Surgical Treatment of Fresh Complete Acromioclavicular Dislocation by Coracoid Process Transfer and K-Wire Transfixation

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Abstract Acromioclavicular dislocations are very common shoulder injuries. The optimal treatment for acute high-grade acromioclavicular joint injury remains a matter of debate. The purpose of this study was to evaluate the results of surgical treatment of complete acromioclavicular dislocation using coracoid process transfer and temporary K-wire transfixation. Twenty-one patients with complete acromioclavicular dislocation underwent coracoid process transfer and temporary K-wire transfixation. Patients were assessed at the follow-up based on visual analog scores (VAS), the Constant–Murley scoring system and the UCLA shoulder rating system. Radiographs were taken to check up vertical instability. The mean follow-up was 32.1 months (25–47 months). The mean Constant and Murley score and UCLA shoulder rating score was 89.9 ± 8.4 and 30.1 ± 4.4 . There were fourteen excellent functional results and six results and one poor result. The overall rate of satisfaction, which means an excellent or good result, was 95.2 %. Nineteen patients (90.4 %) maintained their previous jobs or resume their daily activities. The mean final pain score, as measured from 1 to 10 on the visual analog scale, was 1.91 ± 1.09 . The radiographic analysis revealed twenty patients had maintained reduction at the final follow-up. The coracoid process transfer and temporary K-wire transfixation is a reliable treatment for a complete acromioclavicular dislocation.

Keywords Coracoid process transfer · Acromioclavicular dislocation · K-wire

Introduction

Acromioclavicular dislocation is one of the most common shoulder injuries seen in the general orthopedic practice. Most frequently the mechanism of injury is a force acting on the shoulder from the lateral side with the arm in an adducted position [1]. According to the Rockwood classification, grade V injuries are characterized by disruption of the acromioclavicular (AC) and coracoclavicular (CC) ligament, with 100–300 % superior dislocation of the clavicle [2]. Although acute grade V injuries were generally considered to be required operative intervention, the optimal surgical approach for acute acromioclavicular dislocations is still controversial. The goal of surgical treatment is to restore the joint space and obtain a good functional result, with pain-free loading of the joint [3]. Many techniques used to treat acromioclavicular joint dislocations, including the use of metallic devices to reduce and maintain reduction of the AC joint using K-wires, Steinman pins, tension banding, and clavicle hook plates [2, 3] and reconstruction of the coracoclavicular ligament using local tissue transfers or tendon grafts [4], do not achieve this goal. In this series, the acromioclavicular percutaneous K-wire was chosen to fix the acute type VAC joint dislocations combined with transfer of the conjoined tendon and distal end of the coracoid process to the clavicle, and the functional outcome and radiographic features of patients obtained using the procedure were retrospectively analyzed.

Materials and Methods

From December 2000 to December 2008, 21 consecutive patients with acute Rockwood type VAC joint dislocations were treated with the K-wire fixation combined with transfer of the conjoined tendon and the distal end of the coracoid

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process to the clavicle in our institute. This study was conducted according to the principles established in Helsinki and approved by the ethical committee of Tianjin Hospital. There were 19 men and 2 women. Their average age was 44.95 years (range 22–63 years; 38.9–50.9, 95 % CI). The injury was on the right side in 9 patients and on the left side in 12 patients. The dislocations resulted from falls in 17 patients and from car accidents in 4 patients. Surgery was performed in all cases within 1–11 days (4.0–6.3, 95 % CI) of the trauma by the senior author.

Surgical Techniques

The open operative procedure was performed in general anesthesia. Subsequently, a vertical skin incision over the lateral clavicle toward the coracoid process, the AC joint including the articular surfaces, articular disk, ligaments, and the deltotracheal fascia were examined. After manual repositioning of the AC joint, two percutaneous nonthreaded K-wires were inserted parallel consecutively from the lateral end of the acromion into the clavicle for at least 9 cm in length each. To prevent proximal K-wire migration, the lateral pin

ends were bent. The correct K-wire positions and AC joint position were verified with intraoperative X-ray film examination. In addition, a slight modification of the operation described by Dewar was performed [5]. The tip of the coracoid process was exposed, and the short head of biceps, coracobrachialis, and pectoralis minor were identified. The coracoid process with the former two muscle attachments was osteotomized, with care given not to dissect medially to pectoralis minor in order to avoid damage to the musculocutaneous nerve. This nerve was identified prior to mobilizing the coracoid process. The anterior undersurface of the clavicle was freshened and a short screw of appropriate length was inserted through the tip of the coracoid process into the clavicle and the raw surfaces approximated and firmly held together.

Postoperatively, the patients wore a sling for 3 weeks. Gentle pendulums and passive motion of the shoulder was encouraged. All K-wires were removed 8 weeks after insertion under local anesthetic procedure. Intensive mobilization was started after hardware removal.

Follow-up ranged from 25 to 47 months, with an average of 32.1 months (29.0–35.1, 95 % CI). Patients came back to the outpatient clinics every 4–6 weeks after operation for

Table 1 Patient demography and outcomes

Patient no.	Age (Years)	Gender	Side	Mechanism of injury	Time from injury to operation (Days)	Follow-up (Months)	Pain VAS	ULCA score	Constant and Murley score	Post-AC score	Complications
1	63	Male	Left	Car accident	1	42	1	35	98	Excellent	None
2	56	Male	Left	Fall down	3	28	0	34	97	Excellent	None
3	55	Male	Left	Fall down	4	25	1	31	94	Excellent	None
4	52	Male	Left	Fall down	6	27	1	33	92	Excellent	None
5	22	Male	Left	Fall down	4	44	2	30	94	Good	Coracoid tip fracture
6	45	Male	Right	Fall down	5	43	1	32	93	Excellent	None
7	47	Female	Right	Fall down	4	37	2	30	94	Excellent	None
8	35	Male	Left	Fall down	3	28	1	30	92	Excellent	Superficial wound infection
9	32	Male	Right	Car accident	7	29	2	29	89	Excellent	None
10	33	Male	Left	Fall down	5	31	2	31	91	Excellent	None
11	24	Female	Right	Fall down	3	33	3	28	92	Excellent	None
12	47	Male	Right	Fall down	5	29	1	29	89	Good	None
13	50	Male	Right	Fall down	6	36	2	31	94	Excellent	None
14	23	Male	Left	Fall down	10	26	2	31	90	Excellent	None
15	47	Male	Right	Fall down	1	27	3	27	84	Good	None
16	45	Male	Left	Car accident	7	31	2	33	93	Excellent	None
17	54	Male	Left	Fall down	5	26	3	28	87	Good	None
18	56	Male	Right	Fall down	11	28	5	13	56	Poor	Arthrosis
19	32	Male	Right	Fall down	4	47	1	33	89	Excellent	None
20	63	Male	Left	Car accident	6	27	2	31	88	Good	Subluxation
21	63	Male	Left	Fall down	8	30	3	32	92	Good	None

clinical and radiographic follow-up. At the time of the latest follow-up, the UCLA shoulder rating system and the Constant and Murley scoring system questionnaires were utilized for a final evaluation of the shoulder function. Anteroposterior radiographs of both acromioclavicular joints were made for each patient. The radiographic outcome was defined and classified as (1) maintained reduction (with a side-to-side difference less than the width of the clavicle) and (2) complete loss of reduction (with a side-to-side difference in excess of the width of the clavicle) [6]. Patients assessed pain relief using a visual analog scale graded from 0 (no pain) to 10 points (maximal pain). The results at the follow-up evaluation were rated as excellent, good, fair, or poor according to the criteria made by Jiang [6].

Results

At the final follow-up evaluation, the mean Constant and Murley score and the UCLA shoulder rating score were 89.9 ± 8.4 (86.1–93.7, 95 % CI) and 30.1 ± 4.4 (28.0–32.1, 95 % CI). According to the criteria made by Jiang, there were 14 excellent functional results and 6 results and 1 poor result. The overall rate of satisfaction, which means an excellent or good result, was 95.2 %. Nineteen patients (90.4 %) maintained their previous jobs or resume their daily activities. The mean final pain score, as measured from 1 to 10 on the visual analog scale, was 1.91 ± 1.09 (1.4–2.4, 95 % CI) (Table 1).

There were two surgical complications. In one of the early cases, there was a fracture of the coracoid tip as the screw was tightened. This was then wired in place and healed uneventfully. One patient developed superficial wound infection that resolved with a short course of oral antibiotics. Both of two cases were eventually placed in good category. There were no brachial plexus or peripheral nerve injuries, and following surgery there were no elbow or shoulder contractures.

Radiographic bony union at the coracoid process transfer site was obtained in all patients, and the mean period required for healing was 3.5 ± 1.3 (3.0–4.1, 95 % CI) months. Follow-up radiographs revealed the maintenance of reduction in 20 patients. Partial loss of reduction that did not increase over time was found in 1 patient (Case 20), and the result ranked good according to the rating criteria made by Jiang. One male patient (Case 18) who experienced acromioclavicular arthrosis was considered a poor result because his symptom of the right injured shoulder was pain necessitating analgesics medication, though full range of motion was regained. None suffered from pin loosening, or breakage and migration of the pin (Fig. 1).

(A)

(B)

Fig. 1 a Surgical technique for AC reconstruction with coracoid process transfer and temporary K-wire transfixation. With the patient lying in beach-chair position, a vertical skin incision is made from the lateral clavicle toward the coracoid process. After manually repositioning of the AC joint, two acromioclavicular K-wires are placed in order to keep the AC joint stable. The coracoid process with the short head of biceps and coracobrachialis was osteotomized and secured onto the clavicle with a screw. **0062** X-ray taken 4 weeks after surgery showing satisfactory reduction of the AC dislocation

Discussion

In Rockwood VAC joint dislocation, complete disruptions of acromioclavicular ligaments and coracoclavicular ligaments with additional lesions of the deltoid or trapezius muscles are determined for operative repair. There is a great variety of operative treatment options for acromioclavicular joint instability. One surgical option to stabilize the lateral clavicle focuses on reconstruction of the CC ligament by transferring the coracoacromial (CA) ligament or using tendon grafts. In the classic Weaver–Dunn procedure, biomechanical studies have found that the initial strength of the CA ligament transfers is one-eighth to that of the normal CC ligaments [7]. Incomplete reduction or recurrence of dislocation was reported to be as high as 24 % [8, 9].

Recently, there has been an increasing trend toward the reconstruction of the AC joint by the use of tendon grafts, either autografts or allografts. Biomechanical studies have demonstrated that anatomical reconstructions with a tendon

graft rebuild the tensile strength of the native acromioclavicular joint complex and initial stability significantly better than a modified Weaver-Dunn [10, 11]. In recent published clinical studies, the CC ligament reconstruction using autogenous semitendinosus tendon graft for revision acromioclavicular stabilization provided varying satisfactory outcomes [12–14]. But these procedures have the disadvantages of implant cost and remote donor site morbidity [11, 12, 14].

Clinical and biomechanical results of combined procedures at the AC joint and the CC space are superior to either technique alone [7, 15]. In this study, we tried to reconstruct both the CC ligaments and the AC ligamentocapsular complex. Regarding a stable CC reconstruction, we adopted Dewar procedure. The dynamic effect of the transferred coracobrachialis and short head of the biceps brachii appears to hold the clavicle in the reduced position. This also allows the remnant fibers of the torn coracoclavicular ligament to be more closely aligned and thus heal at its near preinjury tensile strength. The ultimate strength of tendon graft transfer and the strengths of primary healed, torn, native CC ligaments may be additive. For stabilization of the AC joint, the temporary K-wire technique was employed. This method has the advantage over other forms of technique in that transarticular pin fixation can provide mechanical stabilities and protect the joint from anterior–posterior translation forces, which cannot be avoided effectively by coracoclavicular augmentation. However, the K-wire technique implies the risk of pin migration and always necessitates a second surgical procedure to remove the wires 6–8 weeks after the first procedure. An attempt was made to avoid pin migration by bending the tip of the K-wire out of skin, which means that pin removal can be performed simply in an outpatient clinic.

Our results showed a high incidence of good outcome, with partial loss of reduction in a single case only after a mean follow-up of 32.1 months. The mean final follow-up constant scores and the UCLA shoulder rating score were 89.9 and 30.1, respectively. Because only one patient experienced partial reduction loss, the correlation between maintenance of the reduction and functional outcome could not be detected. However, our data correlate with previous studies, demonstrating that a partial loss of reduction does not necessarily lead to a poor functional outcome [6, 14].

The incidence of acromioclavicular arthrosis may, however, cause great concern. The authors had one patient, who experienced this complication, but the arthrosis was only slightly and occasionally symptomatic, and it did not deteriorate. Early removal of the transacromial Knowles pin after bony union should be performed to prevent arthrosis from developing.

This study has several limitations. First, it had a relatively small sample size and a short follow-up and was retrospective. Second, Dewar procedure is technically demanding at the risk

of injury to the musculocutaneous nerve [3], although no patient in our series developed these complications.

In conclusion, our study demonstrates that surgical treatment with temporary K-wires transfixation and coracoid process transfer of acute Rockwood grade VAC separations enables good and reliable results with a promising functional outcome in the long term.

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