Technical Note

Optimizing Anchor Placement for Cone-Shaped Rotator Cuff Tears

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Abstract: There are various technique preferences when performing arthroscopic rotator cuff repair. Currently, most surgeons address all intra-articular pathology as well as assess the extent of a rotator cuff tear with the arthroscope in the joint prior to moving to the subacromial space, where they will initiate footprint preparation, anchor placement, and rotator cuff repair. Although this technique often yields good or at least acceptable visualization of the footprint, it does not always provide an optimal view of the medial footprint even when using a "50—yard line view" from a lateral portal. This can particularly be an issue with "cone-shaped" supraspinatus tears in which a smaller full-thickness bursal-sided tear often expands to a much larger articular-sided component. When surgeons are visualizing with the scope in the subacromial space, it is much more difficult to obtain a full appreciation of the extent of the articular-sided tear as well as optimal visualization of the medial footprint right up to the articular margin for both bone preparation and anchor placement. This article describes the benefit of keeping the arthroscope in the joint to facilitate footprint preparation and medial-row suture anchor placement prior to going to the subacromial space. This small technical modification can often offer surgeons far superior visualization of the entire greater tuberosity footprint especially when encountering a cone-shaped tear or high-grade articular-sided tear that requires repair. To further enhance viewing of the footprint with the scope intra-articularly, proficiency in using a 70° scope directed laterally will typically allow surgeons the most ideal view achievable. Once anchors are placed into the medial row, the arthroscope is inserted into the subacromial space to complete the repair.

Although most surgeons begin their careers replicating surgical techniques they were taught in training, continued progressive learning and incorporation of evolving technical tips can enhance proficiency over time.[1,2] Optimal visualization during arthroscopic rotator cuff (RC) repair is essential to an efficient and successful repair. This is especially true during the placement of the medial-row anchors, when it can be occasionally challenging. The literature surrounding specific visualization techniques to improve medial-row anchor placement is limited. Arthroscopic repair of a full-thickness RC tear typically consists of 2 stages: an intra-articular stage and a subacromial stage. Whereas most surgeons elect to prepare the greater tuberosity footprint and place medial-row anchors (double-row repair) once the arthroscope is in the subacromial space, we propose that these steps may be more optimally performed while the scope is still intra-articular, prior to moving subacromial. Although there is no major advantage to this technique in the setting of a large tear with clear visualization of the medial footprint, it can be challenging to optimally visualize the medial footprint of the tuberosity when addressing a larger articular-sided supraspinatus tear but with a small bursal-sided component. We term this pattern the "cone-shaped" tear. In this setting, the surgeon will typically never obtain a better look at the medial footprint adjacent to the articular cartilage than with the scope in the joint looking laterally (using a 70° scope is often optimal). It is not unusual in this setting to need to place 2 to 3 medial-row anchors. Like most surgeons, we initially performed this technique for only PASTA (partial articular supraspinatus tendon avulsion)—type tears. However, over the past decade,

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we have evolved to preparing the greater tuberosity footprint and placing medial-row anchors for most our repairs because we can take advantage of optimal medial footprint visualization. It is understood that for smaller tears, it is often more challenging to perform a double-row repair because of visualization problems when placing the medial-row anchor adjacent to the articular cartilage. This modification in technique is especially useful for small tears and repair of cone-shaped tears, which we classify as an iteration of a PASTA tear. The cone-shaped tear appears similar to a large articular-sided tear, but also has an additional smaller full-thickness bursal sided component. The overall impact of this technique is improved visualization of the articular side of the entirety of the medial footprint, efficiency, and "quality of life" for the surgeon.

Surgical Technique

The arthroscopic technique described is shown in Video 1. The patient may be in the beach-chair or lateral decubitus position. A standard posterior portal is established. A 30°, 4-mm arthroscope (Smith & Nephew, Andover, MA) is placed into the glenohumeral joint. If the surgeon suspects that most of the work will be related to the superior RC, then we often "cheat" the posterior portal slightly more laterally. This will typically not significantly adversely affect the described technique. A standard anterior working portal is established in the rotator interval with a spinal needle, and a cannula is placed. Diagnostic arthroscopy is performed in a standard fashion. Once the diagnostic arthroscopy and concomitant intra-articular work are completed, the entire RC is evaluated from the articular side. For most tears involving the supraspinatus and infraspinatus, the 30° scope is switched to a 70° scope (directed laterally) for improved visualization of the RC tear itself and the greater tuberosity from inside the joint (Fig 1 A and B).

From this position, a lateral portal is established in the subacromial space using a spinal needle. This portal is optimized to access the tuberosity footprint through the supraspinatus tear. A 3.5- or 4.5-mm shaver (Smith & Nephew) is introduced through this portal. Standard preparation of the RC tear is performed including debridement of nonviable RC tissue and debridement and/or abrasion of the cortical bone right up to the articular margin of the footprint (Fig 1C). Often, the articular side of the tear enlarges posteriorly on the

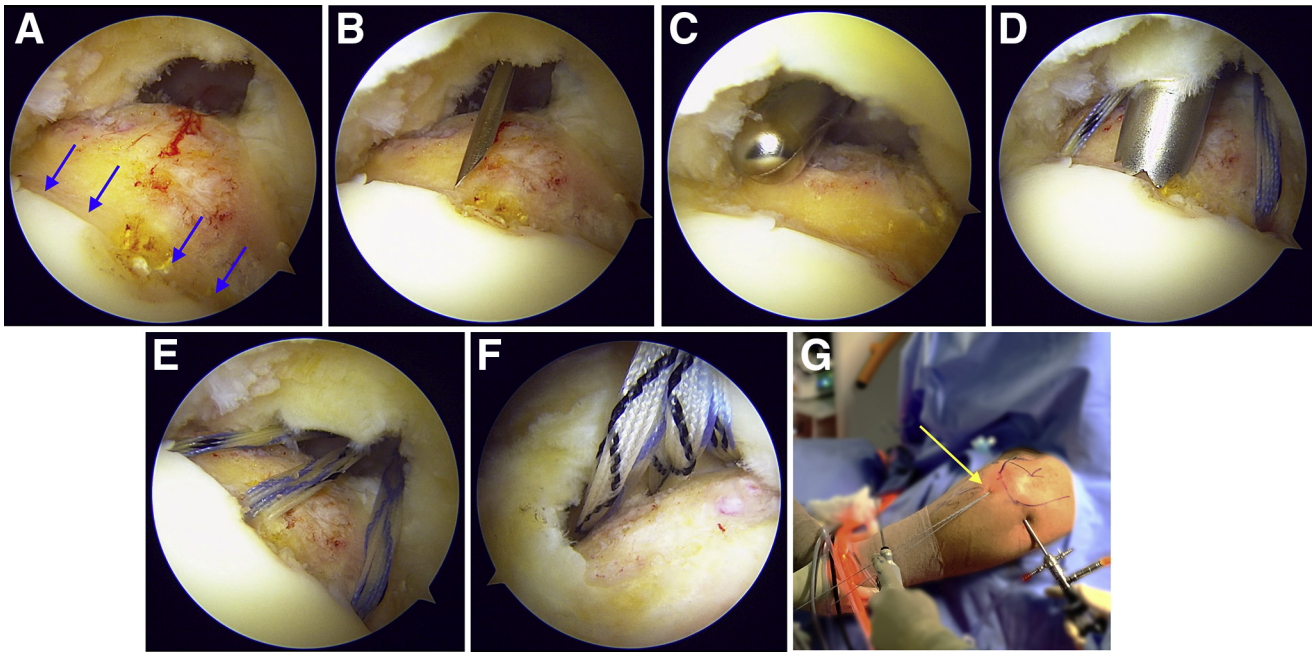

Fig 1. Intra-articular arthroscopic images of the right shoulder during rotator cuff repair with the patient in the beach-chair position while a laterally directed 70° scope positioned through the posterior portal is used. These images show excellent visualization of the greater tuberosity and articular margin achieved by keeping the scope in the joint, facilitating optimal placement of medial-row anchors. (A) An optimal view of the medial greater tuberosity footprint in a cone-shaped tear is obtained by using a 70° arthroscope in the joint (arrows indicate articular margin). (B) Preparation of the greater tuberosity footprint (shaver in lateral portal). (C) The spinal needle aids in planning placement of the accessory lateral portal for the optimal trajectory for the medial-row anchors. (D) The anchor drill guide is positioned adjacent to the articular margin during placement of the medial-row anchors. All-suture anchors (Arthrex) are used in this case. (E) After completion of medial-row anchor placement, the sutures are tensioned through the lateral portal (identified by the arrow in G). (F) View from the lateral portal of the medial-row anchor sutures after completed placement. (G) Lateral portal (arrow).

Table 1. Pearls and Pitfalls

Pearls
A spinal needle is used with the scope in the joint pointed laterally to optimize lateral portal placement for access to the tuberosity.
Preparation of the greater tuberosity footprint is performed with a shaver through the lateral portal (with the 70° scope pointed laterally).
The anterior and superior bursectomy is performed first; the sutures are then transferred to the anterior cannula.
Bursectomy is completed laterally with the sutures docked in the anterior cannula.
The sutures are transferred into the lateral portal after bursectomy is completed to perform rotator cuff repair.
Proficiency with a 70° scope can enhance the utility of this technique.
Pitfalls
Potential iatrogenic damage to the sutures can occur while performing bursectomy

medial footprint. A curette can be useful to prepare this area of the footprint. This technique should allow for the most optimal visualization of the footprint, especially in the treatment of cone-shaped tears that enlarge posteriorly on the articular side.

Next, medial-row suture anchors (Arthrex, Naples, FL) are placed at the articular margin under direct visualization with the scope looking laterally but with appreciation of the anchor trajectory relative to the joint and tuberosity (Fig 1D). These anchors will typically be placed through a second small lateral portal just off the edge of the acromion, which is judged to have an optimal trajectory based on the use of a spinal needle. As each anchor is placed, sutures are passed and docked out of the first, more inferior lateral portal (Fig 1 E-G). It is not uncommon to need only 1 lateral portal for both tuberosity preparation and anchor placement. This step is repeated until the surgeon is satisfied with the placement and number of medial-row anchors. Typically, the senior author (KFB) does not use lateral portal cannulas, but they can be used if desired. Additionally, for multiple medial-row anchors, each set of sutures is tagged with a clamp outside, with attention to which clamp is anchored to which anchor. Once all sutures are delivered and docked through the lateral portal, the arthroscope is placed into the subacromial space. With the arthroscope in the posterior portal (or an additional posterolateral portal if desired but typically unnecessary), a bursectomy is performed with a shaver through the lateral portal. During the bursectomy, a surgical assistant provides tension on the sutures through the lateral portal to prevent iatrogenic damage to the sutures. The bursectomy is typically started anterior and more superior to the tear and sutures. Once the anterior and superior subacromial bursa (not lateral, which is where the sutures are at risk) is completely cleared out with excellent visualization, the medial-row sutures are pulled through the previously established anterior portal cannula, which is redirected to the subacromial space. With the sutures docked anteriorly with some tension, the lateral bursectomy can be completed so that optimal visualization can be obtained to complete the repair. Once the bursectomy is completed, the RC sutures are transferred to the lateral portals and passed using the surgeon's preferred technique. In our technique, we keep the scope in the posterior portal to perform most, if not all, of the repair with the use of a 70° scope. With this technique, alongside proficiency using the 70° scope, the repair can become much more efficient because one does not need to switch viewing portals. Certainly, we do not hesitate to do so if needed, but enhanced efficiency, once proficiency is achieved, is one of the advantages of this technique. We typically prefer to tie the medial-row sutures prior to incorporating into the lateral-row anchors. If an acromioplasty is performed, it is the senior author's preference to perform it at the end, after the RC repair, so as to avoid bleeding bone as well as increased fluid extravasation into the deltoid during the repair.

Discussion

The illustrated technique presents a different way to approach the treatment of cone-shaped RC tears. We share surgical pearls and pitfalls in Table 1, and the advantages and disadvantages of this technique are listed in Table 2. This type of tear, which has not been frequently described in the literature, is commonly encountered, and properly preparing the medial footprint can prove to be challenging, especially as the tear propagates posteriorly on the articular side. Additionally, with the arthroscope in the subacromial space, it can be virtually impossible to truly visualize the entire medial footprint to optimize medial-row anchor placement. Frequently, the placement of 2 to 3 medial-row anchors is desired with this type of repair, and this can be difficult especially as one moves posteriorly on the tuberosity. Even the "50—yard line view" does not offer nearly as good of an appreciation of the footprint as a view from the articular side.

In comparison, the described intra-articular technique allows for optimal visualization of the medial footprint, especially for small tears or cone-shaped tears. Additionally, as one becomes comfortable with the workflow

Table 2. Advantages and Disadvantages

Advantages
The technique optimizes visualization and preparation of the medial footprint and is quite advantageous in treating cone-shaped tears.
The technique facilitates placement of medial-row anchors just off the articular surface.
Disadvantages
Sutures are at risk of damage from the shaver in the subacromial space.
The standard workflow is altered.

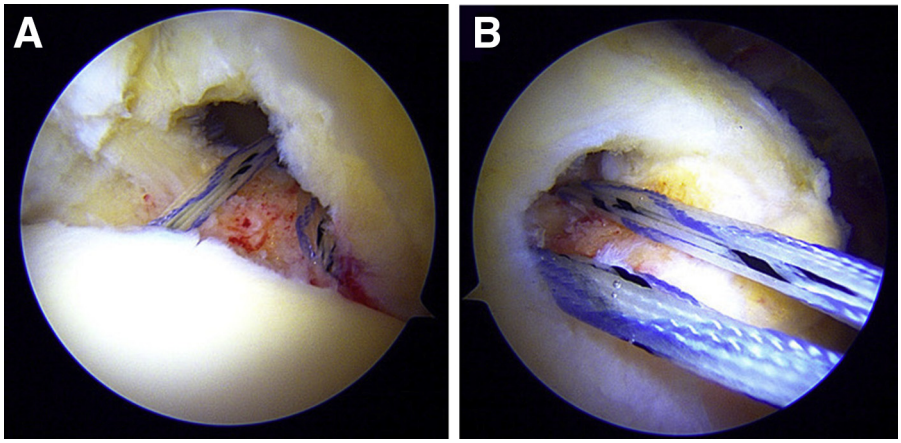

Fig 2. Arthroscopic images of the right shoulder taken with a 70° scope with the patient in the beach-chair position. The difference in the view from the intra-articular versus subacromial positions is shown. (A) Intra-articular view after medial-row anchor placement. (B) Subacromial view after medial-row anchor placement.

and the ease with which this technique can be performed, one may consider expanding its indications to most tears. The use of the 70° arthroscope (Fig 2) can provide additional benefit in expanding excellent visualization of the articular margin and tear, especially as the tear propagates posteriorly on the medial footprint. Optimal visualization not only will allow for easier debridement and preparation of the bone bed, as shown in Fig 1A and C, but also will facilitate medial-row anchor placement for many tears.

Because cone-shaped tears may present less-than-optimal visualization of the far medial footprint when viewing from the subacromial space, they may potentially cause surgeons to place medial-row anchors in a more lateral anchor position. This could decrease the contact area of the final construct as well as create an overall weaker construct, increasing the risk of anchor pullout and RC repair failure. Compared with lateral positions, the superior and medial areas of the humeral head offer areas of higher bone density and thus are stronger sites for medial-row anchor placement.[3-6] Therefore, this juxta-articular positioning allows for placement of the medial-row anchors into denser bone, allowing for higher pullout strength from the anchor,

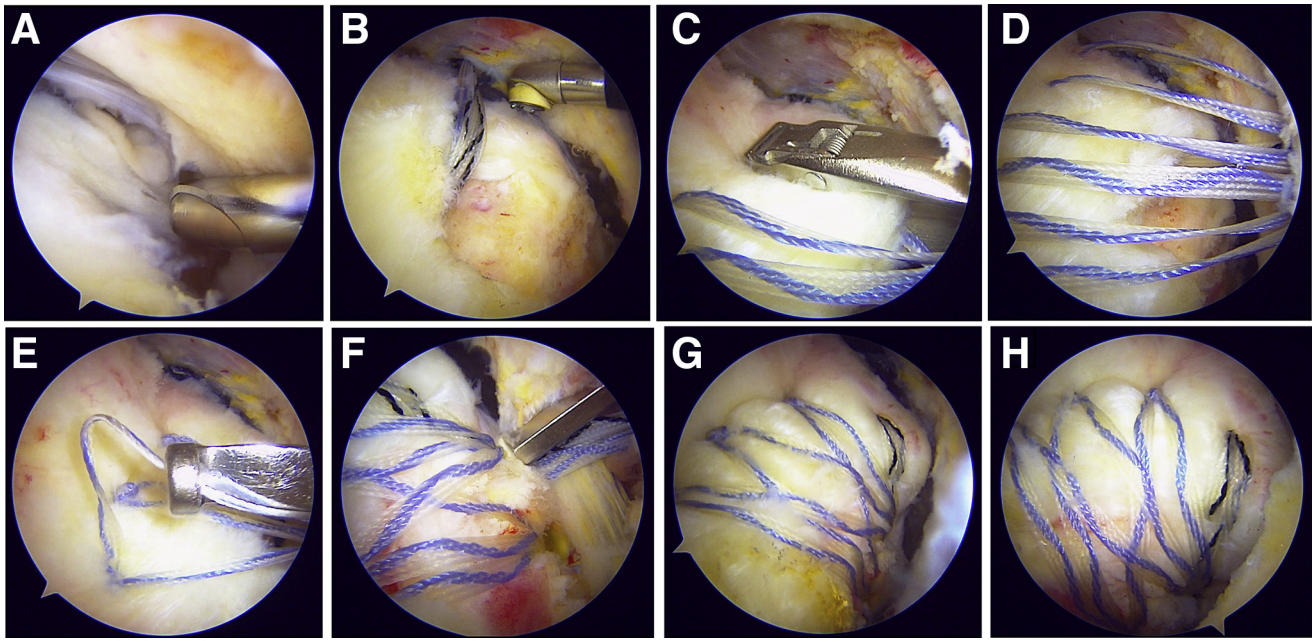

Fig 3. Arthroscopic images taken within the subacromial space after medial-row anchor placement. (A) The scope is positioned through the posterior portal in the subacromial space to perform anterior bursectomy. (B) Medial-row sutures are delivered into the anterior cannula and protected during lateral bursectomy to avoid damage. (C, D) Medial-row sutures are passed through the supraspinatus tendon. (E) Knot tying on the medial row. (F) After the medial row is tied, the sutures are secured with lateral-row anchors. (G, H) Completed rotator cuff repair.

whether in normal or osteopenic bone.[7,8] Through the use of this technique, surgeons can be confident in precisely placing anchors just adjacent to the articular cartilage on the medial footprint to optimize the final repair construct.

In sum, this technique is simply an expansion of many PASTA repair techniques in which the arthroscope is kept intra-articular for footprint preparation and anchor placement at the articular margin. This is how the senior author evolved into using this technique for expanding tear patterns including cone-shaped tears. Once proficiency is achieved, this technique typically makes the case more efficient.

This technique does present some challenges to the surgeon. First, proficient use of the 70° arthroscope is often optimal but not always required to achieve the best view possible. This requires a learning curve for some surgeons who are not accustomed to using the 70° arthroscope regularly or to using it within the joint space. Suture management and the avoidance of inadvertent suture damage during bursectomy within the subacromial space may be challenges early on. Whereas performing suture management and avoiding suture damage are not difficult, care must be taken to avoid probably the greatest risk of this technique. Awareness, suture tensioning, and transfer of the sutures to the anterior cannula during the lateral bursectomy provide a reliable method to protect the sutures (Fig 3B). Although this technique initially was borne out as a way for the senior author to optimally visualize and treat cone-shaped RC tears that expand on the articular side, it is now used in most supraspinatus tear patterns.

References

1. Bell JP, Field LD. Combined intra-articular and extra-articular visualization for repair of a complete subscapularis tear: The "blended view" technique. *Arthrosc Tech* 2021;10:e1879-e1882.
2. Gumina S, Rionero M, Candela V. The 2-scope technique for rotator cuff surgery: Are 2 scopes better than 1? *Arthrosc Tech* 2020;9:e1591-e1596.
3. Hepp P, Lill H, Bail H, et al. Where should implants be anchored in the humeral head? *Clin Orthop Relat Res* 2003;(415):139-147.
4. Saitoh S, Nakatsuchi Y, Latta L, Milne E. Distribution of bone mineral density and bone strength of the proximal humerus. *J Shoulder Elbow Surg* 1994;3:234-242.
5. Tingart MJ, Bouxsein ML, Zurakowski D, Warner JP, Apreleva M. Three-dimensional distribution of bone density in the proximal humerus. *Calcif Tissue Int* 2003;73:531-536.
6. Yamada M, Briot J, Pedrono A, et al. Age- and gender-related distribution of bone tissue of osteoporotic humeral head using computed tomography. *J Shoulder Elbow Surg* 2007;16:596-602.
7. Zumstein MA, Raniga S, Labrinidis A, Eng K, Bain GI, Moor BK. Optimal lateral row anchor positioning in posterior-superior transosseous equivalent rotator cuff repair: A micro-computed tomography study. *Orthop J Sports Med* 2016;4:2325967116671305.
8. Meyer DC, Fucentese SF, Koller B, Gerber C. Association of osteopenia of the humeral head with full-thickness rotator cuff tears. *J Shoulder Elbow Surg* 2004;13:333-337.