e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(8); 946-951

Original Research Article

A Study of Functional Outcome of Acromioclavicular Joint Reconstruction with Double Button Fixation System

Avinash G. C.[1], Bharath M.[2], Yogananda Gali Hanumaih[3], Hariprasad K.A.[4]

[1]Assistant Professor, Department of Orthopaedics, Sri Chamundeshwari Medical College, Hospital & Research Institute, Channapatna, Karnataka, India.
[2]Consultant Orthopaedician, Department of Health and Family Welfare, Mysuru, Karnataka, India.
[3]Senior Resident, Department of Orthopaedics, Sri Chamundeshwari Medical College Hospital & Research Institute, Channapatna, Karnataka, India.
[4]Senior Resident, Department of Orthopaedics, Sri Chamundeshwari Medical College Hospital & Research Institute, Channapatna, Karnataka, India.

Received: 15-06-2023 / Revised: 18-07-2023 / Accepted: 17-08-2023
Corresponding author: Dr. Hariprasad K.A
Conflict of interest: Nil

Abstract:

Background: This study was conducted to evaluate the double-button fixation system in the management of Rockwood type III, IV, V and VI acute acromioclavicular joint dislocations.

Methods: This was a hospital-based prospective study conducted among 30 patients who underwent surgical management by the double-button fixation system for acute AC joint dislocation at the Department of Orthopaedics at Mandya Institute of Medical Sciences, Mandya, over a period of 18 months from January 2019 to June 2020 after obtaining clearance from the institutional ethics committee and written informed consent from the study participants.

Results: The mean age of patients was 40.6 years. Males comprised 97.7% and females were 3.3%, showing a male preponderance. The involvement of the right side (60%) was higher than the left (40%). The mode of injury in 11 patients was RTA (36.7%), and 19 patients sustained injuries due to falls (63.3%). The majority (73.3%) belongs to Rockwood type 5. Significant differences were observed between pre-operative and post-operative DASH scores and constant shoulder scores.

Conclusion: According to the results, the double-button fixation system for acute acromioclavicular joint dislocation provides a stable reduction of the acromioclavicular joint with a very good functional outcome and a pain-free full range of shoulder movement with minimal intraoperative and post-operative complications.

Keywords: Double-Button Fixation, Acromioclavicular Joint, Dislocation.

Introduction

Injuries to the acromioclavicular (AC) joint are common, especially in the young and active population. A 5-fold male predominance is seen in acromioclavicular (AC) joint injuries, with half the cases within the age group of 20-30 years. Acromioclavicular (AC) joint injuries contribute to around 9% of shoulder girdle injuries.[1] This commonly occurs in athletes and contact sport persons in which the mechanism of injury is a direct blow to the lateral aspect of the shoulder.[2]

The majority of the AC lesions will be successfully treated without surgery, particularly type I and II while operative treatment is indicated for Rockwood type IV, V and VI injuries.[1,3] The most effective treatment for Rockwood type III injuries continues to be controversial. A recent study showed a significantly better functional outcome following operative management compared to non-operative management.[4] Fixation of the joint and reconstruction of the CC ligament are the primary surgical procedures in the AC joint. AC joint fixation methods involve the utilization of wires, screws, and hook plates, although these techniques have significant limitations including unsatisfactory maintenance of AC joint reduction, osteolysis and fracture-related hardware related complications.[5] One of the most popular methods for treating chronic AC joint dislocation is the modified WD method, but it has its drawbacks and the CA ligament may be biomechanically insufficient in terms of strength and stiffness as a replacement for the CC ligament. The ST graft used for anatomical reconstruction of the CC ligament in chronic AC joint dislocation provides stability to the clavicle that is very close to that provided by the intact ligaments.[6]

The absolute reconstruction procedure of the coracoclavicular complex has yet to emerge for the

AC joint reconstruction. Most of the techniques used not only fail to recreate the exact anatomy but also don't use materials that are strong enough to maintain the reduction during the healing process. The utilization of a weak and non-anatomical construct has predictably led to problems with slippage of the initial reduction and implant-related complications. The endobutton material has been shown to possess both strength and stiffness far greater than the native anatomy, ensuring a stable reduction.

The device is placed through holes in the coracoid and clavicle, reproducing the course of the conoid portion of the coracoclavicular ligament. The procedure has low morbidity and typically easily adapts to an arthroscopic technique.[7]

Aims and Objectives

To evaluate the double-button fixation system in the management of Rockwood type III, IV, V and VI acute acromioclavicular joint dislocations.

Materials & Methods

This was a hospital-based prospective study conducted among 30 patients who underwent surgical management by the double-button fixation system for acute AC joint dislocation at the Department of Orthopaedics at Mandya Institute of Medical Sciences, Mandya, over a period of 18 months from January 2019 to June 2020 after obtaining clearance from the institutional ethics committee and written informed consent from the study participants.

Study Procedure

General Measures

All patients admitted to the emergency ward and orthopedic outpatient department were evaluated for any associated major injuries like chest injuries or brachial plexus injuries. Then an x-ray of the involved shoulder AP and an x-ray of both shoulders in standing stress AP view were taken. The patient was immobilized with an arm sling.

Surgical Technique

The coracoid tip was palpated and an incision 2 inches above it was made, extending to the anterior edge of the distal clavicle. Flaps were raised medially and laterally. The deltoid was split along the fibers and the coracoid was identified and cleared up to the base. At the coracoid base, the medial and lateral edges were clearly visible. Debridement of the articular disc of the AC joint was done to allow good reduction. A manual reduction of the clavicle was done and the reduction was held. The clavicle and coracoid processes were drilled separately using a 4.5 mm drill bit. About 3 cm medially to the AC joint, midway between the anterior border and posterior border for the clavicle and at the base of the corocoid centered between the medial and lateral edges. Through the first and fourth holes of the endobutton, the first loop of fiberwire was inserted and the second loop of fiberwire was inserted into the second and third holes, making a double loop. The endobutton with its sutures passed through the clavicle hole drilled. The endobutton was seen in the space between the clavicle and coracoid, which was pushed into the coracoid drill hole until it protruded out of the underside of the coracoid. One loop of fiber wire was pulled up to lock the endobutton to the undersurface of the coracoid, and then a second loop of fiberwire was pulled up. Then the second loop of fiberwire was passed through the second and third holes, the first loop of fiber wire was passed through the first and fourth holes of the clavicular endobutton and separate knots were placed for each loop over the endobutton with firm downward pressure applied on the clavicle to maintain the best reduction. The joint was over-reduced, and a knot was placed over the endobutton to avoid loss of joint reduction during knot placement. Therefore, the locking of the endobutton in place and the reconstruction of the coracoclavicular ligament were complete. The surgical wound was closed in layers.

Postoperative Protocol

Three doses of intravenous antibiotics were given to all the patients postoperatively. The wound dressing was done on the second postoperative day, and the patient was discharged and called for suture removal after 10 days. Pendulum exercises were started on the 2nd postoperative day, and active assisted mobilization was started as patient tolerance permitted. Within 3 weeks' active exercises were started and full range of movement was started after 3 weeks. Patients were advised to resume preinjury levels of activity after 3 months. We have used the DASH score and the constant score as they reflect the subjective and objective perspectives of shoulder function. The range of movement as required in the Constant score was measured with a goniometer. The forms were filled out at each visit, and at that time they were evaluated for signs of implant failure, irritation, impingement or infection. X-rays were taken preoperatively, immediately postoperatively and subsequently at 3 weeks, 6 weeks, 3 months and 6 months. Placement of the endobutton and reduction of the AC joint were assessed at serial intervals.

Inclusion Criteria

Patients aged 18 to 60 years of either sex who were active and motivated and gave consent for surgery and AC joint dislocation, Rockwood type III, IV, V and VI and acute injuries.

Exclusion Criteria

Open dislocation, dislocation in a polytrauma patient, fracture of the ipsilateral coracoid process of the scapula, fracture of the clavicle, AC joint arthritis, vascular injury**,** and Chronic injuries.

Statistical Methods

Complete data was collected from the patients in a specially designed case record form by taking a history of illness and doing a detailed clinical examination and relevant investigations. Standard preoperative, operative, and postoperative protocols were followed. Results were analysed using the constant score and the DASH score. Data analysis was done using SPSS Office.

Results

Table 1: Demographic Distribution

Age Group (years)	Number	Percentage (%)
≤30	3	10
31 – 45	21	70
46 – 60	6	20
Age Distribution		
Gender	**Number**	**Percentage (%)**
Male	29	97.7
Female	1	3.3
Total	30	100
Sex Distribution		

The highest number of AC joint injuries was seen in patients in the age group 31–45 years (70%) with a mean age of 40.6. The highest age of the patients in this study was a 60-year-old male patient, and the least age of the patients encountered in this study was a 25-year-old male patient. Among the 30 patients, 29 were male (97.7%), and 1 was female (3.3%).

Table 2

Type of Injury	Number	Percentage (%)
Fall Injury	19	63.3
Road Traffic Accidents	11	36.7
Distribution According to Mode of Injury		
Side	**Number**	**Percentage (%)**
Right	18	60
Left	12	40
Distribution According to the Side		

In our study, the most common mode of injury was fall injuries (63.3%) followed by road traffic accidents (36.7%).

Among the 30 patients, 18 patients (60%) sustained injuries to the right AC joint and 12 patients (40%) sustained injuries to the left AC joint.

Table 3

Classification	Number	Percentage (%)
Type 3	6	20.0
Type 4	2	6.7
Type 5	22	73.3
Distribution According to the Rockwood Classification		
Time Interval	**Number**	**Percentage (%)**
< 2 days	2	6.7
2-5 days	13	43.3
5-7 days	15	50
Time Interval between Injury and Surgery		

In our present study, 22 out of 30 patients (73.3%) belong to Rockwood type 5, 6 patients (20%) belong to Rockwood type 3 and 2 patients (6.7%) belong to Rockwood type 4.

All the patients included in our study were operated on within 7 days of their injury. Out of 30 patients, 15 patients (50%) were operated in 5 to 7 days, 13 patients (43.3%) were operated in 2 to 5 days, and only 2 patients (6.7%) were operated within 2 days of injury.

Table 4

Associated Injury	Number
Right 4th rib fracture	1
Left fibula fracture	1
Associated Injuries	
Co-Morbidity	**Number**

Diabetes mellitus	2
Hypertension	1
Comorbid Conditions	
Complications	**Number**
Superficial infection	1
Stitch granuloma	1
Stiffness of shoulder	3
Joint disruption	1
Postoperative Complications	

Out of 30 patients, one patient had a single rib fracture, and one patient sustained a fibula fracture, both were treated conservatively. Postoperative rehabilitation was not affected by these associated injuries. In our study, two patients were diabetic, and one was hypertensive. One of the diabetic patients developed a postoperative superficial wound infection. In this study, six patients developed postoperative complications, and the remaining 24 patients' postoperative period was uneventful. Among the four patients, one developed a superficial infection, one had a stitch granuloma, three developed shoulder stiffness, and another had joint disruption.

Functional Outcome

Constant score and DASH score were both used to evaluate the success of AC joint reconstruction.

Constant Score

A constant score was obtained from subjective and objective scoring including pain, activities of daily living, range of movement and muscle power. 100 is an excellent score and zero indicates a poor score. Constant score outcome according to Rockwood classification. These observations conclude that there was no significant difference in functional outcome based on the severity of the injury. In our study, the mean preoperative constant score was 41.60; gradually, it improved in the postoperative period, with the final follow-up mean score of 96.20.

DASH Score

The DASH questionnaire has 30 questions to be answered by the patient relating to activities of daily living, pain and confidence. The poorest outcome is 100, while the best outcome is a score of zero. DASH score according to type of Rockwood classification, DASH score observations according to type of Rockwood classification show no significant difference in functional recovery. The mean preoperative DASH score was 32.40 in our study, gradually increasing with the postoperative functional recovery; the final follow-up mean score obtained was 2.87.

Discussion

In clinical practice, acromioclavicular joint injuries are one of the most common shoulder injuries. There are various surgical techniques described in the literature for the treatment of AC joint disruptions but none of them is considered the gold standard. The Prime suspensory ligaments of the AC joint are the CC ligaments.[8] Each CC ligament has a different role in providing acromioclavicular joint stability in response to various loading conditions.[9] The conoid is the major restraint against superior loading and the trapezoid against posterior loading as reported by Debski et al.[10]

In our study, we used synthetic ligament reconstruction techniques with two endobutton and fiber wire.

Two titanium buttons, one over the clavicle and one under the coracoids process, are used to allow homogenous distribution of loads on bone surfaces and thus avoid the sawing effect of the sutures associated with failure in other anchor and suture techniques.[11,12] A continuous loop of No. 5 fiber wire suture (Arthrex, Naples, FL) organized as a pulley is used to connect the two buttons. Imhoff and Chernchujit.[13] showed that No. 5 fiber wire failed at 485 N, whereas the native CC ligament complex failed at 589 N. Thus, the tensile strength of two strands of No. 5 fiber wire is higher than the tensile strength of an intact CC ligament complex.

In our study, males comprised 97.7% and females 3.3%, showing a male preponderance. A similar male predominance was also reported by Steven Struhl, MD, and Theodore S. Wolfson, MD,[14] in a study performed at New York University Hospital for Joint Diseases, New York, USA, where the male was 89% and the female was 11%. In a study by Ali Torkaman, MD, et al.[15] conducted at Firouzgar Hospital, University of Medical Sciences, Tehran, Iran, males were 85.71% and females were 14.28%. Male predominance could be due to more predispositions to trauma because of travel and work-place injuries.

Acromioclavicular joint dislocation may occur in people of all ages. The age of the subjects enrolled in this study ranged from 25 to 60 years, with a mean age of 40.6 years. This was in concurrence with the mean age from earlier studies by Steven Struhl, MD, and Theodore S. Wolfson, MD, which showed a mean age of 42 years, and by Ali Torkaman, MD, et al., which showed a mean age of 33.23 years. The

maximum number (70%) of subjects were between 31 and 45 years old, this could be due to the active participation of young adults in travelling, field work and sports activities.

In our study, the mode of injury in 11 patients was due to RTA (36.7%), and 19 patients sustained injury due to a fall (63.3%). In the study by Ali Torkaman, MD, et al., the commonest mechanism was road traffic accidents (71.42%), followed by fall injuries (28.57%). Fall injuries commonly observed in our study could be due to manual work in agricultural fields, which is common in this region.

In our study, the involvement of the right side (60%) was greater than the left (40%). The right side was dominant for all the patients with right side involvement. This may be due to the fact that the dominant extremity reaches out first to have the first impact of trauma. This was in concurrence with the earlier studies of Alexander Beris et al.[16] which showed 66% right involvement and 34% left involvement and also the study conducted by Ali Torkaman, MD, et al., which showed 75% right involvement and 25% left involvement.

22 out of 30 patients (73.3%) belong to Rockwood class 5, 6 patients (20%) belong to Rockwood class 3 and only 2 patients (6.7%) belong to Rockwood class 4 in our study. There were no significant differences in functional outcome based on the type of classification observed in our patients.

The mean interval between injury and surgery was 4.50 days. 5 days was the mean interval shown by Alexander Beris et al. study and 2.70 days in Ali Torkaman, MD, et al. study.

The final outcome in our study after an average follow up of 6 months showed that the mean constant score was 96.20, showing a significant increase compared with the mean pre-operative value of 41.60**.** Steven Struhl, MD, and Theodore S. Wolfson, MD, showed a mean constant score of 98 at the final follow-up. The study conducted by Alexander Beris et al. found significant differences in the mean preoperative (34.4) and postoperative (94.8) constant scores. The mean pre- and post-operative constant scores were 33.54 and 89.36, respectively, in a study by Ali Torkaman, MD et al.

The mean DASH score significantly decreased from 32.40 preoperatively to 2.87 at the last follow-up in our study. The mean pre- and post-operative DASH scores were 20.79 and 1.43, respectively and there was a significant difference in these scores obtained in the study conducted by Ali Torkaman, MD, et al. One more study by Alexander Beris et al. concluded that the mean DASH score decreased from 19.6 preoperatively to 0.25 at the last follow-up.

In our study, six patients developed postoperative complications, and the remaining 24 patients postoperative period was uneventful. Among the four patients, one developed a superficial infection and one had a stitch granuloma, which were treated with antibiotics and regular wound dressing. 3 patients developed shoulder stiffness, which was improved by physiotherapy, and another 1 patient had joint disruption following reinjury at 3 months follow-up; treated conservatively with bracing, the patient later obtained a satisfactory functional outcome at the end of 6 months.

Conclusion

The double button technique provides a stable reduction of the acromioclavicular joint reduction with a very good functional outcome and a pain-free, stable full range of shoulder movements. Intraoperative and post-operative complications were minimal in our case series.

Endobutton and fiber wire avoid further surgery to remove the implant and have no implant related complications. As we are using synthetic material for reconstruction, this procedure is not associated with graft donor site complications. Endobutton and fiber wire give both vertical and horizontal stability to the acromioclavicular joint. At present, we have only a 6-month follow-up. In this short-term follow-up, Endobutton provides excellent outcomes, and long-term results are awaited.

References

1. Rockwood CA, Young DC. Disorders of the acromioclavicular joint. In: Rockwood CA, Matsen FA, eds. The Shoulder. Philadelphia: WB Saunders 1990:413-76.
2. Bishop JY, Kaeding C. Treatment of the acute traumatic acromioclavicular separation. Sports Medicine and Arthroscopy Review 2006;14(4): 237-45.
3. Smith TO, Chester R, Pearse EO, Hing CB. Operative versus non-operative management following Rockwood grade III acromioclavicular separation: a metaanalysis of the current evidence base. Journal of Orthopaedics and Traumatology 2011;12(1):19-27.
4. Gstettner C, Tauber M, Hitzl W, Resch H. Rockwood type III acromioclavicular dislocation: surgical versus conservative treatment. J Shoulder Elbow Surg 2008;17(2):220-5.
5. Tamaoki MJ, Lenza M, Matsunaga FT, Belloti JC, Matsumoto MH, Faloppa F. Surgical versus conservative interventions for treating acromioclavicular dislocation of the shoulder in adults. Cochrane Database Syst Rev 2019;2019(10): CD007429.
6. Hegazy G, Safwat H, Seddik M, Al-Shal EA, Al-Sebai I, Negm M. Modified Weaver-Dunn procedure versus the use of semitendinosus autogenous tendon graft for acromioclavicular joint reconstruction. Open Orthop J 2016;10: 166-78.

7. Struhl S. Double endobutton technique for repair of complete acromioclavicular joint dislocations. Techniques in Shoulder Elbow Surg 2007;8(4) :175-9.
8. Costic RS, Labriola JE, Rodosky MW, Debski RE. Biomechanical rationale for development of anatomical reconstructions of coracoclavicular ligaments after complete acromioclavicular joint dislocations. Am J Sports Med 2004;32(8):1929-36.
9. Lee KW, Debski RE, Chen CH, Woo SL, Fu FH. Functional evaluation of the ligaments at the acromioclavicular joint during anteroposterior and superoinferior translation. Am J Sports Med 1997;25(6):858-62.
10. Debski RE, Parsons IM, Fenwick J, Vangura A. Ligament mechanics during three degree-of-freedom motion at the acromioclavicular joint. Ann Biomed Eng 2000;28(6):612-8.
11. Somers JF, Van der Linden D. Arthroscopic fixation of type III acromioclavicular dislocations. Acta Orthop Belg 2007;73(5):566-70.
12. Wellmann M, Zantop T, Weimann A, Raschke MJ, Petersen W. Biomechanical evaluation of minimally invasive repairs for complete acromioclavicular joint dislocation. Am J Sports Med 2007;35(6):955-61.
13. Imhoff AB, Chernchujit B. Arthroscopic anatomic stabilization of acromioclavicular joint dislocation. Operative Techniques in Sports Med 2004;12(1):43-8.
14. Struhl S, Wolfson TS. Continuous loop double endobutton reconstruction for acromioclavicular joint dislocation. Am J Sports Med 2015;43 (10):2437-44.
15. Torkaman A, Bagherifard A, Mokhatri T, Haghighi MH, Monshizadeh S, Taraz H, et al. Double-button fixation system for management of acute acromioclavicular joint dislocation. Arch Bone Joint Surg 2016;4(1):41.
16. Beris A, Lykissas M, Kostas-Agnantis I, Vekris M, Mitsionis G, Korompilias A. Management of acute acromioclavicular joint dislocation with a double-button fixation system. Injury 2013;44 (3):288-92.