

Functional Outcome of Acromioclavicular Joint Reconstruction Using Double Endobutton Fixation for Acute High-Grade Acromioclavicular Joint Dislocations: A Prospective Clinical Study

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Abstract

Background: High-grade (Rockwood type IV–VI) acromioclavicular (AC) joint dislocations are increasingly managed operatively to restore both horizontal and vertical stability. Double endobutton (cortical button) fixation has emerged as a minimally invasive, biomechanically favourable technique that avoids the drawbacks of hook plates and rigid coracoclavicular screws. This prospective study evaluated the functional and radiological outcomes of double endobutton fixation in acute high-grade AC joint dislocations.

Methods: This prospective clinical study included 32 patients with acute (<3 weeks) Rockwood type IV or V AC joint dislocations treated with arthroscopically assisted or mini-open double endobutton coracoclavicular fixation. Functional outcome was assessed using the Constant-Murley Score (CMS), Visual Analogue Scale (VAS) for pain, and the University of California, Los Angeles (UCLA) shoulder score, preoperatively and at final follow-up. Coracoclavicular distance was measured radiologically. Complications were recorded prospectively.

Results: The mean age was 31.4 ± 7.8 years, with a male predominance (84.4%). Mean follow-up was 15.8 ± 3.6 months. The mean Constant-Murley Score improved from 46.3 ± 6.1 preoperatively to 91.7 ± 5.4 at final follow-up ($p < 0.001$). Mean VAS score decreased from 6.8 ± 1.1 to 0.9 ± 0.6 ($p < 0.001$). Coracoclavicular distance improved from 18.4 ± 2.7 mm to 8.9 ± 1.6 mm ($p < 0.001$). Minor complications occurred in 6 patients (18.8%), including partial loss of reduction in 3 (9.4%); one patient (3.1%) required revision surgery. No implant failures, coracoid fractures, or neurovascular injuries were noted.

Conclusion: Double endobutton fixation provides reliable anatomical reduction, excellent pain relief, and good-to-excellent functional outcomes in acute high-grade AC joint dislocations, with an acceptable complication profile. It represents a safe, minimally invasive alternative to conventional fixation methods.

Keywords: Acromioclavicular Joint Dislocation; Double Endobutton Fixation; Coracoclavicular Reconstruction; Rockwood Classification; Constant-Murley Score; Shoulder Trauma.

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Introduction

Acromioclavicular (AC) joint dislocation is a common shoulder girdle injury, accounting for nearly 9–12% of all shoulder injuries, and predominantly affects young, physically active males following a direct fall onto the point of the shoulder or high-energy trauma such as road traffic accidents and contact sports. [1,2] The Rockwood classification remains the most widely used system to grade the severity of injury based on the degree of acromioclavicular and coracoclavicular ligament

disruption and the direction of clavicular displacement. [3] While low-grade injuries (types I–II) are managed conservatively with predictably good outcomes, high-grade dislocations (types IV, V, and VI) are associated with complete disruption of both the AC and coracoclavicular (CC) ligaments, marked instability, and significant cosmetic and functional deficit, and are generally considered for surgical stabilisation, particularly in young, active individuals and manual labourers.

[4,5] Numerous surgical techniques have been described for AC joint stabilisation, including hook plate fixation, coracoclavicular screw fixation, Weaver-Dunn procedure with or without augmentation, and various suture-button (endobutton) constructs. [6,7] Hook plate and screw fixation, though effective in achieving early reduction, are associated with implant-related complications such as subacromial erosion, screw loosening, and the requirement for mandatory implant removal. [8,9] In contrast, the double endobutton technique uses two cortical suture-button constructs passed through clavicular and coracoid tunnels, functioning as a flexible, load-sharing fixation that more closely reproduces the native biomechanics of the CC ligament complex while allowing physiological micromotion and avoiding a second surgery for implant removal. [10,11] Although several biomechanical and retrospective clinical studies have reported favourable results with endobutton constructs, prospective clinical data specifically addressing functional outcomes of double endobutton fixation in acute high-grade AC joint dislocations remain relatively limited. [12,13] The present prospective study was therefore undertaken to evaluate the clinical, functional, and radiological outcomes, along with the complication profile, of double endobutton fixation in patients with acute Rockwood type IV and V AC joint dislocations.

Materials and Methods

Study Design and Setting: This was a prospective, longitudinal, observational clinical study conducted on 32 patients with acute (<3 weeks) Rockwood type IV or V AC joint dislocation

Inclusion Criteria

- Skeletally mature patients aged 18–55 years
- Acute AC joint dislocation (presenting within 3 weeks of injury)

- Rockwood type IV or V dislocation confirmed on standard and stress radiographs
- Willingness to comply with follow-up protocol

Exclusion Criteria

- Chronic AC joint dislocation (>3 weeks)
- Rockwood type I, II, III, or VI injuries
- Associated fracture of the clavicle, coracoid, or acromion
- Open injuries, pre-existing shoulder pathology, or previous ipsilateral shoulder surgery
- Skeletally immature patients or those with polytrauma precluding early surgery

Preoperative Evaluation: All patients underwent clinical assessment and standard anteroposterior radiographs of both shoulders (Zanca view), with stress radiographs where required, to confirm the grade of injury according to the Rockwood classification. Baseline functional status was documented using the Constant-Murley Score, VAS for pain, and UCLA shoulder score.

Surgical Technique: Surgery was performed under general or regional anaesthesia with the patient in the beach-chair position. Through a mini-open deltopectoral or arthroscopically assisted approach, the coracoid base was identified and a guide pin was passed from the superior clavicle to the base of the coracoid under fluoroscopic guidance, avoiding the coracoid tip to reduce fracture risk. Two parallel bone tunnels were drilled through the clavicle and coracoid process. Two independent cortical suture-button (endobutton) constructs were passed through the tunnels — one anteromedial and one posterolateral — and secured on the superior clavicular cortex after achieving anatomical reduction of the AC joint under direct vision and fluoroscopic confirmation. Additional AC capsular repair or suture augmentation was performed where feasible. Wound closure was done in layers, and the limb was immobilised in an arm pouch/sling.

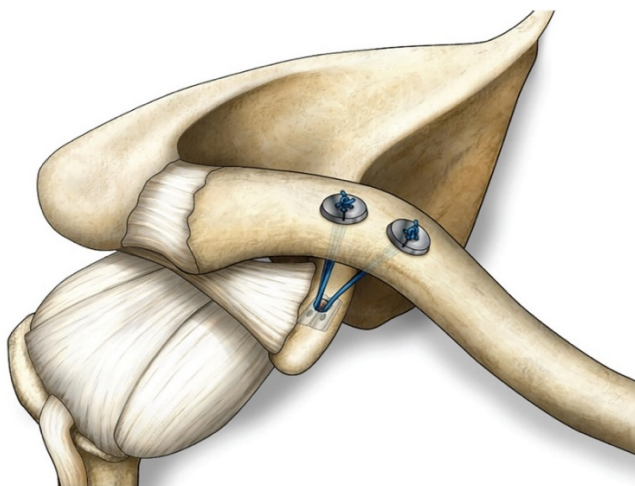


Figure 1:

Postoperative Rehabilitation: A standardised rehabilitation protocol was followed: sling immobilisation for 4 weeks with pendulum exercises from the first postoperative week, followed by progressive passive and active-assisted range-of-motion exercises from the fourth week, active range-of-motion and strengthening exercises from the eighth week, and return to sport/heavy labour permitted after 4–6 months depending on functional recovery.

Outcome Assessment: Patients were followed up at 2 weeks, 6 weeks, 3 months, 6 months, and final follow-up. Functional outcome was assessed using the Constant-Murley Score (0–100, higher indicating better function), VAS for pain (0–10), and the UCLA shoulder rating scale. Radiological evaluation included measurement of the coracoclavicular distance on anteroposterior radiographs, compared with the contralateral uninjured shoulder, and assessment of loss of reduction, tunnel widening, and implant position. Complications, including infection, implant-related irritation, loss of reduction, and revision surgery, were recorded.

Statistical Analysis: Data were entered in Microsoft Excel and analysed using SPSS version. Continuous variables were expressed as mean $\pm$ standard deviation and compared using the paired t-test for pre- and postoperative comparisons. Categorical variables were expressed as frequencies and percentages.

A p-value of <0.05 was considered statistically significant.

Results

A total of 32 patients meeting the inclusion criteria were enrolled and completed the minimum follow-up period. The mean age of the study population was 31.4 ± 7.8 years, with a marked male predominance (84.4%). Road traffic accidents were the most common mode of injury (56.3%), followed by fall from height and sports-related trauma (43.7%). Rockwood type V injury was more common (71.9%) than type IV (28.1%).

The mean time from injury to surgery was 6.2 ± 2.4 days, and the mean duration of follow-up was 15.8 ± 3.6 months. Baseline demographic and injury characteristics are summarised in Table 1.

Table 1:

Parameter	Value / n (%)	Mean $\pm$ SD
Total patients	32	-
Age (years)	-	31.4 ± 7.8
Sex (Male / Female)	27 (84.4%) / 5 (15.6%)	-
Side involved (Right / Left)	19 (59.4%) / 13 (40.6%)	-
Dominant limb involved	21 (65.6%)	-
Mode of injury – RTA	18 (56.3%)	-
Mode of injury – Fall from height / sports	14 (43.7%)	-
Rockwood type IV	9 (28.1%)	-
Rockwood type V	23 (71.9%)	-
Time from injury to surgery (days)	-	6.2 ± 2.4
Mean follow-up (months)	-	15.8 ± 3.6

A statistically significant improvement was observed in all functional outcome parameters at final follow-up compared with preoperative values. The mean Constant-Murley Score improved from 46.3 ± 6.1 to 91.7 ± 5.4 ($p < 0.001$), and the mean VAS pain score decreased from 6.8 ± 1.1 to 0.9 ± 0.6 ($p < 0.001$). The UCLA shoulder score

improved from 14.2 ± 2.3 to 32.6 ± 2.1 ($p < 0.001$), corresponding to good-to-excellent outcomes in the majority of patients. Radiologically, the mean coracoclavicular distance reduced from 18.4 ± 2.7 mm preoperatively to 8.9 ± 1.6 mm at final follow-up, closely approximating the contralateral side ($p < 0.001$), as shown in Table 2.

Table 2:

Outcome Measure	Preoperative	Final Follow-up	P value
Constant-Murley Score	46.3 ± 6.1	91.7 ± 5.4	<0.001
VAS Pain Score	6.8 ± 1.1	0.9 ± 0.6	<0.001
UCLA Shoulder Score	14.2 ± 2.3	32.6 ± 2.1	<0.001
Coracoclavicular Distance (mm)	18.4 ± 2.7	8.9 ± 1.6	<0.001

According to Constant-Murley Score grading, excellent results (≥ 90) were achieved in 21 patients (65.6%), good results (80–89) in 8 patients (25.0%), fair results (70–79) in 2 patients (6.3%),

and poor results (<70) in 1 patient (3.1%). Overall, 29 patients (90.6%) achieved a good-to-excellent functional outcome.

Complications were noted in 6 patients (18.8%) and are summarised in Table 3. Partial loss of reduction, evident as mild residual widening of the coracoclavicular distance, was seen in 3 patients (9.4%) but did not significantly affect functional scores. One patient (3.1%) developed a superficial wound infection that resolved with oral antibiotics. Implant-related discomfort over the clavicle was

reported in 2 patients (6.3%), and 2 patients (6.3%) had mild restriction of terminal abduction ($<10^\circ$) that did not require intervention.

One patient (3.1%) with significant loss of reduction required revision fixation. No cases of coracoid or clavicle fracture, neurovascular injury, or deep infection were recorded.

Table 3:

Complication	n	%
Loss of reduction (partial)	3	9.4
Superficial wound infection	1	3.1
Implant-related discomfort	2	6.3
Restricted terminal abduction ($<10^\circ$)	2	6.3
Coracoid fracture (intraoperative)	0	0.0
Revision surgery required	1	3.1

Discussion

This prospective study demonstrates that double endobutton fixation provides significant and sustained improvement in pain relief, shoulder function, and radiological alignment in patients with acute high-grade AC joint dislocations, with a low rate of major complications. The mean Constant-Murley Score improved from 46.3 to 91.7, and 90.6% of patients achieved a good-to-excellent outcome, findings that are comparable with previously reported outcomes of suture-button and endobutton techniques in the literature. [14,15]

The rationale for double, rather than single, endobutton fixation lies in improved rotational and horizontal stability of the AC joint. Biomechanical studies have shown that a single coracoclavicular tunnel construct primarily restores vertical stability but is less effective in controlling anteroposterior translation and axial rotation of the clavicle, which are important components of high-grade injuries with associated deltoid trapezial fascial disruption. [16,17] Placing two independent button constructs — one anteromedial and one posterolateral within the coracoid base — more closely reproduces the anatomical footprint of the conoid and trapezoid ligaments, thereby providing a biomechanically superior and more rotationally stable construct, as reflected in the low rate of residual instability in the present series. [18]

Compared with hook plate fixation, which is associated with subacromial impingement, rotator cuff irritation, and the near-universal requirement for a second surgery for implant removal, the double endobutton technique avoids a mandatory second procedure and permits earlier, more physiological shoulder motion. [19,20] Similarly, coracoclavicular screw fixation, although effective, carries a recognised risk of screw breakage and loss of fixation with early mobilisation, necessitating a period of prolonged immobilisation that may

compromise final range of motion. [21] In the present study, no implant breakage or coracoid fracture was observed, which may be attributed to careful tunnel placement away from the coracoid tip and the load-sharing nature of the flexible button-suture construct. The rate of partial loss of reduction (9.4%) in this series is consistent with previously reported rates of 5–15% following endobutton reconstruction and is generally attributed to suture creep, cyclic loading during early rehabilitation, or technical factors related to tunnel placement. [22,23] Importantly, in the present cohort, mild radiological loss of reduction did not translate into significant functional compromise, suggesting that absolute anatomical restoration of the coracoclavicular distance may not be a strict prerequisite for a satisfactory clinical outcome, a concept supported by several previous reports. [24]

The findings of this study support the use of double endobutton fixation as a reliable, minimally invasive option for acute high-grade AC joint dislocation, particularly in young, active patients who place a premium on early functional recovery and avoidance of a second implant-removal surgery. Nonetheless, careful patient selection, meticulous surgical technique, and a structured, progressive rehabilitation protocol remain essential to optimising outcomes and minimising the risk of construct failure.

Limitations

This study has certain limitations. The sample size was relatively modest and derived from a single centre, which may limit generalisability. The absence of a comparator arm (e.g., hook plate or screw fixation) limits direct comparative conclusions, and the follow-up duration, while adequate to assess short- to medium-term functional outcomes, may not capture very late complications such as symptomatic osteoarthritis or

delayed loss of reduction. Multicentric, adequately powered randomised controlled trials with longer follow-up are warranted to further validate these findings.

Conclusion

Double endobutton fixation is an effective and reliable technique for the surgical management of acute high-grade (Rockwood type IV and V) acromioclavicular joint dislocations, providing significant improvement in pain, functional shoulder scores, and radiological coracoclavicular alignment, with an acceptable and largely minor complication profile. It offers the additional advantages of a minimally invasive approach, avoidance of mandatory implant removal, and early return to function, making it a favourable option in the surgical armamentarium for high-grade AC joint injuries.

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