



Orthopaedics

DOUBLE BUTTON FIXATION SYSTEM FOR THE TREATMENT OF ACUTE HIGH-GRADE ACROMIOCLAVICULAR JOINT DISLOCATION

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ABSTRACT **Background:** Acromioclavicular joint injuries represent the spectrum of soft tissue disruptions. These injuries usually occur in young males associated with athletic activities in which a direct blow to the lateral aspect of the shoulder occurs. Athletes belonging to the population at risk individuals, especially those who play football, rugby, or hockey. Conservative management is still considered a better modality for type 1, type 2, and some type 3 injuries. **Materials and methods:** This prospective interventional study was conducted on patients who underwent surgery for AC joint dislocation. Mini-open surgery with a double-button fixation technique was performed. Rockwood classification types 4-6 were included in the study. Proper pre-operative radiographs were obtained for better planning and management. Follow-up was taken at 2 weeks, 4 weeks, 3 months, 6 months, and 12 months. **Results:** A total of 24 patients were included in the study, with a mean age of 32.54 years. Among them 19(79.16%) were male and 5(20.83%) were females. According to Rockwood classification, 18(75%) patients belonged to type 4 injuries and 6(25%) patients to type 5 injuries. The mean VAS score at the final follow-up was 0.16 ± 0.38 which was significantly improved from the pre-operative value of 6.87 ± 1.15 . The improvement in DASH score was from 19.6 ± 2.66 pre-operatively to 0.35 ± 1.42 at 12 months postoperatively. There were no complications associated with the procedure. **Conclusion:** Acute traumatic high-grade acromioclavicular joint dislocations should be treated with operative methods. Double button fixation device using a mini-open technique provides adequate exposure, better anatomical fixation, and excellent functional outcomes.

KEYWORDS : ACROMIOCLAVICULAR INJURIES, DOUBLE BUTTON FIXATION, DASH SCORE, ROCKWOOD, MINI-OPEN TECHNIQUE.

Introduction:

The most common mechanism of injury in AC joint dislocation is a fall directly onto the dome of the shoulder, usually occurring in young athletes involved in contact sports. The injury involves the rupture of acromioclavicular and costoclavicular ligaments, it may also include tears in the clavicular attachments of the deltoid and trapezius muscles, fractures of the acromion, clavicle, and coracoid process. Rockwood classification is used to classify the AC joint dislocation^{1,2}, where in type 1 and type 2 injuries are managed conservatively⁷. Type 3 injuries are treated surgically in individuals involved in heavy manual labour. Type 4 – Type 6 injuries are unstable in both horizontal and vertical directions and therefore these injuries should be managed surgically in order to restore the normal anatomy of the AC joint^{4,5}.

Various surgical treatment modalities are currently used, which include 1) acromioclavicular reduction and fixation 2) acromioclavicular reduction, coracoclavicular ligament repair, and coracoclavicular fixation 3) a combination of the first 2 categories 4) distal clavicular excision and 5) muscle transfers⁶⁻¹². With the availability of various modalities, to date, the best modality of treatment has not been described in the management of this injury. Each surgical modality has its own advantages and disadvantages, the aim of the present study involves the evaluation of the functional and radiological outcomes in the anatomical reconstruction of AC joint using a double button fixation system.

Aims and objectives:

To assess the functional and radiological outcome in patients with acute AC joint dislocation treated by using a double button fixation system.

Material and methods:

A prospective interventional study was conducted in the dept of Orthopaedics, in a tertiary care hospital between January 2020 and November 2022. A universal sampling technique was adopted in this study. The patient cohort consists of 24 patients with acute

acromioclavicular dislocation undergoing anatomical reconstruction with a double button fixation system. X-ray views included anteroposterior, axillary, and zanca view¹³, and severity is assessed using the Rockwood classification system for AC joint injury.

Inclusion criteria:

- Acute acromioclavicular joint dislocation (within 3 weeks of injury).
- Rockwood classification type 4,5, and 6 injuries.
- Age more than 18 yrs.
- Normal shoulder function before the injury.

Exclusion criteria:

- Past history of injury to the same-sided shoulder.
- Patients who are unfit for surgical intervention.

After obtaining the informed written consent, the patients fulfilling the inclusion criteria were included in the study. After routine preoperative workup and pre-anesthetic evaluation patients were posted for the surgery. The patient was placed in the beach chair position under the effect of general anesthesia and the reducibility of the acromioclavicular joint is assessed. After sterile painting and draping the anatomical landmarks such as the distal clavicle, coracoid process, and anterior part of acromion were marked. By using Roberts's approach to the acromioclavicular joint and coracoid process a curved incision of 5 cm is given starting just medial to the tip of the coracoid process and extending upwards to curve laterally to extend over the anterior aspect of the distal fourth of clavicle (Fig.1). The exposure of the anterior origin of the deltoid fibers from the clavicle is done. Later freeing of the fibers of the anterior deltoid from the distal fourth of the clavicle is done and by retracting the deltoid distally, the distal fourth of the clavicle along with the coracoid process is also exposed. Under C-Arm guidance, a 2.4mm guide wire is inserted from the midpoint on the superior surface of the clavicle at the level of the coracoid process directed towards the center of the coracoid process and passing through it. Then, this was over-drilled with a 4 mm cannulated drill bit. The guide wire and the drill were removed and the double button

fixation system was inserted through the tunnel in the clavicle and further advanced through the coracoid process using the button inserter.

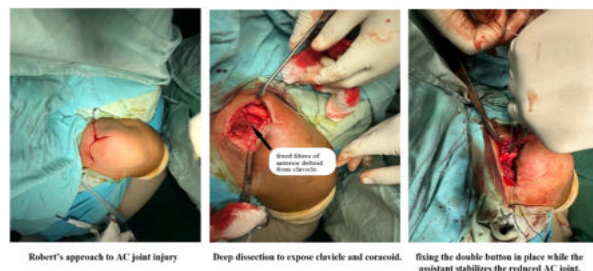


Fig.1: Intra-operative images

By pulling the traction cord the oblong button is flipped and placed beneath the coracoid process. Then the acromioclavicular joint is reduced under C-Arm guidance and the round button was advanced over the superior surface of the clavicle and the ends were secured by 3 alternating knots. Closure of the skin is done in layers and a sterile dressing is then applied and a shoulder immobilizer is applied.

Postoperatively, the sutures were removed on the 12th day and the shoulder immobilization is continued for 4 weeks. Followed by, the range of motion and strengthening exercises were started. Day-to-day activities were allowed after 3 months and a return to sports activities was allowed after 6 months.

Patients were followed up for a maximum period of 12 months (Fig.2). The functional outcome is assessed using DASH¹⁴, constant¹⁵, and VAS scores. Along with this, the vertical distance between the superior border of the coracoid process and the inferior border of the clavicle was calculated on the anteroposterior radiographs on both sides at the final follow-up. Statistical analysis was done using paired t-test and a p-value <0.05 was considered significant.

Results:

The following results were obtained from the study conducted on 24 patients with ages of the patients ranging from 23yrs to 50yrs. The mean age group was 32.54 ± 6.09 yrs. Among 24 patients 19 were male and 5 were female. The mode of injury included road traffic accidents in 17 (70.83%) patients and falling injuries in 7 (29.16%) patients. The injury involvement on the right side was 19 (79.16%) cases and on the left side were 5 (20.83%) cases with no cases of bilateral AC joint injuries. The grade of injury was type 4 in 18 (75%) cases and type 5 in 6 (25%) cases with zero cases of type 6 injury. The average time interval from injury to surgery is 6 days duration. No patients were lost to follow-up.

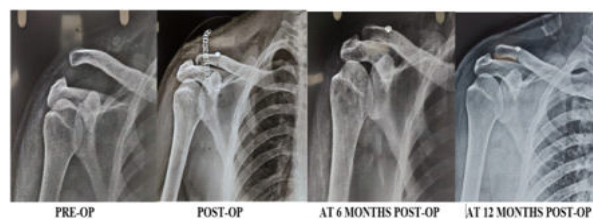


Fig. 2: Pre-operative and Post-operative Roentgenographs.

In the pre-operative period, the mean VAS was 6.87 ± 1.15 , and in the postoperative period the mean VAS was 2.0 ± 1.14 and 0.16 ± 0.38 at 6 and 12 months respectively. There was a significant difference in pre- and postoperative VAS scores $p < 0.0001$. In addition, the mean pre-operative constant score was 33.54 ± 9.60 , and the mean postoperative constant score was 60.25 ± 3.61 and 96.16 ± 2.66 at 6 and 12 months respectively. There was a significant difference in pre- and postoperative VAS scores $p < 0.0001$. The DASH score improved from 19.6 ± 2.66 pre-operatively to 7.41 ± 1.28 at 6 months and to 0.35 ± 1.42 at 12 months suggesting there was a significant difference in pre- and postoperative VAS scores $p < 0.0001$. At the end of the follow-up period, all 24 patients had an excellent postoperative outcome. All patients resumed their daily activities at around 12 weeks' time. There were no complications associated with the surgical procedure.

Radiological assessment at the last follow-up revealed no significant difference from the mean CC distance of the operative side to that of

the contralateral normal side ($p = 0.351$) (Fig. 3). There was no radiological evidence of AC joint arthritis at the last follow-up.



Fig. 3: Comparison of CC distance between the operated and non-operated side

Discussion:

The important goal in treating acromioclavicular joint dislocation is to re-establish the normal anatomy and physiology of the joint. Various methods have been suggested in the literature for the treatment of AC joint dislocations. Such methods included temporary fixation with k wires and cerclage wires which resulted in degenerative changes of the AC joint. coracoid process transfers also failed in providing the stability, and non-union and also resulted in musculocutaneous nerve injury¹⁶. Weaver-Dunn procedure and Bosworth procedure were also attempted but the procedures have proven biomechanically inferior with respect to the tendon graft reconstruction.

By realizing the anatomy of the coracoclavicular ligament complex with the conoid being the prime suspensor in the anterior and superior translation of the clavicle^{17,18} especially under high loads, the trapezoid ligament has a less important role^{17,18}. A double-button fixation system is used in place of the cc ligaments which aids in reducing the dislocated AC joint. The titanium buttons used at both ends allow equivalent distribution of the loads on bone surfaces and thus avoiding the failure of the suture^{19,20}. The strength of the suture and the biological reaction to the suture allows for the long-term stability of the fixation.

In the current study, 24 patients with AC joint dislocation who underwent surgical treatment with a double-button fixation system were evaluated functionally using DASH, VAS, and Constant scores preoperatively followed by postoperatively at 6 and 12 months. A study done by Beris et al²¹ in 2013 used a similar technique of a double button fixation system in 12 patients of AC joint dislocation and recorded similar results at their latest follow-up. Another study done by Ali Torkaman et al²² in 2015 included 28 patients who underwent surgical management by double button fixation system for acute AC joint dislocations. Their results were comparable to our study with a DASH score of $1.43 (\pm 1.37)$ and a VAS score of $0.82 (\pm 0.94)$ during the final follow-up.

Acute AC joint reconstruction with the double button fixation system performed by an arthroscopic approach has theoretical advantages and better cosmetic results. Shin et al²³ in the year 2015 studied the post-operative complications from arthroscopic cc reconstruction using a single adjustable loop length suspensory fixation device in 18 patients with acute AC joint dislocation. Their results showed satisfactory clinical outcomes after surgery with cc fixation failure of 50% in 33% of patients within a period of 3 months after surgery. In a study by S. Vijayan et al²⁴ in 2020, 32 patients underwent surgery for AC joint injuries. They achieved bifocal fixation by using a suture anchor for CC ligament reinforcement, in addition to temporary K-wires for the AC joint stabilization along with repair of the AC joint stabilizing structures. Their results showed good clinical outcomes with a mean DASH score of $4.12 (\pm 1.05)$ at the final follow-up.

In the present study, we devised a simple and less time-consuming approach that restores the AC and CC ligaments with minimal soft tissue damage and allows adequate visualization of the tunnel placement. Our study is not without its limitations, which involved a small sample size with a short duration of follow-up. Because of the excellent results obtained in the present study, we continued to follow the same technique in patients with acute AC joint dislocations requiring surgical treatment.

Conclusion:

In conclusion, Acute type 4,5, and 6 AC joint dislocations treated with a double button fixation system using a mini-open technique provide adequate exposure of the clavicle and coracoid with minimal soft tissue damage surrounding the CC ligaments. Henceforth, we were able to achieve better anatomical fixation, excellent functional

outcomes, and better cosmetic results.

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