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Original Article

Hook Plate Versus Suture-Button Fixation for Rockwood Types 3 and 5 Acromioclavicular Joint Dislocations

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ABSTRACT

Objective: Our study aimed to compare clinical outcomes and complication rates of hook plate (HP) and suture-button (SB) fixations for Rockwood types 3 and 5 acromioclavicular (AC) joint dislocation.

Methods: Patients who treated with SB were included in group 1, and patients who treated with HP were included in group 2. Functional evaluation of the patients was performed using the Disabilities of the Arm, Shoulder, and Hand (DASH) score and the University of California Los Angeles (UCLA) scoring systems. Preoperative, postoperative, and contralateral side coracoclavicular distance (CCD) were evaluated on Anterior-Posterior (AP) shoulder radiographs.

Results: All patients included in the study were male. Suture-button fixation was performed for 28 of the patients. Hook plate fixation was performed for 20 of the patients. There is a significant difference between group 1 and group 2 for first- and sixth-month visual analog scale (VAS) scores ($P < .001$, $P = .03$, respectively). And a significant difference determined between group 1 and group 2 for first- and third-month DASH and UCLA scores ($P < .001$, $P < .001$, $P < .001$, $P < .001$. respectively). Preoperative and postoperative CCD difference was 8.43 ± 3.19 mm for group 1 and 7.55 ± 2.14 mm for group 2. No significant difference was determined between group 1 and group 2 ($P = .291$).

Conclusion: Suture-button and HP techniques provide satisfactory results in the treatment of AC joint dislocation. Functional scores and VAS score are better in the SB technique in the early postoperative period, but there is no difference between SB and HP techniques at the 12-month postoperative results.

Keywords: Acromioclavicular joint dislocation, hook plate, suture button

INTRODUCTION

Acromioclavicular (AC) joint injuries are more common in the younger population and in athletes interested in contact sports. Twelve percent of all shoulder injuries are AC joint injuries.[1] Acromioclavicular joint injuries are more common in the population aged 20-30 years and are 5 times more common in men compared to women.[11] Acromioclavicular joint horizontal stabilization is provided by the AC capsular ligaments, and vertical stabilization is provided by the coracoclavicular (CC) ligaments. Acromioclavicular joint dislocations are classified using the Rockwood classification system. Types 1 and 2 injuries are generally treated conservatively. There is no consensus for the treatment of type 3 injuries. Types 4, 5, and 6 injuries are treated surgically.[2]

Different surgical techniques can be used in the surgical treatment of AC joint dislocations. However, a gold standard technique has not been determined. The hook plate (HP) fixation is one of the common surgical treatment techniques. The learning curve for the HP fixation technique is not long, and good clinical outcomes have been reported in the literature.[3,4] One of the most important advantages of HP fixation is that it can provide both horizontal and vertical reduction.[5] Complications such as rotator cuff tear (RCT), impingement, bone erosion, and infection have been reported.[6,7] Hook plate is usually removed after adequate healing has been achieved within 6 months.[12] The suture-button (SB) technique is performed with arthroscopic or open surgical technique. The SB is located between the coracoid process and the

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clavicle and provides AC joint and CC ligament stabilization. Many studies have reported satisfactory radiological and clinical results in the treatment of AC joint dislocation with the SB technique.[8-10] In patients using SB, a second surgery is not required for implant removal.

The aim of the study is to compare clinical results and complication rates of HP and SB fixations for Rockwood types 3 and 5 AC joint dislocations. The hypothesis of the study is that the functional scores of SB fixation are higher than HP fixation and the complication rates of HP fixation are higher.

MATERIAL AND METHODS

All researchers signed the most recent version of the Helsinki Declaration. Informed consent forms were obtained from all the patients in the study. After the approval of the Ankara Bilkent City Hospital Ethics Committee (Date: 06-09-2023, Number: E1-23-3950), the study was started. Patients who underwent SB or HP fixation for Rockwood Types 3 and 5 AC joint dislocation between January 2017 and December 2022 were included in the study.

In this retrospective study, patients who were treated with SB fixation were included in group 1, and patients who were treated with HP fixation were included in group 2. All patients were over 18 years old, and there was no neurovascular injury or additional trauma. Patients with simultaneous trauma with acromioclavicular dislocation, dislocations combined with neurovascular injury, AC joint arthritis, scapular girdle fracture, history of shoulder surgery, shoulder stiffness, less than 12 months follow-up, and patients under 18 years old were excluded from the study. All patients underwent surgery within 1 month after trauma.

The surgeon of the case decided on the surgical technique. All surgeries were performed in the beach chair position and under general anesthesia. All patients underwent open surgery. For HP fixation, an approximately 6-7 cm incision was made over the clavicle, starting from the dislocated AC joint. After the incision, soft tissue dissection was performed and the AC joint was reached. After AC joint reduction, the hook of the HP was placed posterior of the joint as possible. The subcutaneous tissue and skin were then closed (Figure 1). All patients underwent implant removal. For SB fixation, an approximately 6 cm incision was made, starting from 2 cm medial to the AC joint and extending to the coracoid process. After soft tissue dissection, the coracoid process and the clavicle were reached. First, the clavicle bony tunnel was determined with a guide pin to be at the center of the borders of the clavicle, and then it was checked with fluoroscopy. The bone tunnel was drilled with a cannulated drill. Afterward, the coracoid process bone tunnel was determined with a guide pin close to the coracoid neck and checked with fluoroscopy. The bone tunnel was drilled with a cannulated drill. After passing the endobutton through the tunnels, the endobutton was placed on the inferior surface of the coracoid process. Acromioclavicular joint reduction was checked by fluoroscopy, and the round button was placed on the superior surface of the clavicle. The subcutaneous tissue and skin were then closed (Figure 2). After surgery, a shoulder sling was used for 4 weeks. All patients were included in the standard rehabilitation program.

MAIN POINTS

- Suture-button fixation and HP fixation provide satisfactory outcomes in the treatment of AC joint dislocations.
- Preoperative and postoperative CCD difference was 8.43 ± 3.19 mm for the SB group and 7.55 ± 2.14 mm for the HB group. No significant difference was determined between the groups ($P = .291$).
- Functional scores and VAS scores are better in the SB group in the early postoperative period, but there is no difference between the SB and HP groups in the late postoperative period.

Age, gender, mechanism of injury, hand dominance, time from trauma to surgery, visual analog scale (VAS) score, and HP removal time were evaluated. Functional evaluation of the patients was performed using the University of California Los Angeles (UCLA) score and the Disabilities of the Arm, Shoulder, and Hand (DASH) scoring systems at postoperative first, third, sixth, and 12th months. Standard anterior–posterior (AP) shoulder radiographs were used for radiological evaluation. Preoperative, postoperative, and contralateral side coracoclavicular distance (CCD) were evaluated on AP shoulder radiographs. Implant-related complications, surgical-site infection, AC joint arthritis, and osteolysis were evaluated.

Statistical Analysis

Research data were evaluated via Statistical Package for Social Sciences for Windows 26.0 (IBM SPSS Corp.; Armonk, NY, USA). Continuous variables were presented with mean and standard deviation values, and categorical variables were presented with frequency and percentage values. Categorical variables were compared between groups using the chi-square test. The suitability of continuous variables to normal distribution was examined by calculating skewness and kurtosis values. Normally distributed continuous variables were analyzed using independent samples *t*-test. Preoperative and postoperative CCD measurements were analyzed using a dependent samples *t*-test. An ANOVA test was used to compare the

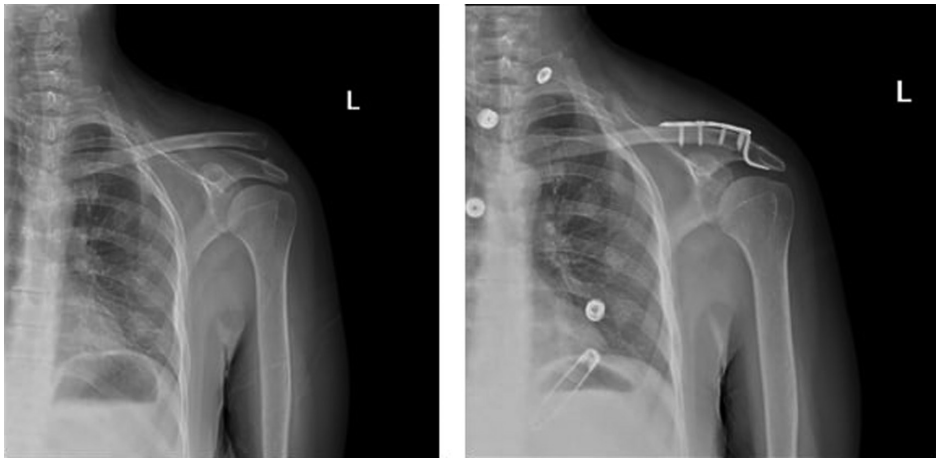

Figure 1. Hook plate fixation.

measurements made in the first, third, sixth, and 12th months after the operation. The amount of change in the variables was analyzed using the independent samples *t*-test between groups. G*Power program (Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany) was used for power analysis. $P < .05$ was determined as the statistical significance level.

RESULTS

Fifty one patients were operated for AC joint dislocation. Three patients whose follow-up data could not be obtained were excluded from the study. All patients included in the study were male. Suture-button fixation was performed for 28 patients, and they were included in group 1. Hook plate fixation was performed for 20 patients, and they were included in group 2. The average age of group 1 was 39.29 ± 13.93 (21-75). The average age of group 2 was 45.30 ± 11.96 (26-66). No significant difference was determined between group 1 and group 2 for age ($P = .125$). In group 1, 11 left sides and 17 right sides were operated. In group 2, 13 left sides and 7 right sides were operated. There was no significant difference between groups for side ($P = .079$). The dominant side was operated on in 16 patients in group 1 and 8 patients in group 2. There was no significant difference between group 1 and group 2 for dominant side ($P = .242$). In group 1, 13 of the patients were Rockwood type 3, and 15 were Rockwood type 5. In group 2, 9 of the patients were Rockwood type 3, and 11 were Rockwood type 5. The mean HP removal time was 9.75 ± 2.31 months. The average follow-up time was 18.2 ± 4.65 months for group 1 and 19.4 ± 5.25 months for group 2 (Table 1). The power of the study was calculated as 85% with an effect size of 0.8 and a standard error of 0.05 with the G*Power program.

For group 1, preoperative CCD was 19 ± 2.58 mm, and postoperative CCD was 10.57 ± 1.68 mm. For group 2, preoperative CCD was 17.95 ± 2.23 mm, and postoperative CCD was 10.4 ± 1.05 mm. There was a significant difference between preoperative CCD and postoperative CCD

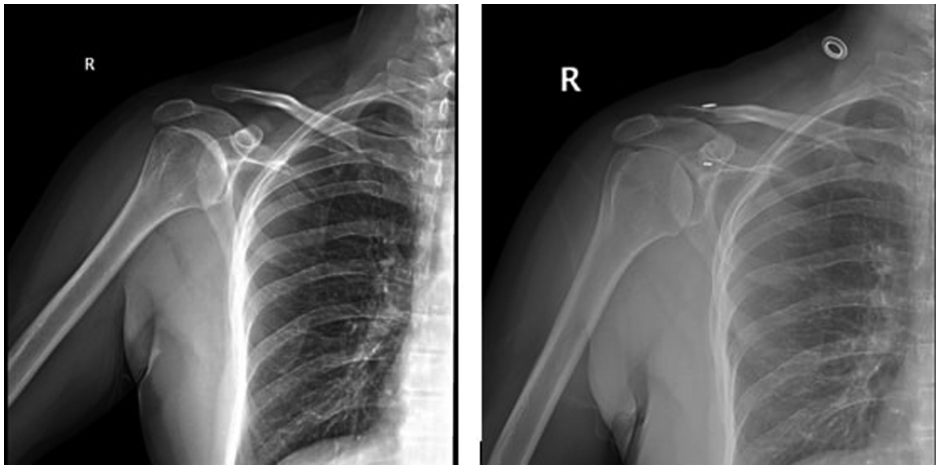

Figure 2. Suture-button fixation.

Table 1. Characteristics of the Patients

	Suture Button (n = 28)	Hook Plate (n = 20)	*P*
Age			.125
<30 years	9	2	
30-39 years	9	7	
40-49 years	3	1	
>50 years	7	10	
Average	39.29 ± 13.93	45.30 ± 11.96	
Limb			.079
Right	17	7	
Left	11	13	
Dominant side			.242
Dominant	16	8	
Non-dominant	12	12	
Rockwood classification			.922
Type 3	13	9	
Type 5	15	11	
Follow up (months)	18.2 ± 4.65	19.4 ± 5.25	>.05
Hook plate removal time (months)		9.75 ± 2.31	

Table 2. Comparison of Preoperative and Postoperative Coracoclavicular Distance in Hook Plate and Suture-Button Groups

	Suture Button (n = 28)	Hook Plate (n = 20)	*P*
Preoperative CCD	19 ± 2.58 mm	17,95 ± 2.23 mm	> .05
Postoperative CCD	10.57 ± 1.68 mm	10.4 ± 1.05 mm	> .05
P	.001	.001	
ΔCCD	8.43 ± 3.19 mm	7.55 ± 2.14 mm	=.291

CCD, coracoclavicular distance.

for group 1 and group 2 ($P < .001$, $P < .001$ respectively). Preoperative and postoperative CCD difference was 8.43 ± 3.19 mm for group 1 and 7.55 ± 2.14 mm for group 2. No significant difference was determined between group 1 and group 2 ($P = .291$) (Table 2).

For group 1 and group 2, there was a significant difference between postoperative first-third months, third-sixth months VAS, and sixth-12th months VAS, DASH, and UCLA scores (Figure 3). Additionally, there is a significant difference between group 1 and group 2 for first- and sixth-month VAS scores ($P < .001$, $P = .03$, respectively). A significant difference was also determined between group 1 and group 2 for first- and third-month DASH and

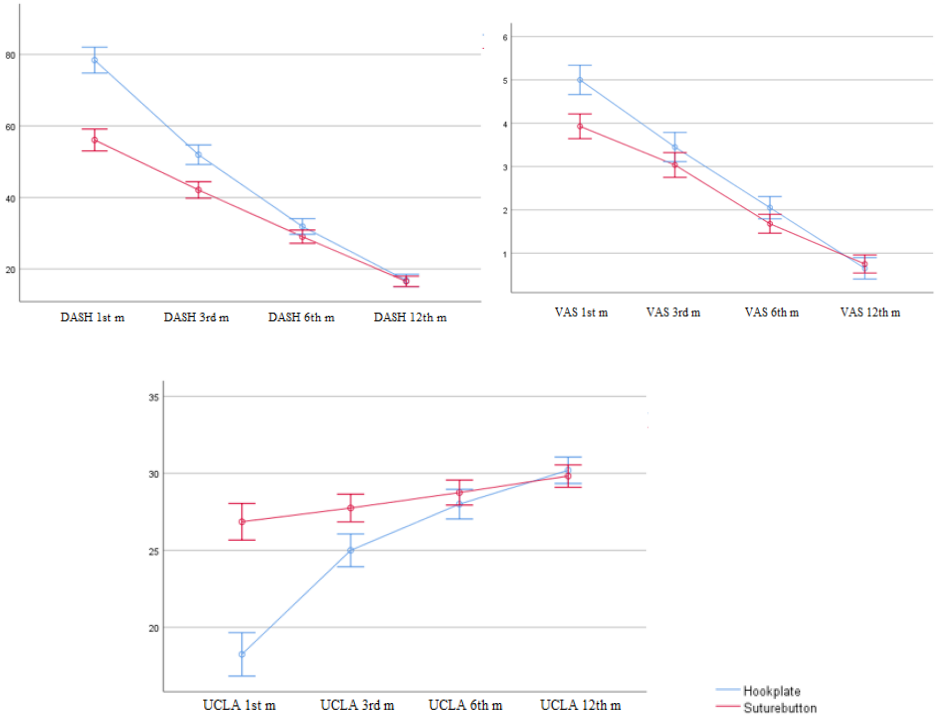

Figure 3. First-, Third-, Sixth-, and 12th-Month Visual Analog Scale, Disabilities of the Arm, Shoulder, and Hand Score, and University of California Los Angeles Score Follow-up Graphics of Hook Plate and Suture-Button Groups.

Table 3. Comparison of VAS, DASH, and UCLA at First-, Third-, Sixth-, and 12th-Month Follow-Up Between Hook Plate and Suture-Button Groups

	Suture Button (n = 28)	Hook Plate (n = 20)	*P*
VAS score			
Postoperative first month	5.00 ± 0.92	3.93 ± 0.60	**<.001**
Postoperative third month	3.45 ± 0.89	3.04 ± 0.64	.08
Postoperative sixth month	2.05 ± 0.61	1.68 ± 0.55	**.03**
Postoperative 12th month	0.65 ± 0.49	0.75 ± 0.59	.54
UCLA score			
Postoperative first month	18.25 ± 3.93	26.86 ± 2.42	**<.001**
Postoperative third month	25.00 ± 2.75	27.75 ± 2.05	**<.001**
Postoperative sixth month	28.00 ± 2.56	28.76 ± 1.78	.24
Postoperative 12th month	30.20 ± 2.17	29.82 ± 1.70	.50
DASH score			
Postoperative first month	78.40 ± 6.55	56.07 ± 8.92	**<.001**
Postoperative third month	51.95 ± 5.41	42.11 ± 6.49	**<.001**
Postoperative sixth month	31.90 ± 5.31	29.04 ± 4.49	.05
Postoperative 12th month	16.80 ± 3.65	16.54 ± 3.91	.81–

DASH, Disabilities of the Arm, Shoulder, and Hand Score; UCLA, University of California Los Angeles Score; VAS, visual analog scale.

UCLA scores ($P < .001$, $P < .001$, $P < .001$, $P < .001$, respectively) (Table 3).

In the SB group, there were 6 implant failures, 2 wound infections, and 1 AC arthrosis. Patients with implant failure underwent revision with HPs or allografts. One of the patients with a wound infection underwent debridement, and the other was treated with antibiotics. The patient with AC arthrosis was followed up with medical treatment and physiotherapy. In the HP group, there were 3 cases of AC arthrosis, 2 cases of subacromial osteolysis, 1 wound infection, and 1 implant failure. The patients with AC arthrosis and osteolysis were followed up with medical treatment and physiotherapy. The patient with implant failure underwent implant removal. There was no statistically significant difference between group 1 and group 2 for complications ($P = .836$).

DISCUSSION

In the current study, VAS, UCLA, and DASH scores were better in the SB group in the early postoperative period. Preoperative–postoperative CCD differences were similar for groups. Complication rates were similar. Suture-button and HP techniques provide satisfactory results in the treatment of AC joint injury. Functional scores and VAS scores are better with the SB technique in the early postoperative period, but there is no difference between the SB and HP techniques at the 12th-month postoperative results.

There are different SB fixation techniques such as Tight Rope, Twin Tail Tight Rope, and Double Tight Rope.[15,16] In these techniques, non-physiological AC joint fixation is provided with fiber cables. It has been stated that vertical and horizontal stability is better in the double SB technique compared to the single SB technique. However, there is no difference between the 2 techniques for clinical scores and CCD.[17] In our study, the single SB technique was preferred.

Hook plate acts as a leverage arm between the acromion and the clavicle. It provides dynamic fixation. This technique is mostly used in the treatment of acute injuries. However, it can be used with ligament reconstruction in the treatment of chronic injuries.[18] Although HP provides satisfactory results in AC joint injuries, some of the HP complications are postoperative RCT, impingement syndrome, acromial fracture, and subacromial osteolysis.[19-21] Patients treated with HP require a second surgery to remove the implant. Implant removal is not required in patients treated with SB. Some of the complications that can be seen with SB fixation are loss of reduction, implant failure, coracoid fracture, and overcorrection. Arirachakaran et al.[22] reported that functional scores were better, postoperative pain was less, but the complication rate of the SB technique was higher than the HP technique. Complication rate of SB was 1.7 times higher. In the current study, complications for the SB group were implant failure, wound infection, and AC arthrosis. Complications for the HP group were AC arthrosis, subacromial osteolysis, wound infection, and implant failure. The complication rate was 32.14% for the SB group and 35% for the HP group. The complication rates of the groups were similar.

Biomechanical studies have shown that the SB technique provides greater horizontal and vertical stability and stiffness than the HP technique. Nüchtern et al.[23] showed in their study that external and internal rotational stability

were better in SB group than in the HP group. Walz et al.[24] reported that the SB technique has greater durability than natural ligaments and facilitates healing by providing greater stability to the AC joint. Although the SB technique is considered biomechanically superior to the HP technique, many studies have shown that the results are similar. In the current study, the functional results of the SB group were better in the early postoperative period. But, there was no difference in the results after the 12th postoperative month.

Satisfactory functional scores are obtained in AC joint injuries treated with both SB and HP techniques. The SB technique is less invasive. For the best results, surgical treatment of AC joint injury must be performed within the first 3 weeks. The outcomes of patients who undergo acute surgery are better than those who undergo late surgery.[5] In our study, all patients were operated on in the first month. Qi et al.[25] reported that better functional results were obtained with the SB technique than the HP technique. Wang et al.[26] reported that the SB technique has better functional results compared to the HP technique. Additionally, there is no difference between the 2 techniques for CCD and complications. Jensen et al.[14] reported that although implant removal is required in the HP technique, the results of the HP technique are similar to the arthroscopic SB technique for acute AC injuries.Yuan et al.[27] compared the SB and HP groups in their study. Visual analog scale improvement was better in the SB group. Patients in the SB group reached normal shoulder range of motion in the postoperative first month. Yapici et al.[28] reported that postoperative pain, complication, and reoperation rates are lower, and functional scores are higher in the SB technique compared to the HP technique. In the current study, functional scores were better in the SB group in the early postoperative period. However, there was no difference between the SB group and the HP group for functional scores at the 12th-month follow-up. The SB technique has advantages such as faster rehabilitation and early mobilization and no need for implant removal.[10]

In SB fixation, we use bicortical clavicle and coracoid process holes. Holes may cause iatrogenic fracture.[29,30] In arthroscopic SB procedures, the risk of iatrogenic fracture and neurovascular injury can be reduced by correct tunnel placement with direct visualization.[23] In different studies, 20-24.1% of patients with AC joint injuries are accompanied by intra-articular pathologies.[14,20,31] In our study, the open SB technique was used, and implant failure occurred in 6 patients. The rate of implant failure can be reduced with the arthroscopic technique. Additionally, diagnosis and treatment of accompanying intra-articular pathologies can be performed in the same session using the arthroscopic technique.

There were some limitations to the study. Firstly, our study had a retrospective design. Secondly, all of the patients were male. Thirdly, the patient group was not large enough. More valuable results can be obtained with larger patient groups.

Suture-button and HP techniques provide satisfactory results in the treatment of AC joint injury. Functional scores and VAS scores are better with the SB technique in the early postoperative period, but there is no difference between the SB and HP techniques at the 12th-month postoperative results.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

Ethics Committee Approval: Ethics committee approval was received for this study from the Ethics Committee of Health Ministry of Türkiye Republic Ankara Bilkent City Hospital (Date: 06-09-2023, Number: E1-23-3950).

Informed Consent: Written informed consent was obtained from patients who agreed to take part in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – E.K.; Design – E.K., B.S.; Supervision – B.S.; Resources – B.S.; Materials – E.K.; Data Collection and/or Processing – E.K.; Analysis and/or Interpretation – E.K., B.S.; Literature Search – E.K., B.S.; Writing Manuscript – E.K.; Critical Review – B.S.; Other – E.K.

Declaration of Interests: The authors have no conflict of interest to declare.

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REFERENCES

1. Mazzocca AD, Arciero RA, Bicos J. Evaluation and treatment of acromioclavicular joint injuries. *Am J Sports Med*. 2007;35(2):316-329. [CrossRef]
2. Li XN, Ma R, Bedi A, Dines DM, Altchek DW, Dines JS. Management of acromioclavicular joint injuries. *J Bone Joint Surg Am*. 2014;96(1):73-84. [CrossRef]
3. Johansen JA, Grutter PW, McFarland EG, Petersen SA. Acromioclavicular joint injuries: indications for treatment and treatment options. *J Shoulder Elbow Surg*. 2011;20(2)(suppl):S70-S82. [CrossRef]
4. Simovitch R, Sanders B, Ozbaydar M, Lavery K, Warner JJP. Acromioclavicular joint injuries: diagnosis and management. *J Am Acad Orthop Surg*. 2009;17(4):207-219. [CrossRef]
5. Von Heideken J, Boström Windhamre H, Une-Larsson V, Ekelund A. Acute surgical treatment of acromioclavicular dislocation type V witha hook plate: superiority to late reconstruction. *J Shoulder Elbow Surg*. 2013;22(1):9-17. [CrossRef]

6. 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. [CrossRef]
7. Eschler A, Gradl G, Gierer P, Mittlmeier T, Beck M. Hook plate fixation for acromioclavicular joint separations restores coracoclavicular distance more accurately than PDS augmentation, however presents with a high rate of acromial osteolysis. *Arch Orthop Trauma Surg*. 2012;132(1):33-39. [CrossRef]
8. El Sallakh SA. Evaluation of arthroscopic stabilization of acute acromioclavicular joint dislocation using the TightRope system. *Orthopedics*. 2012;35(1):e18-e22. [CrossRef]
9. Spoliti M, De Cupis M, Via AG, Oliva F. All arthroscopic stabilization of acute acromioclavicular joint dislocation with FiberWire and Endo-Button system. *Muscles Ligaments Tendons J*. 2014;4(4):398-403.
10. Scheibel M, Dröschel S, Gerhardt C, Kraus N. Arthroscopically assisted stabilization of acute high-grade acromioclavicular joint separations. *Am J Sports Med*. 2011;39(7):1507-1516. [CrossRef]
11. Mehrberg RD, Lobel SM, Gibson WK. Disorders of the acromioclavicular joint. *Phys Med Rehabil Clin N Am*. 2004;15(3):537-555. [CrossRef]
12. Kashii M, Inui H, Yamamoto K. Surgical treatment of distal clavicle fractures using the clavicular hook plate. *Clin Orthop Relat Res*. 2006;447:158-164. [CrossRef]
13. Torkaman A, Bagherifard A, Mokhatri T, et al. Doublebutton fixation system for management of acute acromioclavicular joint dislocation. *Arch Bone Jt Surg*. 2016;4(1):41-46.
14. Jensen G, Katthagen JC, Alvarado LE, Lill H, Voigt C. Has the arthroscopically assisted reduction of acute AC joint separations with the double tight-rope technique advantages over the clavicular hook plate fixation? *Knee Surg Sports Traumatol Arthrosc*. 2014;22(2):422-430. [CrossRef]
15. Borbas P, Angelella D, Laux CJ, et al. Acromioclavicular joint stabilization with a double cow-hitch technique compared to a double tight-rope: a biomechanical study. *Arch Orthop Trauma Surg*. 2022;142(7):1309-1315.
16. Lädermann A, Gueorguiev B, Stimec B, Fasel J, Rothstock S, Hoffmeyer P. Acromioclavicular joint reconstruction: a comparative biomechanical study of three techniques. *J Shoulder Elbow Surg*. 2013;22(2):171-178. [CrossRef]
17. Patzer T, Clauss C, Kühne CA, et al. Arthroscopically assisted reduction of acute acromioclavicular joint separations: comparison of clinical and radiological results of single versus double TightRope™ technique. *Unfall*. 2013;116(5):442-450. [CrossRef]
18. Dursun M, Altun G, Ozsahin M. Surgical treatment of acromioclavicular dislocation: hook plate versus suture button. *Acta Ortop Bras*. 2023;31(spe1):e252916. [CrossRef]
19. Metzlaff S, Rosslenbroich S, Forkel PH, et al. Surgical treatment of acute acromioclavicular joint dislocations: hook plate versus minimally invasive reconstruction. *Knee Surg Sports Traumatol Arthrosc*. 2016;24(6):1972-1978. [CrossRef]
20. Stein T, Müller D, Blank M, et al. Stabilization of acute high-grade acromioclavicular joint separation: a prospective assessment of the clavicular hook plate versus the double double-button suture procedure. *Am J Sports Med*. 2018;46(11):2725-2734. [CrossRef]
21. Schmidt J, Altmann T, Schmidt I, Hackenberger J, Letsch R. The effects of hook plates on the subacromial space: a clinical and MRI study. *Eur J Trauma Emerg Surg*. 2009;35(2):132-140. [CrossRef]
22. Arirachakaran A, Boonard M, Piyapittayanun P, et al. Postoperative outcomes and complications of suspensory loop fixation device versus hook plate in acute unstable acromioclavicular joint dislocation: a systematic review and meta-analysis. *J Orthop Traumatol*. 2017;18(4):293-304. [CrossRef]
23. Nüchtern JV, Sellenschloh K, Bishop N, et al. Biomechanical evaluation of 3 stabilization methods on acromioclavicular joint dislocations. *Am J Sports Med*. 2013;41(6):1387-1394. [CrossRef]
24. Walz L, Salzmann GM, Fabbro T, Eichhorn S, Imhoff AB. The anatomic reconstruction of acromioclavicular joint dislocations using 2 TightRope devices: A biomechanical study. *Am J Sports Med*. 2008;36(12):2398-2406. [CrossRef]
25. Qi W, Xu Y, Yan Z, et al. The tight-rope technique versus clavicular hook plate for treatment of acute acromioclavicular joint dislocation: a systematic review and meta-analysis. *J Invest Surg*. 2021;34(1):20-29. [CrossRef]
26. Wang C, Meng JH, Zhang YW, Shi MM. Suture button versus hook plate for acute unstable acromioclavicular joint dislocation: a meta-analysis. *Am J Sports Med*. 2020;48(4):1023-1030. [CrossRef]
27. Yuan TBWX, Liu J, Chen SC, Jiang LM, Chen JW, Qin J. Effacacy comparison of AC TightRope plate and clavicular hook plate for arcomioclavicular joint dislocation. *Chin J Trauma*. 2018;34:1089-1095.
28. Yapici F, Üçpunar H, Gür V, et al. Open double-button technique is superior to hook plate in the treatment of acute Rockwood type III/V acromioclavicular dislocations. *Ulus Travma Acil Cerrahi Derg*. 2022;28(6):839-848. [CrossRef]
29. Coale RM, Hollister SJ, Dines JS, Allen AA, Bedi A. Anatomic considerations of transclavicular-transcoracoid drilling for coracoclavicular ligament reconstruction. *J Shoulder Elbow Surg*. 2013;22(1):137-144. [CrossRef]
30. Woodmass JM, Esposito JG, Ono Y, et al. Complications following arthroscopic fixation of acromioclavicular separations: a systematic review of the literature. *Open Access J Sports Med*. 2015;6:97-107. [CrossRef]
31. Natera-Cisneros L, Sarasquete-Reiriz J, Escolà-Benet A, Rodriguez-Miralles J. Acute high-grade acromioclavicular joint injuries treatment: arthroscopic non-rigid coracoclavicular fixation provides better quality of life outcomes than hook plate ORIF. *Orthop Traumatol Surg Res*. 2016;102(1):31-39. [CrossRef]