

Research Article

Clinical and Radiological Outcomes of Combined Coracoclavicular and Acromioclavicular Ligament Reconstruction Using Semitendinosus Autograft and Cortical Button Augmentation for Acute High-Grade Acromioclavicular Joint Dislocation

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Abstract

Objectives: To evaluate the clinical and radiological outcomes of open anatomical reconstruction of both the coracoclavicular and acromioclavicular ligaments using semitendinosus autograft augmented with a cortical button construct in acute high-grade acromioclavicular joint dislocation.

Methods: This retrospective consecutive case series included patients treated for acute Rockwood type III–V acromioclavicular joint dislocation between 2018 and 2023. All patients underwent open anatomical ligament reconstruction using semitendinosus autograft with cortical button augmentation. Clinical outcomes were assessed using the Constant–Murley, Quick Disabilities of the Arm, Shoulder and Hand, and Simple Shoulder Test scores. Radiological evaluation included coracoclavicular distance measurements preoperatively and at final follow-up. Complications and loss of reduction were recorded.

Results: Thirteen patients (mean age 35.4 ± 8.7 years) were included, with a mean follow-up of 28.6 ± 4.3 months. All functional scores significantly improved ($p < 0.001$). The coracoclavicular distance decreased from 17.3 mm to 8.5 mm. Loss of reduction occurred in two patients (15%) but remained asymptomatic. Twelve patients (92%) returned to previous activities. No major complications or revision surgeries were observed.

Conclusion: Combined anatomical coracoclavicular and acromioclavicular ligament reconstruction with semitendinosus autograft and cortical button augmentation provides reliable functional recovery, satisfactory radiological stability, and a low complication rate in acute high-grade injuries.

Keywords: Acromioclavicular, Coracoclavicular, Dislocation, Joint, Reconstruction

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Acromioclavicular joint (ACJ) dislocations are common shoulder injuries, particularly in young and active individuals, and account for a substantial proportion of shoulder girdle trauma.^[1] High-grade injuries (Rockwood type III–V) may result in persistent pain, cosmetic deformity, and functional impairment when inadequately treated.^[2] Although conservative management is appropriate for low-grade injuries, surgical treatment is frequently recommended for unstable high-grade acute dislocations, especially in physically active patients.^[3]

Over time, numerous surgical techniques have been described, including hook plate fixation, coracoclavicular (CC) screw fixation, and various ligament reconstruction procedures.^[4,5] However, non-anatomical methods have been associated with implant-related complications, need for secondary removal, and failure to restore horizontal stability.^[6] Consequently, attention has shifted toward anatomical reconstruction of the native CC ligaments (conoid and trapezoid), aiming to restore both vertical and horizontal stability.^[7]

Autologous tendon graft reconstruction, particularly using the semitendinosus tendon, has demonstrated favorable biomechanical properties and satisfactory clinical outcomes in both acute and chronic ACJ instability.^[8,9] Nevertheless, concerns remain regarding early graft elongation and loss of reduction during the biological healing phase.^[10] To mitigate this risk, augmentation with cortical fixation devices such as EndoButton or suture-button constructs has been proposed to provide load-sharing support and protect the graft during early rehabilitation.^[6,10]

Despite increasing use of combined biological reconstruction and cortical button augmentation, clinical data specifically evaluating anatomical reconstruction of both the CC and acromioclavicular ligament (AC) ligaments using semitendinosus autograft with EndoButton protection in acute injuries remain limited.

Methods

Study Design and Patient Selection

This retrospective case series included patients who underwent surgical treatment for acute high-grade ACJ dislocation between January 2018 and December 2023 at a tertiary referral center. Institutional review board approval was obtained prior to data collection, and the study was conducted in accordance with the Declaration of Helsinki.

Inclusion criteria: Acute ACJ dislocation (≤ 3 weeks from injury),

Rockwood type III–V instability confirmed clinically and radiographically,

Age ≥ 18 years,

Treatment with open anatomical reconstruction of both the CC and AC ligaments using semitendinosus autograft augmented with a cortical button (EndoButton/suture-button) construct,

Minimum follow-up of 24 months.

Exclusion criteria: included chronic instability (>3 weeks), previous shoulder surgery on the affected side, associated clavicle or coracoid fractures, concomitant rotator cuff tears requiring repair, neurological injury, or incomplete follow-up data.

A total of 15 consecutive patients met the surgical criteria during the study period. Two patients were lost to follow-up, leaving 13 patients available for final analysis.

Preoperative Evaluation

All patients underwent standardized clinical and radiographic evaluation. Injury severity was classified according to the Rockwood classification using bilateral anteroposterior and Zanca radiographs. The CC distance was measured as the vertical distance between the superior cortex of the coracoid process and the inferior cortex of the clavicle, and compared with the contralateral side.

Magnetic resonance imaging was performed selectively in cases with suspected associated soft tissue injuries.

Surgical Technique

All procedures were performed by the senior author under general anesthesia with the patient in the beach-chair position.

A longitudinal skin incision was made over the distal clavicle and AC joint. The deltotrapezial fascia was carefully elevated and preserved for later repair.

Coracoclavicular Reconstruction

After identification of the coracoid base, the semitendinosus tendon was harvested from the ipsilateral knee and prepared as a single-strand graft. Anatomical reconstruction of the CC ligaments was performed using two clavicular tunnels corresponding to the native footprints of the conoid and trapezoid ligaments.

The graft was passed beneath the coracoid process and routed through the clavicular tunnels to reproduce the anatomical orientation of the CC ligaments. Reduction of the AC joint was achieved under direct visualization (Fig. 1).

Cortical Button Augmentation

To protect the biological reconstruction and provide additional load-sharing support, a cortical button (EndoButton/suture-button construct) was applied between the clavicle

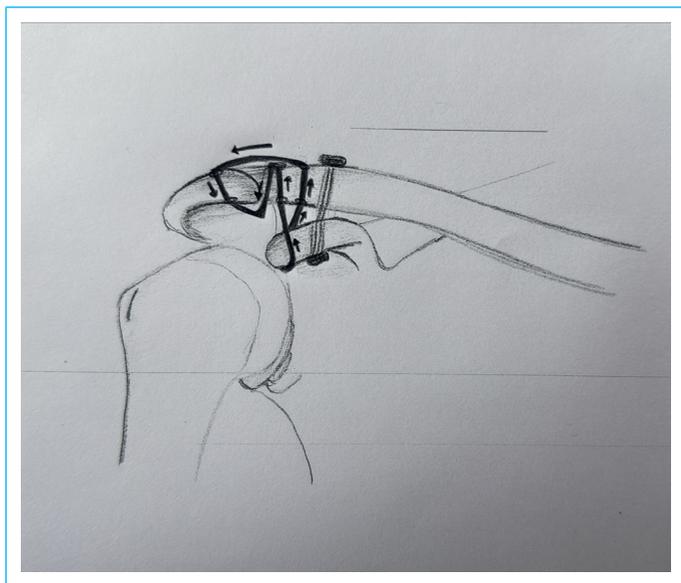


Figure 1. Schematic illustration of combined anatomical coracoclavicular and acromioclavicular ligament reconstruction using a semitendinosus autograft augmented with a cortical button. The graft is passed beneath the coracoid and through the clavicle and acromion. Arrows indicate the direction of tendon passage.

and coracoid. The device was tensioned after anatomical reduction to maintain vertical stability during the graft healing phase.

Acromioclavicular Ligament Reconstruction

To restore horizontal stability, the remaining graft limb was directed toward the acromion and fixed through an acromial tunnel, reconstructing the superior AC ligament complex in an anatomical fashion.

The deltotrapezial fascia was meticulously repaired, and the wound was closed in layers.

Postoperative Rehabilitation

The operated arm was immobilized in a sling for 4 weeks. Passive range-of-motion exercises were initiated after the first postoperative week, limited to 90° of forward elevation for the initial 4 weeks. Active-assisted motion began at 4 weeks, and strengthening exercises were introduced at 8–10 weeks. Return to sports or heavy labor was permitted after 4–6 months depending on functional recovery.

Outcome Measures

Clinical evaluation was performed preoperatively and at final follow-up using:

- Constant–Murley Score
- QuickDASH
- Simple Shoulder Test (SST)

Radiographic evaluation included measurement of the CC distance immediately postoperatively and at final follow-up. Loss of reduction was defined as an increase in CC distance greater than 5 mm compared with immediate postoperative measurements.

Complications, including infection, hardware-related problems, graft failure, and need for revision surgery, were recorded.

Statistical Analysis

Statistical analyses were performed using SPSS software (Version 26.0; IBM Corp., Armonk, NY, USA). Data distribution was assessed using the Shapiro–Wilk test.

Preoperative and final follow-up functional scores and CC distances were compared using the paired t-test for normally distributed variables or the Wilcoxon signed-rank test for non-normally distributed data.

A p-value <0.05 was considered statistically significant.

Continuous variables are presented as mean±standard deviation, and categorical variables as frequencies and percentages.

Ethical Approval Statement

This retrospective study was approved by the Non-Interventional Clinical Research Ethics Committee of Kütahya Health Sciences University (Approval No: 2025/14; Document No: 216449; Date: December 16, 2025). The study was conducted in accordance with the ethical standards of the institutional and national research committee and with the principles of the Declaration of Helsinki.

Results

Patient Demographics

A total of 13 patients (11 males, 2 females) with acute high-grade acromioclavicular joint dislocation were included in the final analysis. The mean age at surgery was 35.4±8.7 years (range, 23–58 years). The dominant side was involved in 7 patients (54%) (Table 1).

According to the Rockwood classification, 4 patients (31%) had type III injuries, 3 (23%) had type IV injuries, and 6 (46%) had type V injuries. The mean time from injury to surgery was 7.9±2.1 days (range, 5–14 days).

The mean follow-up duration was 28.6±4.3 months (range, 24–36 months).

No intraoperative complications were observed.

Clinical Outcomes

Significant improvements were observed in all functional outcome scores at final follow-up compared with preoper-

ative values. The mean Constant–Murley score improved from 19.8 ± 4.2 preoperatively to 91.3 ± 3.8 at final follow-up ($p < 0.001$). The mean QuickDASH score improved from 62.5 ± 6.3 to 3.6 ± 3.9 ($p < 0.001$). The mean Simple Shoulder Test (SST) score improved from 5.8 ± 5.4 to 88.1 ± 4.7 ($p < 0.001$) (Table 2).

At final evaluation, 12 patients (92%) returned to their previous occupational and sports activities without restrictions. One patient reported mild discomfort during heavy overhead activity but did not require further intervention.

Radiological Outcomes

The mean preoperative CC distance was 17.3 ± 3.9 mm. This was reduced to 7.8 ± 1.1 mm in the immediate postoperative period and measured 8.5 ± 2.0 mm at final follow-up. Maintenance of reduction at final follow-up is demonstrated in Figure 2.

The reduction in CC distance from preoperative to final follow-up measurements was statistically significant ($p < 0.001$).

Loss of reduction greater than 5 mm compared with immediate postoperative measurements was observed in 2 patients (15%). However, these patients remained asymptomatic and demonstrated satisfactory functional outcomes without the need for revision surgery.

Table 1. Patient demographics and injury characteristics

Variable	Value
Number of patients	13
Age, years (mean \pm SD)	35.4 ± 8.7
Sex (male/female)	11/2
Dominant side involvement, n (%)	7 (54)
Time from injury to surgery, days (mean \pm SD)	7.9 ± 2.1
Follow-up duration, months (mean \pm SD)	28.6 ± 4.3
Rockwood classification, n (%)	
Type III	4 (31)
Type IV	3 (23)
Type V	6 (46)

Table 2. Clinical and radiological outcomes

Outcome	Preoperative	Final follow-up	p
Constant–Murley score	19.8 ± 4.2	91.3 ± 3.8	< 0.001
QuickDASH score	62.5 ± 6.3	3.6 ± 3.9	< 0.001
Simple shoulder test	5.8 ± 5.4	88.1 ± 4.7	< 0.001
Coracoclavicular distance (mm)	17.3 ± 3.9	8.5 ± 2.0	< 0.001



Figure 2. Anteroposterior radiograph at 2-year follow-up after combined anatomical coracoclavicular and acromioclavicular ligament reconstruction, demonstrating maintained reduction and stable coracoclavicular distance.

Radiographic degenerative changes of the AC joint were not observed in any patient at final follow-up.

Complications

No cases of deep infection, coracoid or clavicular fracture, hardware migration, or graft failure were recorded.

Superficial wound irritation occurred in one patient (8%) and resolved with oral antibiotics.

Transient incisional hypoesthesia was observed in two patients (15%) and resolved within six months.

No patient required hardware removal or revision surgery during the follow-up period.

Summary of Findings

Open anatomical reconstruction of both the coracoclavicular and acromioclavicular ligaments using semitendinosus autograft augmented with a cortical button construct resulted in significant functional improvement, maintenance of radiographic reduction, and a low complication rate at a minimum of two-year follow-up.

Discussion

The principal finding of the present study is that open anatomical reconstruction of both the CC and AC ligaments

using a semitendinosus autograft, augmented/protected with a cortical button construct, yielded excellent clinical recovery, maintained radiographic reduction, and was associated with a low complication rate at a minimum 2-year follow-up in acute high-grade ACJ dislocations.

High-grade ACJ dislocations are typically described using the Rockwood classification, and unstable patterns (type III–V) may compromise shoulder girdle function through persistent vertical and/or horizontal instability if inadequately stabilized.^[10] In recent years, the concept of “horizontal instability” has become increasingly emphasized as a clinically meaningful component of ACJ pathology, because residual anteroposterior translation may persist even when vertical reduction appears acceptable.^[11] This is particularly relevant for techniques that primarily address CC stabilization without directly restoring the AC capsuloligamentous complex.

Biomechanical and clinical work has suggested that isolated CC fixation/reconstruction may be insufficient in a subset of patients, especially regarding restoration of horizontal stability. In a biomechanical context, direct AC ligament repair/reconstruction methods within an anatomic reconstruction framework demonstrate differences in rotational/translational control, highlighting that the AC component is not merely an adjunct but a determinant of physiologic kinematics.^[11] Consistent with this concept, clinical and endoscopic series have questioned whether CC stabilization alone is adequate for severe ACJ dislocations, supporting strategies that also address the AC ligament/capsule complex when horizontal instability is a concern.^[12] Accordingly, the rationale for our combined CC + AC reconstruction is to restore both planes of stability rather than relying on vertical stabilization alone.

Anatomic reconstruction principles depend on accurately reproducing native ligament geometry and footprints. Detailed anatomic studies of the conoid and trapezoid ligaments have clarified attachment sites and orientations, supporting the logic of anatomic tunnel placement and graft routing.^[13] This anatomic “footprint fidelity” is also a key reason why tendon-graft based reconstructions have gained popularity: they aim to recreate the CC complex rather than substitute it with rigid implants or non-anatomic transfers.

Tendon graft reconstructions (including semitendinosus) have been described with standardized indications, surgical steps, and rehabilitation protocols within anatomic CC reconstruction frameworks.^[14] Clinically, tendon-graft based anatomic reconstructions have shown favorable outcomes in terms of functional recovery and stability, particularly in chronic instability cohorts where biological

reconstruction is essential.^[15] Mid-term clinical series using semitendinosus-based reconstructions with adjunct fixation/augmentation have also reported reliable improvements and acceptable maintenance of reduction, supporting the durability of tendon-based constructs when appropriately protected during healing.^[16] Our functional outcomes (marked improvement in Constant and Quick-DASH with high return-to-activity rate) are aligned with these reports and strengthen the argument that biological reconstruction can provide robust restoration of function.

A persistent concern with graft-based reconstructions is early elongation/creep and loss of reduction before biological incorporation. Therefore, the concept of augmenting or “protecting” the graft using cortical button (suture-button) constructs has been proposed to share load and maintain reduction during early rehabilitation. Clinical outcome studies of suture-button fixation for ACJ instability have demonstrated generally favorable results while also defining a spectrum of complications and radiographic changes, including partial loss of reduction in some cases.^[17] Importantly, comparative literature suggests that suture-button strategies may achieve functional outcomes that are at least comparable to hook-plate fixation, with different complication/reoperation profiles and without routine implant removal.^[18] In our approach, the cortical button construct was intentionally used as a protective load-sharing device rather than the sole stabilizer, aiming to combine immediate mechanical stability with long-term biological restoration.

Complication avoidance is a central technical priority in cortical button and anatomic CC procedures. Prior complication analyses have identified risks such as coracoid/clavicle fracture, hardware failure, loss of reduction, and graft-related problems events that can be influenced by tunnel position, tunnel size, and bone stock.^[19,20] Additionally, experimental and biomechanical observations indicate that suture-button repair may contribute to tunnel widening, which can be a surrogate marker of micromotion and may have implications for long-term construct behavior.^[21] In our series, the absence of coracoid or clavicular fracture and the lack of graft failure suggest that meticulous tunnel placement and controlled tensioning may mitigate these recognized risks.

Because horizontal stability is clinically relevant, dedicated AC ligament reconstruction/repair has been increasingly described, including open techniques using semitendinosus graft to reconstruct/repair AC structures as a method to restore anteroposterior control.^[22] Nevertheless, the clinical relationship between residual horizontal instability and patient-reported outcomes remains debated. Some clinical work has reported weak or absent correlations between

postoperative anatomic parameters (including horizontal measures) and functional scores after isolated CC fixation, suggesting that not all patients require formal horizontal fixation.^[23] Against this background, our combined CC + AC technique may be best conceptualized as a strategy for maximizing stability (especially in clearly unstable acute injuries or in patients with high functional demand), while acknowledging that optimal indications for routine AC augmentation remain an evolving topic.

Timing also matters. Long-term follow-up after conservative management has shown that satisfactory clinical outcomes may occur despite persistent radiographic displacement, underscoring that “perfect anatomy” is not universally required for acceptable function.^[24] Conversely, long-term follow-up after operative treatment of type III injuries demonstrates that surgical strategies can provide durable outcomes, although techniques, indications, and expected trade-offs have evolved considerably over time.^[25] In the acute setting, early surgical stabilization may facilitate reduction and support biological healing conditions; however, future prospective comparative studies are still needed to define which patient subgroups derive the greatest incremental benefit from adding AC reconstruction and cortical button protection to an anatomic CC graft reconstruction.

Conclusion

Overall, our results support that, in acute high-grade ACJ dislocations, open anatomic reconstruction of both CC and AC ligaments with semitendinosus autograft augmented/protected by a cortical button construct is a safe and effective option, providing excellent functional recovery, stable radiographic outcomes, and a low complication profile at a minimum 2-year follow-up.

Disclosures

Ethics Committee Approval: This study was approved by the Non-Interventional Clinical Research Ethics Committee of Kültür Health Sciences University (Approval No: 2025/14; Document No: 216449; Date: December 16, 2025).

Conflict of Interest: The authors declare that they have no conflicts of interest.

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