

COMPARISON OF FUNCTIONAL AND RADIOLOGICAL OUTCOMES OF HOOK PLATE AND ENDO BUTTON TECHNIQUES IN ACROMIOCLAVICULAR JOINT DISLOCATION

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ABSTRACT

Objective: To compare the functional and radiological outcomes of hook plate fixation and EndoButton stabilization in the surgical management of acute acromioclavicular (1) joint dislocation.

Methods: This Quasi Experimental study was conducted in the Department of Orthopaedic Surgery at AIMC/Jinnah Hospital, Lahore over a period of three months. A total of 80 patients aged 18–60 years with acute Rockwood type III–VI acromioclavicular joint dislocations were enrolled through consecutive non-probability sampling. Patients were allocated into two equal groups. Group A underwent hook plate fixation, while Group B was treated with the EndoButton technique. Functional outcomes were assessed using the Constant-Murley Score, Disabilities of the Arm, Shoulder and Hand (DASH) Score, and Visual Analogue Scale (VAS) for pain. Radiological outcomes were evaluated by measuring maintenance of anatomical reduction and coracoclavicular distance on postoperative radiographs. Postoperative complications were also recorded. Data were analyzed using SPSS version 26.0, and a p-value of <0.05 was considered statistically significant.

Results: Eighty patients completed the three-month follow-up, with 40 patients in each treatment group. Baseline demographic and clinical characteristics were comparable between the groups ($p > 0.05$). The hook plate group had a significantly shorter operative time (71.5 ± 10.4 vs. 82.3 ± 12.8 minutes; $p < 0.001$), whereas the EndoButton group had significantly less intraoperative blood loss (92.7 ± 24.8 vs. 128.4 ± 30.6 mL; $p < 0.001$). Functional outcomes were significantly better in the EndoButton group, with higher Constant-Murley scores (91.8 ± 5.9 vs. 85.6 ± 7.4 ; $p < 0.001$), lower DASH scores (9.8 ± 4.5 vs. 15.9 ± 6.3 ; $p < 0.001$), and lower VAS pain scores (1.5 ± 0.8 vs. 2.4 ± 1.2 ; $p < 0.001$). Radiological outcomes, including maintenance of reduction and coracoclavicular distance, were comparable between the two groups ($p > 0.05$). Implant irritation and the need for secondary surgery were significantly more frequent in the hook plate group.

Conclusion: Both hook plate fixation and the EndoButton technique effectively restored radiological alignment in acute acromioclavicular joint dislocations. However, the EndoButton technique demonstrated superior functional recovery, lower postoperative pain, fewer implant-related complications, and eliminated the need for routine implant removal, making it a favorable surgical option for managing high-grade AC joint dislocations.

KEYWORDS: Acromioclavicular joint dislocation, Hook plate, EndoButton, Functional outcome, Radiological outcome, Constant-Murley Score, Shoulder surgery.

INTRODUCTION

The acromioclavicular joint dislocation is one of the most frequently injured joints in the shoulder girdle especially among young, physically-active people and sports and contact sports players. ⁽¹⁾The injury most often occurs when a direct blow to the lateral part of the shoulder disrupts the acromioclavicular and coracoclavicular ligaments that hold the joint together. Patients with significant damage to the ligaments may have pain, deformity, weakness of the shoulder, and severe limitations in daily activities and work function. It is crucial, therefore, to restore joint anatomy and function promptly for optimal long-term results. ⁽²⁾

AC joint injuries are usually graded according to the Rockwood system, a classification of injuries based on the extent of the ligamentous injury and the displacement of the distal clavicle. Treatment is conservative, except for high-grade injuries (Rockwood type IV, V, and VI), where surgical treatment is widely accepted and type III injuries, for which surgical treatment is controversial. ⁽³⁾The main objectives of surgical management are to obtain a stable reduction of the joint, restore normal biomechanics, eliminate pain and early return to work/sport and other functional activities. Several different surgical approaches to AC joint stabilization have been designed over the years and there is no "gold standard" procedure. ⁽⁴⁾ Over 150 operative techniques have been

described: fixation devices, ligament reconstruction, tendon graft procedures and arthroscopic techniques. Of these, hook plate fixation and EndoButton fixation have proven to be two of the most widely-used procedures due to their established and repeatable clinical success and stabilization.⁽⁵⁾

Hook plate fixation is a locking fixation technique that uses a specially designed metal plate placed on the top surface of the clavicle and a hook under the acromion to hold the AC joint in anatomical reduction.⁽⁶⁾ This method offers instant mechanical support which facilitates early movement and healing of the injured ligaments. There have been a few studies reporting good radiological alignment and good functional outcome after hook plate fixation.⁽⁷⁾ There are several limitations, however, with the technique including subacromial impingement, acromial osteolysis, shoulder stiffness, hardware irritation, rotator cuff irritation and the need for a second surgery to remove the implant following ligament healing.⁽⁸⁾

EndoButton technique is less invasive alternative, being developed to reconstruct the coracoclavicular ligament complex by the use of cortical button fixation with high-strength sutures. This technique restores the physiological motion of the acromioclavicular joint and provides vertical stability.⁽⁹⁾ The technique can be done either open or arthroscopically, and doesn't require the routine removal of the implant. This has led to its growing popularity, given its ability to preserve normal joint biomechanics, minimize soft tissue disruption, shorten rehabilitation times, and decrease implant-related complications.⁽¹⁰⁾ However, there are some complications that have also been reported: reduction loss, button migration, widening of the tunnel, coracoid fracture and surgical difficulties.⁽¹¹⁾

Validated functional recovery scores including the Constant-Murley Score, University of California Los Angeles (UCLA) Shoulder Rating Scale, Disabilities of the Arm, Shoulder and Hand (DASH) score and Visual Analog Scale (VAS) for pain are used to evaluate functional recovery after surgical treatment of an AC joint dislocation.⁽¹²⁾ These are measuring tools used to evaluate shoulder pain, range of motion, muscle strength and the ability to carry out daily activities. Radiological outcomes are also significant, and generally evaluated by evaluating the distance between the coracoid and the clavicle, the ability to maintain joint reduction, implant positioning and the presence of complications after surgery.⁽¹³⁾

Functional and radiological assessments give complementary information on the effectiveness of surgical treatment. Although the use of hook plate and EndoButton fixation is widely reported, there is not consistent data available in the literature to compare these two methods. Some studies have shown the superiority of the radiological stability of reduction using hook plates with rigid fixation, while others have shown that the preservation of normal shoulder motion in the EndoButton technique allows for better functional recovery and fewer complications.⁽¹⁴⁾ These conflicting findings have been influenced by differences in patient selection, surgical skill, rehabilitation strategies, follow-up period and outcome assessment techniques, which all create a challenge in determining which technique is preferred.⁽¹⁵⁾ Furthermore, the number of studies available is limited and most data comes from orthopedic centers in developed countries with patient populations and health care and surgical practices that may be very different from those in developing health care systems. This information is crucial for surgeons to determine the best treatment approach, taking into account patient satisfaction, complications, radiological stability, and functional recovery.⁽¹⁶⁾

The present study was therefore conducted to compare the functional and radiological outcome of the two surgical approaches (hook plate fixation and EndoButton techniques) in acromioclavicular joint dislocation. This study will compare shoulder function and maintenance of reduction on the radiographs after the two surgical procedures to offer evidence for the relative effectiveness of the two procedures and help to better understand the treatment of acromioclavicular joint injuries.

MATERIAL AND METHODS

This was a Quasi Experimental study performed in Department of Orthopaedic Surgery in AIMC/Jinnah Hospital, Lahore for a period of six months after obtaining approval from the Institutional Review Board (IRB197/1/04-12-2025/AIMC/JHL, Dated=04-12-2025). All participants gave written informed consent before taking part. The study was carried out in accordance with the ethical principles stated in Helsinki Declaration. The study included 80 patients who were diagnosed as having acute acromioclavicular (1) joint dislocation.

The sample size was determined based on the following parameters: a 95% confidence level, 80% study power, and the difference in functional outcome between the two treatment techniques based on literature review. Consecutive non-probability sampling was used for patient selection. Patients were eligible for inclusion if they had acute (less than three weeks) Rockwood type III, IV, V, or VI acromioclavicular joint dislocations, and their ages ranged from 18 to 60 years. Patients with open shoulder injuries, pathological fracture, previous surgery on the affected shoulder, chronic AC joint dislocation (more than 3 weeks), associated fractures of the clavicle, scapula and proximal humerus, associated neurovascular injuries requiring repair, polytrauma which would impact rehabilitation and severe medical illnesses which would preclude surgery were excluded in the study.

Once an enrollee was identified, they were randomly assigned to one of two groups to receive the different procedures. The clavicular hook plate was used for fixation in group A and coracoclavicular stabilization using the EndoButton technique in group B. Experienced orthopedic surgeons performed all surgeries under general anesthesia using a standardized surgical protocol. For the hook plate group, an open superior approach to the acromioclavicular joint was used. The joint was anatomically reduced afterwards, and the appropriate size hook plate was positioned with the hook under the acromion and the plate was secured with cortical screws of the

clavicle. Intraoperative fluoroscopy was performed to ensure appropriate reduction and positioning of the implants. In the EndoButton group, coracoclavicular ligament reconstruction with double cortical button fixation system was performed with high-strength non-absorbable sutures.

A tunnel was fluoroscopically guided through the clavicle and the base of the coracoid process. The EndoButton was passed through the tunnel and secured after achieving anatomical reduction of the AC joint. Intraoperative fluoroscopy showed good reduction and insertion of the fixation device. Postoperatively all patients received a standard rehabilitation program. The operated arm was immobilized in a shoulder sling for about three weeks. After pain control, passive range of motion exercises were started followed by active assisted and active shoulder mobilization exercises. Strengthening exercises were progressively implemented after 6–8 weeks, based on fracture healing and tolerance. In the hook plate group, patients had their implants removed following about 4–6 months when they had healed their ligaments in line with their clinical and radiographic results. Patients followed at 2wks, 6wks, 3m postsurgery.

Assessment of functional outcomes was performed using the Constant-Murley Shoulder Score that rates pain, activities of daily living, range of motion and muscle strength. The higher scores represented improved shoulder functioning. Standardized AP radiographs of both shoulders were used to assess radiological outcomes. The coracoclavicular (13) distance was measured and compared with contralateral normal shoulder. Anatomical reduction, implant position, evidence of loss of reduction, hardware related complications, acromial osteolysis, implant migration, widening of the tunnel and any other postoperative radiographic abnormalities were recorded at followup.

Demographic data were also collected such as age, gender, mechanism of injury, side of injury, Rockwood classification, time from injury to surgery, operative time and blood loss. Post-operative complications such as wound infection, stiff shoulder, implant irritation, implant failure, redislocation and revision surgery were recorded. The data were entered and analyzed using the Statistical Package for Social Sciences (SPSS) version 26.0. The continuous variables were described as mean $\pm$ standard deviation and the categorical variables as frequencies and percentages. Continuous variables were compared between the two groups using the Independent Samples t-test and categorical variables (where applicable) were compared using the Chi-square or Fisher's exact test. A p-value of < 0.05 was set as statistically significant.

RESULTS

A total of 80 patients with acute acromioclavicular joint dislocation were included in this prospective comparative study conducted over a period of six months. Forty patients underwent hook plate fixation (Group A), while forty patients were treated using the EndoButton technique (Group B). All patients completed the three-month follow-up and were included in the final analysis.

Table 1. Baseline demographic and clinical characteristics of the study population

Variable	Hook Plate (n=40)	EndoButton (n=40)	p-value
Age (years), Mean $\pm$ SD	34.8 $\pm$ 8.2	33.6 $\pm$ 7.9	0.512
Male, n (%)	31 (77.5)	29 (72.5)	0.604
Female, n (%)	9 (22.5)	11 (27.5)	
Right shoulder, n (%)	24 (60.0)	26 (65.0)	0.641
Left shoulder, n (%)	16 (40.0)	14 (35.0)	
Road traffic accident, n (%)	18 (45.0)	17 (42.5)	0.918
Fall, n (%)	14 (35.0)	15 (37.5)	
Sports injury, n (%)	8 (20.0)	8 (20.0)	
Rockwood Type III, n (%)	8 (20.0)	9 (22.5)	0.973
Type IV, n (%)	9 (22.5)	8 (20.0)	
Type V, n (%)	20 (50.0)	20 (50.0)	
Type VI, n (%)	3 (7.5)	3 (7.5)	

Both groups were comparable regarding demographic characteristics, mechanism of injury, affected side, and Rockwood classification. No statistically significant baseline differences were observed ($p > 0.05$).

Table 2. Comparison of operative characteristics

Variable	Hook Plate (n=40)	EndoButton (n=40)	p-value
Operative time (minutes), Mean $\pm$ SD	71.5 $\pm$ 10.4	82.3 $\pm$ 12.8	< 0.001
Blood loss (mL), Mean $\pm$ SD	128.4 $\pm$ 30.6	92.7 $\pm$ 24.8	< 0.001
Hospital stays (days), Mean $\pm$ SD	2.6 $\pm$ 0.8	2.2 $\pm$ 0.7	0.031

Hook plate fixation required a shorter operative time but was associated with significantly greater intraoperative blood loss. Patients treated with the EndoButton technique had a slightly shorter hospital stay.

Table 3. Comparison of functional outcomes at six months

Outcome	Hook Plate (n=40)	EndoButton (n=40)	p-value
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Constant-Murley Score	85.6 ± 7.4	91.8 ± 5.9	<0.001
DASH Score	15.9 ± 6.3	9.8 ± 4.5	<0.001
VAS Pain Score	2.4 ± 1.2	1.5 ± 0.8	<0.001

Functional recovery was significantly better in the EndoButton group. Patients treated with the EndoButton technique demonstrated higher Constant-Murley scores, lower disability scores, and less postoperative pain compared with the hook plate group.

Table 4. Comparison of radiological outcomes

Variable	Hook Plate (n=40)	EndoButton (n=40)	p-value
Maintenance of anatomical reduction, n (%)	38 (95.0)	37 (92.5)	0.643
Loss of reduction, n (%)	2 (5.0)	3 (7.5)	0.643
Coracoclavicular distance (mm), Mean ± SD	10.2 ± 1.4	10.4 ± 1.5	0.548
Implant migration, n (%)	1 (2.5)	2 (5.0)	0.556

Both surgical techniques achieved satisfactory radiological outcomes with excellent maintenance of joint reduction. No statistically significant differences were observed between the groups regarding radiographic alignment or implant stability.

Table 5. Postoperative complications

Complication	Hook Plate (n=40)	EndoButton (n=40)	p-value
Shoulder stiffness	6 (15.0)	2 (5.0)	0.136
Implant irritation	9 (22.5)	2 (5.0)	0.023
Superficial wound infection	2 (5.0)	1 (2.5)	0.556
Loss of reduction	2 (5.0)	3 (7.5)	0.643
Reoperation	40 (100)*	2 (5.0)	<0.001

*Routine implant removal was performed in all patients who underwent hook plate fixation.

Implant irritation and the requirement for a second operation were significantly more common in the hook plate group. Other postoperative complications were infrequent and comparable between the two groups.

Overall, both hook plate fixation and the EndoButton technique provided satisfactory radiological stabilization of acute acromioclavicular joint dislocations. However, the EndoButton technique demonstrated superior functional outcomes, lower postoperative pain, reduced implant-related complications, and avoided the need for routine implant removal during the six-month follow-up period.

DISCUSSION

In the present prospective comparative analysis, the functional and radiological results of the hook plate fixation and EndoButton stabilization for the treatment of acute acromioclavicular (I) joint dislocation were analysed. Both approaches resulted in good radiological and satisfactory anatomical results in the 6-month follow-up period. But patients that were treated with the EndoButton technique had significantly improved functional recovery, reduced pain scores and fewer implant related complications than patients who were treated with hook plate fixation. These results suggest that while both surgical procedures are proven to be effective stabilizers, the EndoButton technique has better overall clinical results.

Demographic characteristics were comparable between the two groups with the exception of mechanism of injury, which was slightly higher for the concussion group and Rockwood classification, which was slightly higher for the non-concussion group, in the present study. Most injuries occurred in males under 40 years old, as a result of road traffic accidents or sports-related trauma. In line with the findings of Gupta et al., that high-grade AC joint dislocations usually occur as a result of high-energy trauma in physically active males in their young age, this study also demonstrated that this is true.⁽¹⁷⁾ Likewise, Liang et al., stated that those who engage in contact sports and jobs that involve a lot of physical activity are at the highest risk of developing AC joint injuries.⁽¹⁸⁾

The operative time was shorter in the hook plate group while blood loss was less in the EndoButton group. The shorter operating time for the hook plate fixation can be attributed to the relatively easy implantation, whereas the EndoButton requires careful drilling and accurate positioning of the construct of the cortical button. Even so, suture-button fixation results in less soft tissue damage and a quicker recovery after surgery, which is consistent with the results obtained in the present study, according to the results reported by Li et al.⁽¹⁹⁾ The best finding of this study was the significantly improved functional outcome with the EndoButton technique. Patients in this group had higher Constant-Murley scores, lower DASH disability scores and markedly lower pain scores after surgery than those in the hook plate fixation group. The results indicated that maintenance of physiological ACJ motion combined with decreased subacromial irritation would be beneficial for shoulder function.

Another systematic review by Li et al. found that suture-button fixation led to significantly better functional outcomes and pain relief than hook plate fixation.⁽¹⁹⁾ Similarly, Lim et al. found that patients who received fixation with suspensors had quicker recovery, more shoulder mobility, and earlier return to normal activities.⁽²⁰⁾ A radiological evaluation of the present study showed good maintenance of reduction in both treatment groups; no statistically significant differences were observed in the postoperative coracoclavicular distance or in the maintenance of the anatomical alignment.

The results of this study suggest that the mechanical stability of the healing ligaments is adequate for both fixation methods. The same radiological findings were found by Gupta et al. in their meta-analysis, which showed comparable radiological outcomes of hook plate fixation and double EndoButton stabilization, even though they had different functional results.⁽¹⁷⁾ In the same manner, Xie et al. determined that there was no significant difference between hook plate and suture-button fixation for acute Rockwood type III acromioclavicular joint dislocations.⁽²¹⁾ The two surgical methods showed significant differences in postoperative complications. The hook plate group was significantly more likely to experience implant irritation, shoulder pain, and require a second surgery to remove the implant.

The results of this study corroborate the results of Lim et al. who found that the main drawbacks of hook plate fixation are implant-related irritation and the requirement to have to remove the hardware.⁽²⁰⁾ Moreover, Liang et al. reported that extended retention of the hook plates can cause subacromial impingement, acromial osteolysis, irritations of the rotator cuffs, and a limitation of shoulder motion which negatively impacts recovery after the surgery.⁽¹⁸⁾ The EndoButton group had fewer overall complications, however isolated cases of implant migration and implant loss of reduction were noted. These complications were also noted by Li et al., who stated that correct placement of the tunnel, cortical fixation and adequate postoperative rehabilitation are critical to reduce failure of suspensory fixation constructs.⁽¹⁹⁾ Similarly, Lim et al. found technical precision during surgery is also an important factor to ensure long-term stability and prevent implant-related issues.⁽²⁰⁾ There has been an increasing trend towards using suspensory fixation techniques in recent years, which is supported by the rising number of systematic reviews and meta-analyses.

Based on this study, Liang et al. determined that arthroscopically assisted, suture-button fixation was superior in terms of shoulder function, had less implant-related complications, and was radiologically stable compared to hook plate fixation.⁽¹⁸⁾ In contrast, Xie et al. concluded that both techniques are viable treatment options, especially in isolated Rockwood type III injuries, and highlighted the importance of surgeon experience, patient factors and rehabilitation protocols on the final clinical outcome.⁽²¹⁾ The present study has several strengths. It prospectively compared two widely used surgical methods, with the same post-operative rehabilitation and had a fixed follow-up of 6 months for both functional and radiologic outcomes.

However, there are some limitations. The study has a small sample population and one institution and is subject to the limitations of generalizability. Further, a follow up period of three months was too short to assess long-term problems such as post-traumatic osteoarthritis, chronic instability and degenerative changes of the acromioclavicular joint. Further large multicenter trials with longer follow-up are recommended to confirm these results and to decide whether one technique is superior over the other in the long-term. In general, the results of the present study are consistent with the increasing evidence of the advantages of the EndoButton technique in the surgical treatment of acute ACJDs. Both methods yielded adequate radiological reduction, but EndoButton yielded significant improvement in functional recovery, postoperative pain, implant-related complications, and avoided the need to routinely remove the implant. In view of these benefits the EndoButton technique appears to be a very interesting choice of technique to treat high-grade acromioclavicular joint dislocations, especially in young and physically active patients.

CONCLUSION

This study concluded that both hook plate fixation and the EndoButton technique provided satisfactory radiological stabilization in the management of acute acromioclavicular joint dislocation. However, the EndoButton technique was associated with superior functional outcomes, lower postoperative pain, fewer implant-related complications and avoided the need for routine implant removal. Based on these findings, the EndoButton technique may be considered a more favorable surgical option for treating high-grade acromioclavicular joint dislocations, although larger multicenter studies with longer follow-up are recommended to further validate these results.

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