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Latissimus dorsi transfer or lower trapezius transfer: a treatment algorithm for irreparable posterosuperior rotator cuff tears muscles transfers in posterosuperior rotator cuff tears

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Background: Tendon transfers of the latissimus dorsi transfer (LDT) or the lower trapezius transfer (LTT) are treatment options for irreparable posterosuperior irreparable rotator cuff tears (PSIRCT). There is still no consensus on which type of tendon transfer is superior in the treatment of PSIRCT. Due to the differences in the anatomy and biomechanics, we hypothesize that there are different clinical situations in which either LDT or LTT should be preferred. The aim of this study was to evaluate the clinical and radiological outcomes of LDT and LTT in patients with PSIRCT to establish a clinical algorithm for the treatment decision.
Materials and methods: This is a retrospective, single-center observational study. Included were patients who underwent arthroscopically assisted LDT (aaLDT) or arthroscopically assisted LTT (aaLTT) for PSIRCT. In all patients, range of motion (ROM), external rotation strength, visual analog scale of pain and subjective shoulder value were determined pre- and postoperatively. Constant–Murley score was evaluated at the final follow-up. The complication rate, failure of the tendon transfer, and revision rate were analyzed.
Results: In total, 29 aaLDT (age 64 years, median follow-up time 45 months) and 8 aaLTT (age 54 years, median follow-up time 34 months) were included. Active ROM, visual analog scale and subjective shoulder value was significantly improved in both cohorts. At follow-up, the median Constant–Murley score was 73 (aaLDT) and 77 (aaLTT), respectively. The failure rate, including revision surgery, was 14% (aaLDT) and 13% (aaLTT), respectively. Low functional findings preoperatively were correlated to a lower functional outcome at follow-up in both groups. Painful loss of anterior elevation and loss of external rotation had no significant impact on functional outcomes in aaLDT.
Conclusion: Following the treatment algorithm based on the clinical examination, clinical outcome parameters, active ROM and pain could be significantly improved. A good preoperative function was associated with a good clinical outcome in both transfers. A low failure and revision rate supports the good decision-making of the algorithm presented.

Massive rotator cuff tears (RCTs) may be associated with shoulder pain, weakness, and limited range of motion (ROM), with considerable repercussions for the patient's quality of life. When massive tears persist for a long period of time, degeneration of the tendons and muscles occurs, making arthroscopic repair difficult

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and compromising tendon healing. RCTs with advanced fatty muscle degeneration, atrophy, shortened tendon length, and severe tendon retraction are associated with impaired tendon healing after arthroscopic repair and are considered irreparable.[13,22,24] In patients with posterosuperior irreparable rotator cuff tears (PSIRCTs), the anterior-posterior and superior-inferior force couple may become unbalanced and result in superior migration of the humeral head, leading to impaired shoulder function.[6] In case this impairment can be functionally compensated by the surrounding muscles, a conservative treatment may be appropriate, but if symptoms persist, surgical procedures should be considered.[4,23] Reverse total shoulder arthroplasty (rTSA) with or without tendon transfer is becoming more frequently used in advanced age.[28] In younger patients with high functional demands on the shoulder, tendon transfers (open or arthroscopically assisted), such as the latissimus dorsi transfer (LDT) and the lower trapezius transfer (LTT) may be considered. The LDT was first performed and described by Gerber et al in 1988 [12] and has long been the mainstay for treatment of PSIRCT using a tendon transfer. Recently, however, the LTT has emerged as another option for PSIRCT.[9] The aim of both transfers is to restore shoulder function and to decrease pain. Active forward elevation (FE) and active external rotation (ER) can be significantly improved by both transfers.[10,25] But care should be taken in decision- making, because shoulder function may worsen after tendon transfer in patients who have a balanced, functional shoulder preoperatively. Furthermore, aaLDT and aaLTT are very demanding procedures that require a long rehabilitation. For these reasons, precise patient selection is of tremendous importance in the success of the LDT.[26]

In a recent retrospective multicenter study, Warner et al compared open LDT, arthroscopically assisted LDT (aaLDT) and arthroscopically assisted LTT (aaLTT) in patients with PSIRCT.[27] The authors concluded that arthroscopically assisted tendon transfer techniques achieved better results than open techniques. However, the authors did not find that either transfer technique was superior in patients with PSIRCT, which is comparable to the current literature. But there are several biomechanical and clinical differences that should be considered. Even though both procedures generate a force vector for ER and stabilize the glenohumeral center of rotation,[20] there are certain biomechanical differences between the two transfers. In biomechanical comparative studies, an overall larger moment arm was observed for LTT in ER with the shoulder in a neutral (ER0), while LDT has an advantage for ER in abduction (ER2) and for FE.[5,15]

Due to the differences in the anatomy and biomechanics of the two muscles and the transfer techniques, we hypothesize that there are different clinical situations in which either aaLDT or aaLTT should be preferred. The aim of this study was to evaluate the clinical and radiological outcomes of aaLDT and aaLTT in patients with PSIRCT to establish a clinical algorithm for the treatment decision.

Material and methods

This is a retrospective, single-center observational study. After approval by the institutional review board, all consecutive patients who underwent aaLDT or aaLTT for PSIRCT between 2015 and 2022 were included. The included were patients with intact or reparable subscapularis (SSC) tendon. Patients with prior failed arthroscopic rotator cuff (RC) repair were not excluded. The surgery was performed by two fellowship-trained specialized shoulder surgeons (L.L. and T.L.). The surgical techniques are shown in Supplementary Appendix S1 and the rehabilitation protocol in Supplementary Appendix S2.

Indication for surgery and therapy algorithm

Indication

The indication for a tendon transfer for PSIRCT was given in predominantly active and painful patients, unsuccessful conservative treatment, and a good passive ROM (no stiffness). RCTs were considered irreparable according to the following criteria: Goutallier grade 2-4 and Patte grade 2 and 3.[21] Fatty infiltration and muscle atrophy usually occur together and are primarily decisive for the treatment decision. An isolated retracted tendon, on the other hand, can usually be reconstructed if the muscles are in good condition.

Contraindications

Contraindications for both transfers were glenohumeral osteoarthritis (Hamada classification >3)[14] and pseudoparesis of the shoulder with an active FE <90°.[1] However, patients with painful loss of anterior elevation (PLEA), as described by Boileau et al were included.[2] To distinguish between pseudoparesis and PLEA, the examiner passively elevates the arm to the maximum anterior elevation position between 90 and 180°. If the patient is unable to hold the arm in this position due to lack of strength (elevation lag sign), tendon transfer was not determined to be a sufficient treatment option. A preoperative painful loss of ER or/and an ER lag sign were not a contraindication for the tendon transfer.

Clinical examination

This study focused on the active ER in two different positions: ER in 0° adduction of the shoulder (ER0) and ER in 90° abduction of the shoulder (ER2) (Fig. 1). When testing the ER, the patient's elbow was positioned in a 90° flexion. The muscle strength in ER0 was tested with the shoulder in a neutral adduction and neutral rotation position. The muscle strength in ER2 was tested with the shoulder in a 90° abduction and neutral rotation position. A deficit in ER was defined as no movement against resistance (isometric muscle strength grade 3 or less), with or without an ER lag sign, in the different ER positions.[17] The ER0 lag sign was positive if the patient could not maintain the position and the arm rotated inward. The ER2 lag sign was tested by passively rotating the arm to the full ER2 position. If the patient could not hold the arm in this position and the arm rotated internally, the ER2 lag sign was considered positive.

Treatment decision

The therapeutic decision was made according to clinical examination (Fig. 2). aaLDT was performed in patients with limitations in ER2 or with combined limitations in ER0 and ER2. aaLTT was indicated for patients with isolated restricted ER0. If the ER is not restricted in either position, we recommend the aaLDT.

Clinical outcome

The following patient-reported outcome measures were collected pre and postoperatively: subjective shoulder value (SSV), visual analog scale of pain (VAS). At the final follow-up, active daily living in external rotation,[3] Constant–Murley score (CS)[7] and the American Shoulder and Elbow Surgeons score (ASES)[19] were assessed. Clinical assessment was performed pre and postoperatively by measuring the active ROM. The resistance and isometric muscle strength in ER0 (RER0) was pre and postoperatively assessed by the surgeons (L.L. and T.L.) using an ordinal scale from 5 (normal muscle strength) to 0 (no muscle contraction).[17] The pain during the ER resistance test in ER0 was determined according to the CS pain scale from 15 (no pain) to 0 (strongest pain).

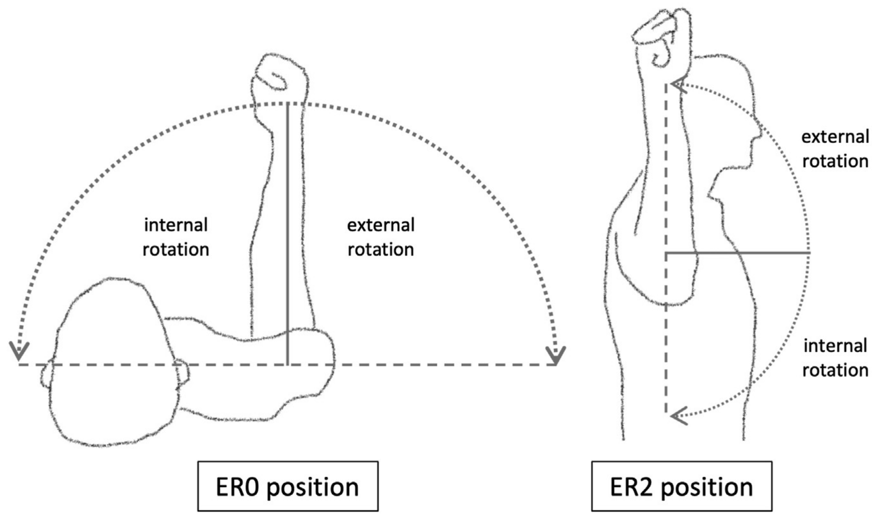

Figure 1 External rotation of the shoulder in different positions: *ER0*, external rotation in 0° shoulder abduction; *ER2*, external rotation in 90° shoulder abduction.

Failure or complication

All cases that required further surgery related to the tendon transfer on the affected shoulder were considered complications. Increasing RC arthropathy (Hamada >2) was considered a radiologic failure of the tendon transfer. In aaLDT, limited strength <3 in FE and ER and/or pseudoparesis was considered a functional failure. In aaLTT, a limited force <3 and/or a sign of delay in ER0 was considered a functional failure. In addition, general complications, such as infections, nerve lesions, fractures, or anchor misplacement or migration were recorded.

Statistical analysis

Cohorts were formed according to the transfer type (cohort aaLDT and cohort aaLTT). As the indications for the tendon transfers were different, the postoperative results were not comparable. Statistical analyses were performed using SPSS software (version 28.0; IBM Corp., Armonk, NY, USA). The nominal variables were summarized as percentages. The arithmetic mean and its standard deviation were used for descriptive statistics for variables with normal distribution. Abnormal distributed quantitative variables were grouped with medians and ranges. Shapiro–Wilk test was used to test the normality of the variables. Wilcoxon–Mann–Whitney test (U test) was used for quantitative variables based on distribution normality. To compare pre and postoperative variables, the paired Wilcoxon rank-sum test was used because of an abnormal distribution. To test the correlation between two nominal variables, Pearson's Chi-square test was calculated. Pearson's correlation coefficient (PCC) was used to evaluate the correlation between metric variables, and Spearman's Rho (Rho) was tested for ordinal variables (2-tailed testing). The level of significance was set for $P < .05$.

Results

Study population

A total of 37 patients were available for follow-up in this study. The aaLDT was performed in 29 (78%) patients and the aaLTT in 8 (22%) patients. Complete radiologic imaging was available in 28 (76%) patients.

Arthroscopic assisted latissimus dorsi transfer (aaLDT)

General information and intraoperative findings

Patients undergoing aaLDT had a mean age of 64 (IQR: 6) years. Twenty-two (76%) were men. Prior RC repair was performed in 10 (35%) patients (Table I). The mean preoperative active FE was 150° (IQR: 75). Seven (24%) patients with a PLEA were identified.

In 19 (66%) patients, additional SSC tear was found, which was repaired in the same surgery using suture anchor techniques. In 19 (66%), the long head of the biceps tendon was treated by tenotomy or tenodesis. In 10 (35%) patients, the long head of the biceps tendon could not be identified, because it was either torn or had been treated in a previous operation. A subacromial temporary spacer (balloon) was inserted in 16 (55%) patients. A summary of the intraoperative findings is shown in Table I.

Functional and radiological outcome

The mean follow-up time was 45 (SD: 29) months. At the final follow-up, improvement was seen in all measurements compared to the preoperative outcomes. They are as follows: active FE (160° vs. 150°, $P = .003$), active ER0 (40° vs. 35°, $P = .373$), active ER2 (80° vs. 48°, $P = .015$), SSV (80% vs. 40%, $P < .001$), and VAS (1 vs. 5, $P < .001$). The median CS score was 73 (IQR: 24), and the median ASES score was 84 (IQR: 23). An overview of the functional and radiological results is shown in Table II.

Regarding the radiologic findings, in none of the patients Hamada grade >2 was observed. Revision surgery was performed in two (7%) patients. In one patient, aaLDT failure was observed, leading to revision surgery with implantation of a rTSA. Another patient underwent revision surgery (lavage and arthrolysis) due to postoperative infection. This patient had an active FE of less than 90° at follow-up. In both cases, an SSC tear Lafosse 2 was present preoperatively.

Arthroscopically assisted lower trapezius transfer (aaLTT)

General information and intraoperative findings

Patients with aaLTT were on average 54 (IQR: 9) years old and were all male. In 4 (50%) patients, a previous RC repair was performed. In addition to the aaLTT, 5 (63%) patients had an additional SSC rupture (1 graded as Lafosse 2 and 4 as Lafosse 3) requiring reparation. In 2 (40%) of the patients with an SSC tear, a traumatic event was present. Fascia lata allograft was chosen for tendinous

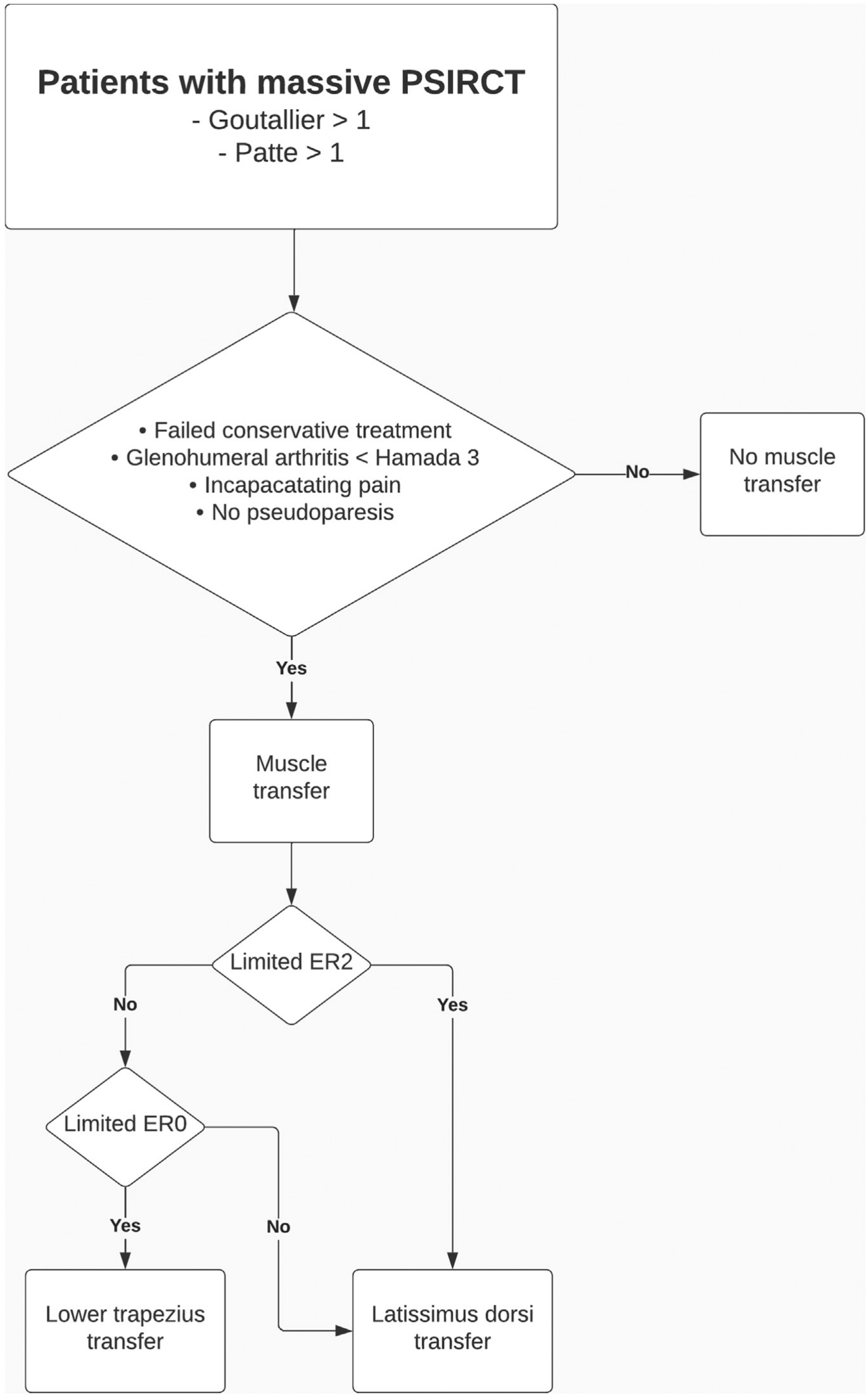

Figure 2 Therapeutic algorithm for the treatment of posterosuperior irreparable rotator cuff tears (PSIRCTs) with latissimus dorsi tendon transfer or lower trapezius transfer (*ER0*, external rotation in 0° shoulder abduction; *ER2*, external rotation in 90° shoulder abduction).

augmentation in 3 (38%) patients. Achilles tendon allograft was used in 5 (63%) patients.

Functional and radiological outcome

The mean follow-up time was 34 (SD: 22) months. Comparing pre-too-postoperative results, active ER0 (30° vs. 18°, $P = .028$) and SSV (80% vs. 45%, $P = .011$) improved significantly (Table II). At the final follow-up, the median CS score was 77 (IQR: 21), and the median ASES score was 79 (IQR: 16). The median strength in ER0 improved significantly from 3/5 preoperatively to 4/5 at follow-up ($P = .034$).

No revision surgery was noted in the cohort of aaLTT. At the final follow-up, 1 (13%) patient was found to have a Hamada grade 4B, which was defined as a serious complication. This patient showed worse functional outcomes compared to patients without aaLTT failure (SSV 45%, CS 55, ASES 57). On clinical examination, the lower trapezius muscle was able to contract but with decreased strength in ER0 (3/5).

Table I
Description of the study cohort including demographic parameters, functional parameters, and intra-operative findings.

Study population	aaLDT (n = 29)	aaLTT (n = 8)
Demographic parameters		
Age, mean (SD)	64 (6)	54 (9)
Follow-up, mean months (SD)	45 (29)	34 (22)
Sex, n (%)		
Female	7 (24)	0 (0)
Male	22 (76)	8 (100)
BMI, median (IQR)	27 (6)	25 (7)
Diabetes, n (%)	0 (0)	0 (0)
Hypercholesterolaemia, n (%)	4 (14)	0 (0)
Smoking, n (%)	3 (10)	1 (13)
Affected dominant side, n (%)	16 (62)	7 (88)
Prior RC repair, n (%)	10 (35)	4 (50)
AHD <5 mm, n (%)	7 (24)	1 (13)
Traumatic cause, n (%)	12 (41)	2 (25)
Preoperative parameters		
SSV, median % (IQR)	40 (13)	45 (21)
VAS pain, median (IQR)	5 (2)	5 (3)
Active FE, median ° (IQR)	150 (75)	130 (73)
Strength in ER0, median 0-5 (IQR)	4 (1)	3 (1)
Pain in ER0, median 0-15 (IQR)	10 (4)	10 (5)
Active ER0, median ° (IQR)	35 (25)	18 (55)
Active ER2, median ° (IQR)	48 (70)	50 (20)
ER0 lag sign, n (%)	8 (38)	5 (63)
Intraoperative findings		
SSC tear		
No tear	10 (35)	3 (38)
Grade 1, n (%)	1 (3)	0 (0)
Grade 2, n (%)	16 (55)	1 (13)
Grade 3, n (%)	2 (7)	4 (50)
SSC repair, n (%)	19 (66)	5 (63)
LHBT treatment		
Tenotomy, n (%)	5 (17)	0 (0)
Y shape tenodesis, n (%)	4 (14)	4 (50)
360 tenodesis, n (%)	10 (35)	4 (50)
Absent, n (%)	10 (35)	0 (0)
Balloon, n (%)	16 (55)	0 (0)
Tendon graft		
Allograft achilles tendon, n (%)	0 (0)	5 (63)
Allograft fascia lata, n (%)	0 (0)	3 (38)

aaLDT, arthroscopically assisted latissimus dorsi transfer; *aaLTT*, arthroscopically assisted lower trapezius transfer; *ER0*, external rotation 1; *ER2*, external rotation 2; *FE*, forward elevation; *AHD*, acromiohumeral distance; *BMI*, body mass index; *ER0*, external rotation 1; *ER2*, external rotation 2; *IQR*, interquartile range; *LHBT*, long head of the biceps tendon; *n*, number; *RC*, rotator cuff; *SD*, standard deviation; *SSC*, subscapularis tendon; *SSV*, subjective shoulder value; *VAS*, visual analogue scale.

Table II
Functional and radiological outcomes after aaLDT and aaLDT for posterosuperior irreparable RCTs.

Outcomes	aaLDT (n = 29)	aaLTT (n = 8)
Functional outcomes		
VAS pain, median (IQR)	1 (2)	1 (1)
SSV, median % (IQR)	80 (23)	80 (18)
Constant Score, median (IQR)	73 (24)	77 (21)
ASES, median (IQR)	84 (23)	79 (16)
ADLER, median (IQR)	30 (4)	30 (3)
Active FE, median° (IQR)	160 (30)	170 (15)
Active abduction, median° (IQR)	160 (25)	150 (42)
Strength in ER0, median 0-5 (IQR)	4 (1)	4 (0)
Pain in ER0, median 0-15 (IQR)	15 (0)	15 (5)
Active ER0, median° (IQR)	40 (40)	30 (32)
Active ER2, median° (IQR)	80 (13)	80 (0)
Active IR better T12, n (%)	24 (17)	2 (25)
Radiological outcomes		
AHD preop, median mm (IQR)	5 (7)	6 (5)
AHD postop, median mm (IQR)	5 (7)	8 (2)
Hamada grade, n (%)		
I	24 (83)	4 (66)
II	3 (10)	1 (17)
III	0 (0)	0 (0)
IV	0 (0)	1 (17)
V	0 (0)	0 (0)
Failure and complication		
Revision, n (%)	2 (7)	0 (0)
Functional failure, n (%)	1 (3)	0 (0)
Radiological failure, n (%)	3 (10)	1 (13)

aaLDT, arthroscopically assisted latissimus dorsi transfer; *aaLTT*, arthroscopically assisted lower trapezius transfer; *ADLER*, Activities of Daily Living that require External Rotation; *FE*, anterior forward elevation; *AHD*, acromionhumeral distance; *ASES*, American Shoulder and Elbow Surgeons; *ER0*, external rotation 1; *ER2*, external rotation 2; *IQR*, interquartile range; *IR*, internal rotation; *n*, number; *postop*, postoperatively; *preop*, preoperatively; *SSV*, Subjective Shoulder Value; *SD*, standard deviation; *VAS*, visual analogue scale; *T12*, 12th thoracic vertebra.

Analysis of factors influencing clinical outcomes

Logistic regression analysis showed that the need for SSC tendon repair had no significant effect on clinical outcome in both groups. Nevertheless, it is worth noting that the failures in both cohorts had massive SSC tears that were repaired at the time of surgery. Previous surgery did have an impact on postoperative outcome and was associated with poorer functional outcome, but no statistical significance was found. In patients with a traumatic event, clinical outcomes were generally better, but no significant difference was found.

In the aaLDT cohort, patients with a good preoperative active ER0 had a significantly improved active ER0 postoperatively (PCC = 0.737, P < .001). An increased active FE preoperatively showed increased SSV (PCC = 0.381, P = .041) and CS (PCC = 0.391, P = .036) postoperatively.

In the aaLTT cohort, good active FE was associated with significantly better active ER0 (PCC = 0.738, P = .037), CS (PCC = 0.771, P = .025), and ASES score (PCC = 0.873, P = .005) at the final follow-up. A good active ER0 preoperatively also showed significantly better functional results after aaLTT in the active ER0 (PCC = 0.872, P = .005) and ASES score (PCC = 0.721, P = .043). Patients without pseudoparesis in ER0 showed significantly better postoperative outcomes (CS 86 vs. 61, P = .029, ASES 92 vs. 74 P = .029). Other factors showed no significant correlation with the outcomes.

Discussion

Patients with PSIRCTs, nonarthritic shoulders, and high functional demands present a challenging cohort; fortunately, LDT and LTT have both proven to be successful treatment options in a selection of patients. This study aims to describe the outcomes after the two transfers (aaLDT and aalTT) and proposes a more personalized treatment algorithm based on the clinical limitations at ER0 and ER2, rather than using one of the two techniques for all cases.

The proposed treatment algorithm, based on the limitations of ER in two different arm positions, is supported by clinical experience and previous biomechanical studies. Hartzler et al showed in a cadaveric study that the LTT potentially results in superior restoration of ER with the arm at the side compared with LDT.[15] In addition, this transfer results in a closer synergistic function to the infraspinatus (scapula retraction and ER) and a parallel traction line, which may have an advantage in ER0.[5] The LDT converts its adduction and internal rotation function into abduction, elevation, and ER. Therefore, it may represent a better option for restoration of ER2. It also restores superior-inferior balance of the glenohumeral joint. As an antagonist of the deltoid muscle, the LDT, like the LTT, acts as a depressor of the humeral head.

In this study, satisfactory postoperative results were found in both groups. As the two groups had different preoperative characteristics and indications, the two techniques are not directly compared in our analysis. While the current study is not comparative and does not prove or disprove the utility of the proposed treatment algorithm, we hypothesize that the algorithm is of added practical value based on the aforementioned biomechanical studies and the positive outcomes that are presented in our study. In both groups, ROM, strength, functional scores, and pain were significantly improved. Increased pain was not reported in any of the cases. The median CS of 73 (aaLDT) and 77 (aaLTT) are favorable when compared to other studies. In addition, the revision rate was low (7% aaLDT and 0% aaLTT). Based on these results, we can conclude that our proposed therapy algorithm leads to good postoperative results despite the complex surgical technique and the challenging patient population. Larger, comparative studies are required to further analyse this assumption, which is challenging with a rare procedure such as the studied tendon transfers.

Although direct comparative studies are lacking, several previous studies have separately analyzed the clinical results after LDT and LTT. The first LDT was published by Gerber et al for patients with massive PSIRCT to regain ER and depress the humeral head to allow more effective action of the deltoid muscle.[12] The same group published 10-year results of 46 patients with PSIRCT.[11] At the final follow-up, the SSV increased by 41%-70%, and the relative CS improved from 56% to 80%. Inferior results were seen in patients with insufficient SSC muscle and fatty infiltration of the teres minor muscle. Similar results are reported by Iannotti et al, who published the results of a clinical trial of 14 patients who were treated with LDT due to PSIRCT.[16] In addition to a good satisfaction rate, the authors conclude, similar to our study, that preoperative shoulder function and overall strength influence the final clinical outcome. Comparable results are reported in other recent studies.[8,18] However, in the aaLDT group of the current study, we did not find a significant impact of preoperative PLEA on clinical outcome, postoperative active FE, or ER0. We hypothesize that aaLDT can also be considered in cases with limited active FE of the shoulder, although patients with true pseudoparesis of the active FE are not included, because they were excluded for tendon transfer. Preoperative function still needs to be considered, as we have found that good preoperative clinical status (ROM in ER0 and active FE) correlates with good functional outcome.

Elhassan et al recently published the clinical results after aaLTT in patients with PSIRCT.[9] The study consisted of 41 patients and in 90% of the patients, significantly increased VAS, SSV, and Disabilities of the Arm, Shoulder and Hand score were observed. The authors conclude that the aaLTT may lead to a good functional outcome in patients with massive PSIRCT, including patients with pseudoparesis. The authors defined pseudoparesis as active shoulder flexion $<60^\circ$ and active shoulder abduction $<60^\circ$, with no improvement in motion once pain was eliminated with a lidocaine injection. Since we did not include patients with pseudoparesis, the populations are only comparable to a limited extent. Comparing the results of Elhassan et al with our results, we conclude that the aaLTT can significantly improve ER strength in patients with preoperatively impaired ER0 in addition to the clinical outcome parameters (SSV).

Limitations

Limitations were identified in the analysis of the clinical parameters. Not all prospectively collected parameters were available preoperatively; no preoperative CS, ASES and active daily living in external rotation scores were available. Regarding the radiological analysis, it should be noted that postoperative radiographs were not available in all cases. Full radiological data sets including pre and postoperative imaging were available for 28 of the patients (76%). A postoperative magnetic resonance imaging scan was not part of the study protocol and therefore could not be evaluated. The strength of the transferred muscle was tested by at least two authors, including the senior author but is based on a subjective isometric test of strength. Blinding patients would have been one way to avoid this type of bias in a prospective study. In addition, since not all patients were available for follow-up, a recall bias is also to be expected due to postoperative data collection. Overall, a small sample size was achieved, but this is comparable to the literature on this rare procedure.

Strengths

This study is, to our knowledge, the first clinical study evaluating two different arthroscopically assisted tendon transfer techniques for PSIRCT, using a decision algorithm based on preoperative functional findings. Furthermore, all surgeries were performed at the same institution by two fellowship-trained shoulder surgeons using the same standardized technique; this increases internal validity of the results. In addition, the follow-up times of 45 months (aaLDT) and 34 months (aaLTT) were high compared to the available literature.

Finally, the limited number of patients included in the aLTT cohort should not be seen as a limitation due to lack of surgical experience. Indeed, the practice of the surgeons who operated on the patients is wide and includes the treatment of patients with peripheral nerve sequelae in whom open LTTs were performed (the number of patients with lower traps performed during the study period is 9). These patients were not included as we preferred to avoid bias by including open procedures and focus exclusively on PSIRCTs. Nevertheless, more long term and prospective studies are needed to analyze the long-term results.

Conclusion

The aim of the study was to propose a treatment recommendation for a specific therapeutic transfer (aaLDT and aaLTT) in PSIRCTs based on the clinical examination, especially ER, and to analyze the clinical results after the respective tendon transfer. Following the treatment algorithm based on the clinical examination, clinical outcome parameters, active ROM, and pain could be significantly improved. Good preoperative function was associated with a good clinical outcome in both transfers. A low failure and revision rate supports the good decision-making of the algorithm presented.

Disclaimers:

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Conflicts of interest: Geert-Alexander Buijze is a consultant for Stryker. Laurent Lafosse has royalties for Depuy Mitek. Thibault Lafosse is consultant for Stryker, Depuy Synthes, Zimmer Biomet, Smith&Nephew. The other authors, their immediate families, and any research foundation with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

Supplementary Data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jseint.2024.08.184.

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