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Functional Outcome of Double Endobutton Technique in Acute Acromioclavicular Joint Dislocation: A Prospective Observational Study

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Learning Point of the Article:

The Double endobutton fixation technique is an effective, reliable, and safe surgical technique for acute high-grade acromioclavicular joint dislocation, providing stable fixation, early mobilization, and ensuring excellent functional recovery.

Abstract

Introduction: Acute acromioclavicular (AC) joint dislocations are frequent shoulder-girdle injuries in young and physically active adults. High-grade injuries disrupt both AC and coracoclavicular (CC) stabilizers and frequently require operative stabilization. The double endobutton technique reconstructs CC stability using a suspensory construct and may permit stable reduction with early functional recovery.

Materials and Methods: This prospective observational study included 30 patients aged 18–60 years with closed acute Rockwood type III–VI AC joint dislocation treated with the double endobutton technique at a tertiary care orthopedic department from March 2024 to December 2025. Functional outcomes were assessed using shoulder abduction, forward flexion, constant shoulder score (CSS), and Visual Analog Scale (VAS) preoperatively and at 6 weeks, 3 months, and 6 months. Radiological outcome was assessed using CC distance on radiographs. Complications and maintenance of reduction were recorded during follow-up.

Results: The mean age was 38.5 ± 11.0 years; 24 patients (80.0%) were male. Road traffic accidents were the most common mechanism of injury (46.7%), and Rockwood type V was the most frequent injury grade (46.7%). Mean shoulder abduction improved from 65 ± 10° preoperatively to 170 ± 8° at 6 months, whereas forward flexion improved from 70 ± 12° to 172 ± 7° ($P < 0.001$). Mean CSS increased from 32.6 ± 6.4 to 92.4 ± 5.6 ($P < 0.001$), and mean VAS decreased from 7.2 ± 1.1 to 1.1 ± 0.5 ($P < 0.001$). Mean CC distance reduced from 23.2 ± 6.82 mm preoperatively to 12.0 ± 2.56 mm immediately after surgery and remained stable at 12.5 ± 2.56 mm at 6 months. An excellent or good functional outcome was achieved in 26 patients (86.7%). Reduction was maintained in 29 patients (96.7%), and complications were limited to one case each of loss of reduction, superficial infection, and implant irritation.

Conclusion: Double endobutton fixation for acute AC joint dislocation produced significant pain relief, near-normal shoulder motion, excellent functional recovery, maintained radiological reduction, and a low complication rate at 6 months. The technique represents an effective and safe surgical option for acute high-grade AC joint dislocations in appropriately selected patients.

Keywords: Acromioclavicular joint dislocation, constant shoulder score, coracoclavicular distance, double endobutton, Visual Analog Scale.

Introduction

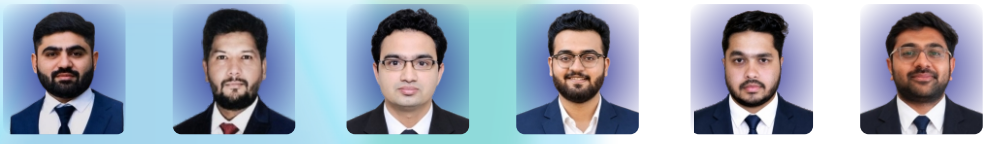
Acromioclavicular (AC) joint dislocations are common shoulder-girdle injuries and account for a substantial proportion of traumatic shoulder presentations, particularly among young

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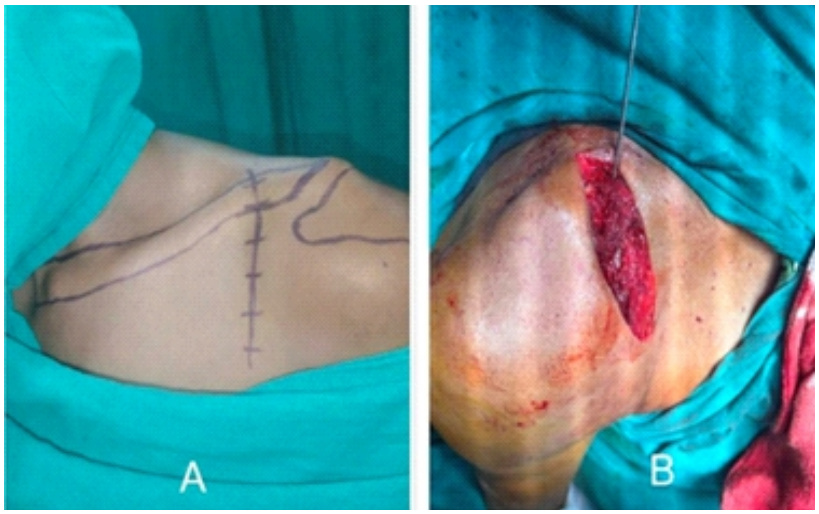


Figure 1: Intraoperative images showing surface marking and guidewire placement. The figure shows skin marking extending from the tip of the coracoid process to the anterior aspect of the lateral end of the clavicle. Moreover, it also shows guidewire placement after dissection.

and active individuals exposed to road traffic trauma, falls, contact sports, and direct impact to the lateral shoulder [1,2,3]. The injury mechanism most often involves a direct force applied to the lateral aspect of the shoulder with the arm adducted, driving the acromion inferiorly in relation to the clavicle and progressively disrupting the soft-tissue stabilizers of the AC joint [1,3].

Stability of the AC joint depends on both static and dynamic restraints. The AC ligaments provide horizontal stability, whereas the coracoclavicular (CC) ligament complex, comprising the conoid and trapezoid ligaments, is the principal restraint to vertical displacement. Dynamic support from the deltoid and trapezius further contributes to shoulder-girdle integrity during movement [1,4]. Disruption of these structures can produce pain, deformity, restricted shoulder function, and loss of normal scapulo-clavicular mechanics.

The Rockwood classification remains the most widely used system for grading AC joint injuries. The original three-grade descriptions by Tossy and Allman were expanded by Rockwood to six types based on the degree and direction of clavicular displacement and the extent of injury to the AC ligaments, CC ligaments, and delto-trapezial fascia [5,6,7]. Type I and II injuries are generally treated non-operatively. Type III injuries remain controversial and are managed according to patient demands and instability pattern, whereas Types IV, V, and VI injuries are usually considered for operative management due to severe displacement and soft-tissue disruption [8,9,10].

Several operative techniques have been described, including Kirschner-wire fixation, hook plate fixation, ligament transfer, suture-button constructs, and arthroscopic or open CC reconstruction. Although hook plates provide rigid fixation, they are associated with implant-related morbidity, subacromial impingement, acromial erosion, restriction of shoulder motion, and the need for implant removal [9,10]. Suspensory fixation using endobutton-based constructs has therefore gained attention because it can restore the clavicle-coracoid relationship while limiting soft-tissue dissection and avoiding routine implant removal [11,12].

The double endobutton technique aims to recreate the stabilizing function of the CC ligaments by securing the clavicle to the coracoid through a low-profile button and high-strength suture construct. Biomechanical work has shown that double endobutton reconstruction can provide strong load-bearing capacity and reduced joint translation compared with alternative coracoid sling methods [13]. Clinical evidence continues to evolve, particularly in acute high-grade AC dislocation. This study evaluated the functional, radiological, and safety outcomes of acute AC joint dislocation treated with the double endobutton technique.

Materials and Methods

Study design and setting

This was a prospective observational study conducted in the Department of Orthopaedics, People's Hospital, Bhanpur,

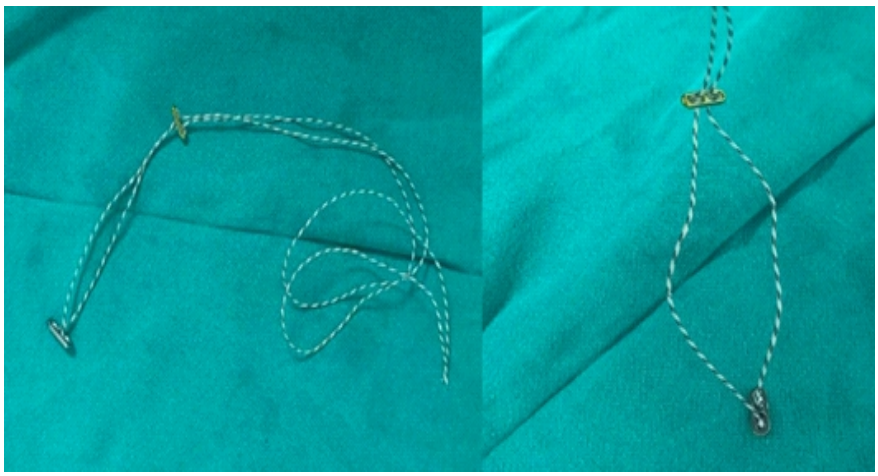


Figure 2: Double endobutton construct. A No. 5 fiber wire was passed through the central (2nd and 3rd) holes of the endobutton to create the primary loop, then through the peripheral (1st and 4th) holes to form the secondary loop, and again through the central holes for the tertiary loop. An identical second endobutton was prepared in a similar manner.

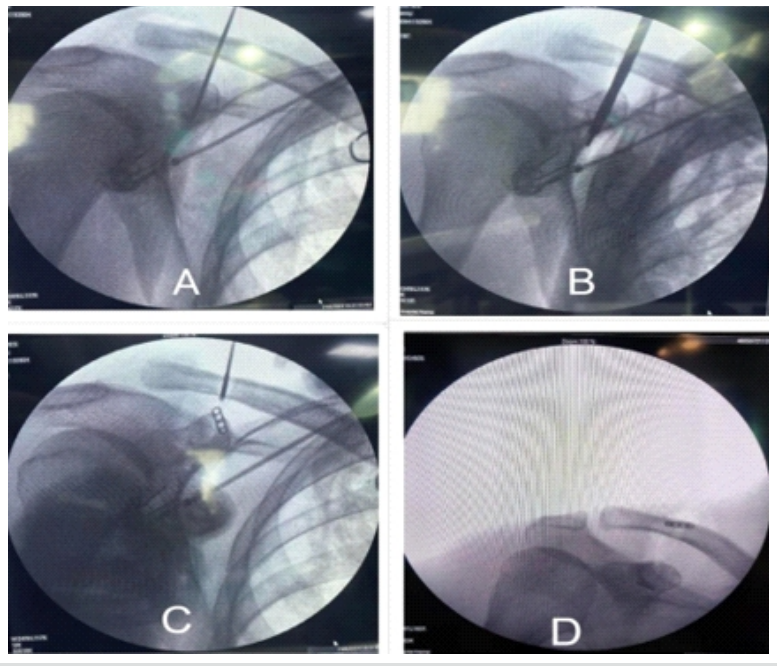


Figure 3: Fluoroscopic images showing operative steps. (a) Placement of guide wire (b) Drilling with 4.0 mm cannulated drill (c) Advancement of the double endobutton construct in coracoid process (d) Final image after achieving reduction.

affiliated with People's College of Medical Sciences and Research Centre, Bhopal. The study period extended from March 2024 to December 2025.

Participants

Patients aged 18–60 years presenting with closed acute AC joint dislocation of Rockwood type III, IV, V, or VI within 6 weeks of injury and willing to undergo surgical intervention were included. Patients younger than 18 years or older than 60 years, those with ipsilateral brachial plexus injury, dislocation older than 6 weeks, previous ipsilateral shoulder surgery or fracture, pre-existing ipsilateral shoulder pathology, open AC joint dislocation, or unwillingness for surgery were excluded.

Surgical technique

After standard pre-operative preparation, the base of the coracoid was identified, and an approximately 2-inch incision was made superior to the coracoid tip, extending laterally toward the anterior border of the distal clavicle (Fig. 1). The skin and subcutaneous flaps were raised, the deltoid was split along its fibers, and the coracoid was exposed and cleared to its base. The AC joint articular disc was excised to facilitate reduction. After manual reduction of the clavicle, a guide wire was passed from the superior surface of the distal clavicle approximately 2.5–3 cm medial to the AC joint and directed slightly anteriorly toward the coracoid base. A 4.0-mm cannulated drill was used to create the clavicular and coracoid tunnels while maintaining reduction (Fig. 2). A double endobutton-fiberwire construct (Fig. 3) was passed through the tunnels; the inferior button was flipped beneath the coracoid, and the superior button was seated over the clavicle. The construct was tightened and tied after confirming reduction under fluoroscopy.

Post-operative protocol and outcome assessment

The average operative duration was approximately 45 min, and patients remained hospitalized for 2–3 days after surgery. Assisted pendulum exercises were started on the 2nd post-operative day, passive mobilization was initiated as tolerated from approximately the 3rd post-operative day, and active range-of-motion exercises were commenced by the 3rd post-operative week. Functional assessment was performed using shoulder abduction, forward flexion, constant shoulder score (CSS), and Visual Analog Scale (VAS) preoperatively and at 6 weeks, 3 months, and 6 months. Range of motion was measured with a goniometer. Radiological assessment was performed using CC distance on shoulder stress anteroposterior (AP) view preoperatively and AP shoulder radiographs immediately postoperatively and at 6 months. Implant-related complications, reduction loss, superficial infection, irritation, impingement, and neurovascular complications were evaluated during follow-up.

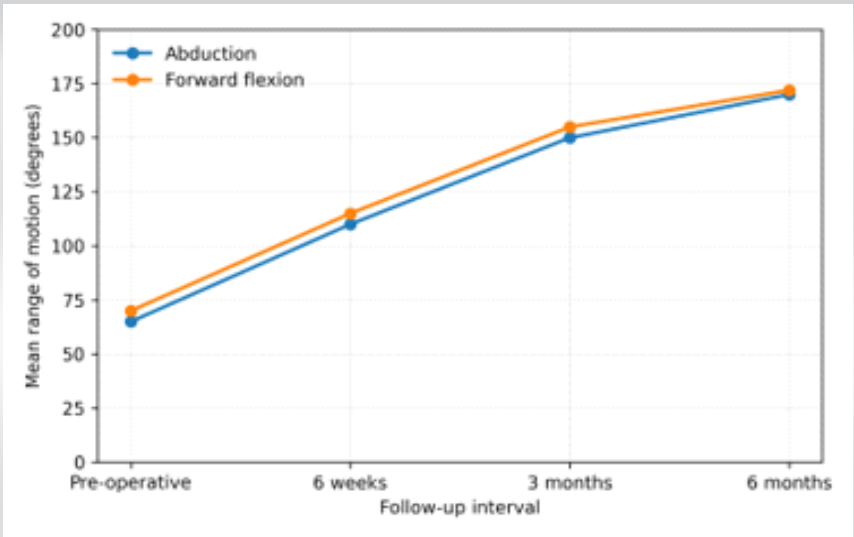


Figure 4: Shoulder range of motion during follow-up. This graph shows significant improvement in shoulder abduction and forward flexion in regular sequential follow-ups ($P < 0.001$).

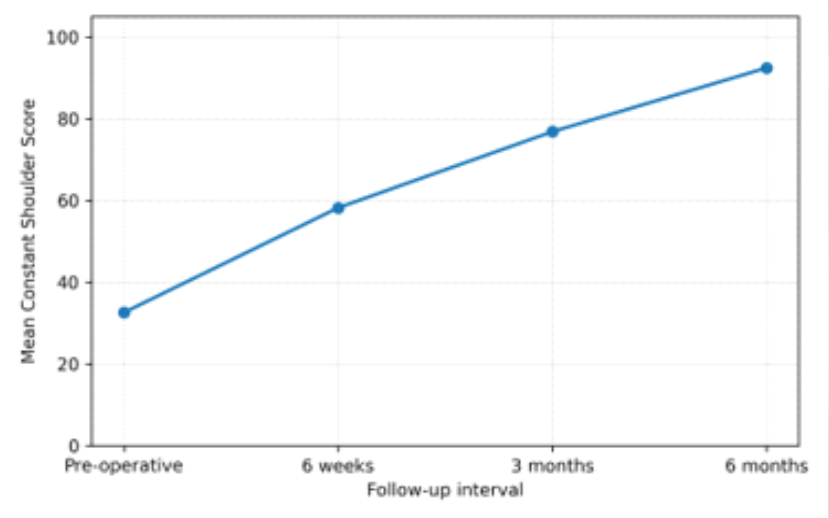


Figure 5: Mean constant shoulder score during follow-up. This graph shows considerable improvement in functional outcome of the shoulder joint during follow-ups, assessed using Constant Shoulder Score (P < 0.001).

Statistical analysis

Categorical variables were summarized as frequencies and percentages. Continuous variables were expressed as mean ± standard deviation. Pre-operative and follow-up values were compared using paired t-tests for continuous outcomes. Statistical analysis was performed using Statistical Package for the Social Sciences version 20, and P < 0.05 was considered statistically significant.

Ethical considerations

The study was conducted after Institutional Ethical Committee approval of People's College of Medical Sciences and Research Centre, Bhopal (approval code no. IEC-2024/62) dated March 26th, 2024, and in accordance with institutional research requirements and after obtaining written informed consent from all enrolled patients.

Results

A total of 30 patients with acute AC joint dislocation were included, and no patient was lost to follow-up. The mean age was 38.5 ± 11.0 years, with patients ranging from 18 to 59 years. The largest age group was 31–40 years (30.0%). Male predominance was observed, with 24 male patients (80.0%) and 6 female patients (20.0%). Road traffic accidents were the most common mechanism of injury, followed by a fall from height. Rockwood type V was the most frequent injury grade, and no type VI injury was observed (Table 1).

Clinical recovery was progressive across the follow-up period (Table 2). Mean shoulder abduction increased from 65 ± 10° preoperatively to 170 ± 8° at 6 months, and mean forward flexion increased from 70 ± 12° to 172 ± 7° at 6 months (Fig. 4). CSS improved from 32.6 ± 6.4 to 92.4 ± 5.6 (Fig. 5), whereas VAS improved from 7.2 ± 1.1 to 1.1 ± 0.5 (Fig. 6). All clinical changes were statistically significant (P < 0.001). The mean pre-operative CC distance reduced from 23.2 ± 6.82 mm to 12.5 ± 2.56 mm at 6 months (P < 0.001), confirming significant and sustained radiological correction.

At final follow-up, 18 patients (60.0%) achieved an excellent outcome, and 8 patients (26.7%) achieved a good outcome, giving an excellent-to-good outcome rate of 86.7%. Three patients (10.0%) had a fair outcome, and one patient (3.3%) had a poor outcome. Immediate post-operative CC distance was 12.0 ± 2.56 mm and remained comparable at 12.5 ± 2.56 mm at 6 months. Reduction was maintained in 29 patients (96.7%), whereas one patient (3.3%) developed radiological loss of reduction. The overall complication rate was 10.0%; complications included one case each of loss of reduction, superficial infection, and implant irritation. No neurovascular injury or implant failure was reported (Table 3).

Discussion

This prospective observational study demonstrates that double endobutton fixation for acute high-grade AC joint dislocation is associated with significant improvement in pain, shoulder motion, functional score, and radiological alignment at 6 months. Functional recovery was reflected by near-normal abduction and forward flexion, a marked increase in CSS, and a substantial reduction in VAS pain score. Radiological reduction was also sustained, with only one case of reduction loss and a low overall complication rate.

The demographic and injury profile observed in this series is

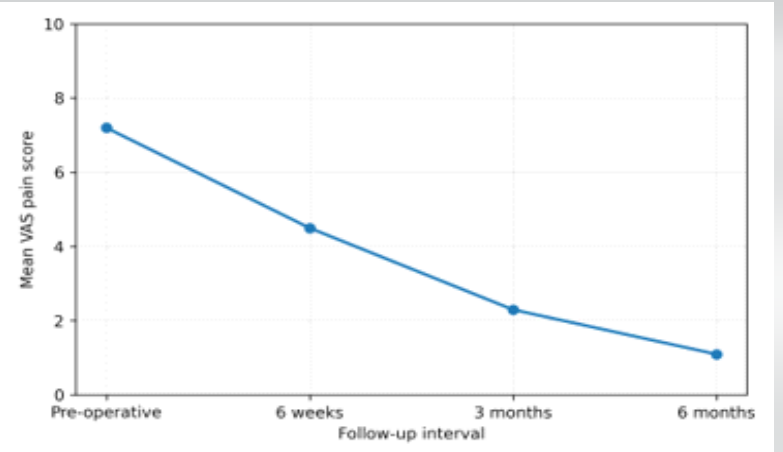


Figure 6: Mean Visual Analog Scale during follow-up. The graph shows a marked reduction in pain during follow-ups, assessed using Visual Analog Scale (P < 0.001).

Table 1: Baseline demographic and injury characteristics (*n*=30)

Characteristic	Category	Number (%)
Age (years)	18–30	8 (26.7)
	31–40	9 (30.0)
	41–50	7 (23.3)
	51–60	6 (20.0)
Sex	Male	24 (80.0)
	Female	6 (20.0)
Mechanism of injury	Road traffic accident	14 (46.7)
	Fall from height	9 (30.0)
	Sports injury	5 (16.7)
	Direct trauma	2 (6.6)
Rockwood classification	Type III	7 (23.3)
	Type IV	9 (30.0)
	Type V	14 (46.7)
	Type VI	0 (0.0)

consistent with the usual epidemiology of AC joint dislocation. Most patients were young or middle-aged adults, and 80.0% were male. This pattern is expected because AC injuries are commonly linked to high-energy mechanisms, occupational exposure, sports, and vehicular trauma [1,2,3]. Dey et al. similarly reported a predominantly male cohort in acute Rockwood type III–VI injuries treated with double endobutton fixation, while other double-button series have also described male predominance and presentation in the active adult age group [14,15,16,17].

The road traffic accidents were the most common mechanism of injury in the present series. This differs from some athletic cohorts in which sports-related trauma predominates, but it is clinically plausible in settings where vehicular trauma contributes heavily to orthopedic injury burden. The majority of injuries were Rockwood type V, followed by type IV and type III. These grades represent substantial disruption of the AC and CC ligament complexes and justify operative stabilization when the goal is to restore anatomical alignment and shoulder-girdle mechanics [7,8,9,10].

Range-of-motion recovery was substantial. Mean abduction improved from 65° preoperatively to 170° at 6 months, and forward flexion improved from 70° to 172°. These findings support early functional restoration after suspensory CC fixation. Pan et al. reported near-normal shoulder function after endobutton reconstruction, whereas contemporary studies and systematic reviews of suture-button constructs have reported post-operative motion and functional scores consistent with marked recovery after acute AC joint stabilization [18,19].

The improvement in CSS from 32.6 to 92.4 points indicates conversion from severe pre-operative dysfunction to excellent shoulder function at final follow-up. Comparable functional recovery has been reported by Das et al., Dey et al., Sharma et al., and Bansal et al. in patients managed with double endobutton or related double-button techniques [14,15,16,17]. Pan et al. and Lafosse et al. also reported post-operative Constant scores above 90 in many patients after endobutton-based reconstruction [18,20]. These comparable findings suggest that the magnitude of functional recovery in this series is consistent with the published performance of suspensory-button constructs.

Pain relief was equally marked. The mean VAS score decreased from 7.2 preoperatively to 1.1 at 6 months. A similar decline in pain has been described after endobutton or suture-button fixation. Pan et al. reported major improvement in VAS after endobutton reconstruction, and Li et al. concluded in a systematic review that suture-button techniques provide greater functional improvement and pain relief than hook plate fixation in acute AC dislocation [18,19]. Wang et al. also reported favorable pain outcomes after tight-rope fixation compared with hook plate fixation [21].

Radiological stability is a central determinant of success after AC joint reconstruction. In this study, the mean CC distance decreased from 23.2 mm preoperatively to 12.0 mm immediately after surgery and remained stable at 12.5 mm at 6 months. Reduction was maintained in 96.7% of patients. These findings align with Manohara and Reid, who reported significant CC distance correction after percutaneous endobutton fixation, and with biomechanical observations showing that double endobutton constructs can maintain stability under physiological load [22,23]. Struhl and Wolfson

Table 2: Clinical and radiological changes from baseline to final follow-up

Outcome measure	Pre-operative mean±SD	6-month mean±SD	Mean change	*P*-value
Shoulder abduction (degrees)	65±10	170±8	+105°	<0.001
Forward flexion (degrees)	70±12	172±7	+102°	<0.001
Constant shoulder score	32.6±6.4	92.4±5.6	+59.8 points	<0.001
VAS pain score	7.2±1.1	1.1±0.5	−6.1 points	<0.001
CC distance (mm)	23.2±6.82	12.5±2.56	−10.7 mm	<0.001

VAS: Visual Analog Scale, CC: Coracoclavicular, SD: Standard deviation

Table 3: Radiological stability, final functional outcome, and post-operative complications

Endpoint	Value (%)
Immediate postoperative CC distance	12.0±2.56 mm
CC distance at 6 months	12.5±2.56 mm
Maintained reduction	29 (96.7)
Loss of reduction	1 (3.3)
Final functional outcome: Excellent	18 (60.0)
Final functional outcome: Good	8 (26.7)
Final functional outcome: Fair	3 (10.0)
Final functional outcome: Poor	1 (3.3)
No postoperative complication	27 (90.0)
Superficial infection	1 (3.3)
Implant irritation	1 (3.3)

CC: Coracoclavicular

reported that some reduction loss can occur during biological healing after continuous-loop double endobutton reconstruction, whereas Lu et al. found double endobutton fixation to provide adequate radiological stability compared with triple endobutton fixation [24,25]. A recent systematic review and meta-analysis also supported endobutton-based techniques for maintaining CC distance with favorable complication profiles compared with hook plates [26].

The complication profile was acceptable. Only three patients had complications: One each of reduction loss, superficial infection, and implant irritation. No neurovascular injury or implant failure occurred. Reduction loss is the most frequently discussed complication after endobutton fixation; Chen et al. identified reduction loss as an important post-operative concern, and Fang et al. further analyzed risk prediction for reduction loss after endobutton treatment [27,28]. In comparison with these reported concerns, the single case of reduction loss in this cohort suggests satisfactory mechanical stability over the 6-month observation period.

Taken together, the results indicate that double endobutton fixation provides stable restoration of the clavicle-coracoid relationship, supports early mobilization, and achieves excellent functional recovery with limited morbidity. The technique avoids routine implant removal and the subacromial hardware-related issues associated with hook plates while providing a biologically favorable environment for CC ligament healing [9,10,11,12,13,19,26].

Limitations

The sample size was relatively small, and the study was conducted at a single center without a comparative control group such as hook plate fixation or conservative treatment. Follow-up was limited to 6 months, so late complications, long-term maintenance of reduction, post-traumatic AC joint arthrosis, and return-to-work or return-to-sport outcomes could not be fully assessed. Larger comparative studies with longer follow-up are required to validate these findings and define the long-term durability of double endobutton fixation.

Conclusion

Double endobutton fixation is an effective and safe surgical technique for acute high-grade AC joint dislocation. The procedure produced statistically significant improvement in shoulder abduction, forward flexion, CSS, VAS pain score, and CC distance, with 86.7% excellent-to-good functional results and 96.7% maintenance of reduction at 6 months. The low complication rate and absence of major implant or neurovascular complications support its use as a reliable operative option for acute AC joint dislocation, particularly in active patients requiring stable fixation and early functional recovery.

Clinical Message

Double endobutton fixation provides stable coracoclavicular fixation with early mobilization and favorable functional recovery in appropriately selected patients with acute high-grade AC joint dislocation. The technique demonstrated good radiological stability and a low complication rate at 6 months, supporting its clinical utility as a surgical stabilization option.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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