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Surgical anatomy of the lower trapezius tendon transfer

Reza Omid, MD*, Matthew J. Cavallero, MD, Danielle Granholm, BS, Diego C. Villacis, MD, Anthony M. Yi, BS

Orthopaedic Surgery Department, University of Southern California Keck School of Medicine, Los Angeles, CA, USA

Background: The precise surgical anatomy of the lower trapezius tendon transfer has not been well described. A precise anatomic description of the different trapezius segments and the associated neurovascular structures is crucial for operative planning and execution. We aimed (1) to establish a reliable demarcation between the middle and lower trapezius, (2) to establish the precise relationship of the main neurovascular pedicle to the muscle belly, and (3) to evaluate the utility of the relationships established in (1) and (2) by using the results of this study to perform cadaveric lower trapezius tendon harvest.
Methods: In phase 1, a single surgeon performed all measurements using 10 cadavers. In phase 2, 10 cadaveric shoulders were used to harvest the tendon by using the relationships established in phase 1.
Results: We found anatomically distinct insertion sites for the lower and middle trapezius. The lower trapezius inserted at the scapular spine dorsum and the middle trapezius inserted broadly along the superior surface of the scapular spine. The distance from tip of tendon insertion to the nearest nerve at the most superior portion of the lower trapezius was 58 mm (standard deviation ± 18). By use of these relationships, there were no cases of neurovascular injury during our cadaveric tendon harvests.
Conclusion: The lower trapezius can be reliably and consistently identified without violating fibers of the middle trapezius. Muscle splitting can be performed safely without encountering the spinal accessory nerve (approximately 2 cm medial to the medial scapular border).
Level of evidence: Basic Science Study, Anatomy, Cadaver Dissection.

Keywords: Surgical anatomy; surgical landmarks; lower trapezius; tendon transfer; cadaveric study; spinal accessory nerve

Numerous surgical options have been proposed for irreparable rotator cuff tears, including rotator cuff débridement,[6] partial rotator cuff repair,[10] biceps tenotomy or tenodesis,[17] tendon transfer,[7] and arthroplasty.[13] There exists concern with arthroplasty regarding longevity of implant survivorship in the population of younger, more active patients. Such concern often precludes the use of arthroplasty in this specific population. As such, tendon transfers may offer a more reasonable and acceptable option to decrease pain and to improve function for younger patients.

Classically, the latissimus dorsi tendon transfer was performed for posterosuperior rotator cuff-deficient shoulders

Institutional Review Board approval was not necessary for this cadaveric, basic science study.

*Reprint requests: Reza Omid, MD, Division of Shoulder and Elbow/Sports Medicine Service, Department of Orthopaedic Surgery, University of Southern California, Keck School of Medicine, 1520 San Pablo St, Suite 2000, Los Angeles, CA 90033, USA.

E-mail address: Omid@usc.edu (R. Omid).

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with the goal of restoring elevation and external rotation and providing a more balanced biomechanical state to the glenohumeral joint. However, the mechanism by which the latissimus dorsi tendon transfer exerts its effects remains controversial. Trapezius transfers have previously been described in the literature, with historically poor results being attributed to elongation of the fascia lata augmentation and scarring.[14,15] Of note, most early published reports involved the isolated transfer of the upper portion of the trapezius.[1,9,11,15] More recently, the lower trapezius transfer has been used successfully to improve elevation and external rotation in patients with brachial plexopathies.[2,4,5]

The lower trapezius tendon transfer may provide a more direct line of pull that improves external rotation relative to other tendon transfers. Despite limited evidence supporting its use, the lower trapezius tendon transfer may be a viable alternative option for patients with irreparable posterosuperior rotator cuff tears. Of note, a recent cadaveric biomechanical study illustrated that the lower trapezius transfer resulted in superior restoration of shoulder external rotation with the arm at the side relative to the latissimus dorsi tendon transfer.[8]

The anatomy of the trapezius muscle, with its demarcations into upper, middle, and lower thirds, is poorly defined. Identifying and distinguishing the lower trapezius fibers represent some of the greatest intraoperative challenges during trapezius tendon transfers. Further, the middle and lower trapezius segments are vital structures that support scapular motion, especially if a patient requires subsequent glenohumeral fusion. Proper identification of the lower trapezius is thus essential. There also exist concerns for denervation during splitting of the middle and lower trapezius during trapezius tendon transfer as the relationship of the neurovascular pedicle within the muscle belly has not been well established (Fig. 1). Most of the current pertinent literature focuses on the anatomy of the upper trapezius, in the region of the posterior triangle of the neck.[12,16] Dailiana et al[3] described the location of the spinal accessory nerve intramuscularly, but only briefly commented that the intramuscular portion ‘‘followed an oblique caudal course towards the middle and lower parts of trapezius.’’ A more precise anatomic description is necessary for operative planning.

The purpose of this cadaveric study was to better define the surgical anatomy of the trapezius transfer by (1) establishing a reliable demarcation between the middle and lower trapezius, (2) establishing the precise relationship of the main neurovascular pedicle to the muscle belly at the level of the muscle splitting, and (3) evaluating the utility of the relationships established in purposes (1) and (2) by using the results of this study to perform cadaveric lower trapezius tendon harvests.

Materials and methods

A cadaveric anatomy study consisting of 2 phases was performed. The first phase consisted of defining the precise anatomy of the trapezius muscle and its neurovascular pedicle in 20 cadaveric shoulders. The second phase involved using this information to perform trapezius tendon harvests in 10 cadaveric shoulders through limited incisions in an effort to determine the utility of relying on the relationships determined in the first phase.

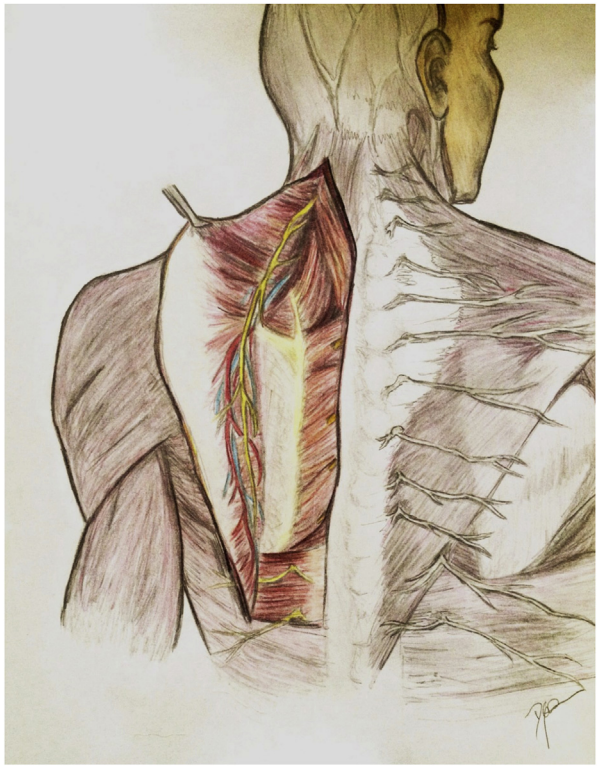

Figure 1 An illustration demonstrating the neurovascular pedicle within the trapezius muscle belly.

Phase 1

Ten fresh frozen adult cadavers (20 shoulders) were obtained from the Los Angeles County Fresh Tissue Dissection Laboratory/Surgical Skills Center. Each specimen was secured in the prone position, and a wide T-shaped incision was made. Both the skin and subcutaneous tissue were reflected to expose the origin and insertions on the scapula (Fig. 2, *A*). Next, the triangular aponeurosis, which corresponds to the middle trapezius, was identified, and its caudal and rostral extent was noted by counting the spinous processes (the C7 vertebra served as a reference point). We then noted the inferior extent of the lower trapezius origin.

During our dissections, we confirmed that the middle trapezius (corresponding to the area of aponeurosis) inserts broadly along the scapular spine when it is traced laterally. The lower trapezius fibers, beginning at the spinous process inferior to the triangular aponeurosis, converge at its insertion on the dorsal surface of the scapula at the dorsal trapezius tubercle. The length of the tendinous portion of the lower trapezius and the width at the myotendinous junction were measured. All measurements were performed with a hand-held sliding digital caliper (General Tools & Instruments, New York, NY, USA). Measurements were performed by a single observer.