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ARTHROSCOPY AND SPORTS MEDICINE

Arthroscopic reconstruction of chronic anteroinferior glenoid defect using an autologous tricortical iliac crest bone grafting technique

Markus Scheibel · Natascha Kraus · Gerd Diederichs · Norbert P. Haas

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Abstract Only a few reports exist on the management of severe anteroinferior glenoid defects in case of recurrent shoulder instability most of them including open approaches. We describe an all-arthroscopic reconstruction technique of the anteroinferior glenoid that includes an autologous iliac crest bone grafting using bio-compression screws and a capsulolabral repair using suture anchors. This technique recreates the bony and soft-tissue anatomy of the anteroinferior glenoid while preserving the integrity of insertion of the subscapularis (SSC) tendon.

Keywords Shoulder instability · Glenoid defects · Arthroscopic reconstruction · Iliac crest bone grafting

Introduction

Chronic anteroinferior glenoid bone deficiency has been reported in up to 90% of cases of recurrent anteroinferior shoulder instability [20]. With a large glenoid rim defect the shape of the glenoid changes to an "inverted pear" where the superior half is wider than the lower half [2, 3]. Glenoid bone loss shortens the safe arc through which the glenoid can resist axial forces. Biomechanical studies have shown an inverse relationship between the size of the glenoid defect and the stability of the shoulder: the larger the defect, the less the stability [6, 9, 11]. Clinical studies have confirmed that major bone loss is associated with an unfavourable or at least unpredictable outcome after arthroscopic Bankart-repair [2, 14].

Different open intra- and extra-articular bone grafting techniques have been described for the treatment of large glenoid rim deficits [4, 5, 7, 19, 21]. Recently published studies reported on the open anatomical glenoid reconstruction using an intraarticular tricortical iliac crest bone grafting technique [19, 21]. The authors achieved good and excellent clinical results with regards to shoulder stability and patient satisfaction. In addition union and incorporation of the graft was achieved in all cases. The open surgical procedure requires take-down of the subscapularis (SSC) tendon. Despite previously thought that this approach might not significantly disturb the integrity of the SSC musculotendinous unit, postoperative SSC dysfunction due to failure of the tendon repair and/or muscular changes (atrophy and fatty infiltration of the SSC muscle) have recently been described and appears to occur more frequently than previously appreciated [12, 15–18].

We describe an all-arthroscopic reconstruction technique of the anteroinferior glenoid that includes an autologous iliac crest bone grafting using bio-compression screws and a capsulolabral repair using bioabsorbable suture anchors (Arthrex, Naples, FL). This technique recreates the bony and soft-tissue anatomy of the anteroinferior glenoid while preserving the integrity of the insertion of the SSC tendon.

Preoperative work-up and planning

The diagnosis of recurrent shoulder instability is established by history, clinical examination and radiographic evaluation. On clinical examination a complete physical

M. Scheibel (✉) · N. Kraus · N. P. Haas
Center for Musculoskeletal Surgery,
Campus Virchow, Charité-Universitaetsmedizin Berlin,
Augustenburger Platz 1, 13353 Berlin, Germany
e-mail: markus.scheibel@charite.de

G. Diederichs
Department of Radiology, Campus Mitte,
Charité-Universitaetsmedizin Berlin, Berlin, Germany

exam of the shoulder is performed to evaluate any potential concomitant lesions. Patients with severe glenoid defects typically present with midrange-of-motion instability [21]. Clinical signs for anterior instability in particular the apprehension and relocation tests are found to be positive. Although a bony defect of the anteroinferior glenoid can be diagnosed on plane radiographs and on oblique sagittal or axial MR- or CT-images we prefer to use a 3-D-CT imaging with subtraction of the humeral head and en face view of the glenoid as suggested by Sugaya [20] (Fig. 1). Gerber and Nyffeler have shown that if the length of the glenoid defect exeeds the maximum anteroposterior radius of the glenoid then the dislocation resistance decreases to no more than 70% of the value of an intact joint [6]. In our practice we use this criteria for the decision making of autologous bone grafting.

Surgical technique

Under general anaesthesia and perioperative antibiotics the patient is placed in the lateral decubitus position with 5 kg of horizontal and 3 kg of vertical arm traction. The shoulder and the ipsilateral iliac crest are prepped and draped in a steril fashion. A diagnostic arthroscopy is performed through a standard posterior portal. An anteroinferior working portal just above the SSC tendon through the rotator interval and a anterosuperior viewing portal just behind the biceps tendon are established using an outside-in technique. With the arthroscope switched to the anterosuperior portal the inverted-pear shaped appearance of the glenoid is visualized. A 8.25 mm × 7 cm translucent twist-in cannula is inserted via the anteroinferior portal and another 6 mm × 7 cm cannula via the posterior portal (Arthrex, Naples, FL) (Fig. 2). Next a deep anteroinferior 5 o′clock working portal is established through the inferior aspect of the SSC.

Again a 8.25 mm × 9 cm twist-in cannula is inserted via the deep anteroinferior portal. After the diagnosis is verified and other potential pathologies are excluded the next step includes the harvesting of the iliac crest bone graft that is performed as described by Warner et al. for the open bone grafting technique [21] (Fig. 3). The tricortical graft is contoured ex-vivo using an oscillating saw to recreate the inferior glenoid circle.

With the arthroscope in the anterosuperior portal and the Bankart-knife/shaver in the anteroinferior portal the glenoid neck is exposed and glenoid preparation is performed by mobilizing the capsulolabral complex medially (Fig. 4). Mobilization is conducted beyond the 6 o′clock position. An arthroscopic bur is used to abrade the medial wall of the glenoid to create a suitable bed for bony healing. The prepared iliac crest bone graft is introduced inside the joint using a clamp via the anterosuperior portal while the twist-in cannula is temporarily removed (Fig. 5). After placing the graft in position it is temporarily fixed using three K-wires. The position of the graft relative to the joint line is established using a standard Wisinger rod that is inserted via the posterior portal. The first K-wire is introduced via the deep anteroinferior portal, the second percutaneously

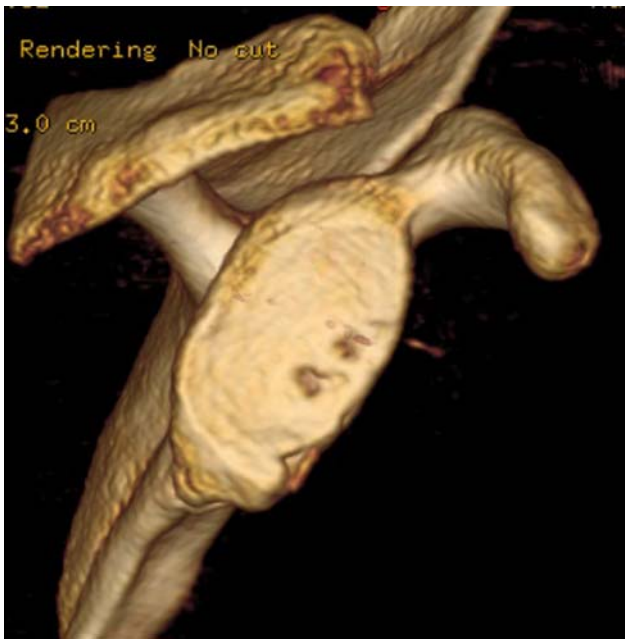

Fig. 1 Preoperative 3D-CT imaging of the right shoulder with the humeral head eliminated showing a severe anteroinferior glenoid defect

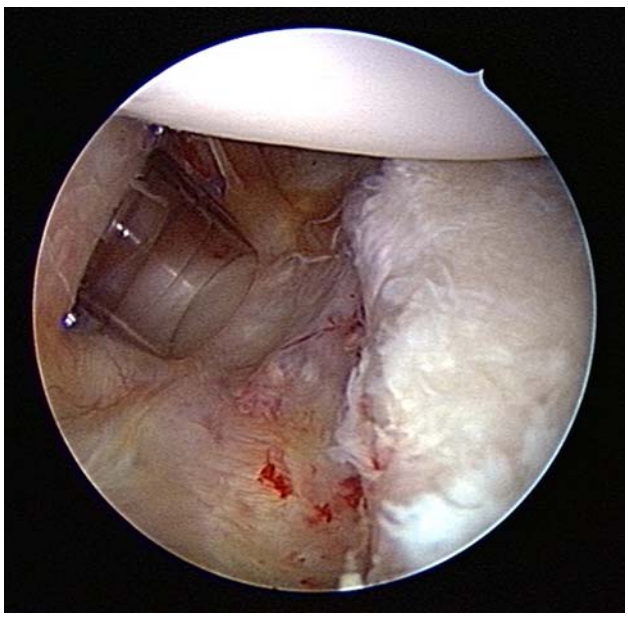

Fig. 2 Intraoperative view from the suprabicipital portal showing the anteroinferior bone loss, a typical ALPSA lesion and a twist-in cannula placed in the deep anteroinefrior portal

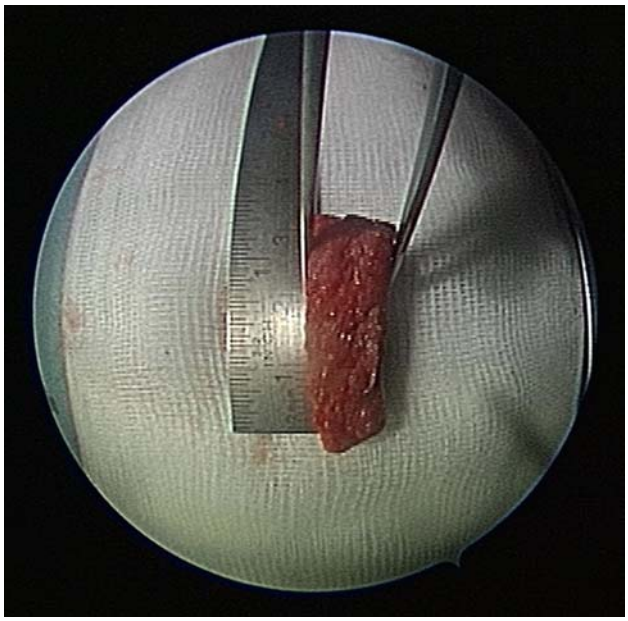

Fig. 3 The harvested tricortical graft is contoured ex-vivo using an oscillating saw to recreate the inferior glenoid

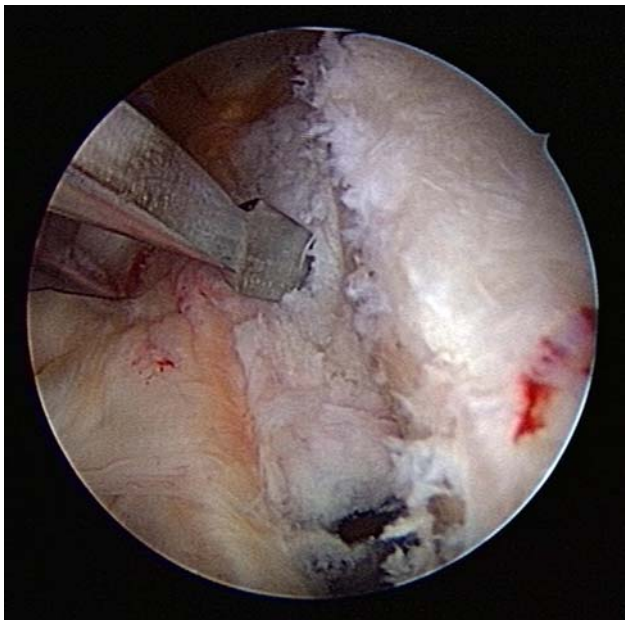

Fig. 4 With the arthroscope in the anterosuperior portal the glenoid neck is exposed and glenoid preparation is performed by mobilizing the capsulolabral complex medially beyond the 6 o′clock position

through the upper part of the SSC tendon and the third via the anteroinferior portal (Fig. 6). The inferior and afterwards the superior K-wire are overdrilled using a cannulated drill bit and the graft is fixed using two 2.7–3.7 mm bio-compression screws (Arthrex, Naples, FL) (Fig. 7). If the defect is located more inferior than anterior both screws are introduced via the deep anteroinferior portal. The screws are placed underneath the joint line to avoid screw impingement. In cases of glenoidal incongruity due to

Fig. 5 The prepared iliac crest bone graft is introduced inside the joint using a clamp via the anterosuperior portal while the twist-in cannula is temporarily removed

Fig. 6 After placing the graft in position it is temporarily fixed using K-wires. The position of the graft relative to the joint line is established using a standard Wisinger rod that is inserted via the posterior portal

prominence of the graft a small bur is used to restore the glenoid depth. Finally bioabsorbable Fastak-suture anchors armed with Fiber-wire (Arthrex, Naples, FL) are placed superiorly and inferiorly to the graft and the capsuloligamentous complex is reattached using horizontal mattress stitches (Fig. 8). The final construct reveals a reconstructed anteroinferior glenoid (Fig. 9). The arthroscopic portals are closed in a standard fashion.

Fig. 7 The K-wires are overdrilled and the graft is fixed using two 2.7–3.7 mm bio-compression screws (Arthrex, Naples, FL)

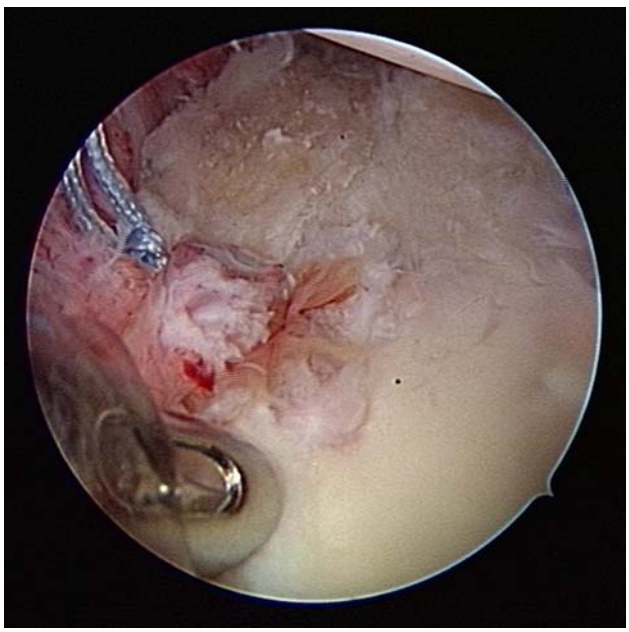

Fig. 8 Finally bioabsorbable Fastak suture anchors armed with Fiberwire (Arthrex, Naples, FL) were placed superiorly and inferiorly to the graft and the capsuloligamentous complex was reattached using horizontal mattress stitches

Postoperative management

Postoperative management included immobilization in a sling (Ultrasling ER 15°, DJO, Carlsbad, CA) for 6 weeks. Physical therapy involved passive range of motion exercises during that time. Flexion in internal rotation was limited to 90° and external rotation in adduction was limited to 20°. At 7 weeks active range of motion exercises are initiated. After 12 weeks an intensive strengthening program including deltoid, rotator cuff and scapulothoracic muscles is started.

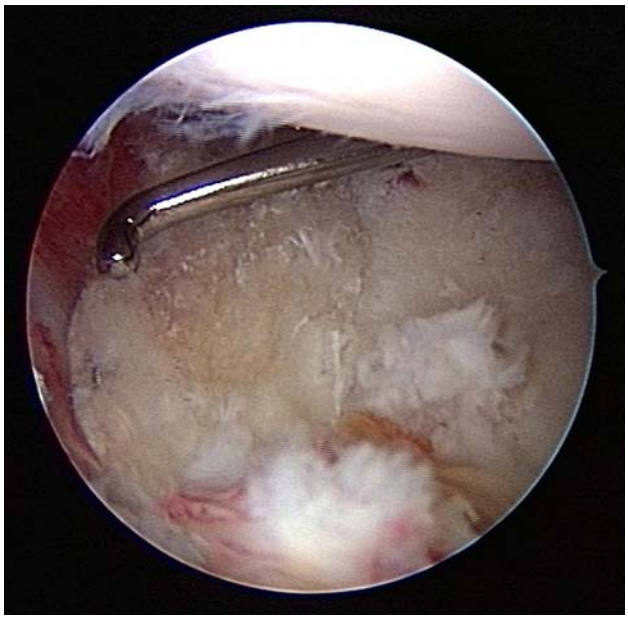

Fig. 9 The final construct reveals a reconstructed anteroinferior bony glenoid

Discussion

Reestablishing the bony buttress to accommodate the axial and shear forces present in the glenohumeral joint is the ultimate goal in the treatment of anterior-inferior glenoid deficiency [2, 3]. Different surgical techniques for approaching chronic glenoid rim defects have been reported in the literature including the coracoid process transfer procedures as well as intra- or extraarticular iliac crest bone grafting techniques. The Latarjet or Bristow procedure has been described as a nonanatomical solution to this problem [1, 3, 4, 8, 10].

Warner et al. proposed the intraarticular autologous tricortical iliac crest bone grafting technique in response to some of the limitations seen with coracoid process transfer (for example loss of motion, hardware impingement, loosening or non-union of the bone graft and difficulties at revision surgery) [21]. We were able to confirm the reliable results achieved by Warner et al. for the open autologous iliac crest bone grafting technique combined with a capsulolabral repair in terms of stability and the good to excellent overall clinical outcome demonstrated by 5 well-established shoulder scores [19]. In both studies no hardware related problems due resorption and/or non-union of the

Fig. 10 Postoperative 3D-CT imaging of the right shoulder showing a consolidated iliac crest autograft after arthroscopic reconstruction

iliac crest were observed. In fact CT-imaging obtained after surgery revealed a consolidated autograft in all cases without signs of graft necrosis and/or resorption.

Based on these promising results we have started to perform this procedure via an all-arthroscopic approach. Beside the obvious general advantages of arthroscopy including better cosmesis, lower risk of infection, less scar formation, the possibility to allow a rapid home return and an accelerated rehabilitation program the described procedure has further potential benefits compared to the open approach. Clinical studies using open stabilization surgery indicate that anterior approaches to the shoulder using SSC tendon take-down or incision techniques may impair SSC recovery and cause irreversible changes of the muscle in particular fatty infiltration with or without failure of the tendon repair, all of which may result in permanent loss of SSC function [12, 15–18]. It recently has been shown that an all-arthroscopic approach does not significantly compromise clinical SSC function and structural integrity of the SSC musculotendineous unit [18].

Mochizuki et al. were the first who recently reported on an all-arthroscopic autologous bone graft with arthroscopic bankart repair for a large bony defect lesion caused by recurrent shoulder dislocation [13]. The authors performed this technique by an arthroscopic bone grafting from the acromion to the anteroinferior glenoid rim using two harvested cylindrical bone grafts from the lateral site of the acromion and transplanted them into the inferior glenoid rim. We prefer to use an autologous iliac crest bone graft as described for the open technique. We believe that due to the tricortical nature of the iliac crest a better anatomic reconstruction can be achieved compared to the acromial cylindrical grafts (Fig. 10). The bio-compression screw fixation (Arthrex, Naples, FL) offers excellent interfragmentary compression including a headless profile to promote healing.

In summary the all-arthroscopic reconstruction technique of the anteroinferior glenoid that includes an autologous iliac crest bone grafting using bio-compression screws and a capsulolabral repair using suture anchors recreates the anatomy of the anteroinferior glenoid while preserving the integrity of insertion of the SSC tendon.

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