Technical Note

Arthroscopic Middle Trapezius Transfer for Treatment of Irreparable Superior Rotator Cuff Tendon Tears

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Abstract: Irreparable supraspinatus tendon tears are challenging to treat, especially in a young and high-demanding patient population. Whereas interposition tendon grafting and partial repair are limited by the quality of the remaining rotator cuff tendons and muscles, superior capsular reconstruction and subacromial spacers do not provide the active biomechanical principle of a contracting supraspinatus. The purpose of this technical note is to introduce an arthroscopic middle trapezius transfer below the acromion to replace the former supraspinatus unit. This technique might combine the benefits of both the static concepts seen with subacromial spacers or superior capsular reconstruction and dynamic concepts such as interposition grafting and partial repairs.

Irreparable supraspinatus tendon tears (ISTTs) present a treatment challenge, especially in young patients, for whom reverse total shoulder arthroplasty may not be a viable option because of limited longevity and a high risk of complications.[1] Thus, different joint-preserving treatment options have been proposed, such as partial repairs, interposition tendon grafting, subacromial spacers, and superior capsular reconstruction (SCR).[2-6] Despite promising early clinical outcomes of these procedures, interposition tendon grafting and partial repair depend on the still available rotator cuff tendon and muscle tissue whereas SCR and subacromial spacers do not provide the active biomechanical principle of a contracting supraspinatus.

A common salvage option for irreparable tendon tears in general is to perform a tendon transfer because of their independence from the residual muscle and tendon tissue of the torn musculotendinous unit. Several tendon transfer procedures for the treatment of irreparable rotator cuff tendon tears have been described previously and executed frequently for anterosuperior and posterosuperior rotator cuff tendon tears. However, no tendon transfer option for isolated ISTTs other than the delta flap procedure has been proposed so far. Whereas the trapezius is a commonly transferred tendon in patients with pseudoparalysis due to brachial plexus palsy involving the delta muscle,[7] it also may be a viable option in patients with ISTTs. Therefore, the purpose of this surgical note is to describe the technique of an arthroscopic middle trapezius transfer (MTT) as salvage treatment in patients with ISTTs.

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Surgical Technique

Indication

Transfer of the middle trapezius is indicated if (1) patients have shoulder pain and a strength deficit with or without loss of range of motion due to a superior rotator cuff tear; (2) irreparability of the supraspinatus tendon is revealed on magnetic resonance imaging with severe tendon retraction (grade 3 according to the Patte classification) and muscle degeneration (grade 3 or higher according to the Goutallier classification); (3) the integrity or repairability of the horizontal force couple (infraspinatus and subscapularis tendons) is ensured; and (4) the present cuff arthropathy does not exceed stage 2 according to the Hamada classification.

Fig 1. Operative setup. The patient is placed in the beach-chair position with the left arm resting in a pneumatic limb positioner.

Preoperative Setup

The patient is placed in the beach-chair position with sufficient exposure of the affected shoulder including the acromion and the lateral aspect of the spine of the scapula. The operative arm is placed in a pneumatic limb positioner (Spider; Smith & Nephew, Andover, MA). The operative setup is shown in Figure 1.

Diagnostic Arthroscopy and Repair of Horizontal Force Couple

The complete surgical technique is shown in Video 1, and technical pearls and pitfalls are highlighted in Table 1. Important bony landmarks (clavicle, spine of the scapula, acromion, coracoid process, and acromioclavicular joint) are marked, and a standard posterior portal is created.

A 30° scope is used throughout the procedure. An additional anterosuperior working portal within the rotator interval is established, and a diagnostic arthroscopy is performed to assess for any concomitant pathologies. The long head of the biceps tendon, if still present, is treated with a tenotomy or tenodesis. Next, concomitant pathologies can be addressed by chondroplasty, synovectomy, and debridement. The rotator cuff tear is then evaluated for the level of retraction, tissue quality, and mobility. In case of concomitant tears of the subscapularis or infraspinatus, a partial repair is performed using a double-loaded suture anchor in a mattress stitch or Mason-Allen configuration to restore the horizontal force couple and to make the superior tendon defect smaller.

Table 1. Pearls and Pitfalls of Middle Trapezius Transfer

Pearls
Arm abduction and scapular retraction help in decreasing the pathway length between the origin and the new insertion of the middle trapezius tendon. In some cases extension of the transfer by means of a graft might be necessary.
Subperiosteal detachment of the osseous middle trapezius insertion at the acromial insertion is important to (1) provide sufficient and strong tissue to withstand suture rip-through and (2) achieve a sufficient length of the transferred tendon.
The middle trapezius tendon is armed with Krackow stitches to gain sufficient stability.
Pitfalls
An extension of the split too medially while mobilizing the middle trapezius tendon can lead to injury to the accessory nerve.
Injury to the AC joint capsule can occur during tendon harvesting owing to the proximity of the middle trapezius, which curves behind the AC joint.

AC, acromioclavicular.

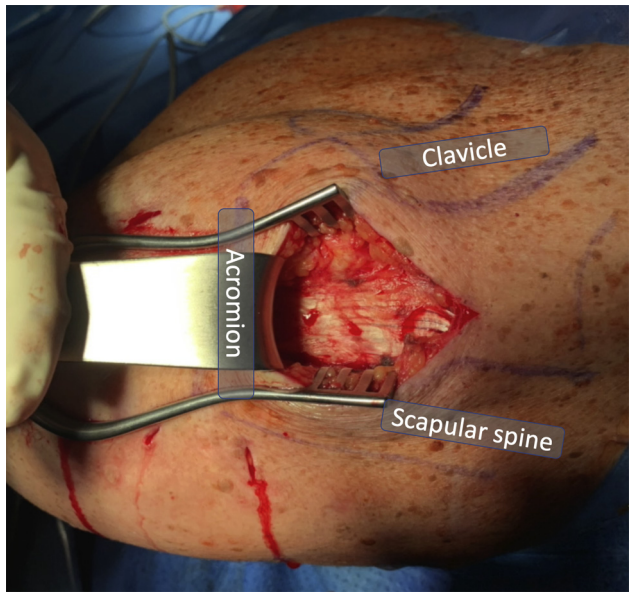

Fig 2. View of a left shoulder from the top with the patient in the beach-chair position. After the clavicle, acromioclavicular joint, acromion, and scapular spine are identified, a 5-cm incision is performed parallel to the anterior border of the spino-acromial junction to harvest the middle trapezius tendon.

Middle Trapezius Tendon Harvest

After the clavicle, acromioclavicular joint, acromion, and scapular spine are identified, a 5-cm incision is performed parallel to the anterior border of the

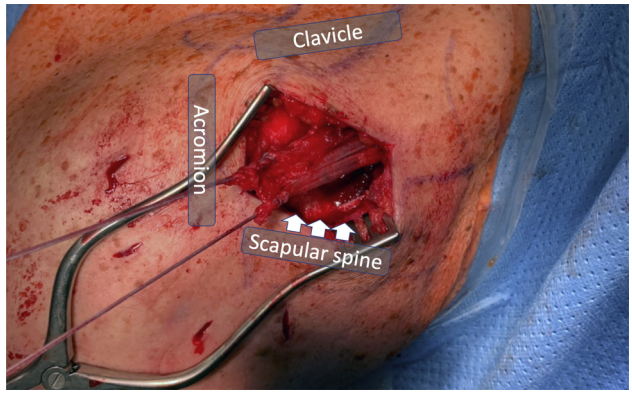

Fig 3. View of a left shoulder from the top with the patient in the beach-chair position. A 3-cm longitudinal split of the trapezius muscle is performed. Care has to be taken not to extend the split too far medially to avoid injuries to the accessory nerve. The released middle trapezius tendon is then armed with 2 No. 2 nonabsorbable sutures in Krackow stitch fashion.

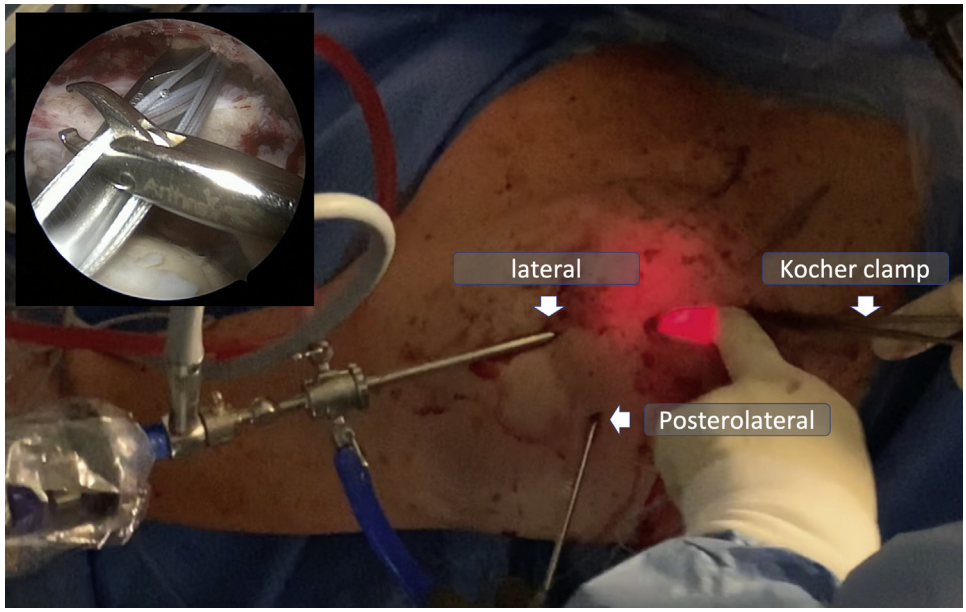

Fig 4. View of a left shoulder from the top with the patient in the beach-chair position. The sutures of the middle trapezius transfer are shuttled underneath the acromion by the use of a Kocher clamp and then captured by an arthroscopic grasper intra-articularly via a posterolateral working portal. The inset shows an arthroscopic image of the left shoulder from the lateral viewing portal.

spino-acromial junction (Fig 2). The osseous insertion of the middle trapezius at the acromion site is sub-periosteally detached, starting as lateral as possible, to increase the length of the harvest. A 3-cm longitudinal split of the trapezius muscle is then performed. Care has to be taken not to extend the split too medially to avoid injuries to the accessory nerve. The released tendon is then armed with 2 No. 2 nonabsorbable sutures in Krackow stitch fashion (Fig 3). Underneath the released trapezius muscle, the remnants of the supraspinatus muscle in the fossa supraspinata can be identified. The space under the acromion is then freed by blunt dissection to create space for later muscle transfer.

Middle Trapezius Transfer

The sutures are shuttled underneath the acromion by the use of a Kocher clamp; then, the sutures are separated and captured by an arthroscopic grasper intra-articularly coming from a posterolateral portal (Fig 4). Next, lateral fixation of the MTT is performed equally to a standard rotator cuff repair in a lateral single-row fashion: Additional working portals (anterolateral, lateral, and posterolateral) are established as needed and possibly secured by cannulas. The greater tuberosity is debrided with an oscillating shaver until a flush and bleeding surface is achieved. Next, the anterior sutures of the MTT graft are shuttled through the anterolateral portal and the posterior sutures are then shuttled via the lateral portal, while the posterolateral portal is used as the viewing portal (Fig 5). Two self-punching suture anchors with a metal tip (5.5-mm PEEK [polyether ether ketone] SwiveLock anchor; Arthrex, Naples, FL), each loaded with a suture pair, are inserted at the greater tuberosity. The anchor distance in the anteroposterior direction equals the anteroposterior length of the harvested MTT autograft. Scapular retraction and slight abduction of the arm help to reduce the tension on the transfer. The final MTT is shown in Figure 6.

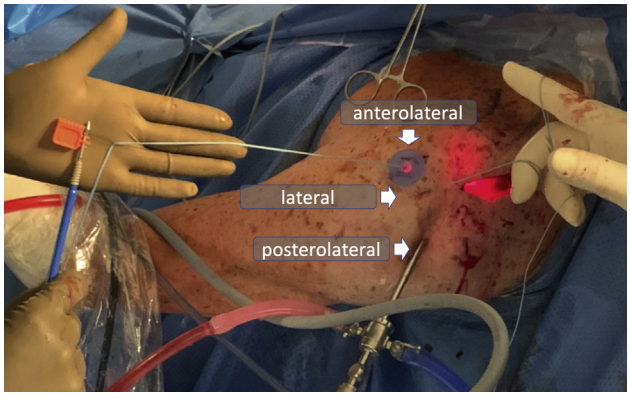

Fig 5. View of a left shoulder from the top with the patient in the beach-chair position. The anterior sutures of the middle trapezius transfer are shuttled through the anterolateral portal, and the posterior sutures are then shuttled via the lateral portal.

Postoperative Care

Immediately after surgery and for 6 weeks postoperatively, the affected arm is supported with an abduction sling. Within the first 6 weeks, only pain-free passive range of motion is permitted. To improve tendon healing, a gradual increase in passive motion starting in week 4 is encouraged. At week 7, active full range-of-motion exercises are started.

Discussion

The surgical management of ISTTs remains challenging, and the gold standard, especially in a young

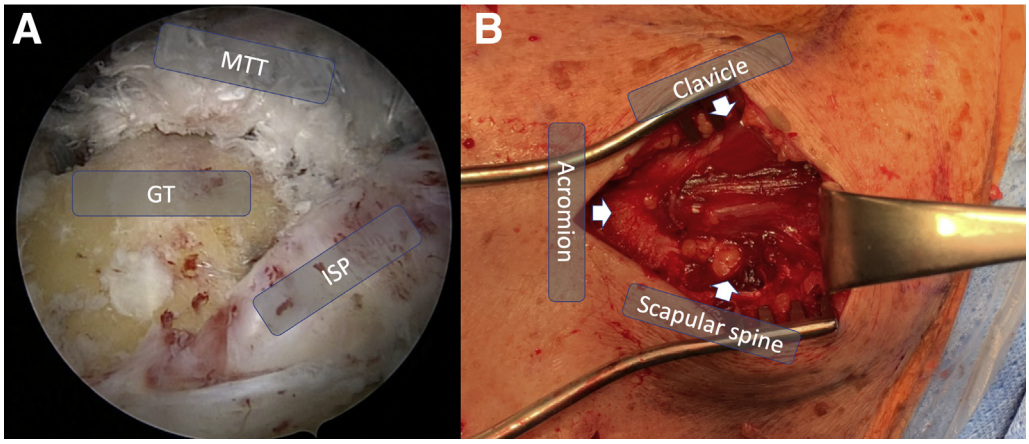

Fig 6. View of a left shoulder from the top with the patient in the beach-chair position. The final arthroscopic view (A), via the posterolateral portal, visualizing the greater tuberosity (GT) with partial repair of the infraspinatus tendon (ISP) and the final middle trapezius transfer (MTT) that is shuttled underneath the acromion as visible on the outside view of the left shoulder from the top (B).

and high-demanding population, has not been established yet. Partial rotator cuff repairs have been shown to be successful in elderly patients, but in a young and active population, the benefits are limited as tear size and symptoms progress over time.[8] Recently, static subacromial spacing concepts have been introduced, as seen with subacromial balloon spacers[3] or SCR,[4] with promising early clinical results but also high failure rates. The concept of both procedures is to statically stabilize the humeral head to produce functional improvements. However, these procedures lack the dynamic biomechanical component of a healthy supraspinatus that actively supports the flexion and abduction process of the arm. Furthermore, with SCR, the graft loses its tension and, furthermore, its stabilizing effect at higher abduction angles.[9] Structural SCR failure rates of approximately 50% using allografts and approximately 5% using autografts were reported. In a recent systematic review, the overall complication rate was 17% for SCR.[10]

Several tendon transfers for irreparable rotator cuff tendon tears have been described. Common transfer options include pectoralis major and latissimus dorsi transfer for anterosuperior tears and latissimus dorsi and lower trapezius transfer for posterosuperior tears. For isolated superior rotator cuff tendon tears, no tendon transfer other than the deltoid flap procedure has been described yet.

The trapezius has been proposed as a tendon transfer option for irreparable rotator cuff tendon tears

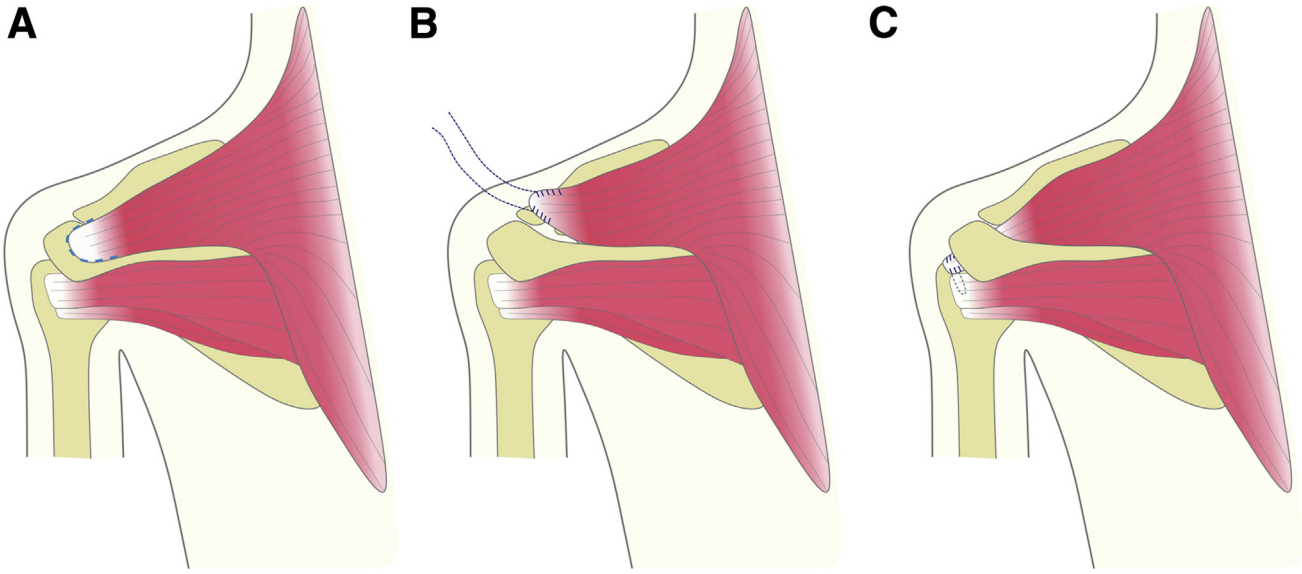

Fig 7. Middle trapezius transfer with tendon harvest at the acromion—scapular spine site (A), shuttle process of the Krackow-stitched tendon stump (B) underneath the acromion, and final fixation to the greater tuberosity (C).

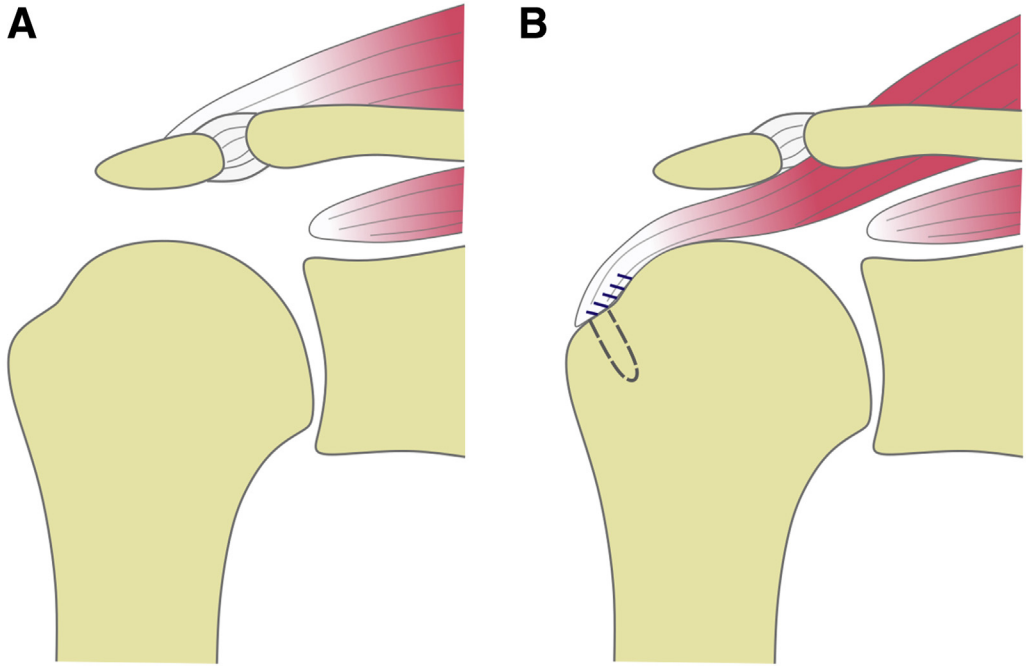

Fig 8. (A) Retracted and irreparable supraspinatus tendon stump preoperatively. (B) Middle trapezius transfer is performed underneath the acromion as a salvage option to treat irreparable superior rotator cuff tears.

previously. Transfer of the upper trapezius was attempted to replace irreparable subscapularis tendon tears; however, outcomes were dissatisfactory.[11] Transfer of the lower trapezius was reported for the treatment of irreparable infraspinatus tendon tears, showing promising preliminary results.[12] In addition, trapezius transfers have been performed for many years in patients with brachial plexus palsies and delta muscle insufficiencies to counteract abduction paralysis.[7] The described techniques mostly involve osteotomy of the scapular spine, acromion, or clavicle with detachment of the deltoid, transposition of the acromion to the humerus, and reinsertion of the deltoid on the trapezius. The reported functional gains in abduction seem minor at first; however, they can still be considered quite impressive given the adverse initial situation with true paralysis of the cuff and the deltoid muscle. Patients with superior rotator cuff tendon tears can present with pain and loss of strength with or without pseudoparesis but typically with a functioning deltoid muscle. Therefore, the rationale behind the introduced MTT is to transpose the acromial portion of the middle trapezius through the subacromial outlet and reattach it to the former footprint of the supraspinatus while the deltoid and acromion are kept intact (Figs 7 and 8). If successful, this transfer could provide a viable replacement to the superior aspect of the rotator cuff that mimics its characteristics in terms of tendon dimension and force vector. The static spacing and the dynamic joint-centering effect might combine the benefits of both the static concepts seen with subacromial spacers or SCR and dynamic concepts such as interposition grafting (Table 2).

Table 2. Advantages and Disadvantages of Middle Trapezius Transfer

Advantages
Arthroscopic procedure to replace the superior aspect of the rotator cuff
Combination of static spacing and dynamic joint-centering effect
Easy harvesting of middle trapezius at its acromial insertion
No need for osteotomy of the scapular spine, acromion, or clavicle
Combination with additional procedures such as partial repair of the horizontal force couple and tenotomy of the long head of the biceps
Disadvantages
Potential donor-site morbidity
Risk of injury to the accessory nerve
Higher costs owing to the use of additional sutures and suture anchors compared with partial repair

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