Arthroscopic Lateral Border Resection in Medialized Scapula Neck Fractures

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Abstract: Scapula neck fractures are rare injuries, leaving several treatment options. Standardized markers for operative treatment are a decreased glenopolar angle $\leq$22°, lateral border offset (LBO) of the glenoid $\geq$20 mm, angular deformity $\geq$45°, or LBO $\geq$15 mm plus angular deformity $\geq$35°. If operative treatment is not performed before union, the fracture heals malaligned with possible mechanical complications due to a medialized glenoid and the protruding lateral border. Common operative treatment comprises a corrective osteotomy for the anatomic correction of the malunited fracture, leaving intra-articular pathologies like adhesive capsular stiffness unaddressed. Our presented arthroscopic technique for the treatment of sequelae of scapula neck fractures combines a 270° capsulotomy with arthroscopic resection of a protruding lateral border. With use of this technique, excellent shoulder function can be restored with a minimally invasive procedure. Therefore, arthroscopic treatment could be favorable in selected cases of malunited scapula neck fractures.

Indications for operative treatment of scapula neck fractures remain controversial: although good results could be shown with nonoperative treatment,[1-8] operative treatment is an effective method to prevent loss of function, with only a few complications reported.[9] Apart from patient age, activity level, comorbidities, and accompanying injuries, the presence of certain radiographic features should be considered to decide on the operative treatment of extra-articular scapula neck fractures. As proposed by Cole et al.,[10] a decreased glenopolar angle $\leq$22°, lateral border offset of the glenoid $\geq$20 mm, angular deformity $\geq$45°, or lateral border offset $\geq$15 mm plus angular deformity $\geq$35° are standardized markers that indicate the need for surgery of the scapula. However, controlled randomized trials are missing. Hence, such characteristics of scapula fractures only imply recommendations and therefore only pose relative indications for operative treatment. Surgery, however, is strongly suggested in any case where fractures are displaced to a large scale.[11-13]

Impaired shoulder function after malunion of scapula neck fractures are mainly explained mechanically: changes in the geometry of the surrounding muscles are thought to reduce stability and function of these muscles.[14] A bony impingement limiting the shoulder function mechanically can be another reason for impaired function of malunited scapula neck fractures. With the described technique, reduced shoulder function can be improved after removal of the protruding lateral border.

If an operative treatment is delayed, the operative treatment of scapular fractures becomes increasingly more difficult the longer it is delayed as displaced fractures may heal improperly. Subsequent operative treatment then results in less favorable outcomes.[15] Here we present a technique that can be used when scapula neck fractures have already healed in malalignment.

Surgical Technique

Operative Indication

Arthroscopic removal of a protruding lateral border should be considered in patients with malunited scapula neck fractures, a relative medialization of the glenoid, and a protruding lateral border of the scapula. The arthroscopic technique is especially indicated in cases where a capsular stiffness is also clinically present. We highly recommend a 3-dimensional computed tomographic scan

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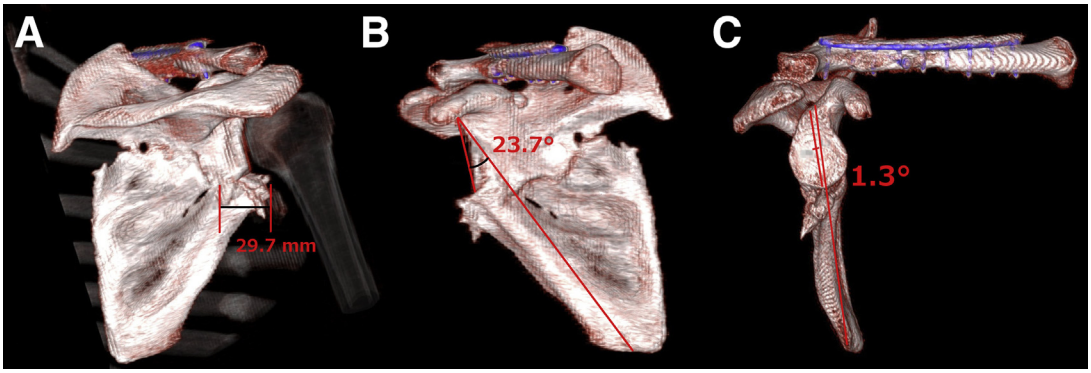

Fig 1. Volume rendering images of a 3-dimensional computed tomographic scan of the right shoulder before arthroscopy. (A) Lateral border offset of 29.7 mm. Lateral displacement is calculated by measuring the distance from the most lateral point of the distal fragment to the most lateral point of the proximal fragment. (B) Glenopolar angle of 23.7°. GPA is measured at the intersection between a line from the inferior glenoid to the superior glenoid and a line from the superior glenoid to the inferior angle of the scapula. (C) Glenoid angulation of 1.3°. Angulation is measured between a line parallel to the proximal fragment and a line parallel to the distal fragment.

before surgery (Fig 1). Thereby, the protruding lateral border, the position, and its orientation can be visualized and the resection can be planned. Table 1 summarizes the indications and contraindications for this technique.

Advantages of this procedure are the minimal invasiveness compared with alternative treatment options such as corrective osteotomy. Also, if shoulder stiffness is present, this technique combines an arthroscopic arthrolysis with resection of an osteophyte. However, prevention of damage to the surrounding structures such as the axillary nerve are of utmost importance. Detailed advantages and limitations are summarized in Table 2.

Patient Positioning and Anesthesia

Table 3 presents the step-by-step surgical technique. The patient is positioned in beach-chair position with the arm in an arm-holder (Arthrex TRIMANO, Arthrex, Naples, FL). The patient is in general anesthesia. Additionally, an interscalene catheter is used in all cases for analgesia and immediate postoperative mobilization of the shoulder.

Arthroscopic Arthrolysis

First, a posterior portal is applied and a diagnostic arthroscopy is performed screening for intra-articular pathologies besides the adhesive capsulitis (Video 1). Second, the anterior portal is applied with a needle in an outside-in technique and after careful debridement using the shaver. A radiofrequency ablation device (Ambient Super TurboVac 90; Smith & Nephew, Austin, TX) is introduced into the joint and the anterior capsulotomy starts with the incision of the superior glenohumeral ligament and adhesiolysis of the subscapularis tendon. Next, the medial and the anterior portion of the glenohumeral ligament are incised (Fig 2). Because of the relative medialization of the glenoid, the coracoid process can appear more lateral and inferior than usual and can be the cause of a coracoid impingement (Fig 2A). In these cases, a partial resection of the lateral coracoid process is performed using a round burr (CoolCut; Arthrex). After the capsulotomy of the anterior capsule, the arthroscope is introduced through the anterior portal and the posterior capsule is released analogous to the anterior capsule with the radiofrequency ablator for a 270° capsulotomy. Great care must be taken at the inferior recess to spare the axillary nerve. We prefer to use the radiofrequency ablation device for the release, because proximity to the nerve can be seen when the arm is twitching. The arm is positioned in abduction and neutral rotation to ensure the greatest distance between the axillary nerve and the inferior glenoid. At the axillary recess, the protruding lateral border can be localized with a switching stick (Fig 2D).

Arthroscopic Lateral Border Resection and Postoperative Care

For the following resection of the protruding lateral border, a deep anteroinferior portal at the 5:30 position is applied. We begin the resection with careful

Table 1. Indications and Contraindications

Indications
• Malunited scapula neck fractures with protruding lateral border
• Concomitant shoulder stiffness
• Inferior bony impingement
Contraindications
• Recent scapula neck fracture with possible anatomic reduction
• Neurologic damage

Table 2. Advantages and Disadvantages

Advantages
• Minimally invasive procedure
• Combination with arthroscopic arthrolysis
• Excellent clinical outcome possible
Disadvantages
• Axillary nerve in close proximity
• No anatomic correction

Table 3. Step-by-Step Surgical Technique

Anaesthesia: general with use of interscalenar catheter **Positioning of patient:** beach-chair position, arm in holder
Apply dorsal portal first, diagnostic arthroscopy, apply anterior portal
Begin with 270° capsulotomy: start with SGHL, subscapularis tendon, MGHL and AGHL, then dorsal capsulotomy
Apply deep anterio-inferior portal (5:30 position) for better accessability of the inferior glenoid, preparation of the bony impingement at the inferior glenoid, resection with arthroscopic burr
Careful lavage and wound-closure, post-operative mobilization instantly with CPM and active physiotherapy

preparation of the inferior glenoid and the lateral border, freeing the bone of all adhesive scar tissue with the radiofrequency ablator (Fig 2E). Again, if a twitching of the arm is noticed, the preparation should be stopped to prevent damage to the axillary nerve. When the protruding bone can be visualized completely, the following resection can be achieved with a 4.0-mm arthroscopic round burr (CoolCut; Arthrex) (Fig 2F). After adequate resection of the protrusion, detailed lavage to remove bony fragments and wound closure is performed.

The postoperative treatment includes immediate mobilization on the day of surgery passive with a motor splint and active with help of a physiotherapist with no limitations. A postoperative computed tomography is optional but can be performed to ensure successful resection of the fragment (Fig 3).

Discussion

In the presented case, a floating shoulder lesion was treated with osteosynthesis of the clavicle fracture alone, leaving the scapula neck fracture unaddressed. Alternative treatment options include open surgical procedures as open resection of the lateral border or a corrective osteotomy. Cole et al.[16] described corrective osteotomies to be a safe and effective method to improve function and reduce symptoms in patients with a malunion of the scapula. However, with the open procedures, intra-articular pathologies and capsular stiffness cannot be addressed. Considering the invasiveness of a corrective osteotomy or to reach the inferior glenoid for open resection of the lateral border, the presented arthroscopic technique can be an alternative option in cases where a minimally invasive approach is favored or shoulder stiffness is present. With cautious arthroscopic resection of the bony fragment and a 270° capsulotomy, an excellent

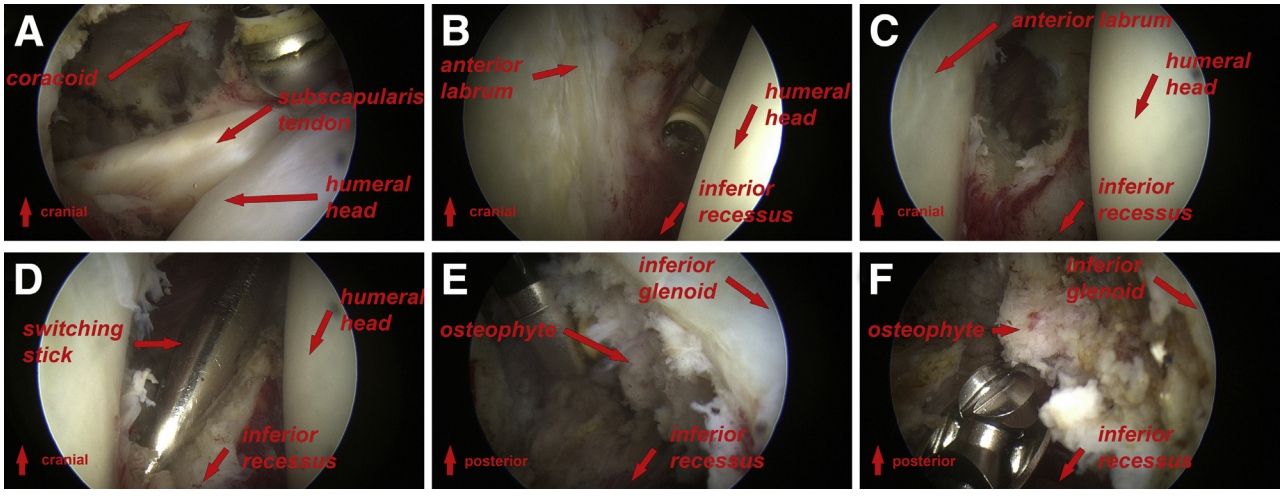

Fig 2. Intraoperative pictures during arthroscopy. The arthroscopy is performed in beach-chair positioning on a right shoulder. (A) First, a standard posterior portal is applied. The camera is introduced though the posterior portal. After diagnostic arthroscopy and careful debridement of the joint, the relative lateralized coracoid process can be visualized above the subscapularis tendon. (B) We start the 270° capsulotomy with the adhesiolysis of the subscapularis tendon and cautiously proceed to the inferior axillary recessus. The radiofrequency ablator is introduced through a standard anterior portal. Note the capsulitis. (C) After partial capsulotomy at the inferior recessus. (D) A switching stick is introduced through the anterior portal to localize the osteophyte. We then apply an additional deep anteroinferior portal at the 5:30 position. (E) The camera is now switched to the anterior portal. After localization of the osteophyte, the scar tissue is cautiously resected. Therefore, the radiofrequency ablator is introduced through the deep anteroinferior portal. Great care must be taken to spare the axillary nerve. If a twitching of the arm occurs, stop the use of the radiofrequency ablator immediately. (F) At last, the protruding osteophyte is resected with use of the 4.0-mm arthroscopic burr.

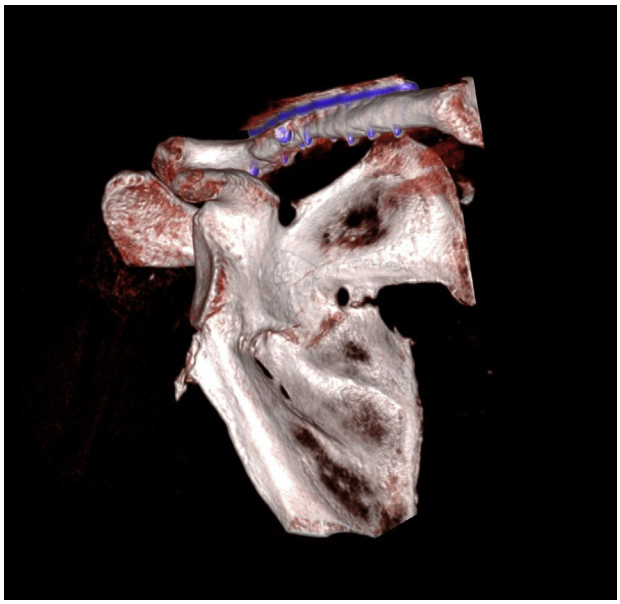

Fig 3. Three-dimensional computed tomographic scan of the right shoulder after arthroscopy. Note that the protruding lateral border of the right scapula has been resected.

result can be achieved. However, great care must be taken to spare the axillary nerve. Anatomic proximity of this nerve close to the inferior glenoid makes this structure prominent for accidental iatrogenic injuries. Lesions of the axillary nerve can have a devastating effect on operative outcome, because paralysis of the deltoid muscle frequently occurs, leading to limited shoulder movement. To preserve the nerve, resection of the fragment was performed with the arm in abduction and in neutral rotation position. This position has been shown to be favorable, as it maintains the greatest distance between the axillary nerve and the inferior glenoid rim.[17] This likely results in fewer accidental iatrogenic injuries. For preparation close to the inferior glenoid rim, we prefer radiofrequency ablation, as electricity can cause a feedback from the nerve resulting in a twitching of the arm in close proximity to the nerve.[18,19] However, possible damage can occur from the resulting heat, and the radiofrequency should be used with breaks to allow cooling of the fluid.[20] We also use an ablation device with a continuous temperature control and suction, which can also help to prevent damage to this area.

Because of the controversial indication for operative treatment, diagnostics of fractures seem to be of utmost importance in patients suffering a scapula fracture: when a dislocation of a scapula neck fracture cannot be ruled out, patients should be evaluated thoroughly for a dislocation of the fragment to prevent complications. More reliable 2- or 3-dimensional computed tomographic scans should therefore be performed routinely in cases with inconclusive plain radiographs to assess the indication for operative treatment.[21,22]

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