Latissimus Dorsi Tendon Transfer using Tendinous Allograft for Irreparable Rotator Cuff Lesions: Surgical Technique*

Transferência tendínea do grande dorsal com enxerto tendíneo homólogo para as lesões irreparáveis do manguito rotador: técnica cirúrgica

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Abstract

Latissimus dorsi transfer around the shoulder is the most frequently used surgical technique to treat young patients with irreparable posterosuperior rotator cuff lesions. This technique, as initially described and popularized by Gerber et al., has two main drawbacks that may predispose to complications and unsatisfactory functional results: 1) postoperative rupture of the origin of the deltoid, as its detachment from the acromion is necessary during the superior approach to the shoulder; and 2) postoperative rupture of the transferred tendon. In an attempt to avoid these problems, the authors have developed the following modifications to the original technique. Through a deltopectoral approach, the latissimus dorsi tendon is identified and detached from the humerus shaft. After being reinforced and elongated with a tendinous allograft, it is transferred around the humerus and fixed to the superolateral aspect of the greater tubercle. No rigid thoraco-brachial immobilization is used postoperatively.

Keywords
- rotator cuff injuries
- tendon transfer
- shoulder injuries
- shoulder
- orthopedics

Resumo

No contexto do tratamento cirúrgico dos pacientes jovens com lesões irreparáveis da porção posterossuperior do manguito rotador, a técnica mais usada é a transferência do tendão do grande dorsal para a porção superolateral do tubérculo maior, conforme

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Palavras-chave
- lesões do manguito rotador
- transferência tendinosa
- lesões do ombro
- ombro
- ortopedia

descrita e preconizada por Gerber et al. Entretanto, duas características dessa técnica podem levar a resultados ruins e complicações: 1) a deiscência da origem do deltoide, que ocorre devido à sua violação durante a criação da via em golpe de sabre; e 2) a ruptura pós-operatória da inserção da transferência. Na tentativa de solucionar esses dois problemas, as seguintes modificações foram feitas à técnica cirúrgica original. Por meio de uma única via deltopeitoral, o tendão do grande dorsal é isolado e desinserido do úmero. Ele é então alongado e reforçado com um enxerto tendíneo homólogo, transferido ao redor do úmero e fixado à porção superolateral do tubérculo maior. Não foi usada imobilização pós-operatória com órtese toracobraquial rígida.

Introduction

Chronic rotator cuff tendon lesions can lead to atrophy, fatty degeneration and functional alterations of the respective muscles.[1] When affecting the posterosuperior region of the cuff, they mostly result in pain, reduction of shoulder lateral rotation and elevation, and difficulty in positioning the hand in space.[1–3]

Several surgical techniques were described to improve the quality of life of patients with irreparable lesions in these tendons. Especially among the younger population (< 60 years old) and with a higher functional demand, the latissimus dorsi tendon (LDT) transfer to the greater tubercle (initially described by Gerber[1] in 1992) is the most commonly used therapeutic option.[4] A number of works demonstrated that it provides good results in relieving pain and improving dysfunction.[3,4] However, up to 36% of failures were found. Moreover, findings about the predictive factors of bad results are scarce and controversial.[2,3]

Nevertheless, there is evidence that most failures are due to one of the following reasons: 1) transfer reinsertion dehiscence; or 2) deltoid origin dehiscence.[5] As such, some authors recently proposed changes to the original Gerber technique. The use of arthroscopy[6] or a single approach,[7] for instance, was recommended to prevent the violation of the proximal deltoid attachment. Latissimus dorsi detachment sparing some bone fragments of the humeral cortex next to the tendon was recommended to reinforce the healing of the transfer along with the greater tubercle.[5]

However, the literature lacks a technique that concurrently prevents these two complications. Since this is exactly our goal, we propose the following modifications to the surgical technique: the LDT is elongated and reinforced with a tendinous allograft, enabling the deltopectoral approach.

The objective of the present work is to describe the modifications proposed to the surgical technique.

Technique Description

The patient is placed in the beach chair position. The irreparable rotator cuff lesion is identified through the deltopectoral approach. In order to identify the axillary nerve, the radial nerve and the LDT and teres major tendon attachments (►**Fig. 1**), the conjoined tendon must be medially retracted,

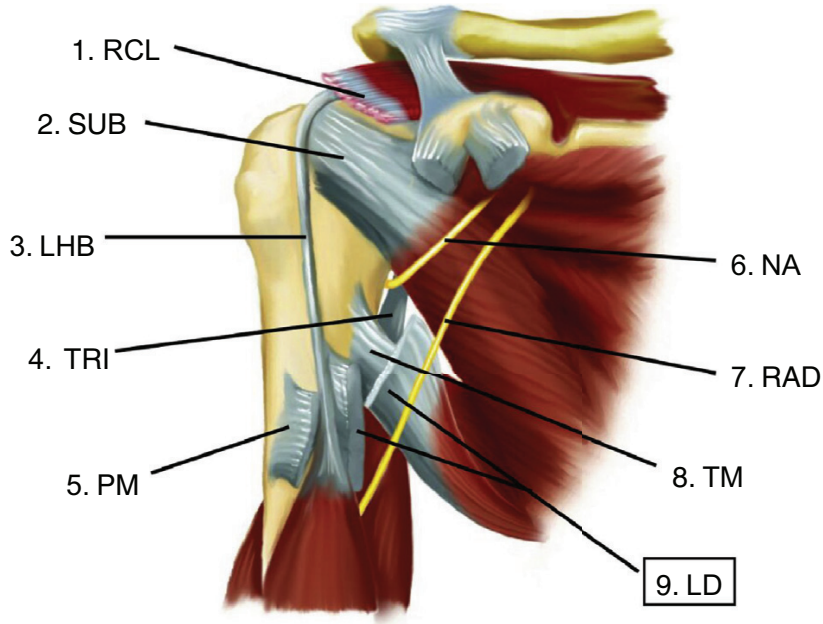

Fig. 1 Illustration of a right shoulder, frontal view, without the deltoid and the conjoint tendon muscles. Abbreviations: AN, axillary nerve; LD, latissimus dorsi tendon (already isolated and detached); LHB, long head of the biceps brachii; PM, tendinous attachment of the pectoralis major; RAD, radial nerve; RCL, rotator cuff lesion; SUB, subscapular tendon; TM, tendinous attachment of the teres major; TRI, long head of the triceps brachii.

while the pectoralis major tendon is distally retracted (sometimes, this requires a tenotomy of the proximal third of its attachment, which must be reattached at the end of the surgery). The LDT is repaired, fully detached from the humerus, and its muscular belly is partially dissected. The muscle is then elongated and reinforced with a tendinous allograft that is cut to have the same width as the patient's tendon, and enough length to reach the greater tubercle (►**Figs. 2A** and **B**).

With a long, curved tweezer passed subperiosteally between the humerus and the long and lateral head of the triceps

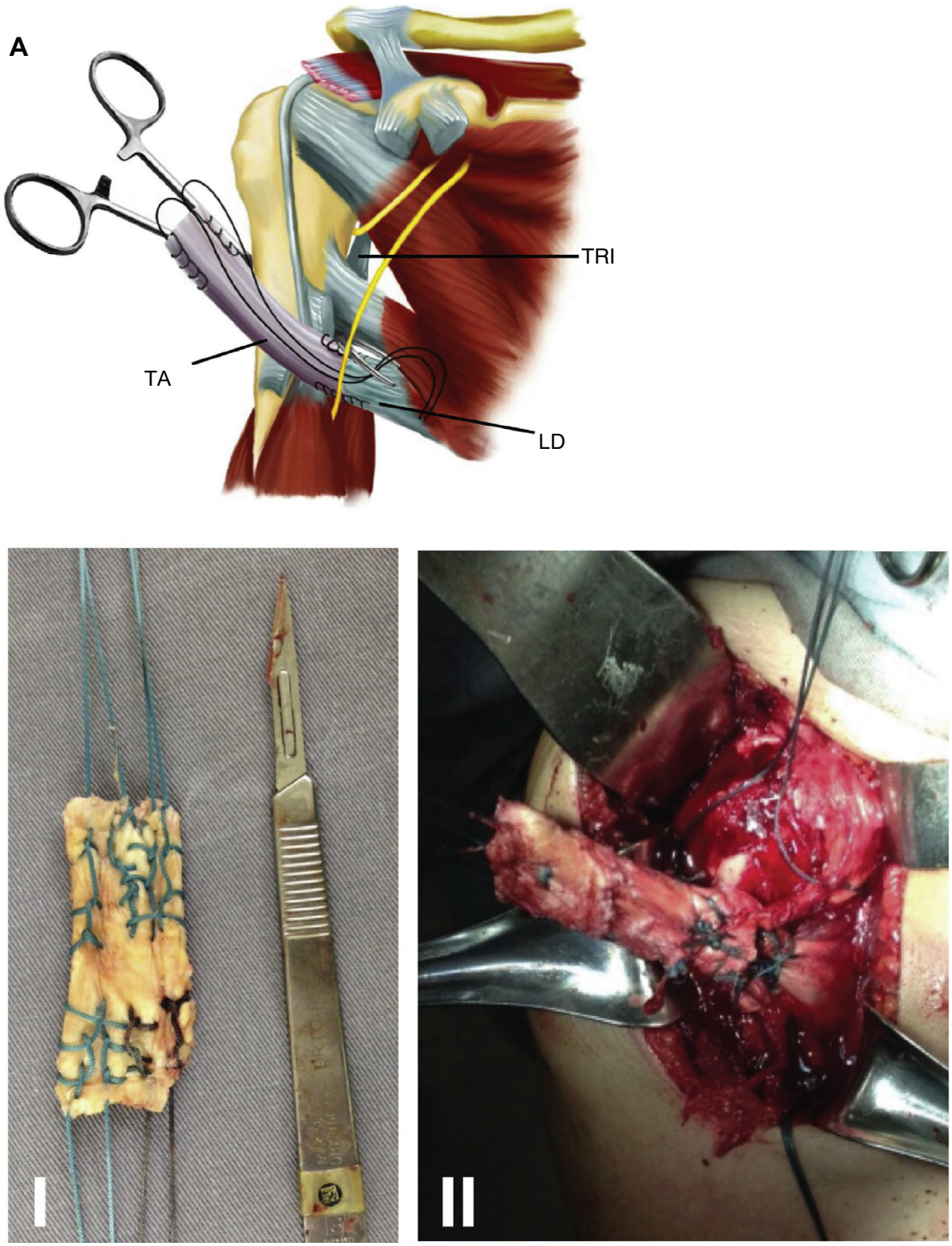

Fig. 2 (**A**) At this stage of the surgery, the tendinous allograft (TA) had already been sutured to the latissimus dorsi (LD) tendon, and the tweezer had already been passed around the humerus (between the proximal portion of the shaft and the muscular bellies of the lateral and long heads of the triceps brachii (TRI). (**B**) Prepared calcaneal tendon allograft before (I) and after (II) suture to the LD tendon (before passing around the humerus).

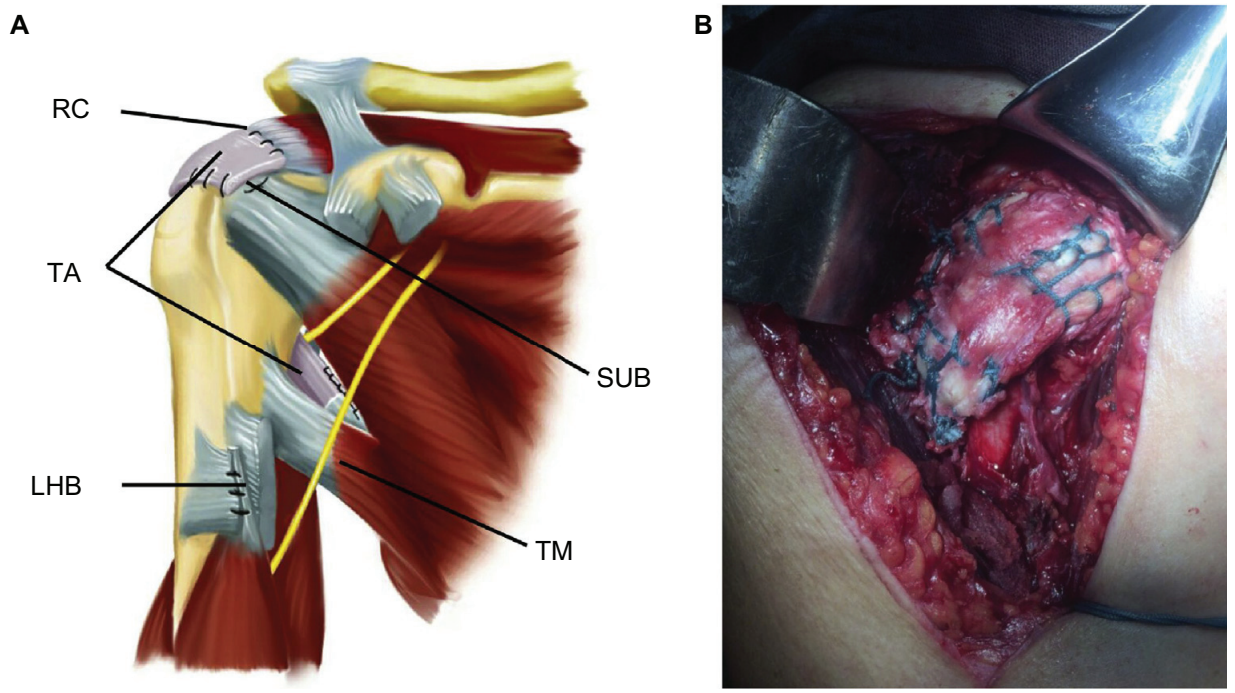

Fig. 3 At the last stage of the surgery, the transferred latissimus dorsi (LD) tendon, already elongated and reinforced by the tendinous allograft (TA), is sutured to the superolateral portion of the greater tubercle, if possible, at the remaining stump of the rotator cuff (RC), and to the proximal portion of the subscapular (SUB) tendon. Note that after the transfer, the LD tendon is posterior to the teres major (TM) tendon. Note as well that in this illustration the long head of the biceps (LHB) was submitted to a tenotomy and a tenodesis to the pectoralis major tendon.

(►**Fig. 2A**), a tunnel is created to pass the (already elongated) tendon to the posterior portion of the humerus. Lastly, with the shoulder at 15 degrees of abduction and 60 degrees of rotation, and the tendon drawn so it is not loose, the transfer is fixed (with a resistant, non-absorbable suture) to the superior lateral aspect of the greater tubercle (►**Figs. 3A** and **B**). Preferentially, as recommended by Gerber,[1] the most anterior sutures must also encompass the subscapular tendon (they can even be used to repair proximal subscapular lesions, if present). The most medial sutures can be used to fix the remaining cuff stump to the transfer (►**Fig. 3A**).

At the end of the surgery, the patient is immobilized with an abduction splint in neutral rotation for six weeks. After this period, exercises to gain and maintain range of motion are performed for all shoulder movements, but still with no strengthening. The performance of the exercises begins four months after surgery.

Final Remarks

In the occasional failure of the tendinous transfer in the treatment of such lesions, reverse arthroplasty is probably the only therapy substantiated enough in the literature to relieve shoulder pain and improve its function. This improvement, however, requires a functional deltoid, since this is the only motor unit that generates vectors resulting in joint elevation in this situation.[2] As such, the prevention of its surgical violation may be exceedingly prudent, as performed in the saber approach described by Gerber,[1] for instance.

Therefore, there are only three access approaches: the posterior approach, the axillary approach, and the anterior approach. The posterior approach enables a good dissection of the latissimus dorsi muscular belly, but its isolated detachment (without detaching the teres major) is difficult (since its tendon is anterior to the teres major tendon). Moreover, this approach does not enable the identification and treatment of occasional lesions in the subscapular and bicipital long head tendons.

The axillary approach does not enable the occasional primary repair of the rotator cuff, which must always be attempted before a tendinous transfer. Moreover, it represents a risk of severe neurovascular lesions due to the proximity with the brachial plexus structures and the axillary vessels.

Lastly, there is the chosen approach: the deltopectoral approach. In addition to being the usual approach chosen by shoulder surgeons, it enables an attempt to repair the primary rotator cuff (►**Fig. 1**), it facilitates the isolated detachment of the latissimus dorsi (►**Fig. 1**) and the identification and isolation of axillary and radial nerves (►**Fig. 1**), and enables the treatment of occasional lesions at the bicipital long head and subscapular tendons (►**Fig. 1**). Its only drawback is the impossibility of dissecting the muscular belly of the latissimus dorsi, therefore making it impossible to be drawn up to the superior portion of this muscle. However, since the LDT is exceedingly thin and friable, its attachment at the greater tubercle must somehow be reinforced (its postsurgical detachment is even one of the few statistically-proven predictive factors of bad functional results,[2] and there is evidence that its reinforcement with the incorporation of small bone fragments reduces this risk).[6] Therefore, the use of the tendinous allograft can solve two problems at once: it elongates the tendon to be transferred (enabling the anterior approach) and reinforces the

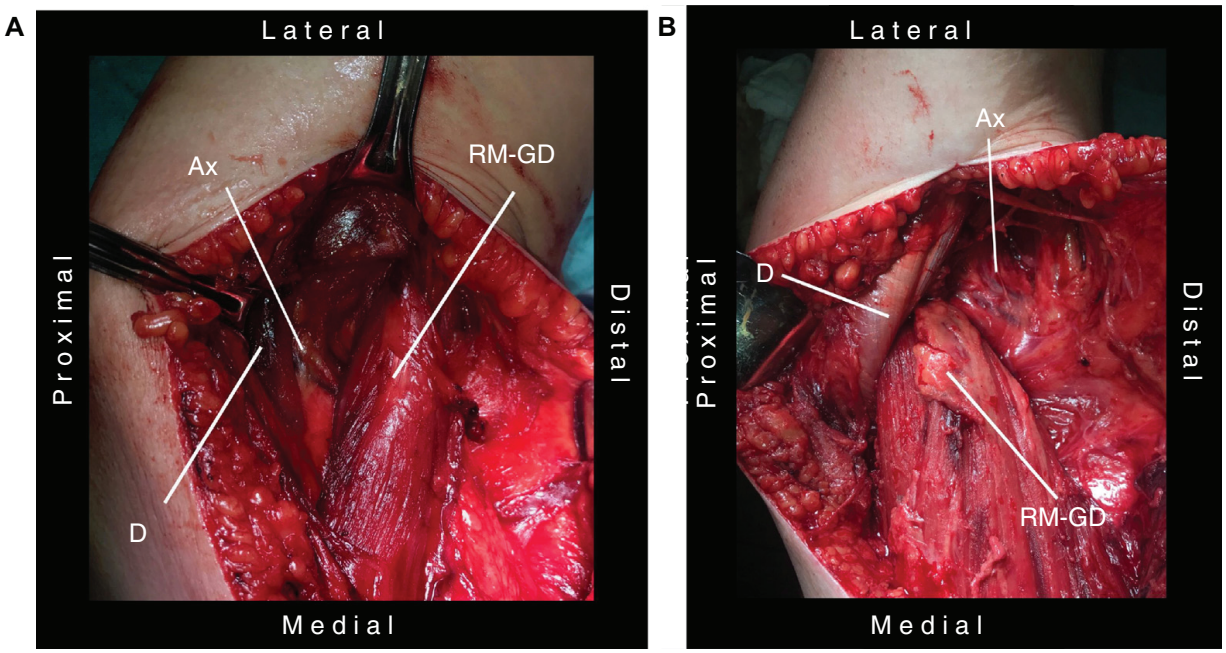

Fig. 4 Right shoulder, posterior view. Conventional technique, as proposed by Gerber.[1] Note the relationship before (**A**) and after (**B**) the teres major (TM) and latissimus dorsi (LD) transfer to the axillary nerve (Ax) and the posterior humeral circumflex vessels. Abbreviation: D, deltoid.

attachment of the tendon to the greater tubercle (possibly reducing the risk of postsurgical detachment). We were so certain of the reinforcement strength during surgery that we even allowed the postoperative immobilization with an abduction sling, with no rigid thoraco-brachial device.

It is worth mentioning that the association between the anterior and posterior approaches would enable the adequate dissection and elongation of the LDT, but it would not be capable to provide, at once, a reinforcement to the tendinous attachment. Therefore, this association seems less advantageous than the technique proposed in the present article.

Finally, there are four concerns that are inherent to these modifications. The first involves the creation of a new weak point at the transfer, which is the suture site between the allograft and the native tendon. The second concern refers to the healing ability of the allograft to the bone. This is due to some evidence[8] that suggests that, in the long term, the allograft takes longer to remodel and possibly provides inferior mechanical resistance compared with the autologous graft.

The third concern refers to the possibility of over-elongation of the LDT, excessively reducing the final strength of the musculotendinous unit transferred to the shoulder. These three possibilities can only be confirmed or ruled out after the long-term post-op follow-up.

The fourth concern is that, when performed according to the technique described here, the transfer develops topographical relations (with the remaining shoulder anatomical structures) that are different from those obtained with the technique proposed by Gerber.[1] One of them is that the transferred tendon, instead of being posterior to the triceps, is anterior to it (between the muscle and the humerus; ►**Fig. 3A**) and that this eventually leads to the formation of fibrous adherence. Another one is that the tendon passes inferiorly, rather than superiorly, to the axillary nerve and the posterior humeral circumflex vessels (►**Fig. 4**). We did not perform a long-term follow-up, but we can inform that an early, partial analysis of ten subjects submitted to the procedure with this technique showed no neurovascular alteration during the physical exam.

Conflicts of Interest

The authors have none to declare.

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