Rotator cuff surgery aims to provide tendon fixation secure enough to hold the repaired tendon in place until biological healing occurs. In concert with advances in arthroscopy, some novel methods, such as the double-row and suture bridge techniques, have been developed to increase the tendon–bone contact area and provide a better environment for tendon healing. Recently, double-pulley or double-pulley–suture bridge techniques using a medial anchor as a pulley have been introduced to improve healing. However, inadequately high pressure in the suture loop of the medial row can result in cuff retears. In addition, the overtensioning of suture limbs could result in strangulation and retear of rotator cuff tissue. Therefore, tendon healing ideally requires changes in suture tension over the cuff tissue in accord with rotator cuff muscle activity; that is, low tension is applied when cuff muscle is at rest and high tension is applied when it is active, much like the Chinese finger trap, whereby when a finger is trapped inside a small flexible cylinder, and the more the finger is pulled, the more the traps tighten.

The authors describe a tendon trap technique with all suture limbs sharing the tension evenly and responding synchronized to the cuff tendon. The technique provides simple biologic repairs of rotator cuff tears.

**Abstract:** Strangulation around cuff tissue is a possible cause of retear after rotator cuff repair. Therefore, tendon healing ideally requires changes in suture tension over the cuff tissue in accord with rotator cuff muscle activity. The authors present a type of fixation that mimics the mechanism of the Chinese finger trap. The devised knot-free tendon trap technique resembles the double-pulley–suture bridge technique, but all suture limbs share the tension evenly and respond synchronized to the cuff tendon. The technique provides simple biologic repairs of rotator cuff tears.

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**Surgical Technique**

After the induction of general anesthesia, the patient is placed in the beach-chair position with the arm in traction at 15° of abduction and 30° of forward flexion. Diagnostic arthroscopy is performed through a posterior viewing portal, and an anterior working portal is

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**Figure 1:** Arthroscopic image showing a crescent tear (supraspinatus and anterior infraspinatus tears) via the lateral viewing portal.

**Figure 2:** Arthroscopic image showing a doubly loaded (with blue strand and dotted-white strand) suture anchor being inserted at the most anteromedial footprint of the greater tuberosity via an anterior accessory portal. The eyelet of the anchor can be seen well above the bone cortex.

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created using an outside-in technique. All intra-articular pathologies are assessed. An arthroscope is then inserted into the subacromial space. The lateral portal is created for viewing and passing instruments through a cannula. Cuff mobility and tear configuration are then assessed after releasing adhesive cuff tissue from surrounding soft tissue.

A case with a crescent tear (supraspinatus and anterior infraspinatus tear) combined with a coracohumeral ligament tear in the left shoulder (Figure 1) is presented. A doubly loaded (blue and dotted white strands) 5.0-mm Bio-Corkscrew suture anchor (Arthrex, Naples, Florida) was inserted at the most anteromedial footprint of the greater tuberosity at a deadman angle of approximately 45° via an anterior accessory portal (Figure 2). The suture strand eyelet can be seen well above the bone cortex in Figure 2. The size of the accessory portal was 5 mm, and instruments were passed without a cannula (Figure 3).

Another doubly loaded 5.0-mm Bio-Corkscrew suture anchor was inserted at the most posterosmedial footprint of the greater tuberosity via a posterior accessory portal. To prevent the strands from being twisted together in next steps of the procedure, the 2 posterior strands from the anterior anchor and the 2 anterior strands from the posterior anchor were marked at their ends using a marking pen (Figure 4).

The passage of 4 strands through the cuff was accomplished using a 45° curved Spectrum suture hook (Linvatec, Largo, Florida). Using the suture hook in the posterior portal, 1 FiberWire (Arthrex) suture was passed through the postero-medial cuff (Figure 5). The free limb of the FiberWire in the rotator cuff was extracted through the anterior portal.

Next, all 4 strands in the posterior accessory portal were pulled out of the anterior portal for a shuttle-relay method. The free limb of the suture loop of the FiberWire with 4 strands was then pulled through the posterior portal. This maneuver delivered 4 strands through the posterosmedial cuff and out of the posterior portal (Figure 6), and these strands were retrieved through the posterior accessory portal. Then, another 4 strands from the anchor at the anteromedial footprint were passed through the anteromedial cuff in the same manner and retrieved through the anterior accessory portal (Figures 7, 8).

To create the medial row, the marked blue suture strands from the anterior and posterior anchors are pulled out through the lateral cannula. Until this step in the procedure, the technique is the same as the double-pulley–suture bridge technique. However, instead of tying these 2 blue strands extracorporeally, the blue strand from the posterior anchor is loaded into an empty round needle (#3 size) and passed through the blue strand from anterior anchor extracorporeally (Figure 9). This technique of passing a suture strand from 1 anchor through the eyelet of another anchor was first described by Kim et al.9

After pulling the unmarked blue strand through the anterior accessory portal, the marked blue strand from the posterior anchor is then passed through the eyelets of the anterior anchor and anteromedial cuff and retrieved through the anterior accessory portal. While the marked blue strand continues to be pulled, the section of the strand between the anteromedial and posterosmedial cuff compresses the medial cuff (Figure 10).

The sliding abilities of both ends of the blue strand should then be checked before...
During tensioning of these 3 strands through the PopLock eyelet, the other 3 strands (the blue strand and unmarked white strand from the anterior anchor and the marked white strand from the posterior anchor) are pulled so they do not slide inside. After fixing the PopLock anchor, the other 3 strands are retrieved into the lateral cannula for anterolateral fixation using the second PopLock. In contrast with other techniques, any strand over the cuff tendon is not fixed, and thus the 3 strands can slide through the eyelet of the medial anchor.

The strands retrieved through the lateral cannula are then pulled to achieve appropriate tension in the strands over the cuff tendon. The tension of the medial blue strand should be checked carefully because it passes the eyelets of 2 medial anchors. The 3 strands passing through the eyelet of the second Poplock anchor, placed 1.5 cm distal to the lateral edge of the anterior footprint, are then fixed firmly (Figure 12). The whole figure of this repair resembles the double-pulley–suture bridge repair (Figure 13).

As postoperative management, the arm is supported in a sling with an abduction pillow for 5 weeks. Passive motion exercises are started at 5 weeks postoperatively and maintained within a comfortable range. Isometric strengthening and rehabilitation of the rotator cuff, deltoid, and scapular stabilizers are initiated at 9 to 10 weeks. Rehabilitation by home-based exercise is continued for 12 months.

**DISCUSSION**

The retear rate of massive cuff tears remains high despite many advances in arthroscopic techniques and has been attributed to factors such as fatty infiltration, muscle atrophy, and overtensioning of tendon tissue. The authors focused on preventing the overtensioning of sutures overlying cuff tissue. Several techniques developed to provide high grasping...
Strengths were shown to produce result improvements in a time-zero cadaveric study. However, the conclusions reached in biomechanical studies are not entirely compatible with those reached by clinical studies; an excessively secure fixation resulting in the strangulation of tissue and tearing around knotted cuff tissue with time is possibly responsible for this discrepancy. The current authors hypothesized that dynamic fixation of the cuff tendon in a manner that mimics the mechanism of the Chinese finger trap could allow the cuff tendon to heal because it would provide good vascularity and stable fixation. Consistently excessive tension in suture strands results in cuff tissue strangulation, whereas consistently low tension allows gap formation between the tendon and bone during active abduction. Although this technique was designed based on the double-pulley–suture bridge technique, all suture strands can work dynamically in a manner dictated by cuff tendon tension because it allows all suture strands to slide since it does not involve a suture-tying procedure.

The following factors should be considered to enable suture strands to share the tension evenly. First, suture strands from the medial anchor should slide well even after penetrating the cuff; therefore, care should be taken not to insert the anchors too deeply into bone and to avoid twisting the suture strands. Second, the eyelet of the medial anchor should be composed of strands and not made of metal or hard biopolymer because the increased tension in the blue strand in a doubly loaded anchor can increase tensions at the strand eyelet and in the white strand. An anchor with metal or hard biopolymer eyelet may not transmit the tension in 1 strand into the other. In addition, to prevent the suture strands from being jammed together, an appropriate anchor eyelet length is important. It is difficult to slide strands through anchors with a short eyelet, such as the 5.5-mm Bio-Corkscrew FT suture anchor (Arthrex), as has been previously described.

The current authors’ technique offers several advantages. First, it could result in less strangulation in the cuff tissue while giving the dynamic fixation according to the tensile force. Second, the operative time is reduced because only 2 cuff-penetrating procedures and no suture-tying procedures are required. Third, it provides the minimal profile of suture. Forth, the medial row could block synovial fluid flow between the cuff and footprint and help the cuff heal. Both ends of the strand used in the medial row should be able to slide easily, which is a limitation of the tendon trap technique. However, the classic double-pulley–suture bridge repair is performed instead of the tendon trap technique in such a case.

The devised tendon trap technique provides a means of dynamic cuff tendon fixation whereby all suture limbs share tension evenly by allowing slippage through the eyelet of the anchor. More clinical and biomechanical data are needed to prove the merits of the tendon trap technique; however, the authors believe that this technique should be considered an option for the arthroscopic repair of rotator cuff tears.

**REFERENCES**