Technical Note

Use of a Spinal Needle Through the Deep Rotator Cuff Tissue to Treat Rotator Cuff Tears Under Direct Articular Vision

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Abstract: Achieving sufficient attachment of deep rotator cuff tissue to the footprint area on the greater tubercle of the humerus is essential for functional recovery, yet the optimal approach remains uncertain. We introduce a surgical technique for rotator cuff tear repair using a spinal needle to penetrate deep rotator cuff tissue under direct arthroscopic visualization. After trimming the torn edge, an arthroscope is inserted into the joint cavity through a posterior portal, and a hole is drilled into the humeral head cartilage margin using an upper approach, facilitating the implantation of an internal shoulder row nail. A spinal needle is used to introduce a No. 2 polydioxanone (PDS; Johnson & Johnson) line through sufficient deep rotator cuff tissue. Graspers are then used to extract the stitch and PDS together through the anterolateral opening. Once the PDS is knotted, the stitch is introduced into the rotator cuff. This process is replicated to insert additional stitches into the rotator cuff. Our proposed technique, involving a spinal needle under direct visualization, ensures sufficient coverage of the deep rotator cuff tissue over the footprint area and promotes the healing of the repaired rotator cuff. This method is safe, effective, convenient, and reproducible.

Rotator cuff tears (RCTs) cause shoulder joint pain, muscle weakness, and significant dysfunction that severely affect patients' quality of life and ability to work.[1] Numerous options exist for the conservative management of chronic, nontraumatic RCTs and partial-thickness RCTs. However, surgery becomes the preferred option for RCTs unresponsive to conservative treatment and for acute traumatic full-thickness RCTs.[2] Typically, a tear leads to the separation of the rotator cuff from the footprint of the greater tubercle of the humerus.[3,4] Consequently, surgical treatment focuses on reattaching as much of the rotator cuff to the footprint as possible after suturing while minimizing tension. This approach aims to preserve the stability of the rotator cuff tissue and ensure the healing of the cuff-bone interface after suturing. Such measures facilitate early rehabilitation, helping to reduce pain and improve range of motion, strength, quality of life, and sleep patterns, thus accelerating recovery and expediting the return to work and sports.[5,6] Therefore, it is important to identify strategies for maximizing the reattachment of the footprint, avoiding iatrogenic injury to the long biceps tendon during suturing, and reducing operation time. This article introduces a simple, clear, and replicable surgical technique for RCT repair, in which the rotator cuff is sutured using a spinal needle under direct vision of the joint cavity and secured with an external row of nails after knotting.

This study was performed in compliance with the requirements of the World Medical Association Helsinki Declaration (2013) and was approved by the Medical Ethics Committee of Longyan First Affiliated Hospital of Fujian Medical University (No. LYREC2023-k018-01). All patients provided written informed consent.

Surgical Technique

Under general anesthesia, patients are placed in the lateral decubitus position to enable surgical access to the RCT as shown on magnetic resonance imaging (Fig 1A). Lateral arm traction of approximately 4.5 kg is applied using a traction device. The procedure involves 5

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arthroscopic portals: posterior, posterolateral, lateral, anterior, and anterolateral. Diagnostic arthroscopy (Arthrex) of the glenohumeral joint and subacromial space is performed, followed by thorough debridement of any reactive synovitis or bursa. Acromioplasty is performed in cases of a large bony spur. Subsequently, the RCT's location and characteristics are carefully evaluated.

After trimming the torn edge, an arthroscope is inserted into the joint cavity through the posterior portal. A hole is drilled into the humeral head cartilage margin (Fig 1 C and D) using an upper approach to implant a FOOTPRINT Ultra PK Suture Anchor (Smith & Nephew) (Fig 1E). The number of holes drilled is dependent on the size of the RCT. A spinal needle (Fig 1 B and F) is used to position the needle at the appropriate position on the rotator cuff surface (Fig 2A). The arthroscope is then moved to the side of the joint cavity to verify the needle's position in the deeper layers of the rotator cuff (Fig 2B). If the position of the needle in the rotator cuff's depth is unsuitable, it is adjusted. A No. 2 polydioxanone (PDS; Johnson & Johnson) is inserted into the spinal needle (Fig 2C). Graspers are then used to extract the stitch and PDS together through the anterolateral portal (Fig 2 D and E). Once the PDS is knotted (Fig 2F), the stitch is guided into the rotator cuff through the PDS knot (Fig 3 A and B). This procedure is repeated to insert additional stitches into the rotator cuff (Video 1).

The distribution of sutures on the side of the rotator cuff bursa is examined via arthroscopy through the posterolateral portal (Fig 3C). In the absence of sutures and when the rotator cuff tissue is on the bursa side, PDS is introduced using a suture hook to resuture the stitches. The posterior portal is again used to verify the suturing of both the long head tendon of the biceps brachii and the deep rotator cuff tissue.

Once the suture is knotted, the rotator cuff is repositioned. The 4-wire suture bridge technique is used to secure the suture using the TWINFIX Ultra PK Preloaded Suture Anchor (Smith & Nephew) as a shoulder articular outflow rivet on the lateral side of the nodule (Fig 3D). After suturing, the rotator cuff tissue is examined to ensure that it maintains appropriate shape and tension (Fig 3E).

Postoperative Rehabilitation

The shoulders were immobilized for 4 weeks using a sling immobilizer with an abduction pillow. Passive and assisted active exercises were initiated for forward abduction, flexion, and external rotation, with care taken to avoid provoking pain (i.e., ensuring the visual

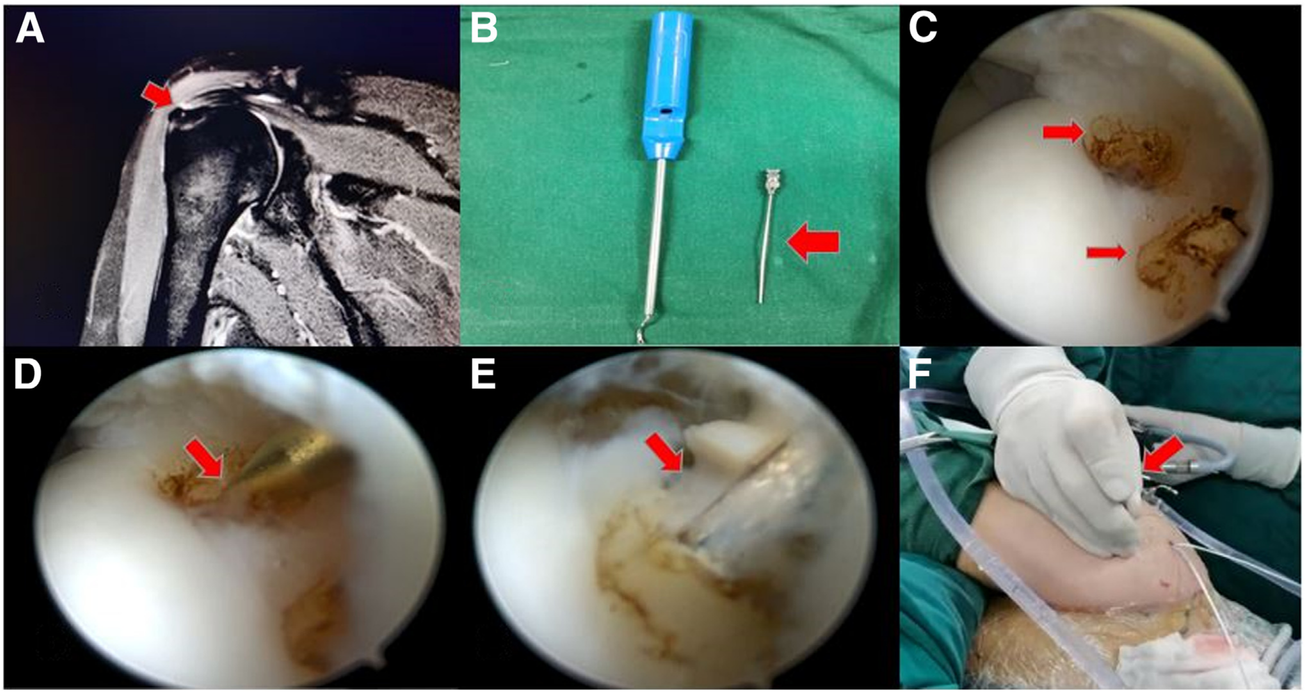

Fig 1. (A) Preoperative coronal T2-weighted fat-saturated magnetic resonance image showing the rotator cuff tear (RCT) (red arrow) (right shoulder, lateral position). (B) Photograph of the spinal needle used for RCT repair. (C) Intraoperative photographs showing the selection of drill hole locations under direct joint cavity visualization, with a plasma knife marking the anchor placement site. The number of holes is contingent on the size of the tear. (D) Drilling. (E) The Implant Footprint Ultra PK Suture Anchor (Smith & Nephew). (F) Introduction of the spinal needle through the anterior and upper aspect of the shoulder, traversing skin, subcutaneous tissue, and the rotator cuff.

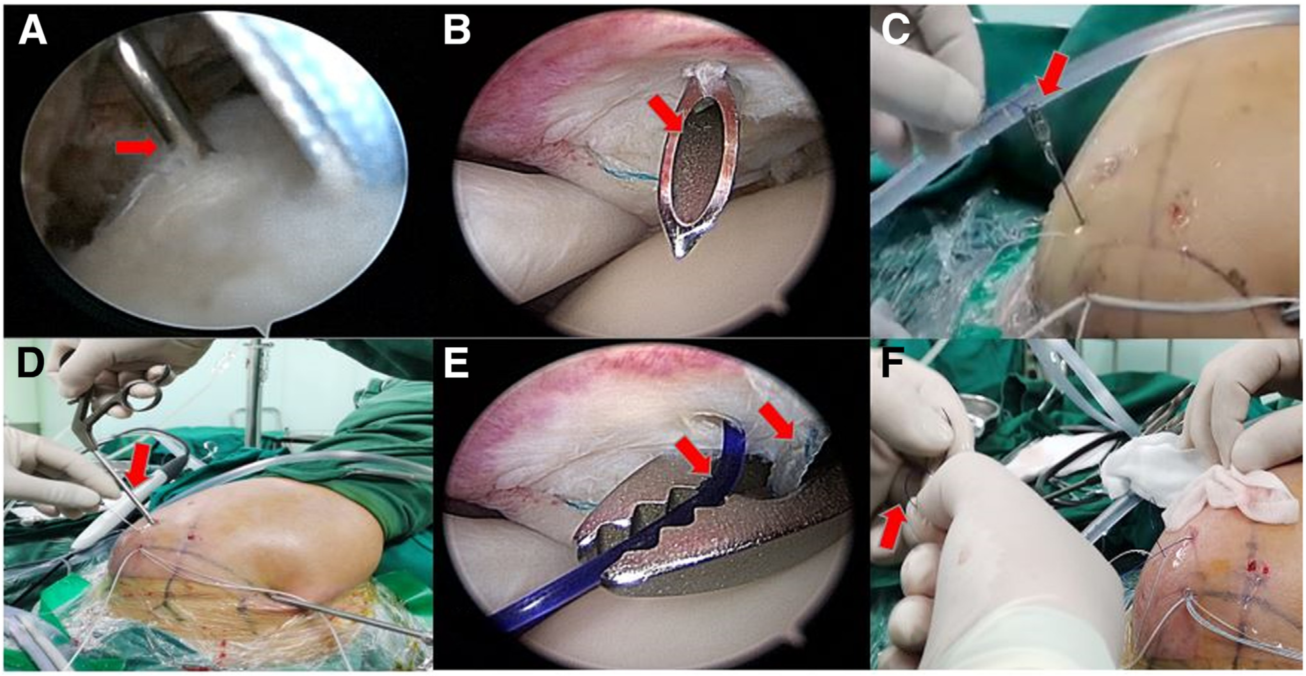

Fig 2. (A) Selection of a suitable insertion point on the side of the rotator cuff joint capsule, followed by spinal needle insertion (right shoulder, lateral position). (B) Ensuring adequate passage of deep rotator cuff tissue through the spinal needle on the side of the joint cavity, adjusting the needle if necessary, and ensuring that the long head of the biceps tendon is not damaged. (C) Introduction of the polydioxanone suture (PDS). (D) Insertion of the grasper into the joint cavity via the anterolateral portal. (E) Grasping of the PDS and stitches simultaneously with the grasper. (F) Knotting the PDS in preparation for threading stitches into it.

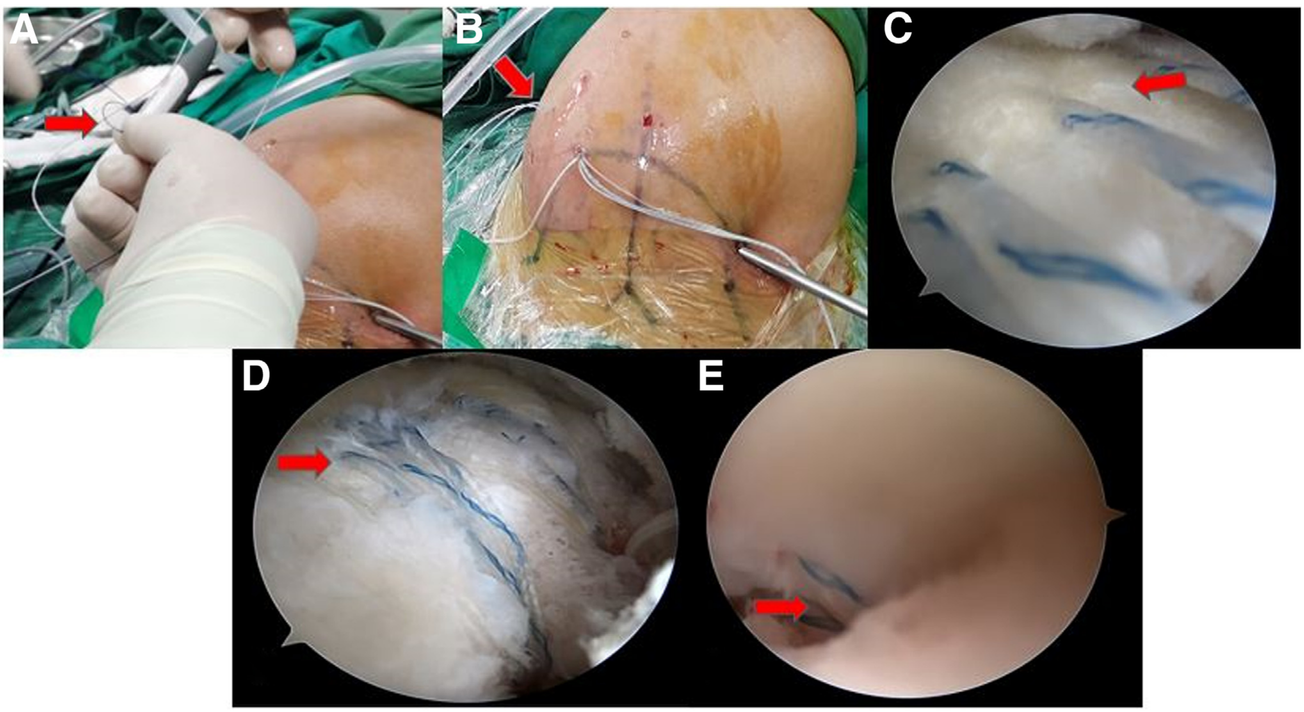

Fig 3. (A) Placement of stitches into the knot (right shoulder, lateral position). (B) Closure of the deep rotator cuff tissue using polydioxanone suture insertion sutures and subsequent repositioning of the sutures. (C) Visibility of the suture material through the joint capsule at a suitable insertion point. (D) Application of TWINFIX Ultra PK Preloaded Suture Anchors (Smith & Nephew) using the suture bridge technique at the exterior of the greater tubercle for stitch security. (E) Achieving stable fixation of the deep rotator cuff at the footprint of the greater tubercle of the humerus, ensuring closure of the deep rotator cuff tear.

Table 1. Pearls and Pitfalls

Pearls
- Full direct vision allows the surgeon to ensure adequate contact between the deep rotator cuff tissue and the footprint area during suturing (Fig 2B).
- Reconstructing the anatomic structure of the tendon origin enables sealing regions within the rotator cuff while avoiding alterations to the origin of the cannula, which could result in movement defects, persistent internal impingement, and potential tear recurrence (Fig 3E).
- Injury caused by the suture passing through the long biceps tendon can be avoided.

Pitfalls
- Repeat operations may result in the polydioxanone suture line being cut and broken by the spinal needle.

analog scale for pain was <3). Each maneuver was maintained for 2 minutes, and the patients underwent 2 rehabilitation sessions daily. Topical ice was applied immediately after passive rehabilitation. At 6 weeks postoperatively, the patients began strengthening exercises for the rotator cuff and scapular stabilizers. Full resumption of sports and heavy labor was permitted from 6 months postoperatively, depending on individual functional recovery.[7-10]

Discussion

The determination of which RCTs should receive surgical versus conservative treatment remains uncertain.[11-13] However, for young athletes with acute RCTs and individuals exhibiting significant functional impairment, early surgical treatment is very important.[14] Short- to long-term efficacy of RCT surgical treatment has been demonstrated, with improvements in flexion, external abduction, external rotation, internal rotation, strength, sleep quality, and restoration of tendon integrity.[15-18] While conservative therapy may alleviate symptoms such as pain, it poses a risk of larger tears over time.[19] Traditionally, open surgery for rotator cuff repair was common, but it frequently resulted in a compromised surgical field, postoperative pain, infections, and deltoid tears.[20] The introduction of shoulder arthroscopic rotator cuff repair addressed these issues, improving postoperative tendon longevity and emerging as the gold standard for the treatment of rotator cuff tears.[21] In this technique, medial anchors are strategically positioned slightly lateral to the articular margin, while the lateral row anchors are situated on the greater tuberosity's lateral aspect, proximal to the "dropoff."[22] This method maximizes the area of tendon compression on the bone surface, aligning with anatomic, biomechanical, and biological factors.[23] Currently, common practice involves using a shoulder suture that anchors to the side of the articular capsule through the rotator cuff tissue. This technique involves the stitching of the rotator cuff tissue using PDS line sutures. However, this approach may lead to iatrogenic injury to the biceps tendon. Additionally, it is challenging to confirm whether sufficient deep tissue of the rotator cuff is sutured and whether the contact area between the rotator cuff and the footprint area is adequate. These uncertainties can contribute to poor tendon-bone healing, resulting in postoperative pain and suboptimal functional recovery. Furthermore, there is a risk of retear, with retear rates following RCT repair ranging from 40% for small to moderate tears to 90% for large and chronic tears.[24] The likelihood of a retear is strongly associated with the initial biomechanical strength of the RCT repair.[25] In this study, we observed the needle insertion from the surface of the rotator cuff on the bursae side. Adjustments could be made for the insertion into the deep layer of the rotator cuff, allowing for modifications if the needle point was not ideally positioned after penetrating the deep layer. This approach ensured sufficient suturing of the deep tissue of the rotator cuff. This method differs from those described in previous studies.[26-28] In the present study, the direct visual guidance of the spinal needle along the line facilitated effective deep tissue—tread contact in the rotator cuff, ensuring tendon-bone healing and initial biomechanical strength.

Table 2. Advantages and Risks/Limitations

Advantages
- Direct observation of the joint cavity and line is possible, allowing for clearer visualization and more comprehensive examination.
- Improved precision and accuracy in assessing the rotator cuff tear.
- Enhanced accuracy in selecting the anchor placement at the cartilage edge (Fig 1C).
- Flexible exchange of the arthroscope beneath the joint cavity and acromion, aiding in the appropriate placement of the suture line.

Risks or limitations
- Use of the spinal needle on the rotator cuff, passing through the skin and subcutaneous tissue, may increase trauma to these areas.

This surgical technique has certain limitations; it requires experienced surgeons and carries an increased risk of skin and subcutaneous tissue trauma, as well as potential fracture of the PDS line caused by repeated passage of the PDS through the spinal needle (Tables 1 and 2). However, the technique offers numerous advantages when using a spinal needle to penetrate the deep layer of the rotator cuff tissue line under direct visualization of the joint cavity: (1) direct observation of the joint cavity and the line allows for clearer visualization and more comprehensive observation; (2) it enables a more precise and accurate assessment of the RCT; (3) the placement of the anchor at the cartilage edge can be selected more accurately; (4) full direct vision allows the surgeon to ensure adequate contact between the cuff and the footprint area when suturing the deep rotator cuff tissue; (5) it facilitates the reconstruction of the anatomic structure of the tendon origin, sealing regions within the rotator cuff while avoiding anatomic alterations at the origin of the cannula, which could lead to movement defects, persistent internal impingement, and potential recurrence of the tear; (6) it minimizes the risk of injury caused by the suture passing through the tendon of the long head of the biceps; (7) the arthroscope can be flexibly exchanged under the joint cavity and acromion, ensuring appropriate placement of the suture line; (8) the operation time is reduced, which reduces the surgical risk; and (9) the technique is simple, making it easy to understand and replicate (Tables 1 and 2).

In conclusion, using a spinal needle for line repair of RCTs under direct visualization of the joint cavity ensures adequate coverage of the deep rotator cuff tissue in the footprint area and facilitates the healing process of the rotator cuff. This method is safe, effective, convenient, and reproducible, and it merits broader adoption in clinical practice.

Disclosures

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