# Arthroscopic Coracoclavicular Ligament Reconstruction for Acromioclavicular Joint Dislocation

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**Background:** The purpose of this study was to evaluate mid- and long-term clinical and radiologic outcomes of arthroscopic coracoclavicular ligament reconstruction (ACCLR) with an artificial ligament for acute dislocation of the acromioclavicular joint (ACJ).

**Methods:** Twelve male patients (average age at the time of surgery: 40.8 years, range: 21–64 years) underwent ACCLR with an artificial ligament for acute dislocation of the ACJ type III or type V according to the Rockwood classification. Arthroscopic surgery was performed with the patient under general anesthesia and interscalene brachial plexus block in the beach-chair position. Reduction of the ACJ was performed manually or using an elevator under control of an imaging intensifier. The ACJ was fixed temporarily with a Kirschner wire. Bone tunnels of the coracoid process and clavicle were made with a cannulated drill. An artificial ligament was pulled out through the bone tunnels and fixed on the upper surface of the clavicle with a staple and interference screw, and on the undersurface of the coracoid process with an Endobutton. The shoulder was immobilized with a shoulder brace for 4 weeks postoperatively, and rehabilitation was started in the first postoperative week. The Japan Shoulder Society Acromioclavicular Joint Function Assessment (JSS-ACJ) score was used for evaluation of clinical outcomes, and plain radiographs were performed after a minimum follow-up period of 5 years postoperatively.

**Results:** The average follow-up period after surgery was 106.3 months (range: 62–128 months). The average postoperative JSS-ACJ score was 97.2 points (range: 92–100). The seven patients who had been playing sports before injury all returned to their pre-injury level. No patients complained of pain or shoulder dysfunction in daily activities, work, or sports. There were no complications such as neurovascular injuries during surgery, infection, or foreign body reaction from the artificial ligament. Radiographs at the final follow-up showed subluxation of the ACJ and non-symptomatic osteoarthritic changes of the ACJ in two patients, respectively.

**Conclusion:** ACCLR for acute dislocation of the ACJ is a useful surgical procedure that gives satisfactory clinical and radiologic outcomes on mid- and long-term follow-up. ACCLR can stabilize vertical instability of the ACJ. If instability in the horizontal direction remains, repair or reconstruction of the acromioclavicular ligament should be added to prevent osteoarthritic changes of the ACJ. (J Nippon Med Sch 2018; 85: 166–171)

Key words: acromioclavicular joint dislocation, arthroscopic reconstruction, artificial ligament, coracoclavicular ligament

#### Introduction

Injuries of the acromioclavicular joint (ACJ) are caused by falls, traffic accidents, and contact sports, with a direct force from above to the acromion. They are classified from sprain to subluxation or dislocation on the basis of the degree of failure of ACJ congruency due to damage

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Fig. 1 An anteroposterior radiograph demonstrating a Rockwood type V dislocation of the acromioclavicular joint.

of the acromioclavicular ligament (ACL) and the coracoclavicular ligament (CCL). The Rockwood classification is widely used to classify ACJ dislocation<sup>1</sup>. Conservative treatment is generally applied for types I and II, and surgical treatment is generally used for type IV or higher<sup>23</sup>. However, treatment for type III is controversial<sup>4,5</sup>. When choosing a treatment for ACJ dislocation, not only the degree of dislocation and instability, but also acuteness or chronicity, patient age, sports activities, or type of work (i.e., desk work, or manual labor including heavy lifting) are considered<sup>6</sup>. The rehabilitation period for conservative treatment is shorter than that for surgical treatment. However, cosmetic problems and residual symptoms of the shoulder girdle such as discomfort and pain from the distal protrusion of the clavicle or instability of the ACJ are involved. In surgical treatment, there are complications such as breakage of internal fixation hardware, deltoid injuries, wound scarring, and re-dislocation, although functional outcomes could be satisfactory. It is important to fully understand the advantages and disadvantages of each treatment to make a treatment decision.

Surgical procedures for dislocation of the ACJ are roughly divided into ACJ fixation (e.g., the Phemister method or plate fixation<sup>7,8</sup>), coracoclavicular fixation (e.g., the Bosworth method or Henry method<sup>9-11</sup>), and CCL reconstruction (e.g., the Weaver method<sup>12</sup>). Because the purpose of surgical treatment is reacquisition of cooperative function of the clavicle and scapula in addition to reduction of the ACJ, reconstruction of the CCL is the most desirable method.

As a surgery for acute dislocation of the ACJ, we have performed a modified Weaver procedure that combined a distal end resection of the clavicle and transfer of the coracoacromial ligament (CAL) with bone chip until 2005. Since 2006, we have performed arthroscopic coracoclavicular ligament reconstruction (ACCLR) using an artificial ligament as a less invasive method without deltoid injury or sacrifice of any ligament. The purpose of this study was to evaluate mid- and long-term clinical and radiologic outcomes of ACCLR.

#### Materials and Methods

### **Patient Selection**

This retrospective study was approved by the ethics committee at our hospital, and consent was obtained from all patients for the research. A database of all ACJ surgeries performed by a single surgeon between 2006 and 2012 was reviewed. Patients with acute ACJ dislocation type III or type V (**Fig. 1**) according to the Rockwood classification and who underwent ACCLR within 1 month after the injury were selected. Patients with chronic ACJ dislocation who required transfer of the CAL, resection of the distal end clavicle, or repair of the deltoid muscle in addition to ACCLR were excluded from this study.

## **Surgical Procedure**

All patients underwent surgery under general anesthesia and interscalene brachial plexus block in the beachchair position. An imaging intensifier was used to check the positions of the ACJ reduction, a drilling guide, a Kirschner wire, and fixation devices. Vertical instability of the ACJ was evaluated by pulling down the upper limb. Horizontal instability of the ACJ was evaluated by posterior protrusion of the distal end of the clavicle with horizontal adduction of the shoulder, or the degree of displacement in the anteroposterior direction of the distal end of the clavicle in grasping the acromion.

Manual reduction of the ACJ was performed by depressing the distal end of the clavicle and pushing up the upper arm and olecranon at a 90-degree elbow flexion position. After confirming anatomical reduction with the imaging intensifier, a 2.4-mm Kirschner wire was inserted from the posterior edge of the acromion through the posterior ACJ to the clavicle, not to penetrate the ACJ (**Fig. 2**). If anatomical congruity could not be obtained by manual reduction, a small incision was made on the ACJ, and an elevator was inserted into the undersurface of the acromion and pushed down the distal end of the clavicle to reduce the ACJ.

Diagnostic arthroscopy of the glenohumeral joint and subacromial bursa was performed to identify labrum or



Fig. 2 Manual reduction of the acromioclavicular joint dislocation and temporary fixation by a Kirschner wire.



Fig. 4 An arthroscopic picture of the Endobutton fixed on the undersurface of the coracoid process.



Fig. 3 A cannulated drill guide placed in the undersurface of the coracoid process and on the superior part of the clavicle.

rotator cuff injury. The arthroscope was advanced to the undersurface of the coracoid process through an anterolateral portal or posterior portal. A radiofrequency device and motorized shaver were used to remove soft tissue under the coracoid process through an anterior working portal. An approximately 2-cm skin incision was made above the conoid tubercle of the clavicle 3 to 4 cm proximal to the ACJ, and the tip of the drill guide was placed in the undersurface of the coracoid base from the anterior portal (**Fig. 3**). A cannulated drill guide was placed on the superior part of the clavicle, and the position of the drill guide tip was confirmed with the imaging intensifier. Then, the coracoid and clavicular bone tunnels were made using the cannulated drill by the guide.

A 2-0 nylon thread attached to a Leeds-Keio artificial ligament (width 3.0 mm×length 50.0 cm, Yufu Seiki) with



Fig. 5 A postoperative anteroposterior radiograph following arthroscopic coracoclavicular ligament reconstruction with an artificial ligament fixed by an Endobutton, staple, and interference screw.

an Endobutton (4.0×12.0 mm, Smith & Nephew) was pulled out from the clavicle to the undersurface of the coracoid process through the cannulated drill. After pulling out the cannulated drill, the nylon thread with the artificial ligament and Endobutton was pulled over to the superior clavicle through the anterior portal. While tensioning the artificial ligament, the Endobutton was fixed to the undersurface of the coracoid process (**Fig. 4**). The artificial ligament pulled out through the clavicular bone tunnel was fixed on the upper surface of the clavicle using a staple (width 5.0 mm×spike length 10.0 mm, Yufu Seiki) and an interference screw (TJ Screw 4.0×9.0 mm, Meira) (**Fig. 5**). The stability of the ACJ and range of shoulder motion were checked carefully. A Kirschner



Fig. 6 A radiograph showing expansion of a bone tunnel of the clavicle as an osteolytic change around an interference screw.

wire was subcutaneously implanted, the wound was closed, and the surgery was completed.

# Postoperative Rehabilitation

The shoulder was immobilized using a shoulder brace for 4 weeks postoperatively. From the first postoperative week, passive range of motion exercises for the shoulder were started. Motion exercises were performed by holding the scapular in the supine position. Passive motion exercises of elevation and abduction were allowed up to 90 degrees, although internal and external rotation exercises were not limited. After the Kirschner wire and the body band were removed at 3 weeks postoperatively, assisted-active motion exercises were started.After removal of the sling at 4 weeks postoperatively, active motion exercises and muscle training without load to the ACJ such as push-ups and wall push training using a balance ball were started. Functional rotator cuff exercises and muscle strength training were started from 6 weeks postoperatively. Patients were allowed to return to heavy work or sports activities at approximately 3 months postoperatively, if shoulder motion and muscle strength had adequately improved.

#### **Postoperative Assessment**

Patients who were able to be observed 5 years or more after surgery were evaluated in this study. Clinical results were evaluated using the Japan Shoulder Society Acromioclavicular Joint Function Assessment (JSS-ACJ) score. The congruity and arthritic change of the ACJ were examined by postoperative radiographs at the final follow-up.



Fig. 7 A radiograph showing arthritic changes of the acromioclavicular joint as irregularities of the joint surface.

#### Results

Twelve patients with acute ACJ dislocation that matched the criteria were examined. All twelve were men with a mean age of 40.8 years (range: 21-64) at the time of surgery; eight patients had type III dislocation, and four had type V according to the Rockwood classification. The mean period from injury to surgery was 7.3 days (range: 3-12). The mean follow-up period was 106.3 months (range: 62-128). The JSS-ACJ score at the final follow-up was 97.2±11.7 points (range: 92-100). The seven patients among them who played sports before injury returned to their pre-injury level. None of the patients complained of pain in their daily life, occupation, or sports, and none had restricted shoulder motion. No intraoperative complications (neurovascular injuries, fractures, infection, hardware problems, etc.) were observed during the follow-up period.

Radiographs at the final follow-up showed subluxation of the ACJ in two patients, but no patients had recurrent dislocation of the ACJ. None showed ossification of the CCL, but transient expansion of the bone tunnels of the coracoid process and clavicle was observed in two patients (**Fig. 6**). Regarding arthritic changes of the ACJ, there were two patients with irregularities of the joint surface (**Fig. 7**), but no complaints of local pain were observed.

#### Discussion

Various open surgeries have been performed for dislocation of the ACJ. In recent years, a hook plate for ACJ fixation is widely performed as the gold standard procedure. For patients who undergo hook plate fixation, postoperative immobilization is unnecessary due to rigid fixation, and their return to daily living is immediate. On the other hand, there are problems related to hardware, such as migration to the acromion and cutout of the plate hook<sup>8</sup>. Since Wolf et al (2001) and Lafosse et al (2005) reported arthroscopic surgery for dislocation of the ACJ<sup>13,14</sup>, such surgery has gradually become more popular, and satisfactory clinical outcomes have been reported<sup>15</sup>. Jensen et al compared outcomes of hook plate and arthroscopic surgery, and stated that there was no significant difference between them<sup>16</sup>. In addition, arthroscopic surgery can provide a diagnosis and treatment for associated injuries of the shoulder joint, and removal of the hardware is unnecessary.

The ACJ functions to maintain cooperative motion of the clavicle and scapula, and as a suspension mechanism for the clavicle. These functions and movements are largely performed by the CCL, which connects the clavicle and scapula<sup>17</sup>. For this reason, we used to consider the modified Weaver procedure for CCL reconstruction to be the most convenient method of surgery, and it was conventionally performed for not only chronic cases but also acute cases. However, the surgical invasion associated with injury to the deltoid muscle and transfer of the CAL was enormous. In addition, there were cosmetic and functional problems, such as incision scars and muscle weakness caused by delaying the start of active motion and muscle strength training. To remove the disadvantages of conventional open surgery, we found arthroscopic surgery without sacrifice of soft tissue such as autograft and ligament transfer was necessary. Therefore, since 2006, we have performed ACCLR using an artificial ligament for acute dislocation of the ACJ. ACCLR is a less invasive procedure, and it is possible to obtain early rigid fixation by using a strong artificial ligament for CCL reconstruction. Initially, we were concerned about problems such as fixation persistence, foreign body reaction to the artificial ligament, bone resorption, fracture, and enlargement of the bone tunnels. Even in patients whom we followed up for more than 5 years, alignment of the ACJ was retained and expansion of bone tunnels due to foreign body reaction or friction of the artificial ligament was not observed.

On the other hand, in stabilizing only in a vertical direction by the ACCLR, minor instability in the horizontal direction may remain in the ACJ; thus, arthritic changes and pain of the ACJ are a concern in the long-term. For this reason, in addition to ACCLR from 2016, we have always performed repair or reconstruction of the ACL to stabilize the horizontal direction. We believe that stabilizing both the vertical and horizontal directions of the ACJ will improve stable joint congruity and clinical outcomes in long-term follow-up.

#### Limitations

This study was a retrospective study, and because surgeries were not performed within the same time period, the learning curve might be affected. Also, there the small number of cases is a limitation. However, few studies have examined the long-term outcomes of ACCLR, and it is a useful study that can provide suggestions for decision-making regarding surgical procedures for ACJ dislocation.

#### Conclusions

Outcomes of ACCLR using an artificial ligament for twelve patients with acute ACJ dislocation followed up for more than five years were assessed clinically and radiologically. Postoperative subluxation and arthritic changes of the ACJ were confirmed in two patients, respectively. The JSS-ACJ scores were 97.2 points on average, and satisfactory clinical outcomes were obtained. There was no case of foreign body reaction of an artificial ligament. ACCLR is a useful surgical procedure that is less invasive and provides good fixation without autograft, ligament transfer, or deltoid injury.

**Conflict of Interest:** The authors declare no conflict of interest.

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