Clinical outcome of latissimus dorsi tendon transfer and partial cuff repair in irreparable postero-superior rotator cuff tear

Abstract

Background and Purpose: Irreparable Rotator Cuff Tears (RCTs) is a common cause of pain in adult population, requiring in many cases a surgical treatment. Possible alternatives are debridement, partial repair, muscle transfers and joint replacement. We evaluated two groups of patients with irreparable rotator cuff tear treated surgically: one group received an arthroscopic assisted Latissimus Dorsi tendon transfer (LDTT), and the other an arthroscopic rotator cuff partial repair. Aim of our study is to compare clinical results and quality of life in two groups of patients with massive irreparable rotator cuff tear: one receiving an arthroscopic Latissimus Dorsi tendon transfer and the other receiving an arthroscopic rotator cuff partial repair.

Methods: 40 patients were assigned to two groups: 20 patients to group TT treated with latissimus dorsi tendon transfer and 20 patients to group PR treated with a partial repair. The average follow-up duration was 2.8 years (1-5; SD: 3). Pre- and post-operative modified-UCLA shoulder score, ROM, measurement of the strength and the RC-QOL were used to asses the outcome.

Results: Latissimus Dorsi Tendon Transfer showed significative improvements when compared to partial repair in UCLA score results, strength and rc-qol (rotator cuff quality of life) questionnaire. No differences were found between the groups in pain relief.

Conclusion: Both techniques are effective in reducing patients' symptoms. We believe that in younger, high-demanding patients with no or mild osteoarthritis, the LDTT represents a valid treatment option with better modified UCLA score improvement and strength at our follow-up.

Conflict of interest: NO

Keywords: rotator cuff tears; irreparable rotator cuff tears; partial repair; tendon transfer; latissimus dorsi transfer;

Introduction

Rotator cuff tears is a common cause of pain in adult population and often produce lasting symptoms as pain and limitation of normal activities. Reduced acromion-humeral distance (<5 mm), fatty degeneration of the muscle and huge tendinous tissue deficit are factors that suggest not to repair the lesion[1]. Possible treatments for irreparable rotator cuff tears are debridement associated to subacromial bursectomy and long head of the biceps tenotomy, partial cuff repair, tendon transfers (latissimus dorsi, pectoralis major) and joint replacement[2]. Reverse total shoulder arthroplasty is often used in elderly patients where the rotator cuff lesion coexists with degenerative gleno-humeral arthropathy. Latissimus Dorsi tendon transfer is advocated in younger patients without gleno-humeral arthropathy, in which a postero-superior irreparable rotator cuff tear causes pain and loss of function. Gervasi et al. proposed an arthroscopic LD transfer avoiding deltoid sacrifice[3]. We didn't found in literature studies comparing the Latissimus Dorsi tendon transfer to other techniques for the treatment of irreparable postero-superior rotator cuff tear. Aim of our study is to compare clinical results and quality of life in two groups of patients with massive irreparable rotator cuff tear: one receiving an arthroscopic Latissimus Dorsi tendon transfer and the other receiving an arthroscopic rotator cuff partial repair.

Methods

Patient population

Inclusion criteria were daily and nocturnal pain, previous conservative treatment (NSAIDs, intrarticular injection of corticosteroids and physiotherapy) without results, strength loss and an intact or reparable subscapularis tendon. Exclusion criteria were: shoulder instability, previous rotator cuff surgery, fracture of the glenoid or smaller tuberosity, gleno-humeral osteoarthritis, prior surgery of the shoulder, cervical radiculopathy, capsule-ligamentous lesions, inflammatory disease of the connective tissue; (6) other general comorbidities (cardiovascular and cerebrovascular diseases, lower extremity ischaemia, neurological diseases, and uncontrolled diabetes), or psychiatric illness. In the period between January 2007 and January 2011 we included in our study 40 patients respecting inclusion and exclusion criteria. These patients were assigned to two groups: 20 patients to group TT (13 men and 7 women) treated with arthroscopic assisted latissimus dorsi tendon transfer and 20 patients to group PR (11 men and 9 women) treated with a rotator cuff partial repair. Patients were intraoperatively allocated to the two groups, according to the possibility to first attempt a partial repair of the cuff. When the tissue's features allowed for partial repair, it was performed, when they didn't allow, the tendon transfer was performed. The mean follow-up was 2.8 years (1-5; SD: ±3), demografic features are reported in Table 1. Patients evaluation was performed immediately before the index operation, and postoperatively at a minimum 2-year follow-up.

Surgical technique

All surgical procedures were performed by the senior orthopaedic surgeon. All the patients received a pre-operative interscalene block plus a general anesthesia. Patient were positioned in a lateral decubitus with the shoulder and elbow flexed at 90° to allow both latissimus dorsi exposure and later arthroscopic transfer. The same set-up was managed for group PR. Gravity joint irrigation was provided using 4 L saline bags hung at a height of 8 feet. The extent of tear and the tendon retraction were measured intra-operatively in both the coronal and sagittal planes according to the classification system described by Boileau et al[4]

Latissimus dorsi tendon transfer

The procedure was performed according to the technique described by Gervasi in 2007(Gervasi, Causero et al. 2007)

Phase 1: diagnostic arthroscopy

Standard portals, including a posterior portal (P), an anterior inferior portal (A), a posterolateral portal (PL), and an anterolateral portal (AL) are performed.

Phase 2: harvesting the tendon

The arm should be released from the traction and abducted and internally rotated. After probing the latissimus dorsi tendon with a finger, a 6–7 cm long curved incision line is firstly marked and then made along the muscle's profile at the axillary level. Using blunt dissection, the tendon can be isolated and detached from its humeral insertion.

Phase 3: prepare the tendon

The two sides of the tendon are reinforced with suture stitches by differently colored high strength sutures. Then the same is done for the end of the tendon, bridging the lateral- and medial-side stitches to strengthen the tendon during its transfer through the subacromial space, preventing the tendon from splitting

Phase 4: tendon transfer

Once the limb traction is restored, we use one finger to isolate the fibers of the brachial triceps. At this point it is identified through a PL portal vision the best way to pass a 30° curved grasper through the AL portal to the armpit, between the teres minor and the posterior deltoid. Once the curved grasper has exited the axillary incision, we use to pass two transparent suction tubes through the pathway to reduces the risk of rotating the graft while shuttling it to the subacromial space. Finally a suture retriever is used to shuttle out of the AL portal the lateral and the medial side tendon sutures through the lateral and the medial tube respectively.

Phase 5: tendon fixation (Fig.1)

To fix the tendon on the prepared site on the greater tuberosity, the medial and the lateral stitches are loaded on 5.5 mm knotless anchors. The lateral one is placed as anteriorly as possible, aiming to the bicipital groove.

Partial repair

After the footprint was identified at the greater tuberosity, through a shaver (Arthex, Naples, FL, USA) it was prepared until a bleeding surface was achieved. We performed a partial repair of the irreparable lesion according to the technique previously described by Burkhart et al[5].

Post-operative Management

After the operation, the joints in the TT group were immobilised in a 45° abduction sling for 6 weeks. The sling was then removed and patients were allowed for assisted passive mobilization on all planes and soft active mobilization until the thirth postoperative month. The main target during this period was to achieve a good neuromuscular control of the transfered Latissimus Dorsii tendon in its new role as a humeral head stabilizer and external rotator. After 3 months trengthening excercises for the deltoid and the scapular stabilizers were started.

In patient included in the partial repair group a sling was used for the first 4 postoperative weeks and were allowed free flexion and internal rotation from the first postoperative day. At 4 weeks a progressive free ROM in all directions was allowed. On the first day after surgery passive external rotation was started while overhead stretching was allowed 4 weeks postoperatively to avoid damaging the repair. At 4 weeks, the sling was removed, and overhead stretching with a rope and pulley was started. Strengthening of the deltoid and of the scapular stabilizers were initiated at 8 weeks after the surgery.

Evaluation

Imaging

All patients received a standard pre-operative assessment using standard radiographs and MRI scans. According to the classification of Hamada et al., the Acromio-Humeral Index (AHI) was preoperatively assessed for each patient (Table 2). Fatty infiltration was evaluated using MRI scans and classified according to Goutallier et al[6]

Functional assessment

A modified UCLA rating scale for pain, function, ROM, and patient satisfaction was used to evaluate each patient pre-operatively and at follow-up. According to Ellman, an excellent UCLA score is 34 to 35 points; a good score is 28 to 33 points; a fair score is 21 to 27 points and a poor score is 0 to 20 points[7]. Pre- and post-operative measurement of the strength were performed through a handheld dynamometer (PowerTrack MMT; JTech Medical Industries, Alpine, Utah, and Muscletester; Hoggan Health Industries, South Draper, Utah).[8] The ranges of motion in elevation, external rotation, internal rotation, and hand behind back lift-off were assessed.

Quality of life (RC-QOL)

All patients completed a self-administered RC-QOL(rotator cuff quality of life) questionnaire. The RC-QOL questionnaire is a simple disease-specific outcome measure that evaluate the impact of rotator cuff disease on the general quality of life. The total score ranges from 0 (worst score) to 3400 (best score), results are given as percentage (0-100%). This questionnaire has been translated and validated for the Italian language[9].

Statistical analysis

We designed the investigation as a prospective case-control study; two independent populations (patients undergoing arthroscopic latissimus dorsi tendon transfer, and patients receiving an arthroscopic rotator cuff partial repair) were considered. The data used to design the study were the following: Alpha-value: 0.05, Power: 0.8, Ratio between cases and control: 1, Probability of the event in cases: 0.3, Probability of the event in controls: 0.3. According to the power analysis calculation, we needed a total of 18 patients in each group to satisfy the above premises. We recruited 20 patients per group. The differences between preoperative and postoperative active forward flexion, external rotation, internal rotation and UCLA shoulder score for both the groups were assessed by an unpaired Student t test. The effects of tear size, tendon retraction, fatty degeneration and AHI grade on outcome were also assessed by 1-way ANOVA. Statistical significance was set at $P < 0.05$. Data are presented using mean, median or standard deviation, and range and data ranges as appropriate. Statistical analysis was performed with the SPSS software package, version 11.0 (SPSS, Chicago, IL).

Source of Funding

There was no external funding source for this study.

Results

Associated procedures

The associated procedures have been performed, are reported in Table 2.

Range of motion

ROM measures of both groups at the latest follow-up (post-operative forward elevation, internal rotation, and external rotation) were significantly improved ($P<0.05$) compared to pre-operative values, with significative intergroup differences (Table 3).

Functional assessment (Table 4)

Pain measures (Visual Analogue Scale, VAS) improved significantly from pre- to post-operative time for both groups [Group TT: from a mean pre-operative value of 6.9±1.7 to the final post-operative value of 1.3±0.7 ($P<0.05$)]; [Group PR: mean preoperative value: 6.6±1.8; final postoperative value: 1.5±0.8($P<0.05$)]. Results from UCLA shoulder score showed a mean pre-operative value of 7.3±2.5 for group TT and 7.6±3.9 (P=n.s.) for group B while the post-operative values at the latest follow-up showed a statistically significant improvement in both groups [30.3±4.2 for group TT and 20.1±3.4 for group PR] ($P<0.05$). Intergroup differences in functional and strength domains were statistically significant ($P<0.05$) starting from the first post-operative month to the whole duration of the study. With regard to the strength, there was a statistically significant improvement between pre-operative evaluation and the last follow-up for both groups, but with significative intergroup differences ($P<0.05$). According to the UCLA rating system, in group TT 12 patients (63%) had an excellent result (34–35 points), 5 (26%) a good result (28–33 points), and 2 (11%) a fair result (21–27 points), whereas in group PR 11 patients (55%) had an excellent result (34–35 points), 5 patients (25%) a good result (28–33 points), and 4 (20%) a fair result (21–27 points). There were no poor results (0–20 points).

Tendons' features

The UCLA shoulder score demonstrated a statistically significant difference between patients of both groups (TT and PR) with stage 2 degeneration and those with stage 3 or stage 4 fatty degeneration ($P < 0.0001$), while no difference in outcome between those with stage 3 and those with stage 4 degeneration. The same was noticed concerning the AHI. Patients with an AHI grade 1 achieved significative better UCLA outcomes than those with an AHI grade 2 ($P < 0.0001$).

Quality of Life (RC-QOL)

The RC-QOL demonstrated a statistically significant difference between the groups [group TT: 81.8±9.3; group PR: 69.3±8.7] ($P<0.05$) (Table 4).

Ruptures

Based on a clinical diagnosis, given a sudden loss of function, a case of LDT rupture was recorded, after 13 months from surgery. In this patient a reverse total shoulder arthroplasty was performed.

Discussion

Changing the insertion site, from the anatomical one to the great tuberosity, the Latissimus Dorsi muscle become an external rotator [(10,11,12)] and this is the biomechanical feature on which the LDT transfer lies. In 2007 Gervasi and colleagues(Gervasi, Causero et al. 2007) proposed an arthroscopically assisted LDT transfer. Our technique proposes few changes compared to the Gervasi's one. We developed some tricks to obtain the widest footprint coverage and to avoid the graft rolling and rotation while shuttling it to the subacromial space: the particular pattern of tendon edge's stitches, the use of two separate sutures and of two suction tubes and the use of an in-out positioned grasper to shuttle the tendon through the subacromial space. A biomechanical study of Oh and colleagues[13] demonstrated as the abnormally increased maximum internal rotation occurring in massive rotator cuff tears was reversed after LDT transfer. But the authors also outlined as an excessive muscle tension (as in the case of a LDT transfer with limited excursion) could cause, paradoxically, lost of internal rotation. To avoid this troublesome scenario, we recommend an accurate release of the muscle, allowing the tendon to reach the posterior rim of the acromion, thus ensuring sufficient length once it is passed into the subacromial space. Our aim was to cover as more as possible the humeral head. The wider is the coverage, the better will be the healing potential of the tendon and the higher will be the depressive action on the humeral head. Moreover, we try to fix the tendon edge as anteriorly as possible to the bicipital groove, to obtain the maximal tenodesis effect and the best balance between the subscapular and the latissimus dorsi muscles. As suggested by Gervasi (Gervasi, Causero et al. 2007), when fixing the tendon close to the articular cartilage and the long head of biceps groove, the fiber's distension generates an elastic force pulling back distally and posteriorly along the LD bill axis, thus this force contributes maintain the humeral head located at the rotation centre of the glenoid track. The main positive effects on external rotation is achieved just by changing the biomechanical features of the LDT. At its natural insertion it acts as an important restraint to external rotation, while the maximum moment-generating capacity is restored significantly through each new insertion site[14]; for this reason we believe that it is more important to cover as much surface as possible of the rotator cuff footprint. Results of our study show how partial repair leads to pain relief and slightly improvement of shoulder function, conversely the tendon transfer allows for a greater recovery of the shoulder active movements. In the post-operative period, patients' quality of life improved in the overall cohort but better results were found in the tendon transfer group considering shoulder function and strength. Our results, in agreement with the literature, demonstrated good to excellent recovery of shoulder function.[(15,16,17,18)] We attributed this successful outcomes to the careful postoperative rehabilitation targeted to an extensive work to achieve the best neuromuscular control. Strenghts of the study are a single surgeon performing all the operations and the strictly inclusion and exclusion criteria. Limitations are given by the short follow-up, the small study population and the lack for postoperative radiological controls. We recorded 1 case of tendon rupture after 13 months from surgery and no clinical detectable failure of any partial repair. The lack for radiological controls didn't allow us to record partial repair failures during the follow-up period neither the possible progression of the AHI. Although it has been shown as latissimus dorsi transfer is not able to avoid the risk for glenohumeral joint arthropathy[19], our study shows its effectiveness in younger patients leading to significative ROM, strength and pain reduction. An ideal candidate for a tendon transfer has mild to moderate shoulder weakness associated with an irreparable posterior-superior rotator cuff tear[20] .Also if both techniques are effective in reducing patients' symptoms we think that for high demanding, younger patients, latissimus dorsi tendon transfer should be considered, since it restores an higher shoulder strength compared to partial repair. We didn't found in literature other studies comparing the LDTT to other techniques. It's not possible to demonstrate the superiority of one technique on the others but, according to results of our study, we believe that in younger, high-demanding patients with no or mild osteoarthritis, the LDTT represents a valid treatment option.

Figures and tables

Figure 1: picture showing the LDT fixed. Intrarticular arthroscopic view.

Table 1: patients's features and associated surgical treatments. Values are given as average with range in brackets

Table 2: preoperative tendon features

Table 3: Range of movement. Values are given as average ± standard deviation with range in brackets

Table 4: Pre-and post-operative values of UCLA, VAS and RC-QOL. Values are given as average ± standard deviation with range in brackets

References

1 - Oh, J. H., et al. (2009). "Prognostic factors affecting anatomic outcome of rotator cuff repair and correlation with functional outcome." Arthroscopy 25(1): 30-39.

2 - Khair, M. M. and L. V. Gulotta "Treatment of irreparable rotator cuff tears." Curr Rev Musculoskelet Med 4(4): 208-213.

3 - Gervasi, E., et al. (2007). "Arthroscopic latissimus dorsi transfer." Arthroscopy 23(11): 1243 e1241-1244.

4 - Boileau, P., et al. (2005). "Arthroscopic repair of full-thickness tears of the supraspinatus: does the tendon really heal?" J Bone Joint Surg Am 87(6): 1229-1240.

5 - Burkhart, S. S., et al. (1994). "Partial repair of irreparable rotator cuff tears." Arthroscopy 10(4): 363-370.

6 - Goutallier, D., et al. (1994). "Fatty muscle degeneration in cuff ruptures. Pre- and postoperative evaluation by CT scan." Clin Orthop Relat Res(304): 78-83.

7 - Ellman, H., et al. (1986). "Repair of the rotator cuff. End-result study of factors influencing reconstruction." J Bone Joint Surg Am 68(8): 1136-1144.

8 - American Academy of Orthopaedic Surgeons, (1965). Joint Motion: Method of Measuring and Recording. Chicago, American Academy of Orthopaedic Surgeons.

9 - Papalia, R., et al. "RC-QOL score for rotator cuff pathology: adaptation to Italian." Knee Surg Sports Traumatol Arthrosc 18(10): 1417-1424.

10 - Bogduk, N., et al. (1998). "The morphology and biomechanics of latissimus dorsi." Clin Biomech (Bristol, Avon) 13(6): 377-385.

11 - Magermans, D. J., et al. (2004). "Effectiveness of tendon transfers for massive rotator cuff tears: a simulation study." Clin Biomech (Bristol, Avon) 19(2): 116-122.

12 - Magermans, D. J., et al. (2004). "Biomechanical analysis of tendon transfers for massive rotator cuff tears." Clin Biomech (Bristol, Avon) 19(4): 350-357.

13 - Oh, J. H., et al. "Biomechanical effect of latissimus dorsi tendon transfer for irreparable massive cuff tear." J Shoulder Elbow Surg 22(2): 150-157.

14 - Ling, H. Y., et al. (2009). "Biomechanics of latissimus dorsi transfer for irreparable posterosuperior rotator cuff tears." Clin Biomech (Bristol, Avon) 24(3): 261-266.

15 - Aoki, M., et al. (1996). "Transfer of latissimus dorsi for irreparable rotator-cuff tears." J Bone Joint Surg Br 78(5): 761-766.

16 - Gerber, C., et al. (1988). "Latissimus dorsi transfer for the treatment of massive tears of the rotator cuff. A preliminary report." Clin Orthop Relat Res(232): 51-61.

17 - Iannotti, J. P., et al. (2006). "Latissimus dorsi tendon transfer for irreparable posterosuperior rotator cuff tears. Factors affecting outcome." J Bone Joint Surg Am 88(2): 342-348.

18 - Miniaci, A. and M. MacLeod (1999). "Transfer of the latissimus dorsi muscle after failed repair of a massive tear of the rotator cuff. A two to five-year review." J Bone Joint Surg Am 81(8): 1120-1127.

19 - Namdari, S., et al. "Latissimus dorsi tendon transfer for irreparable rotator cuff tears: a systematic review." J Bone Joint Surg Am 94(10): 891-898.

20 - Petriccioli D., Bertone C., Marchi G, Garofalo G. Arthroscopically assisted latissimus dorsi transfer with a minimally invasive harvesting technique: surgical technique and anatomic study Musculoskelet Surg (2012) 96 (Suppl 1):S35–S40

Figure1

Table1

	Group TT	**Group PR**
Sex	13 M; 7 W	11 M; 9 W
Age	62.5 years (range 45–77)	64.9 years (range 47-78)
Dominant arm involved	18	17
time from symptoms to surgery	7 months (range 7-23)	8 months (5–13)
Associated treatment		
Acromiolasty	4	6
LHB tenotomy	14	13
Subscapular repair	2	3

Table 1: patients's features and associated surgical treatments. Values are given as average with range in brackets

Table2

	Group TT	Group PR
Size		
Large (3-5 cm)	4	7
Massive (> 5 cm))	16	13
Tendon retraction		
Stage III	6	4
Stage IV	14	16
Location		
SSP	4	8
SSP+ISP	16	12
Stage of Fatty infiltration		
0	0	0
1	0	0
2	8	10
3	9	9
4	3	1
AHI grade		
1	3	4
2	17	16
3	0	0
4	0	0
5	0	0

Table 2: preoperative tendon features

Table3

ROM	Group TT			Group PR	
	Baseline	Last follow-up	p Value	Baseline	Last follow-up
Passive External rotation, degree	22.6±13.5 (15-55)	59.1±10.2 (53-74)	<0.05	18.3±11.7 (17-33)	57.4±9.1 (35-62)
Active, External rotation, degree,	14.5±11.3 (9-26)	41.2±8.7 (31-52)	<0.05	15.8±9.2 (11-31)	38.4±12.0 (33-54)
Internal rotation, degree	a level between L3-S1	11 pts T8; 5 pts T9; 4 pts T10		a level between L3-S1	14 pts T8; 4 pts T9; 2 p T10
Passive Forward flexion, degree	119 .8±13.0 (105-130)	171.2±9.7 (148-178)	<0.05	129.2±18.2 (90-160)	169±10.9 (145-180)
Active Forward flexion, degree	83.5±11.0 (72-98)	131±9.0 (117-145)	<0.05	86.3±8.2 (68-89)	110±12.7 (98-132)

Table 3: Range of movement. Values are given as average ± standard deviation with range in brackets

Table4

	Group TT			Group PR		
	Baseline	Last F-U	p Value	Baseline	Last F-U	
UCLA	7.3±2.5 (4-9)	30.3±4.2 (29-34)	<0.05	7.6±3.9 (4-10)	20.1±3.4 (18-25)	<
VAS	6.9±1.7 (6-9)	1.3±0.7 (1-3)	<0.05	6.6±1.8 (6-9)	1.5±0.8 (1-3)	<
RC-QOL	n.a.	81.8±9.3 (78-92)		n.a.	69.3±8.7 (63-77)	

Table 4: Pre-and post-operative values of UCLA, VAS and RC-QOL. Values are given as average ± standard deviation with range in brackets.