



Technical Note

Reconstruction of the distal biceps tendon using triceps graft: a technical note[☆]



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ABSTRACT

Rupture of the distal biceps brachii tendon typically occur in a contraction against resistance with the elbow in 90° of flexion. Chronic ruptures are uncommon and are complicated by tendon and muscle retraction and poor quality. Some reconstruction techniques have been described in the literature, with variations on the surgical exposures, type of graft (allo or autograft), graft donor site, and type of attachment to the radial tuberosity. The authors report the case of a patient presented a rupture of the distal biceps brachii tendon that took place five weeks earlier and, therefore, underwent reconstruction using autograft from the central strip of triceps tendon through double incision and fixation with anchors to the radial tuberosity. The use of the triceps brachii as autograft for reconstruction of chronic ruptures of the distal biceps had not yet been described in the literature. The authors have chosen to use it due to its biomechanical characteristics that qualify it as suitable for this procedure and because this is easier for collection, using the same operating field at the same joint, minimizing the negative effects of the donor area. After six months postoperatively, the patient has full movement arc and restoration of 96% of the flexion strength and 90% of the supination strength when compared with the contralateral limb. This procedure appears to be a good option for cases of chronic distal biceps rupture in older patients who have functional demand of supination.

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Reconstrução do tendão distal do bíceps com enxerto do tríceps: nota técnica

RESUMO

Rupturas do tendão distal do bíceps braquial ocorrem tipicamente com uma contração contrarresistência com o cotovelo em 90° de flexão. Rupturas crônicas são lesões incomuns e são complicadas pela retração e pobre qualidade tendínea e muscular. Algumas

Palavras-chave:

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[☆] Study conducted at the Hospital Ortopédico e Medicina Especializada (Home), Serviço de Cirurgia de Ombro e Cotovelo, Brasília, DF, Brazil.

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Procedimentos cirúrgicos
reconstrutivos
Transplante autólogo
Reconstrução

técnicas de reconstrução têm sido descritas na literatura, com variações na via de acesso, no tipo de enxerto (alo ou autoenxertos), na área doadora do enxerto e no tipo de fixação à tuberosidade radial. Descrevemos o caso de um paciente que apresentava ruptura do tendão distal do bíceps braquial havia cinco semanas, foi submetido à reconstrução com autoenxerto da tira central do tendão tricúspital através de dupla incisão e fixação com âncoras à tuberosidade radial. O uso do tríceps braquial como autoenxerto para reconstrução de rupturas crônicas do bíceps distal ainda não havia sido descrito na literatura. Os autores optaram por ele devido às características biomecânicas que o credenciam como adequado para esse procedimento e à facilidade de coleta com o mesmo campo cirúrgico na mesma articulação, que minimizam os efeitos negativos da área doadora. Após seis meses de pós-operatório, o paciente apresenta arco de movimento completo e restauração de 96% da força de flexão e 90% da força de supinação quando comparado com o membro contralateral. A técnica descrita parece ser uma boa opção para casos de ruptura crônica do bíceps distal para pacientes mais velhos e que apresentam demanda funcional de supinação.

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Introduction

The biceps brachii is the primary supinator and secondary flexor of the forearm.¹ Ruptures of the distal tendon of the biceps are rare injuries that usually affect the dominant arm of middle-aged men. The injury typically occurs during resisted contraction, with the elbow at 90° of flexion.² Significant loss of flexion strength and more pronounced loss of supination strength are often associated with chronic ruptures.² Ruptures are considered chronic 4–6 weeks after the injury.¹ In these cases, the muscle-tendon unit retracts and there is formation of fibrosis, which hinders the radial tuberosity repair.^{3–5} Several procedures have been described to treat chronic ruptures of the distal biceps tendon, including tenodesis in the brachial tendon and the use of tendon graft.³

The authors describe the surgical technique used in a patient who presented chronic retracted rupture of the distal tendon of the biceps brachii, which was reconstructed using double incision with grafting from the distal tendon of the brachial triceps.

Case report

Patient, 51 years, male, taxi driver, right-handed, attended to this service with history of sudden pain and deformity on the anterior aspect of the left arm when attending to lift weights at home five weeks before. He reported having pain and difficulties while driving, which impaired his professional activity.

He had no significant history of diseases or previous elbow pain. He did not practice any physical activities.

Upon physical examination, evident deformity was observed on the anterior aspect of the left arm, with bulging contour of the biceps muscle belly. He had pain at palpation and absence of the biceps tendon on the anterior aspect of the elbow, in addition to a great strength reduction during supination and pain during flexion. Neurological and vascular status was preserved.

Magnetic resonance imaging disclosed signs of complete rupture of the distal biceps tendons, with 4.4 cm retraction.

Surgical technique

The surgical treatment was selected due to the functional demand of the patient's professional activity (taxi driver), which relies heavily on the movements of the upper limbs.

The authors opted for a reconstruction of the distal biceps tendon through the double incision technique described by Boyd and Anderson⁶ and modified by Morrey et al.⁵ Tendon graft from the distal triceps was used; this technique has not been described in the literature, but the authors' literature research^{7,8} indicated that this procedure would be useful in the present case of a middle-aged patient with high functional demand of the affected limb for his work activities and no sports demand.

The patient was placed on the operating table in the supine position, without tourniquet. A transverse incision of approximately 3 cm was made in the anterior cubital fold. The biceps tendon is easily captured when the skin is retracted proximally, separated from the deep tissues. The most distal portion of the degenerated tendon was resected; the tendon was repaired with Bunnell sutures using nonabsorbable No. 5 thread (Fig. 1).

Then, the radial tuberosity was palpated and a curved Kelly forceps was passed through the biceps tendon tunnel, between the ulna and the radius, and it was advanced until its tip could be palpated on the dorsal aspect of the proximal forearm. A second incision was made over the forceps. The tuberosity was exposed through muscle divulsion with the forearm in maximal pronation (Fig. 2). The radial tuberosity was scarified until bleeding was observed. Two bioabsorbable, double-loaded 2.9-mm anchors were positioned.

Then, the brachial triceps tendon graft was collected, without olecranon bone fragments, through a posterior longitudinal incision and subcutaneous dissection until the tendon was exposed. The authors chose to remove a strip from its middle portion, measuring 1 cm wide and 10 cm long, with



Fig. 1 - Intraoperative image showing the repair of the ruptured tendon.



Fig. 2 - Intraoperative image showing the exposed radial tuberosity.

no need to explore the ulnar nerve (Fig. 3). Subsequently, the medial and lateral borders of the removed portion were approximated and the interval was closed.

The most distal end of the graft was attached to the tuberosity by four U-shaped sutures with anchor wires (Fig. 4). The other end of the tendon was then passed to the region of the antecubital fossa incision through nonabsorbable No. 5 sutures (Krackow) to pull the tendon through the tunnel previously occupied by the biceps tendon. The biceps was mobilized and then pulled with the use of Allis clamps. The elbow was positioned at 40–60° of flexion, with the forearm in full supination. Moderate traction was applied to the graft, while the tendon stump was distally tractioned. The two structures were initially stabilized with non-absorbable No. 5 U-shaped suture; then several single sutures were made at the edges (Fig. 5). Once the reconstruction was completed, the wounds were



Fig. 3 - Intraoperative image showing removal of the triceps tendon graft.



Fig. 4 - Intraoperative image showing the fixation of the graft in the radial tuberosity.

closed; compressive dressings were applied, and the limb was immobilized with a brachial splint, maintaining the elbow at 90° of flexion and the forearm in mild supination.

Immobilization with a sling was maintained for two weeks; thereafter, physical therapy was initiated. Initially, exercises of passive flexion and limited active extension with the forearm in supination were performed, as well as passive supination and active pronation to 50°. The limb was immobilized with a sling while outside of physiotherapy. This phase lasted until



Fig. 5 – Intraoperative image showing the fixation of the graft to the ruptured biceps tendon.

the end of the third week, when exercises to increase flexion and active supination without load were initiated; at this phase, the patient was instructed to interrupt the use of slings. Muscle strengthening exercises were initiated after the sixth week with light loads, which were progressively increased.

Results

Three months after surgery, the patient had full range of motion without pain, but still presented decreased muscle strength. After the fourth month, he was allowed to return to his work activities. At five months post-operative, the patient had recovered full muscle strength and had completely returned to daily activities.

In his last follow-up assessment, six months after surgery, the patient had full range of motion: 0° extension, 135° flexion, 85° supination, and 85° pronation. At that moment, a digital dynamometer was used; the observed flexion force was 17.35 kgf (19.29 kgf in the contralateral elbow) and the supination force, 7.14 kgf (7.40 kgf in the contralateral). Furthermore, the extension force was 16.25 kgf in the operated elbow vs. 15.45 kgf in the contralateral.

The patient's result is encouraging, with recovery of 90% of the flexion strength and 96% of the supination strength, and maintenance of extension force, even after graft removal.

Discussion

The primary repair of a chronic rupture of the distal brachial biceps is technically challenging. Non-anatomical tenodesis in the brachialis muscle has been proposed as a treatment option. However, despite the high satisfaction rate of the patients who underwent this procedure, Klonz et al.⁹ observed that half of their patients lost over 50% of the supination

strength. The risk of weakness in supination after this technique may be unacceptable for patients with high functional demand.

Several techniques for the reconstruction of the distal biceps tendon have been described; they differ in their approach, the graft choice, and the type of fixation.¹⁻⁴ Both auto- and allografts have been used for this purpose. Several allografts have been reported in the literature,^{1,10,11} including the Achilles tendon, semitendinosus, anterior tibial, and gracilis. Regarding autografts,¹⁻⁴ some studies indicated the use of the fascia lata, semitendinosus, and palmaris longus.

No descriptions of the use of the distal brachial triceps tendon for this purpose were retrieved in the literature. The use of this tendon as an autograft for chronic ruptures of the distal brachial biceps was devised by the authors to avoid the disadvantages observed in the recovery period when the donor area is not located in the same joint as the recipient area. Moreover, other advantages include its presence in every individual, the absence of neurovascular risks during harvesting, and the possibility of variable sizes and lengths, according to the need.

Martin et al.⁷ assessed the biomechanical characteristics of grafts from the central portion of the triceps brachii, comparing them to those of the long palmar, and concluded that the triceps graft is comparable in ultimate load-to-failure and stiffness with the palmaris longus tendon graft. They also observed that the triceps tendon presents greater deformation than the palmaris longus, but without clinical significance. In another biomechanical study, Baumfeld et al.⁸ evaluated the properties of the medial, central, and lateral strips of the distal triceps and concluded that the lateral portion is significantly thinner and less rigid than the central and medial portions, and that the central portion of the triceps brachii presented an ultimate load to failure of 704 N, vs. 357 N for the palmaris longus.

Wiley et al.² compared two groups of patients with chronic ruptures of the distal biceps; one group was conservatively treated and the other underwent reconstruction with semitendinosus autograft through double incision. They concluded that the patients who underwent reconstruction obtained an improvement in flexion and supination strength when compared to those treated conservatively.

Although there is still debate on the best approach for fixation of distal biceps tendon ruptures, whether double or single incision, recent studies show a negligible difference in results and complications between the two techniques.^{12,13} The choice of the best approach for these pathologies should be guided by surgeon experience and confidence.

Conflicts of interest

The authors declare no conflicts of interest.

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