

# Clinical Benefit of Elastography for the Assessment of Musculoskeletal Systems –Elasticity of the Coracoacromial Ligament–

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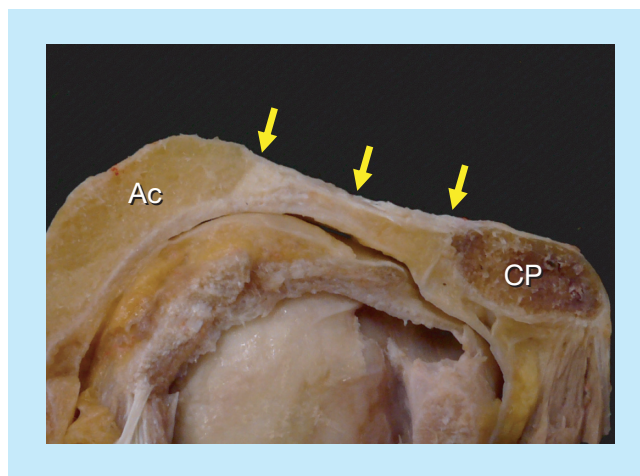
The elasticity of the coracoacromial ligament was evaluated by ultrasound Elastography (EUB-7500, HITACHI, Japan). The elasticity of the coracoacromial ligament increased with age and decreased with the existence of rotator cuff tears. These results indicate that the elasticity of the coracoacromial ligament may influence the onset and symptoms of rotator cuff disease.

**Key Words:** Coracoacromial Ligament, Rotator Cuff Tear, Musculoskeletal, Elastography

## 1. Introduction

Rotator cuff tear is one of the most common causes of shoulder pain and dysfunction. The cause of the tear is described by “extrinsic” and “intrinsic” mechanisms<sup>1)2)</sup>. An extrinsic mechanism is explained as an impingement between the undersurface of the anterior acromion and rotator cuff tendon which attaches to the greater tuberosity. On the other hand, an intrinsic mechanism is explained as age-related degenerative changes originating within the tendon body itself. As good and excellent clinical results were reported by resection of the undersurface of the anterior acromion, so called subacromial decompression, high contact pressure between the undersurface of the anterior acromion and rotator cuff tendon is interpreted as the main cause of shoulder pain<sup>2)3)</sup>. Most of the reports about the effect of subacromial decompression focus on the removal of an adequate quantity of acromion undersurface because the shape of the acromion, which can be hooked, curved or flat, relates to the incidence of rotator tears<sup>4)</sup>. However, release of the coracoacromial ligament is usually performed with subacromial decompression simultaneously. No report quantifies the elasticity of the coracoacromial

ligament in relation to the contact pressure between the coracoacromial arch and rotator cuff tendon (Fig. 1, 2). The purpose of this study was to clarify the elasticity of the coracoacromial ligament in shoulders with rotator cuff tear.



**Fig. 1 :** Coracoacromial ligament (arrows) is a strong triangular band, extending between the coracoid process (CP) and the acromion (Ac).

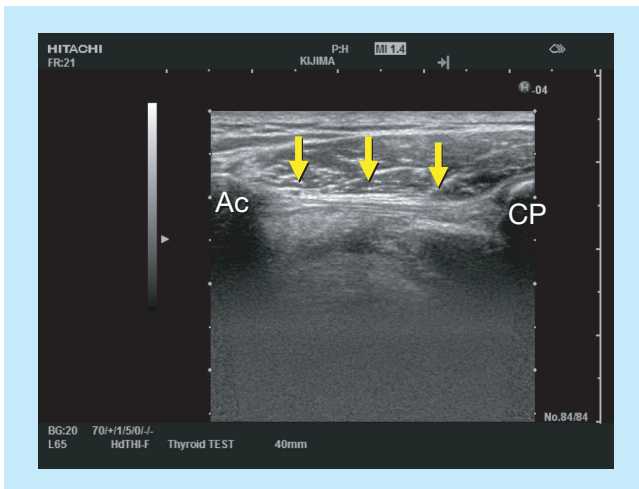


Fig. 2 : Long-axis ultrasound image demonstrates coracoacromial ligament (arrows) as a slightly convex fibrillar band which overlies rotator cuff tendon. Ac, acromion; CP, coracoid process

## 2. Materials and Methods

41 shoulders of 24 subjects enrolled in this study were examined. The average age of the subjects was 52 years (range: 15~84). We investigated the presence of rotator cuff tears and measured the elasticity of the coracoacromial ligament by ultrasound Elastography (EUB-7500, HITACHI, Japan) (Fig. 3). Ultrasound Elastography is one of the useful methods to quantify the strain of soft tissue. The strain ratio was determined by the strain of the coracoacromial ligament and that of the rotator cuff tendon (Fig. 4). Higher strain ratios indicate softer ligament elasticity. The relationship between the elasticity of the coracoacromial ligament and aging was evaluated using the Pearson coefficient. Elasticity of the coracoacromial liga-

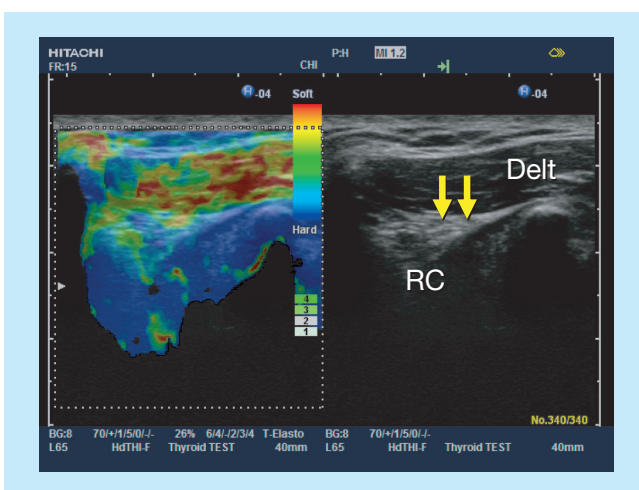


Fig. 3 : Short-axis ultrasound Elastography shows different tissue elasticity among deltoid muscle (Delt), coracoacromial ligament (arrows), and rotator cuff tendon (RC).

ment was compared between symptomatic and asymptomatic rotator cuff tear shoulders, and among a younger group without rotator cuff tear (<50 years old), an older group without rotator cuff tear (>50 years old), and a cuff tear group (Student t-test).

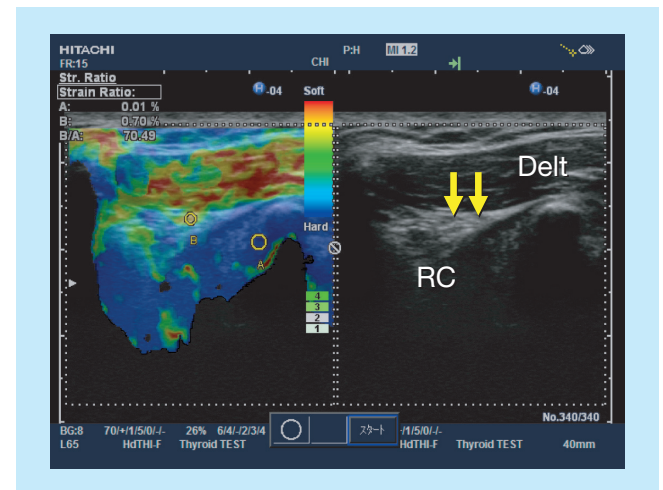


Fig. 4 : Strain ratio was measured between tissue compressibility of the coracoacromial ligament (arrows) and that of the rotator cuff tendon (RC).

## 3. Results

The strain ratio of coracoacromial ligaments without rotator cuff tears (29 shoulders) showed a negative correlation to age ( $r = -0.825$ ) (Fig. 5). The average strain ratio of the coracoacromial ligaments with symptomatic rotator cuff tear was lower than that of those with asymptomatic rotator cuff tear (14.4, 33.1, respectively) ( $p=0.02$ ) (Fig. 6). The average strain ratios of the coracoacromial ligaments in the younger group, older group, and cuff tear group were 33.0, 12.6 and 23.7, respectively (Fig. 7). Elasticity of the coracoacromial ligaments without rotator cuff tear in the younger group was significantly lower than that in the

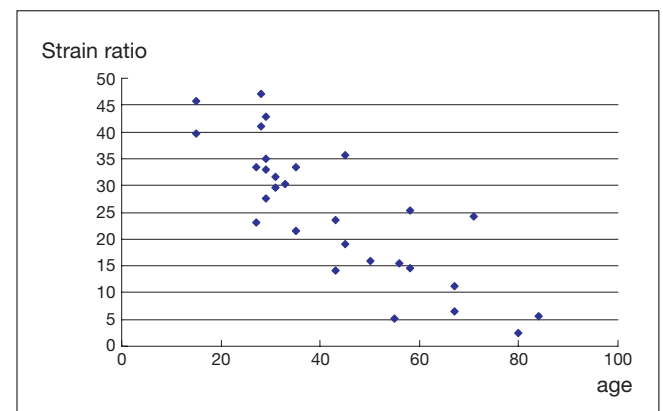
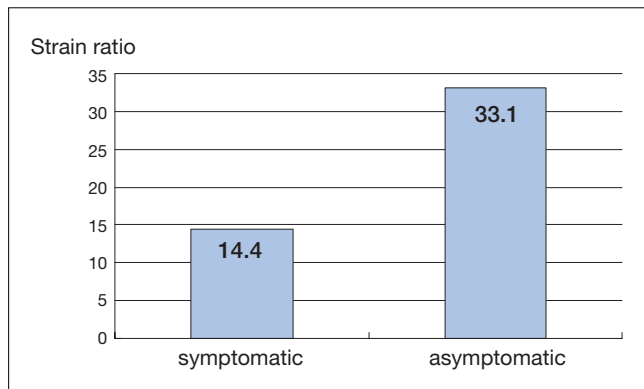
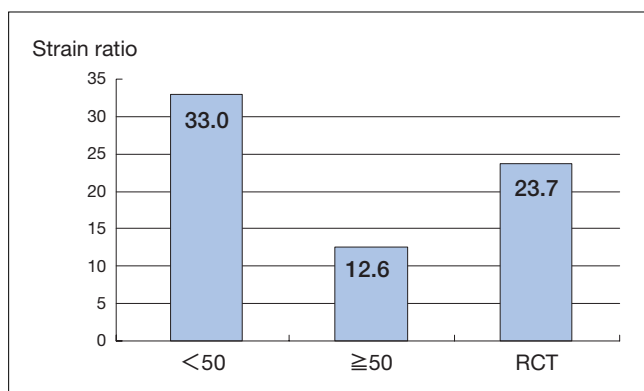


Fig. 5 : Strain ratio of the coracoacromial ligaments without rotator cuff tears showed a negative correlation to the age.

older group ( $p < 0.0001$ ). Elasticity of the coracoacromial ligaments in the cuff tear group was significantly lower than that in the older group ( $p=0.0486$ ).



**Fig. 6 :** The average strain ratio of the coracoacromial ligaments with symptomatic rotator cuff tear was lower than that with asymptomatic rotator cuff tear.



**Fig. 7 :** The average strain ratio of the coracoacromial ligaments in older group (age >50 years old) was significantly lower than those in younger group (age <50 years old) and higher than those in cuff tear group.

#### 4. Discussion

Rotator cuff tear is a typical disorder that causes shoulder pain, restricted range of motion, and muscle weakness. It is interpreted as a progressive “disease” that does not spontaneously heal, with the size of the tear increasing with aging. The mechanism of onset of pain has not been fully elucidated but it is generally considered that mechanical friction between the coracoacromial arch and the tear or the greater tuberosity stimulates the mediating mechanoreceptors of the subacromial bursa and causes the symptoms. However, rotator cuff tear was observed in 7 ~ 30% of cadaver shoulders with the incidence increasing with aging<sup>(5-7)</sup> whereas asymptomatic rotator cuff tear was diagnosed in 15% ~ 23% of patients<sup>(8,9)</sup>. It was therefore elucidated that the presence of rotator cuff tear itself is not always directly related to pain. The pain is therefore

caused by something other than the tear itself. Increased elasticity of the coracoacromial ligament with aging substantiates the increased incidence of tear with aging. Elasticity of the coracoacromial ligament decreases in the presence of rotator cuff tear, so the pain is alleviated when the contact pressure is reduced. In other words, this can be interpreted as supporting the efficacy of conservative therapy and the presence of asymptomatic rotator cuff tear. These are issues that should be evaluated over time in future studies.

This is the first study reporting the in situ quantitative evaluation of ligament elasticity by Elastography. Evaluation of soft tissues by Elastography is applicable not only for ligaments but also for muscles, tendons and peripheral nerves. It is expected to be widely used in clinical settings for the interpretation of orthopedic diseases, evaluation of the repair processes of soft tissues and other applications.

#### 5. Conclusion

The elasticity of the coracoacromial ligament increased with age and decreased with the existence of rotator cuff tears. The elasticity of the coracoacromial ligaments with symptomatic rotator cuff tears was higher than that with asymptomatic rotator cuff tears.

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