Section: Orthopaedics

Original Research Article

FUNCTIONAL AND RADIOLOGICAL OUTCOMES OF DOUBLE ENDOBUTTON FIXATION FOR ACROMIOCLAVICULAR JOINT DISLOCATION: A PROSPECTIVE STUDY

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Received : 10/11/2025
Received in revised form : 01/01/2026
Accepted : 18/01/2026

Keywords:
Acromioclavicular joint, coracoclavicular ligament, endobutton, shoulder dislocation, functional outcome.

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DOI: 10.47009/jamp.2026.8.1.101

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2026; 8 (1); 531-536

ABSTRACT

Background: The aim is to evaluate the functional and radiological outcomes of closed-loop double endobutton fixation for acute AC joint dislocation. **Materials and Methods:** This prospective hospital-based study included patients presenting with Rockwood type III–V AC joint dislocations. Surgical stabilization was performed using a double endobutton construct with fibre wire. Functional outcomes were assessed using the UCLA Shoulder Score and Constant-Murley Score at 1, 2, 3, and 6 months. Radiological outcomes were assessed using coracoclavicular (CC) distance. **Result:** Twenty-one male patients were included. The mean age was 44.47 years, and the majority had type III dislocations. Road traffic accident was the predominant mechanism of injury (86%). Significant improvements in both functional scores were observed over six months. UCLA scores improved from 22.43 at one month to 34.88 at six months ($p < 0.001$). The Constant-Murley Score similarly improved, with 94.2% of patients achieving excellent outcomes at six months. The mean CC distance reduced from 18.07 mm preoperatively to 10.71 mm postoperatively ($p < 0.001$). Loss of reduction occurred in 14.3% of cases, while stiffness was observed in one patient. **Conclusion:** The double endobutton technique provides a reliable method for stabilizing acute AC joint dislocations, yielding excellent functional and radiological outcomes with minimal complications. Its non-rigid design minimizes implant-related problems and eliminates the need for hardware removal.

INTRODUCTION

Acromioclavicular joint injuries constitute approximately nine percent of all shoulder girdle injuries and are frequently associated with high-energy trauma. These injuries are more common in males, particularly those between twenty and forty years of age. Both direct impact to the lateral shoulder and indirect mechanisms such as falls on an outstretched hand can contribute to disruptions of the AC and coracoclavicular ligaments.[1,2]

The Rockwood classification system remains the standard for categorizing AC joint dislocations. Type I and II injuries are typically managed conservatively, while types IV to VI require surgical intervention. The management of type III injuries remains debated, with recommendations often influenced by patient activity level and functional demands.[3,4]

Numerous surgical techniques have been developed, including coracoclavicular screw fixation, suture anchors, hook plates, ligament reconstruction, and suspensory button devices. Rigid fixation methods may result in hardware complications, need for removal, and limited physiological movement.[5,6] In contrast, the double endobutton construct provides suspensory fixation that closely replicates the native CC ligament, maintains reduction under cyclic loading, and avoids secondary implant removal.[7,8]

The present study evaluates the functional and radiological outcomes of AC joint stabilization using a closed-loop double endobutton technique in a tertiary care setting.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

MATERIALS AND METHODS

This prospective hospital-based study was conducted in the Department of Orthopaedics at Sri Manakula Vinayagar Medical College and Hospital (SMVMCH), a tertiary care teaching institution located in Kalitheerthalkuppam, Puducherry, India. The study period extended from November 2022 to April 2024. Ethical approval for the study was obtained from the Institutional Ethics Committee prior to the commencement of patient recruitment. All participants were informed about the purpose, procedure, risks, and benefits of the study, and written informed consent was obtained from every individual. Confidentiality and anonymity were maintained throughout the study period [Figure 1].

Patients presenting to the emergency department or orthopaedic outpatient department with clinically and radiologically confirmed acromioclavicular joint dislocation were evaluated for eligibility. Individuals above eighteen years of age with acute injuries diagnosed within three months and categorized as Rockwood type III, IV, or V were included. Patients with open injuries, chronic dislocations exceeding three months, or associated ipsilateral fractures of the clavicle or acromion were excluded from the study. A universal sampling method was employed, and all eligible patients presenting during the study period were recruited. Although the anticipated sample size was thirty based on previous patient inflow, only twenty-one patients satisfied the inclusion criteria during the study period.

After enrollment, each patient underwent a detailed clinical examination and radiological evaluation, including standard anteroposterior and axillary radiographs of the shoulder. Baseline demographic information and mechanisms of injury were recorded. All surgeries were performed by experienced orthopaedic surgeons with specialized training in shoulder procedures. The operative procedure was carried out under regional anaesthesia. Patients were positioned supine with a bolster placed beneath the interscapular region to elevate the thorax by approximately twenty degrees, allowing optimal visualization of the acromioclavicular region. The affected shoulder and upper limb were prepared under strict aseptic precautions, and an image intensifier was positioned to obtain intraoperative anterior–posterior views of the AC joint.

A vertical incision approximately five centimetres in length was made medial to the AC joint [Figure 2]. Following skin and subcutaneous dissection, the fibres of the deltoid muscle were gently split to expose the coracoid process. Careful dissection was performed circumferentially to identify the base of the coracoid, ensuring protection of surrounding neurovascular structures. A guide wire was introduced through the distal clavicle and advanced across the coracoclavicular interval into the center of the coracoid base under fluoroscopic guidance. The tunnel was subsequently enlarged using a 4.5-mm cannulated reamer. A titanium endobutton loaded with number five fibre wire was then inserted through the tunnel and deployed at the inferior surface of the coracoid.

Once the endobutton was confirmed to have flipped securely beneath the coracoid base, the free ends of the fibre wire were tensioned superiorly over the clavicle. Manual reduction of the AC joint was achieved by applying downward pressure on the distal clavicle while elevating the arm. The fibre wire was tied securely over a second endobutton positioned on the superior surface of the clavicle to complete the suspensory fixation construct [Figure 3]. Intraoperative fluoroscopy was utilized to confirm correct implant position and restoration of the coracoclavicular distance. The deltoid muscle was approximated, and the wound was closed in layers. A sterile compressive dressing was applied, and all patients were immobilized in a shoulder arm sling for six weeks postoperatively.

Postoperative rehabilitation followed a standardized protocol. Suture removal was performed at two weeks. Passive pendulum exercises were initiated after the third postoperative week and continued until six weeks. Active range-of-motion exercises, including forward flexion, abduction, internal and external rotation, and scapular shrugging, were gradually introduced between the sixth and tenth postoperative week. Strengthening exercises were commenced after radiological evidence of maintained reduction.

Patients were reviewed at four weeks, eight weeks, three months, and six months after surgery [Figure 4 & 5]. Functional outcomes were assessed using the University of California Los Angeles (UCLA) Shoulder Score and Constant-Murley Score at each follow-up visit. Radiological evaluation included measurement of coracoclavicular distance using standardized plain radiographs. All data were entered into Microsoft Excel 2010 and analysed using SPSS version 17. Statistical tests were selected based on data distribution, and significance was set at $p < 0.05$.

RESULTS

A total of twenty-one patients met the inclusion criteria and underwent double endobutton fixation for acromioclavicular joint dislocation. All patients were male, with a mean age of 44.47 years. More than half of the study population (52.4%) belonged to the 20–40-year age group, while the remaining patients were evenly distributed between the 41–60 years and 61–80 years categories. The majority of injuries (71.4%) occurred on the left side, and all patients were right-hand dominant. Road traffic accidents constituted the predominant mechanism of injury, accounting for 86 percent of cases, whereas falls from height and slip-and-fall incidents comprised nine percent and five percent, respectively. Rockwood type III dislocations were the most frequent (67 percent), followed by type V (19 percent) and type IV dislocations (14 percent).

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Functional outcomes demonstrated progressive improvement over the follow-up period. The UCLA Shoulder Score at one month revealed that most patients exhibited poor or only fair function, primarily due to postoperative pain and restricted motion. By the second month, however, there was a marked shift, with two-thirds of patients achieving good outcomes and 14.3 percent attaining excellent results. This improvement continued over time, and by the third month, 75 percent of evaluated patients demonstrated excellent shoulder function. At the final six-month follow-up, 83.3 percent of patients achieved excellent UCLA scores, and the remaining patients displayed good functional recovery. Paired statistical analysis revealed significant improvements in scores between one, two, and three months when each was compared with the six-month score ($p < 0.001$), indicating steady and clinically meaningful functional recovery.

Similar trends were observed with the Constant-Murley Score. At the first month, 62 percent of patients were classified as having poor shoulder function, reflecting early postoperative pain and stiffness. This distribution changed substantially by the second month, with 52.4 percent achieving excellent scores and only a small fraction remaining in the poor category. At three months, 31.6 percent of patients were classified as excellent, and by six months, the overwhelming majority (94.2 percent) had achieved excellent outcomes, with only one patient categorized as fair. The improvement across time points was statistically significant ($p < 0.001$), confirming a strong correlation between rehabilitation progression and functional outcomes.

Radiological evaluation demonstrated significant restoration of acromioclavicular alignment. The mean preoperative coracoclavicular distance was 18.07 mm, which decreased significantly to 10.71 mm in the immediate postoperative period ($p < 0.001$). This reduction reflects successful anatomical restoration of the joint. Loss of reduction occurred in three patients (14.3 percent) during the follow-up period; however, these cases were mild and managed conservatively without surgical revision. A moderate positive correlation was found between postoperative coracoclavicular distance and Constant-Murley Score at six months ($r = 0.582$, $p = 0.014$), indicating that better radiological alignment tended to be associated with superior shoulder function. Although a weak negative correlation was observed between UCLA score and coracoclavicular distance, this relationship did not reach statistical significance.

Complications were minimal. Eighteen patients (86 percent) had an uneventful postoperative course. Shoulder stiffness occurred in one patient and improved with physiotherapy. Two cases of loss of reduction were identified during follow-up but remained clinically acceptable and did not warrant reoperation. No patient experienced implant-related complications such as implant migration, breakage, or wound infection.

Overall, the results demonstrate that the double endobutton technique provided effective radiological reduction and progressive functional improvement in the majority of patients, with a low incidence of complications and a high rate of satisfactory recovery by six months.

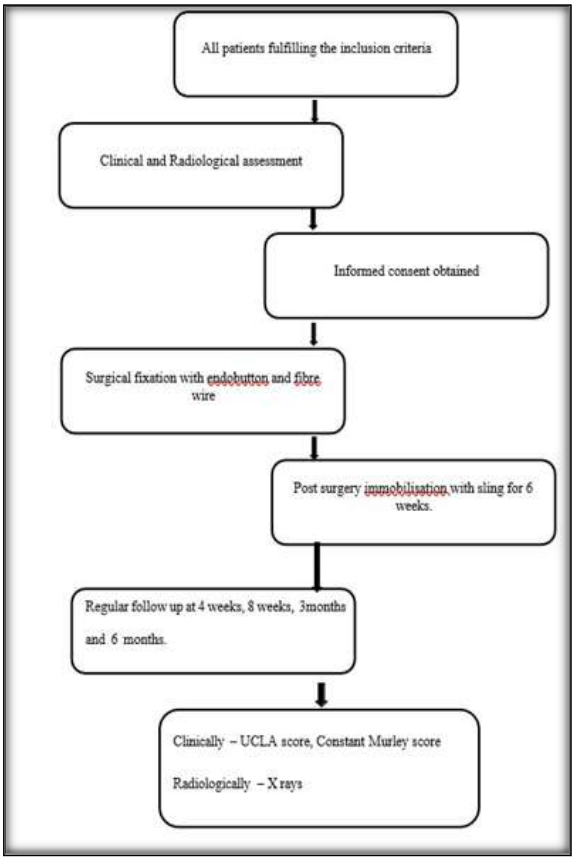

Figure 1 Flowchart of patient selection

Figure 2 Skin markings and incision

Figure 3: Endobutton and fiber wire application technique

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Figure 4: Functional and radiological outcome (Pre OP -A, B) (Immediate, 1month, 3 months and 6 months postop Xray respectively- C, D, E, F) (Functional Range of movements at 6 months-G) – Case 1

Figure 5: Functional and radiological outcome (Pre OP -A, B) (Immediate, 1month, 3 months and 6 months postop Xray respectively- C, D, E, F) (Functional Range of movements at 6 months-G) – Case 2

Table 1: Comparison of UCLA scores at 1st and 6th month

Pair	N	Mean	S. D	t value	p value
UCLA 1M	21	22.43	4.76	-12.15	<0.0001
UCLA 6M	21	34.48	0.51		

Table 2: Comparison of CMS scores at 1st and 6th month

Pair	CMS	N	Mean	S. D	t value	p value
Pair 1	CMS 1M	21	30.00	7.477	17.63	<0.0001
	CMS 6M	21	1.33	2.44		

Table 3: Comparison of Functional and radiological scores at 1st and 6th month

	Mean	SD	Correlation	p-value
Post-op CC Distance	10.714	2.88	0.46	0.037
UCLA 6M	34.88	0.51		
	Mean	SD	Correlation	p-value
Post-op CC Distance	10.714	2.88	0.53	0.014
CMS 6M	1,33	0.485		

DISCUSSION

Acromioclavicular (AC) joint dislocations represent a common challenge in orthopaedic trauma, particularly among young and active individuals exposed to high-energy mechanisms such as road traffic accidents or contact sports. The optimal treatment approach, especially for Rockwood type III injuries, continues to generate debate despite numerous studies evaluating both operative and non-operative strategies. The present study evaluated the functional and radiological outcomes of acute AC joint injuries managed with a double endobutton fixation technique and demonstrated favourable short-term results with minimal complications. These findings align with the growing body of evidence supporting suspensory fixation systems as a reliable alternative to rigid hardware constructs.

The demographic profile of our study population showed a predominance of young to middle-aged males, consistent with the epidemiological patterns described by Mazzocca et al,[9] and Headey et al,[10] who reported the highest incidence among physically active males subjected to high-energy trauma. The strong association with road traffic accidents observed in our cohort contrasts with Western literature, where contact sports such as rugby and ice hockey are more frequently implicated. This variation underscores the regional differences in injury mechanisms and highlights the need for population-specific treatment strategies.

The double endobutton technique used in our study demonstrated significant improvement in functional scores over the six-month follow-up period. The proportion of patients achieving excellent UCLA and Constant-Murley Scores increased markedly between the first and sixth months, reflecting progressive pain reduction, restoration of strength, and improved range of motion. These findings correspond closely with previously published series [Table 1and 2]. Struhl and Wolfson reported a mean Constant-Murley Score of 98 using the closed-loop endobutton system, while Sharma et al,[11] and Montoya et al,[12] reported similarly high functional outcomes following minimally invasive double-button fixation. The consistent improvement across studies reinforces the biomechanical advantages of suspensory fixation, which allows controlled micro-motion at the AC joint and more closely replicates the natural behaviour of the coracoclavicular ligament complex.

Radiological outcomes in our study further support the effectiveness of the technique. The mean coracoclavicular (CC) distance was significantly reduced postoperatively, demonstrating satisfactory anatomical reduction. Similar reductions have been documented by Torkaman et al,[13] and Yapici et al,[14] who also noted that postoperative CC distance correlates with improved shoulder function. In our study, a moderate positive correlation was observed between CC distance and Constant-Murley Score at six months, suggesting that restoration of anatomical alignment contributes meaningfully to functional recovery. However, this correlation was not

ISSN (O): 2687-5365; ISSN (P): 2753-6556

significant for the UCLA score, highlighting that functional recovery is multifactorial and influenced by shoulder mechanics, muscle strength, rehabilitation compliance, and pain tolerance [Table 3].

Loss of reduction remains one of the most frequently reported complications following endobutton or tightrope fixation, with studies quoting rates ranging from 10% to 30%. In our study, loss of reduction occurred in 14.3% of patients, consistent with previously published data. Importantly, the loss of reduction was mild in all affected cases and did not necessitate revision surgery. Similar findings were described by Zanfaly et al., Shin and Kim, and Zhang et al., who observed that most cases of loss of reduction do not translate into poor functional outcomes when the residual displacement is minimal.[15-17] This suggests that the suspensory construct maintains functional integrity even when minor radiological changes occur over time.

Compared with traditional fixation methods such as the Bosworth screw or AC hook plate, the double endobutton technique appears to offer distinct advantages. Hook plates, while effective in restoring reduction, are associated with acromial osteolysis, subacromial irritation, supraspinatus tendon compression, and the need for routine hardware removal. These drawbacks have been consistently documented by Oh et al., Salem and Schmelz, and others.[18-20] Similarly, coracoclavicular screws restrict physiological scapulothoracic motion and have been associated with screw loosening and breakage. In contrast, the double-button technique allows dynamic stabilization while preserving the natural motion of the AC joint, thereby minimizing hardware-related complications and negating the need for secondary implant removal.

Despite these advantages, certain limitations of the technique and our study merit consideration. Fibre wire fatigue, coracoid erosion, foreign-body reactions, and implant migration have been described in the literature, although none of these complications were observed in our cohort. The absence of such complications may be attributed to meticulous surgical technique and the relatively short follow-up duration. Longer follow-up is necessary to assess the development of late complications such as osteoarthritis of the AC joint or failure of the suspensory mechanism under long-term cyclic loading.

The present study's results support the growing consensus that double endobutton constructs provide reliable radiological reduction and excellent functional outcomes. However, the small sample size and lack of a control group limit the generalizability of the findings. Comparative trials evaluating double endobutton systems against other methods such as hook plating, suture-anchor techniques, or biologic ligament reconstruction would be valuable in defining the optimal management strategy for AC joint injuries. High-quality, multi-centre randomized controlled trials with extended follow-up periods would further clarify the long-term safety and efficacy of this technique.

Overall, our study reinforces the applicability of the double endobutton technique as a safe, efficient, and biomechanically favourable method for managing acute AC joint dislocation. It offers distinct advantages over traditional rigid fixation methods and demonstrates predictable clinical and radiological improvement with a low rate of complications.

CONCLUSION

The double endobutton technique demonstrated excellent short-term clinical and radiological outcomes in the management of acute acromioclavicular joint dislocations. Patients experienced steady improvement in pain relief, shoulder mobility, and functional scores, with most achieving excellent outcomes by six months. Radiological assessment confirmed stable restoration of the coracoclavicular distance, and postoperative complications were minimal and manageable without the need for revision surgery.

Although the results are promising, they should be interpreted with caution due to certain limitations. The study included a relatively small sample size and had a limited follow-up period, which restricts the ability to assess long-term construct durability or the development of late complications. Additionally, the absence of a comparative control group limits direct evaluation against other fixation methods. Larger multicentre studies with longer follow-up durations are recommended to validate these findings and further determine the long-term efficacy and reliability of the double endobutton technique.

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ISSN (O): 2687-5365; ISSN (P): 2753-6556

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ISSN (O): 2687-5365; ISSN (P): 2753-6556