Return to Work and Sports After Lower Trapezius Tendon Transfer for Posterosuperior Irreparable Rotator Cuff Tears

Bo Taek Kim,* MD, Jung Gon Kim,* MD, Seung Jin Kim,* MS, Bassem T. Elhassan,† MD, and Chang Hee Baek,*‡ MD
Investigation performed at Yeosu Baek Hospital, Yeosu, Republic of Korea

Background: Lower trapezius tendon (LTT) transfer has demonstrated promising results for patients with posterosuperior irreparable rotator cuff tears (PSIRCTs). However, there has been no study evaluating return to work (RTW) and return to sports (RTS) after LTT transfer.

Purpose/Hypothesis: The purpose of this study was to assess the rates of RTW and RTS and identify associated factors among patients who have undergone LTT transfer for PSIRCTs. It was hypothesized that LTT transfer would result in favorable functional outcomes and high rates of RTW and RTS.

Study Design: Case series; Level of evidence, 4.

Methods: A retrospective review was conducted on patients who underwent LTT transfer for symptomatic PSIRCTs with minimal glenohumeral arthritis. The clinical assessment included patient-reported outcome measures, testing of active range of motion, and a radiological evaluation of arthritis. Patients were surveyed on occupation, sports activity, RTW or RTS status, time to return, and degree of resumption of previous work and sports levels. Exclusion criteria included a follow-up period of <1 year, revision surgery, postoperative infections, loss to follow-up, and unavailability of data.

Results: A total of 110 patients (mean age, 63.0 ± 6.9 years; mean follow-up, 35.3 ± 15.7 months) were included. Clinical scores and active range of motion significantly improved at the final follow-up, with no significant differences between the different work levels. For RTW, 93.6% (n = 103) returned to work (63.1% completely, 36.9% partially), with a mean time to return of 5.2 ± 1.7 months; 6.4% (n = 7) did not return. Patients with lighter work levels had higher return rates and quicker times to return than those with heavier work levels. For RTS, 90.7% (n = 86) returned to sports (70.5% completely, 29.5% partially), with a mean time to return of 5.7 ± 1.3 months. For patients who participated in shoulder sports, 89.9% returned, and 10.1% failed to return. Multivariable logistic regression showed significant associations of higher RTW rates with lighter work levels (odds ratio [OR], 2.72; $P = .005$) and lower retear rates (OR, 5.41; $P = .021$). A lower retear rate was also significantly associated with a higher RTS rate (OR, 7.66; $P = .010$).

Conclusion: LTT transfer for PSIRCTs yielded favorable functional outcomes with high rates of RTW and RTS. Patient-related factors, notably work level and retears, influenced successful RTW and RTS.

Keywords: lower trapezius tendon transfer; return to work; return to sports; posterosuperior irreparable rotator cuff tear; tendon transfer

Lower trapezius tendon (LTT) transfer has emerged as a promising alternative treatment method for posterosuperior irreparable rotator cuff tears (PSIRCTs), offering the potential to alleviate pain, restore shoulder function, and enhance strength.[5-7,12,13] Biomechanically, it mimics the "line of pull" of the infraspinatus and demonstrates comparable "excursion" to the infraspinatus.[8,12,32,34,37,41] Because of these distinct anatomic characteristics, LTT transfer has demonstrated favorable clinical results in PSIRCTs among active and high-demand patients.[6,7,10,12,13,35,37]

With an aging workforce, there is an anticipated escalation in the prevalence of rotator cuff abnormalities among patients.[24] Moreover, given the increasing life expectancy, patients' desire to reintegrate into the workforce and participate in sports or leisure activities becomes increasingly inevitable.[9] Consequently, numerous researchers have endeavored to investigate the factors associated with return to work (RTW) and return to sports (RTS).[1,4,11,20]

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Despite the multitude of studies on RTW and RTS after rotator cuff repair, there exists a considerable variation in reported outcomes and associated factors. Furthermore, there remains a scarcity of research concerning RTW and RTS after surgical interventions other than rotator cuff repair.

Given the successful clinical outcomes associated with LTT transfer in treating PSIRCTs, numerous studies detailing various surgical techniques have emerged.[2,5-7,12,13,37,40,41] Yet, no studies have investigated RTW or RTS results after LTT transfer. The present study aimed to assess RTW and RTS rates and identify associated factors among patients who have undergone LTT transfer for PSIRCTs. We hypothesized that LTT transfer would yield favorable clinical outcomes for patients with PSIRCTs and facilitate successful rates of RTW and RTS. Second, we hypothesized that several factors would be associated with the likelihood of RTW and RTS.

METHODS

The current study was approved by an institutional review board (No. P01-202305-01-006). The need for informed consent was waived because of the retrospective nature of the study and the absence of any additional risk to the patients.

Patient Selection

A retrospective review was conducted on patients who underwent LTT transfer between May 2017 and March 2022. Surgical indications for LTT transfer included an inadequate response to nonoperative treatment, the presence of symptomatic PSIRCTs exhibiting high-grade fatty infiltration and atrophy in both the supraspinatus and infraspinatus muscles (Goutallier[17] grades 3-4), intact or repairable subscapularis tears (Lafosse[28] type $\leq$II), minimal glenohumeral arthritis (Hamada[19] grade $\leq$2), and the absence of neurological conditions affecting the shoulder region. Exclusion criteria included a follow-up period of <1 year, revision LTT transfer, conversion to reverse total shoulder arthroplasty (RTSA), postoperative infections, loss to follow-up, and unavailability of clinical or radiological data. Patients who retired because of advanced age or ceased sports activities for reasons unrelated to shoulder conditions were excluded (Figure 1).

Clinical and Radiological Assessments

Preoperative and postoperative clinical assessments were conducted, encompassing the visual analog scale (VAS) for pain, the American Shoulder and Elbow Surgeons (ASES) score, the Constant score, the Single Assessment Numeric Evaluation (SANE), and active range of motion (ROM) in forward elevation and external rotation. Additionally, the radiological assessment included the acromiohumeral distance (AHD) and Hamada grade to evaluate changes in glenohumeral joint arthritis. The AHD was determined as the shortest distance between the inferior border of the acromion and the apex of the humeral head on the true anteroposterior view of the shoulder.[16] Hamada grades are defined as follows: grade 1 for an AHD >6 mm, grade 2 for an AHD <6 mm, and grade 3 for acetabulization of the acromion along with an AHD <6 mm. Any complications, such as retears, nerve injuries, and postoperative infections, were thoroughly documented. The integrity of the transferred tendon was evaluated using the criteria established by Sugaya et al[38] in which tendon discontinuity (types 4-5) was classified as a retear through magnetic resonance imaging (MRI). MRI was performed postoperatively at 8 weeks, 6 months, 1 year, and then annually thereafter.

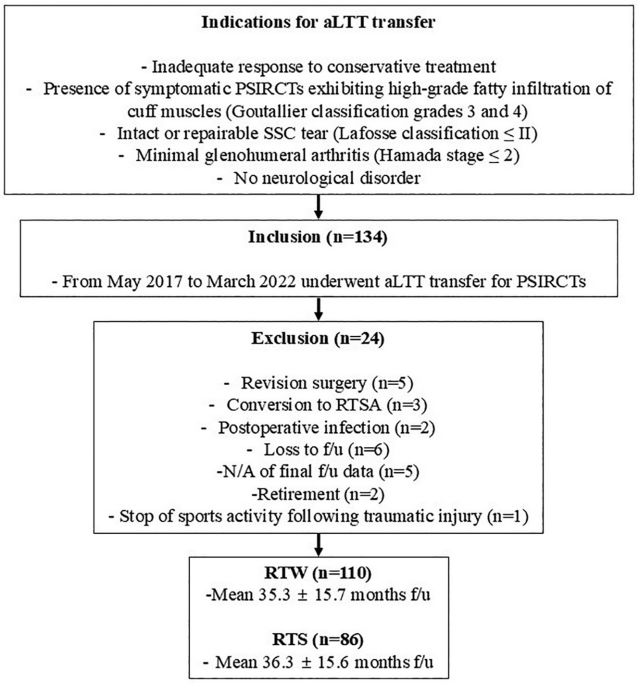

Figure 1. Flowchart showing patient selection for this study. aLTT, arthroscopic lower trapezius tendon; f/u, follow-up; N/A, not available; PSIRCT, posterosuperior irreparable rotator cuff tear; RTS, return to sports; RTSA, reverse total shoulder arthroplasty; RTW, return to work; SSC, subscapularis.

‡Address correspondence to Chang Hee Baek, MD, Department of Orthopaedic Surgery, Yeosu Baek Hospital, 50 Yeoseo 1-ro, Yeosu-si, Jeollanam-do, Republic of Korea (email: Yeosubaek@gmail.com).

*Department of Orthopaedic Surgery, Yeosu Baek Hospital, Yeosu, Republic of Korea.

†Department of Orthopaedic Surgery, Massachusetts General Hospital, Boston, Massachusetts, USA.

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At the final follow-up, patients were administered a survey. They were asked to complete a questionnaire regarding their occupation or sports activities, their RTW or RTS (complete return, partial return, or no return) status, and the time to return. Patients were also requested to describe the extent of task modifications upon returning to work or sports and to rate the degree of resumption of their previous level of work or sports activity. In instances in which patients could not attend outpatient clinics for the questionnaire, a telephone survey was conducted, with 2 separate attempts made to reach each patient; those who did not respond were excluded from the study. A total of 6 patients completed a telephone survey. The questionnaires and telephone surveys were administered by a clinical research coordinator with over 15 years of experience in the shoulder and elbow field, who was blinded to the study's objectives and remained unaware of its details.

For the current study, a complete return was defined as returning to the same or higher level compared with the preinjury state, while a partial return indicated returning to a lower level. Failure to return was classified as no return. The time to RTW and RTS was defined as the duration from the time of surgery until the patient's first time to RTW or RTS. Work level was categorized according to the Canadian Classification and Dictionary of Occupations into 5 groups: (1) sedentary work, involving exerting up to 10 lb occasionally and mostly sitting with brief periods of walking or standing; (2) light work, involving exerting up to 20 lb occasionally with significant walking or standing, sitting with arm or leg controls, or production rate work; (3) medium work, involving exerting 20 to 50 lb occasionally and 10 to 25 lb frequently; (4) heavy work, involving exerting 50 to 100 lb occasionally and 25-50 lb frequently; and (5) very heavy work, involving exerting >100 lb occasionally and >50 lb frequently.[1,14] Sports activity was categorized into 2 groups: shoulder sports (eg, swimming, tennis, badminton) and nonshoulder sports (eg, soccer, running).[25]

Surgical Procedure

All surgical procedures were performed by a single senior surgeon (C.H.B.) and followed surgical techniques described in previous studies.[6,7] Patients were positioned in the lateral decubitus position and administered general anesthesia. First, an arthroscopic examination of the shoulder was performed, and if necessary, repair of the subscapularis tear was carried out using the double-row suture-bridge technique. If more than 50% of the long head of the biceps tendon was symptomatic, we performed either tenotomy or tenodesis of the tendon. Subsequently, the reparability of the remaining supraspinatus and infraspinatus tendons was assessed in the subacromial space. When the irreparable status of the supraspinatus and infraspinatus tendons (not reduced to their original footprint) was confirmed, we began LTT transfer. The remnants of the posterosuperior rotator cuff and any nonviable tissue were debrided using a shaver, and the footprint of the greater tuberosity was prepared. Then, 2 medial-row anchors (5.5-mm Healix; DePuy Synthes) were placed in the supraspinatus footprint near the articular margin: one anteriorly and the other posteriorly.

As LTT transfer requires an interpositional graft to connect the humerus and LTT muscle, the choice of a graft between an Achilles tendon allograft and a fascia lata autograft was made by the patient after the strengths and weaknesses of both types of grafts were explained.[5] In the case of the Achilles tendon allograft (n = 59), the calcaneal bone section was removed, and 2 traction sutures were placed at the end. In the case of the fascia lata autograft (n = 51), a 15 × 4–cm segment was harvested from the ipsilateral thigh, folded in half, and prepared with 2 traction sutures at the end. To harvest the LTT, an incision was made below and along the scapular spine. The lateral border of the LTT was carefully dissected and released from the underlying deep fascial tissue, with traction sutures applied at the end. After preparation, the graft (either a prepared Achilles tendon allograft [n = 59] or a prepared fascia lata autograft [n = 51]) was delivered through the opening of the infraspinatus muscle into the joint and positioned on the prepared footprint, ensuring that its edge covered the lateral margin of the greater tuberosity. Side-to-side suturing between the remnant posterior rotator cuff and the graft was performed using the 2 sutures from the posterior medial-row anchor. The remaining sutures were threaded through the graft, and medial knot tying was performed. Subsequently, 3 lateral-row anchors (4.75-mm SwiveLock; Arthrex) were placed in the lateral aspect of the greater tuberosity to secure the graft with the suture-bridge configuration.

To secure the graft to the LTT muscle, the patient's arm was positioned in maximal external rotation at 60° of abduction. Subsequently, the graft was attached to the LTT muscle by wrapping around its inferior border in a continuous locking suture fashion. Lastly, firm fixation of the graft at the humerus site and LTT muscle site was confirmed.

Postoperative Rehabilitation

After surgery, patients were immobilized in a brace with their shoulder held at a constant 0° of external rotation for 8 weeks, with continuous passive motion exercises initiated at 2 weeks. Throughout this period, patients were allowed to use their elbow, wrist, and fingers while wearing the brace, enabling them to perform daily activities such as eating and writing with minimal restrictions. After the initial 8-week brace period, patients transitioned to active-assisted ROM exercises, gradually advancing to full ROM and strengthening exercises. During the first 6 months after surgery, patients were advised to abstain from engaging in high-level activities and physical labor.

Statistical Analysis

To compare preoperative and postoperative results within each group, continuous data were evaluated using a paired *t* test and the Wilcoxon signed-rank test. Categorical data

TABLE 1
Patient Characteristics[a]

	All Patients (n = 110)	Patients Engaged in Sports (n = 86)
Sex, male/female	73 (66.4)/37 (33.6)	56 (65.1)/30 (34.9)
Age, y	63.0 ± 6.9 (34-77)	61.9 ± 7.0 (34-77)
Symptom duration, mo	12.8 ± 4.9 (3-24)	12.3 ± 5.0 (3-24)
Follow-up, mo	35.3 ± 15.7 (12-75)	36.3 ± 15.6 (12-75)
Total time spent working, y	31.4 ± 7.3 (6-47)	30.5 ± 7.2 (6-44)
Time spent working in a week, h	47.6 ± 4.8 (41-62)	47.4 ± 4.6 (41-61)
Time spent participating in sports in a week, h	8.6 ± 2.7 (4-16)	8.6 ± 2.8 (4-16)
Dominant arm involvement	83 (75.4)	68 (79.0)
Body mass index	24.4 ± 2.7 (17.1-33.9)	24.4 ± 2.9 (17.1-33.9)
Hypertension	36 (32.7)	27 (31.3)
Diabetes mellitus	23 (20.9)	20 (23.2)
Smoker	17 (15.4)	15 (17.4)
Osteoporosis	0 (0.0)	0 (0.0)
Previous rotator cuff repair	19 (17.2)	17 (19.7)

[a]Data are shown as mean ± SD (range) or n (%).

TABLE 2
Types of Work and Sports (n = 110)

Occupation	n (%)	Sport	n (%)
Management worker	8 (7.2)	Shoulder sports	69 (62.7)
Engineer	5 (4.5)	Swimming	8 (7.2)
Housekeeper	19 (17.2)	Dance	5 (4.5)
Artist	7 (6.3)	Golf	10 (9.1)
Service worker	10 (9.1)	Tennis	3 (2.7)
Cook	5 (4.5)	Badminton	6 (5.4)
Cleaner	6 (5.4)	Bowling	3 (2.7)
Self-employed	3 (2.7)	Gateball	5 (4.5)
Office worker	11 (10.0)	Traditional Korean archery	3 (2.7)
Farmer	16 (14.5)	Health training	26 (23.6)
Construction worker	3 (2.7)	Nonshoulder sports	17 (15.4)
Carpenter	6 (5.4)	No sports	24 (21.8)
Fisher	7 (6.3)		
Public transportation driver	4 (3.6)		

were compared utilizing the chi-square and Fisher exact tests. The comparison among the 5 distinct work level groups was conducted through 1-way analysis of variance, with specific pairings determined via the Tukey post hoc test. Factors influencing RTW and RTS were assessed using multivariable logistic regression analysis. All statistical analyses were conducted using SPSS Statistics (Version 19.0; IBM). The mean and standard deviation were reported for the data, and the significance level was set at $P < .05$.

RESULTS

Patient Characteristics

Between May 2017 and March 2022, a consecutive series of 134 patients underwent LTT transfer for PSIRCTs. There were 21 patients excluded from the study for the following reasons: revision surgery (n = 5), conversion to RTSA (n = 3), postoperative infections (n = 2), loss to follow-up (n = 6), and unavailability of data for assessments (n = 5). Specifically, the patients (n = 3) who converted to RTSA after LTT transfer showed promising clinical outcomes at the last follow-up, with improvements in pain and shoulder function and no significant complications. The patients (n = 2) who experienced early postoperative infections were treated with arthroscopic irrigation and debridement without graft removal, followed by intravenous antibiotics. No further treatment was necessary, as the infections were completely resolved. Additionally, 3 patients were excluded because of retirement (n = 2) and cessation of sports activity after a traumatic lower extremity injury (n = 1). A total of 110 patients were included in this study. Of the 110 patients, 86 played sports (shoulder sports: n = 69; nonshoulder sports: n = 17), while 24 did not participate in any sports.

Table 1 describes the characteristics of the patients, and Table 2 details the different types of work and sports that they participated in. The mean age of all patients was 63.0

TABLE 3
RTW and RTS Rates and Times[a]

	RTW						RTS		
	Total (n = 110)	Sedentary (n = 18)	Light (n = 32)	Medium (n = 23)	Heavy (n = 20)	Very Heavy (n = 17)	Total (n = 86)	Shoulder Sports (n = 69)	Nonshoulder Sports (n = 17)
Return (total)	103 (93.6)	18[b,c,d] (100.0)	32[b,c,d] (100.0)	21[e] (91.3)	18[e,f] (90.0)	12[e,f] (70.6)	78 (90.7)	62 (89.9)	16 (94.1)
Complete return	65 (63.1)	15 (83.3)	26 (81.2)	12 (57.1)	8 (44.4)	3 (25.0)	55 (70.5)	42 (67.7)	13 (81.2)
Partial return	38 (36.9)	3 (16.7)	6 (18.8)	9 (42.9)	10 (55.6)	9 (75.0)	23 (29.5)	20 (32.3)	3 (18.8)
No return	7 (6.4)	0 (0.0)	0 (0.0)	2 (8.7)	2 (10.0)	5 (29.4)	8 (9.3)	7 (10.1)	1 (5.9)
Time to return (total), mean ± SD, mo	5.2 ± 1.7	3.7 ± 1.0[b,c,d]	4.2 ± 1.6[b,c,d]	5.9 ± 1.4[e,f]	6.5 ± 1.0[e,f]	6.1 ± 1.3[e,f]	5.7 ± 1.3	5.8 ± 1.2	5.4 ± 1.5

[a]Data are shown as n (%) unless otherwise indicated. RTS, return to sports; RTW, return to work.
Significance at $P < .05$: [b]versus very heavy; [c]versus heavy; [d]versus medium; [e]versus light; and [f]versus sedentary.

± 6.9 years, and the mean follow-up period was 35.3 ± 15.7 months. No significant differences were observed in age and follow-up duration among the different work level groups. Patients represented various occupations, including housekeepers (n = 19 [17.2%]), farmers (n = 16 [14.5%]), and office workers (n = 11 [10.0%]). On average, patients worked 47.6 ± 4.8 hours per week, with no statistically significant differences noted among the different work level groups. Furthermore, patients participated in diverse sporting activities, such as health training (n = 26 [23.6%]), golf (n = 10 [9.1%]), and swimming (n = 8 [7.2%]). The mean time of participation in sports per week was 8.6 ± 2.7 hours.

RTW and RTS

The rate of and time to RTW and RTS are described in Table 3. In regard to RTW, 93.6% of patients (n = 103) returned to work (63.1% with complete return and 36.9% with partial return), while 6.4% (n = 7) failed to return. The mean time to RTW (complete and partial) was 5.2 ± 1.7 months. Notably, patients with lighter work levels tended to return to work more quickly, with a higher proportion achieving a complete return. In the sedentary group, all patients returned to work (83.3% with complete return and 16.7% with partial return), with a mean time to return of 3.7 ± 1.0 months. Similarly, in the light group, all patients returned to work (81.2% with complete return and 18.8% with partial return), with a mean time to return of 4.2 ± 1.6 months. In contrast, the very heavy group exhibited a lower rate of return (70.6%) and a longer time to return (6.1 ± 1.3 months). When comparing between the work level groups, the sedentary and light groups had significantly higher rates of RTW compared with the medium, heavy, and very heavy groups, with all P values <.001. In terms of RTS, among the 86 patients who had previously participated in sports, 90.7% (70.5% with complete return and 29.5% with partial return) returned to sports, with a mean time to return of 5.7 ± 1.3 months. Specifically for shoulder sports, 89.9% of patients returned to sports (67.7% with complete return and 32.3% with partial return), and 10.1% did not return. No significant difference in RTS was found between patients involved in shoulder sports and nonshoulder sports.

Clinical and Radiological Outcomes

The clinical and radiological outcomes of the patients are shown in Table 4. All patients demonstrated significant improvements in VAS, ASES, Constant, and SANE scores and active ROM at the final follow-up. Each work level group exhibited improvements in all clinical scores and showed significant improvements in forward elevation and external rotation at the final follow-up, with no statistical significance between the groups. When comparing the work level groups, the only significant difference observed was in the preoperative SANE score between the sedentary and medium groups (P = .031). All other comparisons, including postoperative outcomes, showed no statistical significance across the different work levels. Regarding radiological parameters for arthritic changes, the AHD decreased and the Hamada grade increased in all groups without statistical significance. Similarly, when comparing patients participating in shoulder sports to those in nonshoulder sports, no significant differences were observed in clinical outcomes, including clinical scores, active ROM, or radiological parameters. A total of 17 patients (15.4%) showed a retear at the final follow-up, with no significant differences between the different work level groups.

Factors Associated With RTW and RTS

Factors associated with RTW and RTS are demonstrated in Table 5. Patients who achieved RTW or RTS, either completely or partially, were compared with those who failed to achieve RTW or RTS. On multivariable logistic regression analysis, the association between higher RTW rates and lighter work levels was statistically significant (odds ratio [OR], 2.72; P = .005). Additionally, the association between a higher RTW rate and a lower retear rate was also statistically significant (OR, 5.41; P = .021). Lastly, a lower retear rate was the only factor that was significantly associated with a higher RTS rate (OR, 7.66; P = .010).

DISCUSSION

The current study assessed RTW and RTS rates among patients who underwent LTT transfer for PSIRCTs. In

TABLE 4
Clinical and Radiological Outcomes[a]

	Return to Work						Return to Sports		
	Total (n = 110)	Sedentary (n = 18)	Light (n = 32)	Medium (n = 23)	Heavy (n = 20)	Very Heavy (n = 17)	Total (n = 86)	Shoulder Sports (n = 69)	Nonshoulder Sports (n = 17)
VAS score									
Preoperative	4.7 ± 1.2	4.6 ± 1.2	4.3 ± 0.8	4.7 ± 0.9	4.9 ± 1.2	5.2 ± 1.4	4.7 ± 1.2	4.6 ± 1.2	5.1 ± 1.3
Postoperative	1.4 ± 0.7	1.4 ± 0.7	1.3 ± 0.5	1.3 ± 0.5	1.5 ± 1.0	1.6 ± 0.9	1.4 ± 0.7	1.3 ± 0.5	1.8 ± 1.2
P value	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]
ASES score									
Preoperative	42.4 ± 8.3	42.5 ± 9.5	44.6 ± 7.4	41.4 ± 7.1	41.6 ± 7.0	40.4 ± 11.3	42.6 ± 8.4	42.5 ± 8.3	43.1 ± 9.1
Postoperative	71.1 ± 13.9	73.6 ± 14.3	74.1 ± 13.0	69.4 ± 16.7	70.6 ± 10.2	66.0 ± 14.5	71.4 ± 13.4	71.3 ± 14.2	71.9 ± 10.0
P value	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]
Constant score									
Preoperative	38.3 ± 9.4	40.9 ± 9.5	37.9 ± 9.4	37.7 ± 9.1	38.8 ± 8.3	36.6 ± 11.1	38.1 ± 9.2	37.7 ± 9.3	39.8 ± 8.9
Postoperative	63.3 ± 12.8	63.4 ± 15.0	65.6 ± 11.5	61.7 ± 14.3	63.8 ± 10.8	60.3 ± 13.5	63.5 ± 12.7	64.5 ± 12.6	59.6 ± 12.7
P value	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]
SANE score									
Preoperative	42.9 ± 7.7	46.3 ± 8.0[c]	43.5 ± 6.9	39.2 ± 8.0[d]	42.5 ± 7.7	43.2 ± 7.6	42.9 ± 7.7	43.6 ± 7.9	39.9 ± 6.0
Postoperative	75.2 ± 12.1	76.6 ± 9.1	77.6 ± 12.1	73.7 ± 14.4	74.9 ± 12.4	71.4 ± 11.5	75.7 ± 12.0	76.3 ± 11.7	72.9 ± 12.9
P value	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]
Active ROM, deg									
Forward elevation									
Preoperative	122 ± 18	127 ± 17	122 ± 16	117 ± 21	122 ± 18	119 ± 19	122 ± 19	120 ± 18	125 ± 18
Postoperative	145 ± 22	146 ± 26	148 ± 22	142 ± 23	145 ± 21	141 ± 16	144 ± 23	146 ± 22	145 ± 23
P value	<.001[b]	.020[b]	<.001[b]	<.001[b]	.007[b]	<.001[b]	<.001[b]	<.001[b]	.040[b]
External rotation at side									
Preoperative	23 ± 10	24 ± 10	26 ± 9	22 ± 12	23 ± 10	19 ± 10	23 ± 10	22 ± 10	26 ± 11
Postoperative	40 ± 11	39 ± 11	43 ± 12	40 ± 10	38 ± 11	35 ± 11	39 ± 11	40 ± 11	37 ± 12
P value	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]	.006[b]
AHD, mm									
Preoperative	8.3 ± 2.1	8.3 ± 1.7	8.5 ± 1.9	8.1 ± 2.2	8.2 ± 2.3	8.4 ± 2.7	8.4 ± 2.1	8.6 ± 2.2	7.8 ± 1.6
Postoperative	7.8 ± 2.3	8.1 ± 2.2	8.2 ± 2.7	7.6 ± 2.5	7.5 ± 2.0	7.5 ± 2.0	7.8 ± 2.3	8.0 ± 2.3	7.2 ± 2.3
P value	.029[b]	.691	.491	.393	.123	.134	.048[b]	.098	.233
Hamada grade									
Preoperative	1.1 ± 0.4	1.1 ± 0.3	1.2 ± 0.4	1.2 ± 0.4	1.1 ± 0.3	1.2 ± 0.5	1.1 ± 0.4	1.1 ± 0.6	1.1 ± 0.4
Postoperative	1.3 ± 0.6	1.2 ± 0.3	1.3 ± 0.6	1.4 ± 0.6	1.3 ± 0.7	1.5 ± 0.7	1.3 ± 0.6	1.2 ± 0.5	1.6 ± 0.7
P value	.005[b]	.579	.374	.103	.096	.172	.013[b]	.146	.027[b]
Retear, n (%)	17 (15.4)	2 (11.1)	4 (12.5)	2 (8.7)	4 (20.0)	5 (29.4)	13 (15.1)	10 (14.5)	3 (17.6)

[a]Data are shown as mean ± SD unless otherwise indicated. AHD, acromiohumeral distance; ASES, American Shoulder and Elbow Surgeons; ROM, range of motion; SANE, Single Assessment Numeric Evaluation; VAS, visual analog scale.
[b]Significance at $P < .05$: [c]versus medium and [d]versus light.

TABLE 5
Factors Associated With RTW and RTS[a]

	RTW		RTS	
	OR (95% CI)	*P* Value	OR (95% CI)	*P* Value
Work level/shoulder sports	2.72 (1.35-5.47)	.005[b]	0.66 (0.09-4.47)	.675
Sex	2.69 (0.68-10.71)	.159	3.53 (0.78-15.96)	.101
Age	1.02 (0.92-1.14)	.618	0.98 (0.89-1.09)	.752
Body mass index	1.02 (0.79-1.31)	.860	1.05 (0.82-1.35)	.690
Retear	5.41 (1.28-22.81)	.021[b]	7.66 (1.62-36.13)	.010[b]
Hypertension	0.23 (0.02-1.96)	.181	0.28 (0.03-2.44)	.253
Diabetes mellitus	1.09 (0.21-5.63)	.919	1.11 (0.20-5.99)	.902
Smoker	1.61 (0.31-8.65)	.561	1.66 (0.30-9.19)	.558
Dominant arm involvement	0.45 (0.05-3.78)	.461	1.30 (0.23-7.01)	.767
Previous rotator cuff repair	1.41 (0.27-7.39)	.683	1.40 (0.25-7.63)	.697
Repairable concomitant subscapularis tear	3.83 (0.66-22.05)	.132	3.38 (0.57-20.02)	.180

[a]OR, odds radio; RTS, return to sports; RTW, return to work.
[b]Significant at $P < .05$.

the analysis of 110 patients, 93.6% returned to work (63.1% returning to their previous level [completely] and 36.9% returning at a lower level [partially]), and 6.4% failed to return. The mean time to RTW was 5.2 ± 1.7 months. When stratified into 5 distinct work levels, patients who were engaged in more strenuous work exhibited lower rates of return and a longer time to return. The RTS rate involving shoulder sports was 89.9%, with a 67.7% rate of complete return and a 32.3% rate of partial return. Factors such as work level and retears significantly influenced RTW, while a retear was associated with RTS.

In this study, LTT transfer demonstrated promising clinical outcomes, consistent with previous studies by other authors.[2,6,7,10,12,13,35,40,41] Patients showed significant pain relief, with the VAS score improving from 4.7 ± 1.2 preoperatively to 1.4 ± 0.7 postoperatively ($P < .001$). Shoulder function also improved significantly, as reflected on several patient-reported outcome measures: the ASES score improved from 42.4 ± 8.3 to 71.1 ± 13.9, the Constant score improved from 38.3 ± 9.4 to 63.3 ± 12.8, and the SANE score improved from 42.9 ± 7.7 to 75.2 ± 12.1, all with $P < .001$. Additionally, active ROM in forward elevation and external rotation showed significant improvements, from 122 ± 18 to 145 ± 22 and from 23 ± 10 to 40 ± 11, respectively ($P < .001$ for both). These findings align with previously reported outcomes of LTT transfer.

Several studies have reported the rates of RTW and RTS after different types of surgery in patients with rotator cuff abnormalities. A recent systematic review on RTW after rotator cuff repair found that a mean of 62.3% of patients returned to their previous level of work at a mean of 8.15 ± 2.7 months after surgery.[20] Additionally, a study by Mihata et al[31] reported an RTW rate of 94.2% after superior capsular reconstruction. In regard to RTSA, a recent systematic review showed that RTW rates ranged up to 65%, with a mean return time of 2.3 ± 2.4 months.[29] In the current study, we found that 93.6% of patients returned to work (63.1% returned to their previous level, while 36.9% returned at a level below their previous level), with a mean time to return of 5.2 ± 1.7 months. Our results demonstrate a comparable rate of RTW compared with the aforementioned surgical techniques, with a shorter return time than rotator cuff repair but a longer return time than RTSA. Furthermore, our findings indicate that patients involved in less physically demanding occupations demonstrated greater rates of RTW and a quicker time to return, which is consistent with the findings of Ting et al.[39] However, our study reveals that even in strenuous work level groups, there were relatively high rates of RTW (90.0% in the heavy group and 70.6% in the very heavy group). Nonetheless, the majority of these patients returned to work at a level below their previous capacity, with partial return rates of 55.6% in the heavy group and 75.0% in the very heavy group. This outcome may be attributed to the characteristics of our patient population. In our study, 14.5% of patients were farmers, and 6.3% were fishers, often serving as the sole economic providers for their families and working as sole proprietors. As a result, there might have been a pressing need for prompt RTW after surgery.

Regarding RTS, 90.7% of patients successfully returned to participating in sports, with 70.5% achieving a complete return and 29.5% experiencing a partial return. The mean time to RTS was 5.7 ± 1.3 months. A broad spectrum of outcomes regarding RTS has been reported in various studies.[3,4,15,23,25,26,31,36] A recent systematic review highlighted variability in both the rate of and time to RTS after rotator cuff repair, with the return rate ranging from 50.0% to 100% and the return time occurring between 4.8 and 14 months.[3] Furthermore, another systematic review indicated that RTSA yielded a mean RTS rate ranging from 60% to 93%, with a mean return time of 5.3 months.[15] The reported wide spectrum of RTS rates is likely influenced by the diversity of patient populations and the broad range of sports activities with varying levels of intensity. On the other hand, there are studies that have specifically focused on patients who are professional sports athletes. In a recent systematic review focusing on RTS after rotator cuff repair among sports athletes, Noffs and Costa[33] reported a 72.9% RTS rate among 140 athletes. Additionally, Migliorini et al[30] conducted another recent systematic review among 692 overhead athletes, revealing a 75.4% RTS rate. Consequently, our observed RTS rate (90.7%) appears to be relatively higher compared with studies involving professional athletes. However, our findings align with those of Altintas et al,[4] who reported higher RTS rates among patients engaged in recreational sports compared with professional athletes. In our study cohort, the mean age was relatively high (63.0 ± 6.9 years), and the majority participated in recreational sports activities, devoid of contact or significant physical demands, with none identified as professional athletes. Many patients might have diminished motivation and concerns regarding potential postoperative complications. Moreover, this demographic composition might have contributed to a relatively higher incidence of partial return in shoulder sports (32.3%) compared with nonshoulder sports (18.8%).

Several studies have extensively explored factors influencing RTW after rotator cuff repair. Notably, previous studies have indicated a lower RTW rate for patients undergoing rotator cuff repair on their dominant arm compared with the nondominant arm.[1,18] Similarly, female sex and younger age exhibited a higher likelihood of RTW after rotator cuff repair.[11,21,22,39] However, our study results diverge from these findings, as we found no significant associations between RTW and dominant arm involvement ($P = .461$), sex ($P = .159$), and age ($P = .618$). Nonetheless, our study identified a significant association between retears and RTW (OR, 5.41; $P = .021$), which contrasts with the findings of previously reported studies in which no differences in RTW rates between patients with and without a retear were observed.[25,31] Also, the level of work demonstrated a significant association (OR, 2.72; $P = .005$), indicating that patients with more physically demanding occupations were less likely to return to work. This corresponds with findings from Ting et al,[39] indicating that patients with lighter workloads were 11 times more likely to return to preinjury work levels compared with those with strenuous workloads. In regard to RTS, studies have identified several factors potentially

affecting a poor RTS rate after rotator cuff repair, including overhead sports, professional engagement, and lower preoperative ASES scores.[4,27] In our study, a retear (OR, 7.66; $P = .010$) emerged as the sole factor significantly associated with RTS. Surprisingly, factors such as age ($P = .752$) and involvement in shoulder sports ($P = .675$) did not influence the rate of RTS. This deviation can possibly be attributed to the composition of our study population, which primarily consisted of older recreational sports participants and no professional athletes.

Several limitations are evident in our study. First, the retrospective nature of our study presents inherent limitations, including potential biases in patient selection and the inability to control all variables. Yet, we have standardized the preoperative and intraoperative decision-making processes. This includes the use of preoperative MRI to assess PSIRCTs with a Goutallier grade $\geq$3, minimal glenohumeral arthritis (Hamada grade $\leq$2), and intraoperative findings in which the torn and retracted supraspinatus and infraspinatus could not be reduced to their original footprint, which defines irreparable tears. Second, patients' responses on the surveys regarding RTW and RTS were based on memory and might have been influenced by the time elapsed since surgery. This limitation stems from our study design, which relied on patients self-reporting their work and sports status without controlling for personal bias or secondary gain. Third, the study has a relatively small sample size for each work level group, which can possibly lead to type II or beta errors with lower power. Fourth, some patients, particularly those who were sole economic providers or business owners, returned to work earlier than the recommended rehabilitation period because of financial constraints. This premature RTW could have potentially affected the observed clinical outcomes and recovery, highlighting the influence of economic and social factors on postoperative rehabilitation. Fifth, our study has a relatively short follow-up period. A prolonged follow-up is essential to comprehensively assess the long-term efficacy and potential complications associated with LTT transfer. Lastly, we did not make comparisons between the 2 different types of interpositional grafts, which could potentially influence our results because of each graft's unique strengths and weaknesses.

CONCLUSION

In the current study of 110 patients who underwent LTT transfer for PSIRCTs, 93.6% returned to work (63.1% with complete return and 36.9% with partial return), while 6.4% failed to return. The mean time to RTW was 5.2 $\pm$ 1.7 months. Patients engaged in more strenuous work exhibited lower rates of return and a longer time to return. Regarding RTS involving shoulder sports, 89.9% returned (67.7% with complete return and 32.3% with partial return), while 10.1% failed to return. Factors such as work level and retears were significantly associated with RTW, while a retear was associated with RTS.

REFERENCES

1. Aagaard KE, Randeblad P, Abu-Zidan FM, Lunsjö K. Return to work after early repair of acute traumatic rotator cuff tears. *Eur J Trauma Emerg Surg*. 2020;46(4):817-823.
2. Aibinder WR, Elhassan BT. Lower trapezius transfer with Achilles tendon augmentation: indication and clinical results. *Obere Extrem*. 2018;13(4):269-272.
3. Alben MG, Gambhir N, Papalia AG, et al. Return to sport after arthroscopic rotator cuff repair of full-thickness rotator cuff tears: a systematic review. *Clin J Sport Med*. Published online February 23, 2023. doi:10.1097/JSM.0000000000001130
4. Altintas B, Anderson N, Dornan GJ, Boykin RE, Logan C, Millett PJ. Return to sport after arthroscopic rotator cuff repair: is there a difference between the recreational and the competitive athlete? *Am J Sports Med*. 2020;48(1):252-261.
5. Baek CH, Kim BT, Kim JG. Arthroscopic-assisted lower trapezius tendon transfer using a fasciae lata autograft in treatment of posterior superior irreparable rotator cuff tears in lateral decubitus position. *Arthrosc Tech*. 2023;12(12):e2227-e2237.
6. Baek CH, Kim BT, Kim JG, Kim SJ. Clinical results of arthroscopically-assisted lower trapezius transfer using fascia lata autograft for posterior superior irreparable rotator cuff tear. *J Orthop*. 2024;52:78-84.
7. Baek CH, Kim BT, Kim JG, Kim SJ. Mid-term outcomes of arthroscopically assisted lower trapezius tendon transfer using Achilles allograft in treatment of posterior-superior irreparable rotator cuff tear. *J Shoulder Elbow Surg*. 2024;33(6):1293-1305.
8. Baek G, Kim JG, Baek GR, et al. Biomechanical comparison between superior capsular reconstruction and lower trapezius tendon transfer in irreparable posterosuperior rotator cuff tears. *Am J Sports Med*. 2024;52(6):1419-1427.
9. Boissonneault M, Rios P. Changes in healthy and unhealthy working-life expectancy over the period 2002-17: a population-based study in people aged 51-65 years in 14 OECD countries. *Lancet Healthy Longev*. 2021;2(10):e629-e638.
10. Chopra A, Wright MA, Murthi AM. Outcomes after arthroscopically assisted lower trapezius transfer with Achilles tendon allograft. *J Shoulder Elbow Surg*. 2024;33(2):321-327.
11. Collin P, Abdullah A, Kherad O, Gain S, Denard PJ, Lädermann A. Prospective evaluation of clinical and radiologic factors predicting return to activity within 6 months after arthroscopic rotator cuff repair. *J Shoulder Elbow Surg*. 2015;24(3):439-445.
12. Elhassan BT, Sanchez-Sotelo J, Wagner ER. Outcome of arthroscopically assisted lower trapezius transfer to reconstruct massive irreparable posterior-superior rotator cuff tears. *J Shoulder Elbow Surg*. 2020;29(10):2135-2142.
13. Elhassan BT, Wagner ER, Werthel JD. Outcome of lower trapezius transfer to reconstruct massive irreparable posterior-superior rotator cuff tear. *J Shoulder Elbow Surg*. 2016;25(8):1346-1353.
14. Feltri P, Monteleone AS, Marbach F, Filardo G, Candrian C. Arthroscopic rotator cuff repair: patients with physically demanding work have significantly worse time to return to work, level of employment, and job loss. *Knee Surg Sports Traumatol Arthrosc*. 2023;31(1):153-160.
15. Franceschetti E, Giovannetti de Sanctis E, Gregori P, et al. Return to sport after reverse total shoulder arthroplasty is highly frequent: a systematic review. *J ISAKOS*. 2021;6(6):363-366.
16. Furuhata R, Matsumura N, Oki S, et al. Risk factors of radiographic severity of massive rotator cuff tear. *Sci Rep*. 2022;12(1):13567.
17. Goutallier D, Postel JM, Bernageau J, Lavau L, Voisin MC. Fatty muscle degeneration in cuff ruptures: pre- and postoperative evaluation by CT scan. *Clin Orthop Relat Res*. 1994;304:78-83.
18. Gutman MJ, Patel MS, Katakam A, et al. Understanding outcomes and the ability to return to work after rotator cuff repair in the workers' compensation population. *Cureus*. 2021;13(3):e14213.
19. Hamada K, Fukuda H, Mikasa M, Kobayashi Y. Roentgenographic findings in massive rotator cuff tears: a long-term observation. *Clin Orthop Relat Res*. 1990;254:92-96.

20. Haunschild ED, Gilat R, Lavoie-Gagne O, et al. Return to work after primary rotator cuff repair: a systematic review and meta-analysis. *Am J Sports Med*. 2021;49(8):2238-2247.
21. Imai T, Gotoh M, Hagie K, et al. Factors affecting return to work in patients undergoing arthroscopic rotator cuff repair. *Prog Rehabil Med*. 2019;4:20190006.
22. Jayasekara M, Lam PH, Murrell GAC. Return to work following shoulder surgery: an analysis of 1,773 cases. *JB JS Open Access*. 2020;5(3):e19.00081.
23. Kholinne E, Singjie LC, Marsetio AF, Kwak JM, Jeon IH. Return to physical activities after arthroscopic rotator cuff repair: a systematic review and meta-analysis. *Eur J Orthop Surg Traumatol*. 2023;33(6):2645-2654.
24. Khoschnau S, Milosavjevic J, Sahlstedt B, Rylance R, Rahme H, Kadum B. High prevalence of rotator cuff tears in a population who never sought for shoulder problems: a clinical, ultrasonographic and radiographic screening study. *Eur J Orthop Surg Traumatol*. 2020;30(3):457-463.
25. Kim H, Hur S, Jeon IH, Koh KH. Effect of retear after arthroscopic rotator cuff repair on return to work and sports in nonathletes: a retrospective cohort study. *Orthop J Sports Med*. 2023;11(7):23259671231186408.
26. Kim HG, Kim SH, Kim SC, et al. Return to sports activity after reverse total shoulder arthroplasty. *Orthop J Sports Med*. 2023;11(11):23259671231208959.
27. Klouche S, Lefevre N, Herman S, Gerometta A, Bohu Y. Return to sport after rotator cuff tear repair: a systematic review and meta-analysis. *Am J Sports Med*. 2016;44(7):1877-1887.
28. Lafosse L, Jost B, Reiland Y, Audebert S, Toussaint B, Gobezie R. Structural integrity and clinical outcomes after arthroscopic repair of isolated subscapularis tears. *J Bone Joint Surg Am*. 2007;89(6):1184-1193.
29. Lalehzarian SP, Agarwalla A, Liu JN. Return to work following shoulder arthroplasty: a systematic review. *World J Orthop*. 2022;13(9):837-852.
30. Migliorini F, Asparago G, Cuozzo F, Oliva F, Hildebrand F, Maffulli N. Patient outcomes and return to play after arthroscopic rotator cuff repair in overhead athletes: a systematic review. *J Orthop Traumatol*. 2023;24(1):3.
31. Mihata T, Lee TQ, Fukunishi K, et al. Return to sports and physical work after arthroscopic superior capsule reconstruction among patients with irreparable rotator cuff tears. *Am J Sports Med*. 2018;46(5):1077-1083.
32. Moraiti K, Zampeli F, Reinares F, Gantsos A, Valenti P. Feasibility of lower trapezius transfer extended by the infraspinatus fascia for restoration of external rotation in irreparable posterosuperior rotator cuff tears: an anatomical study. *Eur J Orthop Surg Traumatol*. 2021;31(4):661-667.
33. Noffs GG, Costa LAV. Rotator cuff repair and return to sports practice in athletes older than 35 years: is it possible? A systematic review. *Arch Orthop Trauma Surg*. 2024;144(2):801-806.
34. Reddy A, Gulotta LV, Chen X, et al. Biomechanics of lower trapezius and latissimus dorsi transfers in rotator cuff-deficient shoulders. *J Shoulder Elbow Surg*. 2019;28(7):1257-1264.
35. Rodríguez-Vaquero G, López-Fernández V, Calvo E. Lower trapezius transfer for massive posterosuperior rotator cuff defects. *Oper Orthop Traumatol*. 2022;34(1):34-44.
36. Sonnier JH, Connors G, Campbell MP, et al. Return to recreational sports participation following rotator cuff repair in adults over 40 years of age: outcomes and return to play analysis. *JSES Int*. 2023;7(2):301-306.
37. Stoll LE, Codding JL. Lower trapezius tendon transfer for massive irreparable rotator cuff tears. *Orthop Clin North Am*. 2019;50(3):375-382.
38. Sugaya H, Maeda K, Matsuki K, Moriishi J. Repair integrity and functional outcome after arthroscopic double-row rotator cuff repair: a prospective outcome study. *J Bone Joint Surg Am*. 2007;89(5):953-960.
39. Ting RS, Rosenthal R, Shin Y, et al. Predictors of return to work following primary arthroscopic rotator cuff repair: an analysis of 1502 cases. *Am J Sports Med*. 2023;51(4):893-900.
40. Valenti P, Werthel JD. Lower trapezius transfer with semitendinosus tendon augmentation: indication, technique, results. *Obere Extrem*. 2018;13(4):261-268.
41. Wagner ER, Elhassan BT. Surgical management of massive irreparable posterosuperior rotator cuff tears: arthroscopic-assisted lower trapezius transfer. *Curr Rev Musculoskelet Med*. 2020;13(5):592-604.