



Arthroscopic Trillat Coracoid Transfer Procedure Using a Cortical Button for Chronic Anterior Shoulder Instability

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Abstract: The Trillat procedure has been proposed to treat chronic anterior shoulder instability by performing a closing wedge osteotomy of the coracoid process fixed with a coracoscapular screw above the subscapularis. The goal of this osteotomy is to distalize and medialize the coracoid tip to place the conjoint tendon in front of the glenohumeral joint. This in turn distalizes and reinforces the subscapularis in abduction and allows the conjoint tendon to act as a sling and push the humeral head posteriorly. It is commonly accepted to perform this surgery for patients with chronic shoulder anterior instability associated with massive irreparable rotator cuff tear (to preserve and retention the residual subscapularis muscle) or in patients with anterior instability and hyperlaxity. We present a less invasive arthroscopic technique for this procedure. This arthroscopic technique allows assessment and treatment of associated lesions and allows for intraoperative assessment of the subscapularis after the coracoid process is moved to prevent subcoracoid impingement and loss of external rotation.

Bankart repair and the Latarjet procedure are the most popular surgical techniques for treatment of chronic anterior shoulder instability.¹⁻³ However, management of anterior instability with a concurrent irreparable rotator cuff tear⁴ or in patients with hyperlaxity and no structural abnormalities^{5,6} remains challenging. In 1954, Trillat⁷ proposed treating chronic anterior shoulder instability by performing a closing wedge osteotomy of the coracoid process fixed with a coracoscapular screw above the subscapularis. The goal of this osteotomy is to distalize and medialize

the coracoid tip to place the conjoint tendon in front of the glenohumeral joint. This in turn distalizes and reinforces the subscapularis in abduction and allows the conjoint tendon to act as a sling and push the humeral head posteriorly. In 1987, Walch et al.⁸ described using the Trillat procedure in patients with chronic anterior shoulder instability with associated massive irreparable rotator cuff tears. This open technique was found to give satisfactory results at a mean 73.5-month follow-up. We hypothesized that this procedure could be performed arthroscopically and allow for simultaneous treatment of associated lesions (partial rotator cuff repair, labral repair/debridement). Therefore, we developed an arthroscopic technique for the performance of the Trillat procedure combined with a Bankart repair using a cortical button. The purpose of this study was to describe the surgical technique of an arthroscopic Trillat procedure in patients with anterior shoulder instability in the setting of hyperlaxity.

Surgical Technique

Anesthesia and Patient Positioning

Surgery is performed under general anesthesia with a peripheral block. The patient is placed in a semi beach-chair position, with the arm draped free to allow shoulder mobilization (Video 1). The shoulder is positioned in neutral rotation and 30° of forward

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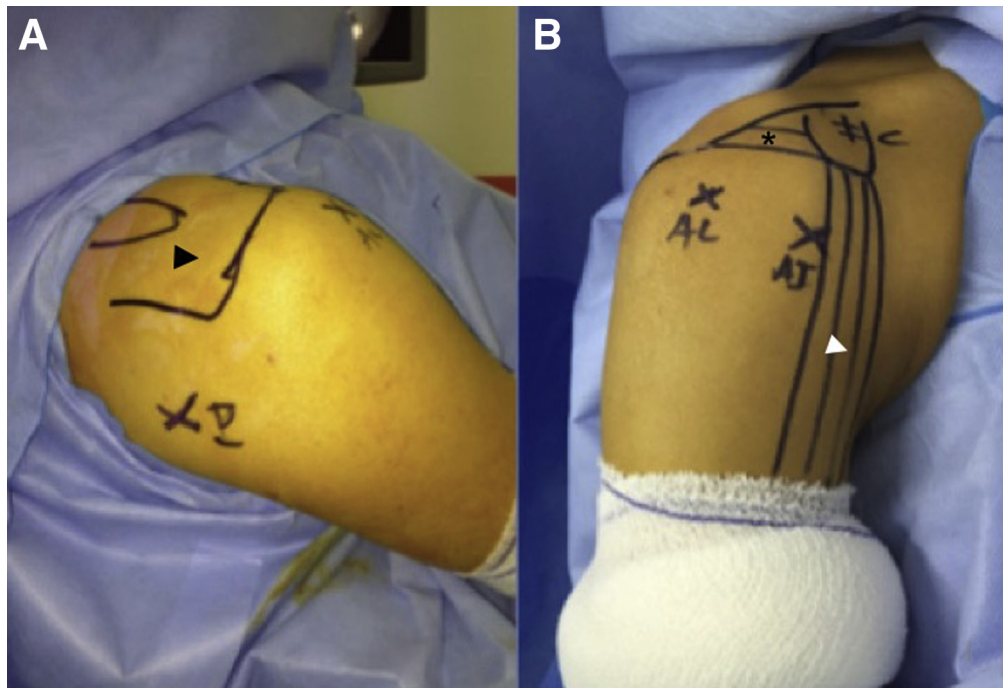


Fig 1. Arthroscopic portals: standard posterior (P) portal 1 cm inferior and 1 cm medial to the posterolateral angle of the acromion; anteroinferior (AI) portal 2 cm distal to the tip of the coracoid process, lateral to the conjoint tendon; anterolateral (AL) portal 2 cm lateral to the anterolateral corner of the acromion; and coracoid (C) portal just above the coracoid process. Preoperative pictures of a right shoulder are shown from the back (A) and from the front (B). The landmarks of the acromion (black arrowhead), conjoint tendon (white arrowhead), and coracoacromial ligament (asterisk) can be seen. All 4 portals are lateral to the conjoint tendon.

flexion with slight distal traction to mobilize the shoulder easily. The head of the patient is secured on a headrest. A 30° arthroscope is used throughout the entire procedure, and the arthroscopic pump is set at 50 mmHg of pressure, to limit bleeding.

Portal Placement

Four portals are used for this procedure (Fig 1). First, a standard posterior portal is created in the soft spot, 2 cm inferior and 1 cm medial to the posterolateral angle of the acromion. Second, an anteroinferior portal is created 2 cm distal and 1 cm lateral to the tip of the coracoid similar to a portal used for a Bankart repair. Third, an anterolateral portal is placed 2 cm lateral to the anterolateral corner of the acromion. Care must be taken when creating this portal, to place it at the same level as the inferior aspect of the coracoid process to facilitate the closing wedge osteotomy. The last portal is the coracoid (C) portal, created just above the coracoid process. A needle is used systematically to facilitate correct positioning of these portals under direct visualization. All the anterior portals are lateral to the conjoint tendon.

Four steps are performed for the arthroscopic Trillat procedure, and 1 additional step is added for the final Bankart repair, which is performed in cases of anterior instability and hyperlaxity.

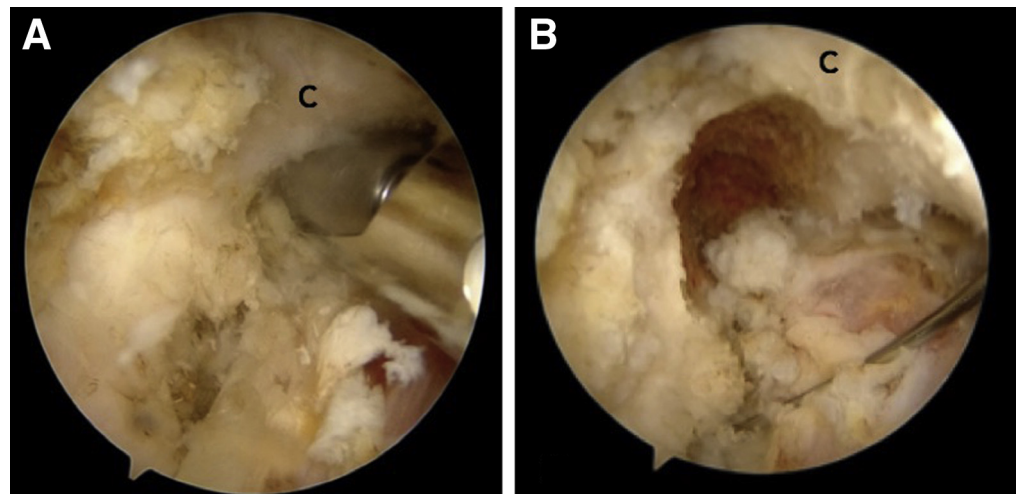
Step 1: Intra-articular Evaluation

The camera is introduced via the posterior portal and the anteroinferior portal is established under direct visualization. A radiofrequency ablation device (RFAD) (VAPR; Mitek, Raynham, MA) is inserted in the anteroinferior portal and the rotator interval is debrided. A diagnostic arthroscopy is performed to assess for the presence of associated lesions. In the case of an associated Bankart lesion, the anterior labrum is mobilized and 3 capsulolabral lasso loop stitches are prepared using braided nonabsorbable sutures for further repair.

Step 2: Preparation of the Coracoid Process and Wedge Osteotomy

The arthroscope is pushed through the rotator interval. The deep surface of the coracoid process is identified and exposed. The coracoacromial ligament is detached from its coracoid insertion, and the lateral surface of the coracoid process is exposed. The arthroscope is then introduced into the anterolateral portal. The RFAD is placed into the anteroinferior portal to finish the preparation of the coracoid process and the glenoid neck. The conjoint tendon is visualized and its lateral aspect is dissected. A partial inferior wedge osteotomy is performed using a 5.5-mm motorized oval burr (Arthrex, Naples, FL) inserted in the anteroinferior portal (Fig 2A) at the junction between the horizontal

Fig 2. (A) Anterolateral arthroscopic view of a right shoulder. A partial inferior wedge osteotomy is performed using a 5.5-mm motorized oval burr (Arthrex) inserted in the anteroinferior portal at the junction between the horizontal arch and vertical base of the coracoid process (about 2.5 cm proximal from its tip). (B) About 80% of the thickness of the coracoid process is removed.



arch and vertical base of the coracoid process (about 2.5 cm proximal from its tip). About 80% of the thickness of the coracoid process is removed (Fig 2B). Care must be taken to avoid a full-thickness osteotomy (Table 1). The superior aspect of the coracoid process is separated from the deep part of the deltoid. The upper and lower borders of the pectoralis minor are identified, and the tendon is carefully detached from the medial part of the coracoid process. Care must be taken to keep the RFAD oriented toward the bone and in constant contact with the medial aspect of the coracoid process to avoid any injury to the brachial plexus. The base of the coracoid process and the superior aspect of the anterior glenoid rim between 12 and 2 o'clock (right shoulder) are exposed and cleaned.

Step 3: Preparation of the Coracoid Transfer

The RFAD is then introduced in the posterior portal and the posterior capsule is separated. Glenoid version is assessed by pushing the RFAD flush to the glenoid articular surface (along the glenoid face) and marked on the skin with a surgical marker, to help with further positioning of the glenoid guide. The skin incision of the posterior portal is expanded to 1 cm and the posterior capsular split is enlarged with blunt scissors. A glenoid

guide is inserted in the posterior portal until complete contact with the posterior wall of the glenoid is obtained. The blade of the guide is locked with a hook over the anterior glenoid rim between 12 and 2 o'clock (right shoulder). A 3.2-mm drill bit is introduced through the guide and a glenoid tunnel is drilled from posterior to anterior. The drill bit is removed and replaced with a metallic sleeve. The glenoid guide is then removed over the sleeve. The coracoid guide is introduced in the C portal to grasp the coracoid perpendicular to its surface. A 3.2-mm tunnel is drilled in the distal aspect of the coracoid (1 cm from the tip). A metallic sleeve is introduced, and the guide is removed.

Step 4: Coracoid Transfer and Fixation

A cortical button (TightRope; Arthrex) is passed from posterior to anterior in the glenoid and from inferior to superior in the coracoid process through the tunnels drilled previously, using a shuttle relay. An additional cortical button is inserted over the strands exiting superiorly through the coracoid process. The cortical button is lowered until it is secured over the superior aspect of the coracoid process by pulling gently and alternatively on the strands exiting through the posterior aspect of the glenoid.

Table 1. Pearls and Pitfalls

Pearls	Pitfalls
1. Partial osteotomy of the coracoid process must not exceed 80% of the thickness of the coracoid to prevent fracture.	1. Protect the brachial plexus during tenotomy of the pectoralis minor.
2. Anterior part of the scapular neck must be debrided thoroughly through an anterolateral view to visualize clearly the exit point of the cannulated drill.	2. Dissection of the medial border of the conjoint tendon should not be performed as it is not needed to distalize the coracoid process as opposed to an arthroscopic Latarjet procedure.
3. The tunnels on the coracoid process must be as distal as possible to facilitate the distalization of the coracoid process.	3. Care must be taken not to lateralize the tip of the coracoid process in front of the glenohumeral joint.
4. Excursion of the subscapularis must be assessed to prevent any impingement.	4. Osteotomy of the coracoid process should not be performed before complete visualization of the whole coracoid process is obtained.

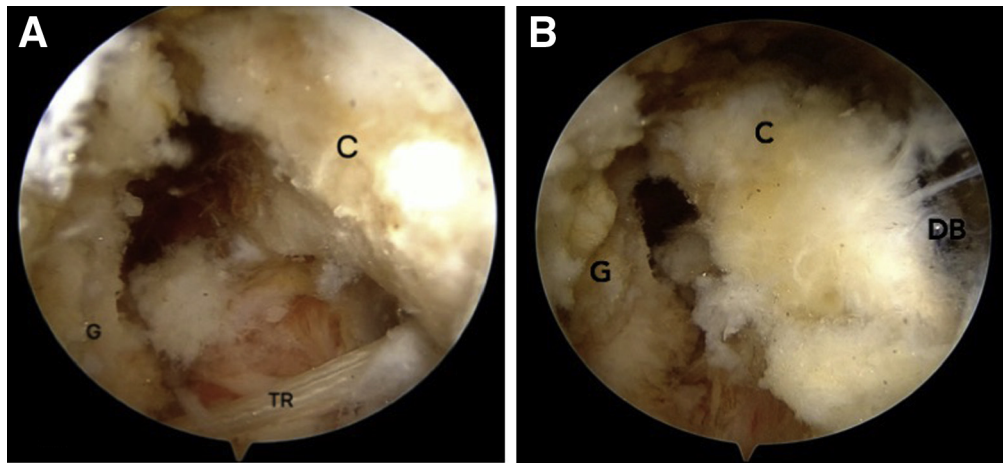


Fig 3. Anterolateral arthroscopic view of a right shoulder. The cortical button (DB) is lowered until it is secured over the superior aspect of the coracoid process (C) by pulling gently and alternatively on the strands of the TightRope (TR) exiting through the posterior aspect of the glenoid (G). These maneuvers act to push the coracoid inferiorly and medially. The tip of the coracoid should not contact the anterior glenoid rim to leave adequate room for sliding of the subscapularis.

An impactor is placed onto the superior aspect of the coracoid process through the C portal. The impactor is gently tapped with a mallet while simultaneously tightening the tight-rope from the glenoid. These maneuvers act to push the coracoid inferiorly and medially (Fig 3). Care must be taken to avoid completion of the coracoid osteotomy. The tip of the coracoid should not contact the anterior glenoid rim to leave adequate room for sliding of the subscapularis. The shoulder is rotated with the arm at the side to assess for subcoracoid impingement on the tendinous portion of the subscapularis. The TightRope is then locked posteriorly.

Step 5: Bankart Repair

The camera is now moved to the posterior portal. The 3 previously passed suture wires are used to complete the Bankart repair.

Postoperative Management

The shoulder is immobilized with a sling in neutral rotation for 3 weeks. Postoperative radiographs

(anteroposterior and lateral Y views) are performed to confirm the correct positioning of the coracoid process (Fig 4). Passive elevation in neutral rotation is started immediately (3 times/d, 15 minutes each session). Rehabilitation with a physical therapist is begun after 3 weeks, with active exercises starting after 6 weeks. Swimming pool therapy is recommended. Return to sports is allowed at 4 months postoperatively.

Discussion

The Trillat procedure was first described by Noeske and modified by Trillat⁷ in 1954. In its original description, an incomplete dorsal osteotomy of the coracoid base was performed to distalize the coracoid tip and fixed with a cortical screw allowing indirect compression of the capsulolabral structures to promote healing. Short-term outcomes were encouraging. In 1988, Gerber et al.⁹ reviewed 52 cases at a mean follow-up of 69 months. Results were excellent (normal shoulder) in 73% of shoulders, good (minimal pain,

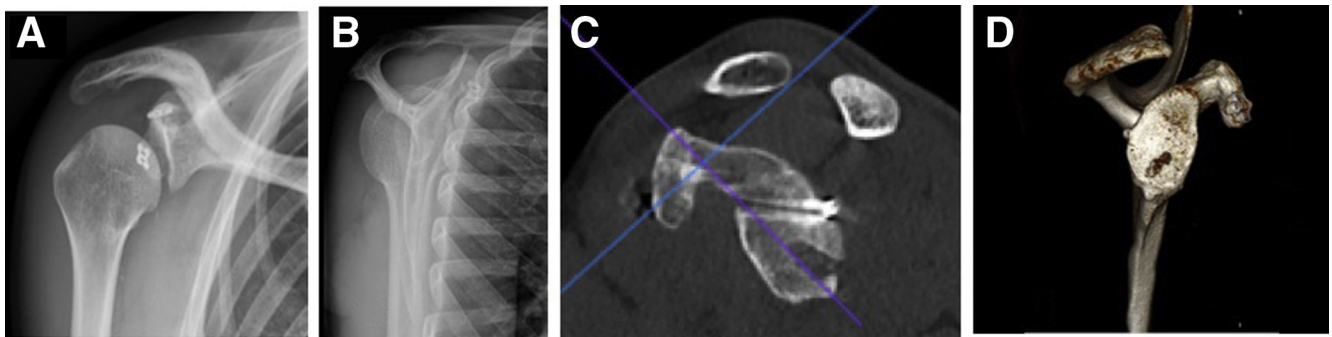


Fig 4. Postoperative radiographs (anteroposterior [A] and lateral Y [B] views) of a right shoulder and computed tomographic scan (sagittal view [C] and 3D reconstruction [D]) at 6 months postoperatively. The partial osteotomy is healed, with the tip of the coracoid process in a more medial and distal position.

Table 2. Advantages and Disadvantages

Advantages	Disadvantages
1. Minimally invasive arthroscopic procedure	1. Risk of lesion of the brachial plexus and of the musculocutaneous nerve during the dissection
2. No need for hardware removal	2. Technically demanding: perfect knowledge of the anatomy of the nerves of the shoulder is mandatory
3. Arthroscopic assessment and treatment of associated lesions (Bankart repair)	3. More expensive than open procedure
4. Precise control of the partial osteotomy of the coracoid process	4. Learning curve
5. Intraoperative assessment of the excursion of the subscapularis	

stable shoulder, full range of motion) in 10%, fair (occasional moderate pain or restriction of some activities) in 7%, and poor in 10%. Dislocation recurred in only 4% of patients, but a positive apprehension sign was present in 18%. However, this series was complicated by severe postoperative pain, loss of external rotation, and degenerative changes in 62% of shoulders.

In 1987, Walch et al.⁸ reported the results of 24 patients, 40 years or older, treated with a Trillat procedure for anterior instability combined with irreparable rotator cuff tear at a minimum 10-year follow-up. Subjectively, 96% of the patients were satisfied but 3 patients (16%) developed recurrent instability. Progression of osteoarthritis was observed in 64.3% of patients.

Recently, Labattut et al.¹⁰ reported a 5.5% recurrence rate and satisfactory functional results at short-term follow-up after arthroscopically assisted Trillat procedure for chronic anterior instability. In their technique, the osteotomy is performed open through a 2- to 3-cm incision. Arthroscopic visualization is then used to guide the fixation of the coracoid process with a screw and to perform an additional inferior capsule tightening in case of hyperlaxity.

The Trillat procedure now has 2 main indications in our practice: (1) chronic shoulder anterior instability associated with massive irreparable rotator cuff tear (to preserve and retension the residual subscapularis muscle)^{4,8} and (2) anterior instability in patients with hyperlaxity (in the absence of bony lesions).

To our knowledge, this is the first article describing an all-arthroscopic surgical technique of the Trillat procedure combined with an arthroscopic Bankart repair. The advantages of an arthroscopic procedure include the ability to view the intra-articular structures and allows diagnosis and treatment of potentially associated pathologies. This also allows for intraoperative assessment of the subscapularis after the coracoid process is moved to prevent subcoracoid impingement and loss of external rotation. This impingement could explain the high rate of severe postoperative pain described previously.⁹

Another advantage of this technique is the use of cortical buttons instead of screws to fix the coracoid

process. This technique leads to a lower-profile implant over the coracoid and may decrease the need for hardware removal in a delayed fashion (Table 2). Possible limitations of this technique include the higher cost of a specific instrumentation and the learning curve required. Indeed, the arthroscopic Trillat procedure requires working in the anterior compartment of the shoulder in the subdeltoid space. The brachial plexus is in this space and, care must be taken not to go medially to the coracoid process in order not to damage the musculocutaneous or the axillary nerves.

In conclusion, this arthroscopic technique of a Trillat procedure with Bankart repair using 1 cortical button, specific coracoid and glenoid guides, and only 4 portals, with no portal medial to the coracoid, could be a satisfactory alternative to the existing open techniques for the Trillat procedure.

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