Metal-Free Fixation for Free Bone-Block Reconstruction of Chronic Anteroinferior Shoulder Instability

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Background: Anterior shoulder instability is common and may cause a considerable effect on quality of life. For cases with glenoid bone loss, there is still a controversial discussion regarding the optimal treatment. Most of the recent methods are using metal implants to attach the needed graft to the glenoid with reported disadvantages such as metal impingement, damage to the humeral head, cartilage destruction, and premature arthritis.

Indications: (1) Erosion-type defects with significant bone loss (>15%-20%); (2) chronic fragment-type defects if the size of the fragment is not large enough for an anatomical reconstruction; and (3) non-reconstructible, multifragmented acute fragment type of lesions.

Technique Description: After placing the patient in a lateral decubitus position and fixing the arm in a traction devise, 3 arthroscopic entries are established: a posterior portal, an anterosuperior portal, and an anteroinferior portal. A harvested tricortical iliac crest bone graft is provided with 2 drilling holes which match the drilling holes through the glenoid. The tapes are then placed from the posterior to the anterior side of the glenoid, and then the graft is passed from the anterior to the posterior side, thus compressing the cancellous side of the bone block onto the glenoid defect. A following interconnection of the sutures creates a continuous loop. The end of the tapes was loaded into a pretied racking hitch knot system, which creates sliding knots between the 2 pair of tapes, whereon the knots can be reduced to the glenoid in a symmetrical fashion. Finally, the reconstruction of the anterosuperior labrum can be done, to cover the bone block with enough soft tissue.

Results: First short-term results show radiographic consolidation after 3 months and an increased median glenoid estimated surface area at 12 months. The functional scores showed good outcomes, and there were no serious complications reported.

Discussion/Conclusion: The presented arthroscopic reconstruction of the glenoid using a tricortical bone graft and high-strength fiber tapes provides a metal-free technique which results in a high primary stability of the construct and should therefore be considered when treating anterior shoulder instability with significant bone loss.

Keywords: arthroscopy; shoulder instability; bone block; glenoid; cerclage

VIDEO TRANSCRIPT

In this surgical video demonstration, we present a technique of a metal-free fixation for free bone-block reconstruction of chronic anterior inferior shoulder instability.

Anterior shoulder instability is a common disease affecting mainly a young and active patient population and may cause a considerable effect on livability.[8] However, especially for cases with glenoid bone loss, there is still a controversial discussion regarding optimal treatment.[2,7]

Within the last 2 decades, there has been a progress in establishing arthroscopic procedures that preserve the integrity of the subscapularis muscle.[1,5] Most of the recent methods are using bone grafts for an anatomical or nonanatomical reconstruction, yet most of them apply metal implants to attach the graft to the anterior glenoid. However, it is known that after subsequent bone resorption and glenoid remodeling, metal components can lead to an overhang and result in metal impingement with damage to the humeral head, subsequent cartilage destruction, and premature arthritis accompanied with lingering pain.[6]

The following technique provides an anatomical arthroscopic reconstruction of the glenoid using a tricortical iliac crest bone graft and 2 ultra-high-strength tapes for

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bone-block fixation, which is a modified technique according to Hachem et al.[4] The tapes are placed from the posterior to the anterior side of the glenoid, and then the graft is passed in a U-shaped fashion and finally retrieved to the posterior aspect of the glenoid, thus compressing the cancellous side of the bone block onto the glenoid defect.

Indications for this method are erosion-type defects with significant bone loss of about 15% to 20%, chronic fragment-type defects if the size of the fragment is not large enough for an anatomical reconstruction, and nonreconstructible, multifragmented acute fragment type of lesions.[1,5]

Contraindications would be an extended Hill-Sachs lesion with no substantial glenoid defect, as well as capsular insufficiency due to multiple unsuccessful soft-tissue stabilization procedures lacking a large glenoid defect.

The surgical procedure is shown in a patient with chronic anterior shoulder instability and an erosion type of defect after a failed arthroscopic Bankart repair of the left shoulder.

To assure a parallel alignment of the glenoid to the floor, the patient is placed in a lateral decubitus position with the arm fixed in a traction devise and tractions applied vertically and horizontally.

This position enables a better visualization due to joint distention, as well as easy accessibility to the ipsilateral iliac crest.

For this procedure, we will establish 3 arthroscopic entries: a posterior portal, an anterosuperior portal, and an anteroinferior portal.

First, a standard posterior portal is established and a diagnostic arthroscopy is performed. Concomitant injuries usually will be addressed after fixation of the graft.

An anteroinferior portal through the rotator interval just above the subscapularis tendon is created and a transparent twist-in cannula is placed.

After establishing the anterosuperior portal, the camera is switched and another twist-in cannula is inserted into the posterior portal. This will gain good accessibility to the defect side.

In case of revision surgery, residual suture material and small bony fragments can be resected.

The capsulolabral tissue is elevated from the glenoid, allowing visualization of subscapular muscle fibers. Afterward, the scapular neck is debrided to improve the biological integration of the graft using a bur.

In cases of revision surgery, previous suture anchor material is removed, if possible. In this particular case, a tap from a Bankart repair system is used, which can be screwed into the anker and then pulled out by applying gentle blows onto the instrument.

To enhance defect visualization and facilitate subsequent bone-block placement, a polydioxanone (PDS) suture is placed through the capsulolabral complex percutaneously to retract the labrum and the capsule anteriorly.

An arthroscopic ruler is inserted from the anterior inferior portal to measure the defect size from proximal to distal.

To gain the needed bony material, a tricortical crest bone block is harvested from the ipsilateral side using an oscillating saw. The block should have an approximate size of 25 $\times$ 10 $\times$10 mm^3. Finally, the wound can be closed in a standard fashion.

On the back table, the graft is appropriately contoured according to the intraoperatively measured dimensions. Until further usage, the block can be stored in a humid compress.

The posterior drill guide is inserted through the extended posterior portal after removing the transparent cannula. First, the position of the posterior guide should be parallel to the glenoid.

This specific guide (Arthrex Inc., Naples, Florida) enables cannulated drilling under constant cooling of 2 holes through the glenoid which are exactly 10 mm apart from each other.

After the drill guide is removed, the distance of the 2 drills to the articular surface is measured to evaluate the position of corresponding drilling holes in the bone block.

After removing the inner stylet of the cannulated drills, 2 nitinol wires with loops (Arthrex Inc) were inserted into each drill and retrieved from the anterosuperior portal.

Securing the wires with a clamp, the drills can now be removed.

The measurements were transferred onto the bone block and 2 tunnels are placed from the cortical to the cancellous side using a 3.0-mm drill.

The 2 tunnels should be 10 mm apart from each other, which corresponds to the dimensions of the drilling guide of the glenoid.

After switching the camera back to the posterior portal, the transparent cannula can be removed from the rotator interval. The incision will now be enlarged to facilitate the insertion of the graft. For the rotator interval opening the surgeon's fingers, scissors, or an electrothermic device can be used.

The 2 nitinol wires were now replaced with 2 loop sutures, one ending up with the loop anterior and the other one with the loop posterior. These can now function as shuttles for the suture tapes.

Two ultra-high-strength suture tapes (Arthrex Inc.) are now passed from the posterior to the anterior side and retrieved via the anteroinferior portal.

Afterward, they are passed through the bone block from the cancellous to the cortical side and then back from the cortical to the cancellous side in a U-shaped fashion.

The 2 FibreTape sutures were then pulled through from the anterior to the posterior side of the glenoid using the anterior loop.

The graft is then finally introduced through the interval portal by pulling all fiber tape cerclage sutures using a kocher clamp.

After complete insertion and approximate positioning of the bone block, the camera is switched into the anterosuperior portal to get a better visualization of the alignment of the graft onto the glenoid defect.

The sutures were then interconnected to gain a continuous loop. The end of the FibreTape was loaded into the pretied racking hitch knot of the TigerTape suture and vice versa.

At the end of this procedure, this creates a sliding knot between the 2 FibreTapes.

This step is repeated with the second pair of tapes.

By holding the sutures like reins, alternating traction can be applied to each end and the knots can be reduced to the glenoid side and reach a symmetrical tension of the construct.

Using a tensioner, the knot of each suture can be locked separately and tensioned with around 40 to 60 N. At least 3 additional alternating half-hitches for back-up fixation are applied.

Finally, the suture can be shortened by cutting.

Knotless PushLock anchors are used distal as well as proximal for the reconstruction of the anterosuperior labrum to cover the bone block with a sufficient amount of soft tissue.

The PDS suture used at the beginning of the procedure is removed.

Here, you can see a 3-dimensional computed tomographic scan after 1 year with a resorption of the bone block comparable with the technique using screws. During this procedure, a good visualization of the defect side is of tremendous importance. We recommend the application of a percutaneous PDS traction suture that allows a constant opening of the space between the glenoid neck and capsular labral complex. While inserting the graft, widening of the anterior interval facilitates the process. For this, the surgeon's fingers, scissors, or an electrothermic devise can be used. Take care that the sutures are not getting twisted or trapped between the graft and the anterior glenoid. Slacks can be removed by pulling on each suture individually.

Before drilling the tunnels, make sure that the posterior drill guide is positioned well. Otherwise, the tunnels could end up too superficial and damage the articular surface and lead to malpositioning of the graft.

During the insertion process of the graft, avoid tilting of twisting of the bone block into soft-tissue structures (eg, the deltoid muscle or the subdeltoid space).

When reattaching the capsular labral complex, we also recommend soft anchors to avoid damaging the construct.

Our rehabilitation protocol involves the use of a brace with 15° external rotation to immobilize the arm during the first 4 weeks postoperatively. During this time, passive mobilization of the arm is allowed to 90° of abduction.

From week 4 postoperatively, active-assisted range of motion exercises can start.

From week 6 postoperatively, strengthening exercises of the glenoid, the scapulothoracic muscle, and the rotator cuff are started. We recommend the return to daily activities from week 6 onward. The return to sports is recommended after 3 months.

Very recently, Hachem et al published first short-term results showing radiographic consolidation after 3 months and an increased median glenoid estimated surface area at 12 months. The functional scores showed good outcomes and there were no serious complications reported.[3]

However, long-term results still need to be evaluated in future investigations.

Over the last couple of years, a few articles that completely avoid the use of metal implants to treat glenohumeral instability and substantial defects have been published with promising clinical and radiographic results.

Kraus et al and Boehm et al observed good to excellent short as well as long-term outcomes for their patients using arthroscopically applied biocompression screws to attach the iliac crest bone graft.[1,5]

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