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All-arthroscopic, guided Eden-Hybbinette procedure using suture-button fixation for revision of failed Latarjet

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Purpose: To report the results of a guided arthroscopic Eden-Hybbinette procedure, using suture button for iliac crest bone graft fixation, in a series of patients with a prior failed Latarjet and persistent glenoid bone loss.

Methods: Seven consecutive patients (5 males, 2 females, mean age: 30.7 years [range, 17-47 years]) with recurrent anterior dislocations and glenoid deficiency greater than 20% underwent the all-arthroscopic revision procedure. The iliac crest bone graft and suture-button device (Bone-Link) were shuttled through the rotator interval. Specific drill guides were used and a suture tensioning device allowed bone graft compression. Previous broken screw shafts (3 patients) were left in situ. Graft placement and healing was assessed postoperatively with computed tomography imaging.

Results: No neurologic injury or hardware problems occurred, and no patient required further surgery. On computed tomography scan, optimal positioning (flush and under the equator) and healing of the bone graft was observed in all patients. At a mean follow-up of 21 months (range, 12-39 months), all but one patient were satisfied and had a stable shoulder; 5 returned to sports. The Constant score increased from 32 to 81 points, and the subjective shoulder value from 31% to 87% ($P < .001$). The Walch-Duplay and Rowe scores averaged 85.7 (range, 65-100) points and 86.4 (range, 70-100) points, respectively.

Conclusion: Recurrence of anterior shoulder instability after a failed Latarjet procedure can be successfully treated by an all-arthroscopic Eden-Hybbinette procedure. Suture-button fixation is reliable and permits optimal positioning and predictable healing of the new bone graft; in addition, it is an appropriate fixation option in the setting of retained broken hardware.

This study was performed according to the medical ethical guidelines of Institut Universitaire Locomoteur et du Sport (Approval Ref: Study 2017-05), and a written, informed consent was obtained for all patients.
A video of the technique is available upon request to the corresponding author.

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The incidence of recurrent shoulder dislocation after the Latarjet procedure is low, ranging from 1% to 5%.[1,28,29,34,48] Technical mistakes that contribute to risk of recurrence include bone block malpositioning (too high, too low, or too medial), or poor bone graft fixation with nonunion, migration, and/or resorption. Because persistent glenoid bone loss is the main contributor to recurrence of anterior instability, soft-tissue revision is insufficient to stabilize such shoulders and restoration of glenoid bone stock is required.[8,10,15,24,30,31,33,55,56] The Eden-Hybbinette procedure, one of the oldest surgical interventions described for the treatment of chronic anterior shoulder instability, has been proposed as a salvage procedure for the treatment of failed Latarjet.[3,14,26,28,31,39,44,47] The procedure is based on the concepts of glenoid bony augmentation: the anterior glenoid rim is reconstructed with an autologous tricortical iliac crest bone graft (ICBG) and is associated with a capsulorrhaphy.[22,25,31,35,44] The technique was initially described by Eden[17] in 1918 and by Hybbinette[23] in 1932. It was later modified by De Palma,[15] who proposed the use of screws for graft fixation.

Despite reports of positive outcomes, open revision of a failed Latarjet with an Eden-Hybbinette procedure is a difficult surgery and, as a result, is not commonly performed.[22,31,39,49] Dissection anterior to the subscapularis, through scar tissue, can be potentially dangerous, putting the axillary nerve and other anterior neurovascular structures at risk.[30,31,43,55,57] The necessity to take down the subscapularis is also a concern as this has been shown to be associated with muscle atrophy and fatty infiltration.[43,44] Furthermore, the management of broken screws after a failed Latarjet is an additional concern.[9,13,21,47,55-57] Reinsertion of screws for fixation of the new bone graft may be difficult and can be a source of intraoperative and postoperative complications.[16,31,39,54,55,57] On the one hand, leaving broken screws in situ may compromise new hardware trajectory and ultimately jeopardize graft positioning, whereas, on the other hand, attempting to extract broken hardware can compound the existing glenoid bone loss.[31,46,55,56]

In a previous publication, a series of patients with recurrent anterior shoulder instability who underwent an arthroscopic Latarjet procedure using a guided surgical approach and suture-button fixation system have been reported.[6,18] At a mean of 14 months postoperatively, 75 of the 76 operated patients had a stable shoulder, 91% of the coracoid grafts had healed on computed tomography (CT) imaging performed 6 months after surgery, and none of the neurologic or hardware complications associated with screw fixation had occurred. Recent clinical and biomechanical studies have confirmed that suture-button fixation devices provide mechanically strong constructs that are equivalent to the classically performed 2-screw technique.[11,18,37,38,52]

After our successful clinical experience with the arthroscopic Latarjet procedure, we have developed an all-arthroscopic guided Eden-Hybbinette technique using the same guiding instrumentation and suture-button device (Bone-Link) for graft fixation. Herein, we describe this guided arthroscopic technique and report the clinical and radiological results in a series of 7 patients revised for a failed Latarjet. We hypothesized that (1) recurrence of instability after an initial Latarjet procedure would be successfully treated by the all-arthroscopic Eden-Hybbinette procedure, and that (2) the use of suture-button fixation would allow accurate placement and healing of the new bone graft.

Materials and methods

Arthroscopically guided system and suture buttons

The all-arthroscopic, guided Eden-Hybbinette technique described here uses the same guiding instruments (Latarjet Guiding System) and same suture buttons (Bone-Link; *S*mith & Nephew, Andover, MA, USA) as the ones used for the arthroscopic Latarjet procedure.[6] The instruments and implants have been developed by the senior author (PB) and are commercially available.[6] The fixation device consists of 2 purpose-designed titanium cortical buttons used with a No. 3-4 ultrahigh-molecular-weight polyethylene suture sling running through them. Based on the surgeon's preference, 1 or 2 double buttons can be used for graft fixation.

Surgical technique

Under general anesthesia and interscalene block, the patient is placed in the "lazy" beach-chair position (30° head of bed elevation) with the arm on a mobile arm holder (Spider Limb Positioner; Smith & Nephew) without traction. The shoulder and the ipsilateral iliac crest are prepared and draped in the standard fashion.

Step 1: *iliac crest graft harvesting and preparation*. ICBG harvesting is performed first to maximize efficiency and avoid

alternating between surgical sites. We believe this helps lower the risk of infection. A tricortical graft is harvested from the ipsilateral side with the technique described by Warner et al.[49] The dimensions of the block are typically 20 mm in length, 15 mm in height, and 10 mm in width, although the size can be customized depending on the patient's size (Fig. 1). Before closing the wound, structural cancellous allograft (Osteopure; OST Développement, Clermont-Ferrand, France) is used to fill the defect in the iliac crest.[16] Using a saw, the bone block is shaped so that the cancellous surface can be positioned on the anterior glenoid neck with a slight oblique cut. A mark is subsequently placed on the inner (concave) table to demarcate the lateral (articular) portion of the graft. The graft is then clamped in the specifically designed coracoid guide (Smith & Nephew), and a 2.8-mm hole is drilled through the graft, 5 mm from the lateral edge of the block. Finally, the sutures of the Bone-Link system are introduced through the drill hole.

Step 2: glenoid preparation. The arthroscope is introduced in the posterior portal, and the anterolateral (North-West) portal is established with a needle, anterior to the acromion. The rotator interval is débrided with a coblator, and the anterior labrum is completely elevated to expose the glenoid defect. The previously placed coracoid bone graft is visualized and its reason for failure is evaluated (malpositioning, migration, nonunion, and/or resorption). If there is a large and deep Hill-Sachs lesion (based on Calandra grading),[13] engaging over the anterior glenoid neck, a capsulotenodesis of the infraspinatus (remplissage) is performed first.[7,41] The inferior tip of the coracoid, when present, is left in situ if possible to preserve the ''sling effect'' function of the conjoint tendon healed within the subscapularis muscle.[20,50]

The glenoid neck is prepared to a flat cancellous surface using a motorized power rasp (Smith & Nephew). When broken screws are encountered, their heads are removed arthroscopically. Broken screw shafts are left in the glenoid. Two anchor holes (1.9 mm) are drilled at 3 and 5 o'clock, and suture anchors (Fastfix; Smith & Nephew) are inserted for future capsulorrhaphy. These also serve as a landmark for future graft positioning and help prevent graft rotation. A polydiaxonone suture (PDS) is passed through the labrum at 5 o'clock and used to retract the labrum laterally, facilitating the eventual introduction of the bone graft onto the glenoid neck.

Step 3: glenoid drilling (Fig. 1, *A* and *B*). The arthroscope is moved to the anterolateral (North-West) portal, and the specific glenoid guide (Smith & Nephew) is introduced over a half-pipe through the posterior portal. The hook of the glenoid guide is rotated around the anterior glenoid rim, and its tip is anchored 5 mm medial to the glenoid surface at the 4 o'clock position. The glenoid neck is drilled from posterior to anterior with a 2.8-mm cannulated drill (Smith & Nephew). The hook of the glenoid guide is positioned at 4 o'clock, 5 mm medial to the glenoid rim (Fig. 1, *B*), to avoid the potential previous broken shaft screws, which are usually located at 3 and 5 o'clock. The cannulated K-wire is introduced through the guide and advanced to the anterior glenoid neck under direct vision. If the cannulated drill is impeded by a broken screw shaft, the guide is repositioned.

Step 4: suture shuttle (Fig. 1, *C*). The glenoid guide is removed, leaving the cannulated K-wire in place in the glenoid. At this stage, the rotator interval is enlarged by removing all soft tissues. The central K-wire is removed and a PDS suture (or a loop cable) is passed through the cannulated sleeve and used to shuttle the suture of the Bone-Link device from anterior to posterior. Once the suture is exteriorized from the posterior aspect of the shoulder, the outer sleeve is removed.

Step 5: graft passing and placement (Fig. 1, *D*). The ICBG is introduced into the glenohumeral joint via the enlarged rotator interval, using a half-pipe (or a large canula) for guidance. Gentle traction is placed on the posterior suture, whereas the coracoid grasper is used to simultaneously guide the bone block through the rotator interval. Holding tension on the posterior suture allows seating of the graft on the anterior glenoid neck. Rotation of the graft can be adjusted with a probe, ensuring that it is flush with the articular surface. The inner table (with the previously placed mark) is facing laterally so as to use the natural concavity of the graft on the articular side of the glenoid.

Step 6: graft fixation (Fig. 1, *E* and *F*). The posterior button is slid along the 2 loops of the Bone-Link. A specific sliding-locking knot (Nice knot)[5] is tied posteriorly. The suture is progressively tensioned, bringing the button down to the posterior cortex of the glenoid neck. Further bone graft compression is achieved with a graduated suture tensioning device that is specifically designed for the Bone-Link system. Tensioning is complete once 100 N of force is achieved twice. Three additional locking (square) knots are tied to lock the construct, and the sutures are cut with an arthroscopic suture cutter. At the end of the procedure, the bone graft is securely positioned on the anterior glenoid, flush to the articular cartilage and below the equator.

Step 7: capsulorrhaphy. The PDS suture, already passed through the labrum, is used to shuttle the suture of the proximal anchor (at the 3 o'clock position). This facilitates a South-North capsular shift. The second suture anchor (at the 5 o'clock position) is finally passed through the labrum to complete the labral repair and ensures extra-articular positioning of the bone graft.

Postoperative management

The patient is discharged from the hospital the same day or the day after surgery. The shoulder is immobilized in a neutral rotation sling for 2 weeks. After 2 weeks, the sling is removed and self-rehabilitation with pendulum exercises is started (5 times a day, 5 minutes each session). After 4 weeks, formal rehabilitation with a physiotherapist is started. Swimming pool therapy is encouraged. No heavy lifting is allowed for the first 12 weeks. Return to all types of sports activities is allowed between 3 and 6 months postoperatively depending on clinical assessment of apprehension.

Clinical and radiographic assessment

Patients were prospectively followed and examined clinically at 2 weeks, 3 months, 6 months, and 12 months postoperatively, and annually thereafter. Any postoperative dislocation or subjective complaint of occasional to frequent subluxation was considered a failure. Functional assessment was performed with the Constant, the Rowe,[40] and the Walch-Duplay[31] scores. Subjective assessment was performed with the subjective shoulder value (SSV) for activities of daily living and for sport practice.[4]

As part of the routine postoperative evaluation, a CT scan of the affected shoulder was obtained in all patients at 2 weeks to assess bone block positioning. The ideal position of the graft was defined as below the glenoid equator (in the vertical plane) and flush to the glenoid rim (in the horizontal plane). The bone block

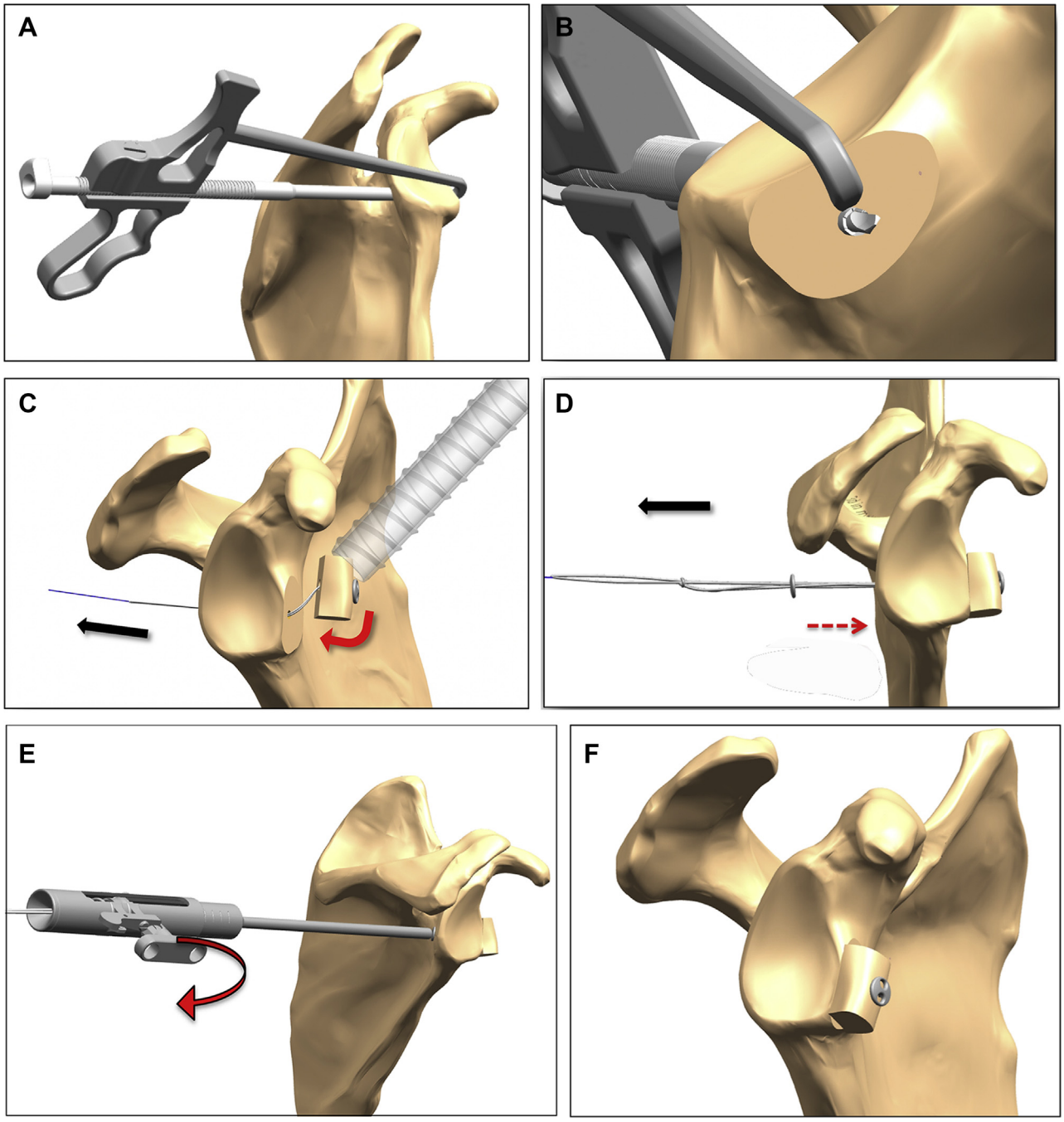

Figure 1 Arthroscopic guided Eden-Hybbinette using suture-button fixation for revision of failed Latarjet. (**A**) After anterior glenoid neck abrasion, the glenoid is drilled from posterior to anterior using a specific drill guide (Smith & Nephew). (**B**) The drilled hole (2.8 mm) is located at 4 o'clock, 5 mm medial to the glenoid rim, and avoids the potential previous broken shaft screws (located at 3 and 5 o'clock). (**C**) After shuttling the suture through the glenoid, the iliac crest bone graft with the anterior peg button is passed through the rotator interval and brought toward the anterior glenoid neck. ⟶, posterior directed tension on suture; ⟶, bone block directed through rotator interval onto the anterior margin of the glenoid. (**D**) The posterior holed button is slid on the suture and a sliding-locking knot (Nice knot) is tied; by pulling posteriorly on the suture, the button is shuttled inside the shoulder, flush onto the posterior aspect of the glenoid neck. ⟶, posterior directed force on suture tails; ⇢, advancement of posterior button to the glenoid neck. (**E**) After control of the bone block rotation and position, the suture tensioning device is used to obtain bone graft compression (100 N). ⟶, clockwise ratcheting of suture tensioner. (**F**) Final aspect showing the new bone graft located at 4 o'clock and flush to the articular surface.

was judged to be too lateral if a step was visible beyond the level of the glenoid rim and too medial if it was 5 mm medial to the rim.[6] A second CT scan at 6 months postoperatively was performed to assess bony union between the ICBG and anterior glenoid. Bony union was determined by the presence of bridging bone between the graft and the scapula neck.

Results

Demographics

The outcomes of this all-arthroscopic Eden-Hybbinette guided technique were assessed in 7 consecutive patients (5 males and 2 females) who had recurrence of anterior shoulder instability after a previous failed Latarjet procedure (Table I). Patients were a mean of 30.7 (range, 17-47) years old at revision surgery, and the dominant arm was involved in all cases. The previous Latarjet procedure was performed in an open fashion in 6 patients and arthroscopically in 1. Average time to recurrence of instability was 18.7 months (range, 3-60 months). The average number of instability episodes after the Latarjet procedure was 36 (range, 3-400). Four patients experienced nighttime dislocations, and 3 patients relied on regular bracing of the affected arm for 6 months before revision surgery. Two patients had previously failed open Bankart procedures before the failed Latarjet procedure. Furthermore, 2 patients underwent arthroscopic Bankart repair after the Latarjet procedure in attempts to restore shoulder stability. Two patients underwent screw removal after Latarjet. One patient underwent broken screw removal and revision screw insertion. Finally, 1 patient had an arthroscopic arthrolysis after the Latarjet. All patients had stopped practicing sports before revision. An arthroscopic Eden-Hybbinette using suture-button fixation and capsulorrhaphy was performed in all patients. For 3 patients with a large, deep, engaging humeral head fracture compression, an additional Hill-Sachs remplissage was performed. Time to revision of the failed Latarjet with arthroscopic Eden-Hybbinette was 33 months (range, 12-72 months).

Pathology

Each patient had glenoid bone loss >20% with an associated anterior labral tear and stretched or torn capsule (Table II). The coracoid bone block was too low in 3 cases and too high in 2 cases. The graft was nonunited in 5 cases and migrated in 2 cases; it was partially resorbed in all but one case. The screws from the previous Latarjet had partly pulled out of the glenoid in 3 cases and were fully removed under arthroscopy. In 3 cases, the screws were broken and only the heads (and washers) could be removed, whereas the shaft was left in the glenoid.

Complications

No intraoperative or postoperative complications occurred. No hardware failures or migration was observed, and no patients needed further surgery. Three patients complained

Table I Demographics of patients

Patient	Age at revision, yr	Sex	Preoperative sport	Previous surgery (Nb and type)	Time to recurrence, mo	Time to revision, mo	Revision procedure	FU, mo
1	18	F	Dance	1, @ Bankart 2, @ Latarjet	14	22	@Eden-Hybbinette + capsulorrhaphy + capsulorrhaphy	39
2	29	M	Swimming	1, Open Bankart 2, Open Latarjet 3, Arthrolysis	6	27	@Eden-Hybbinette + capsulorrhaphy + @HSR	35
3	24	M	Rugby	1, open Latarjet 2, Screw removal + revison Latarjet	10	24	@Eden-Hybbinette + capsulorrhaphy	16
4	32	F	Dance	1, Open Latarjet 2, @ Bankart + screw removal	4	36	@Eden-Hybbinette + capsulorrhaphy	12
5	24	M	Boxing	1, Open Latarjet	34	38	@Eden-Hybbinette + capsulorrhaphy + @HSR	15
6	47	M	Swimming Weight lifting	1, Open Latarjet	3	24	@Eden-Hybbinette + capsulorrhaphy	18
7	41	M	Rugby	1, Open Bankart 2, Open Latarjet 3, Screw removal	60	72	@Eden-Hybbinette + capsulorrhaphy	14

FU, follow-up; *HSR*, Hill-Sachs Remplissage; *Nb*, number; @, arthroscopic.

Table II Anatomic lesions

Patient	Stretched capsule	Coracoid graft malposition	Coracoid graft nonunion	Coracoid graft migration	Coracoid graft lysis	Broken screws	Glenoid bone loss % (Sugaya)	Engaging Hill-Sachs
1	++	Too low	+	+	Partial	No	21	−
2	++	Too low	+	−	Partial	Yes (2)	32	++
3	+	Too low	+	−	Partial	Yes (1)	25	++
4	++	Too high	−	−	Partial	No	20	−
5	+	Too high	−	−	Partial	No	28	++
6	++	No	+	−	Complete	Yes (1)	20	−
7	++	No	+	+	Partial	No	24	+

about hypoesthesia of the iliac crest during the first postoperative year.

Functional and subjective outcomes

The functional and subjective results are summarized in Table III. At the most recent follow-up (mean, 18 months), all but one patient considered their shoulder stable, and were satisfied or very satisfied with the procedure. All patients returned to work and 5 patients returned to their predislocation level of sports. The pain score decreased from 7 points to 2.4 points at the last follow-up. The Constant score increased from 32 to 81.4 points and the SSV from 31% to 87% ($P < .001$). The SSV for sport activities increased from 10% before revision to 70% at the last follow-up ($P < .001$). The Walch-Duplay and Rowe scores averaged 85.7 (range, 65-100) points and 86.4 (range, 70-100) points, respectively. The average anterior flexion was 176° (range, 150° to 180°), and the average external rotation was 56° (range, 0° to 90°). Patients had lost the last 15° (range, 5° to 35°) of external rotation, compared with the other side, but otherwise had regained all other movements.

Bone graft positioning and healing

Postoperative CT scans performed at 2 weeks showed that the bone graft was optimally positioned (flush to the articular surface and below the equator) in all patients (Figs. 2 and 3). On CT scans performed 6 months after surgery, the ICBG had united to the anterior glenoid neck in all patients. In the first 3 operated patients, the bone graft was fixed with 2 double buttons (Fig. 4), whereas in the other 4 patients, only 1 double button was used. However, we did not detect any difference in graft healing between the groups of patients with 1 or 2 double buttons, as the healing rate in both groups was 100%. Glenohumeral osteoarthritis, graded as moderate according to Samilson and Prieto,[42] was seen in 2 of 7 shoulders (29%).

Discussion

Failure of the Latarjet procedure, in the form of recurrent anterior instability, is a rare but challenging surgical problem.[8,30,31,55-57] In the present study, we report the results of a guided all-arthroscopic Eden-Hybbinette procedure using a suture-button fixation device, performed in 7 patients with recurrence of anterior instability after a Latarjet procedure. The results of our study show that recurrence of instability after an initial Latarjet procedure can be successfully treated by the arthroscopic Eden-Hybbinette procedure, and that suture button is a safe and reliable means of fixation, allowing accurate placement and consistent healing of the new bone graft. On the basis of our experience, suture-button fixation facilitates

Table III Clinical results

Patient	Pain score Preoperative/ postoperative (/10)	Constant Preoperative/ postoperative (/100)	SSV Preoperative/ postoperative (%)	Walch-Duplay (/100)	Rowe (/100)	Subjective results	Global results (Rowe)
1	6/3	25/75	20/80	80	80	Satisfied	Good
2	7/3	10/81	30/75	95	95	Very satisfied	Excellent
3	5/2	37/97	20/90	95	100	Very satisfied	Excellent
4	6/1	56/85	60/85	100	95	Very satisfied	Excellent
5	5/1	48/94	70/90	90	90	Very satisfied	Excellent
6	8/4	15/66	0/60	65	70	Satisfied	Good
7	8/3	35/72	20/80	75	75	Satisfied	Good
Total	7/2.4	32/81.4	31/74	85.7	86.4		

SSV, subjective shoulder value.

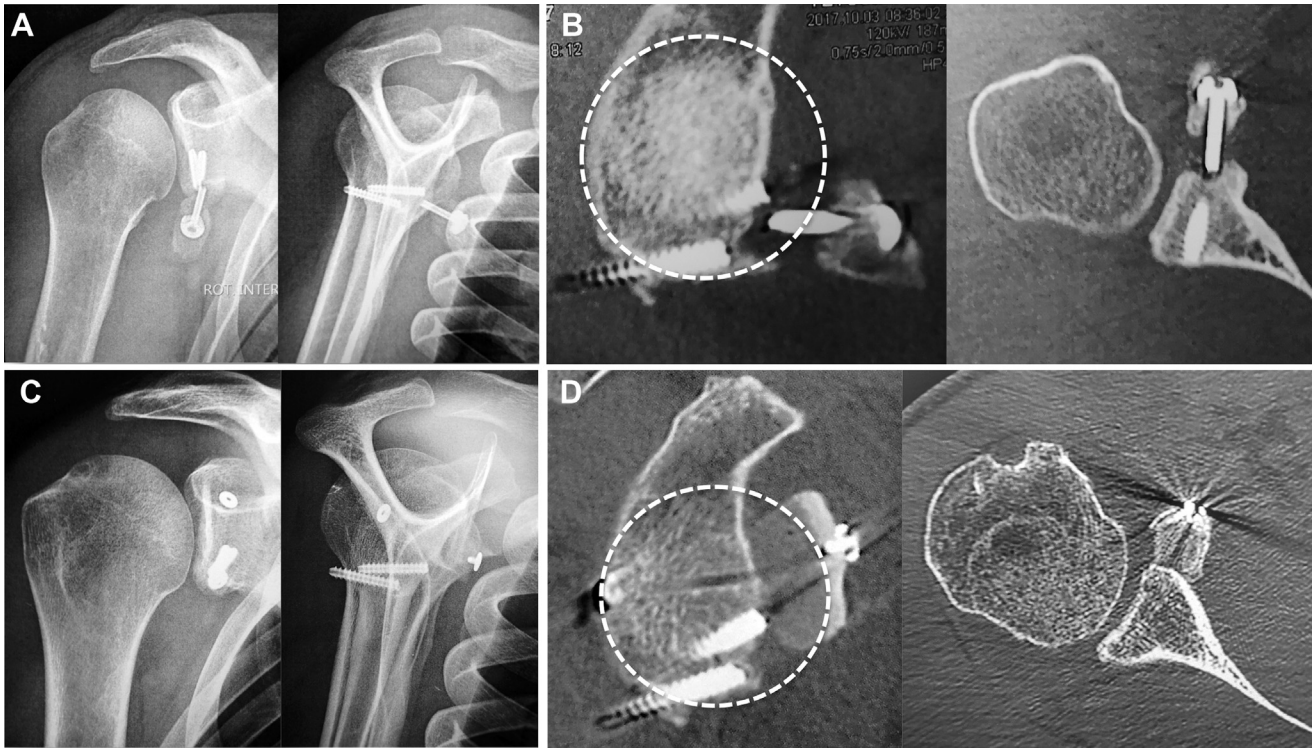

Figure 2 Arthroscopic revision Eden-Hybbinette for failed Latarjet in a 24-year-old rugby player with recurrent dislocations, coracoid bone block nonunion, and broken hardware. (**A, B**) Preoperative radiographs and 2-dimensional (2D) computed tomography (CT) scan images show the partially lysed and nonunited bone graft, and the broken screws. (**C, D**) Postoperative radiographs and 2D CT scan show the anterior glenoid rim reconstruction using an iliac crest bone graft fixed with suture buttons. Notice that the broken screws in the glenoid neck have been left in situ. *Dotted circle* (**B** and **D**), illustrate anterior glenoid bone loss based on the glenoid circle method.

the management of previous broken hardware and minimizes the risks associated with screw refixation.

The results of the present study confirm our first hypothesis. Recurrence of anterior shoulder instability after an initial failed Latarjet procedure can be successfully treated by an all-arthroscopic guided Eden-Hybbinette procedure. At the last follow-up, all but one patient in our series were satisfied with the procedure and felt that their shoulder was stable; all but 2 patients returned to their predislocation level of sports. The benefits of completing the revision instability surgery arthroscopically (in addition to decreased bleeding, less postoperative pain, less risk of infection, better cosmesis) are (1) the preservation of the subscapularis muscle or tendon (the harvested ICBG is introduced inside the glenohumeral joint through the rotator interval) and (2) the ability to treat other associated instability lesions. In our patients, a capsulorrhaphy was systematically added, and in cases of a deep engaging Hill-Sachs lesion (3 cases in our series), a Hill-Sachs remplissage was also performed.

The results of our study also confirm our second hypothesis. A suture-button device is a safe and reliable alternative to screws for fixation of the ICBG. The use of suture-button fixation with an arthroscopic guided technique allows accurate placement and predictable healing of the new bone graft. The results of the present study are in accordance with those previously published using suture-button fixation for the arthroscopic Latarjet procedure.[6,18,36] In addition, we found that suture-button fixation was facilitating the management of previous broken hardware, which is a major concern when revising a failed Latarjet bone block.[46] Removal of broken glenoid screws is not always technically possible and can be deleterious to glenoid bone stock. Our suture-fixation device (Bone-Link; Smith & Nephew) has the major advantage of requiring smaller drill holes (2.8 mm). In 3 of our patients, we overcame the presence of broken screws in the glenoid vault and were able to achieve secure bone block fixation and healing (Fig. 2).

Our arthroscopically guided technique proved to be safe in this case series. No neurologic or hardware complications were observed and no patient required revision surgery. The arthroscopic nature of this technique allows for preservation of the subscapularis muscle and its tendinous insertion, thus minimizing risk to the anterior neurovascular structures.[6,11] In addition, the intra-articular guided glenoid drilling technique (from posterior to anterior) prevents brachial plexus injuries anteriorly and suprascapular nerve injuries posteriorly.[6,12,21,27,32] Finally, the use of a suture-button device simplifies graft transport and positioning, while providing adequate fixation for healing.

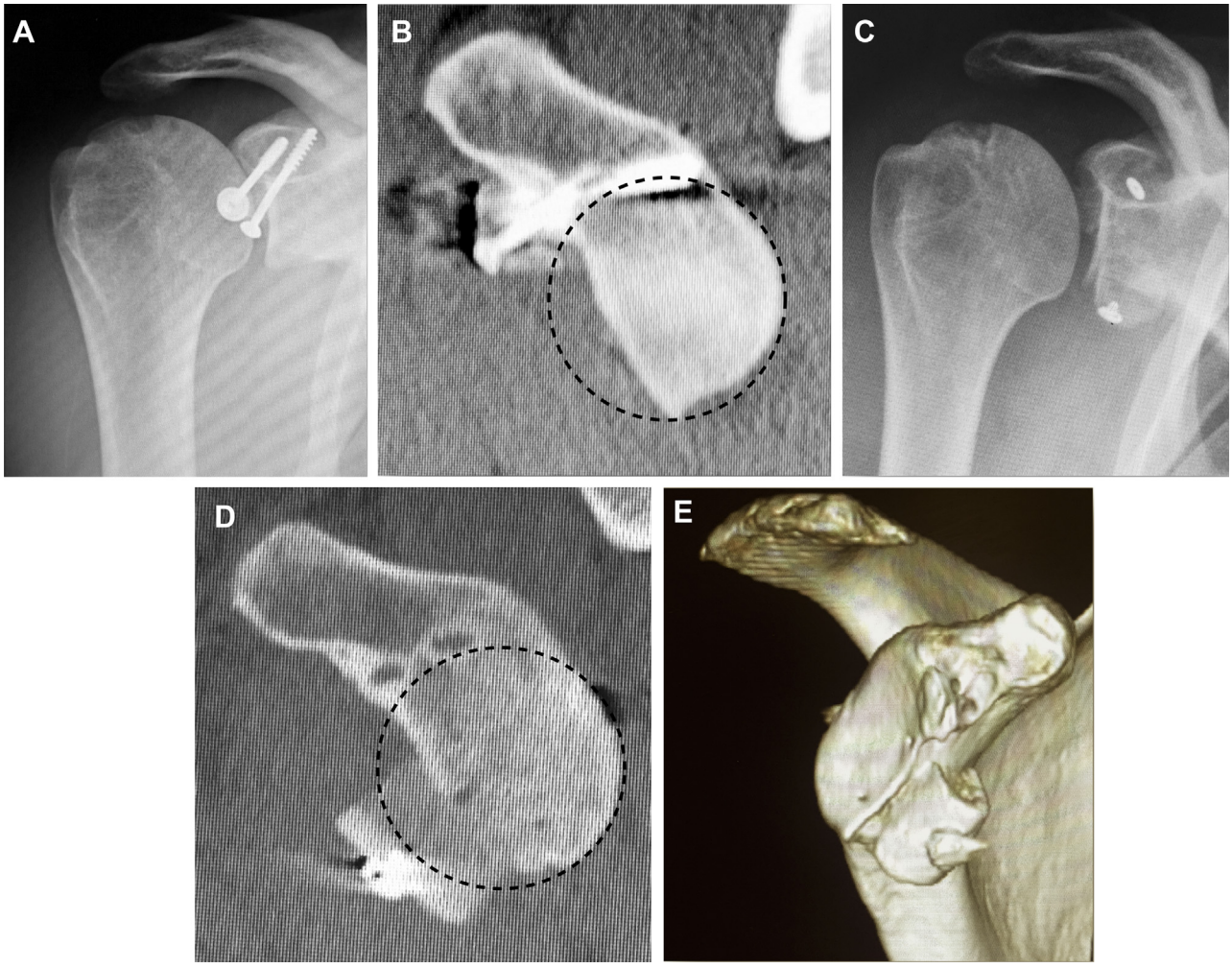

Figure 3 Arthroscopic Eden-Hybbinette with suture-button fixation in a 26-year-old man with recurrent dislocations after failed Latarjet with coracoid graft malpositioning. (**A, B**) Preoperative anterior-posterior (AP) radiograph and 2-dimensional (2D) computed tomography (CT) scan images show coracoid bone block and screw malpositioning (too high) with severe anterior glenoid bone loss. (**C, D**) Postoperative AP radiograph and 2D CT scan images show anterior glenoid rim reconstruction with iliac crest bone graft and suture-button fixation. (**E**) Postoperative 3-dimensional CT scan images show the optimal positioning of the iliac crest bone graft. *Dotted circles* (**B** and **D**), indicate glenoid bone loss based on the glenoid circle method.

Lunn et al[31] reported the results of 34 patients who underwent open Eden-Hybbinette as a salvage for failed Latarjet procedures. In their series, at an average follow-up of 6.8 years (range, 2-17 years), a recurrent dislocation had occurred in 6 patients (18%), with 79% of the patients rating their shoulder as excellent or good. Twenty-three patients (68%) returned to their predislocation level of sports. At the final review, 13 patients (48%) complained of a sensation of persistent apprehension, and 6 (18%) had glenohumeral arthritis, graded as moderate or severe according to Samilson and Prieto.[42]

Most published arthroscopic Eden-Hybbinette techniques are performed in the setting of primary instability cases.[2,43,45] Giannakos et al[19] recently reported the results of an arthroscopic Eden-Hybbinette procedure in the setting of revision of patients with failed instability surgery. In their series of 12 patients, 10 had failed Latarjet and 2 a failed Bankart repair. Using cannulated metal screws, they reported that the procedure was effective and safe, but technically demanding with a steep learning curve. Eight patients (67%) obtained a good or excellent result, whereas 4 patients (33%) reported a fair or poor result. At an average follow-up of 28 months, a positive apprehension test persisted in 5 patients (42%), including 2 patients (17%) with recurrent subluxations. All 4 patients (33%) with a fair or poor result had a nonunion identified on postoperative CT scan. This subgroup of failures highlights the importance of achieving graft union.

Our surgical experience with the all-arthroscopic guided Eden-Hybbinette procedure with the use of a suture-button device for graft fixation has been positive. All bone blocks in our series achieved union. All but one patient had a stable shoulder and 5 patients could return to their

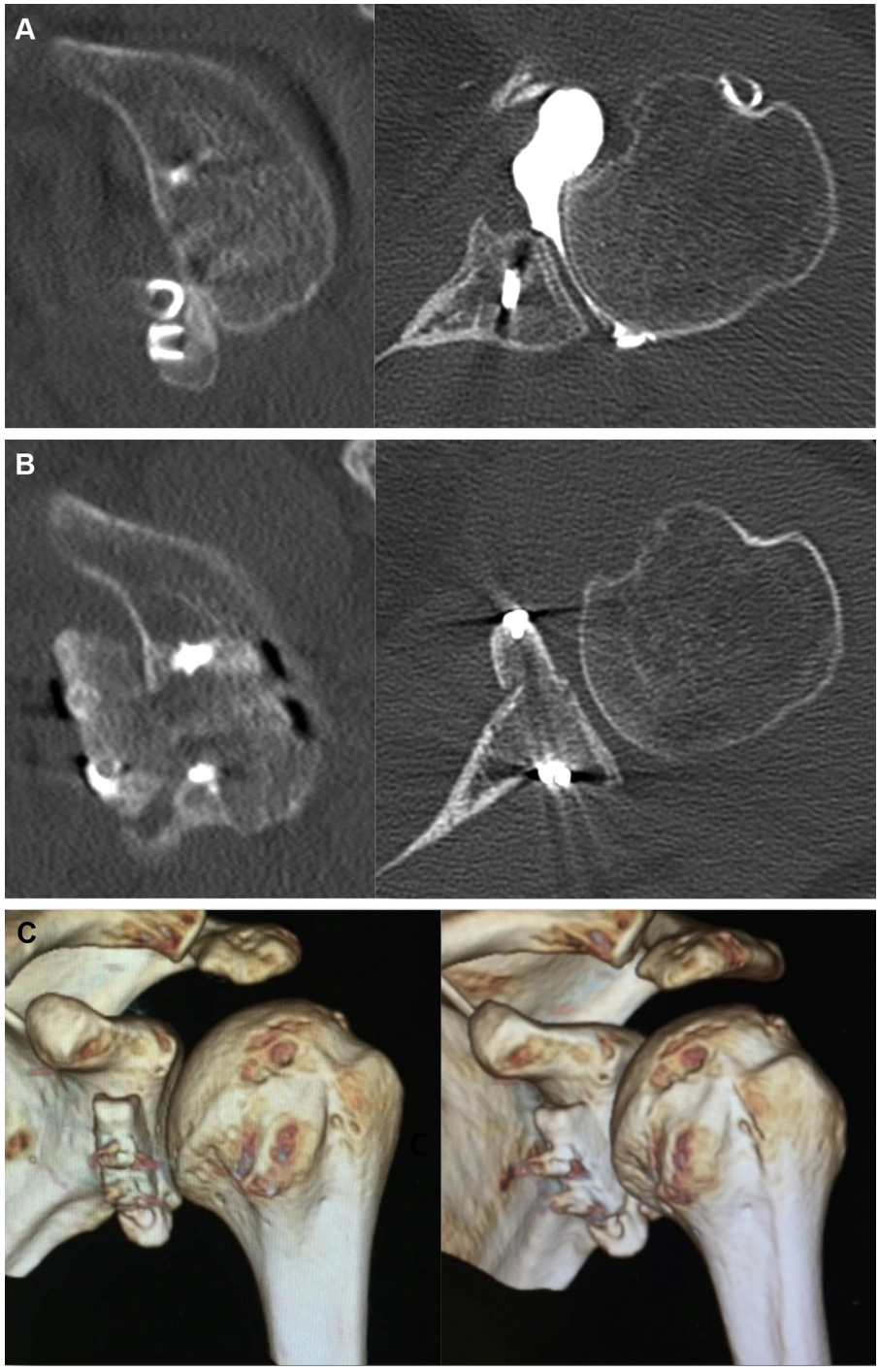

Figure 4 Arthroscopic Eden-Hybbinette in a 29-year-old man with recurrent dislocations after failed open Bankart, failed Latarjet, and partial hardware removal. (**A**) Preoperative 2-dimensional (2D) computed tomography (CT) scan images show coracoid bone block malpositioning (too low) with nonunion, glenoid bone loss, and retained hardware (top hats in the coracoid and metallic anchors in the glenoid). (**B**) Postoperative 2D CT scan show anterior glenoid rim reconstruction with iliac crest bone graft fixed with suture buttons. (**C**) Postoperative 3-dimensional CT scan images show glenoid reconstruction with optimal bone graft positioning. Notice that the previously transferred tip of the coracoid was conserved to retain the ''sling effect'' of the conjoint tendon.

preoperative sports without any apprehension. The one patient who felt that his shoulder had some persistent instability was still satisfied with his result as he no longer required daily sling use and was able to return to work duties highlighting the severe disability the patients in this series had before revision surgery. In contrast to the difficulties reported by Giannakos et al,[19] we believe that our arthroscopic suture-button technique is less technically

demanding with a smaller learning curve. As shown in a recent case report,[46] the use of a suture-button construct for graft fixation can also be performed open, offering the same advantages and safety profile. Suture-button fixation may also be desirable for cases requiring allograft glenoid reconstruction.[38,51]

The limitations of the present study include its retrospective design, the small number of patients, and the absence of a matched cohort for comparison. However, patients presenting with glenoid bone deficiency after a failed Latarjet are quite rare, which makes the execution of a large, randomized study difficult.[19,28,46] We acknowledge that our study follow-up is too short to provide information about late recurrence of instability or development of arthritis. Further studies, with longer follow-up, will be needed to see if the presented all-arthroscopic Eden-Hybbinette procedure will provide better results in terms of prevention of recurrence and lower arthritis in the long term.[31,44,53] We believe that our all-arthroscopic guided Eden-Hybbinette procedure is noteworthy, as it potentially simplifies the treatment of a very difficult clinical problem. The detailed clinical and radiological follow-up of our patients at a minimum 1-year follow-up is a strength of this study. Our good and excellent results provide exciting insight into the future of revision shoulder instability surgery, which is growing.

Conclusion

The all-arthroscopic guided Eden-Hybbinette procedure with suture-button fixation for revision of failed Latarjet is safe and reliable. It allows for successful reconstruction of the anterior glenoid rim and simultaneous treatment of all associated instability lesions (capsular deficiency, humeral bone loss). The use of suture-button fixation and specific drill guides enables accurate graft placement and consistent bone graft healing. In addition, it facilitates management of previous broken hardware and minimizes the risks reported with screw refixation.

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