Technical Note

Arthroscopic Posterior Bone Block Procedure With Two Cortical Buttons Fixation and Specific Glenoid Guide for Posterior Shoulder Instability

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Abstract: Arthroscopic posterior bone block procedure using cortical screws has been reported since 2012 for management of recurrent posterior instability associated with bone defects. To avoid screw complications, we describe a full arthroscopic technique based on cortical button fixation. With 4 portals (posterior, poster lateral, anterior, and anterolateral), we use a specific glenoid guiding system (to perform 2 tunnels) and 2 cortical buttons fixation. With a specific glenoid guide, the iliac crest bone graft (ICBG) is secured to the posterior glenoid rim by fixation with 2 cortical buttons. The ICBG is positioned protruding outside the joint through the space, and the posterior capsule is repaired while maintaining an extra-articular bone graft. The protruding bone graft increases the concavity of the glenoid with a progressive bony remodeling to improve the posterior stability of the shoulder in our clinical experience.

Posterior instability accounts for approximately 3% of all shoulder dislocations, with the prevalence of 1.1/100,000/year.[1-4] The etiology of posterior instability is divided into traumatic instability (the most common type) and atraumatic instability, which is believed to be voluntary, reproducible, and occasionally painful.[5-8] Traumatic instability is frequently combined with a posterior labrum lesion, a posterior bony Bankart, an erosion of the glenoid rim, or a reverse Hill-Sachs lesion.[9] Atraumatic instability is often associated with hyperlaxity, multidirectional instability, and glenoid dysplasia without any bone lesion.[10] Conservative treatment had led to an 80% success rate in treating the involuntary form of posterior instability, even in the presence of hyperlaxity.[11,12] Physiotherapy regimens include strengthening of the deltoid, supraspinatus, and infraspinatus muscles associated with neuromuscular reprograming and proprioceptive training.[13] Surgical treatment is mainly indicated in recurrent post-traumatic posterior instability. Similarly as for anterior instability,[14-16] soft tissue or bone block or mixed repairs have all been previously described by open or arthroscopic techniques.[1,5,7,11,17-20]

In 2012, Lafosse et al.[21] described the first arthroscopic iliac crest bone graft (ICBG) procedure for recurrent posterior instability using 2 cortical screws. They combined their repair with a posterior capsulolabral reconstruction. In 2013, Boileau et al.[17] described an arthroscopic technique for posterior bone block fixation with suture anchors. The purpose of this article is to describe an arthroscopic ICBG fixation with 2 cortical buttons and a posterior capsulolabral repair procedure to treat traumatic recurrent posterior instability with a posterior bony defect.

Surgical Technique

The surgical technique is demonstrated in Video 1.

Anesthesia and Patient Positioning

The surgery is performed with the patient under general anesthesia in combination with an interscalene

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Fig 1. The ipsilateral iliac crest is draped and then exposed with the help of Homann retractors. The desired dimensions are marked using a sterile ruler.

block. The patient is placed in the beach-chair position, with the arm draped free to allow shoulder mobilization. The joint is set in neutral rotation and 30° of forward flexion with only 1 kg of distal traction to easily mobilize the shoulder as needed. A pad along the medial border of the scapula is placed to achieve glenoid retroversion. The head of the patient is secured on a headrest device. A 30° scope is used throughout the procedure. Arthroscopic pump pressure is set at 50 mm Hg of pressure to limit bleeding. For ICBG harvesting, the ipsilateral iliac crest is sterilized and draped.

Step 1: Tricortical ICBG Harvesting

Superficial Exposure

A 3 cm skin incision is performed over the bony iliac ridge 4 to 5 cm posterior to the anterior superior iliac spine to avoid damage to the lateral cutaneous femoral nerve. The superficial soft tissue is dissected and retracted with the use of a self-retaining retractor until the fascia of the external oblique muscles is observed.

Deep Exposure

Iliac Crest Exposure and Harvesting. The fascia of the external oblique muscles is incised and elevated subperiosteally to avoid injury to the ilioinguinal and iliohypogastric nerves. Two Homann retractors are placed internally and externally on the iliac bone. The desired dimensions, 2 to 3 cm × 1 cm × 1 cm, are marked with the use of a sterile ruler (Fig 1).

The anterior and posterior bone cuts are performed with an oscillating saw, with the help of a curved osteotome for the lateral and final cut. The bone graft is detached, followed by wound irrigation, bone wax application, and thorough hemostasis. The wound is then closed in a layer-by-layer fashion, and a compressive dressing is applied.

ICBG preparation. Once harvested, the graft is cleaned of any remaining soft tissue. The orientation of the graft is defined by the cancellous facet, which faces the glenoid defect (Fig 2). Two bone tunnels of 3.0 mm diameter with a separating distance of 8 mm are created by a specific glenoid guide with 2 cannulated drills (Figs 3 and 4). The 2 holes are created 10 mm from the posterior border of the ICBG to obtain an overhang position of the bone block with respect to the posterior glenoid rim (Fig 5).

Fig 2. Example of an iliac crest bone graft, harvested with a length of 2.7 cm. The cancellous facet is facing the ruler.

Fig 3. The presented technique uses a specific graft/glenoid guide (Arthro VIMS).

Step 2: Portal Placement

Four portals are used during this procedure (Figs 6 and 7). A needle is used systematically to facilitate correct positioning of these portals under direct visualization. First, the posterior portal (P) is lower than the classical soft point: 3 cm inferior and 3 cm medial to the posterior angle of the acromion and flush to the posterior glenoid rim. Later in the procedure this portal is extended inferiorly to allow passage of the ICBG and to optimize its positioning in the middle part of the posterior glenoid rim. The tip of a finger can be used to enlarge the passage between the infraspinatus and teres minor and to avoid bone graft entrapment in the soft tissue. Second, an anterior portal (A), just lateral to the tip of the coracoid process, more medial than the classical anterior portal for the Bankart procedure, is used for a wide resection of the rotator interval and preparation of the base of the coracoid process. Third, a posterolateral portal (PL), placed 2 cm lateral to the posterolateral corner of the acromion is used for posterior labrum and capsule detachment, and repair of the respective structures. Fourth, an anterolateral portal (AL) 2 cm lateral to the anterolateral corner of the acromion is used to visualize the base of the coracoid process and the anterior glenoid rim between 0 to 3 o'clock.

Step 3: Intra-Articular Evaluation

The camera is introduced to the P portal and instrumentation in A portal. An intra-articular inspection of the joint is systematically performed to diagnose and treat combined lesions. Cartilage lesions of the posterior glenoid may signify a negative prognostic factor. The rotator interval is largely resected, and the lateral part of the coracoid process is cleaned to visualize the exit point of the drill bit above the subscapularis tendon.

Step 4: Posterior Glenoid Labrum and Posterior Glenoid Wall Preparation

The camera is moved to the A portal. A spinal needle is introduced into the PL portal to confirm an acceptable portal position. The PL portal is established through which a cannula (Twist-In 8.25 mm × 7 cm; Arthrex, Naples, FL) is introduced. A radiofrequency ablation device (Dyonics; Smith & Nephew, London, UK) is introduced through the cannula and used to detach the posterior labrum from the 9 to the 6 o'clock position and the posterior capsule. A satisfactory release is obtained when a clear visualization of the infraspinatus muscle is reached (Fig 8).

Fig 4. The guide is used to create 2 bone tunnels of 3.0 mm. Correct positioning of the guide on the graft is essential to have a correct position of the graft on the glenoid.

Fig 5. View on the cancellous facet of the iliac crest bone graft after the drilling of 2 tunnels. Note the 8 mm gap separating the 2 tunnels.

Two to 3 capsulolabral lasso loop stitches are passed using braided non-absorbable sutures (Fiber Wire; Arthrex) for posterior labral repair (Fig 9). The sutures are retrieved and gently tensioned from the PL portal. The correct height of the bone graft implantation at the level of the equator is marked on the glenoid edge using radiofrequency ablation . The natural posterior glenoid obliquity or the bone loss (Bankart or abrasion) requires a flattening of the posterior glenoid wall to obtain a perfect match with the cancellous surface of the ICBG. The posterior wall is debrided and flattened using a flat burr (Power Rasp; Arthrex) to obtain a bleeding bony bed mandatory to assist graft union.

Step 5: Glenoid Drilling

The camera is moved to the PL portal. The P portal is extended distally on the skin to 20 mm, and the interval between infraspinatus and teres minor is bluntly split with Mayo scissors. The point of entrance of the specific glenoid guide (Vims, Toulouse, France) should be inferiorly with a position at the glenoid rim between 6 to 9 o'clock. The guide blade is locked, with the hook engaging on the anterior glenoid rim above the equator between 12 to 3 o'clock, which is considered a "safe zone" without any consequences on anterior stability of the joint (Fig 10). The glenoid guide is secured posteriorly, pushing the medial stabilizing rod against the skin on the scapular spine and anteriorly with the help of a blunt trocar inserted through the A portal (Fig 11). Two tunnels are performed, in an oblique direction from down to up, using a cannulated 3.0 mm drill bit through the glenoid guide, 8 mm medial to the cartilage, a superior tunnel (A1) and an inferior one (A2). The glenoid guide is then removed.

Step 6: Cortical Suture Button Passage and Positioning on the ICBG

Two polydioxanone (PDS) 1 suture free ends are passed through the A1 and A2 cannulated drill bits from posterior to anterior and are retrieved through the A portal under the control of the camera located in the AL portal (Fig 12). The A1 and A2 cannulated drill bits are removed. The strands of the 2 cortical buttons (ArthroVIMS Button; Vims) are shuttled through the A portal by pulling the PDS from the P portal. The cortical buttons are placed on the anterior glenoid wall between 12 to 3 O'clock without causing damage to the labrum and the medial glenohumeral ligament (Fig 13). Each strand of the 2 cortical suture buttons (ArthroVIMS Button) are passed through the respective superior and inferior holes of the ICBG that has been previously prepared. Although the ICBG is maintained outside the

Fig 6. Arthroscopy of the shoulder is performed in beach-chair position, with the arm draped free. Several arthroscopic portals are used, here presented on a left shoulder.

Fig 7. Overview of all arthroscopic portals illustrated on a left shoulder. The P portal is lower than the classical soft point: 3 cm inferior and 3 cm medial to the posterior angle of the acromion and flush to the posterior glenoid rim.

shoulder, the cortical buttons are pulled down to lay directly on the posterior cortical aspect of the ICBG by gently pulling alternating on the strands exiting through the A portal. (Fig 14). The whole step is detailed in Figure 15.

Step 7: Graft Placement and Tensioning

Blunt dissection using the fingertip through the P portal is necessary to create the proper space needed for the graft and to avoid soft tissue interposition. The graft is now guided through the space between the infraspinatus and teres minor by gently pulling on the strands of the cortical buttons. Starting with traction on the superior strand to create a horizontal introduction of the graft into the joint, followed by the traction on the inferior strand to applicate the cancellous facet against the posterior glenoid rim. The bone block should slightly protrude the glenoid cartilage, and full and entire matching between the cancellous facet and the flat posterior glenoid rim is required (Fig 16).

The presence of 2 different sites of fixation prevents rotations of the graft. The implants are now tightened with a suture tensioner from the anterior portal.

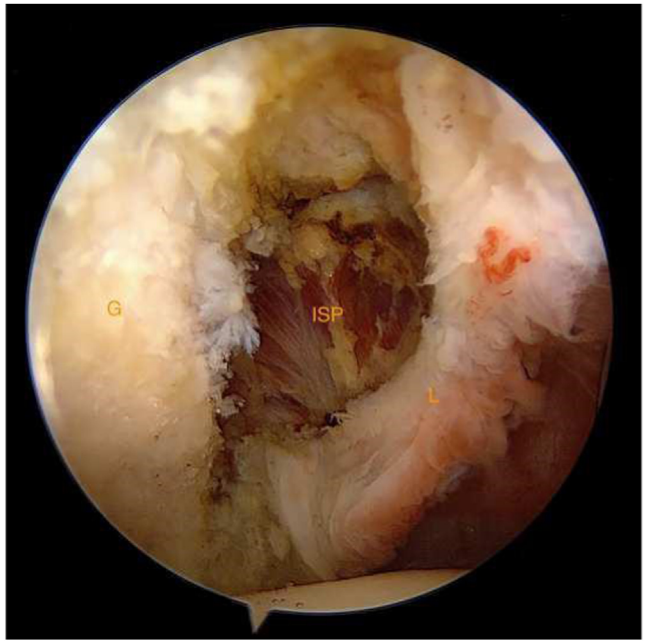

Fig 8. After a standard arthroscopic inspection from posterior, the camera is introduced in the anterior portal. The posterior labrum (L) is detached from the glenoid (G) between the 9 and 6 o'clock positions until the infraspinatus (ISP) muscle fibers are visualized, resulting in the arthroscopic view as here presented in a left shoulder.

Tensioning is complete once 100N of force is achieved twice (200N). Graft stability and positioning are assessed with a hook from the PL portal and scope in

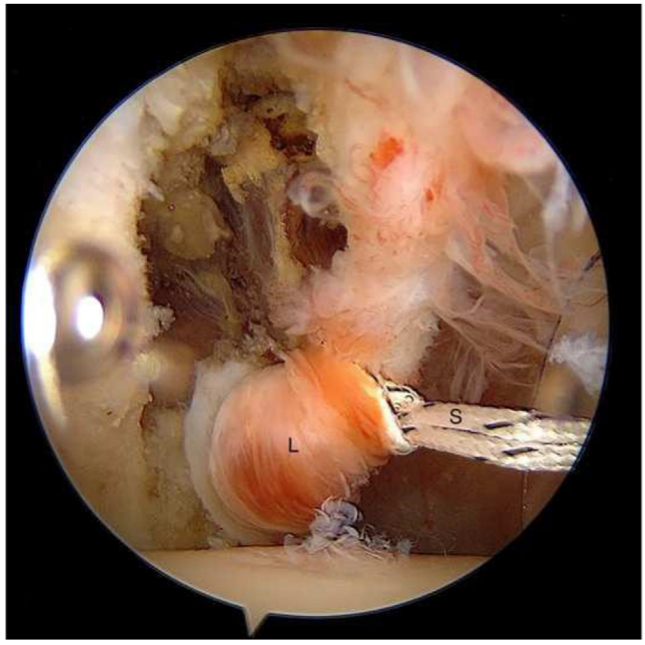

Fig 9. Two to 3 capsulolabral lasso loop stitches are passed through the posterior labrum (L) using braided nonabsorbable sutures (S) (Fiber Wire) for posterior labral repair, illustrated in a left shoulder.

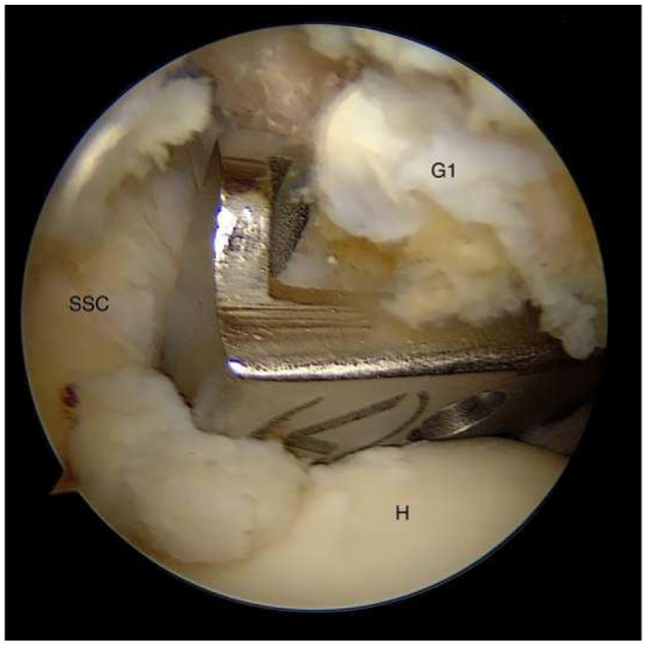

Fig 10. The glenoid guide is introduced through the extended posterior portal to lay anteriorly in the safe zone above the equator of the glenoid (G1) and between 0 to 3 o'clock, illustrated in a left shoulder and visualized from the posterolateral portal. Continuous contact between the glenoid and the guide is essential to prevent cartilaginous injury during the drilling process. H, humeral head; SSC, subscapularis muscle.

the AL. Through the A portal, 3 locking knots are tied to lock the construct, and the sutures are cut with an arthroscopic suture cutter. The overhang of the ICBG restores the width and the concavity of the glenoid. The pressure applied from the humeral head to the exteriorized bone graft allows remodeling and bony integration according to Wolff's law.

Step 8: Capsule Labral Repair

The camera is placed in the A portal. Through the PL portal (and cannula) two to three 2.9 mm knotless anchors (Push Lock 2.9 mm; Arthrex) are loaded on the previously prepared capsulolabral sutures. The anchors are placed on the glenoid rim at the 7, 8, and 9 o'clock positions. This configuration maintains the ICBG extra-articularly and preserves the capsulolabral anatomy (Fig 17).

Postoperative Management

The upper limb is maintained in a sling with the shoulder in neutral rotation for 4 weeks. Between 4 to 6 weeks, painless passive forward elevation (FE) and external rotation (ER) with the aid of the contralateral arm are started. At 6 weeks, painless active FE and ER is initiated. Internal rotation (IR) is prohibited until after 3 months after surgery to allow the healing of the capsuloplasty. Hydrotherapy is recommended, with the exception of IR. Strengthening of the external rotator muscles and deltoid begins at 3 months. Progressive return to sports is allowed at 6 months after surgery. A computed tomography scan with 3-dimensional reconstruction can be acquired at 6 months at the earliest to verify ICBG integration (Figs 18 and 19).

Discussion

The arthroscopic posterior bone block procedure for posterior instability of the shoulder is a challenging procedure with a substantial complication rate and a long learning curve.[22] The presented full arthroscopic technique uses 2 cortical suture buttons to stabilize a bone block over the posterior glenoid rim. The use of a specific glenoid guide allows accurate positioning of the ICBG that results in native glenoid anatomy restoration. Matching between the flat abraded posterior glenoid to the cancellous portion of the ICBG and overhang positioning of the bone block facilitates bony integration. The cortical button system using strand sutures

Fig 11. External view on a left shoulder with the glenoid guide (G) secured in position with the aid of the positioning rod (R) pushing the skin on the scapular spine. A blunt trocar can be inserted through the anterior portal to push the anterior part of the glenoid guide.

Fig 12. By use of a 3.0 mm drill bit, 2 bone tunnels are created through the guide. Two PDS 1 sutures are passed through the superior (A1) and inferior tunnel (A2), as illustrated in this arthroscopic picture of a left shoulder.

allows the guidance of the ICBG through the split between the infraspinatus and teres minor. By alternately pulling the suture strands, a rotational control on the bone block during the transfer and fixation stages is achieved. Additionally, identical distances between the drill holes on the ICBG and on the posterior glenoid rim decrease the risk of graft malrotation.

Fig 13. Arthroscopic view of the anterior cortical buttons and their relation to the safe zone in a left shoulder. The strands of these two cortical buttons are shuttled through the anterior portal by pulling the PDS strand from the posterior portal. G, glenoid; SSC, subscapularis muscle; A1, button facing the superior tunnel; A2, button facing the inferior tunnel.

Fig 14. External view of the Iliac crest bone graft after passing the superior and inferior suture strands in a left shoulder. Note the cortical buttons were pulled to lay directly on the graft cortex.

The use of 2 cortical buttons in our technique is likely more advantageous over the use of a single one, as the rotational component is better controlled. Finally, the glenoid guide helps to prevent an iatrogenic lesion of the suprascapular nerve posteriorly or the axillary nerve anteriorly (Tables 1 and 2).

The glenoid guide allows to achieve control over the graft positioning and prevents the potential risks of medialization (potential osteolysis and bone resorption) or over lateralization (osteoarthritis) encountered in other methods.[19,23] Furthermore, the low-profile cortical button may prevent complications that are otherwise seen with screw fixation techniques, such as impingement, pain, risk of breakage, hardware irritation, loosening, back-out, and the need of hardware removal.[7]

Lafosse et al.[21] reported on the experience of an arthroscopic bone block fixation with a 2-screw technique in 19 shoulders, with 20 months of follow-up showing improved Rowe and Walch-Duplay scores from 18.5 to points to 81.25 points and 37.5 points to 82.9 points, respectively. Bone consolidation was achieved in 94.7% of patients. One patient with a bilateral posterior arthroscopic repair needed a revision surgery for graft resorption. A total of 31.5% of complications described in this series were related to hardware impingement and pain. Six patients needed screw removal, and just 1 patient was painful and unstable without any objective cause.

In 2013, Boileau et al.[17] described a technique of arthroscopic bone block fixation with suture anchors.

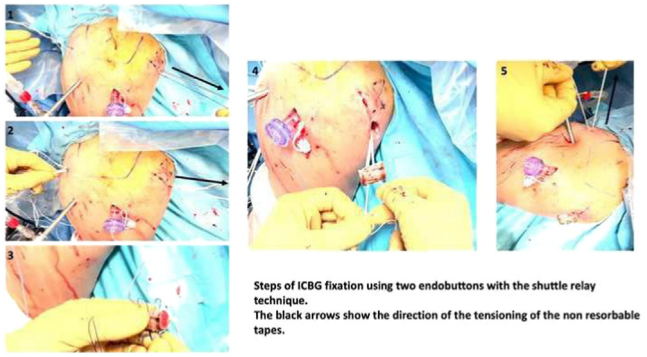

Fig 15. Steps of ICBG fixation using two endobuttons with the shuttle relay technique. The black arrows show the direction of the tensioning of the non-resorbable tapes. (**1**) The strands of the 2 cortical buttons system (ArthroVIMS Button) are passed through the anterior portal and shuttled through the bone tunnels by pulling the PDS sutures from the posterior portal. (**2**) The anterior cortical buttons are placed on the anterior strands of the button system. By pulling the posterior strands, these cortical buttons are placed at the anterior glenoid rim. (**3**) Each strand of the 2 cortical suture buttons are passed through the respective superior and inferior holes of the iliac crest bone graft. (**4**) The graft is held outside the shoulder, cortical buttons are attached to the strands, and the cortical buttons are pulled down to lay directly on the posterior cortical aspect of the graft by gently alternating on the strands at the anterior side of the shoulder. (**5**) The graft is pulled into the joint through the extended posterior portal by pulling and tensioning the strands exiting the anterior portal.

This technique reportedly allowed an adequate strength of fixation and had been used in other surgeries such as bony Bankart repairs with satisfactory clinical results.

Fig 16. Arthroscopic view of the ICGB fixed at the posterior glenoid rim (G) in a left shoulder. Note that a capsulolabral repair has yet to be completed.

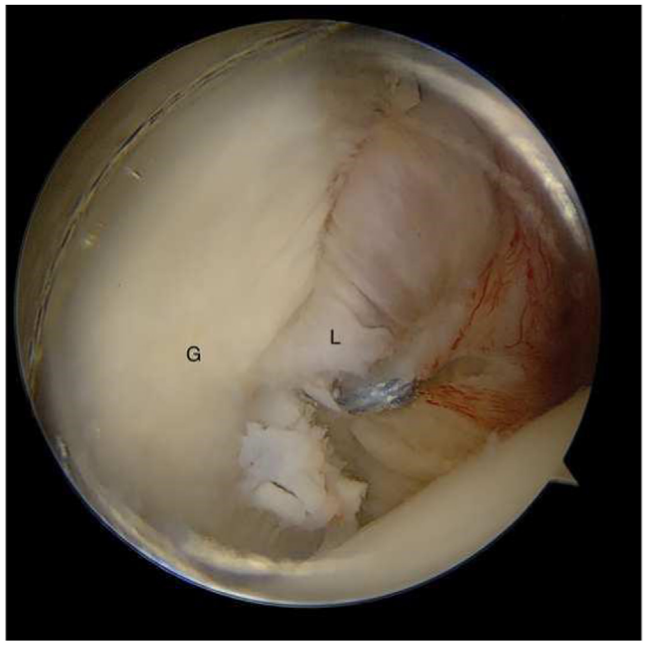

Fig 17. Arthroscopic view after capsulolabral (L) repair on to the posterior glenoid (G) in a left shoulder.

No recurrent posterior dislocation nor complete graft resorption was reported in this series of 15 patients with 1-year follow-up. It prevents complication from screws in terms of impingement, pain, risk of wire breakage, hardware irritation, loosening, back-out, and the need of hardware removal. As with all arthroscopic procedure, the presented technique allows for the treatment of other associated intra-articular pathologies that commonly appear in the unstable posterior shoulder.

Fig 18. Six-month postoperative computed tomography scan demonstrating posterior graft integration and a centered humeral head.

Fig 19. Six-month postoperative 3-dimensional reconstruction demonstrating graft location at the posterior glenoid rim.

Provencher et al.[18] reported the appearance of the Bankart lesion in 51% of cases, posterior capsular stretching in 67% of cases, a combination of both lesions in 16% of cases, and rotator interval damage in 61% of cases.

Servien et al.[19] reported on a retrospective cohort of open posterior bone block in 21 patients with a minimum follow-up of 2 years and an average of 6 years. Fifty-five percent of patients were free of pain, 1 patient had a recurrent dislocation, and 2 patients had persistent apprehension. One patient had a resorption of the graft in the follow-up, and 2 patients presented with osteoarthritis. Struck et al.[8] described a retrospective cohort of open posterior bone block surgery in 15 shoulders with a follow up ranging between 1 to 6 years. One patient had recurrent instability caused by graft resorption 6 months after surgery. Good functional range of motion and improved shoulder stability scores were noted. Four patients needed screw removal because of crepitation and pain. Gosens et al.[24] reported on a small cohort of 11 patients with a long follow-up and 2 descriptions in time. The percentage of recurrence in patients with hyperlaxity was as high as 80%. Resorption of the bone graft was noted in 3 patients. At a follow-up of up to 18 years, Meuffels et al.[25] found an important deterioration of all clinical parameters. Seventy-two percent of the patients had an unstable shoulder, and 36% suffered recurrent posterior dislocation. In addition, all patients had radiological signs of osteoarthritis, whereas only 4 cases (36%) had osteoarthritis at the time of surgery.

Table 1. Pearls and Pitfalls

Pearls
Posterior portal should be in the safe zone less than 1.4 cm medially to the glenoid rim
The arm should be in adduction and forward elevation to protect the axillary nerve
The tunnels through the glenoid bone must be from inferior posterior glenoid rim to the superior anterior glenoid rim above the subscapularis tendon
Maintain ICBG with a Kocher to pass through the posterior muscle and to avoid malrotation
Pitfalls
ICBG too high and too medially on the posterior glenoid rim
Iatrogenic lesion of the SSCN with an extensive medial dissection of the posterior glenoid rim
Anterior portal too lateral and too tight with a tensioner the ICBG in an oblique
direction with a risk of cutting strands
Interposition of soft tissue between the ICBG and the posterior glenoid rim

ICBG, iliac cortical bone graft; SSCN, suprascapular nerve.

Table 2. Advantages and Disadvantages

Advantages
Minimally invasive arthroscopic procedure
Low profile of the cortical button and No need for hardware removal
Arthroscopic assessment and treatment of associated Lesions Biceps, articular part of the cuff
Specific posterior guide to improve positioning of the ICBG
Disadvantages
Risk of lesion of the Axillary nerve and SSCN
Technically demanding: perfect knowledge of the anatomy of the nerves of the shoulder is mandatory
More expensive than open procedure
Learning curve

ICBG, iliac crest boine graft; SSCN, suprascapular nerve.

Conclusion

The arthroscopic posterior bone block procedure with fixation with 2 cortical buttons and a specific glenoid guide offers a safe and reproducible technique for the treatment of posterior shoulder instability. Fixation with cortical buttons simplifies graft transport, allows for controlled positioning of the bone graft with a strong fixation, which may favor bony integration, and prevents complications that are typically associated with screw fixation.

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