Clinical outcomes of arthroscopic assisted fixation of acute high grade acromioclavicular joint disruption

Fahmy Samir Fahmy*, Hossam Fathi, Mohammad ElAttar

Department of Orthopedic Surgery, Zagazig University, Egypt

ARTICLE INFO

Keywords:
High grade
Minimal invasive
Arthroscopic
TightRope

ABSTRACT

Background: Management of high grade acute acromioclavicular (AC) joint dislocation is considered a surgical dilemma. Open methods of fixation are the gold standard but the morbidities are frequent. The goal of this study was to evaluate the results of arthroscopic fixation of acute high grade (AC) joint dislocation.

Methods: A series of 24 patients with acute high grade acromioclavicular joint dislocation were fixed arthroscopically using TightRope device. The study was done between February 2013 and February 2017. The functional outcomes were assessed using Constant-Murley score and University of California at Los Angeles shoulder (UCLA) scale. The preoperative and postoperative means of coraco-clavicular distance were calculated and used for radiological assessment. P-value < 0.05 was statistically significant.

Results: The mean followed up time was 23.25 ± 7.1 (12–35) months. There was highly significant improvement in the Constant-Murley score and (UCLA) scale at the end of the follow up period. The coraco-clavicular distance was improved from 21.7 ± 3.1 mm preoperative to 10.17 ± 2.3 mm postoperative. There were two complications, one case had over correction and the other had mild transient post-operative burning pain along the course of ulnar nerve.

Conclusion: Arthroscopic fixation of acute high grade (AC) joint dislocation is safe, minimally invasive technique with satisfactory functional outcomes and low morbidities provided that it is done by surgeons skilled in shoulder arthroscopy.

1. Introduction

Acromioclavicular (AC) joint dislocation is a common traumatic shoulder insult with male to female ratio (5:1).^{1,2} Direct strike to the lateral aspect of the shoulder is the most common mechanism of this injury.³

Rockwood⁴ classified the (AC) joint disruption into six types according to the direction and the severity. Conservative treatment is indicated in types I and II.^{5–7}

Surgical treatment is recommended for types IV, V and VI and young active patients with type III.^{8–10}

Most of the present studies advocated early surgery for acute type III injuries in highly demanded patients because it had significant better functional results compared to conservative treatment.¹¹

There are several methods used for fixation like K-wires, hook plate, Bosworth screw, Weaver-Dunn and resection of the lateral end of the clavicle, with no gold standard procedure.^{10,12–16}

Wound healing problems, the need for second operation to remove the hardware, big scar and infection are common problems associated

with the traditional open techniques.¹⁷

An arthroscopic technique using the TightRope device for fixation of acute (AC) joint dislocation is minimally invasive procedure with lower morbidity compared to open techniques has been recently developed.¹⁸

The aim of this study was to evaluate the short term results of arthroscopic assisted fixation of acute high grade (AC) joint disruptions using TightRope device in young active patients.

2. Material and methods

This prospective study was done on twenty four young active patients with acute high grade acromioclavicular joint dislocation (< 3 weeks) at Zagazig University Hospitals between February 2013 and February 2017. All patients were treated with arthroscopic assisted fixation using TightRope system. This study was approved from our university IRB ethical committee and informed consents were taken from all patients.

Chronic dislocation (> 3 weeks), Rockwood type I and II dislocation, (AC) joint arthritis, type III dislocation in elderly (> 60 years)

* Corresponding author. Department of Orthopedic Surgery, Faculty of medicine, Zagazig University, Sharkia, Egypt.

E-mail addresses: fahmysamir72@yahoo.com (F.S. Fahmy), hossam.saleem33@yahoo.com (H. Fathi), attar2006@yahoo.com (M. ElAttar).

<https://doi.org/10.1016/j.jor.2019.02.005>

Received 24 May 2018; Received in revised form 12 August 2018; Accepted 17 February 2019

Available online 27 February 2019

0972-978X/ © 2019 Prof. PK Surendran Memorial Education Foundation. Published by Elsevier, a division of RELX India, Pvt. Ltd. All rights reserved.

Table 1
The demographic characteristics of the studied patients*.

Age	
Mean $\pm$ SD	40.79 $\pm$ 7.2
Range (years)	(22–52)
Sex	
Male	21 (87.5%)
Female	3 (12.5%)
Injured side	
Right	19 (79.2%)
Left	5 (20.8%)
Type of injury	
Type III	5 (20.8%)
Type V	19 (79.2%)
Mechanism of injury	
Motor cycle	9 (37.5%)
Motor vehicle	6 (25%)
Pedestrian	5 (20.8%)
Falling	3 (12.5%)
Sport	1 (4.2%)
Occupation	
Manual worker	10 (41.6%)
Farmers	8 (33.3%)
Sport man	1 (4.2%)
Engineer	1 (4.2%)
Policeman	1 (4.2%)
Teacher	3 (12.5%)

*Data are presented as number (n) and percentage (%).

inactive patients with sedentary life and patients associated with other intra-articular lesions were excluded from this study.

The demographic criteria of the studied groups were presented in (Table 1).

2.1. Surgical technique

Pre-operative anti-biotic was given for all cases. The operation can be done under general or regional anesthesia (inter scalene block). The patient was positioned in beach chair position. Three arthroscopic portals were used in this technique (Fig. 1A). Diagnostic arthroscopy of the shoulder was done through the standard posterior portal to detect other gleno humeral joint lesions e.g SLAP lesion and rotator cuff tear. The antero-superior and antero-inferior portals were done using spinal

needle from outside in. The rotator interval was completely released exposing coracoid process. The arthroscope was switched to the antero-superior portal for better viewing the base of coracoid process.

The under surface of the coracoid process was exposed using electro cautery device from the antero-inferior portal. Closed reduction and temporary 1.2 mm K-wire fixation under image intensifier from the lateral border of the acromion was done.

The tip of AC TightRope drill guide was centered under base of coracoid process through antero-inferior portal. The top of the drill guide was positioned over the superior surface of the lateral end of the clavicle where 1.5 cm skin incision was done down to bone. The top of the guide system was positioned at the center of the superior surface of the clavicle. A 2.4 mm guide pin was drilled from the clavicle to the base of coracoid under direct vision until the tip of the pin exited the inferior cortex of the coracoid.

A 4 mm cannulated drill was passed over guide pin under direct vision until it came out of the inferior surface of the coracoid (Fig. 1B).

The guide pin was removed leaving the drill in place, the nitinol wire was passed through the cannulated drill and taken out through the antero-inferior portal by a grasper leaving the suture loop superiorly and the drill was removed. The traction suture of the TightRope was passed through suture loop; traction was done until the button was flipped under the inferior surface of the coracoid (Fig. 1C). The Tight-Rope was tightened, the K-wires were removed from the lateral border of the acromion and final tightening and tying of the TightRope suture was done under image intensifier to check the reduction. The wounds were closed in layers.

2.2. Postoperative management

All patients were discharged from the hospital within 24 h after surgery. Arm sling with immobilizer was used for 6 weeks. Elbow flexion-extension was allowed without active flexion-abduction of the shoulder. Full active motions of the shoulder were allowed after 6 weeks. Heavy strenuous activities were permitted 3 months after surgery.

2.3. Clinical follow up

Wound healing problems, shoulder stiffness and infection were

Fig. 1. (A) Pre-operative picture of the left shoulder showing skin landmarks and portals. (B) Intra-operative image showing the cannulated drill came out of the under surface of the coracoid. (C) The button of the TightRope flipped on the inferior surface of the coracoid process.

Fig. 2. (A) Pre-operative radiograph of the left shoulder shows Rockwood type V dislocation. Post-operative x-rays after reduction and fixation with TightRope were taken at 0 (B) and at 6 months (C).

documented. Also, the pre-operative and post-operative means of Constant-Murley score and University of California at Los Angeles shoulder scale were recorded at the end of the follow-up period.

2.4. Radiological follow up

Postoperative X-ray was taken at 0, 6 weeks, 3 months, 12 months and 24 months (Fig. 2). The coraco-clavicular distance before and after surgery was measured.

2.5. Statistical analysis

Statistical analysis was done using SPSS Microsoft program. The results were presented as mean $\pm$ standard deviation. Paired *t*-test was used to compare means of Constant score, (UCLA) scale and the coraco-clavicular distance before and after surgery. *P*-value < 0.05 was considered statistically significant.

3. Results

The mean follow up time was 23.25 ± 7.1 (12–35) months. No patient was missed during the follow-up period. The main causes of injury were motor cycle 9 cases (37.5%), motor vehicle 6 cases (25%) and pedestrian injuries 5 cases (20.8%). The most common type of injury was type V 19 cases (79.2%).

The mean time of return to work was 10.21 ± 3.6 (7–14 weeks) while, the mean time interval from injury to surgery was 7.5 ± 4.04 (3–19 days).

There was statistically significant improvement in the means of Constant score, (UCLA) scale and (cc) distance from 32.75 ± 7.4 , 8.5 ± 2.1 and 21.7 ± 3.05 mm to 93.2 ± 2.7 , 33.2 ± 2.3 and 10.2 ± 2.4 mm at the end of follow up respectively. *P*-Values < 0.00001 (Table 2).

There were no intraoperative complications such as fracture clavicle or fracture of the coracoid process. All cases regained their normal range of motion. No wound complications or infections were encountered. There was no need to remove the implant in any patient.

Only two complications were encountered, one patient had over correction of the (AC) joint due to over tightening of the TightRope

Fig. 3. Post-operative x-ray shows over reduction of the (AC) joint.

sutures, but this patient had satisfactory functional results without any complaint at the end of the follow up (Fig. 3) and the other had post-operative mild burning pain along the course of ulnar nerve. The pain was completely resolved 6 weeks post-operative without neurological deficit.

4. Discussion

Surgical treatment of acute (AC) joint disruption is still controversial among the orthopedic surgeons.¹⁹ Various methods of fixation were utilized such as K-wires, hook plate and coraco-clavicular screws.

Many drawbacks were encountered with these techniques like K-wire migration and breakage. The increased risk of infection, shoulder

Table 2

The results of Constant score, (UCLA) scale and (CC) distance*.

	Pre-operative mean	Post-operative mean	P- value
(UCLA) scale	8.5 ± 2.1 (5–12)	33.2 ± 2.3 (27–35)	< 0.00001
Constant-Murley score	32.75 ± 7.4 (22–47)	93.2 ± 2.7 (88–98)	< 0.00001
(CC) distance (mm)	21.7 ± 3.05 (17–27)	10.2 ± 2.4 (4–14)	< 0.00001

*The results are presented as mean $\pm$ standard deviation. *P*-value < 0.05 is statistically significant. (UCLA), University of California at Los Angeles shoulder scale. (CC), coraco-clavicular distance.

stiffness, big scar and the need of second procedure for implant extraction associated with open hook plate. Also coraco-clavicular screw failure and subluxation after its removal.^{20–22}

The recently developed arthroscopic fixation of (AC) joint dislocation using TightRope device had the following advantages: minimal risk of stiffness, less infection, detection of associated shoulder lesions, short hospital stay, less wound healing problems and no additional surgery is required to remove the implant.²³

The rationale of this procedure is to maintain the joint reduced during the initial phase of healing (< 3 weeks) to permit healing of coraco-clavicular ligament, acromioclavicular capsule and the delto-trapezial fascia.²⁴

Gstettner et al.¹¹ favored early operative intervention for grade III dislocation in young active patients to avoid persistent pain and improve shoulder function. So, we included these patients in our study accordingly.

The patients in our study were operated using single TightRope device to avoid the risk of coracoid fracture. In a biomechanical study by Beitzel et al.,²⁵ there was no difference in the stability between single and double device but the incidence of coracoid fractures was much higher with double device.

A previous study was conducted on ten patients with acute (AC) joint dislocation fixed arthroscopically by TightRope, the mean post-operative Constant score was 96.3 and all patients had satisfactory clinical and radiological results except in one case due to technical intraoperative error.²⁶

Seventeen patients with acute (AC) joint disruption were operated by Chaudhary et al.²⁷ using TightRope device. The mean postoperative Constant score was 86.4, the mean time to return to work was 4 months and the (CC) distance decreased from 21.5 mm preoperatively to 9.8 mm postoperatively with only one case failure.

Gupta et al.²⁸ performed a study on ten patients with acute (AC) joint dislocation. The mean postoperative Constant score was 92.2 and satisfactory reduction was achieved in all cases.

Referring to our study, the mean postoperative Constant score was 93.2 ± 2.7 , the mean post-operative (UCLA) scale was 33.2 ± 2.3 and the post-operative (cc) distance was 10.2 ± 2.4 mm with high statistically significant difference between the pre-operative and post-operative means of these scores (p -value < 0.00001). All patients had satisfactory functional and radiological results. They regained their normal range of motion in comparison to the healthy side and returned to the previous activity level at the end of follow up. The results of our study were comparable to the aforementioned studies.

There were no cases of infection or failure. There were only two complications, one case had over reduction of the (AC) joint due to over tightening of the TightRope sutures with no functional deficit and the other had mild post-operative burning pain along the course of ulnar nerve. The patient was given neurotonics and the pain was completely resolved within 6 weeks post-operative without neurological deficit.

A study by Jensen et al.,²³ open hook plate was used in 30 patients. The reported complications were hypertrophic scar (63%), revision surgery (13%) and one case of fracture acromion. The complications in our study were fewer and minor compared to the previous study.

The limitations in our study were as follow: it was done on small number of patients. It was a short term study that needs long term follow up to detect (AC) joint arthritis and subluxations. The scores used for functional evaluation were not specific for (AC) joint injuries. There was no control group to compare this technique with other methods of fixation. Finally, this procedure is technically demanding which needs an experienced surgeon in shoulder arthroscopy.

5. Conclusion

Our study demonstrated that arthroscopic assisted fixation of acute high degree (AC) joint disruption in high demand patients using TightRope is safe, minimally invasive procedure with good to excellent

short term functional outcomes and low morbidities but it is technically demanding and should be done by surgeons well trained in shoulder arthroscopy.

Conflicts of interest

The authors declared that there is no conflict of interest related to this study.

References

- Bishop JY, Kaeding C. Treatment of the acute traumatic acromioclavicular separation. *Sports Med Arthrosc.* 2006;14(4):237–245.
- Jacobs B, Wade PA. Acromioclavicular joint injury. An end result study. *J Bone Joint Surg Am.* 1966;48(3):475–486.
- Mazzocca AD, Santangelo SA, Johnson ST, Rios CG, Dumonski ML, Arciero RA. A biomechanical evaluation of an anatomical coracoclavicular ligament reconstruction [published online ahead of print November 10, 2005]. *Am J Sports Med.* 2006;34(2):236–246.
- Rockwood Jr CA, Williams GR, Young DC. Disorders of the acromioclavicular joint. second ed. In: Rockwood CA, Matsen FA, eds. *The Shoulder.* vol. 1. Philadelphia, PA: WB Saunders; 1998:483–553.
- Rolf O, Hann von Weyhern A, Ewers A, Boehm TD, Gohlke F. Acromioclavicular dislocation Rockwood III-V: results of early versus delayed surgical treatment. *Arch Orthop Trauma Surg.* 2008;128(10):1153–1157.
- Hootman JM. Acromioclavicular dislocation: conservative or surgical therapy. *J Athl Train.* 2004;39(1):10–11.
- Bannister GC, Wallace WA, Stableforth PG, Hutson MA. The management of acute acromioclavicular dislocation. A randomized prospective controlled trial. *J Bone Joint Surg.* 1989;71(5):848–850.
- Tauber M. Management of acute acromioclavicular joint dislocations: current concepts. *Arch Orthop Trauma Surg.* 2013;133(7):985–995.
- Prokop A, Helling HJ, Andermahr J, Mönig S, Rehm KE. Type III injuries of the acromioclavicular joint. In what circumstances is surgery still justified? Personal results and literature review. *Orthopä.* 2003;32(5):432–436 German. PubMed PMID: 12743695.
- Weaver JK, Dunn HK. Treatment of acromioclavicular injuries, especially complete acromioclavicular separation. *J Bone Joint Surg Am.* 1972;54(6):1187–1194.
- Gstettner C, Tauber M, Hitzl W, Resch H. Rockwood type III acromioclavicular dislocation: surgical versus conservative treatment. *J Shoulder Elbow Surg.* 2008;17:220–225.
- Horst K, Dienstknecht T, Pishnamaz M, Sellei RM, Kobbe P, Pape HC. Operative treatment of acute acromioclavicular joint injuries graded Rockwood III and IV: risks and benefits in tight rope technique vs. k-wire fixation. *Patient Saf Surg.* 2013;7:18.
- Faraj AA, Ketzner B. The use of a hook plate in the management of acromioclavicular injuries. Report of ten cases. *Acta Orthop Belg.* 2001;67:448–451.
- Sim E, Schwarz N, Hocker K, Berzlanovich A. Repair of complete acromioclavicular separations using the acromioclavicular hook plate. *Clin Orthop Relat Res.* 1995;314:134–142.
- Ballmer FT, Gerber C. Coracoclavicular screw fixation for unstable fractures of the distal clavicle: a report of five cases. *J Bone Joint Surg Br.* 1991;73:291–294.
- Tsou PM. Percutaneous cannulated screw coracoclavicular fixation for acute acromioclavicular dislocations. *Clin Orthop Relat Res.* 1989;243:112–121.
- Richards A, Tennent TD. Arthroscopic stabilization of acute acromioclavicular joint dislocation using the TightRope system. *Tech Shoulder Elbow Surg.* 2008;9(2):51–54.
- Flinkkila TE, Ihanainen E. Results of arthroscopy-assisted TightRope repair of acromioclavicular dislocations. *Shoulder Elbow.* 2014;6:18–22.
- Beitzel K, Cote MP, Apostolakis J, et al. Current concepts in the treatment of acromioclavicular joint dislocations. *Arthroscopy.* 2013;29(2):387–397.
- Sethi GK, Scott SM. Subclavian artery laceration due to migration of a Hagie pin. *Surgery.* 1976;80:644–646.
- Liu HH, Chou YJ, Chen CH, Chia WT, Wong CY. Surgical treatment of acute acromioclavicular joint injuries using a modified Weaver-Dunn procedure and clavicular hook plate. *Orthopedics.* 2010;33.
- Esenyel CZ, Öztürk K, Bülbül M, Ayanoğlu S, Ceylan HH. Coraco-clavicular ligament repair and screw fixation in acromioclavicular dislocations. *Acta Orthop Traumatol Turcica.* 2010;44:194–198.
- Jensen G, Kathagen JC, Alvarado LE, Lill H, Voigt C. Has the arthroscopically assisted reduction of acute AC joint separations with the double tight-rope technique advantages over the clavicular hook plate fixation? *Knee Surg Sports Traumatol Arthrosc.* 2014;22:422–430.
- Larsen E, Bjerg-Nielsen A, Christensen P. Conservative or surgical treatment of acromioclavicular dislocation. A prospective controlled randomized study. *J Bone Joint Surg Am.* 1986;68(4):552–555.
- Beitzel K, Obopilwe E, Chowaniec DM, et al. Biomechanical comparison of arthroscopic repairs for acromioclavicular joint instability: suture button systems without biological augmentation. *Am J Sports Med.* 2011;39:2218–2225.
- El Sallakh SA. Evaluation of arthroscopic stabilization of acute acromioclavicular joint dislocation using the TightRope system. *Orthopedics.* 2012;35:e18–22.
- Chaudhary D, Jain V, Joshi D, et al. Arthroscopic fixation for acute acromioclavicular joint disruption using the TightRope device. *J Orthop Surg.* 2015;23(3):309–314.
- Gupta P, Kansal G, Srivastav S, Agarwal S. Arthroscopic fixation using TightRope device for acute acromioclavicular joint disruption. *J Arthroscopy Joint Surg.* 2016;3(1):7–12.