

Latissimus dorsi transfer for treatment of massive and irreparable rotator cuff injuries

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ABSTRACT

Introduction: The aim of this study was to carry out a medical-radiographic assessment in patients with posterosuperior irreparable massive tear in the rotator cuff treated with transfer of the tendon of the latissimus dorsi muscle.

Materials and Methods: Observational, descriptive, retrospective study. We included <70 year-old patients with posterosuperior irreparable massive injury of the rotator cuff treated with transfer of the tendon of the latissimus dorsi muscle and minimal 2-year follow-up. We assessed mobility and abduction strength. We used the visual analogue scale and the modified Constant-Murley scale. In X-rays, we analyzed the acromio-humeral distance and the degree of arthropathy.

Results: We included 17 patients (12 males, 5 females; average age: 54 years old [ranging from 34 to 65]). The average follow-up was 46 months (ranging from 24 to 71). In the group of primary surgery, the average active mobility gain was of 53° in anterior flexion, of 50° in abduction and of 19° in external rotation. Abduction strength showed an average gain of 1.4 kg. The modified Constant-Murley scale was 75.6 (ranging from 63 to 80) at final follow-up. In revision surgery, the gain in active mobility was of 48° in anterior flexion, of 30° in abduction, and of 10° in external rotation. Abduction strength had an average gain of 1.1 kg. The pre-operative visual analogue scale improved 5.1 marks in the group of primary surgery, and 3.4 marks in the revision surgery group.

Conclusion: The transfer of the tendon of the latissimus dorsi muscle in posterosuperior injuries of the rotator cuff improved range of motion, strength, shoulder function and pain relief.

Key words: Massive tear; rotator cuff; tendon transfer; latissimus dorsi muscle.

Level of evidence: IV

TRANSFERENCIA DE DORSAL ANCHO PARA EL TRATAMIENTO DE LAS LESIONES MASIVAS E IRREPARABLES DEL MANGUITO ROTADOR

RESUMEN

Introducción: El objetivo del trabajo fue realizar una valoración clínico-radiológica de pacientes con rupturas masivas e irreparables posterosuperiores del manguito rotador tratadas con transferencia del dorsal ancho.

Materiales y Métodos: Estudio retrospectivo, descriptivo, de observación. Se incluyeron pacientes <70 años con lesión masiva e irreparable posterosuperior del manguito rotador tratados con transferencia del dorsal ancho y un seguimiento mínimo de 2 años. Se valoró la movilidad y la fuerza en abducción. Se emplearon la escala analógica visual y la de Constant-Murley modificada. En las radiografías, se analizaron la distancia acromiohumeral y el grado de artropatía.

Conflict of interests: The authors have reported none.

Resultados: Se incluyeron 17 pacientes (12 hombres, 5 mujeres; edad promedio: 54 años [rango 34-65]). El seguimiento promedio fue 46 meses (rango 24-71). En el grupo de cirugía primaria, la ganancia de movilidad promedio en flexión anterior fue de 53°, en abducción de 50° y en rotación externa de 19°. La fuerza en abducción registró una ganancia promedio de 1,4 kg. La escala de Constant-Murley modificada fue de 75,6 (rango 63-80) al final del seguimiento. En las cirugías de revisión, la ganancia de movilidad activa en flexión anterior fue de 48°, en abducción de 30° y en rotación externa de 10°. La fuerza en abducción tuvo una ganancia promedio de 1,1 kg. La escala analógica visual posoperatoria mejoró 5,1 puntos en el grupo con cirugía primaria y 3,4 en el otro grupo.

Conclusión: La transferencia del dorsal ancho para lesiones posterosuperiores del manguito rotador mejoró el rango de movilidad, la fuerza, la función del hombro y alivió el dolor.

Palabras clave: Ruptura masiva; manguito rotador; transferencia tendinosa; dorsal ancho.

Nivel de Evidencia: IV

Introduction

Posterosuperior irreparable massive tears in the rotator cuff represent a challenge for the orthopedic surgeon. A tear in the rotator cuff is defined as “massive” when it exceeds 5 cm in diameter or involves two or more tendons.¹ On the other hand, an “irreparable” injury is that one in which the degree of tendon retraction and tissue deterioration does not allow the surgeon tendon-bone reposition.²

Chronic posterosuperior tears in the rotator cuff develop up to the loss of balance in the glenohumeral force couple, with loss of external rotation and, finally, upward migration of the humeral head.³

The main medical finding is limitation in shoulder elevation and external rotation, with or without associated pain.

There are multiple reports on non-prosthetic surgical alternatives that have been described as treatment options for massive injuries of the rotator cuff, such as arthroscopic sub-acromial debridement, partial reparation, acromioplasty, biceps tenotomy, use of autologous or synthetic graft, and tendinous transfer.⁴⁻⁷

However, in young patients with no advanced glenohumeral osteoarthritis and high functional demands, the transfer of the myo-tendinous unit can represent the only alternative among the ones that have been described to restore the function of active external rotation and the patient’s activity above his or her shoulder.

The aim of this study is to carry out a medical-radiographic assessment of patients with posterosuperior massive tears in the rotator cuff treated with isolated transfer of the latissimus dorsi muscle.

Materials and Methods

Observational descriptive study in which we analyzed retrospectively a series of 17 patients with diagnosis of posterosuperior irreparable massive tear in the rotator cuff, treated by the same medical team between 2003 and 2010. Posterosuperior massive tear in the rotator cuff was diagnosed by medical evaluation and MRI without contrast.

We included all the patients who met the following criteria: 1) age <70 years old, 2) posterosuperior irreparable massive injury of the rotator cuff, 3) loss of shoulder strength in external rotation and abduction, 4) MRI showing Patte’s degree III-IV retraction, 5) lack of response to conservative treatment over the past six months with rehabilitation and glenohumeral corticoid infiltration, 6) contralateral healthy shoulder, 7) treatment with isolated transfer of the tendon of the latissimus dorsi muscle, and 8) > post-operative 2-year follow-up.

We excluded the patients with complete tear in the subscapularis tendon, those who showed associated glenohumeral osteoarthritis (Hamada III-IV-V) and patients with pseudo-paralytic shoulder. Neither did we include patients who received double transfer (latissimus dorsi and teres major muscles).

The patients were grouped whether it was primary surgery (without surgical history): 9 cases (53%) or revision surgery (with surgical history): 8 cases (47%). All were subject to both objective goniometric assessment of glenohumeral mobility (anterior flexion, abduction and external rotation) and dynamometric strength in shoulder abduction; they also received subjective evaluation of pain using the visual analogue scale. Moreover, we used the modified Constant-Murley objective scale, which considers pain, day-to-day activities, mobility and strength, giving a minimum score of 0 marks and a maximum of 100 marks.⁸

Before the surgery and at final follow-up, we assessed the affected shoulder X-rays (AP, axial and lateral views) evaluating the acromio-humeral distance and glenohumeral osteoarthritis according to the Hamada classification (Table 1).⁹ We registered the complications and the need for second surgeries.

Surgical technique

The two-incision technique was carried out as described by Gerber et al. in 1988, and up-dated in 2006.¹⁰

Under brachial plexus anesthesia or general anesthesia, the patient goes on lateral position with his or her injured limb towards the zenith, checking the appropriate protection of the support devices to avoid contact injuries.

Table 1. Hamada radiographic classification

Degree 1	>6 mm acromio-clavicular interval
Degree 2	≤5 mm acromio-clavicular interval
Degree 3	Acetabulum-like acromium
Degree 4	Degree 3 plus decrease in glenohumeral space
Degree 5	Humeral head collapse, final stage of the condition secondary to tear in the rotator cuff (cuff tear arthropaty)

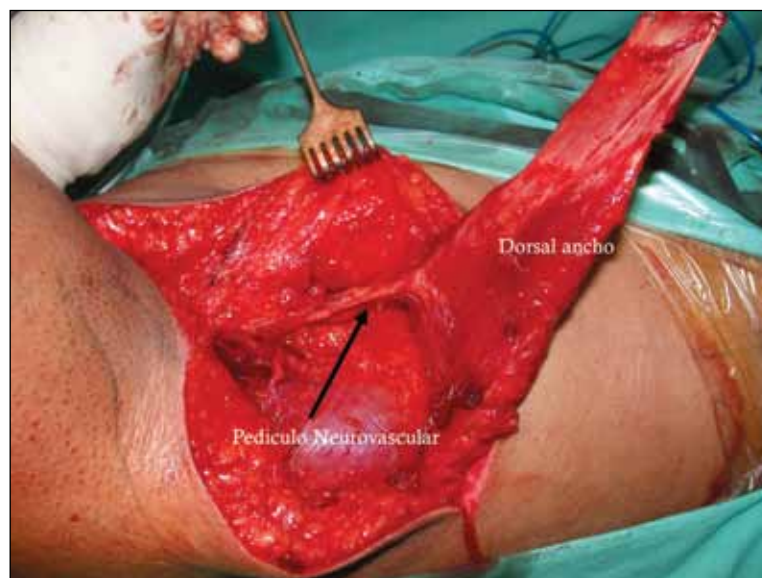
The first surgical step consists of a superolateral shoulder approach, dividing the muscle fibers of the deltoid muscle between its anterior and middle bundles, getting the sub-acromial space and going on to the complete exposure of the humeral head. Afterwards, what comes is tissue debridement with bursectomy, biceps tenotomy or tenodesis if this is considered to be a required surgical gesture. Then, it is necessary to injure the insertion marks of the supraspinatus and infraspinatus muscle tendons on the posterosuperior aspect of the trochiter.

The second surgical step consists of an armpit approach by a transverse incision, what allows the surgeon to identify the tendon of the latissimus dorsi muscle; then, this incision is expanded longitudinally on the mediolateral thoracic region following the axis of the latissimus dorsi muscle. Once the tendon of the latissimus dorsi muscle with its neurovascular pedicle have been identified, what

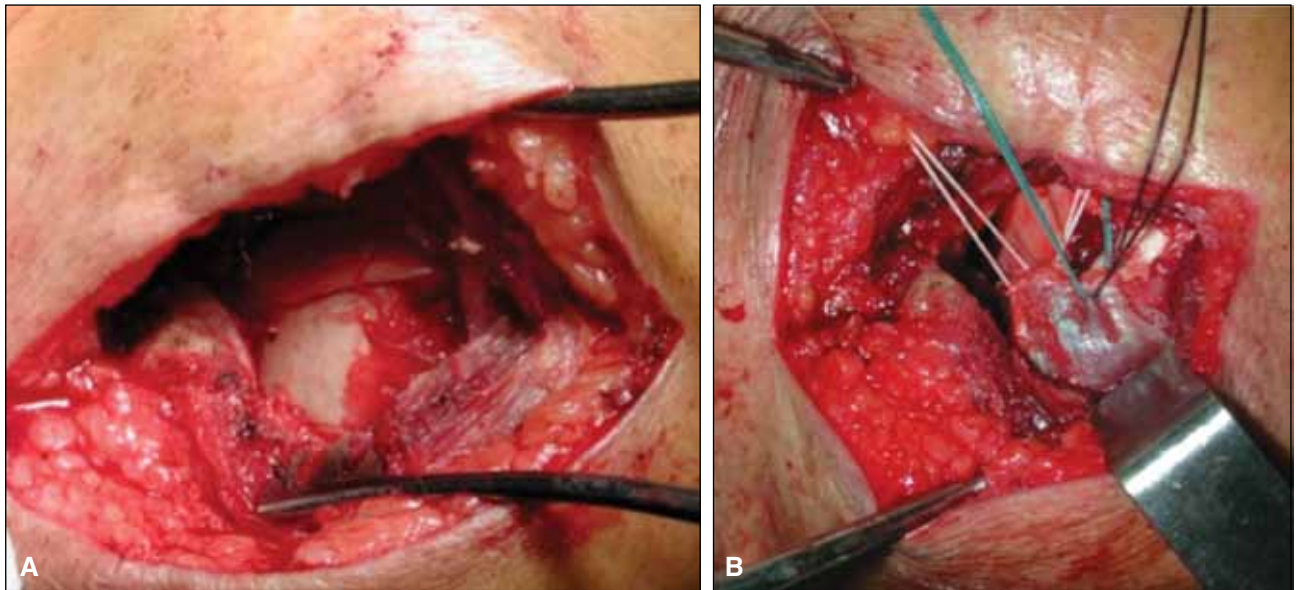
is usually 12 cm below the muscle humeral insertion, the distal muscular end is fixed with Mason-Allen suture and muscular release is carried out at both the insertion fibers on the distal end of the scapula and the rib insertion fibers.

This maneuver allows the surgeon the complete mobilization of the myo-tendinous unit and facilitates the advance of the tendon of the latissimus dorsi muscle towards the femoral head (Figure 1).

The third and last surgical step consists of the conduction of the tendon latissimus dorsi muscle (previously prepared) below the deltoid muscle. With smooth muscle fiber division, the surgeon should try to create a space wide enough for the myo-tendinous unit and the neurovascular pedicle to go through towards the zone previously prepared on the trochiter (Figure 2). Finally, the anchoring of the transferred tendon comes, using three double-suture



▲ **Figure 1.** Armpit approach, with mobilization of the tendon of the latissimus dorsi muscle with its neurovascular pedicle.



▲ **Figure 2.** Shoulder superolateral approach. **A.** Preparation of the insertion mark at the level of the supra-infraspinatus tendons. **B.** Fixation of the latissimus dorsi muscle with double-suture anchors.

anchors, and then wound closure on a drainage timely applied (which will remain 24 hs).

Post-operative immobilization is carried out using a sling in slight glenohumeral abduction and external rotation during six weeks, although throughout this period the patient is allowed to work on assisted active and passive elbow flexion-extension as of the fourth post-operative week, and progressive assisted passive glenohumeral mobility, always supervised by their rehabilitators. From the sixth post-operative week on, immobilization is stopped progressively and rehabilitation by conventional protocol starts.

Results

We evaluated retrospectively 17 patients who met the inclusion criteria: 12 males and 5 females. The average age at the time of the surgery was 54 years old (ranging from 34 to 65). In 10 of the 17 patients, the injured one was the dominant shoulder. Eight patients had history of surgery (4 arthroscopies and 4 open surgeries), and nine had received conservative treatment.

The average follow-up was 46 months (ranging from 24 to 71). The series results were divided into two groups: patients with primary surgery, and patients with revision surgery (Tables 2 and 3).

With respect to the objective assessment of active mobility, in the group of primary surgery we got an average increase in anterior flexion of 53°, in abduction of 50°, and in external rotation of 19°. The objective assessment

of abduction strength had an average gain of 1.4 kg. In subjective assessment, the post-operative values in the visual analogue scale improved 5.1 marks with respect to the average pre-operative value (from 8.2 to 3.1). The average pre-operative score in the modified Constant-Murley scale was of 38.3 (ranging from 30.1 to 55.6) and it was of 75.6 (ranging from 63.4 to 80.7) at final follow-up. Satisfaction rates were 92%.

Regarding the objective assessment of active mobility, in the group of revision surgery we got an average increase in anterior flexion of 48°, in abduction of 30°, and in external rotation of 10°. The objective assessment of abduction strength had an average gain of 1.1 kg. In subjective assessment, the pre-operative visual analogue scale improved 3.4 marks with respect to the average pre-operative values (from 7.5 to 4.1). The average pre-operative score in the modified Constant-Murley scale was of 33.3 (ranging from 27.5 to 52.7) and it was of 55.2 (ranging from 50.3 to 65.1) at final follow-up. Satisfaction rates were 61%.

With respect to the radiographic assessment, in both groups we verified an increase in the acromio-humeral distance, and we did not register advance in the osteoarthritic changes, what is detailed in the respective tables.

The two complications in the series (11%) occurred in the revision group: a superficial infection in the postero-superior approach, treated with antibiotics, and a sterile seroma in the armpit approach, which was drained. At final follow-up, in no case had it been necessary to carry out a second surgery.

Table 2. Primary surgery—average result

	Pre-operative assessment	Post-operative assessment
Anterior flexion	85°	138°
Abduction	75°	125°
External rotation	10°	39°
Abduction strength (kg)	1.9	3.3
Visual analogue scale	7.2	2.1
Modified Constant-Murley scale	38	75
Acromio-humeral (mm)	3.2	5.0
Hamada	1.4	1.4

Table 3. Revision surgery—average result

	Pre-operative assessment	Post-operative assessment
Anterior flexion	70°	118°
Abduction	75°	105°
External rotation	10°	23°
Abduction strength (kg)	2	3.1
Visual analogue scale	7.5	4.1
Modified Constant-Murley scale	35	57
Acromio-humeral (mm)	2.5	4.1
Hamada	1.5	1.7

Discussion

Old patients and those with glenohumeral advanced osteoarthritis with posterosuperior irreparable massive injury of the rotator cuff are candidates for prosthetic shoulder replacement.¹¹ Over the past decades, there have been strong recommendations on the use of total reverse shoulder replacement, whose complication rates are between 4 and 50%, according to diverse authors, with revision percentages of 10%. Bearing in mind the few options of rescue available in the case of prosthetic failure, it is not considered a recommendable option for <60 year-old patients.^{12,13}

Fortunately, irreparable massive tears in the rotator cuff are not frequent. In most cases, this atrophy and retraction are not extreme and it is possible to carry out partial reparation with satisfactory results, being such our first therapeutic option; however, when the myo-tendinous unit is dysfunctional due to severe lipid infiltration or retraction, and the patient suffers clear function impairment due to such muscular deficit (positive dropping arm and horn-

blower tests), it should be considered to resort to muscle-tendinous transfer to get proper balance in the shoulder axial force couple.

Among the surgical alternatives described for postero-superior irreparable massive tears in the rotator cuff, the arthroscopic treatment with partial reparation and sub-acromial debridement has brought about satisfactory results when the main patient's symptom is pain. However, these results wear off at mid- and long-term follow-up, especially among young and active patients.¹⁴

The closure of the defect with autograft or allograft is restricted to small cases series; therefore, it has not won acceptance in international literature.¹⁵

The transfer of the tendon of the latissimus dorsi muscle was first described by L'Episcopo for the treatment of obstetric brachial plexus palsy, and later modified by Gerber for the treatment of the injuries of the rotator cuff.¹⁶ The foundations of the transfer of the tendon of the latissimus dorsi muscle are laid on the provision of a vascularized tendon which generates external rotation at

contraction and, moreover, by balancing the anterior and posterior structural forces upon the glenohumeral joint, favors a more effective action at the deltoid muscle level. The mechanical benefit brought about by these tendinous transfers are based on the direct effect of (active) muscular contraction, and secondarily on a (passive) tenodesis effect by the action of myo-tendinous viscoelasticity, which acts centralizing and, to a lesser extent, depressing the humeral head, thus giving it external rotation. In this sense, patients report advantages in their better control of their hand in the space.

According to a number of authors, improvement in pain in these patients may result rather from associated surgical gestures such as sub-acromial decompression, bursectomy, biceps tenodesis or tenotomy, than the effect of the muscular transfer itself (passive or active effect). On the other hand, no tendinous transfer is destined to analgesic effects.

Results in diverse series of revision surgery cases show decrease in transfer benefits when compared to results in primary surgeries.⁶ The expected satisfactory results are about 80% in primary surgery, whereas they get just 55% in revision surgery, with failure due to some kind of previous injury in the deltoid or the subscapularis muscles.^{10,17} In our series, consistently with the results previously published, we got less satisfactory results both in strength and mobility in the group with previous surgery, even though

we excluded from both groups those patients with complete injury of the subscapularis muscle.

As far as we know, there is no bibliographic support to infer that the transfer of the tendon of the latissimus dorsi muscle stops degenerative processes in the glenohumeral joint. Osteoarthritis did not progress during this group of patients' follow-up; therefore, as other authors have, we infer that this procedure may decrease the speed of onset of degenerative changes.^{6,10,18,19} However, long-term studies with higher levels of evidence are required to clarify later findings in these patients with this condition.

As limitations in this study we consider its retrospective design and the restricted series of patients. However, we present a homogeneous series of young patients treated with the same surgical technique by the same surgeon, and with >2-year follow-up.

Conclusions

The transfer of the tendon of the latissimus dorsi muscle in posterosuperior irreparable massive tears in the rotator cuff showed significant improvement in the patients' range of motion, strength, pain relief, and shoulder function, especially in the group of primary surgery; the advantages brought about by tendon transfer are slightly fewer in the revision group.

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