

“Ninja Technique” for Percutaneous Completion of Partial-Thickness, Articular-Sided Rotator Cuff Tears



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Abstract: Rotator cuff tears are a common source of shoulder pain and dysfunction. Owing to the multifaceted nature of these injuries, various viable methodologies exist for their surgical and nonsurgical management. Among surgically managed patients, those with PASTA (partial articular supraspinatus tendon avulsion) lesions require careful consideration of technique. Both transtendinous repair and tear completion with subsequent repair have been described. Both techniques offer unique benefits. In this publication, we offer an expedient and minimally invasive technique for tear completion and subsequent repair. The “ninja technique” uses localization via a spinal needle and tear completion with an arthroscopically manipulated scalpel blade. Conversion of partial tears to full-thickness tears using the ninja technique allows for technically simplified repairs while maximizing available tendon length.

Rotator cuff pathology exists across a broad spectrum, from impingement and bursitis to complete tears and arthropathy. Appreciation of this pathology continuum allows for appropriate treatment tailored to a patient’s specific goals and activities. Thorough knowledge of available nonoperative therapy and, if necessary, surgical techniques facilitates this care. When deemed clinically necessary, arthroscopic repair of rotator cuff pathology with minimal creation of iatrogenic trauma is sought. In this article, we introduce the “ninja technique” to facilitate minimally invasive rotator cuff tear completion and repair.

Rotator cuff tears are classified based on location, size, and depth. The Ellman classification is used to describe a partial tear’s depth and location. Tears of less than 3 mm are grade I; 3 to 6 mm, grade II; and greater than

6 mm, grade III. A grade I tear corresponds to less than 25% tendon depth; grade II, 25% to 50%; and grade III, greater than 50%. Modifiers A, B, and C further identify tears as articular sided, bursal sided, and intratendinous, respectively.¹

The arthroscopic treatment of PASTA (partial articular supraspinatus tendon avulsion) lesions is based on grade and tissue quality. Special attention is often paid to overhead athletes because of the magnitude and repetitiveness of loading typically directed at the rotator cuff tendon attachments in this patient population. Ellman grade I and II lesions are usually considered for debridement if symptomatic. Ellman grade III lesions can be reattached to the greater tuberosity with either transtendinous repair (TTR) or tear completion with subsequent repair (TCR).²⁻⁵ Both techniques offer unique advantages and disadvantages.

Biomechanical studies have suggested that TTR may decrease shoulder external rotation and posteriorly shift the humeral head,⁶ although strain characteristics are improved with TTR.⁷ Yamakado⁸ reported that biopsy of cuff tissue at the time of TCR for PASTA lesions revealed moderate histopathologic changes, suggesting meaningful tendon changes occur even when part of the tendon remains intact. Meta-analysis of techniques for repair of PASTA lesions has revealed similar American Shoulder and Elbow Surgeons scores, Constant scores, and postoperative pain levels for TCR versus TTR. Despite statistically similar outcome measures, TTR showed a statistically significantly lower retear rate.⁹ A more recent systematic review, however, has suggested statistically significant increased pain and

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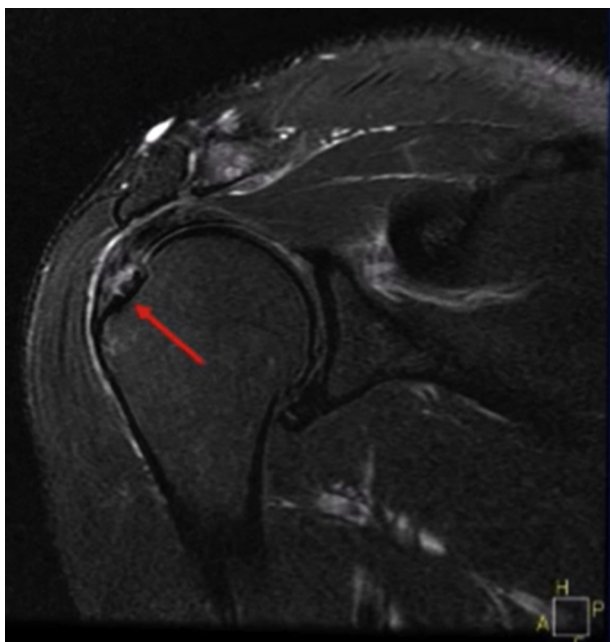


Fig 1. A right shoulder coronal T2 magnetic resonance image shows a high-grade, articular-sided, partial-thickness supraspinatus tendon tear (arrow).

stiffness with TTR compared with TCR at 3-month follow-up.¹⁰ American Shoulder and Elbow Surgeons and Constant scores were lower whereas visual analog pain scores were higher in TTR patients. At final follow-up (>12 months), these early differences did not reach statistical significance.

Special attention must be paid to the overhead athlete, in whom identification of a partial cuff tear may be adaptive to the biomechanics of throwing. Mihata et al.¹¹ found that 34 of 71 asymptomatic college baseball players had partial-thickness rotator cuff tears on ultrasonography. Only 9 of 16 patients who reported shoulder pain showed evidence of a partial cuff tear on ultrasound. This was not statistically different from the asymptomatic group. Therefore, pain and/or loss of function that remains resistant to conservative therapy, in conjunction with supportive magnetic resonance imaging findings, should typically be identified before offering surgical treatment of partial tears in overhead athletes.

In this article, we present a surgically efficient and tissue-conserving arthroscopic technique for articular-sided, partial rotator cuff tear completion and repair. The ninja technique is minimally invasive and allows for optimal rotator cuff and greater tuberosity debridement. It also facilitates the use of techniques very familiar to the surgeon to achieve rotator cuff repair.

Surgical Technique

Preoperative Planning

Careful consideration of patient history, activities, age, and examination findings must be noted before

operative intervention. Special consideration is also given to alternative or concurrent diagnoses for overhead athletes presenting with pain, as illustrated by the high occurrence of both false-positive and false-negative PASTA diagnoses when based solely on patient-reported symptoms. Use of magnetic resonance imaging (Fig 1) and diligent physical examination can also help identify other potentially concurrent pathology.

Patient Positioning

The surgeon may use beach-chair or lateral decubitus positioning. The preference of the senior author (L.D.F.) is to use beach-chair positioning for the treatment of rotator cuff pathology and lateral decubitus positioning for instability. A standard posterior portal is established for systematic evaluation of the glenohumeral joint. After diagnostic arthroscopy, a standard anterior portal is established in the rotator interval.

Rotator Cuff Repair

Step 1. With the arthroscope in the glenohumeral joint, the tear is assessed for medial-to-lateral depth of tendon detachment from the greater tuberosity (Video 1, Fig 2). The medial-to-lateral footprint of the supraspinatus averages 12 mm.¹² Ellman grade III lesions (tear depth > 6 mm, 50%) should strongly be considered for repair.

A spinal needle is then percutaneously advanced through the upper deltoid into the most lateral aspect of the intact supraspinatus tendon fibers and oriented parallel to the slope of the greater tuberosity (Fig 3). In addition, spinal needle insertion parallel to the fibers of the supraspinatus tendon minimizes the risk of

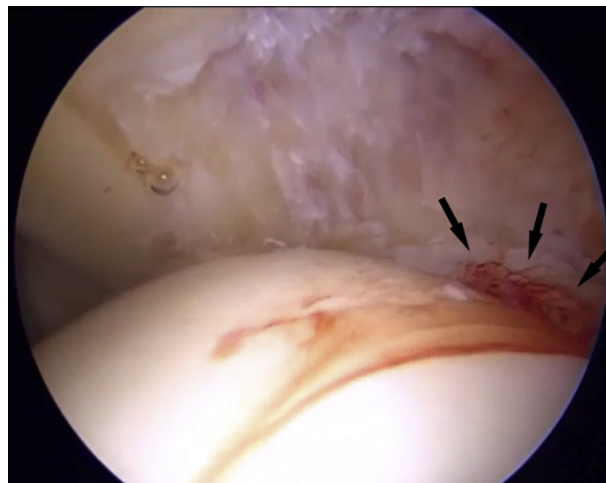


Fig 2. An intra-articular view of the right shoulder with the patient in the beach-chair position shows the clear detachment (arrows) of the supraspinatus tendon from its greater tuberosity insertion.

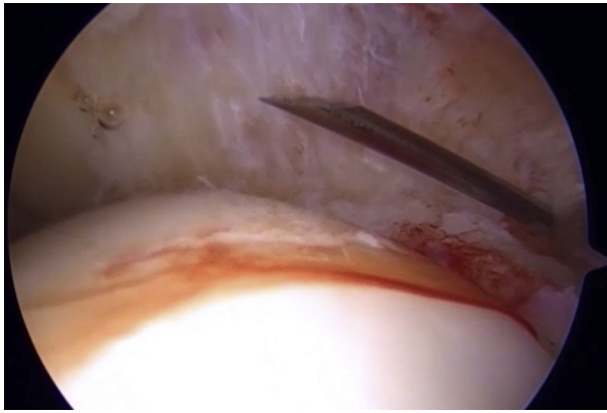


Fig 3. In the right shoulder with the patient in the beach-chair position, a spinal needle is shown after percutaneous insertion. The extent of exposed tuberosity shown indicates a partial-thickness tear of approximately 75% of the medial-to-lateral insertion length of the supraspinatus tendon.

iatrogenic rotator cuff injury when the remaining tendon is released. Placing the spinal needle in the appropriate location and orientation is very important and facilitates percutaneous scalpel insertion. Although this incision should be well away from the axillary nerve, it is important to note that the nerve may be present as close as 5 cm inferior to the anterolateral acromion.¹³

Step 2. The spinal needle is withdrawn, and a standard No. 15 blade scalpel is inserted percutaneously in parallel with the previously established spinal needle track (Fig 4). The blade is introduced into the glenohumeral joint, and the remaining intact rotator cuff tendon tissue is released as close to its insertion as possible to maximize available tissue for subsequent repair. Thus, this technique very efficiently completes the tear while minimizing iatrogenic injury to the detached or adjacent rotator cuff tissue and other structures such as the biceps tendon or articular cartilage. In fact, we coined “ninja” as the name of this technique because, historically, ninja warriors were supremely stealthy and efficient in accomplishing their assigned tasks, often leaving little, if any, trace of their presence at the scene. The precise nature of this ninja technique lies in contrast to, perhaps, the more commonly used technique to complete the tear, which uses an arthroscopic shaver blade. Although effective, release of the remaining intact tendon using a shaver blade puts the rotator cuff tendon at increased risk of excessive damage or even unintentional tissue resection compared with the ninja technique. Similarly, the risk of iatrogenic damage to adjacent structures is likely increased when the arthroscopic shaver is used.

Step 3. The greater tuberosity insertion is debrided after completion of the tear with an arthroscopic shaver

(Dyonics Power II; Smith & Nephew, Watford, England) to improve the potential for bone-tendon healing. Arthroscopically visualizing the tuberosity and articular side of the rotator cuff tendon from a glenohumeral joint perspective usually allows for an improved view compared with visualization using a subacromial perspective because advancing the shaver blade into the rotator cuff defect often obscures the subacromial arthroscopic view of these small tears. In addition, this improved glenohumeral joint view reduces the risk that the shaver may inadvertently damage the rotator cuff tendon, biceps, and articular cartilage (Fig 5).

Step 4. By use of standard techniques at the discretion of the surgeon, the rotator cuff is then repaired. For the case illustrated in this article, the patient underwent repair using a single, triple-loaded anchor incorporating both simple and mattress sutures simulating a modified Mason-Allen construct (Fig 6).

Postoperative Protocol

Postoperatively, the shoulder is maintained in a sling for 4 to 6 weeks. One week after surgery, passive and active-assisted range-of-motion exercises are begun. Active range of motion and progressive strengthening are usually delayed for 4 to 6 weeks after surgical intervention. Full active range of motion and strength are usually achieved by 3 months postoperatively, and patients are then released from formal physical therapy.

Discussion

Rotator cuff tears are a common source of shoulder pain and loss of function. Choosing an appropriate surgical technique for repair requires close attention to

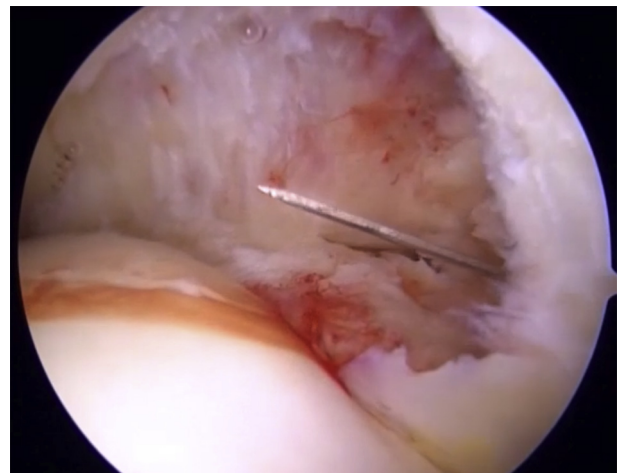


Fig 4. In the right shoulder with the patient in the beach-chair position, following the path established through insertion of the previous spinal needle, a scalpel is advanced to complete the supraspinatus tear.



Fig 5. In the right shoulder with the patient in the beach-chair position, a shaver is shown during debridement of the tuberosity, prior to tendon reattachment.

the patient's history, physical examination findings, and postoperative goals. The ninja technique offers the treating surgeon an expedient treatment pathway. By efficiently completing the partial tear, a complete, unretracted rotator cuff tear is created. In addition, compared with completing the tear using an arthroscopic shaver, the risk of inadvertent excision of rotator cuff tissue or unintentional damage to the cuff is greatly reduced. This simple, complete tear can then be treated using the surgeon's familiar and preferred repair techniques.

The postoperative consequence of arthroscopic rotator cuff repair, whether via TCR or TTR, is a relatively universal acute inflammatory response due to the cellular damage generated during the necessary repair steps. Postoperative pain, swelling, and loss of range of motion are temporary but inevitable byproducts of all commonly performed repair techniques. We speculate

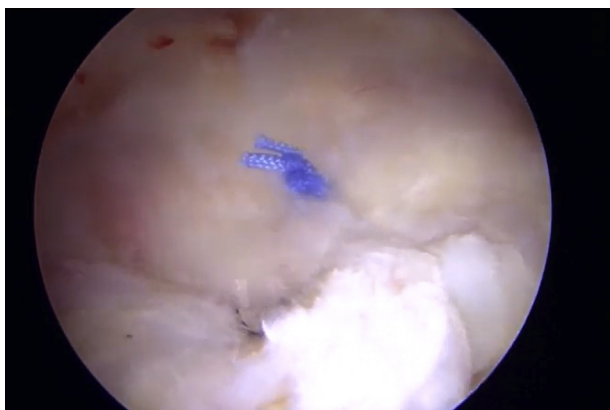


Fig 6. In the right shoulder with the patient in the beach-chair position, as viewed from the subacromial space, the completed supraspinatus repair is seen after use of 1 triple-loaded suture anchor.

Table 1. Pearls and Pitfalls of Ninja Technique for Arthroscopic Completion and Repair of Partial Rotator Cuff Tears

Pitfalls	Pearls
Failure to identify additional, concurrent pain generators	Thorough preoperative examination Careful assessment of advanced imaging Systematic diagnostic arthroscopy
Excessive cuff takedown	Careful placement of spinal needle, tangential to cuff insertion Common path maintained for spinal needle and subsequent scalpel insertion
Failure of repair to heal	Use of techniques familiar to surgeon's practice Careful intraoperative assessment of cuff integrity

that the minimally invasive nature of the illustrated ninja technique may reduce some degree of postoperative pain and stiffness commonly associated with TCR. This is an area of future study. The clinical application of the ninja technique remains especially pertinent for partial cuff tears of Ellman grade III with increased tear depth and/or decreased tissue quality.

One noted potential disadvantage of TCR is the possibility of retear, which has been less frequently noted with TTR in recent publications.¹⁰ In contrast, evidence of the potential for superior biological healing after TCR versus TTR has been observed via published animal models.¹⁴ Regardless of the chosen technique, the involved tendon should be adequately debrided of degenerative tissue before repair is attempted.

Ultimately, the decision between TCR and TTR is made given the clinical details of each case and based on surgeon preference. Overall, the advantages offered by the ninja technique may allow for improved application of TCR within the appropriate cuff pathology cohort. Pearls and pitfalls of the ninja technique are

Table 2. Advantages and Limitations of Ninja Technique for Arthroscopic Completion and Repair of Partial Rotator Cuff Tears

Advantages	
	The ninja technique reduces the risk of iatrogenic rotator cuff tendon injury.
	This technique minimizes the risk of damage to adjacent structures.
	"Familiar" pathology is produced, allowing for commonly used repair methods.
	This technique allows for thorough arthroscopic inspection and debridement of tendon while viewing from the glenohumeral joint.
Disadvantages	
	Percutaneous scalpel insertion puts the adjacent structures at theoretical risk.
	The scalpel blade could potentially break or become detached from the handle.

listed in Table 1. Technique advantages and disadvantages are shown in Table 2.

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