Mid-Term Outcome of Arthroscopic-Assisted Lower Trapezius Transfer Using a Achilles Allograft in Treatment of Irreparable Massive Posterior Superior Rotator Cuff Tear

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INTRODUCTION:

Managing posterior superior irreparable rotator cuff tears (PSIRCTs) in patients without arthritis presents a challenging issue, particularly in young and active individuals or elderly with high activity demands. Lower trapezius tendon (LTT) transfer has gained attention as an alternative treatment for PSIRCTs due to its capacity to alleviate pain and restore shoulder function and strength. It involves synchronized contraction with the native shoulder external rotator muscle, aligns with the “line of pull” of the infraspinatus, and exhibits comparable “excursion” to the infraspinatus. These biomechanical and anatomical characteristics of LTT transfer are indeed distinct features that contribute to its effectiveness and promising clinical outcomes. Although short-term clinical studies have shown promising clinical outcomes, there have been no studies to verify the mid-term effectiveness of this procedure. The purpose of this study is to evaluate the mid-term clinical and radiological outcomes of arthroscopically-assisted lower trapezius tendon (aLTT) transfer for patients with PSIRCTs.

METHODS:

This retrospective study enrolled patients who underwent aLTT transfer between May 2017 and May 2019. A single senior surgeon performed all of the surgical procedures on the patients. The clinical outcomes assessment included pain Visual Analog Scale (VAS), Constant score, American Shoulder and Elbow Society (ASES) score, University of California Los Angeles (UCLA) score, Activities of Daily Living Requiring Active External Rotation (ADLER) score, active Range of Motion (aROM), Single Assessment Numeric Evaluation (SANE) score, and rates of return to work. The radiographic analysis included the acromiohumeral distance (AHD), Hamada grade, and integrity of the transferred tendon at the final follow up. In addition, subgroups analysis was done based on teres minor (Tm) trophicity and graft integrity.

RESULTS:

This study enrolled 36 patients with a mean age of 63.4 years (range: 51-73) who met the inclusion criteria. The patients were followed up for a mean of 58.2±5.3 months (range: 48-70 months) (Table1). At the final follow up, the patients showed a statistically significant improvement in mean VAS, Constant, ASES, UCLA, and ADLER scores postoperatively ($p<.001$). Significant improvements in active range of motion (aROM) in forward elevation, abduction, external rotation in 90° abductions, and external rotation at final follow up ($p<.001$) were observed. Decrease in acromiohumeral distance (AHD) and increase in Hamada grade were observed at final follow up ($p=.040$ and $p=.006$, respectively). At the final follow-up period, three patients experienced progression of arthritis, two from retear and one from infection. No arthritic progression was observed in rest of the patients (Table 2). Subgroup analyses were conducted to assess the integrity of the transferred tendon (Table 3) and the trophicity of Tm (Table 4). Retear group showed improvement in forward elevation and abduction at final follow up, and these values were not significantly different from those of the normal group, ($P=0.804$ and $P=0.424$, respectively). However, both the external rotation (ER) at 90° abduction and the ER at the side were significantly lower in the retear group (51.4°±24.4° and 23.6°±11.4°, respectively) compared to the normal group (73.4°±11.9° and 47.3°±6.2°, respectively). Compared to the Tm non-hypertrophic group, hypertrophic group showed significantly better improvement in external rotation at 90° abductions and at the side, as well as ADLER scores. Among 36 patients, 30 (83.3%) patients were able to successfully resume their previous work. seven patients experienced retear of the transferred tendon, and two individuals developed postoperative infections. While the retear group demonstrated improvement in Visual Analog Scale (VAS) scores, it failed to regain external rotation at the side by the final follow up.

DISCUSSION AND CONCLUSION:

This study confirmed significant improvements in clinical and functional outcomes for the midterm of aLTT transfer, supporting the safety and effectiveness of aLTT as a viable joint-preserving treatment option for PSIRCTs. The findings of our study highlight that the retear group demonstrated improvement in forward elevation and abduction during the final follow up. However, both the external rotation (ER) at 90° abduction and the ER at the side were significantly lower in the retear group. Additionally, the group with trapezius muscle hypertrophy exhibited significantly better external rotation and ADLER scores. Nevertheless, larger and longer-term studies are still warranted to further verify these findings.

Table I Demographic and clinical characteristics of study subjects

Variables	Value
Sex, n (%)	Male 24 (66.7%) / Female 12 (33.3%)
Age (year), mean ± SD (range)	63.4 ± 5.4 (51-73)
Follow-up (month), mean ± SD (range)	58.2 ± 5.3 (48-70)
Dominant arm involvement, n (%)	32 (88.9 %)
BMI (kg/m2), mean ± SD	24.1 ± 2.4
HTN, n (%)	14 (38.9%)
DM, n (%)	4 (11.1%)
Osteoporosis, n (%)	0 (0%)
Preoperative Pseudoparalysis, n (%)	5 (13.9%)
Prior rotator cuff repair surgery, n (%)	12 (33.3%)
RC repair	8
SAD / debridement	3
Suprascapular nerve release	1
Repairable Concomitant SSC tear, n (%)	4 (11.1%)
Preoperative Hamada Grade, n (%)	
Grade 1	33 (91.7%)
Grade 2	3 (8.3%)
Preoperative SSC fatty infiltration grade, n (%)	
Grade 0 or 1	21 (58.3 %)
Grade 2	15 (41.7 %)
Grade 3 or 4	0 (0%)
Preoperative SSP fatty infiltration grade, n (%)	
Grade 3	2 (5.6%)
Grade 4	32 (88.9 %)
Preoperative ISP fatty infiltration grade, n (%)	
Grade 3	2 (5.6%)
Grade 4	32 (88.9 %)
Preoperative TM infiltration grade, n (%)	
Grade 0 or 1	22 (61.1%)
Grade 2	8 (22.2%)
Grade 3	5 (8.3%)
Grade 4	1 (2.8%)
Preoperative TM trophicity, n (%)	
Non-Hypertrophy	14 (38.9%)
Hypertrophy	22 (61.1%)

SD, standard deviation; BMI, body mass index; DM, diabetes mellitus; HTN, hypertension; SSC, subscapularis; SSP, supraspinatus; ISP, infraspinatus; TM, teres minor;

Table II Comparison between preoperative and postoperative clinical outcomes and range of motion

Variables	Preoperative	Final follow-up	P value
VAS pain score	4.5 ± 1.2	1.4 ± 0.7	<.001 *
Constant score	52.9 ± 13.8	70.3 ± 7.6	<.001 *
ASES score	57.1 ± 13.4	83.7 ± 8.2	<.001 *
UCLA shoulder score	19.7 ± 4.7	28.0 ± 2.9	<.001 *
ALDER score	18.7 ± 6.7	27.2 ± 3.9	<.001 *
Active ROM (degree)			
FE (°)	133.8 ± 41.5	159.7 ± 30.0	0.007 *
ABD (°)	115.8 ± 41.1	148.9 ± 32.2	<.001 *
ER at 90° ABD (°)	47.6 ± 19.8	69.0 ± 17.3	<.001 *
ER at side (°)	24.6 ± 12.7	42.6 ± 12.1	<.001 *
IR at back (°)†	6.3 ± 1.6	6.5 ± 1.2	0.283
AHD (mm)	7.9 ± 0.8	7.5 ± 1.0	0.040 *
Hamada grade	1.1 ± 0.3	1.3 ±0.6	0.006 *

VAS, visual analog scale; ASES, American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form; UCLA, University of California Los Angeles; ADLER, activities of daily living that require active external rotation; FE, forward elevation; ABD, abduction; ER, external rotation; IR, internal rotation; AHD, acromiohumeral distance. Unless otherwise noted, values are mean ± standard deviation

* The significant P value is below .05.

† Internal rotation was measured as the level that could be reached by the thumb; 0, greater trochanter; 2, buttock; 4, lumbosacral junction; 6, L3; 8, T12; and 10, T7

Table III Comparison of preoperative and postoperative clinical, functional, and radiology outcomes between patients with Re-tear and Normal Graft Integrity

Variables	Normal (n=29)	Re-tear (n=7)	P-value
VAS pain score			
Preoperative	4.6 ± 1.2	4.0 ±1.4	0.236
Postoperative	1.3 ± 0.7	1.7 ± 1.0	0.232
P-value	<.001 *	<.001 *	
Constant score			
Preoperative	51.6 ± 12.2	57.7 ± 19.3	0.450
Postoperative	70.4 ± 5.9	69.6 ± 12.9	0.791
P-value	<.001 *	0.100	
ASES score			
Preoperative	56.1 ± 12.1	61.0 ± 18.2	0.399
Postoperative	84.4 ± 7.5	77.3 ± 13.9	0.073
P-value	<.001 *	0.083	
UCLA shoulder score			
Preoperative	19.4 ± 4.8	20.6 ± 4.8	0.568
Postoperative	28.5 ± 2.0	26.0 ± 4.7	0.213
P-value	<.001 *	0.080	
ALDER score			
Preoperative	18.3 ± 6.1	20.0 ± 8.9	0.554
Postoperative	28.3 ± 1.6	23.0 ± 7.0	0.095
P-value	<.001 *	0.166	
Active ROM (degree)			
FE (°)			
Preoperative	132.8 ± 40.6	137.9 ± 48.5	0.775
Postoperative	160.3 ± 29.3	157.1 ± 35.0	0.804
P-value	0.006 *	0.501	
ABD (°)			
Preoperative	113.3 ± 39.6	126.4 ± 48.5	0.455
Postoperative	151.0 ± 31.2	140.0 ± 37.4	0.424
P-value	<.001 *	0.667	
ER at 90° ABD (°)			
Preoperative	48.4 ± 19.5	44.3 ± 22.1	0.631
Postoperative	73.4 ± 11.9	51.4 ± 24.4	0.001 *
P-value	<.001 *	0.025 *	
ER at side (°)			
Preoperative	23.9 ± 12.6	27.1 ± 14.1	0.558
Postoperative	47.3 ± 6.2	23.6 ± 11.4	0.001 *
P-value	<.001 *	0.094	
Internal rotation at back (°) †			
Preoperative	6.0 ± 1.6	7.3 ± 1.4	0.069
Postoperative	6.4 ± 1.3	7.0 ± 0.8	0.274
P-value	0.125	0.604	
AHD (mm)			
Preoperative	7.8 ± 0.7	8.1 ± 0.9	0.469
Postoperative	7.6 ± 1.0	7.3 ± 1.2	0.564
P-value	0.092	0.036 *	
Hamada grade			
Preoperative	1.1 ± 0.3	1.0 ± 0.0	0.389
Postoperative	1.3 ± 0.6	1.3 ± 0.5	0.968
P-value	0.016	0.182	

VAS, visual analog scale; ASES, American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form; UCLA, University of California Los Angeles; ADLER, activities of daily living that require active external rotation; FE, forward elevation; ABD, abduction; ER, external rotation; IR, internal rotation. Unless otherwise noted, values are mean ± standard deviation

* The significant P value is below .05.

† Internal rotation was measured as the level that could be reached by the thumb; 0, greater trochanter; 2, buttock; 4, lumbosacral junction; 6, L3; 8, T12; and 10, T7

Table IV Comparison of preoperative and postoperative clinical, functional, and radiology outcomes between patients with TM hypertrophy and TM non-hypertrophy.

Variables	TM Hypertrophy (n= 22)	TM Non-Hypertrophy (n=14)	P-value
VAS pain score			
Preoperative	4.4 ± 1.2	4.7 ± 1.3	0.484
Postoperative	1.24 ± 0.7	1.7 ± 0.8	0.083
P-value	<.001 *	<.001 *	
Constant score			
Preoperative	53.86 ± 12.6	51.2 ± 16.1	0.598
Postoperative	71.7 ± 5.3	68.0 ± 10.0	0.159
P-value	<.001 *	0.003 *	
ASES score			
Preoperative	56.8 ± 12.6	57.6 ± 15.1	0.868
Postoperative	86.0 ± 5.9	78.0 ±11.9	0.038 *
P-value	<.001 *	0.002 *	
UCLA shoulder score			
Preoperative	19.9 ± 5.1	19.2 ± 4.1	0.692
Postoperative	28.9± 1.8	26.6 ± 3.7	0.062
P-value	<.001 *	<.001 *	
ALDER score			
Preoperative	19.0 ± 5.5	18.2 ± 8.4	0.765
Postoperative	28.9 ± 1.2	24.4 ± 5.2	0.004 *
P-value	<.001 *	0.010 *	
Active ROM (degree)			
FE (°)			
Preoperative	139.6 ± 34.4	124.6 ± 50.9	0.346
Postoperative	162.7 ± 28.0	155±33.5	0.459
P-value	0.027 *	0.113	
ABD (°)			
Preoperative	119.8 ± 38.4	109.6 ±45.8	0.479
Postoperative	151.8 ± 29.2	144.3 ±37.2	0.502
P-value	0.005 *	0.070 *	
ER at 90° ABD (°)			
Preoperative	48.6 ± 20.5	45.8 ± 19.2	0.685
Postoperative	75.0 ± 12.2	58.9 ± 20.0	0.005 *
P-value	<.001 *	0.002 *	
ER at side (°)			
Preoperative	26.1 ± 13.0	21.9 ± 12.4	0.352
Postoperative	46.8 ± 7.6	35.4 ± 14.9	0.021 *
P-value	<.001 *	0.011 *	
Internal rotation at back (°) †			
Preoperative	6.0 ± 1.7	6.9 ± 1.1	0.129
Postoperative	6.5 ± 1.4	6.5 ± 1.0	0.987
P-value	0.042 *	0.367	
AHD (mm)			
Preoperative	7.9 ± 0.8	7.9 ± 0.8	0.813
Postoperative	7.6 ± 0.9	7.4 ± 1.1	0.566
P-value	0.174	0.038 *	
Hamada grade			
Preoperative	1.0 ± 0.2	1.1 ± 0.4	0.375
Postoperative	1.2 ± 0.4	1.4 ± 0.8	0.275
P-value	0.05 *	0.055	

VAS, visual analog scale; ASES, American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form; UCLA, University of California Los Angeles; ADLER, activities of daily living that require active external rotation; FE, forward elevation; ABD, abduction; ER, external rotation; IR, internal rotation. Unless otherwise noted, values are mean ± standard deviation

* The significant P value is below .05.

† Internal rotation was measured as the level that could be reached by the thumb; 0, greater trochanter; 2, buttock; 4, lumbosacral junction; 6, L3; 8, T12; and 10, T7