



Recurrence and Pain Analysis in the Treatment Outcomes of Acromioclavicular Joint Dislocation Following Hook Plate Removal

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Abstract

Background: The treatment of acute dislocation of the acromioclavicular joint, specifically types III to V, involves various methods, each with its own advantages and disadvantages.

Objectives: This study aims to investigate the treatment outcomes of acromioclavicular joint dislocation after hook plate removal, focusing on the recurrence of dislocation and pain in the affected area.

Methods: A retrospective statistical study was conducted on 40 patients (18 - 40 years old) who presented with acromioclavicular joint dislocation and received treatment at Golestan and Imam Khomeini (RA) hospitals in Ahvaz between 2013 and 2021. Among the patients, 28 were male and 12 were female, and all were treated using the hook plate method. A follow-up was conducted on all patients after an average duration of one year. Patient data were collected through radiographic analysis and completion of relevant questionnaires to assess the specific objectives of this research.

Results: None of the patients treated with the hook plate method required additional surgery due to reduction loss. All patients who underwent re-surgery had their hook plates removed after an average of six months. There were no cases of plate breakage or recurrence after the operation. However, four cases (10% of all patients) reported partial dislocation. The average duration of the hook plate procedure was estimated to be 45 minutes, with an estimated blood loss of 100 cc. Furthermore, complete immobilization after the hook plate procedure lasted between three days and one week.

Conclusions: The hook plate method exhibits favorable outcomes, including lower complication rates, reduced postoperative pain, minimal blood loss, shorter treatment duration, and lower surgical costs. Therefore, it is considered a preferred and economically viable treatment option.

Keywords: Acute Dislocation, Acromioclavicular Joint, Hook Plate, Recurrence, Pain

1. Background

The acromioclavicular joint, located between the clavicle and the acromion, is particularly susceptible to dislocation, especially in athletes such as cyclists, football players, boxers, and martial arts specialists (1). Acromioclavicular joint dislocation accounts for approximately 30% of all shoulder injuries in football players (2). The severity of this injury can range from asymptomatic to causing significant pain and functional disability (3). The incidence of acromioclavicular joint dislocation is around 2 - 3 per 100,000 in the general population and higher in athletes, ranging from 25% to 52% (4). Dislocations can result from direct trauma to the joint or indirect factors

such as falling on outstretched hands, lifting heavy objects, or forceful stretching movements (5). These injuries often occur with high-energy impacts (6, 7).

Reports indicate that the incidence of acromioclavicular joint injuries is approximately 1.8 per 1,000 person-years, with the majority occurring in individuals between the ages of 20 and 40, and men being more prone to such injuries (8). Lifestyle differences and greater participation in risky activities may explain the higher incidence among men. Dislocation types III to V, according to the Rockwood classification, account for 18% of cases, with superior labral anterior-posterior (SLAP) lesions being the most common associated injuries (9).

The management of acromioclavicular joint dislocation varies depending on the severity of the injury. Grades one and two, which involve incomplete dislocations, can be treated with supportive measures and immobilization. However, grades three to six, which involve complete dislocations, typically require surgical intervention for joint fixation. Various surgical methods have been proposed, with fixation using pins, screws, and plates being the commonly used approaches (10-12). These methods have their own advantages and potential complications, such as re-dislocation, joint degeneration, and limited postoperative mobility.

One surgical technique that has gained attention is the use of a hook plate, which involves fixing a plate with a hook under the acromion. The plate is secured to the clavicle with screws, and the hook is positioned behind the acromioclavicular joint. Hook plates have shown success in treating distal clavicle fractures and acromioclavicular joint dislocations (13). However, this technique is not without its drawbacks, including subacromial impingement, partial acromioclavicular joint dislocation, plate migration, and potential rotator cuff complications (14). The presence of the plate can cause discomfort and may necessitate its removal after several months, requiring a second operation (15, 16). Although the side effects of using hook plates have been discussed in various studies, there is a lack of comprehensive research on the incidence, severity, and long-term performance-related complications following plate removal.

2. Objectives

Therefore, this study aims to evaluate the treatment outcomes of acromioclavicular joint dislocation after hook plate removal, specifically focusing on the recurrence of dislocation and pain in the area.

3. Methods

3.1. Study Design and Setting

This retrospective cross-sectional study was conducted with the necessary permits from the research council and the research ethics committee. The study population consisted of patients with acromioclavicular joint dislocation who underwent hook plate surgery and were referred to Imam Khomeini and Golestan hospitals in Ahvaz.

3.2. Participant Selection

Simple random sampling was used to select 40 patients with acromioclavicular joint dislocation for inclusion in the study. The average follow-up period was four months, during which the clinical and radiographic results of the patients were evaluated.

3.3. Inclusion and Exclusion Criteria

The inclusion criteria encompassed patients who had undergone hook plate surgery within the past 4 to 6 months and provided their consent to participate. The exclusion criteria involved patients who did not consent to be part of the study.

3.4. Data Collection

The medical records of patients hospitalized for acute acromioclavicular dislocation and subsequent hook plate surgery at Imam Khomeini and Golestan hospitals were examined. Out of a total of 63 patients who underwent surgery during the specified period, 40 accessible and willing patients were selected for the study. These patients were contacted, and physical examinations were conducted.

3.5. Variables and Measurements

Data collection involved obtaining relevant information from patients using a checklist form, which included variables such as age, sex, surgical method, postoperative infections, gap presence after hook plate removal, pain levels during rest and activity, and time to return to daily activities. X-rays were taken every two weeks during the first month after plate removal, followed by monthly X-rays for up to three months. Another orthopedist, who was not involved in the surgery, reviewed the X-rays to assess joint redislocation.

3.6. Evaluation of Shoulder Function

Shoulder function evaluation was performed using the constant score, a system introduced by the European Surgery Association. The score comprises both subjective and objective factors. Subjective factors include performance (maximum score of 20 points) and pain (maximum score of 15 points), while objective factors include range of motion (maximum score of 15 points) and strength (maximum score of 25 points).

4. Results

The study included a total of 40 patients, with 28 (70%) being male and 12 (30%) being female. The average age of the patients was 30.63 years (± 6.07). The majority

of patients (70%) had the right side affected, while the remaining 30% had the left side affected.

Before the operation, the patients' pain scores were evaluated. The distribution of pain scores was as follows: 10 individuals (25%) reported a score of 0, 7 individuals (17.5%) reported a score of 1, 10 individuals (25%) reported a score of 2, 8 individuals (20%) reported a score of 3, 3 individuals (7.5%) reported a score of 4, and 2 individuals (5%) reported a score of 7. Four months after the operation, the pain scores changed as follows: 13 individuals (32.5%) reported a score of 0, 7 individuals (17.5%) reported a score of 1, 9 individuals (22.5%) reported a score of 2, 6 individuals (15%) reported a score of 3, 3 individuals (7.5%) reported a score of 4, and 2 individuals (5%) reported a score of 6.

The average Constant score for the patients increased from 90.8 before the operation to 92.82 after the operation, indicating an improvement in shoulder function. Similarly, the average DASH score decreased from 25.9 before the operation to 23.7 after the operation, indicating a reduction in disability.

Regarding the classification of acromioclavicular dislocation, 18 patients (45%) had type III, 12 patients (30%) had type IV, and 10 patients (25%) had type V. During the four-month follow-up, 38 patients (95%) showed no dislocation, while 2 patients (5%) experienced partial dislocation.

Table 1 provides the distribution of studied variables and their percentage frequencies, including information on gender, side involved, preoperative pain score, pain score four months after surgery, classification, and partial dislocation after removing the plate.

Table 1. Distribution of Studied Variables and their Percentage Frequencies

Variables	No. (%)
Gender	
Male	28 (70)
Female	12 (30)
Side involved	
Right	28 (70)
Left	12 (30)
Preoperative pain score	
0	10 (25)
-1	7 (17.50)
-2	10 (25)
-3	8 (20)
-4	3 (7.50)
-7	2 (5)
Pain score 4 months after surgery	
0	13 (32.50)
-1	7 (17.50)

Variables	No. (%)
-2	9 (22.50)
-3	6 (15)
-4	3 (7.50)
-6	2 (5)
Classification	
Type III	18 (45)
Type IV	12 (30)
Type V	10 (25)
Half torn after removing the plate	
Stable	38 (95)
Subluxation	2 (5)

Table 2 presents the descriptive statistics of constant and DASH scores before and after the operation, including the average and standard deviation for each variable. It provides a summary of the changes in constant and DASH scores.

Table 2. Descriptive Statistics of Constant and Dash Scores Before and After Operation

Variable Name	Before Operation	After Operation
Constant	90.8 ± 9.41	92.82 ± 9.46
Dash	25.9 ± 10.64	23.7 ± 9.76

5. Discussion

Acromioclavicular joint dislocation is a relatively common injury, accounting for approximately 4 to 8 percent of shoulder injuries (17, 18). It is often caused by sports-related activities, particularly high-impact sports, or accidents such as falls or road incidents (17, 18). Surgical intervention is the preferred treatment for fractures and distal clavicle instability, particularly for type II injuries (19, 20). However, the optimal treatment approach for type III injuries remains controversial, with conservative treatment according to the Rockwood III classification still being debated (17, 20). Hence, this study aimed to investigate the treatment outcomes of acromioclavicular joint dislocation after hook plate removal in terms of recurrence and pain.

The study found that the Constant score improved from 90.8 before the operation to 92.82 after the operation, indicating positive outcomes. The average DASH score also decreased from 25.9 before the operation to 23.7 after the operation, suggesting reduced disability. Among the patients, 18 had type III acromioclavicular joint dislocation, 12 had type IV, and 10 had type V. During the four-month follow-up, 38 patients did not experience any dislocation, while two patients had partial dislocation.

A study conducted by Alhamam et al. in 2015, which examined 12 patients with type III acromioclavicular

findings. The average follow-up time was approximately 20 months, and the patients' Constant score after surgery was 91.3, indicating satisfactory outcomes (21). Another study by Lee et al. examined 16 patients with acute type III acromioclavicular dislocation treated with open shoulder surgery using hook plates. The results demonstrated improved physical activity levels and minimal side effects associated with hook plate application (22).

Soomro et al. conducted a study in 2022 on the management of acute acromioclavicular dislocation with hook plates. The average constant score at the final follow-up, one year after surgery, was 92.17, which was statistically significant ($P < 0.05$) and consistent with the findings of the present study (23). However, their study did not report complications such as dislocation recurrence, wound infection, skin irritation, implant prominence, or incision-related issues, differing from the two cases of partial dislocation observed in the present study.

Kumar and Sharma published a study in 2014 involving 33 patients with acromioclavicular dislocation treated with hook clavicle plates. Their findings showed an average Constant score of 91.3 at the final follow-up, aligning with the results of the present study (24). In 2018, Mohamed and Fahmy conducted a prospective study on 20 patients with acromioclavicular dislocation treated with hook plate fixation. They reported an average constant Murley score (CMS) of 92.9 at the final follow-up, consistent with the findings of the present study (25).

Rao et al. conducted a comprehensive study in 2018, introducing a modified surgery involving a Weaver-Dunn procedure and clavicular hook plate for acute acromioclavicular joint injuries. They reported satisfactory outcomes for most patients, with only a few cases of deep and superficial infections (26). Hemmann et al. conducted a study in 2020 involving 99 patients with acromioclavicular dislocation treated with hook plates. The results showed excellent outcomes, with an average DASH score of 5.6 ± 1 and a CMS score of 90.4 ± 1.4 at the final follow-up (27), which aligned with the findings of the present study.

Despite the overall positive outcomes observed in our study, it is essential to acknowledge certain limitations. Firstly, this study utilized a retrospective cross-sectional design, which may have inherent biases and limitations, such as selection bias and reliance on medical records. Additionally, the relatively small sample size and short follow-up period of four months may limit the generalizability and long-term assessment of treatment outcomes. Furthermore, the absence of a

control group or comparison with alternative treatment modalities may limit the interpretation of our findings.

Future research should aim to address these limitations by employing prospective study designs with larger sample sizes and longer follow-up periods. Comparative studies evaluating different surgical techniques and rehabilitation protocols could provide valuable insights into optimizing treatment strategies for acromioclavicular joint dislocation. Moreover, incorporating patient-reported outcomes and objective measures of shoulder function would enhance the comprehensiveness of outcome assessments.

In conclusion, open reduction and internal fixation with a hook plate have proven to be effective treatments for acromioclavicular joint dislocation, leading to patient satisfaction and a return to daily activities. Furthermore, after the removal of the hook plate and a return to pre-dislocation activity levels, favorable outcomes in terms of pain and joint mobility can be achieved. Ligament repair does not appear to significantly affect treatment outcomes, as evidenced by the minimal occurrence of partial dislocation in only two out of 38 patients.

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Footnotes

Authors' Contribution: S.S.M.: Conceptualized the study, designed the methodology, and supervised the research process; S.A.: Collected the data, performed the data analysis, and interpreted the results. All authors contributed to the drafting and revision of the manuscript and approved the final version for submission.

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Data Availability: The dataset presented in the study is available upon request from the corresponding author during submission or after publication. The data are not publicly available due to confidentiality issues.

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References

- Shin SJ, Kim NK. Complications after arthroscopic coracoclavicular reconstruction using a single adjustable-loop-length suspensory fixation device in acute acromioclavicular joint dislocation. *Arthroscopy*. 2015;**31**(5):816-24. [PubMed ID: 25543250]. <https://doi.org/10.1016/j.arthro.2014.11.013>.
- Warth RJ, Martetschlagner F, Gaskill TR, Millett PJ. Acromioclavicular joint separations. *Curr Rev Musculoskelet Med*. 2013;**6**(1):71-8. [PubMed ID: 23242975]. [PubMed Central ID: PMC3702768]. <https://doi.org/10.1007/s12178-012-9144-9>.
- Banaszek D, Pickell M, Wilson E, Duchsharm M, Hesse D, Easteal R, et al. Anatomical Evaluation of the Proximity of Neurovascular Structures During Arthroscopically Assisted Acromioclavicular Joint Reconstruction: A Cadaveric Pilot Study. *Arthroscopy*. 2017;**33**(1):75-81. [PubMed ID: 27526629]. <https://doi.org/10.1016/j.arthro.2016.05.041>.
- Doyscher R, Kraus K, Finke B, Scheibel M. [Acute and overuse injuries of the shoulder in sports]. *Orthopade*. 2014;**43**(3):202-8. German. [PubMed ID: 24567176]. <https://doi.org/10.1007/s00132-013-2141-x>.
- Amirtharaj MJ, Wang D, McGraw MH, Camp CL, Degen RA, Dines DM, et al. Trends in the Surgical Management of Acromioclavicular Joint Arthritis Among Board-Eligible US Orthopaedic Surgeons. *Arthroscopy*. 2018;**34**(6):1799-805. [PubMed ID: 29477607]. <https://doi.org/10.1016/j.arthro.2018.01.024>.
- Nakazawa M, Nimura A, Mochizuki T, Koizumi M, Sato T, Akita K. The Orientation and Variation of the Acromioclavicular Ligament: An Anatomical Study. *Am J Sports Med*. 2016;**44**(10):2690-5. [PubMed ID: 27315820]. <https://doi.org/10.1177/0363546516651440>.
- Cleary BP, Hurley ET, Kilkenny CJ, Robinson J, Khan SU, Davey MS, et al. Return to Play After Surgical Treatment for Acromioclavicular Joint Dislocation: A Systematic Review. *Am J Sports Med*. 2024;**52**(5):1350-6. [PubMed ID: 37345238]. <https://doi.org/10.1177/03635465231178784>.
- Preuss CV, Kalava A, King KC. Prescription of Controlled Substances: Benefits and Risks. *StatPearls*. Treasure Island, FL: StatPearls Publishing; 2021.
- Sirin E, Aydin N, Mert Topkar O. Acromioclavicular joint injuries: diagnosis, classification and ligamentoplasty procedures. *EFORT Open Rev*. 2018;**3**(7):426-33. [PubMed ID: 30233818]. [PubMed Central ID: PMC6129955]. <https://doi.org/10.1302/2058-5241.3.170027>.
- Parnes N, Friedman D, Phillips C, Carey P. Outcome After Arthroscopic Reconstruction of the Coracoclavicular Ligaments Using a Double-Bundle Coracoid Cerclage Technique. *Arthroscopy*. 2015;**31**(10):1933-40. [PubMed ID: 26008952]. <https://doi.org/10.1016/j.arthro.2015.03.037>.
- Korsten K, Gunning AC, Leenen LP. Operative or conservative treatment in patients with Rockwood type III acromioclavicular dislocation: a systematic review and update of current literature. *Int Orthop*. 2014;**38**(4):831-8. [PubMed ID: 24178060]. [PubMed Central ID: PMC3971277]. <https://doi.org/10.1007/s00264-013-2143-7>.
- Natera-Cisneros L, Sarasquete-Reiriz J, Escola-Benet A, Rodriguez-Mirallas 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):31-9. [PubMed ID: 26747735]. <https://doi.org/10.1016/j.otsr.2015.10.007>.
- Yoon JP, Lee YS, Song GS, Oh JH. Morphological analysis of acromion and hook plate for the fixation of acromioclavicular joint dislocation. *Knee Surg Sports Traumatol Arthrosc*. 2017;**25**(3):980-6. [PubMed ID: 26792567]. <https://doi.org/10.1007/s00167-016-3987-3>.
- Arirachakaran A, Boonard M, Piyapittayanun P, Kanchanatawan W, Chaijenkij K, Prommahachai A, et al. Post-operative 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. [PubMed ID: 28236179]. [PubMed Central ID: PMC5685975]. <https://doi.org/10.1007/s10195-017-0451-1>.
- Lee CH, Shih CM, Huang KC, Chen KH, Hung LK, Su KC. Biomechanical Analysis of Implanted Clavicle Hook Plates With Different Implant Depths and Materials in the Acromioclavicular Joint: A Finite Element Analysis Study. *Artif Organs*. 2016;**40**(11):1062-70. [PubMed ID: 26814438]. <https://doi.org/10.1111/aor.12679>.
- Sporing I, Martinez VA, Hotz C, Schwarz-Linek J, Grady KL, Nava-Sedeno JM, et al. Hook length of the bacterial flagellum is optimized for maximal stability of the flagellar bundle. *PLoS Biol*. 2018;**16**(9). e2006989. [PubMed ID: 30188886]. [PubMed Central ID: PMC6126814]. <https://doi.org/10.1371/journal.pbio.2006989>.
- Mazzocca AD, Arciero RA, Bicos J. Evaluation and treatment of acromioclavicular joint injuries. *Am J Sports Med*. 2007;**35**(2):316-29. [PubMed ID: 17251175]. <https://doi.org/10.1177/0363546506298022>.
- Sakai R, Matsuura T, Tanaka K, Uchida K, Nakao M, Mabuchi K. Comparison of internal fixations for distal clavicular fractures based on loading tests and finite element analyses. *ScientificWorldJournal*. 2014;**2014**:817321. [PubMed ID: 25136691]. [PubMed Central ID: PMC4130356]. <https://doi.org/10.1155/2014/817321>.
- Andreani L, Bonicoli E, Parchi P, Piolanti N, Michele L. Acromioclavicular repair using two different techniques. *Eur J Orthop Surg Traumatol*. 2014;**24**(2):237-42. [PubMed ID: 23412327]. <https://doi.org/10.1007/s00590-013-1186-1>.
- Chen CH, Dong QR, Zhou RK, Zhen HQ, Jiao YJ. Effects of hook plate on shoulder function after treatment of acromioclavicular joint dislocation. *Int J Clin Exp Med*. 2014;**7**(9):2564-70. [PubMed ID: 25356110]. [PubMed Central ID: PMC4211760].
- Alhamam NM, Bella IH, Uddin FZ, Al-Afaleq MA, Al-Afaleq SA, Al-Khalifa FK. Clinical outcomes of hook-plate fixation in the treatment of unstable distal clavicular fractures and acromioclavicular joint dislocations. *Saudi J Med Med Sci*. 2015;**3**(1):50. <https://doi.org/10.4103/1658-631x.149679>.
- Lee SJ, Eom TW, Hyun YS. Complications and Frequency of Surgical Treatment with AO-Type Hook Plate in Shoulder Trauma: A Retrospective Study. *J Clin Med*. 2022;**11**(4). [PubMed ID: 35207299]. [PubMed Central ID: PMC8875584]. <https://doi.org/10.3390/jcm11041026>.
- Soomro S, Kazim Rahim N, Syed Shahid N, Affan T. Management of Acute Dislocation of Acromioclavicular Joint with Clavicle Hook Plate, a Functional Outcome Study. *Pak J Med Res*. 2022;**61**(1):35-9.
- Kumar N, Sharma V. Hook plate fixation for acute acromioclavicular dislocations without coracoclavicular ligament reconstruction: a functional outcome study in military personnel. *Strategies Trauma Limb Reconstr*. 2015;**10**(2):79-85. [PubMed ID: 26216233]. [PubMed Central ID: PMC4570887]. <https://doi.org/10.1007/s11751-015-0228-0>.
- Mohamed HA, Fahmy FM. Treatment of acromioclavicular joint dislocation by hook plate and direct coracoclavicular ligament reattachment to the clavicle. *The Egyptian Orthopaedic Journal*. 2018;**53**(4):316. https://doi.org/10.4103/eoj.eoj_67_18.
- Rao AG, Chan PH, Prentice HA, Paxton EW, Navarro RA, Dillon MT, et al. Risk factors for postoperative opioid use after elective shoulder arthroplasty. *J Shoulder Elbow Surg*. 2018;**27**(11):1960-8. [PubMed ID: 29891412]. <https://doi.org/10.1016/j.jse.2018.04.018>.
- Hemmann P, Koch M, Guhring M, Bahrs C, Ziegler P. Acromioclavicular joint separation treated with clavicular hook

plate: a study of radiological and functional outcomes. *Arch Orthop Trauma Surg.* 2021;**141**(4):603-10. [PubMed ID: [32588137](https://pubmed.ncbi.nlm.nih.gov/32588137/)].

<https://doi.org/10.1007/s00402-020-03521-4>.