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ORIGINAL ARTICLE

# Surgical treatment of acromioclavicular dislocation with LARS artificial ligament

**S. Giannotti · G. Dell'osso · G. Bugelli · N. Cazzella · G. Guido**

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**Abstract** The choice of the most appropriate procedure for surgical treatment of type IV–V and VI dislocations of the acromioclavicular joint according to Rockwood's classification has always been troublesome because of complications such as residual instability of the joint, delayed arthrosis of the A-C, delayed osteolysis of the clavicle, host intolerance towards artificial ligaments and because of the need of early mobilization of the affected limb. In our study, 17 male patients, ranging in age from 21 to 79 years and affected by A-C dislocation grade IV and V, both acute and chronic, underwent surgical reconstruction of the A-C joint capsule and extra-articular ligaments with ligament augmentation and reconstruction system (LARS) artificial ligament. Following surgery, their affected limb was braced for 3 days and thereafter all patients began an early active and passive mobilization programme. Patients eventually all returned to their previous working and recreational activities. Throughout thorough clinical and radiographic evaluation and the use of both Constant score and Simple Shoulder test, the aim of our study is to prove that at mid-term follow-up, the reconstruction of the conoid and trapezoid ligaments with LARS is a valid and safe alternative to other procedures.

**Keywords** Acromioclavicular dislocation · Conoid and trapezoid ligaments · Surgical treatment · LARS artificial ligament · Clinical outcome

S. Giannotti (✉) · G. Dell'osso · G. Bugelli · N. Cazzella · G. Guido
Universita' di Pisa II Clinica Ortopedica e Traumatologica, Via Paradisa 2, Pisa, Italy
e-mail: s.giannotti@med.unipi.it

## Introduction

Beginning in October 2006 through May 2010 at the Orthopaedic Division of the University of Pisa, 17 male patients with a mean age of 37.53 years and affected with A-C dislocation underwent surgical reconstruction of the conoid and trapezoid ligaments with LARS artificial ligament.

Dislocations accounted for 20 % as acute lesions and for 80 % as chronic lesions.

At a mid-term follow-up ranging from 1 to 41 months all patients, evaluated both radiographically and through two evaluation tests, consider themselves satisfied with the clinical outcomes and have returned to their previous working and recreational activities. The aim of our study, along with the findings of those carried out by Simeone and Memminger, Quinn and Krenn, is to demonstrate that ligament augmentation and reconstruction system (LARS), in carefully selected patients affected with A-C dislocation, represents a valid surgical alternative to other techniques described in literature [5].

LARS® (Ligament augmentation and reconstruction system—Dijon, France) is a system made of industrial synthetic ligament fibres designed to mimic the mechanical and anatomical ligament properties (and suitable for several applications ranging from posterior cruciate and anterior cruciate reconstruction to achilles tendon and acromioclavicular repairs). In the shoulder, the LARS range includes two sizes (LARS 20 and LARS 30) of acromioclavicular ligaments; their use depends on the patient's weight and sport activities. LARS is composed of an intra-articular and an extra-articular portion. The intra-articular portion consists of longitudinal fibres conceived to resist fatigue and allow fibroblastic ingrowth. The extra-articular portion presents woven fibres that provide strength and resistance to elongation. The polyester fibres and the

original design of the knit have been tested for: stretching, rupture and wear. The studies have shown that the LARS® artificial ligament is quite resistant to flexion, torsion, traction and residual stretching.

They allow immediate mobilization with no material through the joint. The fixation is via two bony tunnels and not an "over-the-top" approach, thus reducing clavicular erosions.

The use of loop techniques offers the possibility of an earlier return to activity especially in younger, active patients or ones with a high-grade dislocation.

Any surgical procedure for acromioclavicular dislocation should fulfil three requirements: exposure of and reduction in the acromioclavicular joint, repairment of the coracoclavicular and acromioclavicular ligaments and achievement of stable reduction in the acromioclavicular joint. Procedures, such as the LARS technique, that accomplish these three goals should produce acceptable results.

In order to perform the LARS reconstruction procedure, the patient is placed on the operating table seated in beach-chair position and a skin incision 5–6 cm in length is made from lateral to medial along the anterior border of the clavicle starting from the A-C joint. The A-C joint is exposed and debrided of its articular disc taking care to avoid detaching it from its superior insertion. The distal end of the clavicle and the coracoid process are exposed as well. Two bony tunnels are drilled in the superior cortex of the clavicle in an oblique and non-aligned fashion (size 3.5 mm for the LARS 20 and size 4.5 mm for the LARS 30) being careful to preserve the anterior and posterior corticals in order to preserve strength. The hook-like instrument provided by the LARS company (or alternatively a Dechamp) is used to pass the LARS ligament beneath the coracoid process. The hook-like guide instrument has to be inserted under the coracoid from a medial to lateral direction so that the metallic loop can be placed within the guide; the metallic loop is necessary to pass the LARS neoligament beneath the coracoid process and into the two clavicular bony tunnels. Once the hook guide is retrieved from the coracoid, the ligament is freed from the loop and its posts are passed through the medial and lateral tunnels. The medial extremity of the ligament is fixed onto the clavicle by a conic non-resorbable interference screw. Once the dislocation is reduced even the lateral extremity of the ligament can be secured to the clavicle with another conic screw like the first one used. This kind of fixation of the neoligament to the clavicle resembles the normal anatomy of the conoid and trapezoid ligaments thus avoiding the creation of a loop around the clavicle and its subsequent erosion. The A-C joint previously debrided of its articular disc is then reinforced by reconstructing the torn capsule and ligaments in order to establish antero-posterior stability [7].

Treatment consists in an initial immobilization in a sling of the affected limb. After 2 or 3 days and within the first week, the sling is discarded and gentle active exercises are permitted and encouraged. Usually at the fourth or fifth day following surgery, the patient's range of motion of the affected limb should not exceed 80° of abduction and 60° of flexion in order to preserve integrity of the reconstructed capsule. Within 80° of abduction and 60° of flexion of the glenohumeral joint, the acromioclavicular joint remains quite still; instead it is majorly stressed above 90° of abduction of the affected limb. Sutures are removed at the second week. Active and passive motions above 90° of abduction are avoided until 18 days after surgery. Heavy lifting, strenuous exercises and full activities are avoided until 28 days after surgery. Usually, the hardware is never removed from the clavicle. If the surgeon, for particular reasons, wishes to remove the hardware, this procedure can be performed at 6–12 months following surgery [2, 6].

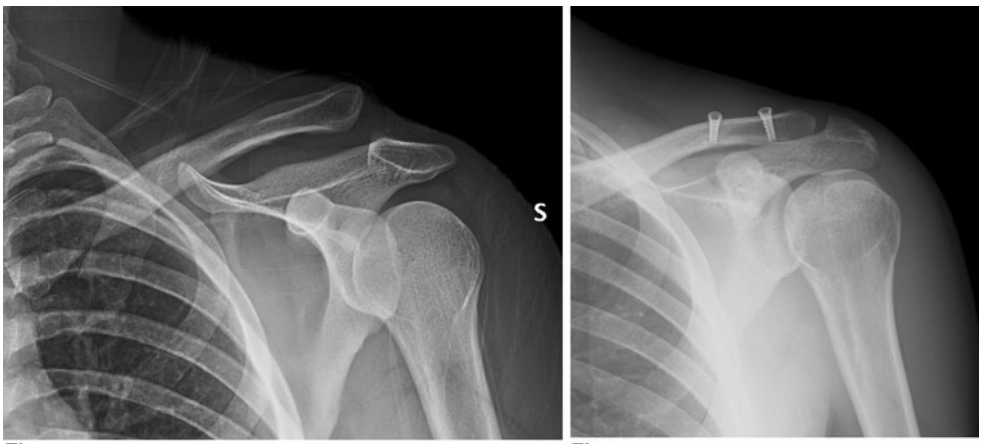
## Materials and methods

At our institution, starting in October 2006 through May 2010, we treated 17 patients suffering acromioclavicular dislocation with the LARS reconstruction technique. The follow-up period ranged from 1 to 41 months. Our study is retrospective and non-blind; we included male patients suffering from acromioclavicular dislocation grade IV and V according to Rockwood's classification. By chance, the patients belonged only to the male gender. We did not include patients suffering from dislocation of the A-C joint grade I, II and III for which we found no clear indication for surgery in literature [1].

Our patients mean age was of 37.53 (21–79 years of age).

Dislocations accounted for 20 % as chronic lesions and for 80 % as acute lesions. The aetiology spread from sport injuries (Rugby, soccer, dirt biking), domestic accidents (1 case) and motorcycle accidents (1 patients), but the mechanism of injury was always reconductible to a fall on the dome of the shoulder while the upper limb was in adduction; the clavicle rests on the first rib, and the rib blocks further displacement of the clavicle. As a result, if the clavicle is not fractured, the acromioclavicular and coracoclavicular ligaments are injured [4].

According to Italian law, ethical approval for this study was not required because it involved only routine clinical follow-up and radiographic examination. Written informed consent was obtained from each patient. With this consent, the patients authorize the surgical treatment and also collection and publication of clinical data about their cases for scientific and educational purposes even outside the institution.




**Figs. 1, 2** Pre- and post-surgical radiographic evaluation

Clinical evaluation of patients was performed using both Constant Score and Simple Shoulder test; similarly radiographic evaluation was determined through measurements taken both on standard views and stress view X-rays (suspending 5 kg to both of the patients' wrists). If possible, the weights should be tied to the wrists to avoid having the patient hold them; this allows the upper extremity muscles to relax completely. With the patient standing erect, anteroposterior radiographs are made for each acromioclavicular joint and the sides are compared. In significant subluxations, the lateral end of the clavicle is displaced superiorly, or the scapula and arm are displaced inferiorly, more than one half the thickness of the clavicle. In dislocations, the distal clavicle is displaced a distance that is equal to or more than its thickness.

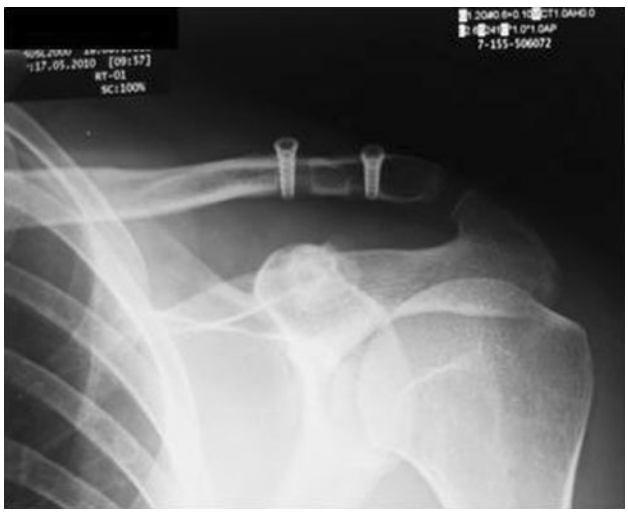


**Fig. 3** Radiographic evaluation at 16 months of follow-up shows an enlargement of the clavicular tunnels

## Results

All 17 patients evaluated by our group totalled excellent results both on the Constant Score test (100 points out of 100) and on the Simple Shoulder test (12 out of 12): following surgical treatment, in fact all patients returned to previous activities.

In order to assess a precise radiographic evaluation, we measured coracoclavicular distance and entity of acromioclavicular dislocation on pre- and post-surgical evaluation (Figs. 1, 2) and evaluations taken on the date of follow-up examination. The mean value of coracoclavicular distance was 1.69 cm before the surgery, 0.58 cm after the surgery and 0.68 cm at follow-up. The mean value of acromioclavicular dislocation was 1.71 cm before the surgery, 0.13 cm after the surgery and 0.14 cm at follow-up.

The statistical analysis of data through the *T*-student distribution gave the following interval at 80 % of confidence: coracoclavicular distance before surgery was 1.31–2.39 cm and after surgery was 0.41–0.72 cm. Acromioclavicular distance before surgery was 1.42–1.88 cm and after surgery was 0.0–0.2 cm.

The follow-up analysis showed no appreciable statistical changes in the intervals.

Follow-up radiographic evaluations showed only one patient with an enlargement of the clavicular tunnels although the reduction in the dislocation was maintained and the clinical outcome was positive (Fig. 3).

## Discussion

We consider the strong points of our study the fact that our mid-term follow-up is quite long (up to 41 months) that the

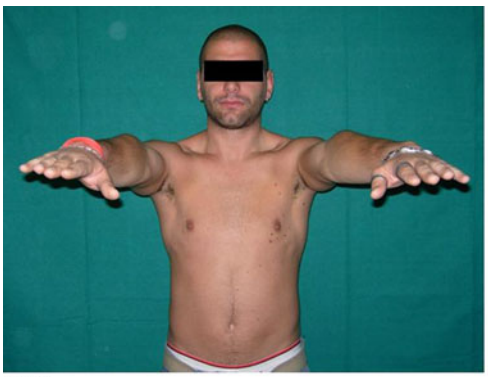


Fig 4

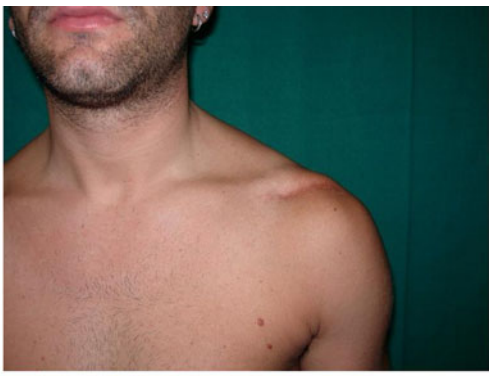


Fig 5

**Figs. 4, 5** Clinical evaluation at 16 months of follow-up

procedures were always performed by the same surgeon and that the patients were evaluated in an objective manner (Constant Score, Simple Shoulder test and radiographic evaluation).

We consider the weak points of our study the relatively small specimen taken into consideration (17 patients), the difficulty of further exposing patients to radiographic evaluation in absence of clinical findings (so far all of our patients are satisfied and have returned to their normal activities) and the absence of a control group treated for the same lesion with an alternative surgical procedure as proposed in literature.

Clinical outcomes lead us to believe that the reconstruction technique of the coracoclavicular ligaments with LARS artificial ligament is effective in reducing dislocation of the A-C joint and capable of providing long lasting results as pointed out by the mid-term follow-up evidence of our study (Figs. 4, 5).

The scores totalled by our patients through the Constant Score and the Simple Shoulder test indicate, on the one hand, that the patient's satisfaction for aesthetic and functional results, and on the other hand, that strength, OMR and mechanical stability are excellent.

Moreover, radiographic evaluation of the patients has shown that coracoclavicular distance and acromioclavicular dislocation resume a normal range for these variables both at post-operatory evaluation and at mid-term follow-up. We consider these data indicative of the fact that the LARS reconstruction technique can be advocated both for acute and chronic dislocations of the A-C joint.

Therefore, comparing the results of studies found in literature with the ones provided by our study, our institution considers the LARS reconstruction technique of the coracoclavicular ligaments a valid and safe alternative to other surgical procedures in the case of grade IV–V and VI acromioclavicular acute or chronic dislocations [3].

**Conflict of interest** No benefits or funds were received in support of this study. None of the authors has any conflict of interests to disclose.

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