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ORIGINAL ARTICLE

Latissimus dorsi transfer for irreparable subscapularis tendon tears

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Background: There are several tendon transfers for reconstruction of irreparable subscapularis tears. The latissimus dorsi (LD) could be used because its direction and function are similar to those of the subscapularis. We performed LD transfers for irreparable subscapularis tears and evaluated clinical outcomes.
Methods: The study enrolled 24 consecutive patients who underwent LD transfers. Clinical and functional outcomes were evaluated using the Constant score, American Shoulder and Elbow Surgeons score, pain visual analog scale, and range of shoulder motion preoperatively and at last follow-up. The lift-off and belly-press tests were performed to assess subscapularis integrity and function. Magnetic resonance imaging was performed preoperatively and 1 year postoperatively to evaluate tendon integrity.
Results: Mean Constant, American Shoulder and Elbow Surgeons, and pain scores improved from 46 ± 6 to 69 ± 5 ($P < .001$), from 40 ± 3 to 70 ± 5 ($P < .001$), and from 6 ± 1 to 2 ± 1 ($P = .006$), respectively. The mean range of motion for forward elevation and internal rotation increased from 135° ± 17° to 166° ± 15° ($P = .016$) and from L5 to L1 ($P = .010$), respectively. Improvement in the range of motion for external rotation was not significant (51° ± 7° to 68° ± 7°; $P = .062$). At final follow-up, the belly-press test results were negative for 18 of 24 patients, and the lift-off test results were negative for 16 of 20 patients. No complications related to tendon transfer, including axillary and radial nerve injuries, were found. No retearing of the transferred LD was observed.
Conclusions: LD transfer resulted in pain relief and restoration of shoulder range of motion and function. LD transfer could be considered an effective and safe salvage treatment for irreparable subscapularis tears.
Level of evidence: Level IV; Case Series; Treatment Study

Keywords: Shoulder; subscapularis tear; latissimus dorsi transfer; irreparable rotator cuff tear; pectoralis major transfer; tendon transfer

Irreparable subscapularis tendon tears result in anteroposterior imbalance of the force couple around the glenohumeral joint, with pain and loss of active internal rotation.[7] Furthermore, when a concomitant supraspinatus tendon tear occurs, it induces vertical imbalance of the glenohumeral joint, resulting in anterosuperior migration of the humeral head and loss of active elevation of the shoulder.[24] However, only a few techniques for subscapularis reconstruction have been

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introduced for irreparable tears. Several authors have advocated musculotendinous transfer to substitute for subscapularis muscle function in active or young patients without arthritis in the glenohumeral joint.[6,29,32]

Various musculotendinous transfers, such as with the pectoralis major (PM), pectoralis minor, and latissimus dorsi (LD), have been introduced as substitutes for subscapularis function.[15,21,24] Among musculotendinous transfers, PM transfer has been the most commonly used. PM transfer has been described in different forms, with passage of the sternal head or clavicular head, or both, and passing the PM tendon over or under the conjoined tendon, with variable outcomes.[14,18,24,33] Although pain is usually improved with PM transfer, recovery of strength, active motion, and stabilization of anterosuperior migrated humeral heads have been reported to be unsatisfactory.[4,5,14,20,24] Recently, an LD transfer for irreparable subscapularis tendon tears has been attempted. In an anatomic cadaveric study, Elhassan et al[3] demonstrated that LD transfer for irreparable subscapularis tears is possible, with no risk for nerve impingement. However, prior reports of LD transfers for irreparable subscapularis tears were anatomic cadaveric studies or single case reports, and no study to our knowledge has reported results of an LD transfer case series.

The purpose of this study was to introduce an LD transfer technique for reconstruction of irreparable subscapularis tears and to evaluate its short-term clinical outcomes. We hypothesized that LD transfer for irreparable tears of the subscapularis would be a reasonable treatment method because of the biomechanical properties and anatomic feasibility of LD.

Materials and methods

Between January 2013 and February 2015, this study enrolled 24 consecutive patients with irreparable subscapularis tendon tears who underwent LD tendon transfer. The inclusion criteria were as follows: a painful shoulder with a massive, irreparable subscapularis tendon tear that was confirmed with preoperative magnetic resonance imaging (MRI) and intraoperatively; patients younger than 65 years; other intact or reparable rotator cuff tears; intact deltoid function; availability for MRI evaluation preoperatively and 1 year postoperatively; and availability for clinical assessment preoperatively and at a minimum of 2 years after surgery. A subscapularis tear was considered irreparable when grade III retraction at the glenoid level was present, according to the Patte classification,[23] or when grade III or grade IV fatty infiltration, according to the Goutallier classification,[9] was seen on preoperative MRI. The irreparability of the subscapularis tendon was confirmed intraoperatively when the retracted subscapularis tendon could not be reached to the medial edge of the lesser tuberosity despite conventional techniques of mobilization and soft tissue releases. The exclusion criteria were as follows: patients with arthritis in the glenohumeral joint, as seen on a radiograph; partial repair of or irreparable posterosuperior cuff tear; and brachial plexus or other nerve injuries.

A total of 32 patients diagnosed with irreparable subscapularis tears on preoperative MRI were selected to undergo LD transfer. Of these 32 patients, 2 were excluded because of partial repair of the concomitant posterosuperior cuff tear, and 6 patients with subscapularis tears underwent repair with the open technique. Finally, a total of 24 patients underwent an LD transfer for irreparable subscapularis tears. They were followed up for an average of 27.8 ± 3.1 months (range, 24-32 months), and none was lost to follow-up. LD transfers for 2 patients were revision operations that were required because of failed subscapularis repairs. The remaining 22 LD transfers were the primary procedure.

Surgical technique

Before surgery, the patient was positioned in the beach chair position under general anesthesia with an interscalene block. Surgery was performed by 1 orthopedic surgeon. A standard deltopectoral approach was used, and a skin incision of approximately 7-10 cm was created. A tenotomy or tenodesis of the long head of the biceps was performed in all patients, unless the biceps tendon was ruptured. The lesser tuberosity was exposed, and the retracted stump of the torn subscapularis tendon was usually found in the subcoracoid space. The musculocutaneous and axillary nerves were identified and protected from any damage. For all patients, an attempt was made to mobilize and to repair the remaining subscapularis tendon. When repair was not possible, the LD tendon was harvested (Fig. 1). The proximal third of the PM tendon was detached at its humeral insertion. Then, the LD tendon insertion, which lies deep in the PM tendon, was exposed (Fig. 2). We dissected the tendinous insertion of the LD proximally and distally to separate it from the teres major. When the tendon of the LD and the teres major were separated completely, the LD tendon was detached at its humeral insertion. Nonabsorbable sutures (Ethibond No. 2; Ethicon Inc., Somerville,

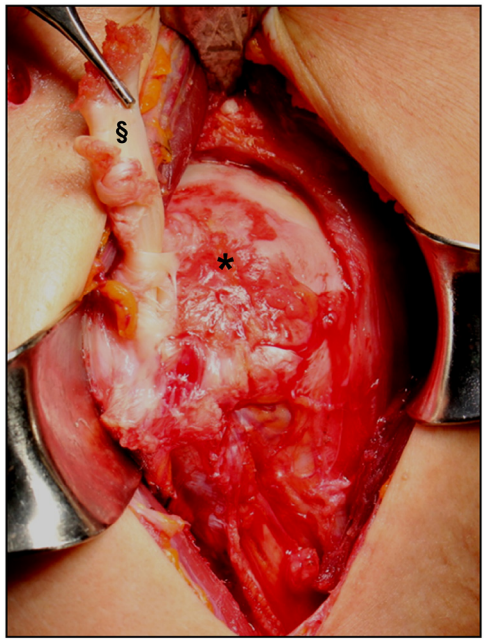

Figure 1 Intraoperative image of the shoulder showing our standard deltopectoral approach for exposing the shoulder in patients with massive anterosuperior rotator cuff tears. The lesser tuberosity (*) is exposed, and the diseased long head of the biceps (§) is tenotomized. A torn subscapularis tendon is not observed on the lesser tuberosity; it retracted to the subcoracoid space.