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Comparison of clinical outcomes of anterior combined latissimus dorsi and teres major tendon transfer for anterior superior irreparable rotator cuff tear between young and elderly patients

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Background: Anterior combined latissimus dorsi and teres major (aLDTM) tendon transfer has shown promise as a treatment for anterior superior irreparable rotator cuff tears (ASIRCTs). Our study aimed to compare aLDTM clinical outcomes for ASIRCTs between young and elderly patients.

Methods: This retrospective study reviewed data from patients who underwent aLDTM tendon transfer for ASIRCTs with minimum 2-year follow-up. Clinical evaluations included visual analog scale (VAS), American Shoulder and Elbow Surgeons (ASES) score, Single Assessment Numeric Evaluation (SANE), active range of motion (aROM), strength, and complications. Radiologic assessments included acromiohumeral distance, Hamada classification, and integrity of transferred tendon. Patients were divided into group total (all ages), group old (≥70 years), and group young (≤60 years).

Results: A total of 123 patients were enrolled with 39 in group young (mean age, 56.6±4.9 years) and 27 in group old (mean age, 73.6±2.3 years). Postoperatively, both groups showed significant improvements in VAS, ASES, and SANE scores and improved aROM for forward elevation, abduction, and internal rotation. No significant differences in clinical coutcomes were noted between the groups. Furthermore, similar rates of complications, including retears and postoperative infections, were observed across all three groups.

Conclusions: Our study highlights the effectiveness of aLDTM transfer for ASIRCTs with minimal glenohumeral arthritis, demonstrating similar outcomes in both group young and group old patients. Moreover, patients in these distinct age groups showed comparable clinical results when compared to group total.

Level of evidence: III.

Keywords: Rotator cuff tear; Irreparable rotator cuff tear; Tendon Transfer; Latissimus dorsi and teres major tendon transfer; Massive rotator cuff tear

INTRODUCTION

Anterior superior irreparable rotator cuff tears (ASIRCTs) present a difficult challenge, particularly among younger patients with high functional demands and active elderly individuals requiring joint integrity maintenance. Several different treatment options are available, including arthroscopic partial repair, superior capsular reconstruction (SCR), pectoralis major (PM) or minor (Pm) tendon transfer, isolated latissimus dorsi (LD) tendon transfer, and reverse total shoulder arthroplasty (RTSA) [1-8].

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Anterior combined latissimus dorsi and teres major (aLDTM) tendon transfer has resulted in promising clinical outcomes, restoring transverse force coupling and utilizing the synergetic strength of both muscles [9]. The aLDTM tendon transfer promotes a humeral head pull-down effect and establishes a robust line of pull, thereby effectively facilitating the restoration of both strength and active range of motion (aROM) [9-11].

Despite the growing evidence supporting tendon transfer surgeries around the shoulder for irreparable rotator cuff tears (IRCTs) with intact articular cartilage, the effect of age on the outcomes of these procedures has not been thoroughly assessed. This knowledge gap is particularly striking given the divergent indications and varying preferences among surgeons. Most published studies have focused on young and active patients; the effectiveness of tendon transfer in elderly patients has been relatively ignored [12-14]. However, a recent study by Kany et al. [15] demonstrated the efficacy of posterior latissimus dorsi transfer for posterior superior IRCTs (PSIRCTs) in elderly patients. This study has broadened our insights into the indications for tendon transfer surgery, particularly regarding age. However, this study was a rarity; the effectiveness of aLDTM for ASIRCTs in elderly patients is largely unknown. Therefore, the primary objective of our study was to compare and report the outcomes of aLDTM tendon transfer for ASIRCTs in young and old patients. Group young patients were 60 years or younger, and group old patients were 70 years or older. We hypothesized that the clinical outcomes of LDTM transfer are similar between group young and group old.

METHODS

The current study is a retrospective single-center comparative case series, and the study was approved by Institutional Review Board of Yeosu Baek Hospital (No. P01-202310-01-067). Due to the retrospective nature of the study and the absence of additional discomfort to patients, the requirement for informed consent was waived.

Patient Selection

A retrospective review of data from patients who underwent aLDTM tendon transfer between June 2016 and February 2022 was conducted. The study included patients who underwent aLDTM for ASIRCTs with a minimum follow-up period of 2 years. Indications for aLDTM tendon transfer in ASIRCT included persistent pain and/or loss of shoulder function, minimal to no glenohumeral arthritis (Hamada [16] classification grade ≤2) (Fig. 1A), preoperatively confirmed IRCTs involving both the subscapularis and supraspinatus tendons (Goutallier [17] fatty infiltration grade ≥3 on MRI) (Fig. 1B and C), and intraoperatively confirmed presence of intact infraspinatus and teres minor tendons. Exclusion criteria included patients with unavailability for clinical assessment both preoperatively and at final follow-up, less than the minimum follow-up period of 2 years, and loss of follow-up. The patients who met these conditions were then categorized into three groups: group total (all ages), group old (aged 70 years and above), and group young (aged 60 years and below) (Fig. 2).

Surgical Procedure

All surgeries were performed by a single senior surgeon (CHB)

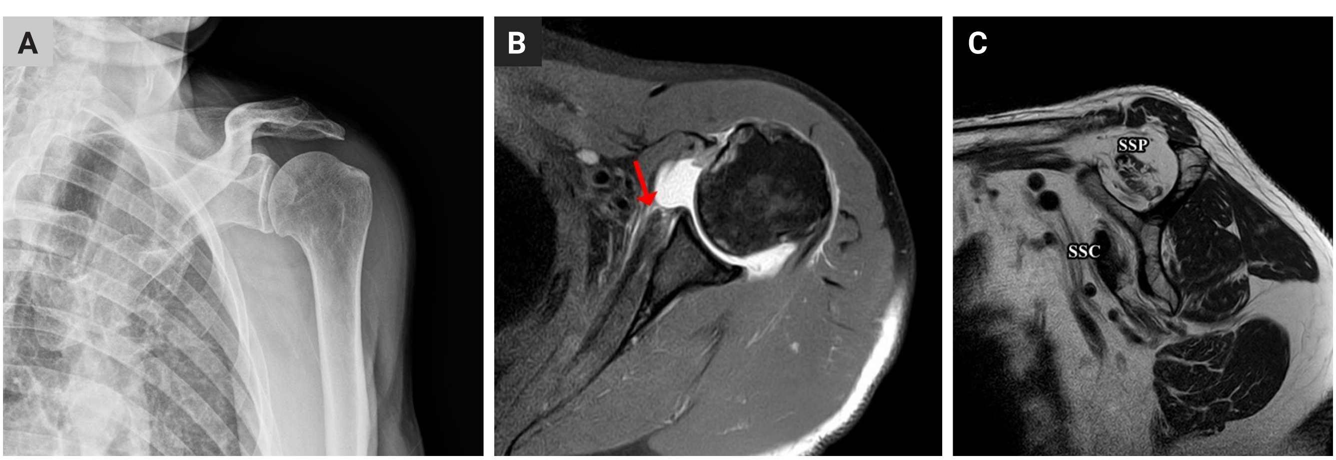

Fig. 1. Preoperative radiograph and magnetic resonance imaging (MRI). (A) Preoperative radiograph of the left shoulder shows minimal glenohumeral arthritis. (B) Axial view of MRI of the left shoulder shows retracted torn subscapularis (arrow). (C) Sagittal view of MRI shows high fatty infiltration and atrophy in both the subscapularis (SSC) and supraspinatus (SSP) muscles.

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and followed the technique described by Baek et al. [18]. The patient underwent general anesthesia, and the procedure was performed in a beach chair. The procedure involved an incision extending from the coracoid process to the inferior border of the PM tendon. Following the standard deltopectoral approach, the reparability of the subscapularis was evaluated. The torn subscapularis was deemed "irreparable" and the transfer procedure began when the subscapularis could not be reduced to its original footprint on the lesser tuberosity. For the long head of the biceps tendon, soft tissue tenodesis was performed. After meticulous dissection of the upper and lower border of the PM muscle, the PM muscle was retracted with a Kolbel retractor to expose the insertion site of the LDTM tendon on the humerus. The LDTM tendon was detached as a single unit without separating the LD and TM tendons (Fig. 3A), and the edges were sutured using non-absorbable sutures in a Krakow fashion (Fig. 3B). After harvesting the LDTM tendon, surrounding adhesions were gently and carefully released using sterile gauze to prevent iatrogenic injury to the radial nerve. During this step, the surgeon carefully avoided forceful medial retraction to prevent iatrogenic injury to the radial nerve passing through the anteroinferior surface of the LDTM muscle. Additionally, sufficient release of the harvested LDTM tendon was performed to enhance tendon mobility and excursion, thereby preventing potential impingement of the axillary nerve due to the bulky volume of the combined LDTM muscle. Harvested LDTM tendon was then passed beneath the PM muscle and pulled towards the greater tuberosity (GT) of the humerus (Fig. 3C). To ensure proper tensioning, the arm was positioned in full internal rotation (IR) at a 45° abduction (ABD). The LDTM tendon was placed approximately 2 cm distal to the GT and lateral to the bicipital groove with a 4.75-mm knotless anchor (Swivelock anchor, Arthrex Inc.). For reinforcement of the attachment of the harvested LDTM tendon to the humerus, a 4.5-mm triple-loaded medial suture anchor (PEEK Corkscrew FT, Arthrex Inc.) was inserted beneath the LDTM tendon along the line of the bicipital groove. These sutures were loaded into two additional 4.75-mm knotless anchors (Swivelock anchor) that were then placed over the harvested LDTM tendon to compress this tendon against the bone. The two knotless anchors were positioned, one medial and the other lateral to the bicipital groove (Fig. 3D). In patients with osteoporotic bones, medial anchor sutures were threaded through the harvested LDTM tendon and fixed with two knotless anchors in the same fashion. A thorough assessment was performed to ensure no impingement was encountered by rotating the humerus.

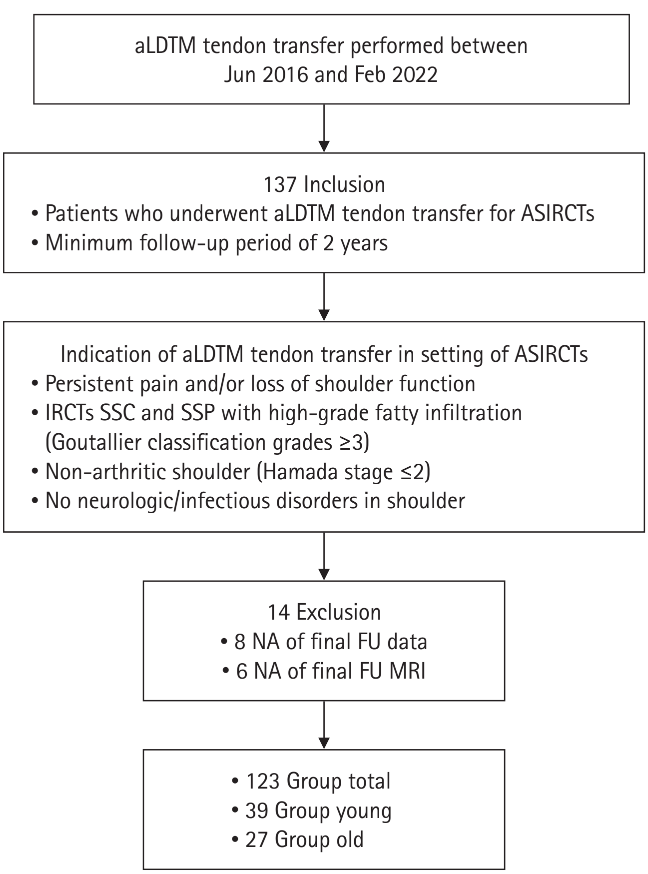

Fig. 2. Flowchart. aLDTM: anterior combined latissimus dorsi and teres major, ASIRCT: anterior superior irreparable rotator cuff tear, IRCT: irreparable rotator cuff tear, SSC: subscapularis, SSP: supraspinatus, NA: not available, FU: follow-up, MRI: magnetic resonance image.

Postoperative Rehabilitation

During the initial 4 weeks post-surgery, patients wore an ABD brace while maintaining an IR posture to aid in proper alignment and stability during the early healing stages. Patients were allowed intermittent movement of the elbow, wrist, and fingers while wearing the brace for daily activities. The use of the brace was discontinued after this initial 4 weeks, and patients began active-assisted range of motion (ROM) exercises to regain motion. At 3 months postoperatively, patients progressed to strengthening exercises encompassing all movement directions. However, engagement in active physical labor and sports activities was restricted until 6 months post-surgery.

Clinical Evaluation

We gathered data on age, sex, body mass index (BMI), medical comorbidities, smoking status, duration of symptoms, and follow-up. Clinical assessments included pain measurement using a visual analog scale (VAS) ranging from 0 to 10, shoulder function assessment using the American Shoulder and Elbow Surgeons

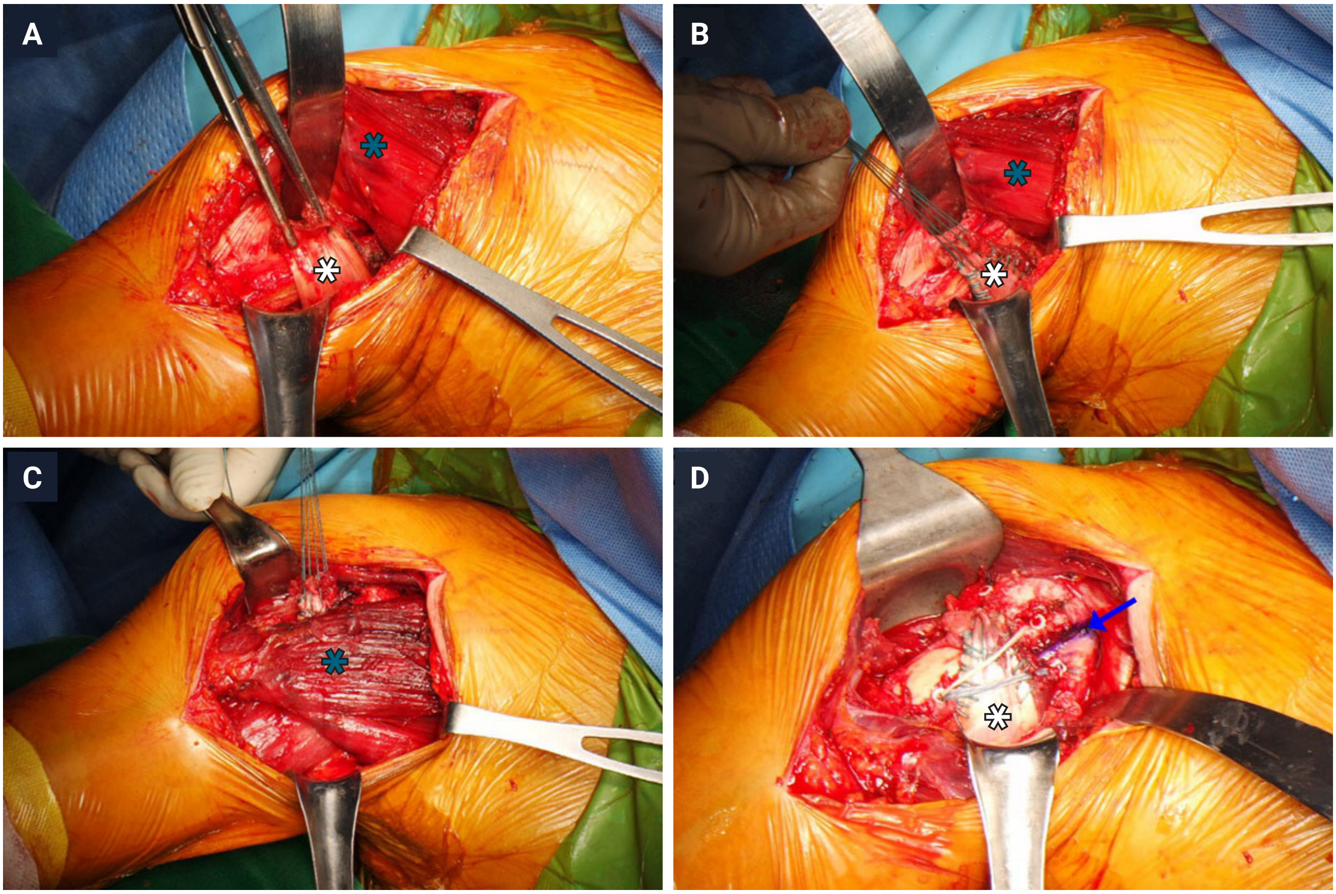

Fig. 3. Intraoperative image. (A) Using a lever retractor, the pectoralis major (PM) muscle (blue asterisk) is elevated and latissimus dorsi and teres major (LDTM) tendon (white asterisk) is detached from the humerus and secured with two long forceps. (B) While the PM muscle (blue asterisk) is being reflected, the harvested LDTM tendon (white asterisk) is secured using a Krakow suture. (C) The prepared LDTM tendon is delivered beneath the PM muscle (blue asterisk). (D) Final appearance of the LDTM tendon (white asterisk) transfer being placed laterally and beyond the bicipital groove (blue arrow).

(ASES) score, and patient satisfaction using the Single Assessment Numeric Evaluation (SANE) score. Shoulder aROM was measured using a goniometer, and any documented complications were recorded. Shoulder strength was assessed using a handheld dynamometer (Hoggan Health Industries) both preoperatively and postoperatively.

Radiologic Evaluation

Radiological assessments included the acromiohumeral distance (AHD) and the Hamada [16] classification system score to evaluate presence of glenohumeral joint arthritis. MRI scans were used to assess the quality of the rotator cuff muscles using the Goutallier [17] grading system. The integrity of the transferred tendon was evaluated through MRI scans (Fig. 4), with a discontinuity indicating retear, according to the criteria established by Sugaya et al. [19] in which types IV and V were considered retear due to the loss of continuity of the transferred tendon. An independent musculoskeletal radiologist, unaware of the clinical results, analyzed the MRI findings.

Statistical Analysis

Comparisons within groups for preoperative and postoperative results were performed using paired t-tests and Wilcoxon signed-rank tests for continuous data. Chi-square and Fisher's exact test were used for categorical data assessments. Statistical analyses were conducted using SPSS version 20.0 (IBM Corp.). The intraclass correlation coefficient (ICC) was calculated to assess the reliability of AHD and Hamada grade between two independent examiners. Mean and standard deviation values were reported for the data, and statistical significance level was set at $P<0.05$.

RESULTS

Comparison of Demographic Characteristics between Young and Old Age Groups

Fourteen patients were excluded due to unavailable data ($n=8$)

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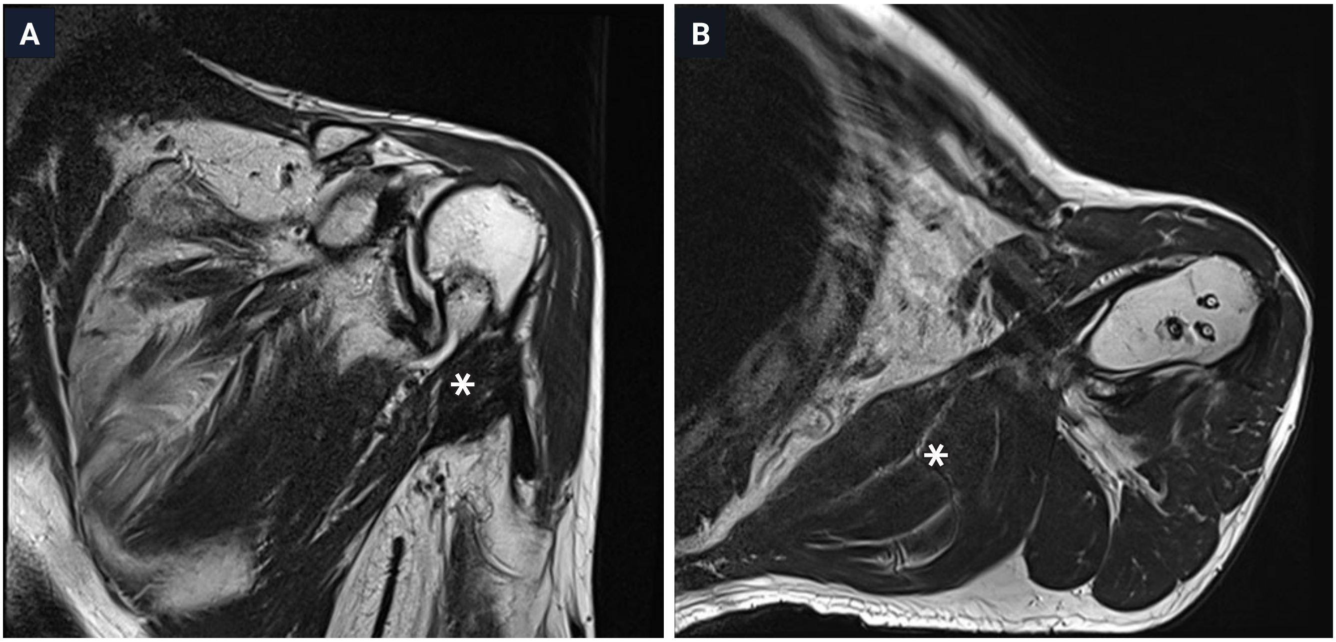

Fig. 4. Postoperative magnetic resonance image (MRI) of the transferred latissimus dorsi and teres major (LDTM) tendon. Postoperative MRI of left shoulder shows normal integrity of transferred LDTM tendon (white asterisks) in oblique coronal view (A) and in oblique axial view (B).

and loss of follow-up (n = 6), resulting in a final enrollment of 123 patients in the Group Total. Thirty-nine patients were in the group young (age ≤ 60 years), and 27 patients were in the group old (age ≥ 70 years). Table 1 presents the demographic and clinical characteristics of the group young and group old patients. The mean ages for these groups were 56.6 ± 4.9 years (range, 36–60) and 73.6 ± 2.3 years (range, 71–81), respectively. The mean follow-up durations for the two groups were not statistically different, 42.1 ± 15.6 months (range, 24–73) and 43.9 ± 19.8 months (range, 24–76), respectively. There were no significant differences in preoperative demographic factors between the groups, including BMI, sex, medical history, smoking status, and degree of fatty infiltration of each rotator cuff.

Clinical Results Comparison between Young and Old Age Groups

Table 2 illustrates the clinical outcomes for the group young and group old patients and the comparison between the groups. Upon comparing preoperative and postoperative clinical outcomes for each group, both demonstrated significant improvements in all clinical scores, including VAS, ASES, and SANE scores, with all P-values < 0.001. Regarding aROM, both groups showed significant improvements in forward elevation (FE), ABD, and IR at the back. However, there was no significant improvement in external rotation (ER) at the side observed in either group. When assessing radiological parameters, excellent ICCs were found for AHD and Hamada classification (ICC: preoperative AHD, 0.977; final AHD, 0.977; preoperative Hamada, 0.718; and final Hamada, 0.791). Both groups showed no significant progression of arthritis. When comparing group young and group old, no significant differences were observed in VAS, ASES, and SANE scores. Similarly, there were no significant differences in aROM and radiological parameters between the groups.

Strength Comparison between Young and Old Age Groups

Table 3 presents the strength data for group young and group old and the comparison between the groups. Preoperative and postoperative strength showed significant improvements in FE, ABD, and IR at the side for both groups. Strength for ER at the side slightly improved, but the degree of improvement did not reach significance for either group. When comparing between the groups, preoperative strengths for all directions except for ER at the side were significantly higher in the group young than in the group old, with all P-values < 0.001. Similarly, postoperative strengths were significantly higher in the group young than in the group old in all directions except for ER at the side. However, the comparison of the delta values, the difference between the preoperative and postoperative values, for each direction between the groups showed no significant differences (FE, P = 0.222; ABD, P = 0.285; ER at the side, P = 0.861; and IR at the side, P = 0.060).

Table 1. Demographics

Variable	Group young (n = 39)	Group old (n = 27)	P-value
Age (yr)	56.6 ± 4.9 (36–60)	73.6 ± 2.3 (71–81)	< 0.001*
BMI (kg/m^2)	24.5 ± 2.2	23.5 ± 2.9	0.115
Follow-up period (mo)	42.1 ± 15.6 (24–73)	43.9 ± 19.8 (24–76)	0.679
Symptom duration (mo)	12.1 ± 4.3 (7–23)	13.6 ± 4.9 (6–24)	0.191
Sex (male:female)	26 (66.6):13 (33.3)	17 (62.9):10 (37.0)	0.761
Dominant arm involvement	31 (79.4):8 (20.5)	22(81.4):5(18.5)	0.844
Prior rotator cuff repair surgery	5 (12.8)	2 (7.4)	0.490
HTN	4 (10.2)	6 (22.2)	0.157
DM	12 (30.7)	13 (48.1)	0.188
Smoker	5 (12.8)	3 (11.1)	0.837
Preoperative SSC FI grade			0.755
Grade 3	13 (33.3)	8 (29.6)	
Grade 4	26 (66.6)	19 (70.3)	
Preoperative SSP FI grade			0.410
Grade 3	17 (43.5)	9 (33.3)	
Grade 4	22 (56.4)	18 (66.6)	
Preoperative ISP FI grade			0.755
Grade 0 or 1	29 (74.3)	21 (77.7)	
Grade 2	10 (25.6)	6 (22.2)	
Preoperative Tm FI grade			0.625
Grade 0 or 1	33 (84.6)	24 (88.8)	
Grade 2	6 (15.3)	3 (11.1)	

Values are presented as mean ± SD (range), mean ± SD, or number (%). Group young: age ≤ 60 years, Group old: age ≥ 71 years.
BMI: body mass index, HTN: hypertension, DM: diabetes mellitus, SSC: subscapularis, FI: fatty infiltration, SSP: supraspinatus, ISP: infraspinatus, Tm: teres minor, SD: standard deviation.
*Significant P-value < 0.05.

Clinical Results and Complications Compared to Group Total

Table 4 presents the comparisons between group total and group young and between group total and group old. No significant differences in demographic information were observed except for the age difference. When comparing group young and group old to the entire cohort, both exhibited comparable results. No significant differences were observed in VAS, ASES, and SANE scores. For both group young and group old, aROM showed no significant difference when compared to the entire cohort. Also, radiological assessments, including AHD and Hamada classification, were similar between group young and group old and the entire cohort.

Table 5 shows rates of complications in all three groups. Retear and postoperative infection rates were similar in all three groups. Both group young and group old had one patient requiring revision LDTM surgery due to retear of the transferred tendon. One patient in group young and two patients in group old required conversion to RTSA due to advanced osteoarthritis and retear.

DISCUSSION

In the current study, the transfer of the aLDTM exhibited promising results. Pain alleviation, clinical scores, aROM, and radiological assessments were comparable between group old and group young. Additionally, both groups demonstrated parallel enhancements in strength and similar complication rates. Notably, the clinical outcomes in both groups were similar to those in group total.

ASIRCTs present a formidable challenge in terms of treatment options [20]. Various approaches have been explored, including arthroscopic debridement; partial repair; SCR; PM and Pm transfers; LD transfer; and, as a last resort, RTSA [1-5,8,12]. Arthroscopic debridement and partial repair offer limited long-term strength restoration [4,21]. SCR has shown suboptimal clinical outcomes and high retear rate and has not been suitable in cases of irreparable subscapularis tear [22-24]. The utilization of PM transfer is limited by its distinct anatomical force vector compared to the subscapularis, but Pm transfer has force vector similarity to the subscapularis [5,25]. Both PM and Pm transfers

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Table 2. Comparison of clinical and radiologic outcomes between group young and group old

Variable	Group young (n = 39)	P-value[a)]	Group old (n = 27)	P-value[a)]	P-value[b)]
VAS pain score		< 0.001*		< 0.001*	
Preoperative	4.7 ± 1.3		4.6 ± 1.5		0.855
Postoperative	1.6 ± 1.1		1.7 ± 1.4		0.815
ASES score		< 0.001*		< 0.001*	
Preoperative	49.3 ± 10.4		48.5 ± 11.4		0.765
Postoperative	73.7 ± 15.1		70.8 ± 14.5		0.442
SANE score		< 0.001*		< 0.001*	
Preoperative	50.4 ± 8.4		49.7 ± 10.5		0.768
Postoperative	73.8 ± 16.4		71.0 ± 15.2		0.488
Active ROM					
FE (°)		< 0.001*		< 0.001*	
Preoperative	105 ± 16		100 ± 19		0.332
Postoperative	150 ± 23		147 ± 24		0.681
ABD (°)		< 0.001*		< 0.001*	
Preoperative	84 ± 17		82 ± 18		0.723
Postoperative	129 ± 25		124 ± 24		0.406
ER at side (°)		0.622		0.339	
Preoperative	46 ± 9		44 ± 7		0.582
Postoperative	44 ± 13		47 ± 11		0.383
IR at back[c)]		< 0.001*		< 0.001*	
Preoperative	3.5 ± 2.1		3.8 ± 1.9		0.564
Postoperative	6.4 ± 2.4		6.2 ± 2.6		0.700
AHD		0.278		0.150	
Preoperative	8.0 ± 1.8		8.3 ± 1.7		0.474
Postoperative	7.6 ± 1.8		7.8 ± 1.6		0.575
Hamada		0.599		0.425	
Preoperative	1.2 ± 0.4		1.1 ± 0.3		0.562
Postoperative	1.2 ± 0.4		1.2 ± 0.4		0.755

Values are presented as mean ± standard deviation. Group young: age ≤ 60 years, Group old: age ≥ 71 years.
VAS: visual analog scale, ASES: American Shoulder and Elbow Surgeons, SANE: Single Assessment Numeric Evaluation, ROM: range of motion, FE: forward elevation, ABD: abduction, ER: external rotation, IR: internal rotation, AHD: acromiohumeral distance.
[a)]Compared between preoperative and postoperative; [b)]Compared between young and old groups; [c)]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.
*Significant P-value < 0.05.

and LD transfer are options for managing irreparable subscapularis tears but are less suitable for cases involving concomitant irreparable supraspinatus tears [5,14,25]. RTSA is the final recourse, entails joint sacrifices, and is fraught with limited longevity and implant- associated complication issues [26-29]. Recently, aLDTM transfer has demonstrated favorable outcomes in ASIRCT patients [9]. The aLDTM tendon introduces a humeral head pull-down effect, mitigating arthritic progression and establishing a robust line of pull. This effectively facilitates the restoration of both strength and aROM [9-11]. A recent study by Baek et al. [30] demonstrated an average 11.4% volumetric increment in transferred LDTM muscle one year postoperatively that correlated with improved clinical outcomes and enhanced strength.

Despite the mounting evidence supporting aLDTM transfer, the effectiveness of this procedure in the elderly had not been demonstrated. In general, many studies compared the effectiveness of surgical procedures such as arthroscopic partial repair, SCR, and RTSA in young and old patients [31-33]. However, studies of tendon transfers in the elderly are notably lacking. Surgeons often have a preference regarding age in shoulder tendon transfers; these procedures are predominantly focused on younger, more active patient cohorts [6,12,13,15]. However, Kany et al. [15] conducted a comparative study between two patient groups, one comprising 31 patients younger than 55 years (mean age, 52) and one comprising 31 patients older than 75 years (mean age,

Table 3. Comparison of strength between group young and group old

Variable	Group young (n = 39)	P-value[a)]	Group old (n = 27)	P-value[a)]	P-value[b)]
Strength (N)					
FE		< 0.001*		< 0.001*	
Preoperative	18.6 ± 6.1		12.9 ± 4.2		< 0.001*
Postoperative	31.9 ± 8.3		23.7 ± 7.5		< 0.001*
Δ Delta	13.3 ± 7.2		10.8 ± 9.4		0.222
ABD		< 0.001*		< 0.001*	
Preoperative	14.2 ± 4.7		10.6 ± 3.4		< 0.001*
Postoperative	26.3 ± 7.4		20.8 ± 5.1		0.002*
Δ Delta	12.1 ± 6.7		10.2 ± 7.0		0.285
ER at side		0.093		0.105	
Preoperative	25.1 ± 5.7		22.3 ± 6.1		0.061
Postoperative	27.0 ± 8.4		24.5 ± 7.5		0.149
Δ Delta	1.9 ± 6.8		2.2 ± 6.8		0.861
IR at side		< 0.001*		< 0.001*	
Preoperative	17.9 ± 6.2		11.9 ± 4.0		< 0.001*
Postoperative	35.3 ± 9.1		25.2 ± 6.6		< 0.001*
Δ Delta	17.4 ± 9.0		13.3 ± 7.9		0.060

Values are presented as mean ± standard deviation. Group young: age ≤ 60 years, Group old: age ≥ 71 years.
FE: forward elevation, ABD: abduction, ER: external rotation, IR: internal rotation.
[a)]Compared between preoperative and postoperative; [b)]Compared between young and old groups.
*Significant P-value < 0.05.

77), who underwent posterior LD transfer for PSIRCTs. Kany et al. [15] reported no significant differences in clinical scores between the two groups, suggesting that posterior LD transfer could be an effective surgical option for patients older than 75. Similarly, our study included relatively young and old groups. Mean age was 56.6 years for our group young (n = 39 patients 60 years or younger) and 73.6 years for our group old (n = 27 patients 70 years or older). Despite no demographic disparities, both groups yielded comparable results in pain relief, clinical scores, aROM, and radiological outcomes. In terms of strength, group young patients were stronger in FE, ABD, and IR preoperatively, likely due to age differences. However, the improvement range in strengths showed no statistical differences between group young and group old. The strength of ER at the side for both groups was slightly improved, but the differences were not statistically significant. These results suggest that aLDTM transfer could be as effective in elderly as in younger patients, challenging the notion that the procedure should be limited to the young and active.

This study had several limitations. The relatively small sample sizes (group young n = 39 and group old n = 27) are notable. This limitation stemmed from the inherent challenge of identifying patients with ASIRCTs and intact cartilage who meet the specific criteria for our aLDTM transfer in an outpatient clinic setting. This recruitment challenge imposes constraints on the generalizability of our findings. Additionally, our follow-up duration (average of 42.1 ± 15.6 months for group young and average of 43.9 ± 19.8 months for group old) is relatively short. Extended follow-up periods are crucial for comprehensive evaluation of the long-term efficacy and potential complications associated with aLDTM transfer. Another limitation of this study is that we did not assess data on pseudoparalysis, internal rotation lag sign, and subscapularis function tests such as lift-off, bear hug, and belly press tests. Last, the absence of multiple regression analysis in our study serves as a limitation. This analysis would have allowed us to explore the relationship between preoperative conditions and postoperative outcomes.

CONCLUSIONS

Our study underscores the efficacy of aLDTM transfer for ASIRCTs with minimal glenohumeral arthritis, and we have demonstrated comparable outcomes in group young (age ≤ 60 years) and group old (age ≥ 70 years) patients. Furthermore, the two distinct age groups did not exhibit significantly different clinical results when compared to group total (all patients). These findings enhance our understanding of the versatility of aLDTM transfer across varying age demographics, highlighting its poten-

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Table 4. Comparison of clinical and radiologic outcomes between young and old groups in relation to total group

Variable	Total (n=123)	Young group (n=39)	P-value[a]	Old group (n=27)	P-value[b]
VAS pain score					
Preoperative	4.8±1.2	4.7±1.3	0.604	4.6±1.5	0.529
Postoperative	1.7±1.1	1.6±1.1	0.997	1.7±1.4	0.976
ASES score					
Preoperative	49.5±10.3	49.3±10.4	0.916	48.5±11.4	0.769
Postoperative	74.3±13.5	73.7±15.1	0.600	70.8±14.5	0.182
SANE score					
Preoperative	50.4±9.1	50.4±8.4	0.958	49.7±10.5	0.836
Postoperative	74.6±13.9	73.8±16.4	0.635	71.0±15.2	0.190
Active ROM					
FE (°)					
Preoperative	104±17	105±16	0.998	100±19	0.573
Postoperative	147±25	150±23	0.518	147±24	0.840
ABD (°)					
Preoperative	84±17	84±17	0.998	82±18	0.896
Postoperative	123±26	129±25	0.112	124±24	0.612
ER at side (°)					
Preoperative	47±9	46±9	0.321	44±7	0.152
Postoperative	47±11	44±13	0.260	47±11	0.915
IR at back[c]					
Preoperative	3.9±2.2	3.5±2.1	0.065	3.8±1.9	0.313
Postoperative	6.4±2.3	6.4±2.4	0.997	6.2±2.6	0.901
AHD					
Preoperative	8.1±1.7	8.0±1.8	0.970	8.3±1.7	0.836
Postoperative	7.8±1.8	7.6±1.8	0.740	7.8±1.6	0.997
Hamada					
Preoperative	1.1±0.3	1.2±0.4	0.928	1.1±0.3	0.951
Postoperative	1.2±0.4	1.2±0.4	0.746	1.2±0.4	0.952

Values are presented as mean±standard deviation. Group total: entire population, Group young: age ≤60 years, Group old: age ≥71 years.
VAS: visual analog scale, ASES: American Shoulder and Elbow Surgeons, SANE: Single Assessment Numeric Evaluation, ROM: range of motion, FE: forward elevation, ABD: abduction, ER: external rotation, IR: internal rotation, AHD: acromiohumeral distance.
[a]Compared between total and young groups; [b]Compared between total and old groups; [c]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 5. Complications

Variable	Total group (n=123)	Young group (n=39)	Old group (n=27)
Retear	10 (8.1)	3 (7.7)	3 (11.1)
Postoperative infection	2 (1.6)	1 (2.5)	1 (3.7)
Revision Surgery	5 (4.1)	1 (2.5)	1 (3.7)
Conversion to PM transfer	1 (0.8)	0	0
Conversion to RTSA	5 (4.1)	1 (2.5)	2 (7.4)

Values are presented as number (%).
PM: pectoralis major, RTSA: reverse total shoulder arthroplasty.

tial as a viable treatment option for a wider spectrum of patients.

NOTES

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Conflict of interest

None.

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Data availability

Contact the corresponding author for data availability.

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