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## Surgical treatment of chronic acromioclavicular joint dislocation by modified Weaver-Dunn procedure

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**Abstract** We present our technique for surgically treating Tossy III acromioclavicular joint dislocation, discuss the indications for various procedures, and evaluate our postoperative results. We operated on 17 patients suffering from chronic acromioclavicular instability after such dislocation using a modified Weaver-Dunn procedure, in which there is no lateral clavicular end resection, the coracoacromial ligament graft is sutured to the inferior part of the clavicle by transosseal sutures, and a Bosworth coracoclavicular screw is used to protect the graft postoperatively for 8 weeks. After a mean of 37 months we evaluated shoulder function by the Constant score and the subjective and radiological results. Mean Constant score was 91.9% (74–100%); it was 80–90% in 5 patients and above 90% in 11. One patient had screw loosening after the operation and suffered partial loss of reduction and discomfort during shoulder loading. All patients

but one returned to work, and all but one have returned to their preoperative activity at the same level. Subjectively, there were 11 excellent and 6 good results. Compared to the contralateral uninjured side, radiography showed anatomical reposition in the vertical plane in 9 cases, slight loss of reduction in 6 (difference in the distance between the inferior border of the acromion and the clavicle is 2–4 mm), and partial loss of reduction in 2 (4–8 mm). We recommend the modified Weaver-Dunn procedure for surgical treatment of chronic, Tossy grade III acromioclavicular joint dislocations as it provides good functional and subjective results. Our modification is indicated mainly for young patients because posttraumatic arthrosis occurs more frequently in elderly patients, making clavicular end resection necessary.

**Keywords** Shoulder injury · Acromioclavicular joint dislocation · Weaver-Dunn procedure

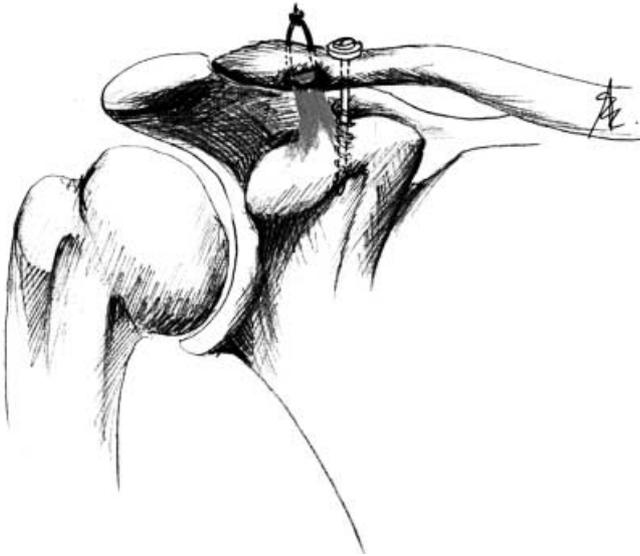
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### Introduction

Many surgical procedures have been proposed for treating chronic, symptomatic acromioclavicular (AC) joint dislocation of Tossy grade III [8, 12, 18, 21, 23, 24, 28], but there is as yet no consensus over the optimal therapy. One of the most important aspects in planning an adequate treatment is to determine the grade of the injury and the state of the injured coracoclavicular ligaments. Most sur-

geons agree on the treatment of grade I and II sprains in which the coracoclavicular ligaments are intact. The proposed surgical intervention is that the lateral clavicular end resection as reported by Mumford in 1941 (see [22, 25]).

Simple excision of the lateral 1.0–2.0 cm of the clavicle is a successful operation in patients whose problems are due to the degenerative posttraumatic AC joint arthritis after grade I and II injuries [22, 23, 25], but this procedure cannot solve the complaints of patients with grade III



**Fig. 1** Modified Weaver-Dunn procedure

injury [25]. The aim of each type of procedure is to stabilize the clavicle by substitution of the ruptured coracoclavicular ligaments. Some authors advocate use of the coracoacromial ligament [6, 7, 12, 15, 16, 20, 21, 23, 24, 28, 29], the long [25] or short [1, 9] head of the biceps tendon, or the autogenous fascia lata [13]. Others use synthetic materials such as Dacron [14], polytetrafluoroethylene (Gore-Tex) [19], polydioxanone sulfate [13], or carbon fibers [5] to maintain reduction. Of the many operations that have been recommended for this purpose, the most rational appears to be the reconstruction of the ruptured ligament by using the coracoacromial ligament as proposed by Weaver and Dunn [28], Copeland and Kessel [7], and Rockwood [24]. However, only short-term results of this procedure have been reported.

The purpose of this study is to discuss our treatment of the chronic grade III AC dislocations which are accompanied by pain, weakness, and shoulder discomfort during activity and to evaluate our postoperative results. We use a Weaver-Dunn type of procedure modified by preserving the AC joint and protecting the repaired graft with a coracoclavicular screw for 8 weeks as described by Rockwood [24] (Fig. 1).

## Material and method

Between October 1994 and September 2000 we used a modified Weaver-Dunn technique to treat 17 patients suffering from chronic (more than 4 weeks), symptomatic, grade III AC dislocations. There were 14 men and 3 women, with a mean age of 37.2 years (range 18–55), including 7 competitive athletes, 8 recreational athletes, and 2 physical workers (Table 1). The injured shoulder was the right in 8 patients and the left in 9; 11 injuries were on the dominant and 6 on the nondominant side. The injuries had been caused by traffic accidents in eight cases, sports accidents in six, a

motorcycle accident in one, and falling a distance of 4 m in two. Patients' principal complaints were discomfort, clicking, and weakness during shoulder activity; they also had positive piano key sign (Fig. 2). The mean duration of symptoms before operation was 7.4 months (range 2–24; Table 1). Increased coracoclavicular distances (minimum 100% increase vs. contralateral side) were noted on radiography, and no degenerative changes were apparent.

The modified Weaver-Dunn procedure is performed under general anesthesia. Patients are placed in supine position. The skin incision is made from the posterior border of the AC joint toward the coracoid process. The deltoid is detached from the outer third of the clavicle. The AC joint is exposed, the residues of the capsule are preserved, and the intra-articular meniscus and all of the scar tissues around the lateral end of the clavicle are removed. Thus the clavicle can be moved upward and downward freely. The coracoacromial ligament is exposed and detached from the acromion by subperiosteal dissection. The anteroinferior part of the clavicle – where the suture of the graft is planned – is débrided, and two separate, 1.5-mm holes are drilled collaterally across the bone 6–8 mm from each other. The AC joint is reduced, and the sutures, which hold the coracoacromial ligament, are passed through the clavicle. Then the clavicle is stabilized by using a coracoclavicular screw of proper size to the coracoid, which is placed approx. 1 cm medially from the previously drilled holes. Afterwards the sutures of the transposed coracoacromial ligament are tied on the upper surface of the clavicle over a bony bridge. The AC ligaments and capsule are repaired over the reduced AC joint. Finally the delto-trapezial fascia is repaired carefully, and a routine closure is performed (Fig. 3).

In the postoperative period the patients wear a sling for 2–4 weeks; however, they are permitted to remove it daily to perform pendulum and “crawling up the wall” exercises. After the wound heals, patients start passive and active range of motion exercises up to 90° of abduction and flexion of the shoulder. The screw is removed after 8 weeks in the hospital under local or general anesthesia, whichever is more convenient for the patient. After wound healing the patients are encouraged to regain whole range of motion, but they are instructed to avoid strenuous activity such as weight lifting or overhead work for 4 weeks.

After a minimum of 18 months (mean 36.6, range 18–66) we evaluated the shoulder function by Constant score and subjective and radiological results. Patient satisfaction was rated as excellent, good, fair, or poor. In evaluating radiological results we evaluated the vertical distance between the inferior border of the acromion and the clavicle in comparison with the contralateral side and measured the differences in millimeters (less than 2 mm, anatomical reposition; 2–4 mm, slight loss of reduction; 4–8 mm, partial loss of reduction; greater than 8 mm, total loss of reduction). We recorded posttraumatic degenerative changes around the AC joint and calcification along the coracoclavicular ligaments.

## Results

All of our operated patients could be reviewed and examined during the follow-up study (Fig. 4). There were no perioperative complications. The mean Constant score was 91.9% (range 74–100%). In 11 patients the results were above 90%, in 5 between 80% and 90%, and one had 74% (Table 1). Pain during activity was the major complaint in three of the five patients with scores of 80–90%. This slightly progressive pain started postoperatively without a new injury. In the beginning, the anti-inflammatory conservative treatment gave good relief for the pain, but later the symptoms became stronger in two cases. An

**Table 1** Detailed data of the patients

Patient no.	Age (years)	Sport	Type of injury	Time to surgery (months)	Follow-up (months)	Complication	Constant score	Subjective results	Radiological results
1	49	Soccer	Sport	12	24	AC arthritis	84	Good	Osteophytes, calcification
2	22	Karate	Traffic accident	8	30	No	100	Excellent	Calcification
3	47	Tennis	Fall	6	66	AC arthritis	82	Good	Minimal loss of reduction, osteophytes
4	28	Soccer	Sport	12	64	No	100	Excellent	Calcification
5	23	Soccer	Traffic accident	2	63	Keloid	100	Excellent	Calcification
6	43	Physical worker	Traffic accident	6	24	Spondyl. cerv., loss of motion	85	Good	Minimal loss of reduction, calcification
7	18	Motor	Motor accident	12	44	No	100	Excellent	Minimal loss of reduction, osteophytes
8	44	Tennis	Fall	2	22	Screw loosening	74	Good	Partial loss of reduction, osteophytes
9	46	Bicycle	Traffic accident	2	52	No	92	Excellent	Minimal loss of reduction, calcification
10	22	Soccer	Sport	24	50	No	94	Excellent	Calcification
11	43	Kayak	Traffic accident	2	46	No	96	Excellent	Calcification
12	32	Soccer	Sport	8	33	Screw loosening, loss of motion	80	Good	Partial loss of reduction
13	45	Glide-sail parachute	Traffic accident	4	31	No	100	Excellent	Calcification
14	55	Bicycle	Bicycle accident	3	18	AC arthritis	84	Good	Minimal loss of reduction, osteophytes
15	41	Bicycle	Sport	5	18	No	92	Excellent	Minimal loss of reduction, calcification
16	27	Kayak	Sport	8	19	No	100	Excellent	Calcification
17	47	Physical worker	Traffic accident	10	18	No	100	Excellent	Calcification

intra-articular steroid injection was given, which had good effect. Radiographs of these patients, two of the three oldest in this study, showed slight loss of reduction and degenerative changes in the AC joint. In the other two patients with scores of 80–90% we found slight tenderness of the AC joint and loss of shoulder motion, but these patients were satisfied with their condition. One patient, whose result was 74%, had screw loosening after the operation, and he suffered partial loss of reduction and discomfort during shoulder loading.

All patients but one have been able to return to work and to resume sports activity, and all but one have returned to their preoperative activity at the same level (Table 1). All but two patients have full range of shoulder

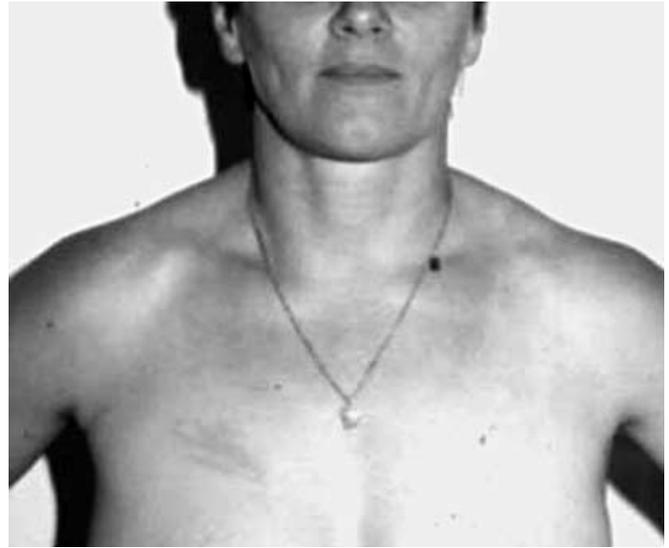
motion and close to normal muscular strength measured by dynamometer as the abduction strength in both arms. Two patients have a minimal abduction and internal rotation deficit (15°).

In the subjective evaluation, there were 11 excellent and 6 good results. All but one of the patients expressed the opinion that the surgery would be chosen again.

Compared to the contralateral uninjured side radiography showed anatomical reposition in the vertical plane in nine cases, slight loss of reduction in six (difference in distance between the inferior border of the acromion and the clavicle 2–4 mm), and partial loss of reduction in two (4–8 mm). Only three patients had degenerative changes in the AC joint, including osteophytes, subchondral cysts,



**Fig.2** Chronic Tossy grade III AC joint dislocation



**Fig.4** Twelve months after surgery



**Fig.3** Surgical technique

and narrowing of the joint. Thirteen patients had some calcification between the clavicle and the coracoid process. This calcification did not cause loss of motion or other symptoms in these cases (Table 1).

## Discussion

Treatment of acute, uncomplicated, grade III AC joint dislocations has recently tended to nonoperative methods [8, 11, 17, 23, 26], most surgeons prefer symptomatic treatment rather than reduction and immobilization as a conservative treatment for this injury [8, 23, 25, 26]. Because of this trend there are a growing number of the patients with longer lasting, symptomatic dislocation of the AC joint; however, there no surgical method for treating this problem has gained uniform acceptance in the literature.

Most orthopedic surgeons agree upon the treatment of the grade I and II injuries, but many management options have been proposed for the grade III injuries [1, 3, 6, 7, 9, 20, 24, 28].

Excision of the distal clavicular end is the simplest surgical method, but if the patient's complaints are due to the lack of function of the coracoclavicular ligaments, the substitution of these ligaments is necessary [25]. In these conditions the stability of the AC joint must be maintained by the scapular and rotator muscles. The loss of stabilizing effects of the ligaments can lead to muscle fatigue and secondary clinical symptoms. For this reason operative treatment, for example, the substitution of these ligaments, gives the patient the best chance of regaining normal shoulder function and strength with restoration of the normal anatomy. There are several methods for this substitution in the literature, among which the coracoclavicular ligament transfer has yielded the best results [7, 12, 19, 24, 29]. The use of this ligament is ideal because it lies adjacent to the disrupted coracoclavicular ligament and is strong, made of the same material, and part of the same anatomical layer [7].

The first proponent of using the coracoclavicular ligament was Neviasser in 1952 [20]. He detached it from the coracoid process and sutured it to the lateral end of the clavicle. Weaver and Dunn [28] in their operation detached the coracoclavicular ligament from the acromion, resected the lateral clavicular end, and secured the coracoclavicular ligament across the bone marrow to the upper part of the clavicle. Rockwood [24] also resected the lateral end of the clavicle and substituted the coracoclavicular ligaments by using the coracoclavicular ligament, but they performed coracoclavicular screwing to protect the graft in the first 12 weeks postoperatively. Nevertheless,

biomechanical studies have shown the importance of the AC ligaments and capsule to prevent the posterior translation of the clavicle during both small and large amounts of loading. Measurements have verified that about 90% of the restraint is fixed by these structures [2, 8, 10]. Given these data and the age and sports activity of our patients, we concluded that clavicular end preservation can be advantageous if the patient is young and has no physical or radiological signs of AC joint arthritis. Moreover, using this technique the direction of the ligament graft more resembles the original, and the biomechanics of the AC joint changes the least. However, we agree with other authors in recommending distal clavicular end resection in older patients and in those who show any arthritic symptoms in the AC joint before the operation.

We use a coracoclavicular screw to protect the graft in the first 8 weeks postoperatively, until the new ligament can heal to the clavicle. This protection appears necessary because without it graft elongation or insufficiency can occur due to the tension developing in the new ligament [12, 25]. Recent data show that posttraumatic arthritis develops more frequently by using transarticular fixation techniques [23, 26]. Some authors propose using several synthetic materials for this purpose to avoid the application of a metallic fixation and its subsequent removal [5,

13, 19, 28], but it is known that bone erosion or clavicular amputation can take place [14]. The coracoclavicular screw technique is a widely accepted and proven method which gives a good stability and therefore results in accelerated rehabilitation [3, 12, 18, 24]. Screw removal is very simple and can be carried out under local anesthesia.

Overall we had 94% satisfactory results (excellent and good). Only one patient had an unsatisfactory result, due to his partial loss of reduction after screw loosening and late posttraumatic arthritis in the AC joint, but conservative treatment partially solved his complaints. However, AC joint arthritis occurred in three of the oldest patients operated with this technique, and because of this we suggest routinely resecting the distal clavicle in patients aged over 45 years.

We have not discussed treatment of acute AC dislocations. This injury is frequent in young and athletically active persons who require a return to sports activity and overhead work without complaints. Reported success rates of surgical treatment in chronic cases are slightly lower [12, 18, 28, 29], but our medium-term findings demonstrate that the modified Weaver-Dunn technique is a useful and reliable method and can be recommended when surgery is indicated for chronic, grade III AC dislocations.

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