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Comparison Between Two Surgical Techniques Acromioclavicular Tension Band Wiring and Coracoclavicular Screw in Acromioclavicular Dislocations

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Background: Acromioclavicular (AC) joint dislocations are common in young, active patients and frequently treated in clinical practice. There are many surgical treatments for acro-mioclavicular joint dislocation. The goal of this study was comparing the functional and clinical post-operative results between two urgical techniques, acromioclavicular tension band wiring and coracoclavicular screw in acromioclavicular dislocations.

Patients and Methods: 20 patients with Rockwood dislocation type III and more referred to Kamyab Hospital from February 2012 to November 2013. They were assessed in terms of surgical indications. The patients were divided in to two groups and the authors used tension band wiring and screw fixation procedures for each group. Coracoclavicular ligaments were repaired in both techniques. In 1, 6 and 12- month follow-up periods, we assessed clinically the acromiomclavicular stability, articular range of motion, VAST score and Oxford shoulder score with stress radiography. The results were then analyzed statistically.

Results: Mean age of the patients was 34 ± 8.1 years and 80% were male. Totally, 17 patients (85%) were type 3 Rockwood and 3 patients (15%) were type 5. Full stability was obtained in all patients by comparing the stress radiography and the post-operative ones. About 50% of patients had Oxford shoulder score (OSS) 42-48. 13 patients (65%) did not complain of any pain and 25% had moderate VAST score (4-7). 17 patients (85%) had range of motion more than 150-180. Using t-Student test, no significant difference in type of Rockwood, articular stability, range of motion, OSS score and VAST SCORE was seen between the two groups ($P > 0.05$).

Conclusions: Bosworth screw and Tension band wiring are both useful procedures in patients with ACJ dislocation, but each should be used in the selected patients with special indications. Both methods had good results during follow-up period. There was not statistically meaningful difference in the articular stability, range of motion, OSS score and VAST SCORE between the two groups ($P > 0.05$).

Keywords: Acromioclavicular; Shoulder; Tension Band Wiring; Screw

1. Background

Acromioclavicular (AC) joint dislocations are commonly seen in clinical practice. They represent approximately 9-12% of the injuries to the shoulder girdle (1), with an overall incidence estimated about 3-4 per 100, 000 in the general population and they mostly affect younger athletes (2). More often than not, the injury occurs when a direct force is applied to the upper part of the acromion, or when the arm is in adduction during the fall (3). It can be classified in several ways and most commonly used is Rockwood grading which has been sub-classified into six types according to the extent of clavicle displacement and the severity of ligament compromise (2). In general, it is commonly accepted that lower degree AC luxations (I-II degree) are treated conservatively, while higher degrees of AC luxations (III-VI degree) are immediately addressed to the surgical treatment. There is; however, lack of consensus on the treatment of III degree of AC luxation. Minority of authors argue about a conservative approach, while the majority contends that surgery is the more appropriate approach (4). The first surgical repair of an acute AC dislocation is credited to Sir Samuel Cooper who, back in 1861, used a loop of silver wire to approximate the clavicle and acromion process (5). Subsequently, 100 other techniques were reported, including suture repair of the AC ligaments and coracoclavicular (CC) ligament, tendon graft for reconstruction, and fixation with nails, screws or wires like tension band wiring. Early described procedures which were often complicated by hardware failure involved direct fixation across the AC joint, the coracoid, and clavicle, as described by Bosworth in 1941. The surgery consists of an open reduction of the AC joint dislocation with insertion of a screw from the distal clavicle to the coracoid process (6). Several modifications of this original technique exist, such as another

surgical technique named as tension band wiring. 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. Modern techniques seek to reconstruct a more anatomic link between the coracoid and the clavicle to reduce the AC joint, such as transferring the CA ligament to augment repair. Although the proponents of each of these procedures have reported favorable results in their own hands, even today there is no consensus on the best resolution of this problem (7).

2. Objectives

In this study, we tried to compare the functional and clinical post-operative results between the two surgical techniques, acromioclavicular tension band wiring and coclavicular screw in acromioclavicular dislocations.

3. Patients and Methods

20 consecutive adult patients with 20 acute complete AC dislocations (types 3-6) were evaluated from February 2012 to November 2013. Twenty patients with Rockwood dislocation type III and more referred to Mashhad Kamyab hospital were assessed in this case control study. The patients were divided in to two groups. One group was treated using Coracoclavicular screw fixation and the other was treated using tension band wiring. All AC dislocations were caused by motor vehicle accidents and associated injuries were few. None of the AC dislocations were treated emergently; however, surgical treatment was arranged as early as possible. We analyzed the data with T-test and fisher test.

3.1. 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 (8). When the AC joint was reduced in patients in group 1, 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 non absorbable sutures (8).

When the AC joint was reduced in each patient in group 2, two 1.8 mm pins from acromion to clavicle and tension band wiring with Noo.9 cerclage wire, were inserted to stabilize the AC joint (9). The coracoclavicular ligament stump was repaired using non absorbable sutures.

After the operation, each patient used a sling for 6 weeks. Then, patients were permitted to implement their daily activities gradually. Abducting the upper extremity above the shoulder was prohibited for 6 weeks. At 10-12 weeks, tension band wires were removed under general anesthesia. At the similar period, each CC screw was removed under the general anesthesia. After that, patients were permitted to perform normal activities. Each patient's clinical recovery course was followed-up 12 months later. To evaluate the functional outcomes of the shoulders, articular range of motion, VAST score and Oxford shoulder score were used. The AC joint stability was assessed with a post-operative radiography and comparing it with stress radiography done before (10). Four grades were categorized and patients' satisfactory outcomes were recorded. This scoring system was used due to its relative simplicity and practicality. The results were analyzed statistically and evaluated the differences among the 2 groups. Fisher's exact test or t-test was used to compare various outcome measures between the two groups. A P level less than 0.05 was considered significant.

4. Results

Mean age of the patients was 34 ± 8.1 years and 16 patients (80%) were male. Totally, 17 patients (85%) were diagnosed with type 3 Rockwood and 3 patients (15%) with

Table 1. Findings Obtained From Patients With Acromioclavicular Dislocation

Distribution	Frequency (All Patients)	Tension Band Wiring	Screw
Pain-VAST score(10 points)			
None	13	8	5
Slight (1-3)	1	1	0
Moderate, tolerable (4-7)	5	2	3
Limited activity, severe, constant, disabling (8-10)	1	1	0
Function-OSS score(48 point)			
Lower than 30	4	2	2
30-36	4	3	1
37-42	2	1	1
43-48	10	7	3
Range of motion-abduction and forward flexion			
Less than 90 degree	0	0	0
90-120 degree	1	1	0
120- 150 degree	2	1	1
More than 150 degree	17	8	9

type 5 Rockwood. All patients were able to return to their pre-surgical occupation after surgery. Full stability was obtained in all patients through comparing the stress radiography and the post-operative ones. 50% of patients had Oxford Shoulder Score (OSS) 42-48 and 4 patients had OSS less than 30. Thirteen patients (65%) did not complain of any pain and 25% had moderate VAST score (4-7). Seventeen patients (85%) had range of motion more than 150°. Anyone had less than 90° range of motion. All the patients were satisfied about the cosmetic view of the shoulder. Using t-Student test, no significant difference in type of Rockwood, articular stability, range of motion, Oxford shoulder score(OSS), and VAST SCORE was seen between the two groups (P = 0.3, P = 0.3, P = 0.4, P = 0.6, P = 0.4, respectively) (Table 1).

5. Discussion

Many methods of fixating the AC joint have been described, but there are certain dilemmas as to which implants are to be used. As there is no unanimous view about the best approach to AC joint dislocation in our clinic, we used both techniques: Screw fixation and Tension Band Wiring. Both of these two techniques have some advantages and disadvantages both in technique of surgery and outcomes. Our main goal is to compare them and the second goal is to evaluate these two procedures with another technique in literature. With respect to gender, male patients were much more numerous than female patients (80% vs. 40%, respectively) and all of them were workers. This is in accordance with the statistical data presented by other authors. Rockwood contends that AC joint injuries are seen especially in competitive athletes, and occur most frequently in the second decade of life. Males are more commonly affected than females, with a male-to-female ratio of approximately 5:1 (10). So, earlier returning to work is important economically. Most of our patients injured themselves due to traffic accidents and one patient due to the accidental falling.

Once surgical treatment is chosen, the principle of reducing destruction of soft tissues and proving sufficient stability should always be followed (8, 10). In some reports in the literatures, fixation of the CC segment can be performed using various non-absorbable sutures, tape, wire or various screws (8, 10). In this study, two common techniques were used and compared. Clinically, each had individual advantages. Fixation of AC dislocation does not inhibit healing of the ligaments and allows for early mobility. Although CC screw fixation, by itself, may not provide sufficient stability, various supplementary techniques normally are needed (8, 10, 11). In this study, a 4.5 mm diameter of cancellous screw provided sufficient stability during the recovery period and all the patients had full articular stability as seen in the tension band wiring technique. The main advantage of cancellous screw technique was its technical simplicity as compared with other techniques and the outcomes were largely similar. Most of our patients (85%) had diagnosis of type 3 Rockwood. However, a large number of orthopedists consider surgical treatment for acute type 3 AC dislocations simply for cosmetic reasons (8, 10). Similarly, all our patients expressed subjective cosmetic satisfaction of the affected shoulder. Using the OSS, we received an objective indicator of the post-surgical state of our patients from the both groups. The OSS results showed that there was no significant difference between the screw and tension band groups (P = 0.6). But more patients from the tension band wiring group received a better median score than the patients from the screw group. Both groups had acceptable OSS scores. These results are in accordance with those published by Sundaram et al. (12) and Kovilazhikathu Sugathan et al. (13).

Most of our patients did not complain of pain when they followed up one year later (VAST = 0) and 25% had expressed moderate pain (VAST = 4-7). Totally, VAST score was acceptable in the two groups and when the results were examined, no significant difference in measured VAST scores was observed among these groups (P = 0.4). Similar to our results, Maier et al. reported only one patient out of 22 patients treated with Bosworth screw fixation complained of residual pain (14) and Wei et al. reported the same results in the patients treated with tension band wiring (15).

No matter what non-surgical or surgical treatment is performed, the most common complaint of treatment failure is shoulder pain (13). In some reports in the literature, symptomatic pain occurs more commonly in patients with surgical treatment. Therefore, clinical treatment of complete AC dislocation should focus on prevention and treatment of shoulder pain (10, 11).

The path mechanism of shoulder pain associated with complete AC dislocation is varied, which can be induced by many bony or soft tissue factors solely or concomitantly (8, 10). 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 (8, 10).

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 wires as seen in screws (16). Therefore, there was a comparative satisfactory rate as shown in the technique used in the two groups. But the greatest advantages of the techniques used, 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).

All the patients in our study had complete articular stabilization rate. The instability of the AC joint may be one factor of shoulder pain. For patients with complete AC dislocation, the torn coracoclavicular ligament normally

is so damaged that the effectiveness of repair is questionable repairing the CA ligament ameliorated the shoulder pain. It may indicate that tenting of soft tissues may induce shoulder symptoms in some cases (8). As the coracoclavicular ligament stump was repaired in all patients, it did not cause bias in comparing the stability and pain in the two groups under study.

Using these techniques, 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 (18). Thus, the rate of loss of reduction of the AC joint is reduced (0%). Loss of reduction of the AC joint in the two groups of these series may have been caused by the acceptable fusion between the CA ligament and the clavicle.

On the other hand, tension band wiring technique requires few longer operating time and more extensive dissection of soft tissues than Screw, lonely. Although shoulder pain may be induced by soft tissue factors or AC arthritis, there was no significant difference in the VAST score between the two groups (19). The satisfaction rate of this study can be comparable to various surgical techniques reported in the literature, which was around 88% (20).

Although regarding post-operative range of motion, 17 (85%) of 20 patients in the two groups recovered more than 150° forward elevation and more than 150° abduction at 12 months postop-eratively, only 3 (15%) of 20 patients in the two groups required approximately more than 1 year to gain their pre-injury range of motion. Any patient did not complain of the range of motion lower than 90°. As for the VAST score, there was no significant difference in function and movement of the shoulder between the two groups (P = 0.6). Open surgery is, to date, technically easier, and allows direct visualization of the reduction in the joint and removal of any degenerative disc material. We have found these two methods safe, reliable and most successful to restore shoulder girdle functionality. These methods provide good short-term results (21, 22). Since shoulder movements are carried out almost immediately after operation, there is usually no loss of motion. If the patient is a handy worker, he is allowed to jog within a matter of days to keep in condition. Additionally, these surgical techniques are low learning curve procedures with low hardware's costs. Surgeons may choose the appropriate techniques according to the situations.

Once surgical methods are chosen for acute complete AC dislocation, CC screw fixation or tension band wiring, achieved similarly high rates of satisfactory. However, the former had relatively shorter operating times. The presented data suggest that screw and tension band wiring procedures for the surgical treatment of acute AC joint dislocations are reliable techniques to restore shoulder girdle functionality. The techniques we proposed led to the good clinical and functional results and proved to be safe, showing a low complication rate.

5.1. Limitations

Because of the small number of patients examined, the results of this study must be taken with some reserve. Still, we can conclude that screw or tension band wires allow stability and strength this study shows that further researches on both short- and long-term results are needed to bring a clearer understanding of the more advanced techniques.

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Authors' Contributions

Study concept and design: Hassan Rahimi Shourin, Ali birjandinejad, and Behnam Shojaee. Analysis and interpretation of data: Masoud Mirkazemi and Seyyed Reza Sharifi. Drafting of the manuscript: Behnam Shojaee, Masoud Mirkazemi and Seyyed Reza Sharifi. Critical revision of the manuscript for important intellectual content: Ali birjandinejad, and Hassan Rahimi Shourin.

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