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EVALUATION OF ARTHROSCOPIC BUTTON AND FIBER TAPE FIXATION IN ACROMIO-CLAVICULAR JOINT INJURIES

Dr. Narottam Das (MBBS, MS) Senior Resident Central institute of Orthopedics Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi.

Dr. B.P. Sharma (MBBS, MS) Professor and Consultant Central institute of Orthopedics Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi

Dr. Sandeep Shaina* (MBBS, MS, DNB) Associate Professor, Central institute of Orthopedics Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi. *Corresponding Author

Dr. Mukul Mohindra (MBBS, MS, FNB) Specialist (CGHS) Central Institute of Orthopedics Vardhman Mahavir Medical College and Safdarjung Hospital Ansari Nagar, New Delhi-110029

Dr. Ekjot Singh Arora (MBBS, MS) Senior resident Central institute of Orthopedics Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi

ABSTRACT

BACKGROUND: Acromio-clavicular injuries (ACI) account for 9% of all shoulder injuries. The injuries are divided into VI types according to Rockwood classification. Surgery is indicated in Type IV to VI and often in Type III injuries. The optimal surgery for these injuries is debatable, though arthroscopic fixation is increasingly being preferred due to small incisions, early rehabilitation and reduced hardware. Dog-bone button (arthroscopic button) is a broad anatomically contoured button and when used with Fiber-tape offers an excellent option to reconstruct the Acromio-Clavicular joint (ACJ). Our study is to evaluate the results of this fixation by using the Constant Score. **METHODS:** Thirty (30) adult patients with Type III-V ACI were operated arthroscopically with Dog-Bone Button and Fiber-tape fixation. The patients were followed up for a period of 6 months. Constant score, range of motion of shoulder joint and Coraco-clavicular distance were taken pre-operatively and 6 months after the surgery. **RESULTS:** Twenty-two patients had RW III injury, six patients had RW IV and two patients had RW V injury. The mean pre-operative Constant Score was 58.53 (±7.38) and the mean post-operative Constant Score at 6 months was 89.83 (± 9.16). The difference between constant score was statistically significant ($p<0.001$). Mean preoperative CC distance was 20.27+ 2.3mm to 10.28 mm + 3.12mm at 6 months follow up. Similarly, the difference between pre-operative and post-operative range of motion in flexion and abduction was significant on paired data analysis ($p<0.001$). One patient had subluxation of AC joint after surgery and had to be re-operated with a threaded K-wire. **CONCLUSIONS:** Arthroscopic Dog-bone button fixation provides good functional and radiological outcome and is a viable method to reconstruct acute acromio-clavicular joint injuries.

Introduction

Acromioclavicular joint injuries (ACI) are common in sportsmen engaged in contact sports, military or police personnel. Inferiorly directed force with the arm adducted is the most common mode of injury. ACI accounts for 9% of all shoulder injuries [1]. Rockwood (RW) has divided ACI into six types. Sprain of Acromioclavicular (AC), Coracoclavicular (CC) ligaments (RW type I). Disruption of AC joint capsule with AC ligaments with intact CC ligaments (RW type II). Type I and II are managed conservatively. The management of RW type III (disruption of both AC and CC ligaments with up to 100% displacement of clavicle) is still debatable. However, in young patients, athletes and manual laborers, surgical intervention is preferred for rapid rehabilitation [2, 3]. Operative procedure is usually required for RW type IV (posterior displacement of clavicle), type V (complete disruption of clavicle from scapula with 100% to 300% displacement) and for rare RW type VI (inferior displacement of clavicle beneath the coracoid or acromion) [4].

There are numerous open surgical procedures for ACI namely K wire fixation, hook plate fixation, screw fixation etc. but they are beset with complications. Arthroscopic suspensory fixation has been preferred over open surgery [5]. Various arthroscopic procedures like Tight-Rope fixation [6], semitendinosus graft [7], non-absorbable sutures have been introduced so far. Dog-bone button was specifically developed for reconstructing the acromio-clavicular joint (ACJ). The surface of button gives good contact under the coracoid process and over the clavicle. Our study evaluates the functional outcomes after ACJ fixation by Dog-Bone button using the Constant score [8, 9]. The Constant Score is a shoulder specific scoring system adopted by the European Society for Shoulder and Elbow Surgery which assesses the shoulder function based on various subjective criteria and range of motion.

METHODS

The study was conducted in Central Institute of Orthopedics, VMMC and Safdarjung Hospital, New Delhi from October 2018 to March 2020. Clearance was taken from the Institutional Ethics Committee prior to start of the study. It was a prospective interventional study which included patients aged between 18 to 65 years who presented with Type III-V ACI (according to RW classification) which was less than three weeks old (Figure-1).

Figure -1: Preoperative anteroposterior radiograph of a patient with AC joint dislocation, Patients with concomitant

ipsilateral upper limb fractures, Type I, II, VI AC injuries, open injuries were excluded from the study. The Constant score was taken pre-operatively and at six months after the surgery. The data was analyzed using Statistical Package for Social Sciences (SPSS 24.0 version). A p-value of <0.05 was considered statistically significant.

Sample size was calculated to be thirty as per the study by Chaudhary et al [10]. The study participants were operated under general anesthesia along with scalene block in lateral decubitus position. Standard posterior and an anterosuperior instrument portal were made through the rotator interval. After preliminary evaluation of the glenohumeral joint through the posterior portal with a 70° arthroscope, the base of the coracoid was cleaned through the anterosuperior portal. A small incision was made around 3 cm medial to the lateral edge of clavicle to reach the center of the clavicular shaft. This point is directly over the coracoid process. An Acromioclavicular (AC) guide (Arthrex, Naples) was then inserted through the anterosuperior portal and the prong was placed under the base of the coracoid bone. A guide pin was inserted through the AC guide from the superior clavicle (dissected earlier) to the coracoid base under fluoroscopic and arthroscopic guidance (Figure-2).

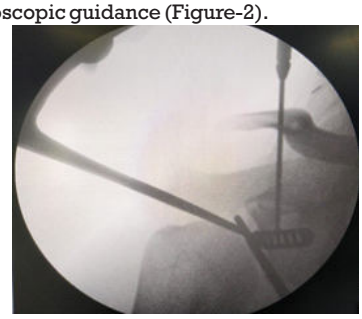

Figure -2: Image showing fluoroscopic view of placement of bone tunnel.

After satisfactory positioning the pin, a 4 mm reamer was passed over the guide pin though the clavicle and coracoid. The guide pin was then removed and a shuttle suture was passed through the reamer and retrieved through the anterosuperior portal. The ends of the Fiber Tape with 2 Fiber- Wires loaded with the dog bone button (Arthrex, Naples). The Fiber-Wires were pulled from top of the clavicle along with the reamer. Consequently, the first dog bone button came to lie under the base of the coracoid (Figure-3).

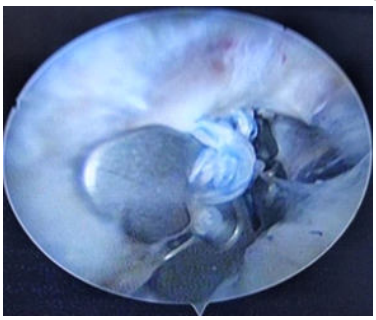

Figure -3: Arthroscopic view of dog bone button placed at the base of coracoid

Finally, the second dog bone button was loaded onto the Fiber-Tape from the top of the clavicle. Both Fiber Tapes were □rmly tied superior to the second dog bone button thereby reducing the AC joint. The reduction of AC Joint was checked fluoroscopically before final tightening of the sutures. Finally, all wounds were closed in layers.

Shoulder immobilizer was applied post-operatively to all the patients for 6 weeks. Passive and active-assisted flexion and abduction exercises were started from the third day, and the range of motion was gradually increased over the period of 6 weeks. The patients were allowed full active motion at 6 weeks. Strength exercises were started at 3 months. Full contact sports were allowed at 6 months [11]. All patients were followed up for 6 months.

RESULTS

Our study included thirty patients, 22(73.3%) of them had RW type III injury, 6(20%) had RW type IV and 2(6.67%) had RW type V injury. Most participants were males (25/30) with preponderance towards the right side (23/30). The most common mode of injury was road traffic accident (15/30) followed by self-fall (9/30) and sport injuries (6/30) (Table-I).

Table I: Patient demographics.

Sl No.	Age/Sex	Side of Injury	Mode of injury	Rockwood type
1	18/M	RIGHT	RTA	III
2	60/M	LEFT	RTA	V
3	46/M	RIGHT	RTA	III
4	30/M	LEFT	Self-Fall	III
5	29/M	RIGHT	Self-Fall	IV
6	32/M	RIGHT	RTA	III
7	22/M	RIGHT	Sports Injury	III
8	34/M	RIGHT	Sports Injury	III
9	24/M	LEFT	RTA	IV
10	29/F	RIGHT	RTA	III
11	39/M	RIGHT	RTA	III
12	47/F	RIGHT	Self-Fall	III
13	36/M	RIGHT	RTA	IV
14	46/F	LEFT	Self-Fall	III
15	57/M	RIGHT	Self-Fall	III
16	62/M	RIGHT	Self-Fall	III
17	40/M	RIGHT	RTA	III
18	38/M	RIGHT	RTA	IV
19	24/M	RIGHT	Sports Injury	III
20	21/F	RIGHT	Sports Injury	III
21	32/M	RIGHT	RTA	III
22	48/M	RIGHT	Self-Fall	IV
23	52/M	LEFT	RTA	V
24	56/M	RIGHT	Self-Fall	III
25	28/F	RIGHT	Sports Injury	IV
26	52/M	LEFT	RTA	IV
27	23/F	RIGHT	Sports Injury	III
28	44/M	LEFT	Self-Fall	III
29	28/F	RIGHT	RTA	III
30	34/M	RIGHT	RTA	III

In our study, mean (± SD) preoperative Constant score was 58.53 (±7.38) and post-operative mean (± SD) Constant score at 6 months was 89.83 (± 9.16) and the change in Constant score was statistically significant (p value <0.001) (Table-II).

Table II: Showing mean CONSTANT score with standard deviation at Pre-operative and post-operative (at 6 month) period.

Mean of pre-operative constant Score [mean±SD]	Mean of post-operative constant Score [mean±SD]	p-value	Mean % changes [mean±SD]
58.53±7.38	89.83±9.16	<0.001	57.15±28.11 (positive)

There was significant difference in pre- and post-operative coraco-clavicular (CC) distance. The mean CC distance of normal side was 9.87 mm, whereas it was 20.27(+ 2.3mm) on the injured side. The mean CC distance postoperatively was

10.28 (+3.12mm). At 6 months, the joint was anatomically reduced in 25 patients (Figure-4),

Figure -4: Immediate post-op radiograph of a patient with type III injury fixed using dog bone button

There was partial loss of reduction in 4 patients and complete loss of reduction (dislocation) in one patient. The failure in one patient was attributed to early weight lifting. The AC joint in this case was fixed using a threaded K wire. The patients with partial loss of reduction accepted the outcome and no further surgery were offered to them. We measured the difference between pre-operative and post-operative range of motion in flexion and abduction at 6 months which was found to be significant on paired data analysis($p<.001$) (Table-III).

Table III: Comparison of pre- and post-operative ROM in patients (n=30).

ROM in degree	Pre-operative (mean ± S.D) [Min-max]	Post-operative (mean ± S.D) [Min-max]	p-value
In abduction	70.17±16.27 [40-105]	128.67±19.70 [90-165]	0.001
In flexion	69.00±11.99 [50-90]	148±19.95 [105-175]	0.007

Clinically, the difference between pre-operative and post-operative range of motion was more in younger patients and in patients which sustained RW III injury.

DISCUSSION

The Acromio-clavicular joint is stabilised by mainly the acromio-clavicular joint capsule, the coraco-acromial ligament and coraco- clavicular ligament. The coraco-clavicular ligament is in turn, composed of a conoid part (which resists vertical translation of the clavicle) and the trapezoid part (which resists compression). The purpose of surgery is to ensure anatomical reduction, so the native ligaments can heal. As far as we know, there is no gold standard for fixation of acromio-clavicular joint. In this scenario, many open and arthroscopic methods have been tried to restore the joint anatomy. Threaded and non-threaded K wire have been used, but there is a risk of migration of the pin into the lungs, heart and great vessels [12,13]. Hook plate fixation has also been propagated, but requires a second surgery for hardware removal, with possibility of infection, shoulder stiffness and osteolysis of the acromion [14, 15]. Percutaneous cannulated screw fixation has a 32% failure, owing to screw migration and subsequent joint subluxation [16]. Primary open repair of coraco-clavicular ligament has also been described for injuries less than 2 weeks old, but difficult surgical access and a large prominent scar have precluded its use [17].

Compared to open surgical techniques, arthroscopic fixation is cosmetically acceptable, does not require hardware removal and possesses less risk of infection. It also enables the surgeon to diagnose and manage gleno-humeral joint pathologies during surgery [18]. Tightrope fixation is a popular arthroscopic fixation technique. It comprises two metallic buttons (10mm in diameter) held by a no. 5 Fiber-Wire loop. It holds the AC joint in a reduced position facilitating healing [19-23]. Nevertheless, complications have been noted with this fixation as well. Osteolysis around the clavicular button has caused subluxation of the AC joint and impaired functional outcome [24]. Approximately 18% patients have experienced loss of reduction following Tightrope fixation [18]. If 2 Tightrope devices are used, the construct becomes stronger than the relative CC ligaments but shoulder mobility is compromised, making it less attractive to patients [25].

Dog bone button construct is claimed to have certain advantages over Tightrope construct according to the manufacturer manual. The larger button (compared to Tightrope) allows greater surface area of contact with the clavicle and coracoid. The concave surface of the button snugly fits under the convex base of the coracoid process. The bone tunnels formed are smaller in diameter since only Fiber-Tapes are passed through them and not the buttons. This prevents weaking of the bones, preventing fracture. The results of studies which used Tightrope are mentioned in Table IV.

Table IV: Comparison of studies of AC joint reconstruction using Tightrope

Authors	No of cases	Post-operative functional score	Failure rate (%)	Complications
Zhang LF et al.[26]	24	Constant score-85.65 UCLA score-31.5	33.33%	Partial loss of reduction among 6 patients Construct failure among 2 cases
Thiel et al (used both single and double Tightrope)	12	Simple shoulder test- average 11 of 12 positively answered questions	16.6	1 loss of reduction
Chaudhary D et al	17	Constant score- 86.41	5.88%	Loss of reduction in 2 patients(11.76%)
Glanzmann MC et al.[27] (used double tight rope)	21	Constant score- 90.2 The simple shoulder test score-11.5	37%	Loss of reduction of >2mm in 6 patients
Shin Set al.[28]	18	Constant score- 98	44%	3 cases of button failure Clavicular bony erosion among 3 cases
El Sallakh SA	10	Constant score- 96.3	10	One patient had subluxation

In our study, we included 30 patients with type III to Type V Rockwood injuries. All of them were arthroscopically treated using Dog Bone button. We were able to demonstrate excellent results in 25 patients, in which the AC joint completely healed at 6 months and there was no loss of reduction. Four patients had subluxation of the joint, post-surgery, but due to satisfactory subjective outcome, we did not offer them any re-surgery. Fixation failed in one patient who was a weight lifter and resumed heavy weight lifting 2 months after surgery. His AC joint was fixed with a K wire which was pulled out after another 3 months, and he had an uneventful recovery after that. We used the Constant Score for assessment as it a comprehensive tool for measuring outcome after shoulder injury as it encompassed subjective criteria like pain, activities of daily living along with objective criteria

like range of motion and strength. In conclusion, we recommend the use of Dog Bone button for fixation of the AC joint as it is simple, safe and arthroscopic technique with consistently good outcome. The main limitation of our study was the number cases assessed as well as the follow up period of the cases. It is recommended to conduct a long term follow up study with larger number of participants to collaborate the results of our study and to determine if the reconstructed acromioclavicular joint will maintain structural and functional integrity over time.

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