Massive cuff tears treated with arthroscopically assisted *latissimus dorsi transfer*. Surgical technique

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Summary

***Latissimus dorsi transfer* is our preferred treatment for active disabled patients with a posterosuperior massive cuff tear. We present an arthroscopically assisted technique which avoids an incision through the deltoid obtaining a better and faster clinical outcome. The patient is placed in lateral decubitus. After the arthroscopic evaluation of the lesion through a posterior and a posterolateral portal, with the limb in traction we perform the preparation of the greater tuberosity of the humerus. We place the arm in abduction and internal rotation and we proceed to the harvest of the latissimus dorsi and the tendon preparation by stitching the two sides using very resistant sutures. After restoring limb traction, under arthroscopic visualization, we pass a curved grasper through the posterolateral portal by going to the armpit in the space between the teres minor and the posterior deltoid. Once the grasper has exited the access at the level of the axilla we fix two drainage transparent tubes, each with a wire inside, and, withdrawing it back, we shuttle the two tubes in the subacromial space. After tensioning the suture wires from the anterior portals these are assembled in a knotless anchor of 5.5 mm that we place in the prepared site on the greater tuberosity of the humerus. A shoulder brace at 15° of abduction and neutral rotation protect the patient for the first month post-surgery but physical therapy can immediately start.**

Key words: shoulder, posterosuperior cuff tear, tendon transfer, latissimus dorsi, arthroscopy.

Introduction

Massive and irreparable rotator cuff tears represent for the orthopedic surgeon a big challenge, especially in young and active patients that are not suitable candidates for inverse arthroplasty. The most frequent and consistent deficit associated with massive and irreparable lesions is the loss of supraspinatus and infraspinatus muscle-tendon-bone continuity leading to loss of active external rotation and inability to stabilize the arm in the space[2,5,8,13]. This condition can be often associated with chronic disabling pain that does not respond to conservative treatment. In the case of massive posterosuperior rotator cuff tears, a *latissimus dorsi tendon transfer* may be done to improve active range of motion and strength, and reduce pain in select patients[15,16,20]. Subscapularis and deltoid integrity, less than 70 years of age, as well as a contained humeral head with an intact coracoacromial arch and the absence of glenohumeral arthritis are factors which impact the success of surgery[21]. In this work we present an arthroscopically assisted technique for the *latissimus dorsi tendon transfer* that we use in the treatment of posterosuperior massive rotator cuff lesions. This technique comes from the one described by Gervasi in 2007[11] and subsequently amended by Paribelli. We have used this technique since 2008 observing good results in terms of active elevation recovery, local pain regression and shoulder functionality improvement.

Surgical technique

We prefer to use, as well as in all the other arthroscopic shoulder surgeries, the lateral decubitus position, which allows a better identification of the *latissimus dorsi tendon* and a better management of arm positions. It is preferable, when possible, to perform general anesthesia associated with an interscalene cervical plexus block, very useful for the postoperative pain control. It is also important to place the limb so that the position can be changed from the arthroscopic traction position along the axis to the position with the arm abducted and internally rotated in the support according to the time of surgical tendon preparation or subsequent phases of tendon suturing to the humerus. The approaches used include, an arthroscopic posterior and a posterolateral portal that allows optimal visualization of the rotator cuff lesion, debridement of the insertional residual of the greater tubercle of the humerus and the identification of the space between deltoid and teres minor, a low anterior and an anterolateral portal essential for the transport and fixation of the tendon transfer. The first step is to assess arthroscopic evaluation of the lesion and its characteristics. It is crucial to establish its non-reparability and the integrity or reparability of the subscapularis tendon. Also in arthroscopy and with the limb in traction we perform a careful preparation of the site that will accommodate the transfer. It is essential the bursectomy that if accurate allows us to easily identify the interval between the rear deltoid portion and the origin of the cuff when still present, i.e. the infraspinatus or the teres minor. Often this condition is accompanied by severe biceps

tendinopathy and in most of our patients at this stage we also perform tenotomy of the long head of biceps. Then, we perform a good debridement of the greater tuberosity of the humerus, where the portion of the tendon transfer will be inserted. It is very important that no soft tissue should be left in this area in order to allow a free passage of the transfer and its subsequent integration. At this point, after releasing the tension and placing the arm in abduction and internal rotation, we proceed to the harvest of the *latissimus dorsi tendon*. We probe with a finger the tendon along its course and we draw it with a dermographic pencil (Fig.1). Then, we make a curved anteriorly concave incision of about 6-7cm and follow the muscle's profile at the posterior axillary level (Fig.2). After feeling its insertion at the level of the crest of the lesser tuberosity, we isolate the tendon of the latissimus dorsi, which usually appears of good quality and resistance

Figure 1. Marking of the incision line along the muscle after probing the *latissimus dorsi tendon* with a finger.

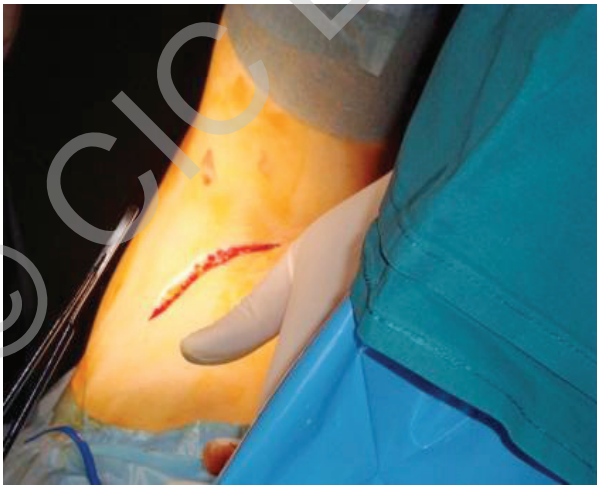

Figure 2. 6-7 cm long curved and anteriorly concave incision along the muscle's profile at the axillary level.

to the longitudinal traction but not to the transverse one. Upon determination of the cleavage plane between the *latissimus dorsi* and the teres major muscles begin dissection using a blunt instrument until the complete isolation of the tendon and its disconnection from the humerus. At this stage it is very important to identify and protect the radial nerve in order not to damage it; the radial nerve crosses the tendon of the latissimus dorsi upward respect to its front surface with a lateral direction from proximal to distal, approximately 2.5-3 cm medially to the humerus. The tendon preparation begins by stitching the two sides using very resistant and possibly different colored wires. The two wires go to arm the medial and lateral sides and in this phase it is essential always traction along the tendon axis to prevent breakage during the passage in the subacromial space. We isolate the fibers of the brachial triceps and, after divaricating its insertion, we make free distally the *latissimus dorsi* muscle in order to obtain a tendon long enough to easily reach the anterior portion of the greater tuberosity, first we try from the outside (Fig.3), taking care to do not damage the thoracodorsal nerve and the thoracic dorsal vein and artery.

Figure 3. *Latissimus dorsi* length evaluation. The tendon must be enough long to easily reach the anterior portion of the greater tuberosity.

After restoring limb traction, under arthroscopic visualization, we pass a curved and blunt grasper through the posterolateral portal by going to the armpit in the space between the teres minor and the posterior deltoid. Continuing its path the grasper should move laterally and posteriorly to the fibers of the triceps, previously divaricated, and in this phase it is essential to respect the axillary nerve. Once the grasper has exited the access at the level of the axilla we fix two transparent drainage tubes, each with a wire inside, and, withdrawing it back, we shuttle the two tubes containing the sutures of the *latissimus dorsi tendon* in the subacromial space through the anatomical pathway created between the deltoid and the teres minor (Fig.4). At this point, using a suture retriever we pass the sutures from the posterolateral portal respectively to the anterior and anterolateral portal. After tensioning the suture wires from the anterior portals these are assembled in a knotless anchor of 5.5 mm (Fig.5) that we place in the prepared site on the greater tuberosity of the humerus, the medial one very close to the articular

Figure 4. Under arthroscopic visualization we shuttle two transparent drainage tubes containing the sutures of the *latissimus dorsi tendon* in the subacromial space through the anatomical pathway created between the deltoid and the teres minor.

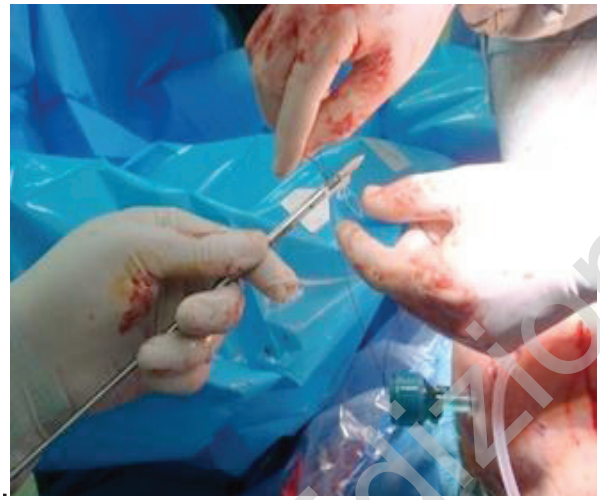

Figure 5. Loading of the sutures used to whip stitch the tendon through a 5.5 mm knotless anchor.

cartilage, and the lateral one in the lateral aspect of the tuberosity, creating a footprint for the *latissimus dorsi tendon* (Fig.6). After that we evaluate the correct positioning of the graft in the footprint of the greater tuberosity (Fig.7). Finally, we proceed with the suture of the arthroscopic portals and with the cutaneous suture of the axillary skin (Fig.8) after a surgical drainage placement. A bracing system at 15° of abduction and neutral rotation is placed.

Post-operative treatment

The patient always leaves the operating room with the shoulder brace previously described, that will protect the patient for the first month post-surgery. Physical therapy intervention is always guided by the pain, the stage of post-operative recovery and the associated medical conditions but generally during the first month just a passive kinesis

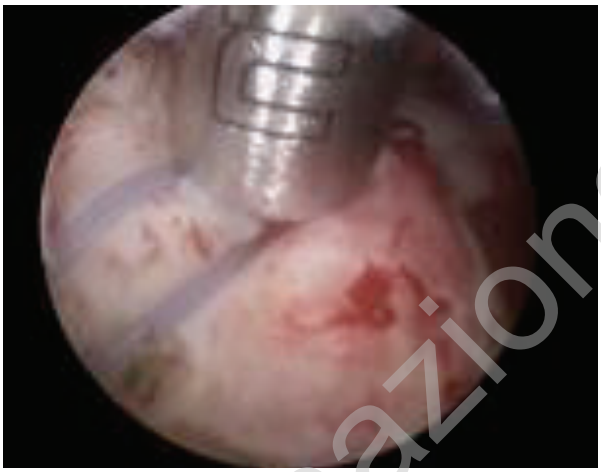

Figure 6. Insertion of the anchor in the prepared site on the greater tuberosity.

Figure 7. X-ray showing the anchors position: the medial one very close to the articular cartilage and the lateral one in the lateral aspect of the tuberosity.

Figure 8. Surgical scar of the incision at the axillary level.

will be allowed[13]. Minimize pain and inflammation, protect the integrity of the repair and gradually restore appropriate pain free passive range of motion are specific goals of the first phase. After that period the second phase of active-assisted movements can be started in order to restore functional ROM. Specific exercises facilitate *latissimus dorsi* to function as an external rotator and depressor of the shoulder and restore proprioception. It's very important in this phase to encourage use of the operative upper extremity for light activities of daily living and in most cases the patient can return to sedentary work. Generally after 12 weeks the initial strengthening phase can start; maintain and enhance optimal ROM and regain muscle strength and shoulder stability are the specific goals of the third phase of postoperative rehabilitation[20]. It is important, especially during the second and the third phase, to integrate the treatment with specific exercises for rebalancing of the scapulothoracic joint and for optimizing neuromuscular control. The full recovery is more prolonged in this kind of surgery because of the need of reconstructions of new routes for nervous message. We must monitor the patient for 6 months after surgery always reminding him that a good recovery physiotherapy is essential in obtaining a satisfactory final result.

Discussion

Treatment of massive and irreparable rotator cuff tears is a topic of great interest and evolving; this is chiefly due to the development of new arthroscopic surgical techniques and the most recent discoveries of rotator cuff biomechanics and kinematics[6,9,17]. There are many parameters that need to be considered in order to implement a proper anatomic and clinical view of massive cuff injury. Despite the depth of research however, complete and exhaustive classification has not yet emerged. There are two major classifications: the first one proposed by Cofield in 1981[3] that considered "massive" a cuff lesion higher than 5 cm; the second one proposed by Gerber in 1997[7] whereby the involvement of 2 or more tendons is the basic requirement to define "massive" a cuff lesion. Among these the posterior-superior lesions, involving the supraspinatus and the infraspinatus tendons, are not so rare and represent a difficult challenge for the surgeon especially when affecting young active patients. In fact, these lesions deeply alter the functional shoulder capability and they are associated with a high level of pain[1-4]. Another concept that needs to be clarified is the reparability of massive tears; many factors might influence the reparability and in our opinion should be sought in: preoperative planning, etiology, objective examination, traditional radiographic and magnetic resonance imaging and arthroscopic evaluation. According to these parameters, it is considered irreparable a chronic injury involving more tendons with an acromion humeral space less than 5 mm and with fatty degeneration of 3° to 4° according Goutallier stages[12]. The surgery of the *latissimus dorsi transfer* is in our opinion a good solution for the treatment of this type of lesion and shows satisfactory results at short and medium term follow-up. The latissimus dorsi muscle is well suited to transfer for several reasons, including its large surface area, strength, and good vascularization, essential for the healing processes. However, it is generally accepted that all transferred muscles lose one grade of muscle strength as the result of the transfer, so the recovery of full strength is not possible[14]. Furthermore, the pedicle with the neurovascular supply of the *latissimus dorsi* muscle by the long thoracic artery and nerve can easily be mobilized over 8 cm without tension on it[18,19]. The surgery was first described by Gerber in 1988[9] and subsequently several authors have reported their experience in this treatment for irreparable posterosuperior rotator cuff tear describing it as an effective technique for the efficient antero elevation, abduction and external rotation recovery giving back to the humeral head its fulcrum action and counterbalances the forces exerted by the subscapularis[2-16]. Miniaci and McLeod[15] and Iannotti et al.[13] reported good results in their studies. 80 to 100% of patients in the literature reported decreased pain following latissimus dorsi transfer. The mean improvement in active forward flexion and external rotation are 35-50° and 9-40° respectively, depending on the study. A key requirement in order to perform this surgery is the presence of an intact subscapularis and deltoid muscles and the absence of arthritic degeneration in patients younger than 70 years. The importance of the subscapularis muscle was demonstrated by Gerber in 2006[8] observing that pain relief in the group of patient's with poor subscapularis function was half of that seen in the patients with good muscle function. Werner et al.[22] explored the biomechanical role of this muscle in a cadaveric model, and it was found that translation and rotation of the humeral head are significantly altered without the subscapularis, thus explaining why post-operative results are found to be inferior in patients without an intact muscle. In the arthroscopic technique presented here the main advantage is to avoid the incision through the deltoid muscle that occurs in open approaches of the rotator cuff. By preserving this muscle clinical outcome can be improved like other investigators have shown[10,11,13]. Our technique comes from the one described by Gervasi with a small cosmetic incision at the axilla more anterior than in the standard approach, closer to the humeral insertion of the *latissimus dorsi*.

Conclusion

For symptomatic irreparable posterosuperior rotator cuff tears in patients less than 70 years old with an intact subscapularis and absence of glenohumeral arthritis, the *latissimus dorsi transfer* can result in functional improvement and pain relief. As with any surgical procedure, patient selection and an understanding of the factors related to obtaining a good outcome from the procedure is crucial to success. We prefer the arthroscopically assisted technique that avoids the incision through the deltoid muscle obtaining a better and faster clinical outcome. In this way, in the long term salvage procedures such as reversed shoulder arthroplasty remain possible.

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