Comparative Efficacy of Latissimus Dorsi and Teres Major Versus Pectoralis Major Tendon Transfers Combined with Medial Glenoid and Lateral Humerus Reverse Total Shoulder Arthroplasty in Improving Internal Rotation

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INTRODUCTION: Internal rotation (IR) weakness remains a significant functional limitation after reverse total shoulder arthroplasty (RTSA), particularly in patients with irreparable massive rotator cuff tears (mRCTs) or cuff tear arthropathy (CTA). Although reverse prosthesis design improvements have enhanced forward elevation and rotational range of motion, IR deficits continue to impair essential daily activities, including toileting and personal hygiene. Tendon transfer procedures, including anterior latissimus dorsi and teres major (LDTM) or pectoralis major (PM) transfers, have been utilized to address this problem, but comparative clinical evidence regarding their relative effectiveness is limited. This study aimed to compare clinical, functional, and radiologic outcomes between LDTM and PM tendon transfers combined with RTSA, focusing on their efficacy in restoring IR.

METHODS: A retrospective review was conducted on 60 patients with mRCT or CTA who experienced a loss of active IR (Fig 1), who underwent RTSA combined with tendon transfer between 2016 and 2022. Thirty-seven patients underwent LDTM transfer, and twenty-three patients underwent PM transfer. The mean patient age was 71.2 years, with a minimum follow-up of 12 months (mean 38.5 months). A standardized surgical technique was used for all cases via a deltopectoral approach. The transferred tendon was fixed distally to the greater tuberosity and lateral to the bicipital groove (Fig 2). Rehabilitation protocols were identical across groups, emphasizing early passive motion followed by gradual strengthening. Clinical outcomes evaluated included the American Shoulder and Elbow Surgeons (ASES) score, Activities of Daily Living requiring Internal Rotation (ADLIR) score, active range of motion (aROM), toileting ability, and subscapularis-specific physical exams (belly-press and lift-off tests). IR strength was measured using a handheld dynamometer at neutral and 45° abduction. Radiologic assessment of tendon healing was performed using ultrasonography at six months postoperatively. Statistical analysis utilized Mann-Whitney U, chi-square, and Wilcoxon signed-rank tests, with significance set at $p<.05$.

RESULTS: Both groups demonstrated significant postoperative improvements in clinical scores, including ASES and ADLIR scores (all $p<.001$). Improvements in forward flexion were also noted in both groups without significant differences between them. The LDTM group achieved superior IR aROM behind the back, reaching a higher vertebral level compared to the PM group (6.4 ± 2.0 vs. 4.6 ± 1.3 levels; $p<.001$) (Table 1). Additionally, the LDTM group showed better toileting ability scores ($p<.001$) and higher rates of negative belly-press (91.9% vs 69.6%, $p=.024$) and lift-off tests (89.2% vs 39.2%, $p<.001$) (Table 2). Conversely, the PM group demonstrated significantly stronger IR strength in the neutral arm position (28.8 ± 3.6 N vs 24.7 ± 4.0 N, $p<.001$). Ultrasonographic tendon integrity at six months showed no significant differences between the groups (89.2% for LDTM vs 91.3% for PM; $p=.782$). Minimal clinically important difference (MCID) analysis demonstrated that LDTM transfer achieved better restoration of functional IR aROM ($p=.010$), whereas PM transfer resulted in greater improvement in IR strength ($p=.019$). Minor complications included one transient axillary nerve palsy and one acromial fracture in the LDTM group and one traumatic anterior dislocation in the PM group.

DISCUSSION AND CONCLUSION: Both LDTM and PM tendon transfers effectively enhanced IR function when combined with RTSA. However, the characteristics of the improvements differed: LDTM transfer resulted in superior behind-the-back IR aROM recovery and better toileting independence, while PM transfer provided greater neutral position IR strength, which may benefit patients requiring strength-intensive activities. These results suggest that tendon transfer selection should be individualized based on the patient's preoperative functional goals. The LDTM transfer is superior in enhancing IR aROM with the arm behind the back, aiding in daily activities such as personal hygiene. The PM transfer more effectively improves IR strength with the arm in a neutral position and 0° adduction, benefiting patients who require strength for front-of-body movements. This comparative study highlights the clinical importance of tailoring surgical strategies to address specific functional demands following RTSA. Further prospective research with larger cohorts and longer-term follow-up is necessary to confirm these findings and refine surgical indications for tendon transfers combined with RTSA.

Fig. 1

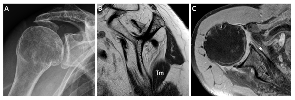

Figure 1 Preoperative anteroposterior radiograph (A) of the right shoulder showing cuff tear arthropathy. Sagittal (B) and axial (C) magnetic resonance imaging scan of a patient with an irreparable massive rotator cuff tear and subscapularis (SSC) deficiency, while the teres minor tendon (Tm) remains relatively intact.

Fig. 2

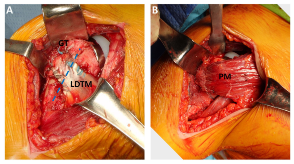

Figure 2 (A) Intraoperative image demonstrating the latissimus dorsi and teres major (LDTM) tendons detached en-bloc from the humerus, with the preserved and elevated pectoralis major (PM) tendon, and non-absorbable Krakow sutures applied to improve tendon excursion. (B) Showing the PM tendon entirely detached and held with two long forceps, followed by soft tissue release to facilitate mobilization.

Table I Comparison between preoperative and postoperative clinical outcomes

Variables	RSA + LDTM (n=37)	RSA + PM (n=23)	P-value
VAS pain score			
Preoperative	6.0 ± 1.6	6.4 ± 1.7	0.322
Postoperative	1.6 ± 0.9	1.6 ± 1.0	0.957
P-value	<.001*	<.001*	
Constant score			
Preoperative	46.7 ± 15.7	43.8 ± 11.0	0.438
Postoperative	67.4 ± 9.6	65.8 ± 9.2	0.515
P-value	<.001*	<.001*	
ASES score			
Preoperative	50.3 ± 14.6	48.1 ± 10.4	0.548
Postoperative	76.7 ± 9.8	73.8 ± 10.3	0.270
P-value	<.001*	<.001*	
UCLA score			
Preoperative	16.9 ± 4.5	16.3 ± 4.5	0.605
Postoperative	27.2 ± 4.8	26.1 ± 4.1	0.384
P-value	<.001*	<.001*	
SANE score			
Preoperative	46.9 ± 15.9	43.7 ± 11.0	0.408
Postoperative	78.2 ± 8.2	74.7 ± 11.4	0.179
P-value	<.001*	<.001*	
ADLIR score			
Preoperative	55.8 ± 13.0	56.7 ± 12.7	0.794
Postoperative	86.5 ± 10.3	81.8 ± 9.9	0.089
P-value	<.001*	<.001*	
Active ROM (degree)			
FE (°)			
Preoperative	110 ± 48	107 ± 43	0.785
Postoperative	144 ± 21	142 ± 25	0.781
P-value	<.001*	<.001*	
ABD (°)			
Preoperative	91 ± 45	87 ± 36	0.727
Postoperative	125 ± 30	123 ± 31	0.746
P-value	<.001*	<.001*	
ER at side (°)			
Preoperative	28 ± 17	29 ± 16	0.948
Postoperative	41 ± 12	42 ± 11	0.885
P-value	<.001*	<.001*	
IR at back †			
Preoperative	2.8 ± 2.0	2.7 ± 1.8	0.823
Postoperative	6.4 ± 2.0	4.6 ± 1.3	<.001*
P-value	<.001*	<.001*	
Strength (N)			
FE			
Preoperative	15.6 ± 3.9	15.3 ± 4.1	0.752
Postoperative	23.5 ± 3.4	24.9 ± 3.6	0.135
P-value	<.001*	<.001*	
ABD			
Preoperative	13.8 ± 3.6	13.5 ± 3.8	0.735
Postoperative	23.2 ± 2.2	22.4 ± 3.0	0.215
P-value	<.001*	<.001*	
ER at side			
Preoperative	17.9 ± 3.6	17.7 ± 3.5	0.755
Postoperative	18.3 ± 3.1	18.4 ± 2.5	0.963
P-value	0.187	0.118	
IR at side			
Preoperative	18.4 ± 3.4	17.8 ± 3.6	0.571
Postoperative	24.7 ± 4.0	28.8 ± 3.6	<.001*
P-value	<.001*	<.001*	

RSA, reverse shoulder arthroplasty; LDTM, latissimus dorsi and teres major transfer; PM, pectoralis major transfer; VAS, visual analog scale; ASES, American Shoulder and Elbow Surgeons; UCLA, University of California Los Angeles; SANE, Single Assessment Numeric Evaluation; ADLIR, activities of daily living requiring active internal rotation; ROM, range of motion; 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 II Comparison of postoperative functional results between RSA with LDTM and PM transfer

Variables	RSA + LDTM (n=37)	RSA + PM (n=23)	P-value
Able to perform toileting, n (%)			<.001*
Easily	25 (67.5)	6 (26.0)	
With difficulty	11 (29.7)	13 (56.5)	
Unable	1 (2.7)	4 (17.4)	
Subscapularis-specific test, n (%)			
Positive belly-press	3 (8.1)	7 (30.4)	0.024*
Positive bear-hug	5 (13.5)	4 (17.4)	0.689
Positive lift-off	4 (10.8)	14 (60.8)	<.001*

RSA, reverse shoulder arthroplasty; LDTM, latissimus dorsi and teres major transfer; PM, pectoralis major transfer;

* The significant P value is below .05.