

Case Report

# Reinforcement of Coracoacromial Ligament Transfer for Severe Acromioclavicular Dislocation using the Suture Anchor and the Hook Plate (Results of the cases)

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## SUMMARY

**Introduction** : Three cases of successfully treated Rockwood type V acute acromioclavicular joint dislocation in high activity patients with modified (reinforced) coracoacromial ligament transfer were reported.

**Materials and methods** : All patients were operated on within 3 weeks after injury. The operation is constructed with three parts, namely the coracoclavicular ligament repair with 2 suture anchors, the coracoacromial ligament transfer, and internal fixation of the acromioclavicular joint with short-hook-3-hole plate as a temporary support until ligaments heal. Postoperatively, the patient's shoulder is lightly immobilized with a sling. The sling is removed at the first postoperative day and the patient is allowed to begin circumduction exercises with a gradual increase. No overhead activities or full abduction was allowed until the hook plate removal at three months.

**Results** : The mean follow-up duration was one year. Mean Constant score at a year was 95 out of a maximum of 100. Mean ASES score at a year was 29 out of a maximum of 30. Although follow-up was a short period, both subjective and objective assessments including X-ray evaluation were excellent.

**Conclusion** : Combination of the repaired coracoclavicular ligament with the suture anchors and the transferred coracoacromial ligament must keep more rigid strength against redisplacement, and the temporary hook plate strongly prevents the ligaments from any stress during their healing period. Since reliable stability from the initial postoperative stage can ease mandatory limitation in daily activities earlier, this reinforced procedure may consequently help early reinstatements of the patients.

**Key Words** : acromioclavicular joint, dislocation, Cadenat procedure, coracoclavicular ligament, suture anchor

## INTRODUCTION

Many authors have addressed that surgical treatment for acromioclavicular dislocation offers no clear

advantages with the possible exception of improved cosmesis after surgery, and recent meta-analysis supported this consensus<sup>1)</sup>. On the other hand, there is a trend toward better results in the group of patients undergoing early repair<sup>2)</sup>. As a comprehensive suggestion, surgical treatment is recommended only for Rockwood type III injury in overhead throwing athletes or heavy laborers<sup>1~5)</sup> and for more severe types (type IV-VI). The most popular surgical procedures worldwide are Cadenat<sup>6)</sup> procedure and its modifications.

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**Table 1** postoperative results of all cases

patient	age (y.o.)	sex	latest follow-up (m)	Abduction (°)	flexion (°)	external rotation* (°)	internal rotation**	Constant score	ASES score
patient 1	32	male	12	170	170	45	D.V.7***	98	29
patient 2	42	male	13	165	165	40	D.V.7	95	27
patient 3	47	male	11	165	165	35	D.V.8	93	27
means	40		12	167	167	40		95	28

\* : arm at 90 degree of abduction. \*\* : internal rotation was evaluated highest posterior anatomy reached with the thumb. \*\*\* : 7th dorsal vertebra.

Since in the original procedure, isolated transfer of the coracoacromial ligament exhibited inferior strength in comparison to intact coracoclavicular ligaments biomechanically<sup>7)</sup>, many modifications have been reported so far with various materials as an augmented substitution<sup>2,8~11)</sup>. Even if already existing modified procedures provide comparative good results, injured coracoclavicular ligament, which failed mainly by midsubstance rupture or coracoid avulsion<sup>12)</sup>, should be ideally repaired for achievement of further anatomical stability, if possible. But its reliable repair is technically difficult, especially in coracoid avulsion.

In this report, we introduce combination technique constructed with coracoacromial ligament transfer, the coracoclavicular ligament repair by suture anchor, and temporary hook plate, for Rockwood type V severe acromioclavicular dislocation with excellent short-term results.

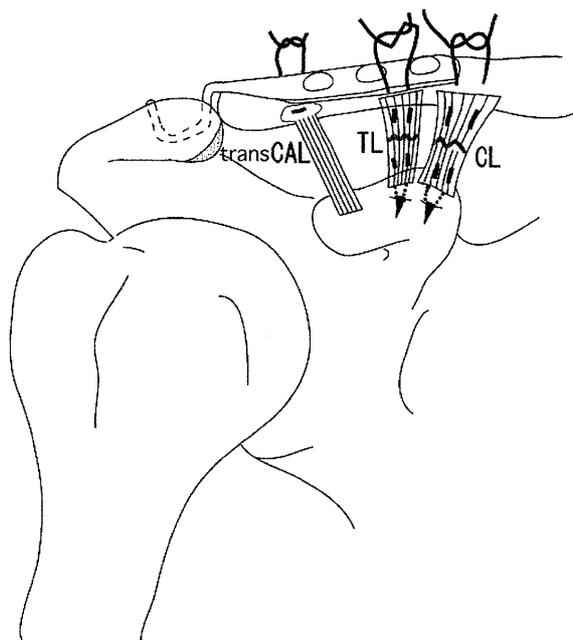
## MATERIALS AND METHODS

In 2003, three patients with Rockwood type V acromioclavicular joint dislocation were treated with the following procedure within 3 weeks after injury. All including 2 heavy laborers were males and high activity-patients. Age of each patient was 32, 42, and 47, respectively (Table 1). All had injured their dominant side. Since the acromioclavicular dislocations of all patients were severe, diagnoses of Rockwood type V dislocation could be pointed out with panoramic view in standing position with own weight of the injured upper extremity. No sign of arthritic changes in the acromioclavicular joint was identified preoperatively in all patients. Postoperative follow-up of each patient was 12, 13, and 11 months, respectively. At the latest follow-up, patients were evaluated subjectively and objec-

tively by Constant scoring system<sup>16)</sup>, American Shoulder and Elbow Surgeons (ASES) evaluation form<sup>17)</sup>, and radiographic findings.

### Operative technique

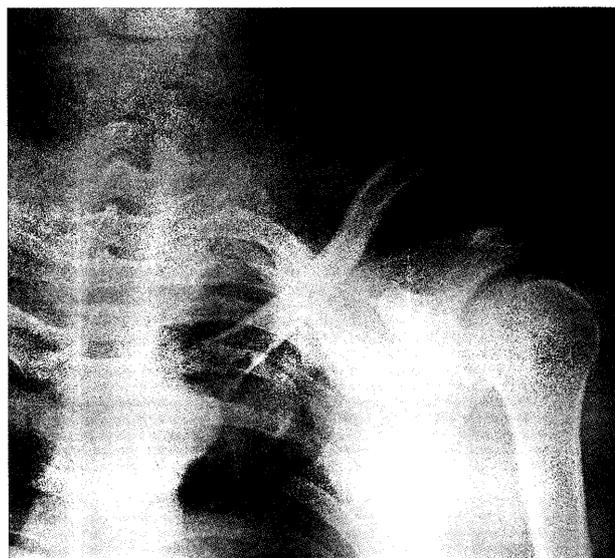
Surgery is performed under general anesthesia. Patients are placed in the beach chair position. A skin incision is made parallel to the distal clavicle and turned posteriorly at the acromioclavicular joint along the Langer's line, being L-shaped. After subcutaneous dissection, the joint is exposed by sharply releasing the origin of the anterior deltoid muscle from the distal clavicle and the acromion. The acromioclavicular joint is debrided with removal of the meniscus<sup>18,19)</sup>, but the distal end of the clavicle nor the acromioclavicular ligaments are never resected<sup>20)</sup>. The distal clavicle is subperiosteally exposed for 10 cm medially as to put the 3-hole hook plate later. The anterior deltoid muscle is released medially until exposing the coracoid process. Then insertions of the conoid and the trapezoid ligaments are identified. Two sets of Miteck G II anchor (Johnson & Johnson, Norwood, MA, USA), which is made of titanium, with preloaded No.2 Ethibond<sup>11)</sup> are prepared. 3.5 mm drill bit is used to create two pilot holes at the ligament insertions in the base of the coracoid. The anchors preloaded on the delivery handle are deployed into the holes<sup>15)</sup>. A pair of transosseous tunnels is made with 1.5 mm Kirschner wire, at the clavicle insertion of each coracoclavicular ligament, and recipient site of later transferred coracoacromial ligament, eventually 3 pairs of 2 drill holes are made in the clavicle. The coracoacromial ligament is harvested with a sliver of bone from the acromion as to achieve solid bone-to-bone contact that can facilitate healing and remodeling. Two small drill holes with 1.5 mm



**Fig. 1** Schema shows an outline of operation : combination of the coracoclavicular ligament repair, the coracoacromial ligament transfer, and the acromioclavicular fixation with the hook plate : transCAL : transferred coracoacromial ligament, TL : trapezoid ligament, CL : cuboid ligament

Kirschner wire are also made in the piece of bone. Each injured coracoclavicular ligament is sutured in weaving fashion using preloaded No.2 Ethibond, and pulled over upper surface of the clavicle through each drill hole. The piece of bone attached to the transferred coracoacromial ligament is also threaded with No.2 Ethibond and pulled over upper surface of the clavicle through the drill holes. After being reduced anatomically, the acromioclavicular joint is fixed with a short-hook-3-hole plate (Wolter clavicular plate, Link, Germany). Then the sutures of the coracoclavicular ligaments and the transposed coracoacromial ligament are tied on the upper surface of the clavicle over a bone bridge. The anterior deltoid and posterior trapezius flaps are reapproximated over the superior aspect of the clavicle using No.2 nonabsorbable braided sutures (Fig. 1).

Postoperatively, the patient's shoulder is lightly immobilized with a sling. The sling is removed at the first postoperative day and the patient is allowed to begin circumduction exercises with a gradual increase. No overhead activities or full abduction was allowed until the hook plate removal at three months.



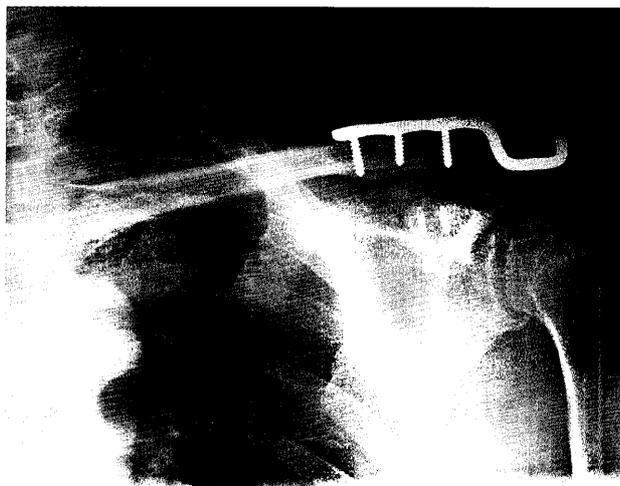
**Fig. 2** A representative case (case 1) : a thirty-two-year-old man injured Rockwood type V acromioclavicular dislocation by the traffic accident. X-ray on initial injury

## RESULTS

All patients were able to return to preoperative work partially in two months, fully in four months after the initial operation (a month after removal of the hook plate). The mean active shoulder movements in the latest follow-up (around a year after the initial operation) were as follows : abduction 167°, forward flexion 167°, external rotation 40°, and internal rotation 74°. Mean constant score was 95 out of the maximum score of 100, and mean ASES score was 28 out of the maximum score of 30. They all accepted final operation scars. No objective complication due to the temporary hook plate could be identified. Although the follow-up period in this study was short, the reduction and radiological appearance of the clavicle remained unchanged and no sign of arthritic change of the acromioclavicular joint was identified in all patients until the most recent follow-up visit (mean, 1 year) (Table 1) (fig. 2~4).

## DISCUSSION

Stability of the acromioclavicular joint is conferred by 2 sets of ligamentous structures. The acromioclavicular ligaments provide horizontal joint stability, and the conoid and trapezoid ligaments provide



**Fig. 3** Postoperative X-ray

vertical stability<sup>21)</sup>. The conoid ligament had a primary role in constraining anterior and superior translation and anterior and superior displacement of the clavicle, especially under high loading conditions<sup>21,22)</sup>. Ligament substitution using the coracoacromial ligament provides an attractive biologic solution for the coracoclavicular ligament-deficient shoulder. But prevalence of clinically significant reduction loss after the simple ligament transfer was reported up to 29%<sup>2,23)</sup>, because structural properties of the transferred coracoacromial ligament has only about half the strength and the stiffness of the native coracoacromial ligament. For reinforcement of the transferred coracoacromial ligament, many modifications have been reported using various temporary or permanent augmented substitutions, such as screws<sup>8)</sup>, Dacron loop<sup>9)</sup>, absorbable<sup>10)</sup> or non-absorbable<sup>2)</sup> sutures, and suture anchors<sup>11)</sup>, with some disappointing rate of recurrences and complications<sup>2,5,8,10,11,18,25~29)</sup>.

Repairing of injured coracoclavicular ligament is technically demanding and simply repaired ligament itself may not re-achieve the native strength owing to scar-healing. Weaving suture repair of injured coracoclavicular ligament using suture anchor which requires neither special skill nor time-consuming effort, combined with the coracoacromial ligament transfer ensure anatomical stability of the acromioclavicular joint.

Use of rigid hardware for temporary support during ligament healing period has been reported with complications. Reapproximation of the disrupted acromio-



**Fig. 4** A month after removal of the hook-plate. The patient was already reinstated in his former work, but no remarkable reduction loss could be seen.

clavicular joint with Kirschner wires may lead to further damage to the articular cartilage and meniscus, resulting in degenerative changes<sup>5)</sup>. The lag screw fixation of the clavicle to the base of the coracoid<sup>27,29)</sup> is technically demanding, and screw loosening<sup>26,28)</sup> and breakage<sup>22)</sup> are not rare complications. Although surgical scar in a clearly visible region may be difficult to accept in female patients with hook plate fixation<sup>30)</sup>, reliable stability during ligament healing period could be achieved in our cases. Since reliable stability from the beginning of the postoperative stage could ease mandatory limitation in daily activities earlier, this reinforced procedure consequently helped early reinstatements of the high active patients.

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