

Outcome of latissimus dorsi transfer as a salvage procedure for failed rotator cuff repair with loss of elevation

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Eighteen patients, referred from an outside institution with massive, irreparable rotator cuff tears and loss of elevation, were treated with a latissimus dorsi tendon transfer as a salvage procedure for failed, prior, attempted rotator cuff repair. Clinical outcomes were measured by the American Shoulder and Elbow Surgeon's (ASES) score, pain level, and active range of motion. The average postoperative ASES score was 61, an increase from 43 pre-operatively ($P = .05$). Active elevation improved to an average of 137° compared to 56° pre-operatively ($P < .001$). The average post-operative pain level was 22 mm, down from 59 ($P = .001$), and the average post-operative active external rotation at the side was 45°, improved from 31° ($P < .001$). We conclude that latissimus transfer, as a salvage procedure for failed rotator cuff repair with loss of elevation, allows for significant return of active elevation and function with minimal post-operative pain. (J Shoulder Elbow Surg 2008; ■: ■-■.)

Massive, irreparable rotator cuff tears can be associated with persistent pain and significant disability.^{6,15,23,24} Chronic tendon deficiency can lead to degradation of tendon tissue quality, fatty infiltration of muscle, and superior migration of the humeral head.^{6,10,11,30,31} There have been a number of suggested solutions to this problem, including debridement,²⁸ partial rotator cuff repair,⁴ subscapularis tendon transfer,² transfer of the subscapularis and teres minor,²¹ transfer of the long head of the triceps,¹⁶ transfer of the teres major,²⁹ interposition of a biceps tendon autograft,²¹ a freeze-dried rotator cuff allograft,²² and use of synthetic grafts.²⁶ The results of these procedures have been highly dependent

on multiple factors, including the quality of the local tendinous tissue and the mobility or viability of the torn cuff muscles.²³

Gerber described transferring the latissimus dorsi for symptomatic, irreparable cuff tears as a method of closing the defect and producing an external rotation and head stabilizing moment to allow better function of the deltoid and pain relief.⁸ This technique, as a primary treatment with an intact subscapularis and deltoid origin, has been shown to produce at least some improvement in function and pain relief.^{1,5,7,8,12,30} A few reports of its use as a salvage procedure for failed rotator cuff repair also show an improvement in pain and function postoperatively.^{7,20,30} However, it has also been shown that transfers for salvage produce less improvement than they do as a primary procedure.^{7,30} It has also been suggested that, although there is improvement in pain and function after a latissimus transfer as a salvage procedure, the postoperative functional level is still at a disability level.²⁰

The purpose of this study is to evaluate the outcome of latissimus dorsi transfer as a salvage procedure for patients with a prior failed rotator cuff repair, who had persistent pain and were unable to elevate the arm to shoulder height, resulting in loss of function. We hypothesize that the outcomes would show improvement to a level of function, which allowed patients to overcome their disability and return to activities of daily living.

MATERIALS AND METHODS

From 2000 to 2007, latissimus dorsi transfer was performed on 19 consecutive patients for massive irreparable posterosuperior rotator cuff tears, with between 1 and 4 failed previous attempts at repair, progressive and persistent pain, and loss of function. All but one patient had the prior attempt at repair done elsewhere and were referred for evaluation and treatment. Diagnosis was based on a clinical history of rotator cuff repair with progression of symptoms, clinical exam, and magnetic resonance imaging (MRI) demonstrating a massive rotator cuff tear. No patient had evidence of anterosuperior escape. Of the 19 patients, 18 were available for follow-up. Follow-up was performed by an independent evaluator not involved in the surgery or post-operative care.

The average age was 60 (range, 48-74), with 14 males and 4 females. Eight of 18 (44%) had surgery on the dominant extremity. One of the 18 had 4 prior failed surgeries

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(6%), 9 (50%) had 2 prior unsuccessful attempts at repair, and 8 (44%) had 1 prior failed repair.

Clinical assessment consisted of both objective and subjective measures. Each patient filled out a preoperative and postoperative American Shoulder and Elbow Surgeon's (ASES) standardized assessment form. Active forward elevation, external rotation at the side, and external rotation in abduction in the plane of the scapula were measured with a goniometer both pre- and postoperatively. The lift-off test and the abdominal press test were also performed to ensure subscapularis integrity, which is required for latissimus transfer success. Motor strength for elevation and external rotation at the side was tested using the manual muscle testing scale (Medical Research Council).¹⁸ Pain was assessed as part of the ASES form both pre- and postoperatively. The patients were also asked if they would undergo the procedure again as a measure of satisfaction.

Surgical technique

All patients underwent a diagnostic arthroscopy first to assess the presence of residual rotator cuff, and to attempt to mobilize and repair any remaining tendons. All tears were greater than 5 cm, torn to the level of the glenoid and classified as massive, as defined by Post et al.²⁷ The supraspinatus and infraspinatus were completely torn and the teres minor was partially torn in all cases. The subscapularis was not involved in any case. There was no case in which adequate mobilization or partial repair of the rotator cuff was possible. None of the shoulders showed any evidence of arthropathy.

After completion of arthroscopy, the patients underwent the surgical approach and technique, which has been previously described.^{8,20} The leading edge of the latissimus was sutured to the subscapularis tendon. It was then secured to the greater tuberosity with suture anchors and then, if possible, sutured medially to any remnants of the supraspinatus and infraspinatus tendons.

The extremity was immobilized in 30 degrees of abduction and forward flexion with 0-15 degrees of external rotation in a brace worn day and night for 6 weeks. Passive range of motion exercises consisting of elevation in the plane of the scapula and external, but not internal, rotation, were begun at 48-72 hours post-operatively. Immobilization was discontinued in the 6th week, and active range of motion exercises were begun. Progressive strengthening was started after 12 weeks.

Statistical analysis of continuous variables was carried out with a student *t* test assuming equal variances. *P* values of $\leq .05$ were considered significant. Microsoft Excel's® data package was used for the analysis.

RESULTS

All patients had a minimum follow-up of 12 months, with an average follow-up of 25 months (range, 12-62 months). One patient had a failure consisting of a late latissimus rupture. This patient had 2 prior attempted rotator cuff repairs and, at the time of the latissimus transfer, was noted to have a deficient deltoid origin, which was repaired.

Table I Pre- and postoperative clinical assessment measure values

	Pre-op avg.	Range	Post-op avg.	Range	<i>P</i> value
ASES*	43	13-57	61	42-90	.05
VAS**	59	20-100	22	0-60	.001
Active ER at Side	31	20-40	45	30-70	< .001
Active ER in Abd ⁺	75	50-85	80	70-90	.20
Active Elevation	56	20-80	137	90-170	< .001
Passive Elevation	126	110-150	146	127-180	.02
Elevation Strength ⁺⁺	3	3-4	3.7	3-4	.02
ER at Side Strength	3.6	3-4	4.4	4-5	.01

*American Shoulder and Elbow Surgeon's standardized assessment score.

**100mm Visual Analog Scale for pain assessment.

⁺Abduction in plane of scapula.

⁺⁺Manual Muscle Test, Medical Research Council Scale.

The ASES score improved from an average of 43 (range, 13-57) preoperatively to 61 (range, 42-90) postoperatively ($P = .05$). Seventeen (94%) of the patients were satisfied with their result and said they would have the surgery again.

Pain, as measured by a 100 mm visual analog scale on the ASES, improved from an average of 59 (range, 20-100) pre-operatively to 22 (range, 0-60) postoperatively ($P = .001$), with a lower score indicating less pain.

Active elevation improved from an average of 56 degrees (range 20-80) preoperatively to 137 degrees (range 90-170) postoperatively ($p < 0.001$). Passive elevation also improved slightly (Table I). Active external rotation at the side improved from an average of 31° (range, 20-40) pre-operatively to 45° (range, 30-70) ($P < .001$) postoperatively (Table I). Active external rotation with abduction in the plane of the scapula was 75° pre-operatively (range, 50-85) and 80° postoperatively (range, 70-90), and showed no significant difference ($P = .20$).

Elevation and external rotation strength at the side showed slight improvement that was statistically significant (Table I); however, the clinical significance of this improvement is not known.

DISCUSSION

Revision surgery for failed rotator cuff repair has had variable success, with some pain relief and variable improvement in function.^{3,24} The success is highly dependent on the quality of the local tendinous tissue and the mobility and viability of the torn cuff musculature.²³ Latissimus dorsi transfer as a primary treatment for irreparable rotator cuff tears has shown moderate improvement in pain and function.^{1,5,7,8,14,30} However, the procedure as a salvage for failed rotator cuff repair has shown mixed outcomes.

In Aoki's series, 2 patients who underwent the procedure as a salvage had poor subjective outcomes and no improvement in active elevation.¹ Warner and Parsons analyzed primary and salvage latissimus transfer reconstructions comparatively, and found that primary reconstructions had greater improvements in pain and function. The salvage transfers did produce significant improvements in pain and function, but to a lesser degree. The primary transfers had postoperative active elevation of 122° (increase of 62°) and an average Constant score of 69% (increased from 37%), whereas the revisions had 105° active elevation (increase of 61°) and an average Constant score of 52% (up from 32%). There was a high rupture rate in the salvage group (44%) compared to the primary group (17%). They also found that the revisions that had the worst postoperative active elevation had deltoid deficiency intraoperatively.³⁰

In their series of 17 salvage transfers, Miniaci et al found satisfactory outcomes in 82% of the patients based on the UCLA rating scale. There was significant pain relief and functional improvement in all patients, regardless of whether the deltoid was intact or deficient, with an average postoperative active elevation of 100° (an increase of 59°). They also noted that those patients with subscapularis tears also showed comparable improvement. Additionally, the average postoperative UCLA score was 16.4, which they acknowledge is moderately disabled at best.²⁰

The most recent report from Gerber et al also shows that, when comparing revisions to primary reconstructions, the revisions had worse ultimate outcomes but nearly comparable improvement in pain relief and function.⁷ It should also be noted that workers' compensation²⁰ and patients with unsatisfactory subjective evaluation of their condition^{7,14} were associated with worse clinical outcomes.

In our series, latissimus transfer as a salvage procedure for failed rotator cuff repair showed improvement in active forward elevation, active external rotation at the side, ASES score, and pain relief at a minimum of 12 months. In a series of 100 full-thickness rotator cuff repairs, Hawkins et al showed that patients attained their maximal improvement at 1 year follow-up, and had no additional improvement thereafter.¹³ In our patients, active forward elevation was markedly improved to a postoperative average of 137°, in a population that had significant disability preoperatively. The average postoperative ASES score was 61, which is comparable to patients who have successfully undergone a primary rotator cuff repair.¹⁷ The average improvement in ASES score was 18, which is 3 times the change in score required for a minimum, clinically detectable difference.¹⁹ In addition, 94% of the patients in our series were satisfied with their outcome and stated they would undergo the procedure again.

The 1 late rupture was noted intra-operatively to have deficiency of the deltoid.

Limitations of this study include being retrospective in nature, lacking randomization, and having no control group for comparison. However, these patients had already failed prior attempts to repair the cuff, did not have sufficient quality tissue to allow other procedures—such as local tendon transfers,^{2,16,25} autografts,²¹ or allografts²²—and can be compared to their pre-operative status, as well as other reported series of latissimus dorsi transfers.

Surgical decision making for a failed rotator cuff repair with loss of elevation should be based on delineation of the patient's primary complaint and expectations, use of a validated outcome instrument, a thorough physical exam, MRI evidence of a rotator cuff tear, and arthroscopic evaluation of the tear size and mobility of the remaining rotator cuff at the time of surgery. While classification of the tear based on size²⁷ or degree of fatty infiltration of the rotator cuff muscles, as described by Goutallier,⁹⁻¹¹ may be helpful in predicting the chronicity of the tear and potential functional outcome for direct repair, the degree of fatty infiltration would not have affected the surgical decision making in our series. In this series, every patient underwent arthroscopy and attempted mobilization and repair first. None of the tears was amenable to direct repair, so MRI staging of the torn, irreparable tendons preoperatively would not factor into the success of a latissimus transfer.

In conclusion, the outcomes from our series support the use of latissimus transfer as a salvage procedure for failed rotator cuff repair with loss of elevation. The procedure can produce marked improvement in active forward elevation, external rotation at the side, pain, and function to an active level. It is not currently known whether this salvage procedure can halt the progression of rotator cuff arthropathy, since as a primary procedure, it has not done so.^{7,20} Deltoid function is likely linked to the degree of improvement possible after this procedure and should be considered when evaluating whether the procedure is indicated or not.

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