Technical Note

Arthroscopic Transfer of the Conjoined Tendon–Coracoid Tip Complex for Anterior Shoulder Instability

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Abstract: In the treatment of anterior shoulder instability, there are various conditions in which a sling effect is needed to enhance anterior stability. The traditional Bristow-Latarjet procedure provides a sling effect but destroys or does not purposely protect the coracoacromial (CA) arch, which may result in superior instability. To preserve the CA arch and create a sling to enhance the anterior-inferior side of the shoulder, we introduce an arthroscopic technique to transfer the conjoined tendon–coracoid tip complex (CTCTC) with the intention to keep the CA ligament intact to the utmost. The indications for CTCTC transfer are patients younger than 45 years who participate in competitive sports, require forceful external rotation and abduction movements of the shoulder, and/or have capsule-ligament insufficiency. The main steps of this procedure include detaching the CTCTC, fashioning the coracoid tip to obtain a coracoid pillar, braiding the CTCTC, creating a glenoid tunnel and socket, placing a guide suture through the glenoid tunnel and subscapularis, passing the CTCTC through the subscapularis and into the glenoid socket, and performing suspension fixation of the CTCTC.

The Bristow-Latarjet procedure is a useful technique to treat anterior shoulder instability and is especially indicated in patients with bony defects.[1-4] One of the main supposed mechanisms of the Bristow-Latarjet procedure to restore shoulder stability is the sling effect provided by the transferred conjoined tendon.[4] However, during the classic or modified Bristow-Latarjet procedure, the coracoacromial (CA) arch is destroyed or not purposely protected,[3,5] which may result in superior instability,[6,7] especially in patients with severe rotator cuff tears.[8,9] To create a sling on the anterior-inferior side of the glenohumeral joint without disturbing the CA arch, we introduce a technique to transfer the conjoined tendon with only an 8-mm-long coracoid tip. During this special conjoined tendon–coracoid tip complex (CTCTC) transfer, the CA ligament is kept intact to the utmost purposely. Control and fixation of the CTCTC are performed through suture braiding of the tendon part, instead of through hardware fixation of the bony part as in the Bristow-Latarjet procedure. Our clinical practice has shown that this procedure can be performed arthroscopically more easily than the traditional Bristow-Latarjet procedure.

The main indication for this technique is patients with anterior shoulder instability who require a sling effect to augment the shoulder on the anterior-inferior side (Table 1). Detailed indications include patients younger than 45 years who participate in competitive sports, require forceful external rotation and abduction movements of the shoulder, and/or have capsule-ligament defects. This technique can be used alone when specially indicated but is usually combined with other reconstructive procedures, such as Bankart repair, remplissage, or glenoid bone grafting. The contraindications of this procedure are patients who do not require a sling effect to augment the shoulder.

Surgical Technique

Patient Position and Incision

General anesthesia and brachial plexus anesthesia are administered (Table 2, Video 1). The patient is placed in

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Table 1. Indications and Contraindications of CTCTC Transfer

Indications
Age <45 yr
Participation in competitive sports
Requirement for forceful external rotation and abduction movements of shoulder
Presence of capsule-ligament defect
Contraindications
Sling effect not required to augment shoulder

CTCTC, conjoined tendon–coracoid tip complex.

the lateral decubitus position with the arm in 30° of abduction and with 10 lb of traction. A 2- to 3-cm-long longitudinal incision (anterior incision) is made on the lateral side of the coracoid tip.

Preparation of CTCTC

Through the anterior incision, the conjoined tendon and coracoid tip are exposed. The CA ligament is identified. A suture is placed through the conjoined tendon with a suture relay system and used as a holding suture. Coracoid osteotomy is usually performed at a site 8 mm away from the coracoid tip to obtain an 8-mm-long coracoid process fragment. When the CA ligament attaches at a more proximal site on the coracoid process, the coracoid osteotomy can be performed at a more proximal site accordingly. The fascia tissue on the medial, lateral, and inferior side of the coracoid tip is released. The coracoid tip along with the conjoined tendon is pulled out of the incision.

A Kocher device is used to hold the coracoid tip. A hole is drilled through the middle of the coracoid tip with a 2.5-mm K-wire. Then, the proximal part of the coracoid tip is fashioned with a motorized burr to form a 5-mm-long, 8- to 9-mm-wide bony pillar that centers the hole (Fig 1).

Three No. 2 high-strength sutures (Ultrabraid; Smith & Nephew, Andover, MA) are used to braid the conjoined tendon in a whipstitch style, with all the suture ends passing through the coracoid hole. The length of the tendon segment to be braided is 3 to 4 cm. The skin is temporarily closed with the CTCTC left under the skin and the suture ends out through the incision.

Portal Creation and Arthroscopic Examination

The posterior and anterosuperior portals for anterior shoulder dislocation are fashioned. The anterior incision is used as the anterior portal. Routine arthroscopic examination is performed to detect all pathologies.

Glenoid Tunnel Creation

The arthroscope is placed in the joint through the anterosuperior portal. Under observation, a customized glenoid guide is placed in the joint through the posterior portal. A 2.5-mm K-wire is drilled into the glenoid from posterior to anterior, 7 mm below the glenoid surface. The posterior entry point of the K-wire is located at the 2- to 4-o'clock position (left shoulder) without strict confinement, whereas the anterior exit point is located at the 4- to 5-o'clock position (left shoulder). The K-wire is overdrilled with a 4.5- or 5-mm cannulated drill to create a primary glenoid tunnel.

A 3.5-mm-wide retrograde drill (FlipCutter; Arthrex, Naples, FL), with the same size as the coracoid pillar (8 or 9 mm) when it is flipped, is placed through the glenoid tunnel from posterior to anterior in a nonflipped condition. Then, the anterior part of the glenoid tunnel is enlarged to the expected size to form a socket. The length of the enlarged part of the tunnel or the depth of the anterior socket is equal to the height of the coracoid pillar, which means it is usually 5 mm long (Fig 2).

Passing Guide Suture Through Glenoid Tunnel and Subscapularis

With the arthroscope placed in the joint through the anterosuperior portal for observation, a folded No. 2 polyester suture, which will be used as a guide suture, is passed through the glenoid tunnel from posterior to anterior with a suture retriever, with the folded end of the suture on the anterior side. By use of another suture retriever placed through the anterior portal, the guide suture is pulled into the joint space. The suture retriever in the glenoid tunnel is removed and passed through the posterior portal into the joint to hold the guide suture again. Then, it is pushed anteriorly along the glenoid surface through the subscapularis at the 4:30 clock-face position along with the guide suture (Fig 3).

Table 2. Step-by-Step Surgical Procedure

1. Make an anterior incision on the lateral side of the coracoid tip. Perform coracoid osteotomy at a site 8 mm from its tip.
2. Pull the CTCTC out of the anterior incision. Drill a hole through the middle of the coracoid tip. Fashion a 5-mm-high, 8- to 9-mm-wide pillar on the proximal side of the coracoid tip.
3. Braid the CTCTC with 3 high-strength sutures, with all suture ends passed through the coracoid hole.
4. Create a glenoid tunnel.
5. Pass a guide suture through the glenoid tunnel from posterior to anterior and then through the subscapularis to the anterior side.
6. Find the guide suture on the anterior side of the subscapularis and pull it laterally to near the bicipital groove.
7. Reroute the braiding sutures and the guide suture through the same cannula in the anterior incision.
8. Place the braiding sutures through the loop of the guide suture, and pull the braiding sutures through the subscapularis and glenoid tunnel and then out of the posterior portal using the guide suture.
9. Pull the CTCTC through the subscapularis and into the glenoid socket.
10. Tie the braiding sutures onto a miniplate placed over the posterior orifice of the glenoid tunnel.

CTCTC, conjoined tendon–coracoid tip complex.

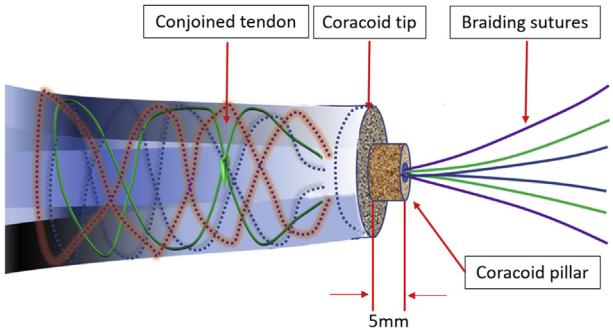

Fig 1. Fashioning of coracoid process. Coracoid osteotomy is performed at a site 8 mm from its tip. A hole is drilled through the middle of the coracoid tip. A 5-mm-high, 8- to 9-mm-wide pillar is fashioned on the proximal side of the coracoid tip. The conjoined tendon–coracoid tip complex is braided with 3 high-strength sutures, with all suture ends passed through the coracoid hole.

Finding Guide Suture on Anterior Side of Subscapularis

The arthroscope is placed through the anterolateral portal and pushed along the anterior side of the subscapularis in an inferomedial direction. Another suture retriever is placed through the anterosuperior portal and used to separate the fibrous tissue in front of the arthroscope until the suture retriever, which is passed through the joint and subscapularis, is touched and then exposed. The guide suture is pulled to the anterosuperior portal.

Passing Braiding Suture Through Subscapularis and Glenoid Tunnel

The braiding suture ends from the CTCTC are pulled through a cannula, which is pushed into the anterior subdeltoid space along the braiding sutures through the anterior incision. A suture retriever is placed through this cannula to pull the guide suture out of it. Then, all the suture ends are passed through the loop of the guide suture (Fig 4). By pulling the guide suture back, the suture ends from the CTCTC are pulled through the subscapularis and glenoid tunnel and out of the posterior portal.

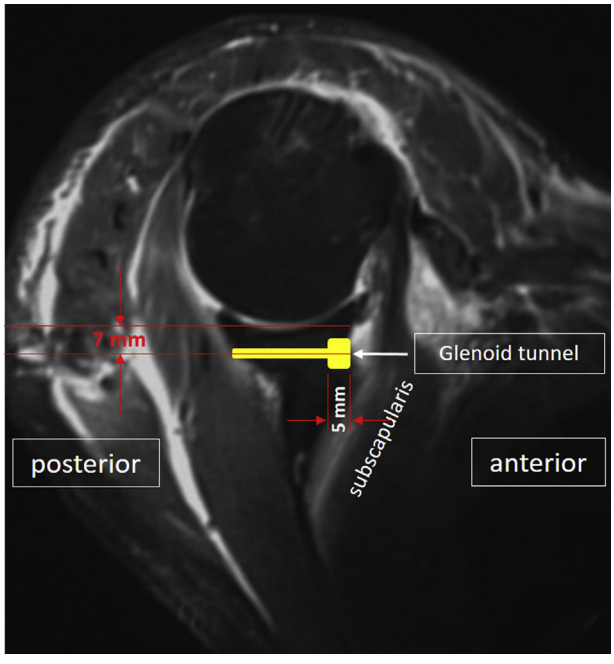

Fig 2. Shape and location of glenoid tunnel.

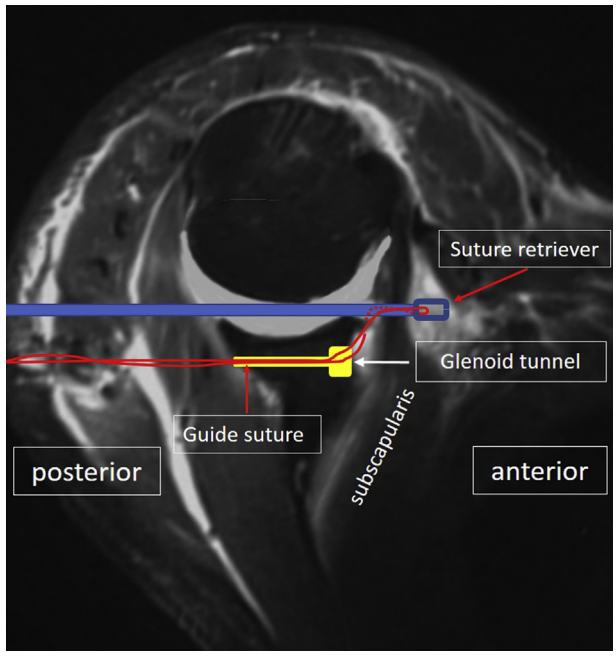

Fig 3. Passing guide suture through glenoid tunnel and subscapularis muscle.

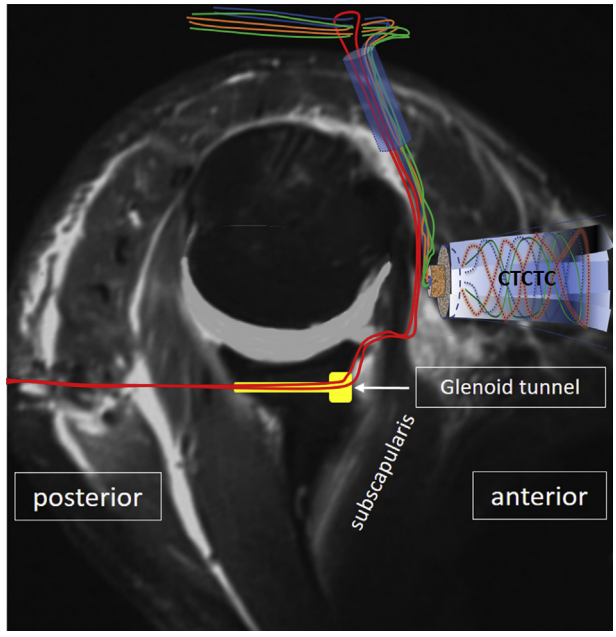

Fig 4. Retrieving guide suture and braiding sutures from same cannula and passing braiding sutures through guide suture loop. (CTCTC, conjoined tendon–coracoid tip complex.)

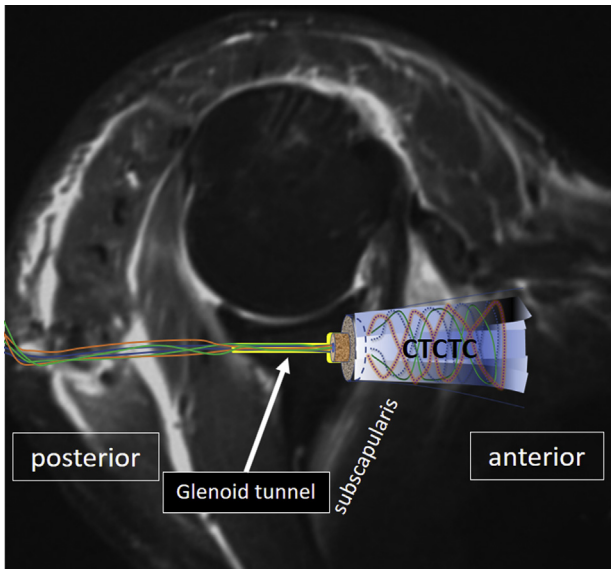

Fig 5. Pulling coracoid pillar into glenoid socket. (CTCTC, conjoined tendon–coracoid tip complex.)

Passing CTCTC Through Subscapularis and Into Glenoid Tunnel

The arthroscope is placed in the joint through the anterosuperior portal. The anterior side of the glenoid is exposed to locate the braiding suture from the CTCTC. A switching stick is placed through the anterior portal. With constant pulling of the braiding sutures, the subscapularis muscle around the braiding sutures and CTCTC is pushed anteriorly. Then, under observation, the CTCTC is pulled through the subscapularis, and the coracoid pillar is pulled into the glenoid socket (Fig 5).

Fixation of CTCTC

The posterior portal incision is enlarged to 2 to 3 cm in length to allow insertion of the index finger of the operator. The soft tissue around the braiding suture is separated with the finger until the posterior orifice of the glenoid tunnel is touched and free of soft tissue. Then, the 2 ends from each suture are passed through the middle 2 holes of a miniplate (EndoButton; Smith & Nephew) separately.

The miniplate is pushed along the sutures to the posterior orifice of the glenoid tunnel. All sutures are tied to their counter limbs on the miniplate. In this way, the CTCTC is fixed into the glenoid socket by suspension fixation on the miniplate over the posterior orifice (Fig 6).

Discussion

Anterior shoulder instability is a common clinical condition. For complicated anterior shoulder instability, the Latarjet procedure is an effective way to restore stability.[10-12] However, during this procedure, the CA ligament is transected or detached, effectively destroying the CA arch. The role of the integrity of the CA arch in superior shoulder stability has been shown in several studies, with the finding that resecting the CA ligament or performing the Latarjet procedure resulted in increased superior shoulder translation in various joint configurations and loading conditions, regardless of whether the rotator cuff was intact.[6,7,9,13-15] Preservation of the CA arch during the Latarjet procedure is the ideal option but is impossible. Preservation of the CA ligament during the Bristow procedure is possible, but it was not purposely performed in previous reports.

The purpose of coracoid process transfer in the Bristow-Latarjet procedure is to address the glenoid defect. A triple-block effect, which includes enlargement of the glenoid surface using the transferred coracoid process, repair of the capsule to the CA ligament stump, and a sling effect of the conjoined tendon, is considered the functional mechanism to restore shoulder stability.[4] To correct the glenoid defect and create a sling simultaneously, without destroying or disturbing the CA arch, a modified Latarjet procedure along with CA arch reconstruction has been reported.[16] However, we recommend performing CTCTC transfer with preservation of the CA ligament to create a sling and protect the CA arch simultaneously, as well as performing free glenoid bone grafting[17] to address the glenoid defect.

Studies have shown that several factors, including younger age, higher sports performance level, sports

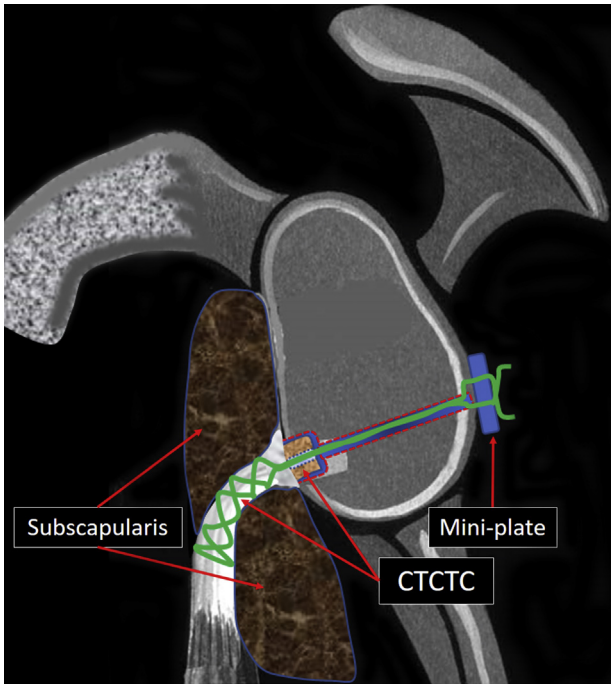

Fig 6. Final fixation of conjoined tendon–coracoid tip complex (CTCTC).

Table 3. Pearls and Pitfalls

1. The surgeon should make sure the pectoralis minor muscle is fully detached from the medial side of the coracoid tip. Otherwise, the transfer of the CTCTC will be hindered.
2. In braiding the CTCTC, the surgeon should make sure to wrap only the superior tendon part. Suture wrapping that is too deep will cut the muscle part of the conjoined tendon.
3. In creating the glenoid tunnel, it should not be too shallow; otherwise, the glenoid surface will be broken when creating the anterior glenoid socket.
4. The surgeon should pass the guide suture through the subscapularis using a suture retriever along the glenoid surface to prevent too medial penetration.
5. The penetrating point of the subscapularis should be located at the 4:30 clock-face position. Too inferior penetration may endanger the axillary nerve.
6. Use of an instrument to detect the hard point on the anterior side of the subscapularis will facilitate locating the subscapularis-penetrating suture retriever.
7. When there is thick scar tissue around the penetrating point of the subscapularis muscle, it should be released. Otherwise, passing the CTCTC through the subscapularis muscle will be hindered.
8. When tying the braiding sutures onto the miniplate over the posterior orifice of the glenoid tunnel, the surgeon should make sure to push the miniplate tightly against the glenoid bone.

CTCTC, conjoined tendon—coracoid tip complex.

types requiring forceful external rotation and abduction movements of the shoulder, and structural defects of the soft tissue and bone, predispose to a higher rate of failure.[18] Theoretically, a sling effect is still required when risk factors other than severe glenoid defects exist.

A recent study showed that the sling effect depends on the loading of the transferred conjoined tendon.[19] In cases of shoulder instability without severe glenoid defects, a bone block is unnecessary to restore shoulder stability when a sling effect exists.[20] To create a sling effect alone, the Bristow procedure may be indicated[21] because, in this procedure, only the tip of the coracoid process is removed along with the conjoined tendon. However, even in the Bristow procedure described in previous studies, the CA ligament was not protected purposely.[22-24] One study showed that the mean distance from the coracoid tip to the anterior and posterior CA ligament was 7.8 mm and 25.7 mm, respectively.[25] This indicates that removal of an 8-mm-long coracoid process keeps the CA ligament intact mostly and that removal of a 17-mm-long coracoid process destroys 50% of the CA ligament. In the Bristow procedure, a 15-mm-long coracoid process is usually removed, which results in the detachment of nearly 50% of the CA ligament.

In 1 study that explored the effect of conjoined tendon transfer without a coracoid bone fragment, Thomas et al.[26] found that the same stability effect can be obtained compared with the Bristow procedure. This indicates the stability effect of a soft-tissue sling only. However, a bone fragment is still needed to ensure the healing of the conjoined tendon to the glenoid.

The unique part of the described technique is that the CTCTC is held and fixed through suture braiding in the tendon part, instead of hardware fixation through the bony part as in the Bristow-Latarjet procedure. This precludes the use of hardware and the possibility of hardware failure on the anterior side of the shoulder. Another unique part of our technique is that we put the coracoid bone plug into the glenoid socket for better bone-to-bone contact.

Compared with the traditional Bristow-Latarjet procedure, this special CTCTC transfer is simpler and less dangerous. The learning curve of the arthroscopic Bristow-Latarjet procedure is relatively long,[27,28] and many surgeons are reluctant to split and manipulate through the subscapularis with the axillary nerve located nearby. In CTCTC transfer, a glenoid tunnel is created in a retrograde manner without risking the axillary nerve. The only dangerous maneuver is blind penetration of the subscapularis using the suture retriever, and with control of the direction and position of penetration, such danger can be minimized. The only maneuver on the anterior side of the subscapularis is locating and retrieving the guide suture, and this can be accomplished easily through the anterosuperior and anterolateral portals, without the far-medial portal, which is required in the arthroscopic Latarjet procedure.[29] However, there is still a learning curve to complete this procedure because the operators have to gain enough experience in manipulating on the anterior side of the subscapularis.

The pearls and pitfalls of our CTCTC transfer procedure are shown in Table 3. The most important points in performing this procedure include creation of a suitable glenoid tunnel, appropriate penetration of the subscapularis, and reliable suspension fixation of the transferred tendon.

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