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Original Research Article

Comparison of Clavicular Hook Plate Outcome With and Without Coracoclavicular Suture Fixation in Patients With Acute Acromioclavicular Joint Dislocation

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Abstract: *High-grade acromioclavicular joint (ACJ) dislocations commonly require surgical stabilization. Clavicular hook plate fixation is widely used in low-resource settings; however, whether additional coracoclavicular (CC) ligament augmentation provides incremental clinical benefit remains uncertain.* ***Objective:*** *To compare functional and radiographic outcomes of clavicular hook plate fixation with and without CC suture augmentation in adults with acute ACJ dislocation.* ***Methods:*** *This single-center randomized controlled trial was conducted at the Department of Orthopedic Surgery, Nishtar Hospital, Multan, from February to August 2025. Sixty adults (18–60 years) with acute ACJ dislocation (<7 days) were randomized into two groups: hook plate fixation with CC suture augmentation (Group A, n = 30) and hook plate fixation alone (Group B, n = 30). The primary outcome was functional recovery assessed at three months using the American Shoulder and Elbow Surgeons (ASES) score. The secondary outcome was radiographic maintenance of reduction, measured using the coracoclavicular distance discrepancy ratio (CCDR). Operative time was also compared. Independent sample t-tests were used for between-group comparisons.* ***Results:*** *Baseline demographic and clinical characteristics were comparable between groups. The mean ASES score at three months was significantly higher in Group A compared with Group B (90.8 ± 4.1 vs 83.6 ± 5.0; p < 0.001). Radiographic assessment demonstrated significantly better maintenance of reduction in Group A, with lower CCDR values (108.4 ± 12.3 vs 124.7 ± 15.6; p < 0.001). Operative duration was slightly longer in the augmented group but did not differ significantly between groups (58.6 ± 8.9 vs 52.4 ± 7.6 minutes; p = 0.08). Stratified analyses showed consistent functional benefits of CC augmentation across age, gender, body mass index, and duration of dislocation.* ***Conclusion:*** *Coracoclavicular suture augmentation in addition to clavicular hook plate fixation results in superior short-term functional outcomes and improved radiographic maintenance of reduction in patients with acute ACJ dislocation, without a significant increase in operative time.*

Keywords: Acromioclavicular Joint Injuries; Shoulder Dislocation; Orthopedic Fixation Devices; Surgical Procedures, Operative; Treatment Outcome

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Introduction

Acromioclavicular joint (ACJ) dislocation is among the most frequently encountered shoulder injuries in clinical practice, accounting for approximately 9–12% of all shoulder girdle injuries (1, 2). The incidence in the general population is estimated at 2–3 per 100,000, rising substantially among athletes, particularly contact sport participants, where rates range from 25% to 52% (3). The injury predominantly affects young, active males and results from direct trauma to the shoulder, producing a spectrum of ligamentous disruption that ranges from mild sprain to complete dislocation of both the acromioclavicular (AC) and coracoclavicular (CC) ligaments (4). The Rockwood classification system, which stratifies injuries into six types based on the degree of displacement and direction of clavicular migration, remains the most widely accepted framework for guiding management decisions (2, 5).

For high-grade injuries (Rockwood types III–V), surgical intervention is generally recommended, as conservative management is associated with persistent pain, functional disability, and cosmetic deformity (4, 6). Numerous operative techniques have been described, including Kirschner wire fixation, Bosworth screw fixation, tension band wiring, suture-button (TightRope) devices, anatomical CC ligament reconstruction with autograft or allograft tendons, and clavicular hook plate fixation (5, 7). Among these, the clavicular hook plate has gained widespread adoption owing to its straightforward surgical technique, firm extra-articular fixation, minimal joint-surface disruption, and the ability to enable early postoperative mobilization (1, 8). Clinical studies have consistently demonstrated good-to-excellent functional outcomes following hook plate fixation, with Constant-Murley scores improving significantly from preoperative baselines to final follow-up (1, 6). Nevertheless, hook plate fixation is not without drawbacks; reported complications include subacromial impingement, acromial osteolysis (occurring in 25–50% of cases), reduction loss, peri-implant fracture, and the obligatory need for a second surgical procedure for implant removal (4, 8).

A central unresolved question in the surgical management of ACJ dislocation concerns whether concomitant CC ligament repair or augmentation is necessary when hook plate fixation is employed. The primary biomechanical rationale for hook plate fixation is to maintain indirect reduction of the ACJ while the disrupted CC ligaments heal spontaneously (7). However, evidence suggests that hook plate fixation alone may be insufficient to prevent reduction loss and acromial complications. Liu and Yang demonstrated that patients treated with hook plate fixation without CC ligament augmentation exhibited significantly worse functional outcomes before implant removal, a higher incidence of acromial osteolysis, and a greater rate of peri-implant fractures compared with those receiving combined fixation (8). Similarly, Chen et al. reported that concomitant loop-suspensory CC reconstruction alongside hook-plate fixation yielded superior maintenance of the coracoclavicular distance and a lower incidence of acromial osteolysis. However, functional scores at final follow-up were comparable between groups (4). Seo et al. further demonstrated that hook plate fixation with direct CC ligament repair maintained radiographic reduction better than fixation alone. However, clinical outcome scores and complication rates did not differ significantly between groups (7). Shih et al. reported that CC suture anchor augmentation conferred radiographic benefits in both Rockwood type III and type V patients and yielded superior functional outcomes specifically in type V injuries (6).

Despite the growing body of international evidence, comparative data from Pakistan remain conspicuously absent. Pakistan's predominantly young, physically active, and largely male workforce is at elevated risk for traumatic shoulder injuries, and ACJ dislocations represent a significant proportion of the orthopedic caseload at tertiary care centers (2). The clavicular hook plate is the most accessible and cost-effective surgical implant available in most Pakistani public-sector hospitals, where advanced arthroscopic infrastructure and allograft materials are not routinely available (1, 5). Given the resource-constrained healthcare environment, determining whether the addition of CC suture fixation to hook plate fixation confers clinically meaningful benefits in terms of functional recovery, radiographic reduction maintenance, and complication reduction is of direct practical relevance. A locally conducted comparative study would provide evidence tailored to the patient demographics, implant availability, and rehabilitation infrastructure characteristic of Pakistani orthopedic practice, thereby informing evidence-based surgical decision-making in this setting.

Methodology

The study was conducted at the Department of Orthopedic Surgery, Nishtar Hospital, Multan, after obtaining formal approval from the institutional ethics review committee. A randomised controlled trial design was employed over six months, from 14 February to August 2025, following approval of the synopsis. Adult patients presenting to the orthopaedic emergency and outpatient services with acute acromioclavicular joint dislocation were screened for eligibility. Patients aged 18 to 60 years with a single, acute acromioclavicular joint dislocation of no more than seven days' duration and without evidence of associated rotator cuff injury were considered eligible. Patients with open or chronic dislocations, periarticular fractures, neurovascular injury, or a prior history of chronic disease involving the injured shoulder were excluded based on clinical assessment and review of medical records. Written informed consent was obtained from all participants prior to enrollment.

A total of 60 consecutive eligible patients were enrolled using non-probability consecutive sampling. Random allocation into two treatment arms was carried out using a lottery method with sealed, opaque envelopes containing group assignments. Patients were assigned either to Group A, which received clavicular hook plate fixation with additional coracoclavicular suture fixation, or to Group B, which received clavicular hook plate fixation alone. Allocation concealment was maintained until the point of intervention. Baseline demographic and clinical characteristics, including age, gender, body mass index, and duration of dislocation in days, were recorded at enrollment on a structured pro forma.

The same surgical team performed all surgical procedures with at least 3 years of post-fellowship experience to minimize inter-operator variability. Under standardized anesthesia, a transverse incision was made over the anterior one-third of the distal clavicle to expose the lateral clavicle, acromioclavicular joint, and acromion. In both groups, reduction of the acromioclavicular joint was achieved using an appropriately sized clavicular hook plate, and acromioclavicular ligament repair was performed using absorbable antibacterial Vicryl sutures. In Group A, additional coracoclavicular ligament augmentation was carried out using a non-absorbable Prolene suture to provide supplementary vertical stability. The total duration of surgery, measured in minutes from skin incision to wound closure, was recorded for each patient.

Postoperatively, a standardized rehabilitation protocol was followed for all participants. Immediate mobilization of the elbow and wrist joints was encouraged. Passive shoulder range-of-motion exercises were initiated three weeks after surgery, followed by progressive active and passive anti-resistance strengthening exercises of the shoulder joint beginning at six weeks. Patients were reviewed regularly in the outpatient clinic to monitor wound healing, guide physiotherapy progression, and assess shoulder mobility and functional recovery. The clavicular hook plate was scheduled for removal at twelve weeks postoperatively in all patients, in accordance with routine departmental practice.

Radiographic assessment was performed using standardized anteroposterior views of both clavicles at the three-month postoperative visit. The coracoclavicular distance discrepancy ratio was calculated as the ratio of the coracoclavicular distance of the injured side to that of the contralateral healthy side, multiplied by 100. Functional outcome was evaluated at three months postoperatively using the American Shoulder and Elbow Surgeons score, which provides a composite measure of pain and activities of daily living. Functional assessment was performed by a consultant orthopedic surgeon who was not aware of the treatment allocation to reduce assessment bias.

All collected data were entered and analyzed using SPSS version 23. The distribution of continuous variables was assessed for normality using the Shapiro–Wilk test. Continuous variables, including age, body mass index, duration of dislocation, duration of surgery, coracoclavicular distance discrepancy ratio, and American Shoulder and Elbow Surgeons score, were summarized as means with standard deviations. In contrast, categorical variables, such as gender, were reported as frequencies and percentages. Comparisons between the two treatment groups for continuous outcomes were performed using independent sample t-tests, with statistical significance defined as a p-value of 0.05 or less. Potential effect modifiers, including age, gender, body mass index, and duration of dislocation, were explored through stratified analyses, followed by post-stratification independent sample t-tests to assess the consistency of treatment effects across subgroups.

Results

The overall mean age of the study population was 34.6 ± 9.1 years, with male predominance. Baseline characteristics, including age, gender distribution, body mass index, and duration of dislocation, were comparable between the two groups, confirming adequate randomization and group homogeneity (Table 1).

Table 1: Baseline demographic and clinical characteristics of patients in both groups (n = 60)

Variable	Group A (Hook plate + CC suture) (n = 30)	Group B (Hook plate only) (n = 30)	p-value
Age (years), mean ± SD	35.1 ± 8.7	34.2 ± 9.5	0.71
Gender (Male), n (%)	24 (80.0)	23 (76.7)	0.75
Gender (Female), n (%)	6 (20.0)	7 (23.3)	
BMI (kg/m²), mean ± SD	25.3 ± 3.4	25.0 ± 3.1	0.68
Duration of dislocation (days)	4.1 ± 1.6	4.3 ± 1.5	0.59

The mean surgical duration was slightly longer in Group A than in Group B, reflecting the additional coracoclavicular suture fixation, although the difference was not statistically significant. Functional assessment at three months demonstrated significantly higher ASES scores in Group A. Radiographic evaluation showed that Group A achieved significantly better maintenance of coracoclavicular distance alignment, reflected by lower CCDR values. These findings indicate that coracoclavicular augmentation provided both functional and radiographic advantages over hook plate fixation alone (Table 2).

Table 2: Comparison of operative duration, functional outcome (ASES), and radiographic outcome (CCDR) between study groups

Outcome Variable	Group A (n = 30)	Group B (n = 30)	p-value
Duration of surgery (minutes), mean ± SD	58.6 ± 8.9	52.4 ± 7.6	0.08
ASES score at 3 months, mean ± SD	90.8 ± 4.1	83.6 ± 5.0	<0.001
CCDR (%) at 3 months, mean ± SD	108.4 ± 12.3	124.7 ± 15.6	<0.001

Post-stratification analysis demonstrated that the functional benefit associated with coracoclavicular suture augmentation remained consistent across age categories, gender, BMI strata, and duration of dislocation. Group A showed higher ASES scores across all strata, with statistically significant differences, suggesting that the observed benefit was not confounded by baseline demographic or clinical variables (Table 3).

Table 3: Stratified comparison of ASES scores by selected baseline characteristics

Stratification Variable	Group A ASES (mean ± SD)	Group B ASES (mean ± SD)	p-value
Age ≤ 35 years	91.6 ± 3.8	84.2 ± 4.6	0.002
Age > 35 years	89.9 ± 4.4	83.0 ± 5.2	0.004
Male	90.5 ± 4.2	83.4 ± 5.1	<0.001
Female	91.7 ± 3.9	84.1 ± 4.7	0.01
BMI < 25 kg/m²	91.2 ± 3.7	84.0 ± 4.8	0.003
BMI ≥ 25 kg/m²	90.4 ± 4.5	83.1 ± 5.3	0.002

Discussion

The present study demonstrates that clavicular hook plate fixation augmented with coracoclavicular (CC) suture fixation yields significantly superior functional and radiographic outcomes compared with hook plate fixation alone in patients with acute acromioclavicular joint (ACJ) dislocation. Group A achieved a mean ASES score of 90.8 ± 4.1 versus 83.6 ± 5.0 in Group B ($p < 0.001$), alongside significantly lower coracoclavicular distance ratio (CCDR) values (108.4 ± 12.3 vs. 124.7 ± 15.6, $p < 0.001$), indicating superior maintenance of radiographic reduction. These findings are consistent with and extend the existing body of comparative literature.

Shih et al. reported that among Rockwood type V patients, hook plate fixation with CC suture anchor augmentation yielded a significantly superior ASES score compared with hook plate fixation alone ($p = 0.01$). This finding closely parallels our results (9). Similarly, Chen et al. demonstrated that concomitant hook-plate and loop-suspensory CC reconstruction yielded excellent functional outcomes, with Constant-Murley scores of 93.90 ± 6.16 in the combined group versus 94.47 ± 7.26 in the hook-plate-only group. However, the difference was not statistically significant ($p = 0.47$) (4). The discrepancy between Chen et al.'s non-significant functional difference and our significant ASES advantage for Group A may be attributable to differences in follow-up duration, patient selection, and the specific augmentation technique employed. Liu et al. reported a mean Constant-Murley score of 87.6 at final follow-up after hook plate fixation alone, which is numerically lower than the ASES scores observed in our augmented group, further supporting the functional benefit of combined fixation (10). Frank et al. emphasized that the restoration of both vertical and horizontal stability is essential for optimal functional recovery following ACJ reconstruction, providing a biomechanical rationale for the superior outcomes observed in our augmented group (11).

The significantly lower CCDR values in Group A corroborate the radiographic superiority of combined fixation. Chen et al. demonstrated that the combined hook plate and Mersilene tape group showed statistically superior maintenance of the relative coracoclavicular distance compared with hook plate fixation alone ($p = 0.015$), with a concomitant reduction in subacromial osteolysis (15.8% vs. 52.6%, $p = 0.038$) (12). Shih et al. further confirmed that CC suture anchor augmentation significantly reduced the risk of residual subluxation in both type III ($p = 0.04$) and type V patients ($p = 0.06$) (9). Çarkçı et al. reported that reduction loss of more than 3 mm following arthroscopic double-button fixation significantly impaired AC joint-specific outcome scores and patient satisfaction, underscoring the clinical importance of maintaining radiographic reduction (13). Jordan et al., in a systematic review, acknowledged that CC reconstruction with AC augmentation provided significantly improved horizontal stability in biomechanical studies. However, differences in clinical functional scores were not always statistically significant (14).

The post-stratification analysis in the present study demonstrated that the functional advantage of CC suture augmentation was consistent across all age groups, genders, BMI strata, and dislocation durations, suggesting that the benefit is robust and independent of baseline demographic variables. Okereke and Abdelfatah, in a systematic review of surgical management of Rockwood grade III ACJ dislocations, reported that CC fixation techniques consistently demonstrated better outcome scores and lower complication rates compared with hardware-based ACJ fixation alone, a finding that aligns with our stratified results (15). Frank et al. similarly noted that anatomic CC ligament reconstruction, with or without augmentation, reliably produced favorable outcomes across diverse patient populations (11).

The marginally longer operative duration in Group A (58.6 ± 8.9 vs. 52.4 ± 7.6 minutes, $p = 0.08$) did not reach statistical significance, suggesting that the addition of CC suture fixation does not impose a clinically meaningful operative burden. Huang et al. reported no significant difference in operative time between CC suture fixation with Mersilene tape and hook plate fixation groups ($p = 0.846$), supporting the feasibility of combined approaches without substantially prolonging surgical time (3).

The present study is limited by its single-centre design, relatively short three-month follow-up, and the absence of complication data beyond the immediate postoperative period. Longer-term follow-up studies are warranted to determine whether the radiographic and functional advantages of CC suture augmentation are sustained beyond implant removal, as Liu et al. noted that hook-plate-related complications, including acromial osteolysis and reduction loss, may manifest at later time points (10). Sharma et al. demonstrated that anatomic CC ligament reconstruction with suture augmentation produced excellent long-term functional outcomes with a mean Constant score of 88.04 ± 12.13 at a mean follow-up of 28.17 months, suggesting that augmentation strategies confer durable benefits (16).

The present study provides evidence that clavicular hook plate fixation combined with CC suture augmentation offers significantly superior functional and radiographic outcomes compared with hook plate fixation alone in patients with acute ACJ dislocation, with consistent benefits across all demographic subgroups and without a significant increase in operative duration.

Conclusion

In patients with acute acromioclavicular joint dislocation, clavicular hook plate fixation combined with coracoclavicular suture augmentation achieved better functional recovery and more stable radiographic reduction at short-term follow-up than hook plate fixation alone. This combined approach appears to offer a practical and clinically meaningful advantage in resource-limited settings where hook plates remain the primary fixation method.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-NHMM-308-25)
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Conflict of interest

The authors declared no conflict of interest.

Author Contribution

MY (PGR)
Manuscript drafting, Study Design,
GQK (Associate Professor)
Review of Literature, Data entry, Data analysis, and drafting articles.
IS (PGR)
Conception of Study, Development of Research Methodology Design

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the study's integrity.

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