Technical Note

Arthroscopic Transhumeral Rotator Cuff Repair: Giant Needle Technique

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Abstract: An arthroscopic transhumeral rotator cuff repair technique is presented with which the same type of cuff repair can be performed as with an open standard procedure. After adequate arthroscopic subacromial decompression, a bone trough is made on the greater tuberosity and a hole is punctured with a sharp hook. A special bone-cutting needle with a suture (giant needle) is then passed through the skin and deltoid muscle in front of the acromion, through the torn tendon, the hole in the trough, and out through the lateral cortical surface through the deltoid and skin. The suture limbs are pulled out through the instrumentation portal and a sliding knot is made to close the defect. No hardware implants are used and the procedure is not technically complicated. During surgery only two thirds of the steps used for open repair were required. With experience, a large tear was repaired as well as with an open repair. The advantages of this technique are that the strength of cuff fixation does not rely on the quality of the bone in the greater tuberosity, there is no need for complicated suture passing techniques through the rotator cuff, and it offers the same fixation technique as the traditional open repair. Key Words: Shoulder arthroscopy—Rotator cuff tear—Repair—Giant needle technique.

The open technique of subacromial decompression and rotator cuff repair has proven successful in decreasing pain and restoring function and has become the standard open surgical treatment for rotator cuff tears. Despite the high success rate that has been reported, this technique is not without its limitations, such as deltoid function deficits, rehabilitation problems, and some functional restrictions. All these represent disadvantages of the approach but not of the repair. By limiting the invasiveness of the surgical procedure, particular problems in treating rotator cuff tears in athletes and elderly patients can be overcome. Studies have shown that the tendon and trough repair achieved with nonabsorbable braided sutures tied over a bony bridge provided more consistent and stronger fixation.

The author has been using the transhumeral technique as described in this report as an alternative to the open technique since 1990. As with the open repair, the strength of fixation using this method relies on a cortical bone bridge. No complications of bone bridge fracture or axillary nerve injury were noticed.

SETUP

Positioning

The patient is placed in an 80° sitting position with the arm hanging freely (Fig 1A). In this position, the shoulder can be manipulated in all directions so as to bring the involved tendon under the instrumentation portal. Furthermore, the sitting position offers the advantage of comparability with the supraspinatus outlet radiographic view and helps in assisting decompression during surgery.
Portals

Three standard portals (Fig 1B) are used for shoulder arthroscopy. (1) The lateral posterior portal is 1 cm below and 1 cm anterior to the posterior angle of the acromion for the arthroscope. (2) The posterior standard portal is 1.5 cm medial and 1.5 cm below the posterior angle of the acromion for an accessory fluid inflow cannula. This portal is also used for evaluation of the glenohumeral joint. (3) The lateral anterior portal is 3 to 4 cm from the acromion in a direct line with the marker measuring pins and at the same level as the apex of the humeral head (important for tying the knots) and is used for surgical instrumentation.

Instrumentation

1. Standard arthroscopy setup and instruments with a 30° arthroscope.
2. The author’s Rotator Cuff Repair Systems Instrumentation (Aeratec, Uniondale, NY) (Fig 2):
   - Special giant needle holder
   - Bone-cutting giant needle with 2 differently colored No. 2 absorbable sutures
   - Soft tissue giant needles with two differently colored No. 2 sutures
   - Set of chop needles
   - Punch needle with absorbable No. 2 suture for subscapularis repair
   - Giant needle guide
3. Additional instruments, including arthroscopy punch, standard arthroscopic hook, small sharp elevator, and ring forceps

Repair Techniques

The giant needle technique is mainly used for cuff repair. In some cases other instruments such as the chop needles or punch needle are needed. The underlying idea of this technique is that special needles with sutures (giant needle) are passed through the tendon and bone or tendon to tendon, unrestricted by any portal, and simply passed through the skin, tendon, and bone in 1 step, tying a knot in another step. No hardware implants are required and the technique is not technically complicated.
Tendon-to-Bone Repair: Giant Needle Technique

Depending on the size of the tear, a 0.5-cm wide bone trough is made on the greater tuberosity where the tendon has been detached using a 4-mm burr. A puncture hole is then made in the trough using an

**Figure 3.** The giant needle being passed through the skin in front of the acromion through the tendon, through the trough, and pulled out through the shaft and the skin. (A) Cross-section and (B) overview.

**Figure 4.** The needle tip can be pointed with the needle guide if necessary. (A) Cross-section and (B) overview.
arthroscopy hook to mark the entry of the giant needle.

With the arm in slight abduction, the tendon stump is brought into contact with the trough and, in this position, using the special needle holder, the bone-cutting giant needle is passed through the skin and deltoid muscle in front of the acromion and then through the torn tendon. The punctured hole is brought to the tip of the needle by abducting the arm. The needle is pushed in the hole and the surgeon takes the patient’s arm with one hand and the needle with its special holder in the other, holding it at its attachment to the needle, and then moving the arm in alternating rotation from the elbow and pushing the needle centimeter-wise by placing the needle holder 1 cm distally and pushing the needle downward. This is repeated until the needle passes through the trough and out through the lateral cortical surface through the deltoid (Fig 3).

If the tip of the needle cannot be seen through the skin, the needle guide is placed at the distal end of the needle and the skin pusher arm is brought down to push the skin medially until the tip is visible through the skin (Fig 4), and it is then pulled out in the same stepwise manner as it was pushed in. The sutures are cut from their attachment to the needle outside the

**Figure 6.** The upper limb of the suture is pulled out through the instrumentation portal, and a simple suture is tied using the giant knot.

**Figure 5.** The lower limbs of the sutures are pulled out through the space between the shaft and deltoid through the instrumentation portal. (A) Cross-section and (B) overview.
For infraspinatus tears, the needle is passed medially to the acromion behind the acromioclavicular joint. If the tear is small, the lower limb of the suture is pulled out through the instrumentation portal with an arthroscopy hook (Fig 5) while holding the lower ends under tension to facilitate finding it, and the upper limb is pulled out with a ring forceps through the same portal. Then a sliding knot (Giant Knot) developed by the author is made to close the defect (Fig 6).

If the tear is large, a second bone-cutting giant needle is placed through both the tendon and the bony trough 5 mm posterior to the first needle to prepare for constructing a giant needle complex (1 mattress and 2 simple sutures). The lower limbs of the sutures are then pulled out through the instrumentation portal with the hook. The upper and lower limbs of the same-color sutures are each fixed together with a clamp separately to be used for the simple suture, and 1 from each pair of the other same-color lower limb sutures are tied together with a secure square knot and several additional throws (Fig 7A).

The sutures are then pulled up through the upper limbs above the skin so that the square knot slips through the instrumentation portal, to be placed on the cortical surface of the humeral shaft to make the lower part of the mattress suture. The upper limb of the anterior simple suture is pulled out above the tendon through the instrumentation portal with a ring forceps. A giant sliding knot using the small concave knot-push is used to tie the anterior simple suture with the arm in slight abduction (Fig 7B).

A similar procedure is used to tie the second upper limb of the posterior simple suture. The upper, same-color suture limbs of the mattress suture are then pulled from the subacromial space outside through the instrumentation portal (Fig 7C).

The 2 limbs are tied using the knot-pusher to make a square knot with several additional throws placed on the tendon. This completes the circle of the mattress suture and firmly embeds the cuff in the trough. The 2
simple sutures adapt the tendon to the head while the mattress suture firmly fixes the tendon to the bleeding bony trough (Fig 7D).

Large and Massive Tears

Medial Closure: For large or massive tears that involve 2 or more tendons and are retracted to the superior rim of the glenoid, the tendons can usually be brought together through mobilization. If the tear extends medially, it is sutured using the tendon end-to-end chop-needle repair technique (Fig 8) and then pulled laterally and tied to the greater tuberosity using the giant needle technique.

Biceps Tenodesis: If the biceps is flattened and split or dislocated, it is realigned and tenodesed in a groove 1.0 cm posterior to the bicipital sulcus using the arthroscopic giant needle complex transhumeral fixation technique. It is then incorporated in repairing the subscapularis and infraspinatus (Fig 9).

A distally slipped biceps rupture can be repaired by first identifying and then fixing the stump with stay sutures through a 3-cm skin incision in the middle of the upper arm. An arthroscopic forceps is then passed through the anterior portal through the sulcus up to the incision on the middle of the anterior upper arm, pulling the stay sutures up to bring the biceps stump to the humeral head and fixing it to the sulcus groove that has just been freshened up with a burr, using the giant needle to form a complete fixation with a giant needle complex.

To review the clinical results of 133 cases of transhumeral rotator cuff repair in 132 patients from the first 4 years of arthroscopic giant needle transhumeral rotator cuff reconstruction: the average age of the patients was 56 years (33 to 83 years) and the average follow-up was 5 years. There were 42 small, 56 medium, and 35 large or massive tears. Preoperatively, all patients complained of pain and weakness and had a positive impingement sign. Postoperatively, only 7% had a positive impingement sign and 82% had no pain. The average score on the UCLA Shoulder Rating Scale improved from a preoperative value of 14.6 to a postoperative value of 31.7.

REFERENCES