

Surgical Treatment of Acute Complete Acromioclavicular Dislocation: Comparison of Coracoclavicular Screw Fixation Supplemented with Tension Band Wiring or Ligament Transfer

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Background: Treatment of acute complete acromioclavicular (AC) dislocation is still controversial. Both non-surgical and surgical methods have been reported with similar results. In addition, once surgical treatment is chosen, a satisfactory surgical technique has not been developed yet.

Methods: Sixty consecutive patients who sustained 60 acute complete AC dislocations were treated using coracoclavicular (CC) screw fixation supplemented with tension band wiring for the AC joint ($n = 30$) or coracoacromial (CA) ligament reconstruction ($n = 30$), respectively. The operating times, functional outcomes, and complications were compared.

Results: Twenty-nine patients with tension band wiring (group 1) and 27 patients with CA ligament reconstruction (group 2) were followed-up for 12-47 (mean, 23.6) months. The operating time was 34-57 (mean, 46.3) minutes in group 1 versus 52-93 (mean, 83.4) minutes in group 2 ($p < 0.001$). The percentage of satisfactory outcomes was 86.2% in group 1 versus 88.9% in group 2 ($p = 0.30$). Loss of reduction of the AC joint was 13.8% (4/29) in group 1 versus 3.7% in group 2 (1/27, $p = 0.17$). Patients who received tension band wiring treatment had a higher rate of unsatisfactory outcomes when loss of reduction of the AC joint occurred ($p = 0.01$).

Conclusions: Once surgical methods are chosen in patients with acute complete AC dislocation, CC screw fixation supplemented with tension band wiring for the AC joint or CA ligament reconstruction achieved similar satisfactory rates. However, patients who received the former had relatively shorter operating times.

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Key words: complete acromioclavicular dislocation, coracoclavicular screw fixation, tension band wiring, coracoacromial ligament reconstruction.

Acromioclavicular (AC) dislocation is not uncommon and normally is caused by high energy impact injuries.^(1,2) In some reports in the liter-

ature, treatment of incomplete AC dislocation is favored using non-surgical methods. However, treatment of complete AC dislocation is still controver-

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sial.⁽¹⁻⁶⁾

AC dislocation has been sub-classified by Rockwood into six types according to the extent of clavicle displacement and the severity of ligament compromise.⁽¹⁻⁴⁾ According to this classification, types 1 and 2 are incomplete dislocations and types 3-6 are complete dislocations. Currently, surgical treatment for types 4-6 AC dislocation is supported by most of orthopedists. As for type 3 AC dislocation, both early surgical treatment and non-surgical treatment initially with late reconstruction if necessary have achieved support. Even so, a satisfactory surgical technique has not been developed yet.⁽¹⁻⁶⁾

Coracoclavicular (CC) screw fixation supplemented with different reinforcing techniques has been supported by some orthopedists.^(1,2,7,8) The advocated advantages of these techniques are technical simplicity, possibility of not needing intra-articular fixation, and provision of sufficient stability. However, the prerequisite requirement is an intact coracoid process.

Among various reinforcing techniques with CC screw fixation, concomitant AC stabilization and coracoacromial (CA) ligament reconstruction have achieved the most support.^(1,2,7-11) In this prospective study, the authors compared two surgical techniques: one was CC screw fixation supplemented by tension band wiring of the AC joint and the other one was CC screw fixation supplemented by CA ligament reconstruction. The aim of this study was to determine which surgical technique had a better outcome in order to further clarify this controversial issue.

METHODS

From January 2000 through February 2004, 60 consecutive adult patients with 60 acute complete AC dislocations (types 3-6) were treated using CC screw fixation supplemented with two different reinforcing techniques at the authors' institution. All AC dislocations were caused by motor vehicle accidents and associated injuries were few. Patients ages ranged from 17- 65 (mean, 34.5) years with a male to female ratio of 3 to 2.

None of the AC dislocations were treated emergently, however, surgical treatment was arranged as early as possible. CC screw fixation supplemented with tension band wiring for the AC joint (group 1) and CC screw fixation supplemented with CA liga-

ment reconstruction (group 2) were performed alternatively according to the chronological order of the patients being treatment.

Surgical technique

All patients underwent general anesthesia with endotracheal intubation and were placed on the operating table in the supine position. The involved shoulder was elevated. An anterior curved approach to expose the AC joint, the lateral end of the clavicle, and the coracoid process was performed.⁽²⁾

For patients in group 1, after the AC joint was reduced on each patient, tension band wiring with two 2 mm diameter of Kirschner wires (Mizuho, Tokyo, Japan) and No. 9 cerclage wire (Zimmer, Warsaw, Ind, USA) was inserted to stabilize the AC joint.^(12,13) A 4.5 mm diameter of cancellous screw (Synthes, Bettlach, Switzerland) was inserted from the clavicle to the coracoid process perpendicularly. The cancellous screw was always inserted following the principle of lag screw effect.^(2,14) The coracoclavicular ligament stump was repaired using absorbable sutures.

For patients in group 2, the CA ligament was identified and its acromial end with the bony attachment was isolated. After the AC joint was reduced, a 4.5 mm diameter cancellous screw was inserted from the clavicle to the coracoid process. Similarly, the principle of lag screw effect was followed. The coracoclavicular ligament stump was repaired using absorbable sutures. After the upper surface of the clavicle was roughed with multiple drilling, the acromial end of the CA ligament with its bony attachment was sutured to the decorticated area using non-absorbable sutures.⁽²⁾

After the operation, each patient used a sling for 3 weeks. Then, patients were permitted to implement their daily activities gradually. Abducting the upper extremity above the shoulder was prohibited for 6 weeks. At 6 weeks, tension band wires were removed under local anesthesia. At 3 months, each CC screw was removed similarly under the local anesthesia. After that, patients were permitted to perform normal activities.

Each patient's clinical recovery course was followed-up annually and whenever necessary. The wound condition and complications were recorded and managed.

To evaluate the functional outcomes of the

shoulders, the Imatani's scoring system was used.⁽¹⁵⁾ It included assessment of pain, function, and movement of the shoulder. Four grades were categorized and a satisfactory outcome included an excellent or good result (Table 1). This scoring system was used due to its relative simplicity and practicality.

Fisher's exact test or unpaired t-test was used to compare various outcome measures of the two groups.

RESULTS

Fifty-six patients were followed up for 12-47 (mean, 23.6) months. Four patients were lost despite our best efforts to continue contact. Thus, 29 patients in group 1 and 27 patients in group 2 completed this study (Table 2).

The operating time in group 1 ranged from 34-57 (mean, 46.3) minutes and ranged from 52-93 (mean, 83.4) minutes in group 2 ($p < 0.001$).

There were no peri-operating complications in either group.

During the latest follow-up examination, satisfactory outcomes were noted in 25 (86.2%) of the 29 group 1 patients and in 24 (88.9%) of the 27 group 2 patients ($p = 0.30$; Figs. 1, 2). The unsatisfactory complaints were all due to intermittent shoulder pain which required irregular oral analgesics.

Table 1. The Scoring System by Imatani for Acromioclavicular Separation

Distribution	Score
Pain (40 points)	
None	40
Slight, occasional	25
Moderate, tolerable	10
Limited activities, severe, constant, disabling	5
Function (30 points)	
Weakness (proportion of pre-injury)	20
Use of shoulder	5
Change of occupation	5
Movement (30 points)	
Abduction	10
Flexion	10
Adduction	10
Result	
Excellent	91 to 100
Good	81 to 90
Fair	61 to 80
Poor	< 60

Table 2. Comparison of Surgical Outcome for Coracoclavicular Screw Fixation Supplemented with Various Reinforcing Techniques for Acute Complete Acromioclavicular Dislocation

Items	Tension band wiring (n = 29)	Coracoacromial ligament reconstruction (n = 27)	p value
Operating time (minutes)			
	34-57 (mean, 46.3)	52-93 (mean, 83.4)	< 0.001
Satisfactory functional outcome			
	86.2%	88.9 %	0.30
Complications			
Loss of reduction of the acromioclavicular joint			
	13.8%	3.7 %	0.17
Others			
	0	0	1.00

During the latest follow-up examination, loss of reduction of the AC joint occurred in four of the group 1 patients and one of the group 2 patients ($p = 0.17$). Two of four patients in group 1 had unsatisfactory outcomes and re-operation with CA ligament reconstruction was performed. Both patients had satisfactory outcomes finally (Fig. 3). Another two patients in group 1 who had loss of reduction of the AC joint but had satisfactory outcomes were not operated on again to reduce the dislocated joint. Patients who had unsatisfactory outcomes but had no loss of reduction of the AC joint were suggested to have resection of the distal clavicle whenever necessary. The patient who had loss of reduction of the AC joint in group 2 had satisfactory results and no further operations were performed (Fig. 4).

In group 1, 25 patients had satisfactory results and two out of these patients had loss of reduction of the AC joint. Another four patients had unsatisfactory results and two out of these patients had loss of reduction of the AC joint ($p = 0.01$). In group 2, three patients with unsatisfactory results had no loss of reduction of the AC joint.

DISCUSSION

In some reports in the literature, conservative treatments for acute type 3 AC dislocations have been reported with high satisfactory rates.⁽¹⁻⁶⁾ Although a satisfactory rate as high as 97% with more than 10-year follow-up has been reported, usu-

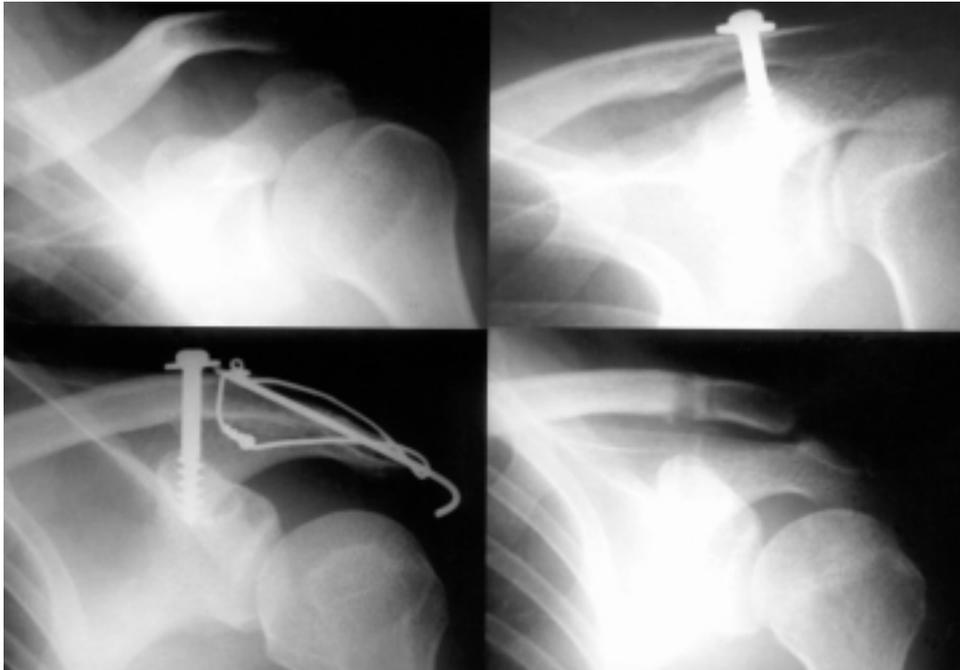


Fig. 1 A 38-year-old man sustained left acute complete acromioclavicular dislocation (left upper). The dislocation was treated using coracoclavicular screw fixation supplemented with tension band wiring (left lower). The tension band wire was removed after 6 weeks (right upper). The screw was removed after 3 months and the patient had a satisfactory outcome (right lower).

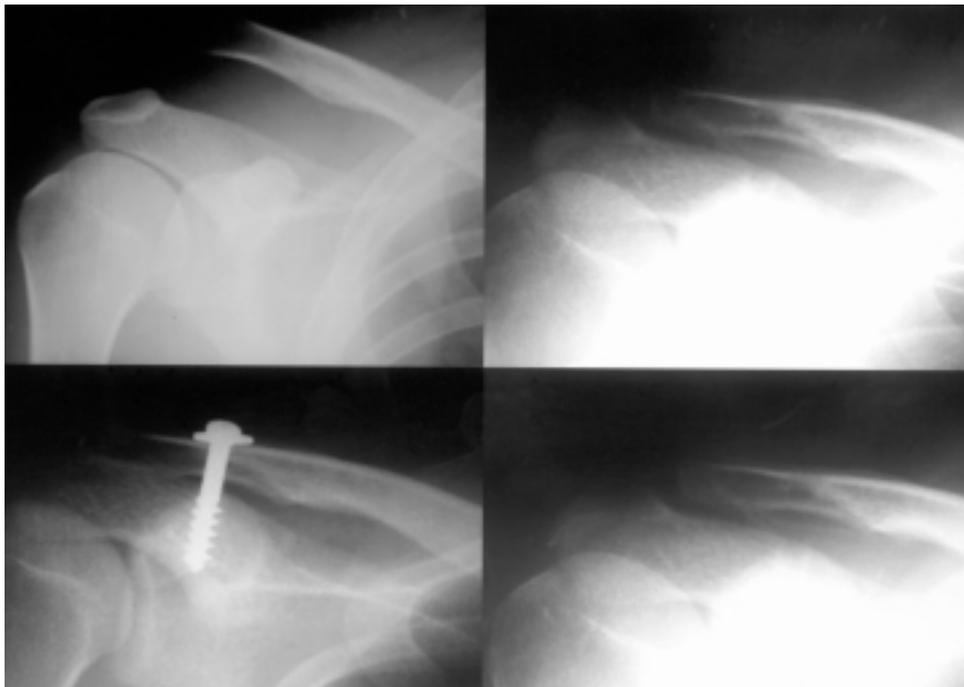


Fig. 2 A 34-year-old man sustained right acute complete acromioclavicular dislocation (left upper). The dislocation was treated using coracoclavicular screw fixation supplemented with coracoacromial ligament reconstruction (left lower). The screw was removed after 3 months (right upper) and the patient had a satisfactory outcome (right lower).



Fig. 3 A 29-year-old woman sustained left acute complete acromioclavicular dislocation (left upper). The dislocation was treated using coracoclavicular screw fixation supplemented with tension band wiring (left lower). Gradual loss of reduction of the joint occurred after tension band wire was removed (right upper). The screw was removed and coracoacromial ligament reconstruction was performed. The patient had a satisfactory outcome finally (right lower).

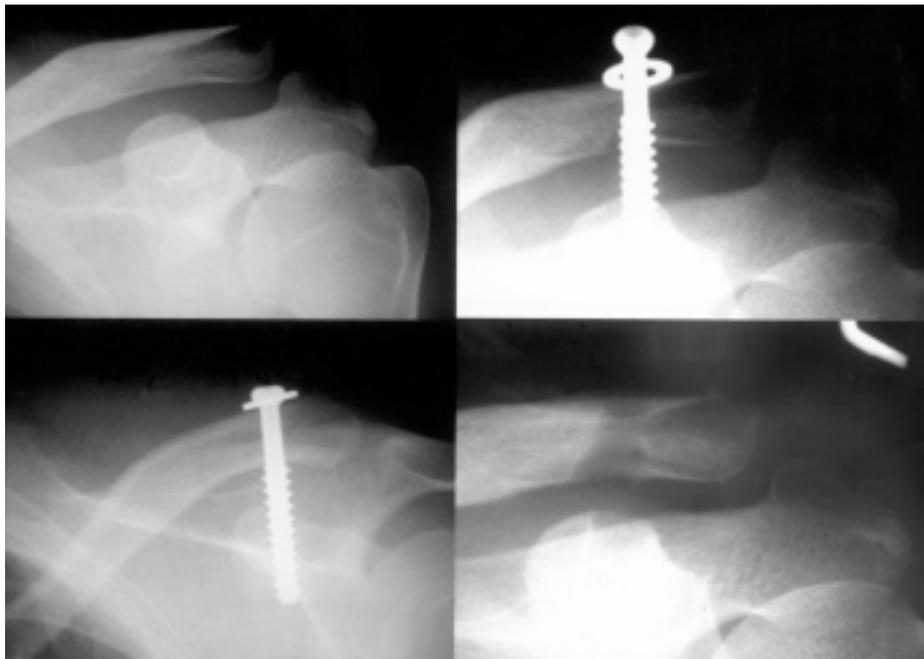


Fig.4 A 42-year-old man sustained left acute complete acromioclavicular dislocation (left upper). The dislocation was treated using coracoclavicular screw fixation supplemented with coracoacromial ligament reconstruction (left lower). Loss of reduction of the joint occurred and the screw migrated proximally (right upper). The screw was removed and the patient had a satisfactory outcome (right lower).

ally around 87% is recognized.⁽⁵⁾ However, the satisfactory rate of surgical treatment is around 88%.^(5,6) Therefore, a large number of orthopedists consider surgical treatment for acute type 3 AC dislocation simply for cosmetic reasons.^(1-4,16)

No matter what non-surgical or surgical treatment is performed, the most common complaint of failure of treatment is shoulder pain.^(5,6) In some reports in the literature, symptomatic pain occurs more commonly in patients with surgical treatment. As for function and movement of the shoulder, both groups have been reported to be nearly normal. Therefore, clinical treatment of complete AC dislocation should focus on prevention and treatment of shoulder pain.^(5,6)

The pathomechanism of shoulder pain associated with complete AC dislocation is varied, which can be induced by many bony or soft tissue factors solely or concomitantly.^(1,2) Theoretically, anatomic reduction of the dislocated AC joint may avoid tenting the soft tissues and the skin. Thus, shoulder pain may be ameliorated. However, surgical reduction of the dislocated joint may extensively destroy the compromised soft tissues. If CA ligament reconstruction is added, the adverse effects may be aggravated. Thus, treatment of acute complete AC dislocation is always controversial from various viewpoints.^(1,2)

Once surgical treatment is chosen, the principle of reducing destruction of soft tissues and proving sufficient stability should always be followed.^(1,2,8,9) By itself, CC screw fixation may not provide sufficient stability, thus, various supplementary techniques normally are needed.^(1,2,7,8,11) In this study, two common supplementary techniques were used and compared. Clinically, each had individual advantages and disadvantages.

Supplemented with tension band wiring can reduce the stress of CC screw fixation during the recovery process. Injury of the articular cartilage of the AC joint may be minimized by using Kirschner wires.⁽¹²⁻¹⁴⁾ Therefore, it had a comparative satisfactory rate as shown in the technique used in group 2, which required no stabilization of the AC joint. The greatest advantages of the technique used in group 1 were the relatively short operating times and no need of CA ligament dissection. The disadvantages were potentially higher rate of loss of reduction of the AC joint due to lack of CA ligament augmentation.⁽¹⁷⁾ The instability of the AC joint may be one factor of

shoulder pain. Once it occurs, re-operation with CA ligament reconstruction may be performed. For patients with complete AC dislocation, the torn coracoclavicular ligament normally is so damaged that the effectiveness of repair is questionable.

Reconstruction using the CA ligament can reinforce the stability of the AC joint. In this study, the procedure followed the Copeland and Kessel's technique.⁽¹⁸⁾ The acromial end of the CA ligament with bony attachment was placed on the upper surface of the clavicle. Using this technique, the coracoid process needs no osteotomy to procure the CA ligament. The intact coracoid process may be helpful for CC screw insertion. Biomechanically, vertical placement of the CA ligament is much more effective than horizontal placement of this ligament.⁽¹⁹⁾ Thus, the rate of loss of reduction of the AC joint is reduced (3.7%). Loss of reduction of the AC joint in group 2 of this series may have been caused by the failure of the fusion between the CA ligament and the clavicle. In addition, this technique requires longer operating time and more extensive dissection of soft tissues. Shoulder pain may be induced by soft tissue factors or AC arthritis. Once it occurs, resection of distal clavicle may be tried.⁽²⁰⁻²²⁾

The satisfaction rate of this study can be comparable to various surgical techniques reported in the literature, which was around 88%.^(5,6) From the results of this study, some other features were also observed. A highly unsatisfactory rate may be noted (50%) in group 1 patients once loss of reduction of the AC joint occurs ($p = 0.01$). Reconstruction of the CA ligament ameliorated the shoulder pain. It may indicate that tenting of soft tissues may induce shoulder symptoms in some cases. Therefore, it is reasonable for those patients who are treated with non-surgical methods initially to receive late reconstruction when necessary.⁽²⁾

In some reports in the literature, fixation of the CC segment can be performed using various non-absorbable sutures, tape, wire or various screws.^(1,2,7-11) In this study, a 4.5 mm diameter of cancellous screw with supplementary techniques provided sufficient stability during the recovery period. The main advantage of this technique was its technical simplicity as compared with other techniques and the outcomes were largely similar.

In conclusion, acute complete AC dislocation may be treated using non-surgical or surgical meth-

ods. Once surgical methods are chosen, CC screw fixation supplemented with tension band wiring for the AC joint or CA ligament reconstruction achieved similarly high rates of satisfactory when compared with other surgical techniques. However, the former had relatively shorter operating times. Surgeons may choose the appropriate techniques according to the situations.

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急性完全型肩峰鎖骨關節脫臼的手術療法： 以鎖骨喙突螺釘固定另附加不同補強技術的比較

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背景：急性完全型肩峰鎖骨關節脫臼的治療方法仍有爭議；非手術或手術療法，據報導會得到相似的結果。特別是，一旦手術治療被選用時，能令人信服的手術療法，迄今仍未被發展出來。

方法：60 位連續性的患者，遭受 60 處急性完全型肩峰鎖骨關節脫臼。被輪流地以鎖骨喙突螺釘固定，另附加肩峰鎖骨關節張力帶鋼絲（30 處）或喙突肩峰韌帶重建（30 處）補強。此兩種治療方法，作手術時間、功能上結果、併發症的比較。

結果：29 位張力帶鋼絲患者和 27 位喙突肩峰韌帶重建患者，接受複查 12-47（平均 23.6）個月。手術時間為 34-57（平均 46.3）分鐘對 52-93（平均 83.4）分鐘（ $p < 0.001$ ）。功能上有滿意的結果，為 86.2% 對 88.9%（ $p = 0.30$ ）。肩峰鎖骨關節復位失敗率，為 13.8% 對 3.7%（ $p = 0.17$ ）。當張力帶鋼絲患者，合併有肩峰鎖骨關節復位失敗時，會有較高比率的不滿意的結果（ $p = 0.01$ ）。

結論：急性完全型肩峰鎖骨關節脫臼，可用非手術或手術方法去治療。一旦手術治療被選用；以鎖骨喙突螺釘固定，另附加肩峰鎖骨關節張力帶鋼絲或喙突肩峰韌帶重建去補強，會得到相似的滿意率的結果。然而，前者有相對的較少的手術時間。
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關鍵字：完全型肩峰鎖骨關節脫臼，鎖骨喙突螺釘固定，張力帶鋼絲，喙突肩峰韌帶重建。

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