MINIMALLY INVASIVE AC JOINT RECONSTRUCTION (MINAR®)
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1 – Minimally Invasive AC Joint Reconstruction (MINAR®)
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Introduction

Luxation of the acromioclavicular (AC) joint is a common sports injury. Depending on its severity, the injury is associated with rupture of the acromioclavicular and coracoclavicular ligaments. The coracoclavicular ligaments (conoid and trapezoid ligament) are major stabilizing components that prevent superior dislocation of the clavicle.\textsuperscript{2,4,5,7}

The therapeutic options for the treatment of AC joint dislocation are based on the severity of the injury (Rockwood classification).\textsuperscript{1,13} For the treatment of mild to moderate injuries, conservative management is commonly sufficient, however, for patients suffering from high-grade injuries, surgical repositioning and stabilization of the joint is recommended.

For surgical stabilization of the AC joint, there is a multitude of operative procedures, however, some of them are fraught with problems related to the use of rigid implants. Multiaxial forces impacting the AC joint have been found to account for implant loosening. Another drawback is that the implant needs to be removed after a few weeks. As a result, coracoclavicular augmentation techniques using a sturdy suture cord (e.g., PDS, absorbable vs. non-absorbable) have been developed.\textsuperscript{3,6} The underlying principle of augmentation of the coracoclavicular ligaments (conoid and trapezoid ligament) has proved efficient to promote healing without inducing elongation.

In clinical studies, this technique has been found to be superior to others. Placing the suture cord in the anterior part of the coracoid process can result in anterior subluxation of the clavicle.\textsuperscript{8} Another problem associated with the use of a coracoclavicular suture cord, lies in the fact that rotational movement of the clavicle can cause the sutures to cut through the bone.\textsuperscript{9} However, the major problem of the coracoclavicular cerclage technique lies in its invasiveness. Prior to passing the cord around the coracoid process, a large incision needs to be made. In order to minimize invasiveness, arthroscopic procedures geared toward stabilizing the AC joint have been developed,\textsuperscript{10} however, they come at the cost of being time-consuming, technically demanding and they require a good level of proficiency on the part of the arthroscopic surgeon.

As demonstrated by biomechanical and clinical studies, sustained coracoclavicular stabilization is feasible by the combined use of a suture cord with a FLIPPTACK fixation button, well-known from cruciate ligament surgery.\textsuperscript{11,12} Even when exposed to cyclic loads, the device did not cut through the clavicle. The combined use of a suture cord with a fixation button offers the same level of pull-out resistance as with a conventional suture cerclage, and it provides almost double the resistance as compared to suture anchor augmentation.

As a rule, arthroscopic deployment of a fixation button onto the coracoid process is a feasible technique, however, prior surface debridement is mandatory. Note, that there is an inherent risk of damaging ligament remnants which are essential to the healing process.

The minimally invasive technique developed by the authors enables easy insertion of a fixation button with a double-suture cerclage without the need to rely on concurrent arthroscopic visualization. The FLIPPTACK fixation button is passed under the coracoid process with a special inserter rod once a bone tunnel has been drilled using a target guide. The operative procedure allows for gentle treatment of AC joint dislocation through a 3-mm skin incision.
Indications and Contraindications

Indications

- Treatment of high-grade dislocation of the AC joint (Rockwood III–VI, Fig. 2.1).
- Treatment of chronic instabilities with concurrent coracoclavicular ligament reconstruction (modified Weaver Dunn or free tendon graft).
- Lateral clavicular fracture.

Contraindications

- Poor general condition of the patient.
- Localized soft tissue infection.
- Clavicular shaft fracture.
- Treatment of chronic instabilities without autologous or allogeneic ligament reconstruction.

Fig. 2.1 Acromioclavicular joint dislocation of Rockwood type V.
Surgical Access

1. The initial skin incision, approx. 3 cm in length, is made above the lateral clavicle (Fig. 3.1). In patients with an AC dislocation of Rockwood grade V, the delto-trapezial fascia are ruptured and the clavicle is found exposed. A Langenbeck retractor can be used to expose the acromioclavicular ligaments. In the anterior part of the clavicle, the deltoid muscle is spread bluntly and the coracoid process is palpated digitally.

In order to improve visualization medial to the coracoid process, a Hohmann retractor can be used.

Placement of the Coracoid Tunnel

2. In order to prepare tunnel placement, a special target guide (28379 S)* is passed laterally beneath the coracoid process. Subsequently, a K-wire is used to drill the bone tunnel until it is stopped by the hook of the target guide (Fig. 3.2, 1). Use of the target guide prevents the K-wire from being drilled too far, thereby preserving integrity of neurovascular structures beneath the coracoid process.

Next, the sliding bullet (28379 SB)* is withdrawn, the target guide is moved aside a little to palpate the position of the K-wire.

The K-wire should be aligned in the central portion of the coracoid process. The target guide is moved back in place (the K-wire is reintroduced through the retainer of the sliding bullet) and the K-wire is overdrilled with a cannulated 4.5-mm drill bit (Fig. 3.2, 2). It is vital that the drill bit be advanced only through the retainer of the sliding bullet to make sure that the K-wire and the drill bit do not overshoot, but will be pushed against the stop of the hook. In order to facilitate localizing the bore hole to pass the FLIPP'TACK, it is advisable to leave the K-wire or drill bit in place until the next step of the procedure is completed.

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### Passage of the FLIPPTACK Fixation Button Through the Coracoid Tunnel

3. In the meantime, the FLIPPTACK buttons are armed with a double suture cord which allows knot-tying to be performed on the clavicular FLIPPTACK button. The suture material may be either of non-absorbable (28729 FC*, Catgut Polyester-S, KARL STORZ, Tuttlingen, Germany) or absorbable type (e.g. PDS) (Fig. 3.3).

A shuttle suture (EH 6527, green) is placed in one of the lateral-most openings of the clavicular FLIPPTACK button.

The shuttle suture will be used when passing the FLIPPTACK button through the bone tunnel. The already prepared FLIPPTACK cord construct is placed in the inserter (28379 SC*), then into the bore hole and pushed through the tunnel with the inserter rod (28379 SD*) until it exits the contralateral hole. The clavicular FLIPPTACK button is held in place by applying traction to the cord / shutter suture (Fig. 3.3).

### Placement of the Clavicular Tunnel

4. Leaving the inserter rod (28379 SD)* in place, the FLIPPTACK button is caused to exit underneath the coracoid process by pulling on the cord (Fig. 3.4, 1). It is only after completion of this step, that the inserter rod is withdrawn and secure positioning of the FLIPPTACK button is confirmed by pulling vigorously on the cord / shutter suture.

In order to prepare clavicular tunnel placement, the target guide is positioned so as to create the bone tunnel in the midportion or anterior third of the clavicle. The following are the same steps as for the coracoid tunnel:

- The clavicular tunnel is prepared with the K-wire correctly inserted in the preinstalled target guide.
- The K-wire is overdrilled with the cannulated 4.5-mm drill bit (Fig. 3.4, 2).

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Passage of the FLIPPTACK Fixation Button Through the Clavicular Tunnel

5. A suture awl (28379 SE)* is mounted with the shutter suture and inserted in the clavicular bore hole to pull the FLIPPTACK cord through the tunnel (Fig. 3.5, ①). Traction is applied to the exiting loop to pass the FLIPPTACK button through the clavicular tunnel. (Fig. 3.5, ②).

Repositioning of the Clavicle

6. Using the AC joint repositioner (28379 SF)* the clavicle is brought back to its normal anatomical position (Fig. 3.6a). The long tail of the dual cord exiting the FLIPPTACK is used for knot-tying on top of the clavicle (Fig. 3.6b). The wound is closed with a non-resorbable suture. The use of a redon drain is considered obsolete.

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Summary

- Minimally invasive procedure performed through a 3-mm skin incision.
- Ease of use; short duration of surgery; high level of stability.
- Anatomical augmentation technique virtually eliminates the risk of anterior subluxation.
- No need for debridement of the coracoclavicular ligament stump on the coracoid process.
- No need for implant removal.
- Use of a special target guide to preserve integrity of neurovascular structures and thorax while drilling the bone tunnels.

Postoperative Care

- Wound dressing from postoperative day 3 to 5.
- Use of arm sling with shoulder abduction cushion (Ultrasling, DonJoy) for 4 weeks after surgery.
- First postoperative day: supervised physical therapy of active and passive type with elbow and hand.
- For 4 weeks: pendulum exercises with the gleno-humeral joint, only.
- At 4 weeks after surgery: supervised physical therapy to restore full range of motion and to strengthen the musculature.

References

Minimally Invasive AC Joint Reconstruction (MINAR®)

It is recommended to check the suitability of the product for the intended procedure prior to use.

**Instruments**

- **MINAR® Set**, for minimally invasive AC joint reconstruction, including:

  - **28379 SA** Target Guide, for AC joint reconstruction

- **28379 SB** Bullet, working length 9.5 cm, for use with target guide 28379 SA

- **28379 SC** FLIPPTACK Inserter, working length 19.5 cm

- **28379 SD** FLIPPTACK Inserter Rod, working length 24.5 cm, for use with FLIPPTACK Inserter 28379 SC

- **28379 SE** Suture Awl, working length 15 cm

- **28379 SF** Repositioner, for AC joint reconstruction, working length 20 cm
FLIPPTACK Fixation Buttons

28729 FT * FLIPPTACK, extracortical fixation button, 4 x 12 mm, sterile, for single use

28729 FC Catgut Polyester-S white, 3 x 75 cm, USP 7, sterile, for single use, package of 24, for use with FLIPPTACK, extracortical fixation button

*For each procedure, two FLIPPTACK fixation buttons are required.

A workable instrument set requires the following instruments:

28729 E Larding Wire, pyramidal tip, diameter 2.4 mm, length 32 cm, unsterile, for single use, package of 10, for use with Undercut Drills 28729 BA – BH, Collar Burrs 28729 BLC – BLF and Drills 28729 GA – GE

28729 BA Undercut Drill, cannulated, diameter 4.5 mm, for use with Drilling Wire 28729 D and Larding Wire 28729 E
Notes: