

New Variant of the Treatment of Acromion-Clavicular Dislocation With TightRope® System in a Mini - Open Approach: A Preliminary Clinical Study

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Abstract

Background: Many different surgical techniques have been described to stabilize the acromion-clavicular (AC) dislocations. So far many of these procedures are performed only in arthroscopy.

Objectives: In this study, we describe a new technique that utilizes the tightrope with a mini-invasive open approach for the acute stabilization of the acromion-clavicular joint (ACJ) dislocation.

Patients and Methods: We set an prospective study aimed to verify the efficacy of this new surgical technique. We treated 28 patients with acute ACJ dislocation with ACJ TightRope® System with dual mini access. We retrospectively reviewed the data of 34 patients treated with arthroscopic technique. They were considered as the control group.

Results: At 6 month's follow-up, all the 28 patients showed a stable joint during clinical examination and obtained an average Constant score of 98.62/100, with a complete recovery of ROM and strength in abduction. The mean operation time was of 33.7 minutes. The mean recovery duration was 102.8 days. No significant difference was found between the experimental and control groups ($P > 0.05$).

Conclusions: Results of this trial suggest the effectiveness of this new mini-invasive surgical technique in producing clinical and functional recovery in patients with ACJ dislocations.

Keywords: Acromion-Clavicular Dislocation, Mini-Invasive Open Approach, Tight Rope System

1. Background

The acromion-clavicular joint (ACJ) dislocation is a very frequent event, with an estimated incidence of 3 - 4 over 100000 (1). Although it might occur at any age, it is more frequent in young athletes, with an incidence between 25% and 52%, and is common in road traffic accidents (bike and motorbike). Usually, it occurs when a direct trauma hit the lateral region of the shoulder with the arm in adduction as in this position the scapula is shifted down and the clavicle impacts on the first rib (2). The high grade dislocations (IV-VI Rockwood degrees) are intended for surgical treatment, while treatment of III degree dislocations is up to the discretion of the surgeon, since there is still few data in literature (3). It is important to obtain correct radiographic views to make a proper diagnosis and classify the lesions (antero-posterior, Zanca and axial views) (4, 5).

Many different surgical techniques have been described to stabilize the acromion-clavicular dislocations,

both intra- and extra-articular, including some recent arthroscopic techniques, which are rather complex and therefore can be performed only by arthroscopic surgeons.

2. Objectives

The TightRope® System (Arthrex Medizinische Instrumente GmbH, Germany) is a device originally designed for the reduction and stabilization of tibio-fibular syndesmosis, then redesigned to be used for the stabilization of the acromioclavicular joint (ACJ TightRope® System) with open or arthroscopic technique (6). This device consists of two metal buttons, one circular and one oval, connected by FiberWire suture (7).

In this study, we describe a new technique that utilizes the TightRope with a mini-invasive open approach for the acute stabilization of the ACJ dislocation. This technique in our experience gives a quick recovery of activity of daily

life, leaves minimal scar incisions and does not require removal of the device.

3. Patients and Methods

We set a prospective study aimed to verify the efficacy of the new surgical technique after approval of the local ethics committee. From January 2011 to September 2014 at our Unit of Orthopedics and Traumatology we treated patients with acute ACJ dislocation with ACJ TightRope® System with dual mini access (the experimental group). All patients were informed and signed the informed consent. The inclusion criteria were the following: acute first episode, a dislocation degree of III or more according to Rockwood classification, treatment within four days after trauma.

In the second part of the study, we retrospectively reviewed the data of patients which, in the same period of time, we treated with arthroscopic stabilization of acute ACJ dislocation using the TightRope system, according to the technique described in literature (6). These patients were considered as a control group and we recorded the same clinical and functional scores of the experimental group.

The outcome of the surgical treatment was based on collection of an objective score:

- The Constant Score (total 101- points score), which assesses pain, degree of function, ROM and muscular force (8). Greater levels of disability are reflected by a lower score.

- The clinical assessment of the stability of the AC joint in front-to-back and top-to-bottom movements at 6 and 12 months.

We also collected the duration of operative time (minutes) and recovery duration (time to return to daily activities and work) (days).

Continuous variables are expressed as means, standard deviations and range. A t-test was used to compare two groups for age, operative time, recovery duration and Constant score. A value of $P < 0.05$ was taken as statistically significant. Data processing was done with Epi-Info 6.00 software (public domain software CDC Atlanta, GA; WHO, Geneva, Switzerland).

3.1. Surgical Procedure

The patient is placed in beach chair position under general anesthesia or Alemanno's brachial plexus block. The first incision, about 2 cm long, is carried out on the skin overlying the coracoid process (Figure 1), which is to be isolated and protected by two Hohmann levers. Then the coracoid is perforated through a guided 4.5 mm cannulated

drill. It is very important to place the drill in the correct position in order to get a good fixation, this is on the posterior 2/3 of the upper surface of the coracoid in its medial line. A drill stop or a malleable retractor is placed underneath the coracoid to protect soft tissues. A suture thread is inserted into this hole that represents the guide for the AC TightRope® System. Then we proceed with a 2 cm cross incision along the lateral clavicle starting from the AC joint moving medially. The distal part of the clavicle is isolated and exposed by partially detaching the insertion of the anterior deltoid muscle and by placing two Hohmann levers allowing a perfect visualization of the AC joint.

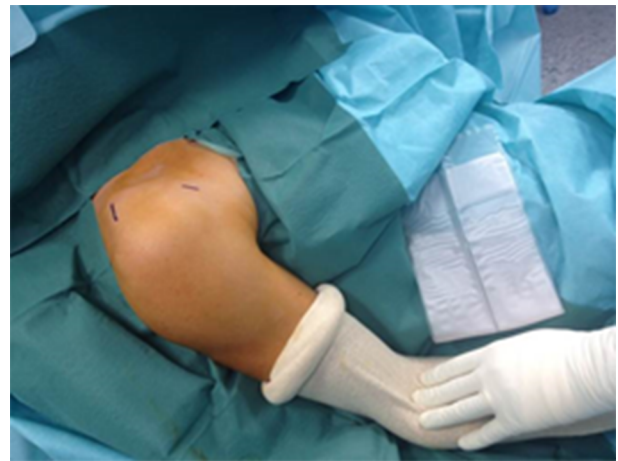


Figure 1. Performing a Longitudinal Incision on the Skin Projection of the Coracoid of About 2 cm

A bone tunnel is created perpendicular to the distal third of the clavicle about 2-3 cm medial to the ACJ with the same guided 4.5 mm drill. Another suture thread is passed through this second tunnel and tied up to the AC TightRope® system, being the carrier to insert the system into the clavicle tunnel. The suture thread is clutched with a Klemmer forceps and then the Tight Rope is pulled down from the clavicle to the coracoid surface deep to the deltoid muscles (Figure 2). The second suture thread seating into the coracoid tunnel after the previous preparation, is tied to the system and drag down through the coracoid tunnel. This simple step allows the surgeon to work on the clavicle and coracoid side through two mini accesses instead of one. In acute cases the dislocation is easily reduced supporting the weight of the arm from the bottom. This reduction can be maintained with a direct pressure or with a bone clamp or with a trans-articular K-wire. When a satisfactory reduction of the dislocation has been achieved, the TightRope® system is tied up by pulling the thread of the top button, making sure that the down button sits

snug and horizontally under the coracoid. We prefer to tie the threads together in a triple knot to be able to bend and bury the knots under the periosteum and the subcutaneous fat layers. Surgical wounds are closed with absorbable threads. Immediately after the operation the arm is tied close to the chest with a provisional bandage that is replaced with an internal rotation brace the next day. We advise to keep this brace for a period of at least six weeks, during which only active movements of the hand, wrist and elbow are allowed. Postoperative clinical and radiographic follow-up is done at six weeks after surgery. At this time active and passive mobilization is allowed for a period of about two months.



Figure 2. Capture of the Suture Thread and the Passage of the System From the Clavicle to the Coracoid

4. Results

In the first part of the study, forty patients with acromion-clavicular dislocation presented at our unit during the period of the study, and 28 matched the criteria of inclusion. The most frequent traumatic event was represented by a road traffic accident, followed by sport trauma and domestic accident. All patients were male with a mean age of 34 years old (Table 1). They were treated with the new technique. The mean operation time was 33.7 minutes. The mean recovery duration was 102.8 days.

At 6 months follow-up, all the 28 patients showed a stable joint during clinical examination in front-to-back and top-to-bottom movements and obtained an average Constant score of 98.62, with a complete recovery of ROM and strength in abduction (Table 2). All patients had a very good esthetical result. Two patients out of 28 have noted a failure of the system with the breaking of the device during the rehabilitation period. This has been caused in one case

by an incorrect positioning of the system and in the other one without any specific reason, probably a failure of the knotting technique. Both of them had, although, achieved a good clinical result. At 12 months follow-up consultation, results were stable.

In the second part of the study, we retrospectively reviewed the data of 34 patients treated with arthroscopic technique (Table 1). Thirty-three patients were male and one was female with a mean age of 38 years old. The mean operation time was 99.3 minutes (Table 2). The mean recovery duration was 109.4 days. At 6 months all these 34 patients had good results with an average Constant score of 98.2. At 6 and 12 months all the shoulders were stable. No patients had complications.

There was no statistically significant difference between the groups in age ($P=0.22$), operation time ($P=0.38$), Constant score ($P=0.22$) and recovery duration ($P=0.1$).

5. Discussion

Results of this preliminary study show the effectiveness of this new mini-invasive surgical technique in producing clinical and functional recovery in patients with ACJ dislocations. So far eight papers have been published on this topic, and all focused on the arthroscopic technique.

Reduction of ACJ dislocation with TightRope® System is the second most common surgical technique used in this type of lesion preceded only by open reduction and synthesis with plates (9). TightRope® System in ACJ dislocation is minimally invasive, provides a dynamic stability of the joint and good clinical result. Compared to open procedures it is less painful in the postoperative period and in our experience permits return to activities of daily life and sports within 5 months' time (10). Compared to other surgical techniques it avoids the need for a second operation to remove the metalwork (11).

However, the arthroscopic technique is technically laborious and requires a surgeon with high experience in shoulder arthroscopy (4). With this study it was observed how the arthroscopic technique can be converted to a mini-open surgery with two accesses of about 2 cm instead of a larger one providing an optimal functional recovery of the joint and a less painful postoperative period with an easier surgical procedure and a relatively quick learning curve; on the other hand, aesthetic result is not very different from that obtained with arthroscopic access.

From the ethical point of view, this new procedure offers new and promising therapeutic possibilities. Mainly, it can also be done in centers where there is not a specialist in arthroscopy. In this way a greater number of patients can be treated with this stabilization system.

Table 1. Demographic Characteristics of the Patients

	Mini-Invasive Group (N = 28; All Male) Mean (+/SD) (Range)	Arthroscopic Group (N= 34; 33 Males and 1 Female) Mean (+/SD) (Range)	P Value
Age, y	34 years old (+/8.7) (range: 21 - 60 years old)	38 years old (+/11.5) (range: 25-58 years old)	0.22

Table 2. Surgical and Clinical Characteristics of the Patients

	Mini-invasive Group Mean (+/SD) (Range)	Arthroscopic Group Mean (+/SD) (Range)	P Value
Operation Time	33.7 minutes (+/-4) (range: 28 - 42 minutes)	99.3 minutes (+/11.7) (range: 89 - 122 minutes)	0.38
Recovery Duration	102.8 days (+/19) (range: 90 - 150 days)	109.4 days (+/20.7) (range: 90 - 150 days)	0.1
Constant Score	98.62 (+/- 3.06) (range: 95 - 100)	98.2 (+/- 2.3) (range: 87-100)	0.22

Weaknesses of this study include the absence of a control group with arthroscopic technique and the size of the series that is pretty small with only 28 cases. Based on our preliminary results we are now planning to set up a prospective randomized study with a larger series.

Stabilization of ACJ dislocation with TightRope® system is a minimally invasive method, provides good clinical results and does not require the removal of metalwork. The proposed simple surgical technique with a 2 mini-approach allow a larger number of orthopedic surgeons, not familiar with the more complicated arthroscopic techniques, to perform this common procedure with minimal cosmetic damage.

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Footnote

Authors' Contribution: Angela Notarnicola, Giuseppe Sforza and Paola Damato drafted the manuscript and reviewed the literature; Antonio Panella, Giuseppe Solarino and Claudio Mori conceived the study, participated in its coordination and in the acquisition of the data; Cristina Margiotta and Biagio Moretti were involved in analysis and interpretation of the results of the data. All authors read and approved the final manuscript.

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