

Clinical and Radiological Evaluation of Double Endobutton Fixation in Acute Acromioclavicular Joint Injuries and Unstable Lateral Clavicle Fractures: A Prospective Observational Study

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Abstract

Background: Acromioclavicular (AC) joint injuries and unstable lateral clavicle fractures are common shoulder girdle injuries that frequently affect young and active individuals. High-grade AC joint dislocations and unstable distal clavicle fractures often require surgical stabilization because of persistent instability, functional impairment, and a high risk of nonunion. Double Endobutton fixation has proven to be a biomechanically advantageous procedure that restores coracoclavicular stability but allows for natural shoulder function. The objective is to evaluate the functional and radiological outcomes of double Endobutton fixation with Fiber Wire in patients with acute acromioclavicular joint injuries and unstable lateral clavicle fractures. **Material and Methods:** It was a prospective observational study done in the Department of Orthopaedics in tertiary care teaching hospital. Thirty patients with acute injuries to the AC joint and/or lateral clavicle fractures that were unstable were treated with double Endobutton fixation. Double Endobutton fixation was performed on 30 patients with acute AC joint injuries and/or unstable lateral clavicle fractures. The patients were clinically and radiologically followed for 6 months. Functional outcome was evaluated by the Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) score, and radiological evaluation was carried out on maintenance of reduction, coracoclavicular distance and fracture union. Postoperative complications also were noted. **Results:** 30 patients (80.0% male) aged 36.00 ± 8.20 years were included in the study. 63.3% of falls were the most common mechanism of injury. At six months, radiological reduction was maintained in 83.3% of patients, while mild and significant loss of reduction occurred in 13.3% and 3.3% of cases, respectively. The mean fracture union time for patients sustaining lateral clavicle fractures was 12.31 ± 1.32 weeks and all fractures united within 14 weeks. Our complications were rare, with only 6.7% of patients having a superficial infection. At six months, there was no significant relationship between the radiological reduction status and the QuickDASH score ($p = 0.623$ and $p = 0.191$). **Conclusion:** Double Endobutton fixation is effective in providing stabilization of acute acromioclavicular joint injuries and unstable lateral clavicle fractures. The technique is linked with good functional outcome, adequate radiological results, easy to keep reduction and low complication rates. It is a good surgical choice in appropriately selected patients to restore shoulder function and stability.

Keywords: Acromioclavicular joint injury, Double Endobutton, Lateral clavicle fracture, Coracoclavicular fixation and QuickDASH are keywords.

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INTRODUCTION

AC joint injuries and fractures of the distal clavicle are major components of shoulder girdle trauma, and account for a large number of cases especially in young and physically active patients. Such injuries are often caused by collisions in traffic, sports-related injuries and falls on the lateral side of the shoulder. If the acromioclavicular and coracoclavicular ligament complex is disrupted, the resulting pain, deformity, instability and significant functional loss may be preventable if treated properly.^[1]

The AC joint is a critical joint for the upper extremity that is crucial for scapulohoracic rhythm and for shoulder biomechanics. Injuries to AC joints tend to be high-grade, especially lesions of Rockwood type III–VI, and lead to a loss of stability in most cases. Similarly, the distal clavicle (specifically Neer type II fractures) have a high tendency to

displace and not heal due to failure of the coracoclavicular ligament complex.^[2]

A variety of surgical procedures have been proposed to deal with these traumas; fixation with Kirschner wires, fixation with bosworth screws, hook fixation, Weaver–Dunn reconstruction and several ligament reconstruction techniques. While many of

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these procedures are effective at reducing the size, there are issues including hardware migration, implant failure, subacromial impingement, osteolysis and the requirement for implant removal to consider.^[3]

With the latest developments in shoulder surgery, there has been a shift towards techniques that preserve and restore the native biomechanics of the shoulder while reducing the risk of complications associated with shoulder implants. It is the suspenders fixation with cortex button device that has become a favored method which mimics the role of coracoclavicular ligaments but maintains physiological motion. Two cortical buttons are joined by high-strength sutures to enable stable fixation and good load distribution, the double Endobutton technique.^[4]

Biomechanical research studies have shown that double Endobutton constructions offer very good resistance against superior displacement and against cyclic loading and have an anti-implant failure effect. This technique enables controlled micromotion, and normal shoulder motion to be better reproduced than with rigid fixation procedures. Thus, this technique is now becoming more popular in the treatment of both the acute AC joint disabling dislocation and the unstable lateral clavicle fracture.^[5]

Double Endobutton fixation has been reported as a viable technique in clinical studies with encouraging results, such as better pain reduction, recovery of functional capacity, maintenance of reduction, and early return to activities. However, the safety of reduction loss, widening of the tunnels, clavicular fracture and durability remain under study. In addition, there is a lack of prospective data from tertiary care centers in India.^[6]

The aims of this prospective observational study were thus to investigate the functional and radiological results of double Endobutton fixation of patients with acute acromioclavicular joint injuries and unstable clavicle fractures lateral to the acromion. The purpose of the study was to evaluate functional recovery, radiologic maintenance of reduction, fracture union and postoperative complications associated with this procedure.

MATERIALS AND METHODS

The study was prospective observation study which was conducted in orthopaedics department in Netaji Subhash Chandra Bose Medical College and Associated Hospital, Jabalpur, India. From written informed consent, 30 consecutive eligible patients were recruited and underwent double Endobutton surgical stabilization. The outcome of clinical, functional and radiological evaluation was carried out systematically over a period of at least six months for all patients in a prospective manner.

Inclusion Criteria

- Age ≥ 18 years.
- Acute acromioclavicular joint injury presenting within three weeks of trauma.
- Rockwood Type III, IV, V, or VI acromioclavicular joint dislocation.
- Unstable lateral clavicle fractures, including Neer Type II fractures.

- Patients willing to undergo surgical intervention and regular follow-up evaluations.

Exclusion Criteria

- Chronic acromioclavicular joint injuries (>3 weeks duration).
- Open fractures or pathological fractures.
- Associated ipsilateral upper limb fractures that could influence functional assessment.
- Previous surgery involving the affected shoulder.
- Neurological disorders affecting shoulder function.
- Patients unwilling or unable to comply with follow-up protocol.

Preoperative Evaluation: All patients had a comprehensive clinical examination and radiographical evaluation before surgery. Plain AP shoulder and specific AC joint radiographs were taken. The injuries were diagnosed using Rockwood's classification for AC joint injuries and Neer's classification for injuries to the lateral clavicle. Baseline demographic data, mechanism of injury, interval between injury and surgery and clinical characteristics assessed.

Surgical Technique: All procedures were done under proper anesthesia and once the surgery performed, the anatomical reduction of acromioclavicular joint or lateral fracture of the clavicle was performed. Then two cortical buttons were fixed with high-strength FiberWire sutures (Double Endobutton fixation). The construct was tensioned enough to allow for a satisfactory coracoclavicular stability and reduction. Intraoperative fluoroscopy was used to confirm reduction prior to closing the wound.

Patients were assessed at six-week, three-month and six-month intervals following surgery.

Functional Outcome Assessment: Functional outcome was determined by using the Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) score. The lower the QuickDASH score, the greater the functional recovery and the less the disability. Change in QuickDASH score from baseline was also assessed for follow-up functional improvement, where greater improvements indicated better recovery.

Radiological Outcome Assessment

- Maintenance of reduction of the acromioclavicular joint.
- Coracoclavicular (CC) distance measurement.
- Fracture union status in patients with lateral clavicle fractures.
- Detection of implant-related complications.

Statistical Analysis: Statistical analysis was performed using SPSS version 26.0. Continuous variables were expressed as mean \pm standard deviation (SD), while categorical variables were expressed as frequencies and percentages. The independent Student's t-test was used to compare continuous variables between two groups. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations: The study was approved by Institutional Ethics Committee. Written informed consent was obtained from all participants prior to enrollment.

RESULTS

A total of 30 patients with acute acromioclavicular joint injuries and/or unstable lateral clavicle fractures who underwent double Endobutton fixation were included in the study. The majority of

patients were young adult males, with falls being the most common mechanism of injury. Functional and radiological

outcomes were assessed during follow-up, along with fracture union and postoperative complications.

Table 1: Baseline Demographic and Injury Characteristics of Study Participants (n = 30)

Variable		Frequency (n)	Percentage (%)
Age (years)	18-25	3	10%
	26-35	12	40%
	36-45	10	33.3%
	46-55	5	16.7%
	>55	0	0%
Sex	Male	24	80%
	Female	6	20%
Mode of Injury	Fall	19	63.3%
	Road Traffic Accident	11	36.7%
Diagnosis	AC Joint Injury	17	56.7%
	Lateral Clavicle Fracture	13	43.3%
Rockwood Classification (n = 17)	Type III	12	70.6%
	Type IV	5	29.4%
Neer Classification (n = 13)	Type IIa	7	53.8%
	Type IIb	6	46.2%

Mean Age: 36.00 ± 8.20 years (Range: 22–50 years)

The study population predominantly consisted of young adult males, with a mean age of 36.00 ± 8.20 years. The majority of injuries resulted from falls (63.3%). AC joint injuries constituted 56.7% of cases, while lateral clavicle fractures accounted for 43.3%. Among AC joint injuries, Rockwood Type III was the most common subtype (70.6%), whereas Neer Type IIA fractures were slightly more frequent than Type IIB fractures in the lateral clavicle fracture subgroup. At six months follow-up, satisfactory maintenance of reduction was achieved in 83.3% of patients. Mild loss of reduction was observed in 13.3% of cases, while significant loss of reduction (>50%) occurred in only one patient (3.3%), indicating reliable radiological stability with the double Endobutton construct.

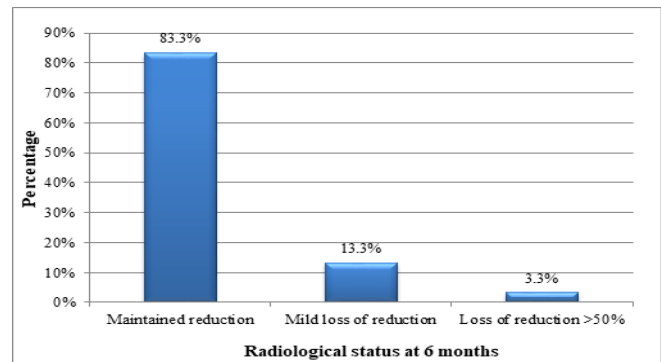


Figure 1: Radiological Outcome at 6 Months Following Double Endobutton Fixation (n = 30).

Table 2: Fracture union time (weeks) — descriptive statistics

Parameter	Value
Mean Union Time (weeks)	12.31 ± 1.32
Range (weeks)	10–14

Table 3: Distribution of union time (weeks) (lateral clavicle fracture)

Union Time (weeks)	Frequency (n)	Percentage (%)
10	1	7.7%
11	3	23.1%
12	3	23.1%
13	3	23.1%
14	3	23.1%

The mean fracture union time was 12.31 ± 1.32 weeks. Most fractures achieved union between 11 and 14 weeks, reflecting

satisfactory fracture healing following double Endobutton fixation.

Table 4: Postoperative Complications (n = 30)

Complications	Frequency (n)	Percentage (%)
None	28	93.3%
Superficial Infection	2	6.7%

Postoperative complications were uncommon. No complication was observed in 93.3% of patients. Superficial infection occurred in only two patients (6.7%) and was

managed conservatively without adverse effects on final outcome.

Table 5: Maintained Reduction vs Any Loss of Reduction

Reduction Status(n)	Mean QuickDASH ± SD	t-value	p-value
Maintained Reduction (25)	10.48 ± 1.12	0.497	0.623
Any Loss of Reduction (5)	10.20 ± 1.30		

Table 6: Comparison across Three Radiological Outcome Categories

Radiological Status	Number	Mean Rank (QuickDASH)
Maintained Reduction	25	15.86
Mild Loss of Reduction	4	10.38
Loss of Reduction >50%	1	27.00
Statistical Test	Value	
Kruskal-Wallis H	3.310	
Degrees of Freedom	2	
p-value	0.191	

There was no statistically significant association between radiological reduction status and QuickDASH score at six months ($p = 0.623$ and $p = 0.191$, respectively). These findings suggest that minor radiological loss of reduction did not adversely affect short-term functional outcomes.

DISCUSSION

The study showed good clinical and radiological results, satisfactory maintenance of reduction in 83.3% of the patients, the mean time of fracture union was 12.31 ± 1.32 weeks in the lateral clavicle fracture group and a low rate of complications. Functional assessment at final follow-up also revealed excellent patient-reported outcomes that further justified the stability and function that the double Endobutton construct restores to the shoulder.^[7]

The present study showed that there was a significant predominance of young adult males with mean age of 36.0 years, and falls as the most common mechanism of injury. In a similar study, Gupta et al. concluded that high-energy trauma and falls are commonly associated with Acromioclavicular (AC) joint injuries and this is common among young active individuals.^[8] This higher prevalence among males may be explained by more involvement in occupations and outdoor activities which pose a risk of harm to the shoulder.

The current study found the most common injury to be an AC joint lesion (56.7%) as opposed to an unstable lateral clavicle fracture (43.3%). Rockwood type III injury was the most common AC joint injury subtype and Neer type IIA fracture was slightly more common than Neer type IIB fracture. The results of this study are similar to that of Vulliet et al., who found Rockwood type III injuries to constitute a significant portion of those that are surgically treated and unstable Neer type II fractures to be a common operative indication for AC joint stabilization.^[9]

83.3% of patients showed maintenance of reduction at 6 months in radiological assessment. Only in 13.3% patients, mild loss of reduction was observed and in only one patient was significant loss of reduction observed. Aliberti et al. performed a systematic review of the radiological outcomes of suspensory fixation techniques, which revealed similar results with the majority of papers showing good maintenance of reduction with the cortical button constructs.^[4] The results of this study indicate the biomechanical benefits of double Endobutton fixation in maintaining coracoclavicular stability with good radiological results.

The mean duration of fracture union was 12.31 weeks, and all fractures united within 14 weeks, in patients with fractures

of the lateral part of the clavicle. The outcome of these techniques is similar to what Oh et al. reported in their study of coracoclavicular stabilization techniques for unstable distal clavicle fractures; they included reliable fracture healing with satisfactory functional results.^[10] Favorable collapse prevention due to stable fixation and preservation of the fracture site's biological environment might be responsible for early fracture union.

Only two superficial infections occurred, which were successfully treated with conservative treatment, and the rate of complications in the present study was low. No major complications regarding the implants were seen or encountered nor was there a case of fixation failure or neurovascular injury. The safety of modern suspensory fixation systems has also been documented, with similar low complication rates reported by Shin et al. when compared to traditional fixation systems (Hook plates and transacromial Kirschner wires).^[11]

One of the fascinating results of the present study was that there was no statistically significant relationship between the radiological reduction status and QuickDASH score at six months. Patients who had mild loss of reduction had functioning that was similar to patients who had maintained reduction. This has also been noted in recent studies which indicate that while radiological displacement may be minor, it does not imply clinical consequences of functional impairment.^[12] It highlights the value of using patient-reported functional outcomes, as well as the radiographic parameters, for assessment.^[13]

The study was limited by the following: The number of participants was limited and the follow-up period was short (six months). Because comparisons with other fixation techniques were not possible, there is no direct comparison. Moreover, long-term results, implant-related complications and post-traumatic degenerative changes were not evaluated. These findings should be further confirmed by multicenter studies of larger numbers of patients and longer duration of follow-up.

CONCLUSION

The Double Endobutton fixation technique is an effective repair method and a reliable approach for repair of the acromioclavicular joint injuries and unstable lateral clavicle fractures. The technique produces great radiological stability, good fracture union, marked functional improvement, and limited complications. Favorable clinical and radiological results were obtained in most of the patients after six months of follow-up. In addition, there was not a significant decrease in functional recovery with slight radiological loss of reduction. This study's results lend to the concept of double Endobutton fixation, as it is a reliable and safe technique with appropriate patient selection for shoulder stability and function restoration.

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Conflicts of interest

There are no conflicts of interest.

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