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Operative Techniques in

Sports Medicine

The Open Eden-Hybinette Procedure for Recurrent Anterior Shoulder Instability With Glenoid Bone Loss

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In the setting of significant glenoid bone loss, soft tissue stabilization procedures for recurrent anterior shoulder instability have high failure rates. The open or arthroscopic Eden-Hybinette procedure with tricortical iliac crest autograft has been shown to provide good results with low rates of recurrent instability. Indications for this technique include severe glenoid bone loss (>40%), recurrent instability following a Latarjet or distal tibial allograft procedure, or patients with abnormal coracoid morphology. In this technique article, we review the indications, contraindications, surgical technique, postoperative care, outcomes, and complications of the open Eden-Hybinette procedure.
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KEYWORDS Eden-Hybinette, recurrent anterior instability

Introduction

Anterior shoulder instability is a common problem in young active individuals with an incidence in the United States (US) general population of 0.08 per 1000 person-years.[1,2] Certain at-risk populations involved in contact and collision activities, such as American football players and military athletes, have anterior instability at an order of magnitude greater of 0.51 and 1.69 per 1000 person-years, respectively.[1,3] Arthroscopic and open Bankart repair are effective treatments for symptomatic anterior shoulder instability.[4-11] However, numerous risk factors have been identified for failure following arthroscopic and open soft tissue anterior stabilization including: glenoid and humeral bone loss, younger age, contact/collision athletic status, and hyperlaxity.[12] Better recognition of anterior inferior glenoid bone loss and Hill Sachs "off track" lesions through advanced imaging with MRI and 3-dimensional reconstruction computed tomography (CT) scans has likely led to increased utilization of bone augmentation techniques such as the Latarjet procedure, distal tibial allograft (DTA), and distal clavicular autograft.[13-17] The Latarjet and DTA procedures have shown to be effective and provide good outcomes with low rates of recurrent instability in primary and revision instability scenarios,[18-20] with the Latarjet showing long-term durability.

In the setting of a failed Latarjet or DTA, abnormal coracoid morphology, or patients with severe bone loss (greater than 40%), glenoid bone augmentation with tricortical iliac crest autograft (Eden-Hybinette) has shown to be effective in achieving stability.[21-24] Additionally, it offers the ability to tailor the size of bone graft to match the corresponding large glenoid bone defect. Also, it negates the risk of disease transmission with allograft and is less costly, although it has the obvious drawback of donor site morbidity.[25]

The purpose of this article is to review the surgical indications, operative technique, postoperative care, outcomes, and complications for the open Eden-Hybinette procedure for treatment of anterior shoulder instability with severe glenoid bone loss.

Surgical Indications

The Latarjet procedure has been shown to provide good long-term outcomes for recurrent anterior shoulder

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instability.[19,20] The benefits of this procedure are bony augmentation, the sling effect of the conjoined tendon in the abduction external rotation position, ability to perform the procedure through a subscapularis split, reduced cost, and studies supporting good long-term outcomes. The disadvantages of the Latarjet for the treatment of anterior inferior bone loss include it being a nonanatomical procedure, incidence of neurologic complications, and complications such as coracoid graft fracture and nonunion. Others have proposed DTA as an alternative to Latarjet, citing a more anatomical procedure with extension of allograft articular cartilage which nearly matches the radius of curvature of the glenoid surface.[18] However, there are few short-term outcome studies demonstrating its effectiveness, the procedure is costly, there is a risk of disease transmission, and it is commonly performed with a subscapularis takedown as opposed to a split. Therefore, it is the preference of the senior author (JJPW) to utilize a tricortical iliac crest autograft (Eden-Hybinette) procedure in the setting of a failed Latarjet or severe glenoid bone loss (>40%). The advantages of this procedure compared to the DTA are the use of autograft bone with no risk of disease transmission, significantly lower cost, and the ability to tailor the graft size to the glenoid defect. The obvious drawback is donor site morbidity.

In addition to continued instability following a previous Latarjet procedure, additional surgical indications for an Eden-Hybinette procedure include anterior shoulder instability associated with greater than 40% glenoid bone loss (Fig. 1), abnormal coracoid morphology precluding the use of a Latarjet procedure, and a nonreconstructable bony Bankart fracture with abnormal coracoid morphology. Surgical contraindications to the procedure include active infection, uncontrolled seizure disorder, and a patient who is unlikely to follow the postoperative restrictions and a strict rehabilitation program.[21,26]

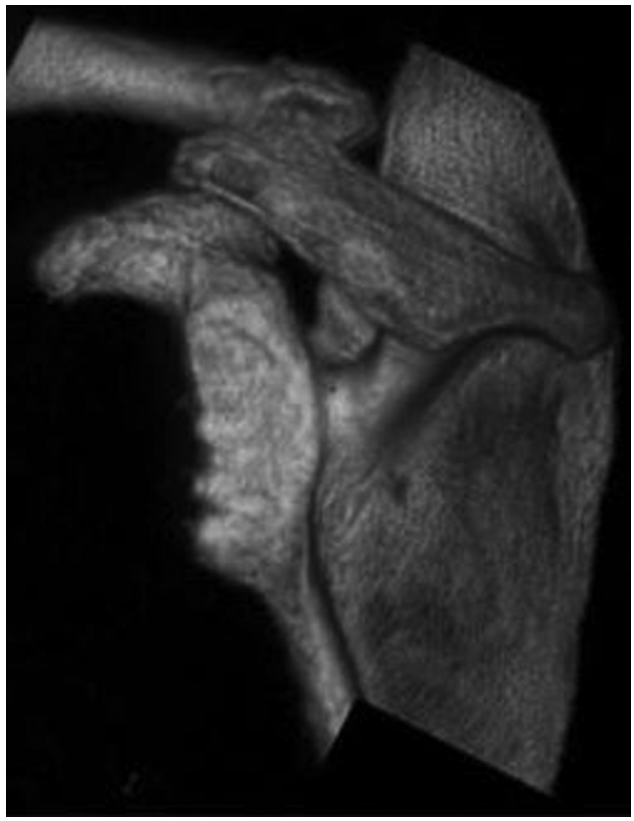

Figure 1 A 3-dimensional (3D) reconstruction of the shoulder with humeral head subtraction demonstrating significant anterior glenoid bone loss. Reprinted with permission.[26]

Operative Technique

A thorough history and physical examination are critical in the initial assessment. Orthogonal radiographs with a true anteroposterior Grashey view and axillary lateral are obtained. A preoperative CT scan with reformatting in the plane of the scapula with 3-dimensional reconstruction and humeral head subtraction is often helpful to identify the magnitude of glenoid bone loss.[27] Numerous techniques exist for accurate measurement of bone loss, including preoperative measurement on MRI and 3-dimensional CT scans as well as arthroscopic methods.[28-32]

The technique for this procedure has been previously described by the senior author (JJPW).[21,26] We prefer an open technique for the Eden-Hybinette procedure; however, others have shown that arthroscopic methods are similarly effective.[23] After regional nerve block and general anesthesia, the patient is seated in a lazy beach chair position, with the head of the bed elevated approximately 30°. This position allows gravity to help maintain the reduction of a typically very unstable shoulder and eases access to the iliac crest, especially in overweight patients. Additionally, a padded bump is placed under the ipsilateral hip to ease in the access of the iliac crest by increasing the crests' prominence. An examination under anesthesia is performed to quantify the severity and direction of instability and document preoperative shoulder range of motion. A pneumatic articulated arm positioner is utilized, and the lateral torso support is adjusted to ensure it does not impede access for the iliac crest harvest. The patient then undergoes sterile preparation and draping. A timeout is performed with confirmation of intravenous perioperative antibiotic administration. A deltopectoral approach is performed with the incision from the coracoid process to the anterior axillary fold, with care taken to identify and protect the axillary nerve as it courses anterior to the subscapularis into the quadrilateral space. This is especially critical in those patients with a history of prior open stabilization surgery as the surgical field can be significantly altered. The subscapularis is either split in line with its fibers or a tenotomy is performed. If a subscapularis takedown is performed, care is taken to dissect the subscapularis from the underlying capsule from lateral to medial. If a prior open surgery involved a subscapularis takedown, it may be of benefit to split the subscapularis tendon. The capsule then is released from the humeral neck and split down to the anterior glenoid in an inverted L-shape (Fig. 2). Subperiosteal dissection is utilized to expose the anterior glenoid and the bony defect. A Fukuda retractor is placed across the glenohumeral joint and seated on to the posterior glenoid rim to displace the humeral head posteriorly, thus allowing exposure of the joint surface. A manually directed posterior force on the humerus also facilitates better exposure. A blunt Hohmann retractor is placed along the glenoid neck to expose anteriorly and medially. In patients who have undergone a prior Latarjet procedure, the conjoined tendon will likely be scarred into the subscapularis tendon and can be left in place and

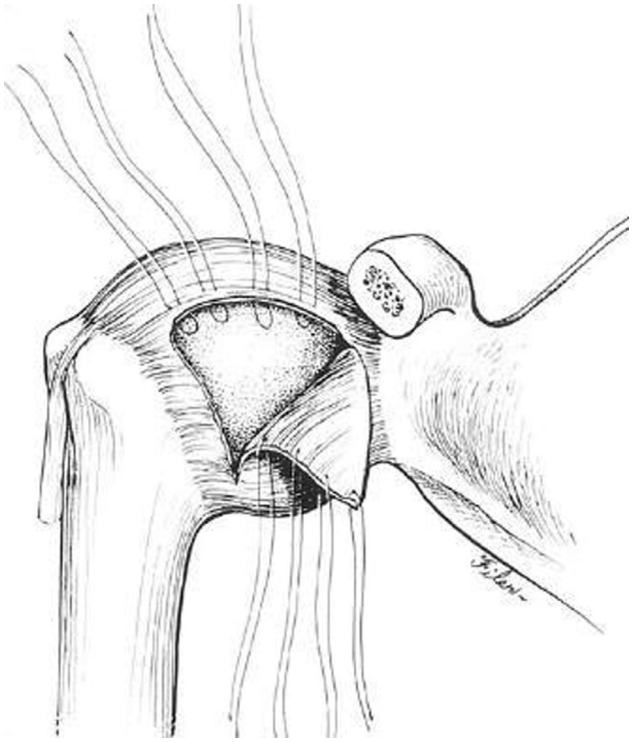

Figure 2 To adequately expose the glenoid, an inverted L-shaped capsulotomy is created through the anterior capsule following the subscapularis split or tenotomy. Reprinted with permission.[21]

retracted medially so as to not damage the axillary and musculocutaneous nerves which are closely associated with the medial aspect of the conjoined tendon.[33] With the anterior glenoid well exposed, screws and implants from the Latarjet or DTA can be removed and an osteotome or high-speed burr is used to create a flat bleeding surface of bone. Graft dimensions can then be measured in preparation for iliac crest harvest.

Iliac Crest Harvest

A 5-cm oblique incision is made 2 cm lateral to the anterior superior iliac spine with care taken to protect the lateral femoral cutaneous nerve. The inner and outer table of the iliac crest are exposed bluntly and retractors are positioned to facilitate exposure. An oscillating saw and osteotome are used to remove a tricortical iliac crest wedge of bone which is of appropriate size to match the glenoid bone defect. Typically, this is 3 cm in length and 2 cm in width; however, the graft size should be specific to the measured glenoid defect. The graft is taken to a sterile table for further preparation. Using an oscillating saw, rongeur, and/or a high-speed burr, the graft is then contoured to the appropriate size and in a manner that the inner table of the graft serves as the extension of the articular surface and the cancellous portion is opposed to the anterior glenoid defect (Fig. 3). Preparation and fixation of the graft in this manner has been shown to normalize the glenohumeral contact pressures.[34] Once contoured to sit flush with the glenoid articular surface and not positioned laterally, the graft is fixated with 2 or 3 3.5 mm cortical screws with washers. Before performing the final tightening of the screw and washers, a number 2 braided polyethylene nonabsorbable suture is wrapped around the screw heads in order to repair the capsule down to the anterior margin of the graft (Fig. 4). The Fukuda retractor is then removed and the final positioning of the humeral head on the glenoid is assessed. If the L-shaped capsulotomy cannot be repaired back to the neck of the humerus with the arm in at least 30° of external rotation, the capsule is then repaired to the undersurface of the lateral edge of the subscapularis tendon. If a subscapularis split was used during the exposure, it is repaired in a side to side manner while a tenotomy is repaired through osseous tunnels over a lateral cortical button or with the use of suture anchors using a modified Mason-Allen stitch (Fig. 5).

Postoperative Care/Rehabilitation

Initial postoperative care is dictated by the management of the subscapularis at the time of surgery. If a tenotomy was performed, physical therapy is delayed for 4-6 weeks, whereas if the subscapularis was split in line with its fibers, therapy is initiated at 1 week postoperatively with passive range of motion and pendulum exercises. From 6 weeks to 3 months, patients work on regaining active range of motion and use of the arm for activities of daily living. Strengthening exercises are started at 3 months. A postoperative CT scan at 4-6 months is an option to confirm radiographic union. Return to sport is allowed at approximately 6-8 months postoperatively (Fig. 6).

Outcomes

The Eden-Hybinette procedure has been utilized as both a primary procedure for recurrent anterior shoulder instability with significant glenoid bone loss as well as in the revision setting. In general, several studies have documented good outcomes following this complex procedure. Steffen et al describe the results of 48 patients, 28 of whom underwent a modified Eden-Hybinette procedure for recurrent instability after a previous open or arthroscopic stabilization procedure. At a mean of 9 years follow-up, 29 patients were very satisfied with the procedure.[24] Warner et al reported on a series of 11 patients who underwent an Eden-Hybinette procedure, 9 of whom had a previously unsuccessful operative procedure. Postoperatively, there were significant improvements in American Shoulder and Elbow Society (ASES), University of California Los Angeles (UCLA), and Rowe functional scores. All patients returned to their preinjury sport level with no complaints of apprehension or instability. Postoperative imaging demonstrated no evidence of arthritis, graft resorption, or hardware failure or impingement.[21] In their series of 46 patients who underwent a modified Eden-Hybinette for a failed previous Latarjet procedure, Lunn et al demonstrated a good or excellent result in 79% of patients while 68% of patients returned to their preinjury level of sport.[22]

More recently, arthroscopic techniques have been developed and shown to be effective. Giannakos et al reported 8 of 12 patients with a good or excellent result following arthroscopic Eden-Hybinette procedure, with 4 patients reporting a fair or poor result. Seven patients returned to preinjury level of sport. Patients also demonstrated increases in their Rowe and Walch-Duplay functional scores.[23] Taverna et al describe an

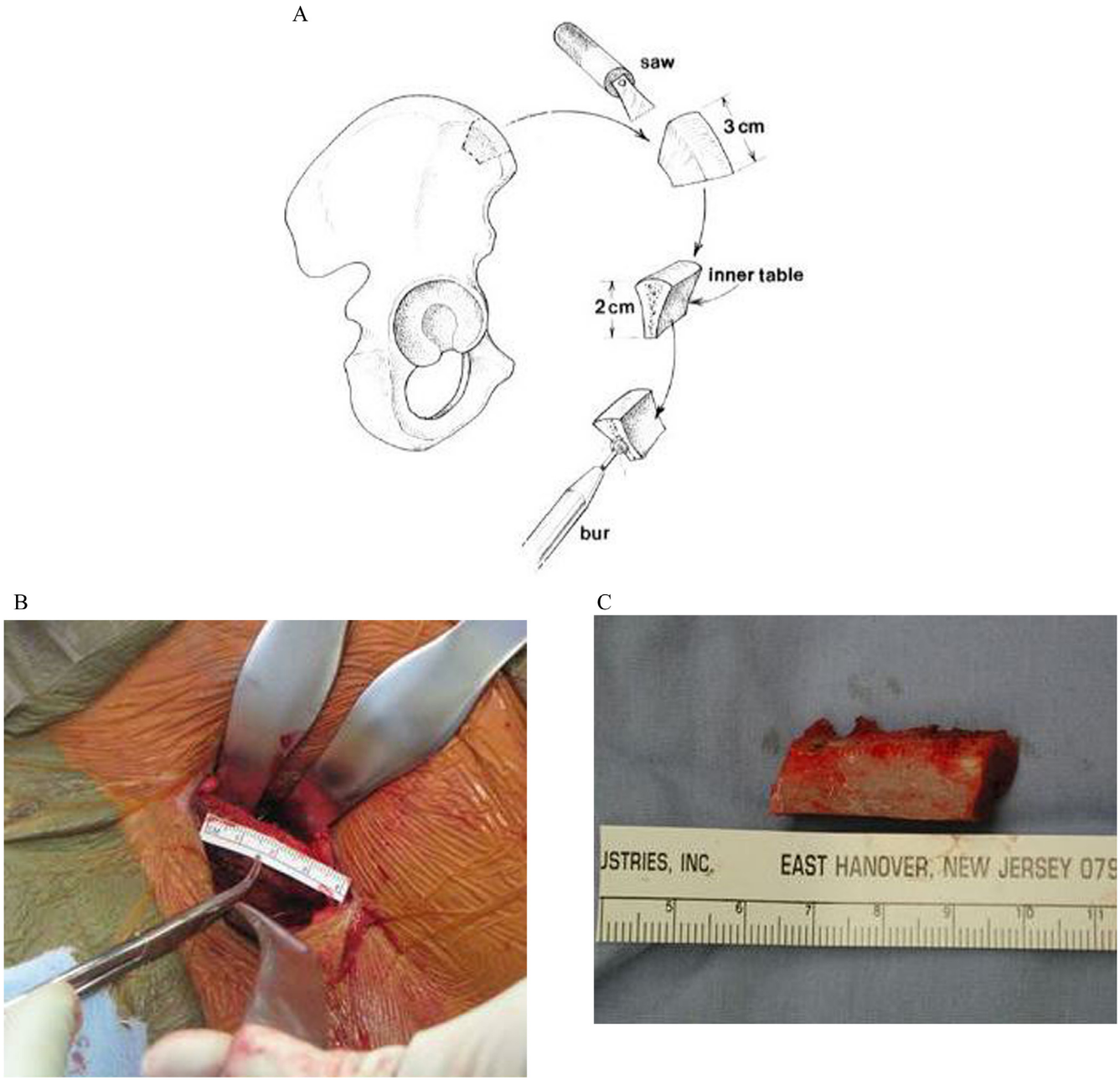

Figure 3 (A): Illustration of the harvest, preparation and contouring of the iliac crest bone graft (B): Intraoperative photographs demonstrating planned harvest of the iliac crest bone graft; (C): The harvested tricortical graft. (A) reprinted with permission.[21] (B) and (C) reprinted with permission.[26]

all-arthroscopic technique using suture buttons rather than screws for graft fixation. They analyzed the outcomes of 26 patients, and reported a satisfaction rate of 88.5% with no recurrent redislocations and graft healing in 92.3% of patients.[35]

Complications

As with any procedure, the Eden-Hybinette procedure is not without complications. One of the most dreaded complications is recurrent instability. In their series, Lunn et al reported 13 patients had continued subjective feelings of apprehension. Four patients experienced a redislocation episode postoperatively with 2 of these patients becoming recurrent dislocators. One of these recurrent dislocators required an eventual glenohumeral arthrodesis.[22] Steffen et al reported 3 patients had a subjective sense of instability while 1 patient experienced a redislocation episode that required surgical intervention.[24] With their arthroscopic technique, Giannakos et al reported 5 (42%) patients with continued apprehension and another 2 (17%) patients who reported subsequent subluxation events.[23]

Another complication reported has been the advancement of glenohumeral arthritis postoperatively. While Lunn et al reported 10 patients with radiographic evidence of arthritis at final follow-up, only 4 of these patients had new onset arthritis after the Eden-Hybinette procedure. Of these 4 patients, 2 were

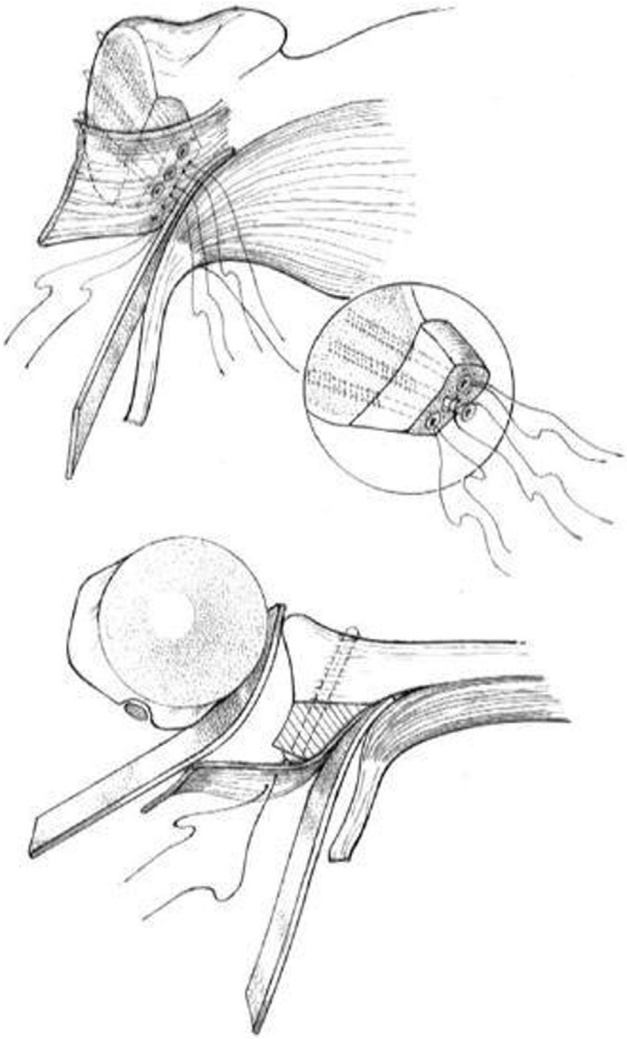

Figure 4 Following graft contouring to recreate normal glenoid concavity, it is secured to the anterior glenoid with 2-3 3.5 mm cortical screws. To assist with capsular closure No. 2 heavy, nonabsorbable suture has been wrapped around each screw head to allow for the capsule to be repaired directly to the graft. Reprinted with permission.[21]

considered mild, 1 was considered moderate, and 1 was considered severe.[22] Another study demonstrated a progression of arthritis of 1 grade in the Samilson and Prieto classification in 7 (20%) patients.[24]

Failure of graft incorporation or presence of graft lysis is another reported complication. In one study, graft lysis was present in 6 patients and in 2 cases where more than two-thirds of the graft resorbed, both patients redislocated.[22] In another study, 2 of 8 patients developed a nonunion with associated hardware failure; however, neither required further surgical intervention due to lack of clinical symptoms.[23] Using their suture button technique for graft failure, Taverna et al report 1 graft nonunion and 1 patient with complete graft resorption.[35]

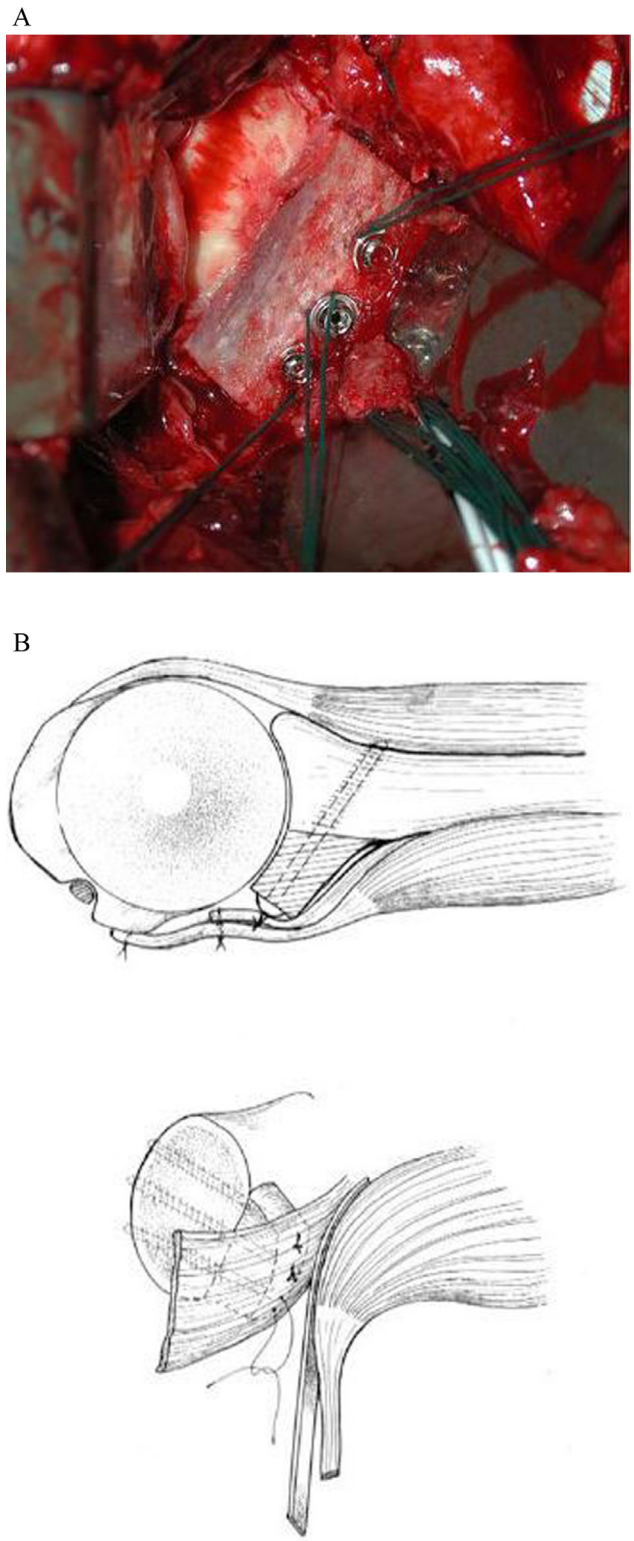

Figure 5 Glenoid reconstruction utilizing tricortical iliac crest bone graft. Note the graft held in place with three 3.5 mm cortical screws with washers, around which heavy suture is placed to aid in capsular repair (A). Illustration demonstrating capsular repair followed by subscapularis repair (B). (A) reprinted with permission.[26] (B) reprinted with permission.[21]

Conclusion

In the setting of significant glenoid bone loss, soft tissue procedures for recurrent anterior shoulder instability have high failure rates. In this scenario, as well as in failed prior coracoid transfers, the Eden-Hybinette procedure utilizing tricortical iliac crest autograft offers an effective surgical option.

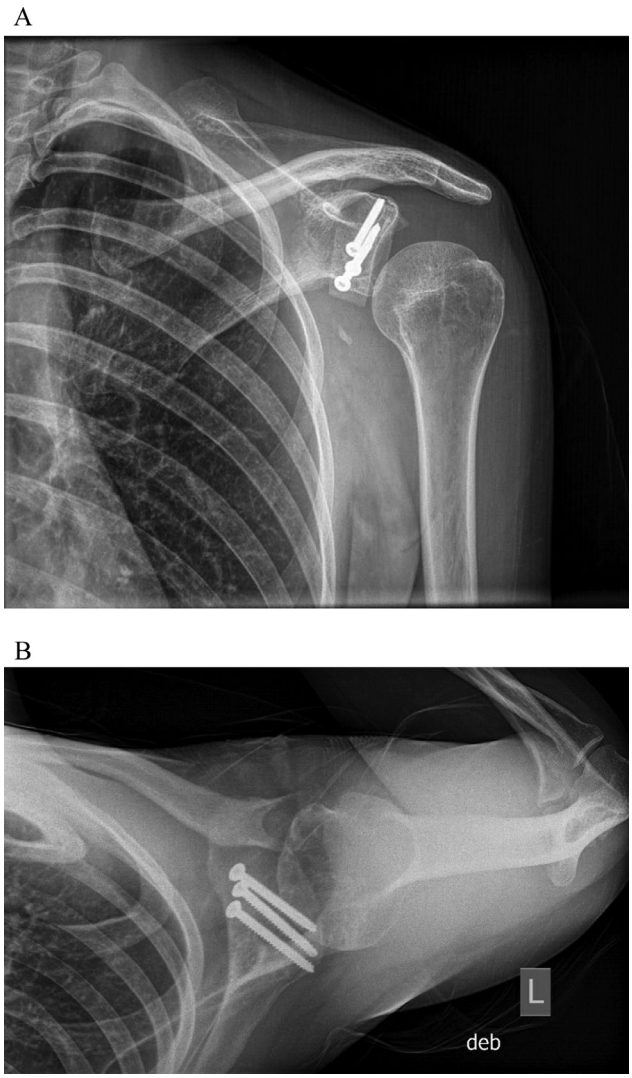

Figure 6 A postoperative anteroposterior (AP) (A) and axillary (B) radiograph following an open Eden-Hybinette procedure.

Both open and arthroscopic techniques have shown promising results as well as the use of traditional screw or suture button fixation methods. Although a good procedure to have in one's armamentarium, the performing surgeon must be aware of the often-altered surgical field that can be encountered in revision surgery as well as the possible complications of the procedure.

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