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Original Article

Post-traumatic acromioclavicular instability reconstruction with coracoacromial ligament and conjoined tendon: A preliminary report

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ABSTRACT

Background: Many surgical techniques have been proposed to treat acromioclavicular (AC) injuries; however, anatomic coracoclavicular (CC) reconstructions with local tissue grafts have not been reported in previous studies. The aim of this study was to investigate early outcomes of this innovative technique.
Methods: Between 2004 and 2011, 15 patients with post-traumatic AC instability underwent anatomic reconstructions by two surgeons at our institution. Nine patients were treated with local tissue grafts, and these included six patients who underwent double-bundle reconstructions and three who underwent single-bundle reconstructions. The remaining six patients were treated with free tendon grafts. The clinical outcomes of the Constant scores and the radiographic results of the CC distance were further analyzed.
Results: In patients who underwent reconstructions with local tissue grafts, those treated with double-bundle and selective-bundle reconstructions had an average postoperative Constant score of 89.0 ± 11.5 and 71.7 ± 38.4, respectively. In patients who underwent reconstructions with free tendon grafts, the average score was 73.0 ± 29.4. There was no statistically significant difference among the three reconstruction procedures. Only one patient showed residual AC separation on plain-film radiography.
Conclusion: This innovative technique provided clinical and radiographic results that were comparable to those achieved with free tendon grafts. This procedure can be an alternative surgical option for treating AC joint instability.

1. Introduction

The Weaver-Dunn and modified Weaver-Dunn procedures, which involve coracoacromial (CA) ligament transfer into the medullary canal, have been the most popular surgeries for acromioclavicular (AC) injuries.[1–8] Other local tissue grafts, such as those involving conjoined tendons, result in similar ultimate tensile strengths in biomechanical studies and serve as an alternative tissue option in studies of nonanatomic reconstruction.[9–11]

Anatomic coracoclavicular (CC) reconstructions with free tendon grafts have been shown in biomechanical studies to provide more resistance to translation force.[12,13] This technique has resulted in promising clinical results and has become popular in recent years.[14–17]

Although numerous surgical techniques have been proposed for treating AC injuries, anatomic reconstructions with local tissue grafts have not been reported in previous studies. We developed this innovative procedure, which involves transferring the CA ligament and conjoined tendon to anatomic tunnels, in order to combine the advantages of local tissue transfer and anatomic reconstruction. The purpose of this study was to investigate the early results of this procedure and to compare it with the results of anatomic reconstructions with free tendon grafts.

2. Materials and methods

2.1. Patient data

The Rockwood classification was used to assess the AC injuries. Types I and II were low-grade injuries. The CC interspace increases in Types III and V were 25–100% and 100–300%, respectively; Type

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IV included posterior displacement, and Type VI included inferior displacement.[18] Surgical indications were: (1) acute Rockwood Type IV, V, or VI AC injuries; (2) chronic Rockwood Type III, IV, V, or VI AC injuries with failed conservative treatment; (3) distal clavicle nonunion; or (4) failure of prior surgery for AC dislocation. Patients with cervical disorder, open fractures, or neurovascular injuries were excluded.

Between 2004 and 2011, 15 patients (12 men and 3 women; mean age 47.5 years, range 19.7–82.4 years) with AC instability underwent CC reconstructions that were performed by two surgeons at our institution. All 15 patients were included in this study and were followed up for a mean duration of 24.4 months (range 8.8–93.1).

The mechanisms of AC injury included falls (3 patients), traffic accidents (11 patients), and contusion during work (1 patient). We classified AC instability according to the Rockwood system. One patient was Type II, four patients were Type III, two patients were Type IV, and eight patients were Type V (Table 1). Six of the 15 patients had concomitant injuries, including intracranial hematomas, ipsilateral hip and femoral shaft fractures, rib fractures, radial head fractures, and metatarsal fractures.

Twelve patients underwent primary CC reconstruction surgery, and these included 10 patients with AC separation and two with a distal clavicle nonunion and a high-riding clavicle. Three patients who had failures of a prior CC screw fixation at other institutions visited our hospital and underwent revision CC reconstruction surgery. The interval between injury and index surgery at our institution was 145 (range 3–730) days (Table 2).

All patients were treated surgically by one of the two surgeons (Chen A.C. and Chan Y.S.) with either local tissue transfers or free tendon grafts. The donor tissue for reconstruction included nine patients with local tissue grafts (6 cases of both CA ligament and conjoined tendon transfer, 2 cases of CA ligament transfer, and 1 case of conjoined tendon transfer) and six patients with free tendon grafts (4 cases of ipsilateral semitendinosus tendon, 1 case of palmaris longus, and 1 case of flexor carpi radialis due to an unavailable palmaris longus). Six of nine patients with local tissue grafts and all six patients with free tendon grafts underwent double-bundle reconstruction. The remaining three patients with local tissue grafts underwent selective-bundle reconstruction (2 cases of trapezoid ligament reconstruction and 1 case of conoid ligament reconstruction).

Nine patients were augmented with a hook plate, and six patients with Mersilene tape or nonabsorbable sutures. Eleven of the total 15 patients had AC arthrosis and underwent distal clavicle excision (Table 2).

Table 1
Patient information.

Patient	Sex	Age (y)	Injury	Side	Dx[|]	RW	Polytrauma[#]
01	M	67	TA	R	AC	V	—
02	M	37	Fall	R	AC	IV	Rib fracture
03	M	42	TA	R	AC	V	—
04	M	62	TA	L	AC	V	—
05	M	49	Fall	L	AC	V	ICH, hemopneumothorax
06	F	37	TA	R	AC	V	Hip and femoral fracture
07	F	22	TA	R	AC	V	Metatarsal fracture
08	M	51	TA	L	AC	IV	Rib fracture
09	M	26	TA	R	Clavicle	III	—
10	F	51	TA	R	AC	II	—
11	M	56	TA	R	AC	III	—
12	M	65	TA	L	AC	III	—
13	M	40	TA	R	AC	V	Radial head fracture
14	M	48	Cont	L	AC	III	—
15	M	85	Fall	L	Clavicle	V	—

AC = acromioclavicular injury; Clavicle = distal clavicle fracture; Cont = direct blunt contusion; Dx = diagnosis; ICH = intracranial hemorrhage L = left side injured; R = right side injured; RW = Rockwood classification; TA = traffic accident.

2.2. Surgical technique of local tissue grafting

In patients with AC arthrosis, 5–8 mm of the distal clavicle were resected. The dissection was performed meticulously in order to evaluate the injury severity of the conoid and trapezoid ligaments. In the patient with complete tears of both the conoid and trapezoid ligaments, a double-bundle reconstruction was performed. If either the conoid or the trapezoid ligament had a sprain or partial tear injury, the sprained or partially torn ligament was preserved and selective-bundle reconstruction performed on the completely torn ligament. We used the CA ligament and conjoined tendon for trapezoid and conoid ligament reconstruction, respectively. The CA ligament was detached without bone chips, and the lateral half of the conjoined tendon was split and harvested 5 cm distal to the coracoid. Great care was taken to avoid musculocutaneous nerve injury.

Based on the bony landmarks described by Harris and Salzmann, the anatomic insertion sites of the conoid and trapezoid ligaments were identified.[19,20] There should be a 20–25-mm distance between the two tunnels in the clavicle, and a 10–12-mm distance in the coracoid. The anatomic ligament tunnels were created using 3-mm drills, and the grafts were passed through the bony tunnels (Fig. 1). The reduction was performed, and the grafts fixed with nonabsorbable sutures. Reconstruction was augmented with a hook plate if patient consent was obtained. If the patient declined implant treatment, augmentation with Mersilene tape or nonabsorbable sutures was the alternative method used (Fig. 2).

2.3. Surgical technique of free tendon grafting

The tendon was harvested with a closed-loop tendon stripper and prepared with nonabsorbable sutures. The clavicular and conoid insertion sites of the conoid and trapezoid ligaments were identified, and the anatomic tunnels drilled. After passage through drill holes in the coracoid, the graft was passed through the bony tunnels in the clavicle (Fig. 3). The reduction was performed, and the graft fixed with nonabsorbable sutures. The reconstructed ligaments were protected with a hook plate, Mersilene tape, or nonabsorbable sutures.

2.4. Postoperative treatment and follow-up

Postoperatively, patients were immobilized in a sling for 6 weeks. Patients were immediately allowed passive pendulum exercise in the first 2 weeks. Closed-chain passive exercise was initiated in the 3rd postoperative week. Following removal of the sling, the passive overhead stretching was continued and active motion added in the 7th week. Full active shoulder motion was allowed 3 months postoperatively. Surgery for removal of implant was suggested, and most plates were removed at around 3–4 months from the index surgery.

Data regarding the patients' profiles, injury mechanisms, graft source, methods of reconstruction, and complications were collected. The average follow-up duration was 24.4 months. The functional outcomes were assessed with Constant scores.[21] The results were also assessed by anteroposterior and axillary view radiographs of the shoulder. The CC distance was measured in order to evaluate the displacement preoperatively, postoperatively, and at the final follow-up examination.

2.5. Statistical analysis

ANOVA was used to determine whether there was a significant difference in the Constant scores among the reconstruction techniques. Unpaired t tests were used to compare the outcomes