Technical Note

Rotator Cable Reconstruction: A Technique to Restore the Rotator Cable in the Setting of Large Cuff Tears

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Abstract: The rotator cable is an essential biomechanical structure in the shoulder that is commonly injured in the setting of large rotator cuff tears. Surgical techniques designed to reconstruct the cable have followed advancements in our understanding of the biomechanics and anatomic importance of this structure. Owing to its role in load sharing and stress shielding of the rotator cuff crescent, rotator cable reconstruction offers the potential to reduce retear rates and promote longevity of rotator cuff repairs. The purpose of this article is to describe a technique to augment rotator cuff repair with cable reconstruction.

Rotator cuff injuries are increasingly common in orthopaedic practices as patients remain active in later life.[1] Retear rates can theoretically be reduced with improved biomechanical repair constructs, which has led to the development of innovative surgical techniques including techniques that help restore the rotator cuff cable (RCC).

The RCC is a collection of thickened fibers that spans from anterior to posterior along the medial margin of the rotator cuff crescent, running perpendicular to the axis of the supraspinatus tendon insertion.[2] Burkhart et al.[2] named this structure the "rotator cable" because of its resemblance to the cable of a suspension bridge and its similar function. Biomechanical studies have shown that the RCC plays an important role in the biomechanics of the shoulder joint and limiting anterior translation of the humeral head.[3,4] In a clinical study, Cho et al.[5] reported a significantly higher retear rate in patients with a rotator cuff tear that involved the anterior attachment of the RCC.

Advances in our knowledge and understanding of this essential structure have led to the development of techniques aimed at reconstruction of the cable and lowering retear rates. It is our view that reconstruction of the RCC should be attempted when repairing rotator cuff tears that involve this anatomic structure. In this article, we present a technique for arthroscopic RCC reconstruction with tensionable suture anchors to aid in restoration of the native shoulder biomechanics and potentially reduce retear rates.

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Surgical Technique

We describe a step-by-step technique for reconstruction of the RCC using a tensionable suture anchor construct. Informed consent was obtained from the patient prior to undergoing the surgical procedure described in this article. Advantages and limitations of the technique are presented in Table 1, and technical pearls and pitfalls are summarized in Table 2.

Indications

Arthroscopic reconstruction of the RCC using a tensionable suture anchor construct is indicated in patients with large rotator cuff tears that are repairable and involve the RCC.

Table 1. Advantages and Limitations of Technique

Advantages
Increased load sharing and stress shielding are hypothesized.
The rotator cuff repair is augmented, and repair longevity is promoted.
Readily available instrumentation and implants are used.
Limitations
Suture management is challenging.
Tensionable anchor technology requires good bone strength.
A narrow subacromial space may limit the use of a Scorpion suture passer.

Patient Examination and Imaging

After a thorough history and physical examination are performed and appropriate diagnostic imaging is obtained, rotator cuff repair surgery may be indicated. In patients with larger retracted tears, confirmation of disruption of the RCC will be made and the indication for RCC augmentation will be determined at the time of surgery.

Patient Positioning and Initial Arthroscopic Evaluation

The patient is positioned in either the beach-chair or lateral decubitus position; our preference is the lateral decubitus position. A standard diagnostic arthroscopy of the glenohumeral joint is performed using standard anterior and posterior portals. After intra-articular evaluation, the arthroscope is placed into the subacromial space, and an accessory lateral portal is made. An extensive subacromial bursectomy is performed to allow for complete visualization of the rotator cuff. If necessary, maneuvers for tear mobilization are performed. The tuberosity footprint is then gently debrided to generate bleeding bone to encourage a healing milieu.

Table 2. Technical Pearls and Pitfalls

The technique should be considered in patients with rotator cuff tendon tears that compromise the rotator cable.
Complete bursectomy is performed to allow for full visualization of the tear pattern.
The FiberLink weave is passed just lateral to the myotendinous junction.
Our recommendation is to separate the FiberLink passes by ≥2 cm to avoid problems transferring the repair stitches.
The surgeon should ensure that both the looped end and the tail end of the FiberLink suture exit on the bursal side of the tendon, regardless of how many passes are performed.
When completing the rotator cuff repair, the surgeon should ensure that the repair stitches from the construct do not transect the FiberLink weave.
When shuttling the posterolateral anchor repair stitch anteriorly, the surgeon should also shuttle the looped end of the FiberLink (not the tail end).
The surgeon should avoid over-tensioning the knotless cable mechanism unilaterally to avoid asymmetrical tensioning.
Tensioning the suture cable construct after rotator cuff repair allows the cable construct to act as an internal brace to the actual repair.

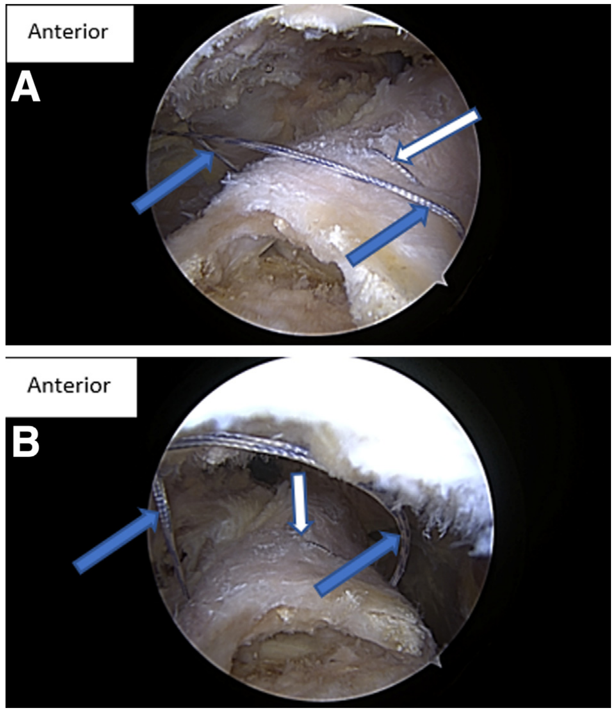

Fig 1. Posterior (A) and lateral (B) arthroscopic views of left shoulder. (A) While viewing from the posterior portal, a FiberLink suture is weaved through the leading edge of the rotator cuff tendon tear, just medial to the myotendinous junction. This is performed through the lateral portal. The FiberLink tail end is the end that is weaved (white arrows). To weave, the suture-passing device is first used to pass the FiberLink tail through the tendon, exiting on the articular side. This is followed by a pass to the bursal side. The first pass through the tendon should begin as far anterior as the tear limit. The looped end of the FiberLink is to remain on the bursal side of the tear to allow for lateral suture shuttling. The number of passes is dictated by the size of the tear. Ultimately, the tail end must exit toward the bursal side. Thus, both ends of the FiberLink will exit toward the bursal aspect of the tear (blue arrows). Once the passes are complete, both ends are shuttled to the anterior portal until needed again later in the case. (B) The FiberLink weave configuration is shown from the lateral portal.

Rotator Cable Reconstruction Technique

While viewing from the posterior portal, the tail end of a FiberLink suture (Arthrex, Naples, FL) is weaved just lateral to the myotendinous junction using a Scorpion suture passer (Arthrex) (Fig 1). With the Scorpion suture passer inverted, the first pass is performed at the most posterior aspect of the rotator cuff tear, allowing the tail of the FiberLink to exit the deep aspect of the tear. With the next pass, the FiberLink tail is passed through the tear from the articular side to the bursal side. This is performed by inverting the suture passer. This continues throughout the length of the tear, with the number of passes dictated by the size of the tear. The final pass should result in the FiberLink

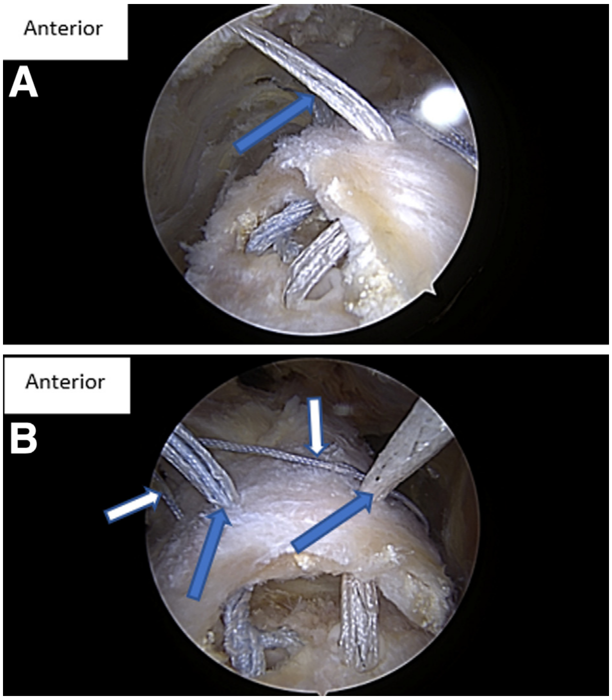

Fig 2. Posterior (A) and lateral (B) arthroscopic views of left shoulder. Medial-row placement and suture passage are completed for a standard suture bridge repair. The FiberTape sutures are passed from deep to superficial through the leading edge of the rotator cuff tear, just lateral to the weaved FiberLink. Careful attention must be paid to ensure that the medial-row sutures (blue arrows) have not passed through the more medial FiberLink weave (white arrows). Simple toggling of the FiberLink weave in the anterior portal can ensure correct placement.

tail exiting the bursal side of the tendon at its most anterior portion. Both suture limbs of the FiberLink are then shuttled through the anterior portal for later use.

Next, a standard transosseous-equivalent suture bridge repair is performed. A medial row incorporating 2 anchors (4.75-mm PEEK [polyether ether ketone] SwiveLock; Arthrex), each loaded with 1 FiberTape (Arthrex), is placed in standard fashion, after the usual preparation with an arthroscopic punch (Fig 2). An arthroscopic tap can be used if necessary. The FiberTape sutures are then passed through the rotator cuff tear, from the articular side to the bursal side, with careful attention paid to ensure that the passes are lateral to the previously weaved FiberLink (Fig 2). The FiberTape looped ends are now cut, delivering 2 suture limbs each. The anterior limb from each FiberTape is retrieved and loaded into a knotless anchor, which is equipped with a tensionable repair stitch. This tensionable repair stitch is key to the RCC reconstruction (4.75-mm PEEK Tensionable SwiveLock; Arthrex). The anterolateral anchor site is prepared in standard fashion with an arthroscopic punch, and the previously loaded anchor is placed into the prepared bone socket.

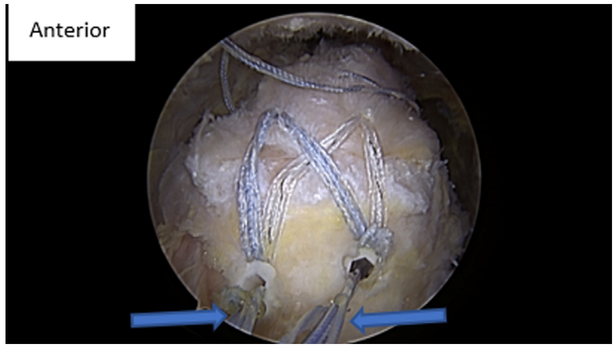

Fig 3. Lateral arthroscopic view of left shoulder. The medial-row sutures are placed into two 4.75-mm PEEK SwiveLocks, completing the suture bridge repair. Each lateral-row SwiveLock contains 3 additional limbs (blue arrows): 1 repair stitch limb and 2 shuttling stitch limbs.

Arthroscopic guidance is used for tension maintenance. The FiberTape suture ends are cut. The same sequence of events is performed for the remaining FiberTape suture limbs, ultimately placing them into a posterolateral knotless anchor (Fig 3).

After completion of the transosseous-equivalent suture bridge repair, the RCC reconstruction is now tensioned through the following steps: The arthroscope is placed into the lateral portal. The next steps are to exchange the anterior repair stitch to the posterior anchor and to bring the posterior repair stitch to the anterior anchor. This is accomplished by using the previously placed FiberLink suture to transfer the anterior repair stitch posteriorly. Along with the anterior repair stitch, a second FiberLink is passed posteriorly to be used to pass the posterior repair stitch anteriorly. The repair sutures are now placed through the knotless anchor shuttle loops in the respective anchors and deployed sequentially. Care should be taken to ensure that equal tension is applied to the repair sutures when complete (Fig 4). These sutures serve to re-create the biomechanical construct of the RCC (Video 1).

Postoperative rehabilitation restrictions and protocols are similar to our standard rotator cuff repair protocols. A period of immobilization is followed by gentle progressive range of motion and strengthening exercises.

Discussion

Surgical techniques developed to reconstruct the RCC have followed advancements in our understanding of this essential structure. Park et al.[6,7] showed that anterior cable reconstruction with either a proximal biceps tendon autograft or a semitendinosus allograft led to decreased superior migration of the humerus and reduced subacromial contact pressures in cadaveric specimens. These findings suggest that cable reconstruction may provide increased rotator cuff tendon

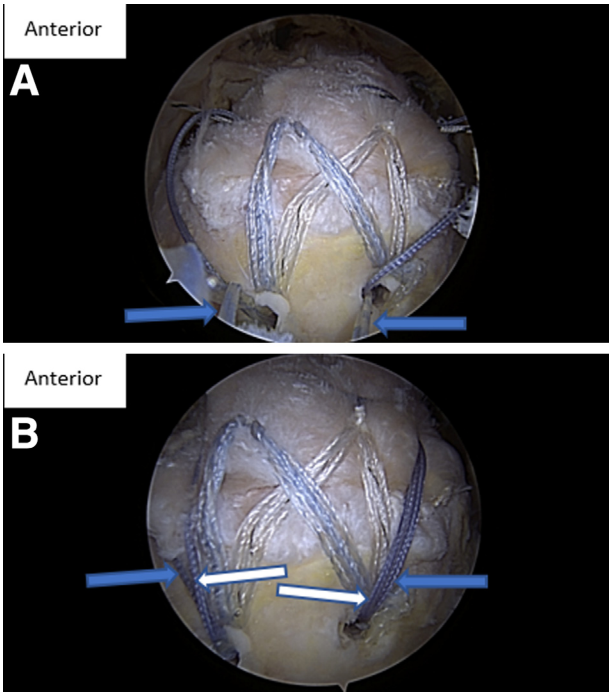

Fig 4. (A, B) Lateral arthroscopic views of left shoulder. Completion of the rotator cuff cable reconstruction after shuttling of each repair stitch is shown. There are 2 FiberWire sutures present after shuttling. These 2 sutures correspond to each anchor's native repair stitch, as well as the repair stitch from the other lateral-row anchor. (A) After appropriate shuttling, tension is obtained by pulling each tensioning stitch (blue arrows) exiting each lateral-row anchor. (B) Appropriate tension is obtained, and the tensioning stitches are cut, leaving 2 FiberWire limbs (blue and white arrows) as part of the completed construct.

repair longevity.[6,7] Three recent publications have highlighted techniques to utilize the biomechanics of the rotator cable in the treatment of complex rotator cuff tears. Two of them focused on reconstruction of the anterior portion of the cable using the long head of the proximal biceps tendon to support a repaired rotator cuff,[8,9] and the third illustrated a technique to perform suture-based cable reconstruction for irreparable rotator cuff tears.[10] Although further studies following the clinical outcomes of patients after RCC reconstruction with biceps tendon autograft are needed, initial reported outcomes have provided evidence for the development of additional techniques for RCC reconstruction.[11]

Our technique provides an option for RCC reconstruction in rotator cuff tears involving the RCC. The hypothesized advantages of the technique are increased load sharing and stress shielding of the repaired rotator cuff tendon. The construct can be used to augment standard rotator cuff repair and utilizes readily available instrumentation and implants. Limitations of the technique include additional suture management and the requirement for good bone strength for proper functioning of the tensionable anchor technology; moreover, a narrow subacromial space may limit the use of the Scorpion suture passer. As with any technique, future studies following clinical outcomes represent a logical next step. In conclusion, our technique aims to more closely restore the native biomechanics of the healthy shoulder.

References

1. Kemp KA, Sheps DM, Luciak-Corea C, Styles-Tripp F, Buckingham J, Beaupre LA. Systematic review of rotator cuff tears in workers' compensation patients. *Occup Med (Lond)* 2011;61:556-562.
2. Burkhart SS, Esch JC, Jolson RS. The rotator crescent and rotator cable: An anatomic description of the shoulder's "suspension bridge. *Arthroscopy* 1993;9:611-616.
3. Pinkowsky GJ, ElAttrache NS, Peterson AB, Akeda M, McGarry MH, Lee TQ. Partial-thickness tears involving the rotator cable lead to abnormal glenohumeral kinematics. *J Shoulder Elbow Surg* 2017;26:1152-1158.
4. Mesiha M, Derwin KA, Sibole SC, Erdemir AG, McCarron JA. The biomechanical relevance of anterior rotator cuff cable tears in a cadaveric shoulder model. *J Bone Joint Surg Am* 2013;95:1817-1824.
5. Cho NS, Moon SC, Hong SJ, Bae SH, Rhee YG. Comparison of clinical and radiological results in the arthroscopic repair of full-thickness rotator cuff tears with and without the anterior attachment of the rotator cable. *Am J Sports Med* 2017;45:2532-2539.
6. Park MC, Itami Y, Lin CC, et al. Anterior cable reconstruction using the proximal biceps tendon for large rotator cuff defects limits superior migration and subacromial contact without inhibiting range of motion: A biomechanical analysis. *Arthroscopy* 2018;34:2590-2600.
7. Park MC, Hung VT, DeGiacomo AF, McGarry MH, Adamson GJ, Lee TQ. Anterior cable reconstruction of the superior capsule using semitendinosus allograft for large rotator cuff defects limits superior migration and subacromial contact without inhibiting range of motion: A biomechanical analysis. *Arthroscopy* 2021;37:1400-1410.
8. De Giacomo AF, Park MC, Lee TQ. Anterior cable reconstruction using the proximal biceps tendon for large rotator cuff defects. *Arthrosc Tech* 2021;10:e807-e813.
9. Shin SJ, Kim IW, Park I, Lee S, Kim MS. Anterior cable reconstruction using the biceps tendon in retracted anterior L-shaped rotator cuff tears. *Arthrosc Tech* 2021;10:e55-e60.
10. Adams CR, Pasqualini I, Heidenthal JM, Brady PC, Denard PJ. A technique for a suture-based cable reconstruction of an irreparable posterosuperior rotator cuff tear. *Arthrosc Tech* 2022;11:e2055-e2060.
11. Veen EJD, Diercks RL, Landman EBM, Koorevaar CT. The results of using a tendon autograft as a new rotator cable for patients with a massive rotator cuff tear: A technical note and comparative outcome analysis. *J Orthop Surg Res* 2020;15:47.