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.

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 reparability 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.
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.

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 spinop-acromial junction to harvest the middle trapezius tendon.

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.
spino-acromial junction (Fig 2). The osseous insertion of the middle trapezius at the acromion site is subperiosteally 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 working portal. The final MTT is shown in Figure 6.

**Postoperative Care**

Immediately after surgery and for 6 weeks post-operatively, 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
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. Recently, static subacromial spacing concepts have been introduced, as seen with subacromial balloon spacers or SCR, 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. 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.

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 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).

**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).
previously. Transfer of the upper trapezius was attempted to replace irreparable subscapularis tendon tears; however, outcomes were dissatisfactory. Transfer of the lower trapezius was reported for the treatment of irreparable infraspinatus tendon tears, showing promising preliminary results. In addition, trapezius transfers have been performed for many years in patients with brachial plexus palsies and delta muscle insufficiencies to counteract abduction paralysis. 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 acronion 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                                                                 | Disadvantages                                |
|----------------------------------------------------------------------------|----------------------------------------------|
| Arthroscopic procedure to replace the superior aspect of the rotator cuff | Potential donor-site morbidity                |
| Combination of static spacing and dynamic joint-centering effect          | Risk of injury to the accessory nerve        |
| Easy harvesting of middle trapezius at its acromial insertion              | Higher costs owing to the use of additional sutures and suture anchors compared with partial repair |
| 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 |                                              |

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