavicle that can be removed while retaining costoclavicular ligament function is not well established. A survey of the literature revealed only an anatomic study by Bisson et al,<sup>3</sup> using formaldehyde-preserved cadavers, in which they measured the distance between the inferior articular surface of the medial clavicle and the most medial insertion of the costoclavicular ligament, reporting mean values of  $1.2 \pm 0.3$  cm in male specimens and  $1.0 \pm 0.2$  cm in female specimens. The goal of this anatomic study on fresh cadavers is to measure the distance between the inferior articular surface of the medial clavicle and the most medial clavicular insertion of the costoclavicular ligament, as well as to confirm whether there is a relationship between this measurement and clavicular length. This will provide better guidelines for resections of the proximal segment of the clavicle, when necessary.

## MATERIALS AND METHODS

After prior approval of the study by the ethics committee, 50 cadavers (100 shoulders) were dissected in the autopsy section of the Coroners Institute of the Federal University of São Paulo ("Escola Paulista de Medicina"). At the time of death, the mean age of the cadavers was 37 years (range, 17-65 years; SD, 14 years). All specimens were from male individuals, of whom 9 (18%) were black and 41 (82%) were white.

Exclusion criteria included clavicular fracture, dislocation of the acromioclavicular joint, and degenerative signs of the articular surface of the proximal clavicle.

The approach was through a horizontal incision of about 7 cm over the sternoclavicular joint. After detachment of the pectoralis major muscle and the clavicular tendon of the

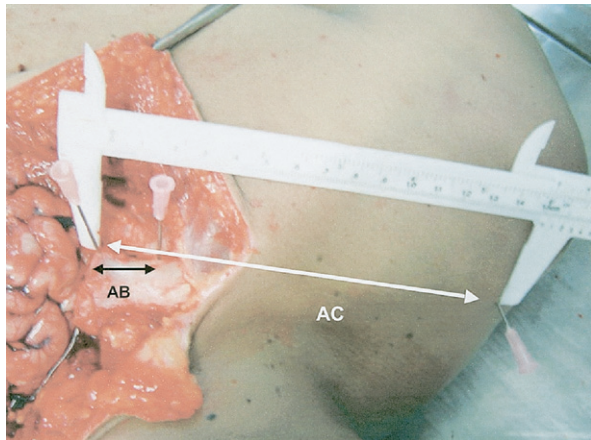
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**Figure 1** To determine distance A-B, the inferior articular surface of the medial clavicle and the more medial clavicular insertion of the costoclavicular ligament was measured with two No. 18 needles. To determine distance A-C (length of the clavicle), the distance between the acromioclavicular joint and the inferior articular surface of the medial clavicle was measured with another No. 18 needle.

sternocleidomastoid muscle, the anterior portion of the sternoclavicular capsule was identified and resected to visualize the articular surface of the medial clavicle. The costoclavicular ligament was dissected subperiosteally, preserving its insertions on the clavicle and the first rib. The inferior articular surface of the medial clavicle and the more medial clavicular insertion of the costoclavicular ligament were identified with two No. 18 needles, followed by measurement of the distance between them (distance A-B). Next, the acromioclavicular joint was identified with another No. 18 needle, and the distance between it and the inferior articular surface was measured (distance A-C); this measurement was considered to be the length of the clavicle (Figure 1). The same investigator carried out all measurements, using a caliper (precision, 0.05 cm).

The results were submitted to statistical analysis by use of the Pearson linear coefficient.

**RESULTS**

Table I shows the measurements obtained in 100 shoulders. Figure 2 illustrates the relationship between distances A-C and A-B.

A statistically significant correlation was not verified between distances A-C and A-B:  $r = 0.14$  ( $P = .154$ ). This indicates that the explanatory coefficient,  $R^2$ , equals 0.02; thus, if we attempted to predict the value of distance A-B by using total distance (ie, A-C), we would be correct in 2% of cases.

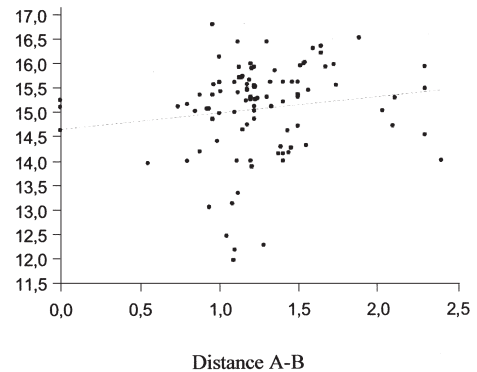
**DISCUSSION**

The importance of preserving or reconstructing the costoclavicular ligament in resection of the medial end of the clavicle has been mentioned by various authors.<sup>2,4,6,9,10</sup> The use of metal wires for mainte-

**Table I** Measurements obtained in 100 shoulders

Distance	Mean (cm)	SD (cm)	Minimum (cm)	Maximum (cm)
A-C	15.06	0.94	11.95	16.79
A-B	1.26	0.41	0	2.40

Length of clavicle – distance A-C



**Figure 2** Relationship between distances A-C and A-B.

nance of reduction of the sternoclavicular joint in cases of instability has led to fatal complications, such as migration of the wires to the heart and large vessels.<sup>7</sup> Therefore, a biologic solution for maintaining the costoclavicular ligament is preferred. This ligament has a mean length of 1.3 cm, maximum width of 1.9 cm, and mean thickness of 1.3 cm. Bearn<sup>2</sup> experimentally demonstrated that the anterior fibers resist excess upward rotation and lateral dislocation and that the posterior fibers resist excess downward rotation and medial dislocation. Despite the well-known biomechanical importance of the costoclavicular ligament, there is considerable debate regarding the amount of the medial clavicle that can be removed safely without injuring this ligament during surgery. A survey of the literature failed to discover an anatomic study in fresh cadavers assessing this measurement and verifying whether it varies in relation to the clavicular length. Rockwood et al,<sup>8</sup> studying resection arthroplasty of the sternoclavicular joint, recommended resection of 1.5 to 2.0 cm of the medial clavicle, observing better results in patients in whom the costoclavicular ligament was preserved.

Using cadavers preserved in formaldehyde, Bisson et al<sup>3</sup> measured the distance between the inferior articular surface of the medial clavicle and the more medial insertion of the costoclavicular ligament, finding a range from 0.5 to 2.0 cm (mean, 1.0 cm) in female specimens and from 0.7 to 1.3 cm (mean, 1.2 cm) in male specimens. According to these authors, if the recommended measurement of 1.5 cm were used,

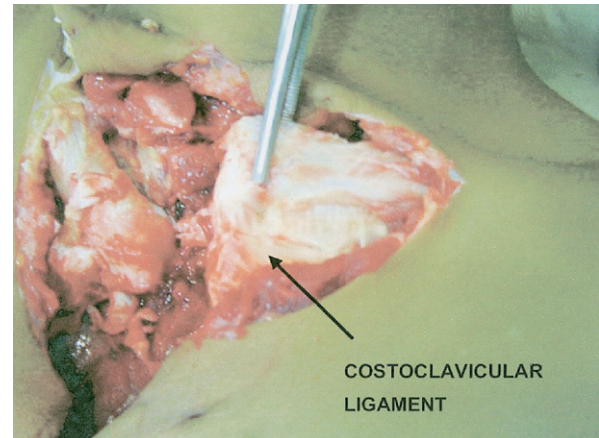
the costoclavicular ligament would be injured 100% of the time in women and 74% in men. Therefore, they proposed a 1.0-cm resection in men and 0.9 cm in women to prevent any injury to the ligament in 84% of men and 89% of women, thereby establishing a safe zone for resection of the proximal clavicle.<sup>3</sup>

Cave<sup>5</sup> related that a continuity exists medially between the capsule of the sternoclavicular joint and the costoclavicular ligament without any space between these structures and that, laterally, the anterior and posterior portions are in continuity. According to this author, insertion of the ligament in the rhomboid fossa can occur in a flat area (60%), a scooped-out area (30%), or a protruding area (10%).<sup>5</sup>

In our study, we also adopted the inferior articular surface of the medial clavicle as a reference, because it is easily identifiable and is uniformly present in cadavers. On the lateral side, we selected the acromioclavicular joint as a reference for measuring the clavicular length, as it is easy to identify, without the necessity of its surgical exposure, permitting its reproduction during surgery. Only fresh cadavers were used.

The distance between the inferior articular surface of the medial clavicle and the most medial insertion of the costoclavicular ligament ranged from 0 to 2.40 cm (mean, 1.26 cm). We did not find a statistically significant difference between this measurement and the length of the clavicle, which ranged from 11.96 to 16.79 cm (mean, 15.06 cm). Because of this, we do not recommend use of the clavicular length as a factor of variation in determining the amount of the proximal clavicle to be removed in its resection.

We were surprised, during dissection, to find continuity between the capsule of the sternoclavicular joint and the costoclavicular ligament in 3% of the shoulders—that is, the absence of a free space between the ligament and the inferior articular surface of the medial clavicle as described by Cave<sup>5</sup> (Figure 3). We believe, therefore, that there is no real safe zone for resection of the proximal clavicle if we consider that the ligament cannot be sectioned and that identification of the costoclavicular ligament is



**Figure 3** Absence of free space between costoclavicular ligament and inferior articular surface of medial clavicle.

necessary in all resections of the medial end of the clavicle.

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