MINAR
Minimal INvasive AC Joint-Reconstruction
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Introduction
Luxation of the acromioclavicular joint (AC joint) is a common sports injury. Depending on the severity of the injury, it can lead to rupture of the acromioclavicular and coracoclavicular ligaments. The coracoclavicular ligaments (conoid and trapezoid ligament) are important stabilizers for preventing superior subluxation of the clavicle (4, 5, 6, 8).

The therapy used for treatment of an AC joint luxation is based on the severity of the injury (Rockwood classification) (1, 16). Conservative treatment is sufficient for mild to moderate injuries. For treating profound injuries, repositioning and stabilizing the joint is recommended.

For surgical stabilization of the AC joint, a number of different methods are available; however, a problem of many techniques is their use of rigid implants. Multiaxial forces impacting the AC joint can cause rigid implants to loosen. A further disadvantage is the need to remove the implant after a few weeks. As a result, coracoclavicular augmentation techniques using a rigid suture cord (e.g., PDS) have been developed (3, 7). The principle behind this technique is the use of augmentation of the coracoclavicular ligaments (conoid and trapezoid ligament) to promote healing without elongation. In clinical studies, this technique has been found to be superior to others.

By placing a cerclage in the anterior part of the processus coracoideus, it can result in anterior subluxation of the clavicle (9). A further problem with a coracoclavicular suture cerclage is the observation that rotational movement of the clavicle can cause the sutures to cut through the bone (10). However, the main problem of a coracoclavicular cerclage is its invasiveness. To lead a cord around the coracoid process requires a large incision. To minimize its invasiveness, arthroscopic procedures for stabilising the AC joint have been developed (11). Nevertheless, these techniques pose a few disadvantages. They are time consuming, technically demanding and require an experienced arthroscopic surgeon.

A biomechanical study has shown that stable coracoclavicular stabilization can be reached by combining a suture with a fixation button (FLIPPTACK™), which is familiar from cruciate ligament surgery (17). Even under cyclical loadings, the device did not cut through the clavicular. Combining the fixation button and suture delivered the same pull-out-strength as using a conventional suture cerclage, and provided almost double the pull-out-strength as when using a suture anchor augmentation.

In principle, inserting a fixation button arthroscopically onto the proc. coracoideus is possible, but requires debridement of the surface of the proc. coracoideus. This approach destroys ligament residues necessary for healing.

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In cooperation with Prof. Petersen and Dr. Zantop, a new minimally invasive technique for this procedure has been developed. It allows easy insertion of a fixation button with a double suture cerclage, without the need to rely on arthroscopic visualization (18). This technique uses a FLIPPTACK™ fixation button that is placed under the coracoid process through a hole created using a specially designed pusher. This allows gentle treatment of an AC joint luxation while using a 3 cm skin incision.
Advantages

- Minimally invasive
- Easy application
- Short surgery time
- High stability
- Anatomical augmentation, thus no tendency towards anterior subluxation
- No debridement of coracoclavicular ligament stump on the proc. coracoideus is needed
- No implant removal is necessary
- Special aiming guide for drilling through the proc. coracoideus to protect neurovascular structures and the thorax

The complete system meets the traditional KARL STORZ quality standard and complies with the highest requirements.
**Indications**

- Profound luxation of the AC joint (Rockwood III-VI, Fig. 1)

- Chronic instabilities in combination with a replaced ligament (mod. Weaver Dunn or free tendon transplant)

- Lateral clavicular fracture

**Contraindications**

- Generally poor condition

- Local soft tissue infection

- Shaft fracture of the clavicle

- Chronic instabilities not combined with an autologous or allogenic ligament transplant
Surgical Technique

1. The first step of the operation is to make an approx. 3 cm long skin incision above the lateral clavicle (Fig. 2). In the case of a Rockwood V joint dislocation (Fig. 1), the delta and trapezius fascia are ruptured and the clavicle lays free.

A Langenbeck retractor can be used to display the acromioclavicular ligaments. In the anterior part of the clavicle, the M. deltoideus is spread blunt and the proc. coracoideus is palpated with a finger.

For better visualization medial of the proc. coracoideus a Hohmann retractor can be used.

2. A special aiming device for drilling is positioned laterally beneath the proc. coracoideus. Using a larding wire, a tunnel is predrilled. The larding wire is stopped by the hook of the aiming device (Fig. 3-1). This protects neurovascular structures beneath the proc. coracoideus from being injured by the larding wire if drilled too deep.

The sliding rod is removed, the aiming device is moved aside slightly, and the position of the larding wire is palpated. The larding wire should be positioned in the middle of the proc. coracoideus. Now, the aiming device is set back in place (larding wire in the retainer for a sliding bullet) and the tunnel is overdrilled with a cannulated 4.5 mm drill (Fig. 3-2).

It is necessary to lead the drill through the retainer of the sliding bullet to make sure that the larding wire and drill are not going too far distally, but are stopped by the aiming hook.

To simplify locating the drill hole, it is advisable to leave the larding wire in place until the FLIPPTACK™ is applied.
3. In the meantime, a FLIPPTACK™ is prepared with a double suture cord that allows a knot to be made on the clavicular FLIPPTACK™. The non-resorbable fibre used is made out of polyester material (diameter 1mm, Ethibond, Ethicon, Norderstedt, Germany, Fig. 4). It is also possible to use a resorbable suture (e.g., PDS). A passage fibre (green fibre) is placed in one of the outer holes of the FLIPPTACK™. This fibre will be needed later when passing the FLIPPTACK™ through the drill hole in the clavicle.

The prepared FLIPPTACK™-Cord-Construct is placed in the FLIPPTACK™-Inserter. It is held in place by pulling on the cord and passage fibre.

The FLIPPTACK™ is placed into the drill hole of the proc. coracoideus and pushed through using the FLIPPTACK™-Pusher (Fig. 4).

4. Leaving the FLIPPTACK™-Pusher in place, the FLIPPTACK™ is flipped underneath the proc. coracoideus by pulling on the cord (Fig. 5-1).

After this step, the FLIPPTACK™-Inserter and -Pusher are withdrawn and secure positioning of the FLIPPTACK™ is verified by placing repeated tension on the cord. To create a drill hole in the clavicle, the aiming device is positioned so the hole is located in the middle or anterior third of it. The same steps taken for drilling the hole in the proc. coracoideus are performed:

1. Larding wire, 2. Overdrilling the hole with a cannulated 4.5 mm drill (Fig. 5-2).
5. A suture awl equipped with a thread loop (blue fibre) is fed through the drill hole of the clavicle, and the passage fibre (green fibre) is passed through the thread loop (Fig. 6-1). By pulling on the thread loop, the FLIPPTACK™ can be pulled through the clavicle (Fig. 6-2).

6. Using the AC-Repoitioner the clavicle is set to bone (Fig. 7). The cord of the clavicular FLIPPTACK™ is knotted (Fig. 8). The wound is closed by using a non-resorbable fibre. The use of a redon drain is obsolete.
Instruments

28379 S  MINAR Set, minimal invasive AC Joint Reconstruction Set, consisting of:

28379 SA  AC Joint Aimer

28379 SB  Bullet

28379 SC  FLIPPTACK™ Inserter

28379 SD  FLIPPTACK™ Inserter Rod

28379 SE  Suture Awl

28379 SF  AC Joint Repositioner

Required Implants:
2 x 28729FT*  FLIPPTACK™ Femoral Fixation Button, sterile (Not for sale in the US)

Optional:
1 x 28729E   Larding Wire, diameter 2.4 mm, length 32 cm, pyramidal tip, package of 10

*Each surgery requires two FLIPPTACK™ Fixation Buttons