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Original Article

Evaluation of Shoulder Range of Motion and Functional Outcomes in Patients with Acromioclavicular Joint Dislocation Treated with Hook Plate Fixation

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Background: Acromioclavicular (AC) joint dislocation is a common injury, among adults and athletes. While the clavicular hook plate is a widely used surgical intervention, reports regarding postoperative range of motion (ROM) and functional outcomes remain inconsistent. This study aims to evaluate the shoulder ROM and clinical outcomes in patients with AC joint dislocation treated with hook plate fixation.

Methods: This cross-sectional study was conducted at Shahid Beheshti Hospital, Babol, Iran. The study consisted of 60 patients with AC joint dislocation treated with a hook plate. Postoperative outcomes were assessed using Quick Disabilities of the Arm, Shoulder and Hand (Quick-DASH) questionnaire, Visual Analog Scale (VAS) for pain (at rest and motion), and goniometric ROM assessment. Complications such as infection, re-dislocation, and frozen shoulder were recorded.

Results: The mean age of participants was 29.72 ± 8.92 years, with a male predominance (81.7%). The mean postoperative ROM deficit was 35.45° ± 3.62, and the mean Quick-DASH score was 12.98 ± 2.04. The mean pain intensity was 5.95 ± 1.12 during motion and 5.45 ± 0.92 at rest. Complications occurred in 5% of patients (n=3). Statistical analysis revealed no significant differences in surgical duration, length of hospital stay, or clinical outcomes between genders (all $p \geq 0.124$) or age groups (all $p \geq 0.476$).

***Conclusion*:** Hook plate fixation for acromioclavicular dislocation was associated with favourable postoperative functional outcomes and a low complication rate. However, the absence of preoperative functional scores and a comparison group limits conclusions regarding true clinical improvement or superiority over other treatment methods.

Keywords: Acromioclavicular Joint, Dislocation, Shoulder Joint, Range of Motion, Hook Plate

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Introduction

Acromioclavicular (AC) joint dislocation is one of the most prevalent shoulder injuries in the adult population, particularly among athletes involved in contact sports. This joint, located at the superior aspect of the shoulder, is formed by the articulation of the clavicle and the acromion process of the scapula (1, 2).

Dislocation can occur in all age groups, ranging from mild, painless presentations to severe deformities associated with significant functional impairment of the upper limb (3). The incidence is estimated at 2 to 3 per 100,000 in the general population, rising to 25–52% in athletic cohorts (4, 5).

Mechanisms of injury are categorized as direct (e.g., high-energy trauma, falls onto the adducted arm) or indirect (5). While low-grade injuries are typically managed conservatively via immobilization, high-grade dislocations often necessitate surgical intervention to restore joint congruity and repair the coracoclavicular (CC) ligaments (6).

Various surgical techniques exist, including CC screw fixation, suture button fixation, and ligament reconstruction (7, 8, 9).

Among these, the clavicular hook plate remains a popular choice due to its relative simplicity and mechanical stability. The device utilizes a subacromial extension (hook) to maintain reduction while the ligaments heal. However, the superiority of this method is debated (10).

Potential complications include subacromial impingement, rotator cuff erosion, and the necessity for a second surgery for implant removal. Furthermore, literature regarding early postoperative ROM and functional recovery with this technique is inconsistent and geographically sparse (11, 12).

Given the lack of local data, this study aims to evaluate the shoulder ROM and functional outcomes in patients treated with hook plate fixation for AC joint dislocation at a tertiary referral center in Iran.

Materials and Methods

Study Design and Participants

This study was reviewed and approved by the Ethics Committee of Babol University of Medical Sciences (Ethical Code: IR.MUBABOL. HRI.REC. 1402.230). Written informed consent was obtained from all participants prior to enrollment. A total of 69 patients diagnosed with acromioclavicular (AC) joint dislocation were initially evaluated for inclusion in the study. After excluding patients who were lost to inclusion criteria (n=9), 60 patients were included in the final analysis.

Inclusion criteria consisted of patients aged 18 years or older with acute AC joint dislocation who underwent open reduction and internal fixation using a clavicular hook plate. Diagnosis was established based on clinical examination and radiographic assessment according to standard orthopedic criteria. Patients with previous shoulder surgery, associated fractures around the shoulder girdle, chronic AC joint dislocation, neuromuscular disorders affecting shoulder function, or incomplete medical records were excluded from the study.

All patients underwent routine preoperative evaluation, including physical examination, laboratory investigations, and radiographic imaging. Surgical procedures were performed under general anesthesia by the orthopedic surgery team using a standardized operative technique.

Ethical Considerations

This study was approved by the Ethics Committee of Babol University of Medical Sciences under the ethical approval code IR.MUBABOL. HRI.REC. 1402.230. Written informed consent was obtained from all participants prior to enrollment, and patient confidentiality was maintained throughout the study.

Surgical and Postoperative Protocol

The clavicular hook plate technique was selected based on its established efficacy and biomechanical

stability in the treatment of acute acromioclavicular (AC) joint dislocation, particularly in high-grade injuries according to Rockwood and Green's classification (13). The hook plate functions by maintaining reduction of the distal clavicle through a subacromial hook positioned beneath the acromion, thereby stabilizing the AC joint while allowing healing of the coracoclavicular ligaments.

All procedures were performed under general anesthesia with the patient in the beach-chair position. Following standard sterile preparation and draping, a superior approach to the distal clavicle and AC joint was used. After exposing the dislocated joint, anatomical reduction was achieved under direct visualization. A precontoured clavicular hook plate was then inserted, with the hook positioned under the acromion and the plate fixed to the clavicle using cortical screws. Proper implant placement and joint reduction were confirmed intraoperatively using fluoroscopic imaging.

The hook plate technique was preferred because it provides stable fixation, permits early mobilization, and is technically straightforward compared with some ligament reconstruction procedures. In addition, the implant offers reliable maintenance of AC joint alignment during ligament healing.

Postoperatively, patients were immobilized using a neck sling for 2 weeks. Passive shoulder mobilization and light daily activities (lifting <1 kg) were allowed during the first 6 weeks. Thereafter, active range-of-motion exercises and progressive weight-bearing were initiated. Return to sports activities and heavy lifting was permitted approximately 3 months after surgery. Routine implant removal was scheduled approximately 12 weeks postoperatively.

Outcome Measure

Outcomes were assessed during visits by the orthopedic surgeon after routine hook plate removal. All functional assessments, including shoulder range of motion (ROM), Quick-DASH score, Visual Analog Scale (VAS) pain score, and evaluation of complications, were performed after implant removal. The mean interval from surgery to plate removal was 15.57 ± 2.54 weeks.

Range of Motion (ROM): Shoulder ROM was assessed using a standard goniometer. ROM deficit was defined as the difference in degrees between the operated shoulder and the contralateral healthy shoulder. Lower values indicated better postoperative shoulder mobility, with a score of 0 representing no deficit between shoulders.

Functional Disability: Evaluated using the Quick Disabilities of the Arm, Shoulder and Hand (Quick-DASH) questionnaire. This 11-item tool scores disability from 0 (best) to 100 (worst). Validated Persian versions were used (14).

Pain Intensity: Measured via the Visual Analog Scale (VAS), ranging from 0 (no pain) to 10 (worst pain), both at rest and during movement.

Statistical Analysis

Data were analyzed using SPSS software (version 25). Descriptive statistics (mean, standard deviation, median, frequency) were calculated. Normality was assessed; as data did not follow a normal distribution, non-normally distributed continuous variables were presented as median and interquartile range, and between-group comparisons were performed using the Mann–Whitney U test. Categorical variables were compared using the chi-square test or Fisher's exact test, as appropriate. A p-value of < 0.05 was considered statistically significant.

Results

A total of 69 patients were initially identified. After exclusion criteria (n = 9), 60 patients were included in the final analysis. The mean age was 29.72 ± 8.92 years (range: 18–49), with a median age of 28 years. The cohort was predominantly male (n=49,

81.7%). Surgical characteristics of participants are summarized in **Table 1**.

Postoperative functional outcomes indicated favorable recovery **(Table 2).** The mean postoperative ROM deficit was 35.45 ± 3.62 degrees, indicating a residual difference in shoulder motion compared with the contralateral side, and the mean Quick-DASH score was 12.98 ± 2.04. Pain scores averaged 5.95 ± 1.12 during motion and 5.45 ± 0.92 at rest.

Table 1 . Baseline Demographic and Surgical Characteristics of Patients with Acromioclavicular Joint Dislocation

Variables	Mean ± SD / n (%)	Median	Minimum	Maximum
Age (years)	29.72 ± 8.92	28	18	49
Sex (Male/Female)	49 (81.7) / 11 (18.3)	—	—	—
BMI (kg/m²)	25.8 ± 3.4	25.4	20.1	33.2
Involved shoulder (Right/Left)	41 (68.3) / 19 (31.7)	—	—	—
Dominant side involvement	38 (63.3)	—	—	—
Smoking history	17 (28.3)	—	—	—
Duration of surgery (minutes)	62.85 ± 15.32	60	46	120
Length of hospital stay (days)	3.85 ± 1.33	4	2	7
Time from injury to surgery (days)	2.13 ± 0.79	2	1	3
Time from surgery to plate removal (weeks)	15.57 ± 2.54	15	12	21

Table 2: Postoperative Shoulder ROM deficit, Functional Outcomes, Range of Motion, and Pain Scores Following Hook Plate Fixation

Variable	Mean ± SD	Median	Range
Range of Motion (Score)	35.45 ± 3.62	35.50	29–49
Quick-DASH Score	13.04 ± 2.04	13	9–16
Pain (Motion) (VAS)	5.95 ± 1.12	5	4–9
Pain (Rest) (VAS)	5.45 ± 0.92	5	4–8

Table 3. Comparison of Surgical Characteristics and Postoperative Clinical Outcomes Between Male and Female Patients

Variable	Mean ± SD (Male)	Mean ± SD (Female)	P-Value
Surgical Duration (min)	61.49 ± 12.64	68.91 ± 23.82	0.666
Hospital Stay (days)	3.9 ± 1.32	3.64 ± 1.43	0.437
Time from Injury to Surgery (days)	2.14 ± 0.79	2.09 ± 0.83	0.847
Time to Plate Removal (weeks)	15.59 ± 2.63	15.45 ± 2.20	0.992
Range of Motion (Score)	35.38 ± 3.79	35.76 ± 2.71	0.295
Quick-DASH Score	13.1 ± 2.06	12.98 ± 1.89	0.349
Pain (Motion) (VAS)	5.92 ± 1.12	6.10 ± 1.10	0.387
Pain (Rest) (VAS)	5.43 ± 0.82	5.53 ± 1.26	0.124

Subgroup Analysis

Gender

No significant differences were found between males and females regarding surgical duration (p = 0.666), hospital stay (p = 0.437), time from injury to surgery (p = 0.847), time to plate removal (p = 0.992), ROM (p = 0.295), Quick-DASH score (p = 0.349), pain during motion (p = 0.387), or pain at rest (p = 0.124).

Age

Patients were divided into two groups according to the median age: ≤28 years and >28 years. No significant differences were observed in surgical metrics, postoperative pain, functional outcomes, or complication rates between the age groups (all p ≥ 0.476).

Complications were observed in 5.0% of patients (n=3), comprising one case each of surgical site infection, re-dislocation, and frozen shoulder. There was no statistically significant difference in complication rates between genders (p = 0.437) or age groups (p = 0.476) **(Table 3)**.

Discussion

This study demonstrates that surgical fixation with a hook plate is an effective management strategy for AC joint dislocation, yielding satisfactory functional outcomes and low complication rates. Our findings indicate that patients achieved a mean Quick-DASH score of 12.98 and significant functional recovery, irrespective of age or gender.

The favorable outcomes associated with hook plate fixation may be explained by the biomechanical stability provided by the implant. The hook plate maintains anatomical reduction of the acromioclavicular joint by positioning a hook beneath the acromion while securing the plate to the distal clavicle. This configuration counteracts superior displacement of the clavicle and stabilizes the joint during the healing process of the coracoclavicular ligaments. Stable fixation allows early shoulder mobilization, which is essential for preventing joint stiffness, muscle atrophy, and functional limitation. Furthermore, restoration of normal joint alignment improves shoulder biomechanics and facilitates more effective transmission of forces across the shoulder girdle during movement. Compared with some alternative fixation methods, the hook plate technique is relatively simple, provides immediate mechanical support, and enables satisfactory functional recovery with acceptable complication rates.

Our results align with several international studies. Büyükceran et al. and Liu et al. similarly reported improvements in ROM and functional scores following hook plate fixation (15,20). Specifically, the low Quick-DASH scores observed in our cohort suggest that patients regained substantial upper limb capacity. Conversely, our findings contradict the work of Windhamre et al., who reported no significant difference in pain or ROM between hook plate fixation and conservative management (16). Similarly, Qi et al. and Taleb et al. found no clear superiority of the hook plate over other surgical methods (17, 18). These discrepancies may be attributed to variations in fracture classification (Rockwood types), and sample sizes.

Pain management is a critical component of postoperative recovery. In this study, mean VAS scores were 5.95 during motion and 5.45 at rest. Although the Quick-DASH scores suggested favorable functional recovery, moderate residual pain was still present, particularly during shoulder motion. Because preoperative VAS scores were not available, the degree of postoperative pain reduction could not be directly assessed, but it may represents a controlled state consistent with recovery, as supported by Joo et al., who noted pain reduction post-fixation(19). A notable limitation of our study was the inability to compare these values with preoperative pain levels due to the

retrospective nature of the data collection. The complication rate in our series was 5% (infection, re-dislocation, frozen shoulder), which is lower than the 9.5% reported by Büyükceran et al., but higher than the 0% reported by Elmi et al.(15). This suggests that while the technique is safe, meticulous surgical handling and adherence to rehabilitation protocols are essential to minimize risks.

Limitations

This study has several limitations. First, the single-center design and relatively small sample size may limit the generalizability of the findings. Second, the absence of preoperative ROM, VAS, and Quick-DASH scores prevented direct assessment of postoperative improvement. Third, no comparison group was included, limiting conclusions regarding the superiority of hook plate fixation over conservative treatment or other surgical techniques. Fourth, the timing of functional assessment in relation to implant removal should be standardized in future studies. Finally, the distribution of injury severity according to the Rockwood classification should be reported to allow more meaningful comparison with previous studies.

Conclusion

Hook plate fixation for acute acromioclavicular joint dislocation was associated with favourable postoperative Quick-DASH scores and a low complication rate in this cohort. However, moderate residual pain was observed, and the absence of preoperative functional scores and a comparison group limits conclusions regarding true clinical improvement or superiority over other treatment methods

Declaration

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Conflict of Interest

The authors declare that they have no conflicts of interest.

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Authors' contribution

Concept and design: MF, DH.

Data collection: NM, JB.

Statistical analysis: HG.

Interpretation of data: MF, DH, HG.

Writing of the manuscript: NM, JB.

Critical revision of the manuscript: MF, DH.

Supervision: MF, DH.

Final approval of the manuscript: All authors.

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Ethics approval and consent to participate

This study was approved by the Ethics Committee of Babol University of Medical Sciences under ethical approval code IR.MUBABOL.HRI.REC.1402.230. Written informed consent was obtained from all participants prior to enrolment.

References

1. Tang G, Zhang Y, Liu Y, Qin X, Hu J, Li X. Comparison of surgical and conservative treatment of Rockwood type-III acromioclavicular dislocation: A meta-analysis. Medicine (Baltimore). 2018; 97(4): e9690.

2. Cisneros LN, Reiriz JS. Management of chronic unstable acromioclavicular joint injuries. J Orthop Traumatol. 2017; 18(4): 305-18.

3. Haugaard KB, Bak K, Seem K, Hölmich P, Barfod KW. Rockwood type III is the most common type of

acromioclavicular joint dislocation: A prospective cohort study investigating the incidence and epidemiology of acute acromioclavicular joint dislocations in an urban population. Shoulder Elbow. 2023; 15(5): 505-12.

4. Beitzel K, Cote MP, Apostolakos J, Solovyova O, Judson CH, Ziegler CG, et al. Current concepts in the treatment of acromioclavicular joint dislocations. *Arthroscopy*. 2013; 29(2): 387-397.

5. van Bergen CJA, van Bemmel AF, Alta TDW, van Noort A. New insights in the treatment of acromioclavicular separation. World J Orthop. 2017; 8(12): 861-73.

6. Jeong JY, Chun YM. Treatment of acute high-grade acromioclavicular joint dislocation. Clin Shoulder Elb. 2020; 23(3): 159-65.

7. Allemann F, Halvachizadeh S, Waldburger M, Schaefer F, Pothmann C, Pape HC, et al. Different treatment strategies for acromioclavicular dislocation injuries: a nationwide survey on open/minimally invasive and arthroscopic concepts. Eur J Med Res. 2019; 24(1): 18.

8. Gowd AK, Liu JN, Cabarcas BC, Cvetanovich GL, Garcia GH, Verma NN, et al. Current concepts in the operative management of acromioclavicular dislocations: a systematic review and meta-analysis of operative techniques. *Am J Sports Med*. 2019; 47(11): 2745-2758.

9. Martetschläger F, Kraus N, Scheibel M. Acromioclavicular and sternoclavicular joint injuries. *Orthopade*. 2021; 50(5): 359-370.

10. Di Francesco A, Zoccali C, Colafarina O, Pizzoferrato R, Flamini S. The use of hook plate in type III and V acromio-clavicular Rockwood dislocations: clinical and radiological midterm results and MRI evaluation in 42 patients. Injury. 2012; 43(2): 147-52.

11. Hoffler CE, Karas SG. Transacromial erosion of a locked subacromial hook plate: case report and review of literature. J Shoulder Elbow Surg. 2010; 19(3): e12-5.

12. 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): S70-82.

13. Rockwood CA Jr, Williams GR Jr, Young DC. Disorders of the Acromioclavicular Joint. In: Rockwood CA Jr, Matsen FA III, editors. The Shoulder. Philadelphia: Saunders; 2017.

14. Mousavi SJ, Parnianpour M, Abedi M, Askary-Ashtiani A, Karimi A, Khorsandi A, et al. Cultural adaptation and validation of the Persian version of the Disabilities of the Arm, Shoulder and Hand (DASH) outcome measure. Clin Rehabil. 2008; 22(8): 749-57.

15. Büyükceran İ, Çinka H, Yurtbay A, Coşkun HS, Yıldırım AM, Keskin D. Clinical evaluation of treatment with hook plate in patients with acromioclavicular joint dislocation. European Research Journal. 2023; 9(5): 1124-8.

16. Boström Windhamre H, von Heideken J, Une-Larsson V, Ekström W, Ekelund A. No difference in clinical outcome at 2-year follow-up in patients with type III and V acromioclavicular joint dislocation treated with hook plate or physiotherapy: a randomized controlled trial. J Shoulder Elbow Surg. 2022; 31(6): 1122-36.

17. Qi W, Xu Y, Yan Z, Zhan J, Lin J, Pan X, 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): 20-9.

18. Taleb H, Afshar A, Shariyate MJ, Tabrizi A. Comparison of Short-Term Clinical Outcomes of Hook Plate and Continuous Loop Double Endobutton Fixations in Acute Acromioclavicular Joint Dislocation. Arch Bone Jt Surg. 2019; 7(6): 545-50.

19. Joo MS, Kwon HY, Kim JW. Clinical outcomes of bending versus non-bending of the plate hook in acromioclavicular joint dislocation. Clin Shoulder Elb. 2021; 24(4): 202-8.

20. Liu G, Hu Y, Ye F, Huang F, Yu T, et al. Clavicular hook plate for acute high-grade acromioclavicular dislocation involving Rockwood type V: clinical and radiological outcomes and complications evaluation. *International Orthopedics*. 2022; 46: 2405–11.