

A Radiological and Clinical Evaluation of Acromioclavicular Joint Reconstruction Using Dog Bone Double Endobutton Technique

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Abstract

We report the clinical and radiological outcomes of acromioclavicular (AC) joint reconstructive surgery using Arthrex Dog Bone Button Fibertape Construct. 33 Patients were identified between April 2013 and April 2015 who had undergone AC joint repair using the Dog Bone double Endobutton for Rockwood Grade III-V injuries. Radiological follow up was made by measuring coracoclavicular distance (CCD). Patients were clinically evaluated using DASH (Disabilities of Arm, Shoulder and Hand) and ASES (American Shoulder and Elbow Surgeons) scores. Radiologically there was a mean CCD reduction of 7.1 mm (n=26) and mean post-operative CCD of 13.1 (Normal range 11-13 mm) Clinically, the mean post-operative ASES was 89.4 (n=22) (Best score 100). A mean reduction of 50.5 was reported from pre to post-operative DASH scores, with a mean post-operative score of 12.5 (n=18) (Best score 0). One dislocation (due to a fall in the post-operative period) and one infection were reported. Arthroscopic stabilisation of AC joint using Arthrex Dog Bone Fibertape construct is minimally invasive and shows good anatomic restoration of the joint. Early clinical results are promising but more numbers and longer term follow up are needed.

Keywords: Acromioclavicular joint reconstruction; ACJ; Endobutton; Dog bone; Fibertape

Introduction

An Acromioclavicular (AC) joint dislocation affects shoulder biomechanics and leads to degeneration and osteoarthritis. Therefore it is important to restore the normal anatomy following injuries. We report the clinical and radiological outcomes of AC joint reconstructive surgery using Arthrex Dog Bone Button Fibertape Construct. 33 Consecutive case series patients were identified between April 2013 and April 2015 who had undergone AC joint repair using the Dog Bone double Endobutton for Rockwood Grade III-V injuries. Radiological follow up was made by measuring coracoclavicular distance (CCD). Patients were clinically evaluated using DASH (Disabilities of Arm, Shoulder and Hand) and ASES (American Shoulder and Elbow Surgeons) scores. Radiologically there was a mean CCD reduction of 7.1 mm (n=26) and mean post-operative CCD of 13.1 (Normal range 11-13 mm) Clinically, the mean post-operative ASES was 89.4 (n=22) (Best score 100).

A mean reduction of 50.5 was reported from pre to post-operative DASH scores, with a mean post-operative score of 12.5 (n=18) (Best score 0). One dislocation (due to a fall in the post-operative period) and one infection were reported. Arthroscopic stabilisation of AC joint using Arthrex Dog Bone Fibertape construct shows good anatomic restoration of the joint, important in the prevention of further degeneration of the shoulder joint and osteoarthritis. Early clinical results are promising but more numbers and longer term follow up are needed. Acromioclavicular (AC) joint dislocations are involved in around 9% of all shoulder injuries and can represent up to 50% of sporting shoulder injuries [1,2]. It is well known that disruption of the AC joint normal biomechanics leads to early AC joint degeneration,

which affect the shoulder girdle and cause osteoarthritis. AC joint injuries occur as a result of direct contusion to the AC joint, this can be through contact sports like rugby but also commonly through skiing and cycling [3]. The Rockwood classification grades dislocation on extent of the ligamentous injury and site of the clavicle [4]. Literature suggests that Rockwood grade I-II injuries are best managed conservatively and grade IV, V and VI treated surgically [5]. Meta-analysis suggests that grade III injuries should be managed conservatively and surgical intervention is only indicated in those that are symptomatic or chronically unstable, although better functional outcomes have been advocated by new literature for patients with higher physically demanding occupations [6-8]. Surgical intervention has developed from fixation across the AC joint using Bosworth screws and the hook and plate technique to ligamentous reconstruction using coracoacromial ligament transfer (Weaver and Dunn technique) [9]. The current technique of choice is arthroscopic coracoclavicular ligament reconstruction. Arthroscopic methods therefore, allow less damage to the deltoid, the opportunity to diagnose concomitant shoulder pathology and allows non-rigid fixation of the AC joint [10,11]. The details of the technique evaluated in this study are outlined in the manufacture website [12]. This paper aims to evaluate and report the early result of the Arthrex Dog Bone Button Fibertape Construct as an arthroscopic technique in the repair of AC joint dislocations; including radiological finding, clinical outcome and post-operative functional scores.

Method

Between April 2013 and April 2015, all patients who underwent reconstructive surgery using Arthrex Dog Bone Button Fibertape constructs were identified (n=33). These patients were reviewed as a retrospective case series. Patients were followed up by a trained

researcher independent to the procedure and who had not received any sponsorship.

Radiological evaluation

Radiological reduction of the AC joint was considered the primary outcome of this study. This was done through measurement of the coracoclavicular distance (CCD); measured from the most superior border of the coracoid process superiorly to the inferior border of the clavicle (Usually 11-13 mm) [13]. Measurements were taken from the anteroposterior X-rays immediately before and after surgery.

Clinical evaluation

All 33 patients were mailed questionnaires and asked to complete and return them by freepost. Due to slow compliance, 4 weeks after letters had gone out, all patients were then phoned to offer an over-the-phone completion or online option. A clinical assessment of patient's disability related quality of life was made using the Disabilities of the Arm Shoulder and Hand (DASH) score. The pre-operative DASH score was collected retrospectively following surgery. The DASH score is a non-specific upper limb assessment but is comprehensive, exploring daily living tasks, social activities; recreational activities work and sleep [14]. The scoring of the system is designed that a score of 0/100 implies minimum disability and the best result [14]. A post-operative assessment of shoulder function and pain was made through American Shoulder and Elbow Society (ASES) questionnaires. It was designed by the ASES committee specifically for the shoulder and incorporates the Visual Analogue Score (VAS) [15]. A score of 100/100 indicates least pain and maximum function [15]. Safety was evaluated from combining patient notes and questionnaires. Student's T-test using Minitab® Software (Coventry) was used to compare CCD measurements and, pre and post op DASH scores.

Results/Analysis

The mean age in the study group were 34 years (Range: 18-55), 2 female and 29 male. There were 8 type III, 7 type IV and 8 type V dislocations. 6 had distal clavicle fractures.

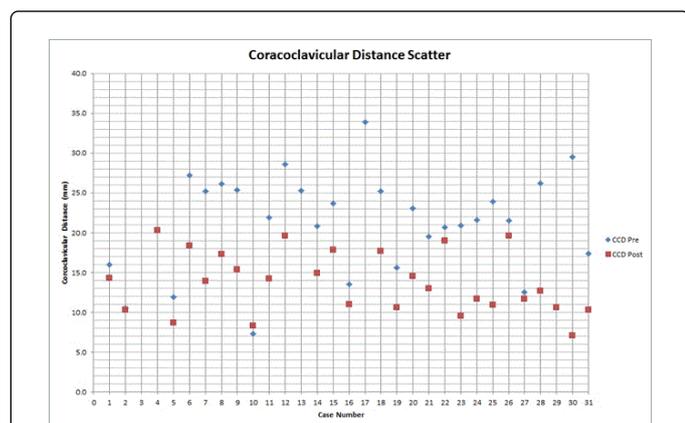


Figure 1: Scatter plot of coracoclavicular distance changes. Scatter plot showing coracoclavicular distance before (blue) and after (red) operation. Normal coracoclavicular distance is 11-13 mm. intervention restored 74% of shoulders to within +/- 2 mm of normal CCD.

3 were unclassified due to unavailability of pre-operative X-rays. 26 patients were included in the radiological analysis. 3 were excluded due to lack of pre-operative X-rays and 2 post-operatively. The mean of pre-operative CCD measurement was 21.0 mm and mean post-operative CCD was 13.1 mm (Figure 1). The reduction in each case was calculated and an overall mean reduction of 7.1 mm (SE, +/- 1.0). A paired t-test showed AC joint reconstruction using the double endobutton technique significantly reduced CCD ($p < 0.0001$).

Response rate to the questionnaires was 67% with a mean follow up was 14 months (Range, 2-26 months). The mean ASES score was 89.4 (SEM, +/-3.1) (n=22). The mean DASH was 63.0 pre-operatively and 12.5 post-operatively (n=18). Reductions were calculated for each case and there was a mean reduction of 50.5 (SEM, +/- 7.1). A paired t-test showed AC joint reconstruction using the Dog Bone double endobutton technique significantly reduced DASH score ($p < 0.0001$) (Table 1).

	Mean	Standard Deviation	Range
Age (Years)	34	11.9	18 -55
Follow Up (Months)	14	7.1	2-26
CCD Post-op (mm)	13.7	3.7	7.1 - 20.3
CCD Reduction (mm)	7.1	5.1	-22.4 - +1.0
DASH Score Pre-op	63	26.2	3 - 96.7
DASH Score Post-op	12.5	18.2	0 - 55.8
DASH Reduction	50.5	30.3	
ASES Score Post-op	89.4	14.7	56.7 - 100

Table 1: Summary of the clinical and radiological results.

Only 1 failure was reported, however this was due to a fall during the immediate post-operative period. Unfortunately this patient had no clinical or radiological data to evaluate. Only one other complication was reported, this was an infection.

Discussion

A mean post-operative CCD of 13.1 mm demonstrates good reduction and restoration of the joint's anatomic relationship (Normal 11-13 mm). The post-operative mean ASES score of 89.4/100 shows a good reduction in shoulder pain and increase in function. The mean reduction in DASH score of 50.5 further suggests that the intervention is having significant impact on quality of life. As expected the paired t-tests generated highly significant results confirming the observations that this intervention is having a significant effect. Together, these results display promise that the aims of surgical intervention are being fulfilled and validated over a mean follow up of 15 months. Safety has been shown in the low infection rate and single, albeit provoked, failure. Further, no basal coracoid fractures have been reported, due to the reduction in diameter of the tunnelling. Longer follow up is needed to confirm the long term safety and efficacy of this procedure.

These results in context of the surrounding literature show why Arthrex Dog Bone Button Fibertape construct may be the gold standard for AC repair at this stage. Cadaveric study has shown that the tensile strength of a Fibertape construct is 1400 N compared to that

of a normal AC joint at 500 N and a Weaver and Dunn repair at 350 N [11]. Compared with other endobutton techniques, the use of the Dog Bone button itself enables narrower tunnelling at the base of the coracoid, decreasing stress and likelihood of fracture [12]. Another advantage of the Dog Bone over similar techniques is by facilitating manipulation of the clavicle through a cinch mechanism and a low profile allowing it to be left in place comfortably [12]. This case series adds positive radiological and clinical evidence to support the biomechanical and osteological literature.

This study has some limitations, largely due to the small size of the cohort that have undergone the double endobutton procedure. Chiefly this case series could be criticized due to small patient numbers and a lack of a control group. This is something that will change as patient numbers grow and a case-control study would be the logical next step, comparing this technique to those managed conservatively. DASH scores, although being comprehensive, are non-specific to the shoulder and asking patients to recall pre-operative scores may have led to inaccuracies. Neither the ASES nor DASH score is specific to the AC joint either, which may also have affected findings; however such a patient score is yet to be developed. Further, patients with <6 month follow up were used in this series, which may actually have denounced the reported outcomes.

It is important to satisfactorily restore AC joint anatomy and functional anatomy of the shoulder joint after traumatic injury to prevent its further degeneration. AC joint osteoarthritis is a common disorder in the population of patients described in this series. Future research could use osteoarthritis as a clinical endpoint, either through onset of symptoms and disease progression or through further surgical intervention. This would be a good assessment of the effectiveness of various procedures at reducing post traumatic arthritis.

Overall, this case series has shown that AC reconstruction using Arthrex Dog Bone Button Fibertape construct is safe, restores anatomical relationship of the joint and improves disability related quality of life, function and pain. As patient numbers grow, future study will compare this technique with those managed conservatively and other techniques; specifically the LARS procedure which utilises a palmaris longus graft. Consistent use of patient scores will allow for eventual meta-analysis. Ultimately RCT will define the gold standard of technique for AC joint reconstructive surgery.

Conclusion

Restore normal anatomy and bio-mechanics of the AC joint would prevent abnormal load and reduce joint degeneration. This case series

has shown that arthroscopic AC reconstruction using Arthrex Dog Bone Button Fibertape construct technique is safe, allows anatomic restoration of the joint and early clinical data shows promising reductions in pain and increases in function.

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