

Assesment of Functional Outcome of Acromio Clavicular Joint Injuries Treated By Hook Plate Using Penn and Constant Score

Amit Dwivedi¹, Ashok Kumar²

¹ Assistant Professor, ² Professor, Dept. Of Orthopedics, Santosh Medical College & Hospital, Ghaziabad, Uttar Pradesh, India.

Corresponding Author: Amit Dwivedi

Abstract: Introduction

Acromioclavicular joint dislocation is very common following upper extremity trauma. For acromioclavicular joint dislocations that are Rookwood type III and above, surgical treatment is currently recommended.

Aims & Objectives: To Analyze the functional outcome of Acromioclavicular joint injuries (dislocations) grade 3 to 6 which were treated surgically using a hook plate.

Material & Methods: A retrospective analysis was performed on the patients treated with a hook plate for Acromioclavicular joint dislocation in our hospital from February 2011 to March 2014. There were total 30 cases of pure acromioclavicular joint dislocation without associated injuries, including 21 males, and 9 females; mean age was 48.27 ± 8.7 years (age range 20-67 years old). There were 28 cases of Rockwood type III acromioclavicular dislocation, 2 cases of type V. 16 cases had the injuries on the left side, 14 cases on the right side. All patients had open reduction and hook plate fixation within 2 to 6 days after injury, and had the hook plate removed within 8 to 12 months after the surgery.

Results: According to the Constant-shoulder score the average scores were 76 ± 6 points 8 to 12 months after the surgery and before the removal of the hook plate, the average scores were 88 ± 6 minutes two months after the removal of hook plate. Postoperative X-ray imaging showed osteolysis in 9 cases (33.3%), osteoarthritis in five cases (20%), osteolysis associated with osteoarthritis in four cases (13.3%), and steel hook broken in one case (3%) PENN score was excellent in 26 patients, good in 2 and fair in 2 cases patients.

Conclusion: The use of hook plate on open reduction and internal fixation of the acromioclavicular joint dislocation had little adverse effect on shoulder function and is an effective method for the treatment of acromioclavicular joint dislocation. Osteoarthritis and osteolysis are the two common complications after hook plate use, which are associated with the impairment of shoulder function. Shoulder function will be improved after removal of the hook plate.

Keywords: Acromioclavicular joint, dislocation, hook plate, function, osteolysis, osteoarthritis

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I. Introduction

Acromioclavicular (AC) joint injuries account for approximately 9% of shoulder girdle. Injuries to the AC joint represent a spectrum of soft tissue disruptions that can result in mild, transient pain to significant displacement, chronic pain, and changes in shoulder biomechanics results in long-term disability. Management of AC joint injury has a debate from the time of Hippocrates [1] and Galen [2], regarding when operative management is necessary and which procedure produces the best functional outcome with least morbidity. In AC injuries, males are India affected most commonly with a male-to-female ratio of approximately 5:1 and age group affected <30 years and are commonly occurs in athletes and contact sport persons, in which the mechanism of injury is direct blow to the lateral aspect of the shoulder [3-6]. The commonly used classification is Rockwood divides these injuries into six types. Rockwood type III injuries remains controversial, Though we still follow conservative management for Rockwood type I and II injuries and surgical treatment for Rockwood type IV, V and VI injuries [8,9,10]. For acromioclavicular joint dislocations that are Rookwood type III and above, surgical treatment is currently recommended. The most commonly used surgical approach is open reduction and hook plate fixation. Because the hook plate matches the anatomy of the clavicle and shoulder and allows for the micro-adjustment of the acromioclavicular joint, it has been widely used clinically. But complications after the use of clavicular hook plate for acromioclavicular joint dislocation and distal clavicle fracture treatment, such as postoperative shoulder pain and limited shoulder motion, are also often reported. Thus, it is important to study the effects of the hook plate fixation on shoulder function. We analyzed retrospectively 30 patients who have been treated with hook plate for acromioclavicular joint dislocation in our hospital from February 2011 to March 2014, to assess the impact of hook plate on shoulder function. We found

that the use of hook plate on open reduction and internal fixation of the acromioclavicular joint dislocation had little adverse effect on shoulder function and is an effective method for the treatment of acromioclavicular joint dislocation. Osteoarthritis and osteolysis are the two common complications after hook plate use, which are associated with the impairment of shoulder function. Shoulder function will be improved after removal of the hook plate.

Materials & Methods: Total of 30 patients with Acromic-clavicular injuries were treated in this study including 21 males, 9 Females, mean age 48.27 ± 8.7 years (20 to 67 years old)

Inclusion Criteria: Grade 3, 4, 5 and 6 Acromic-clavicular injuries (dislocations)

Associated injury of lateral and of clavicle.

Exclusion Criteria: Pediatric Acromic-clavicular dislocation.

Grade 1 grade 2 joint injury

Surgery

All patients were treated with combined neck and brachial plexus anesthesia. After the commencement of anesthesia, patients were on supine position with the injured shoulder raised. A curved incision was cut along the distal clavicle to the acromion, the distal clavicle, the acromioclavicular joint and the acromion were exposed. If there was articular cartilage debris or loose cartilage disk in the acromioclavicular joint, it was removed first. Then the dislocated acromioclavicular joint was reduce and temporarily fixed, the hook end of a pre-bent steel plate was inserted into the rear bottom of the shoulder, and the proximal end of the plate was screwed into the clavicle. X-ray was used to confirm the reduce of the dislocation, then silk suture was used to repair torn ligaments and acromioclavicular joint capsule, the incision was closed after rinse. Postoperative neck wrist strap was used to protect the shoulder and rehabilitation exercises were planned individually in accordance with the situation of each patient.

Postoperative shoulder function assessment

The postoperative shoulder function was assessed using the Constant shoulder score criteria pain [11] (maximum score 15 points); activity level (maximum 20 points); range of motion (maximum 40 points); strength (maximum 25 points), total score of 100 points. The better the function, the higher the rating. Shoulder anteroposterior X-ray was taken six months after the surgery or before the removal of the hook plate to study the subacromial osteolysis, osteoarthritis of the acromioclavicular joint and the reduce condition of the dislocation PENN score was excellent in 26 patients, good in 2 and fair in 2 cases patients.

Statistical analysis

All data are expressed as mean \pm standard deviation. Statistical analysis was performed using SPSS software with group t test and Fisher's exact test. $P < 0.05$ was considered statistically significant.



Figure 1. Subacromial osteolysis shown

II. Results

All 30 cases were assessed for shoulder function using the Constant shoulder function score criteria before and two months after the removal of the hook plate. Shoulder anteroposterior X-ray was taken in all patients before and after the internal fixation surgery, before and after the removal of the hook plate. No postoperative wound infection occurred in any of the 30 patients. X-ray images showed that the dislocated acromioclavicular joints were completely reduce in all cases; no dislocation occurred after the surgery or after removal of the hook plate. Subacromial osteolysis was found in 9 patients (8 males, 1 female) (Figure 1); acromioclavicular joint osteoarthritis was found in 5 cases (4 males and 1 female); and co-occurrence of subacromial osteolysis and acromioclavicular joint osteoarthritis was found in 4 cases (all male) The hook plate

was broken in one case, but no acromioclavicular joint dislocation was found in this case. Co-occurrence of acromioclavicular osteoarthritis and coracoclavicular ligament ossification was found in 1 case. The occurrence rate of hook plate related complications was significantly higher in men than women ($P = 0.034$, Table 1).

The Constant shoulder function scores were 76 ± 6 points at 8 to 12 months after the surgery and right before the removal of the hook plate; the score was 88 ± 6 points at 2 months after removal of the hook plate. There is significant difference between the Constant shoulder function scores before and after the removal of the hook plate ($P = 0.005$). And the scores of patients without complications shown by X-ray were higher than those who have complications of osteolysis and osteoarthritis complications (Table 2). PENN score showed excellent results in 84.6% (26) patients, good in 6.4% (2) and fair in 6.4% (2). There was no bad scoring in both PENN score and Constant score.

III. Discussion:

Acromioclavicular joint dislocation is a common clinical traumatic disease. The mechanism and treatment options of this disease have been widely understood. For acromioclavicular joint dislocation rated Rockwood type III and above, more aggressive surgical approach was usually used to fix the dislocated acromioclavicular joint [12,13]. According to a recent survey among shoulder/sport surgeons in major hospitals in Germany, More than 90% treat Rockwood I or II injuries conservatively and Rockwood III to VI injuries surgically [14]. Choices of surgical fixation approaches include Kirschner wire or hook plate fixation of the acromioclavicular joint, inter-coracoclavicular screw fixation, Endobutton loop plate fixation of clavicle and coracoid process [15]. Although Kirschner wire fixation of the acromioclavicular joint, or screw fixation of the clavicle and coracoid process could achieve the goal of reduction of the dislocation initially, since the acromioclavicular joint is amphiarthrotic, fixation failure often occurred due to loosening and fracture of the internal fixation caused by stress concentration, therefore, they were rarely used clinically. Endobutton loop fixation of clavicle and coracoid process avoids the stiffened fixation of the acromioclavicular joint, allowing movement of the shoulder, but the surgery is more complex, and there is a lack of large sample study and long-term follow-up study to assess the efficacy. Since the clavicular hook plate works by forming a leverage through the proximal end of the plate fixed to the distal clavicle and the hook penetrating the acromion, so it not only reduces the dislocation of the acromioclavicular joint by adding pressure joint, but also maintains the characteristics of amphiarthrosis of the acromioclavicular joint, the measurement results of this technique is the closest to the normal biomechanics of the acromioclavicular joint [16], and thus is the most commonly used treatment plan for acromioclavicular joint dislocation. According to the German survey mentioned above, favored techniques have completely changed since 2001 when the majority of physicians preferred AC joint transfixation or coracoclavicular cerclages, both techniques that are rarely used today. The hook plate appears to have become "standard therapy which is the favored surgical technique in 44% of the surveyed surgeons joint dislocation, time is also critical. von Heideken et al showed that the median Constant Score was 91 for the acute surgery group and 85 for the delayed surgery group. The acutely treated patients had better outcomes according to the median shoulder pain and disability index, shortened version of the disabilities of the arm, shoulder, and hand. The acutely treated patients had less pain in their injured shoulder during rest and during movement [17].

But there have been reports showing that complications could occur postoperatively [18,19]. Lin et al demonstrated by musculoskeletal sonography that clavicular hook plate could cause subacromial shoulder impingement and rotator cuff lesion. Their data also suggest an association between hardware-induced impingement and poorer functional scores. They advocated the removal of the implant as soon as bony union and/or ligamentous healing is achieved [20].

In this study, our retrospective analysis found that all dislocations of the acromioclavicular joint were successfully reduced when treated with hook plate for Rockwood III and V dislocations, which was confirmed by postoperative X-ray films. There was no recurrence of joint dislocation during the follow-up study, but hook plate-related complications were not uncommon. Subacromial osteolysis and acromioclavicular joint

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vicular joint osteoarthritis are the most common complications, where the average incidence rate of osteolysis was 28.3%, and the average incidence rate of acromioclavicular osteoarthritis was 18.4%. There were varying degrees of shoulder dysfunction before removal of the hook plate, and the shoulder function was significantly improved after removal of the plate, indicating a close correlation of hook plate implant with shoulder dysfunction. The idea of acromioclavicular hook plate design is to reduce and fix the acromioclavicular joint by inserting the end of the steel hook into the subacromial space, in theory, this will not damage the nearby structures such as the rotator cuff and shoulder; and since the hook plate does not directly go through the acromioclavicular joint, thus it will not damage the surface of the acromioclavicular joint either. However, biopsy studies performed by ElMaraghy et al showed that when using the hook plate to fix acromioclavicular joint, the hook could easily pierce the subacromial bursa and contact with rotator cuff structures such as supraspinatus muscle, and in some

specimens, the tip end of the hook had reached the subacromial surface. They also found that there were significant gender differences in acromion morphology: the width and thickness of men’s shoulders were larger than those of women. Therefore, if we can further optimize the morphology of the end of the acromioclavicular hook plate and choose a hook plate of different size according to individual needs, it will likely reduce the incidence of shoulder pain and other complications. We also found that in some patients the shoulder pain was not severe, but shoulder motion was poor, especially it was hard for the upper limbs to be raised more than 90 degrees. Studies suggest that if arm elevation is less than 90 degrees, the relative rotation of the clavicle against the shoulder is small; but if arm elevation is more than 90 degrees, the rotation of the clavicle becomes significant. Especially when the hook of the plate is positioned under subacromial surface and in close contact it, the rotation of the clavicle is limited, which may cause difficulties in the elevation of the shoulder after surgery. Removal of the hook plate as early as possible maybe the only way to solve complications such as subacromial osteolysis. But the optimal time to remove the hook plate remains controversial, and in some literatures it was taken about a year after internal fixation. In our study, we removed the plate within 8-12 months after the surgery, no further dislocation

Effects of hook plate on shoulder function

Table 1, Postoperative complications of open reduction and internal fixation with hook plate to treat acromioclavicular joint dislocation

Postoperative Complications	Cases (%)		Total (%0	P value
	Male (21)	Female (9)	30	Fisher’s exact test
Osteolysis	8 (32.0%)	1 (10.5%)	9 (28.3%)	0.362
Osteoarthritis	4 (18.0%)	1 (11.5%)	5 (18.4%)	0.406
Osteolysis + Osteoarthritis	4 (14.0%)	0 (0%)	4 (11.8%)	0.54
Joint re-dislocation	0 (0%)	0 (0%)	0 (0%)	
Incision Infection	0 (0%)	0 (0%)	0 (0%)	
Total	16 (72.0%)	2 (25.0%)	18 (60.0%)	0.034

Coracoclavicular ligament ossification occurred in one case.

Table2. Average Constant score of acromioclavicular joint injury after surgery

X ray changes of the joint (taken before removal of plate)	Constant score of the joint (point)			
	Before removal	After removal	T	P value
Abnormal X ray (18 cases)	72 ± 8	82 ± 6		
Osteolysis (8 cases)	76 ± 4	90 ± 4	3.39	0.008
Osteoarthritis (4 cases)	72 ± 8	81 ± 6	2.523	0.053
Osteolysis + Osteoarthritis (4 cases)	54 ± 8	68 ± 6	3.236	0.048
Normal X ray (11 cases)	84 ± 6	92 ± 6	2.179	0.05
Total (30 cases)	76 ± 6	88 ± 6	3.015	0.005

vicular joint osteoarthritis are the most common complications, where the average incidence rate of osteolysis was 28.3%, and the average incidence rate of acromioclavicular osteoarthritis was 18.4%. There were varying degrees of shoulder dysfunction before removal of the hook plate, and the shoulder function was significantly improved after removal of the plate, indicating a close correlation of hook plate implant with shoulder dysfunction. The idea of acromioclavicular hook plate design is to reduce and fix the acromioclavicular joint by inserting the end of the steel hook into the subacromial space, in theory, this will not damage the nearby structures such as the rotator cuff and shoulder; and since the hook plate does not directly go through the acromioclavicular joint, thus it will not damage the surface of the acromioclavicular joint either. However, biopsy studies performed by ElMaraghy et al [21] showed that when using the hook plate to fix acromioclavicular joint, the hook could easily pierce the subacromial bursa and contact with rotator cuff structures such as supraspinatus muscle, and in some specimens, the tip end of the hook had reached the subacromial surface. They also found that there were significant gender differences in acromion morphology: the width and thickness of men’s shoulders were larger than those of women. Therefore, if we can further optimize the morphology of the end of the acromioclavicular hook plate and choose a hook plate of different size according to individual needs, it will likely reduce the incidence of shoulder pain and other complications. We also found that in some patients the shoulder pain was not severe, but shoulder motion was poor, especially it was hard for the upper limbs to be raised more than 90 degrees. Studies suggest that if arm elevation is less than 90 degrees, the relative rotation of the clavicle against the shoulder is small; but if arm elevation is more than 90 degrees, the rotation of the clavicle becomes significant [22]. Especially when the hook of the plate is positioned under subacromial surface and in close contact it, the rotation of the clavicle is limited, which may cause difficulties in the elevation of the shoulder after surgery. Removal of the hook plate as early as possible maybe the only way to solve complications such as subacromial osteolysis. But the optimal time to remove the hook plate remains controversial, and in some literatures it was taken about a year after internal fixation. In our

study, we removed the plate within 8-12 months after the surgery, no further dislocation was found. Alexander DF et al [23] removed the plate one year after the surgery and studied the acromioclavicular joint 18 months after the injury occurred (6 months after removal of the plate) using shoulder MRI, they found the rate of acromioclavicular ligament healing was 88%. There has been no follow-up report on early and midterm acromioclavicular ligament healing condition after the surgery.

IV. Conclusion

In summary, open reduction and internal fixation with hook plate is an effect treatment for acromioclavicular joint dislocation, but hook plate had a significant impact on shoulder function, for example it could cause complications such as osteolysis, acromioclavicular osteoarthritis. But the shoulder function was significantly improved after the hook plate was removed. And how to further optimize the design of hook plate and what is the optimal time to remove the hook plate in order to decrease the incidence of complications are the focus for future studies.

References

- [1]. Adams FL. The Genuine Works of Hippocrates vols. 1 and 2. New York: William Wood; 1986.
- [2]. Arenas AJ, Pampliega T, Iglesias J. Surgical management of bipolar clavicular dislocation. *Acta Orthop Belg.* 1993;59:202–205.
- [3]. Trainer G, Arciero RA, Mazzocca AD. Practical management of grade III acromioclavicular separations. *Clin J Sport Med.* 2008;18(2):162–166. doi: 10.1097/JSM.0b013e318169f4c1.
- [4]. Motta P, Bruno L, Maderni A, et al. Acromioclavicular motion after surgical reconstruction. *Knee Surg Sports Traumatol Arthrosc.* 2012;20(6):1012–1018. doi: 10.1007/s00167-011-1627-5.
- [5]. Mazzocca AD, Arciero RA, Bicos J. Evaluation and treatment of acromioclavicular joint injuries. *Am J Sports Med.* 2007;35(2):316–329. doi: 10.1177/0363546506298022.
- [6]. Fraser-Moodie JA, Shortt NL, Robinson CM. Injuries to the acromioclavicular joint. *J Bone Joint Surg Br.* 2008;90(6):697–707. doi: 10.1302/0301-620X.90B6.20704.
- [7]. Rockwood CA. Injuries to the acromioclavicular Joint. In: Rockwood CA, Green DP, editors. *Fractures in adults* vols. 1, 2. Philadelphia: JB Lippincott; 1984.
- [8]. Rolf O, Hann von Weyhern A, Ewers A, Boehm TD, Gohlke F. Acromioclavicular dislocation Rockwood III–V: results of early versus delayed surgical treatment. *Arch Orthop Trauma Surg.* 2008;128(10):1153–1157. doi: 10.1007/s00402-007-0524-3.
- [9]. Hootman JM. Acromioclavicular dislocation: conservative or surgical therapy. *J Athl Train.* 2004;39(1):10–11.
- [10]. Tauber M. Management of acute acromioclavicular joint dislocations: current concepts. *Arch Orthop Trauma Surg.* 2013;133(7):985–995. doi: 10.1007/s00402-013-1748-z
- [11]. Constant CR, Murley AH. A clinical method of functiona assessment of the shoulder. *Clin Orthop Relat res* 1987; 214: 160-164. Gstettner C, Tauber M, Hitzl W, Resch H. Rockwood type III acromioclavicular dislocation: surgical versus conservative treatment. *J shoulder Elbow surg* 2008; 17: 220-5.
- [12]. Phillips AM, Smart C, Groom AF. Acromioclavicular dislocation. Conservative or surgical therapy.
- [13]. *Clin Orthop Relat Res* 1998; 353: 10-7Balke M, Schneider MM, Akoto R, Bähis H, Bouillon B, Banerjee M. Acute acromioclavicular joint injuries: Changes in diagnosis and therapy over the last 10 years. *Unfallchirurg* 2014; [Epub ahead of print].
- [14]. Zhu Li, Yang Hejie, Zhao Wanjun, Yang WM, Zhou H. Case-control study on Endobutton plate or clavicular hook plate for the repair of acromioclavicular joint dislocations. *China J Orthop Trauma* 2012; 25: 120-123.
- [15]. McConnell AJ, Yoo DJ, Zdero R, Schemitsch EH, McKee MD. Methods of operative fixation of the acromioclavicular joint: a biomechanical comparison. *J Orthop Trauma* 2007; 21: 248-253.
- [16]. von Heideken J, Boström Windhamre H, Une-Larsson V, Ekelund A. Acute surgical treatment of acromioclavicular dislocation type V with a hook plate: superiority to late reconstruction. *J Shoulder Elbow Surg* 2013; 22: 9-17.
- [17]. Ejam S, Lind T, Falkenberg B. Surgical treatment of acute and chronic acromioclavicular dislocation Tossy type III and v using the Hook plate. *Acta Orthop Belg* 2008; 74: 441-5.
- [18]. Kienast B, Thietje R, Queitsch C, Gille J, Schulz AP, Meiners J. Mid-term results after operative treatment of Rockwood grade III-V acromioclavicular joint dislocations with an ac-hook-plate. *Eur J Med Res* 2011; 16: 52-56.
- [19]. Lin HY, Wong PK, Ho WP, Chuang TY, Liao YS, Wong CC. Clavicular hook plate may induce subacromial shoulder impingement and rotator cuff lesion--dynamic sonographic evaluation. *J Orthop Surg Res* 2014; 9: 6.
- [20]. ElMaraghy AW, Devereaux MW, Ravichandiran K, Agur AM. Subacromial morphometric as sessment of the clavicle hook plate. *Injury* 2010; 41: 613-619.
- [21]. Fung M, Kato S, Barrance PJ, Elias JJ, McFarland EG, Nobuhara K, Chao EY. Scapular and clavicular kinematics during humeral elevation: a study with cadavers. *J Shoulder Elbow Surg* 2001; 10: 278-85.
- [22]. Alexander DF, Carmine Z, Olivo C, Renzo P, Stefano F. The use of hook plate in type III and V acromio-clavicular Rockwood dislocations: Clinical and radiological midterm results and MR evaluation in 42 patients. *Injury* 2012; 43: 147-152.

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