

Anterior Surgical Repair of Distal Ruptures of the Brachial Biceps Tendon*

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Purpose. Distal ruptures of the brachial biceps tendon are an infrequent injury. The purpose of this paper is to assess the outcome of distal ruptures of the tendon addressed surgically through an anterior approach between November 1998 and December 2003.

Materials and methods. Retrospective study of 12 patients and 13 injuries with a mean follow-up of 37 months (range: 12-60). Mean age was 37.6 years and all patients were male. All injuries were located in the dominant arm, except for one case in which the rupture was bilateral. All were operated with an anterior approach. In ten injuries (76.9%) harpoon sutures were used, in two (15.4%) bone tunnels and in one instance (7.7%) an endobutton anchor. All patients but one were immobilized with a brachioantebraial plaster splint during the first two weeks post-op. In five patients, this immobilization was continued, whereas in four it was replaced by an articulated brace.

Results. Range of movement, strength, pain and personal satisfaction were the parameters assessed. All patients had full mobility. Eleven patients (91.6%) recovered their full strength. As far as complications are concerned, we had a transient radial nerve palsy. Personal satisfaction was excellent in eleven patients (91.6%) and good in one (8.4%). There was no re-rupture.

Conclusions. Our clinical and functional results are excellent, for which reason we recommend harpoon suturing with an anterior approach.

Key words: *rupture, distal biceps tendon, anterior approach, harpoon suture.*

Reparación quirúrgica por vía anterior de la rotura distal del tendón del bíceps braquial*

Objetivos. La rotura distal del tendón del bíceps braquial es una lesión poco frecuente. El objetivo de nuestro estudio es evaluar los resultados de las roturas distales de dicho tendón, intervenido quirúrgicamente por vía anterior entre noviembre de 1998 y diciembre de 2003.

Material y método. Estudio retrospectivo con 12 pacientes y 13 lesiones, con un seguimiento medio de 37 meses (12-60). La edad media fue de 37,6 años, y todos los pacientes eran del sexo masculino. Todas las lesiones se localizaron en el brazo dominante, excepto un caso de rotura bilateral. Todos fueron intervenidos a través de un abordaje anterior. Diez lesiones (76,9%) se suturaron con arpones, dos (15,4%) con túneles óseos y una (7,7%) se suturó con un anclaje con *endobutton*. Todos los pacientes, excepto uno, fueron inmovilizados con una férula de escayola braquioantebraial posterior durante las dos primeras semanas postoperatorias. En cinco pacientes se continuó con esta inmovilización y en seis se substituyó por una ortesis articulada.

Resultados. Se evaluaron los parámetros de: movilidad, fuerza, dolor y satisfacción personal. Todos los pacientes presentaron una movilidad completa. Once pacientes (91,6%) recuperaron la fuerza totalmente. Como complicaciones se encontró una paresia transitoria del nervio radial. La satisfacción personal fue excelente en once pacientes (91,6%) y buena en un paciente (8,4%). No existió ninguna nueva re-ruptura.

Conclusiones. Los resultados clínicos y funcionales han sido en la mayoría de los pacientes excelentes, por lo que se recomienda la sutura con arpones por vía anterior.

Palabras clave: *rotura, tendón distal del bíceps, vía anterior, arpones.*

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Distal brachial biceps tendon tears are a rare occurrence. In 1897 Johnson reported the first successful surgical repair, but since then few other cases have been documented in comparison with other pathologies¹. Tears account for just 3% of all brachial biceps injuries².

The typical injury occurs in the dominant upper limb of middle-aged males when an eccentric load is inflicted on their flexed elbow².

Surgical and orthopedic treatment options have been published in the literature, but a growing body of biomechanical studies demonstrates that, when the distal biceps tendon is not reattached anatomically, elbow flexion and supination strength fall by 30% and 40% respectively³.

All surgical methods geared to the anatomical repair of acute biceps tendon tears have shown better recovery of strength, although consensus on what the best repair method may be has as yet not been reached.

Anatomic reattachment of the tendon at the bicipital tuberosity was initially described as part of an anterior approach (Fischer and Shepanek in 1956⁴, Mc Reynolds in 1963⁵, etc.), but in the face of a high radial paresis/palsy risk, in 1961 Boyd and Anderson⁶ described a two-incision technique which, though superior in certain aspects, could lead to radioulnar synostosis in a percentage of cases that varies in the different studies carried out (5%⁷, 11%¹, 22%⁸, etc.).

Nowadays, suture harpoons reduce the amount of dissection needed and minimize the risk of radial palsy in anterior approaches.

The purpose of our study is to assess the results afforded by the treatment of distal brachial biceps tears by an anterior surgical approach performed over a five year period at the 12 de Octubre Hospital (between November 1998 and December 2003).

MATERIALS AND METHODS

This is a retrospective study of 12 patients and 13 injuries. Our study included all adult patients (older than 14) who came to our emergency department and were clinically diagnosed with a distal biceps tendon tear (pain, swelling, limited elbow flexion and, especially, supination, depression on the anterior aspect), confirmed by either ultrasound or MRi. Mean follow-up was 37 months (range: 12-60).

Mean patient age was 37.6 years (29-61). All were male and their tears located in their dominant arm, except for one case with a bilateral tear (first the bicipital tendon of the dominant arm tore and the year after that of the contralateral arm, in both cases while practicing martial arts). Ten tears (76.9%) involved the right arm and three (23.1%) the left one.

In our study, the tear occurred in 4 cases (30.8%) further to trauma to the elbow, in 7 cases (53.8%) after a fortuitous fall and in 2 cases (15.4%) after strenuous activity (one patient lifting a heavy object at work and the other playing tennis). The patient with the bilateral tear sustained his first tear after a blow to his dominant elbow and the second one after a fall.

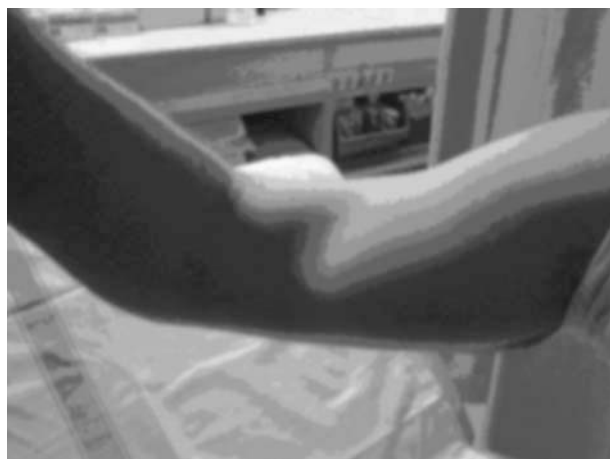


Figure 1. View of one of the full tears observed



Figure 2. MRi view of a distal biceps tendon tear.

As far as the different etiological factors published in the literature are concerned⁹, half of our patients smoked (six). No patient was overly obese. Eight patients (66.6%) took sports regularly and four (33.4) led rather sedentary lives.

Diagnosis was based on a clinical examination (fig. 1) and was confirmed by an ultrasound and, in four cases, with an MRi (fig. 2)

All patients were operated by means of an anterior approach.

Surgical technique

A curvilinear incision was made on the anterior aspect of the shoulder. Then a plane-by-plane dissection was carried out until the deep aponeurosis was reached. The aponeurosis was sectioned longitudinally in order to locate the distal biceps tendon, which often slides back

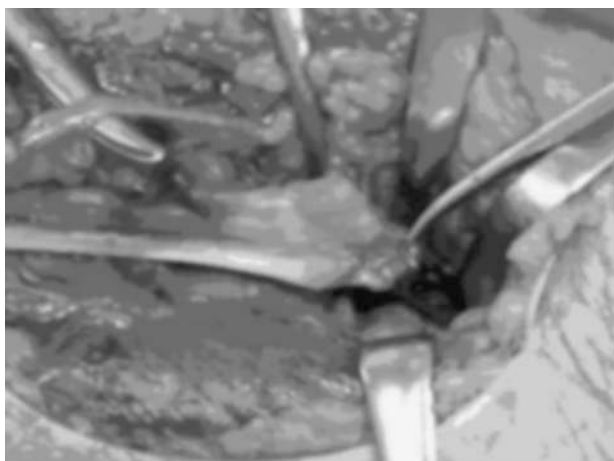


Figure 3. Intraoperative view showing the distal biceps tendon tear (anterior approach).

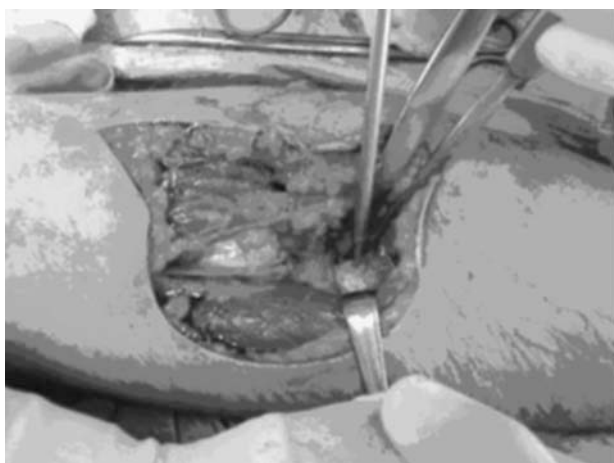


Figure 4. Placement of a harpoon during the procedure.

5-6 cm over the elbow (fig. 3). During dissection, it is important to protect the lateral cutaneous nerve of the forearm. Subsequently, the bicipital tuberosity of the radius is identified in order to reattach the tendon. In 10 cases (79.6%) reattachments and sutures were performed with harpoons (fig. 4), in two cases with bone tunnels (15.4%), and in one case with an *endobutton technique* (7.7%). Harpoons used came from different manufacturers, but they were always threaded and 3.5 mm thick (fig. 5). In 5 tears (50%) a single harpoon was used (fig. 4), four tears (40%) were fixed with 2 harpoons and one (10%) with 3 (fig. 5).

Mean time elapsed between sustaining the tear and surgery was 22.5 hours (4-48 hours).

In the early postoperative period, all patients were immobilized with a posterior brachioantibrachial plaster splint for two weeks, except for one patient who refused to wear it for longer than one week. The first five patients (38.5%) in

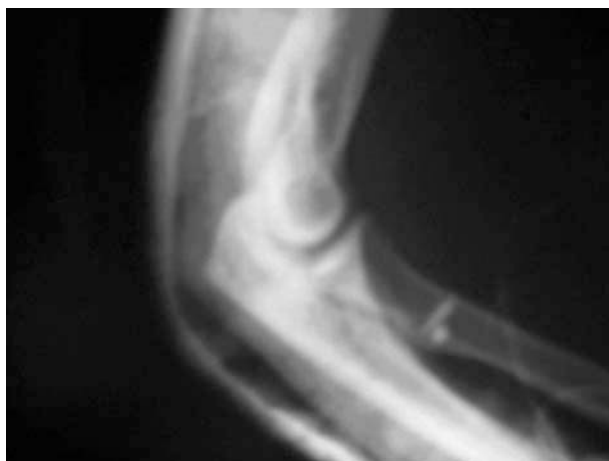


Figure 5. Lateral X-ray view showing the arrangement of the harpoons. Postoperative follow-up.

the study were made to wear a brachioantibrachial plaster cast subsequently. After voluntary splint removal in one patient after just one week, we observed that the final outcome of this patient was not any worse than that of others who had been immobilized longer, which made us replace the splint by an articulated orthosis in the next eight tears (61.5%), patients being allowed to start flexing/extending their elbow with the said orthosis. Mobilization was started after two weeks in patients with orthosis, and 4.1 weeks on average (1-6) after splint removal in the first group of patients. The group of patients with orthosis had to wear the latter for a mean of 7.5 weeks (4-12) whereas the group with a splint was immobilized for a mean of 4.1 weeks (1-6). Maximum immobilization time for patients with a splint was 6 weeks.

No statistical method was used to analyze our results because we thought that given our low number of cases, the results obtained would not be significant.

RESULTS

Patients were assessed 15 days into their post-op and one month after surgery. We subsequently saw them at intervals of one month in the outpatient facilities of our hospital. We assessed the following parameters: mobility, strength, pain and personal satisfaction.

All patients achieved full mobility (flexo-extension and pronosupination) at 5 months from surgery on average (2-7 months). Mobility was assessed by comparison with the contralateral arm and manually measuring ROM with a goniometer.

Eleven patients (91.6%) regained the same force as in their contralateral arm (as graded on the modified MRC [Medical Research Council] muscle strength scale, which assesses movements made with and without resistance)¹⁰,

also at around 6 months post-op on average (4-10 months). No electronic measuring device was used.

Pain was assessed by means of a simple scale: a) persistent pain when performing activities of daily living that provoked regular use of painkillers; b) occasional pain on performing activities of daily living that sometimes required the use of painkillers; c) absence of pain. Eleven patients reported no pain on performing their activities of daily living and one patient complained of a kind of occasional pain that did not interfere with his regular work or sporting activities.

Degree of personal satisfaction was assessed by means of Karunakar et al's scale⁷. The patient's degree of satisfaction is considered excellent if they do not present with alterations in their activities of daily living; it is considered good when they have slight alterations; a fair degree of satisfaction points to moderate alterations and a poor one significant ones. Eleven patients (91.6%) reported an excellent level of satisfaction and one patient (8.4%) classed his level of satisfaction as good. We had no instances of re-tears.

After an average 6 months from surgery (3-11), all patients were able to go back to their previous occupations and manager to resume their usual sporting activities with the same degree of intensity as before they sustained the injury.

As regards complications, one patient had transient radial nerve paresis, which resolved fully at around six months.

DISCUSSION

We agree with the majority of authors^{3,7} that, when treating these injuries, it is essential to attach the distal tendon of the torn biceps in its anatomical position. Non-anatomical repair consists of a tenodesis to the brachial muscle, which does not lead to a reduction in flexing strength but which does diminish supination strength^{3,11}. The advantage it has over anatomical reattachment is that less dissection is required, which leads to a lower risk of complications.

Rantanen and Orava¹ carried out a metaanalysis of 147 cases in the literature. 90% of patients treated with anatomical reattachment had good or excellent results after a mean 3-year follow-up, while the percentage of these results fell to 60% in patients without anatomical reattachment and to 14% in unoperated subjects. Fourteen patients were treated orthopedically and in 123 patients the tendon was reattached anatomically: in 45 cases through a double incision and in 76 by mean of an anterior incision (although harpoons were used in only 11 of these). As regards complications, there were 5 cases of radio ulnar synostosis (11%) in cases in which two incisions were used, 6 radial nerve palsies (7.7%) and 2 synostoses (2.6%) in anterior approach

surgeries. No functional differences between both techniques were found.

Klonz et al¹¹ asked themselves if non-anatomical reattachment through a tenodesis to the brachial muscle provided similar functional results with a lower surgical risk. They analyzed fourteen tears, of which eight were repaired non-anatomically and six were anatomically reattached with an anterior approach using harpoons. The authors compared the flexion-supination strength achieved with that of the contralateral arm. Even if they found no differences between both techniques in terms of flexion strength, they did find a difference as regards supination strength, which did not improve in patients subjected to tenodesis but which did improve in all cases of anatomic reattachment, who achieved an average of 91% supinating force as compared to the contralateral.

Predisposing factors to distal biceps tendon tears are similar to those related to the other tendons in our anatomy, i.e. long-term treatment with quinolones and steroids, chronic diseases like diabetes mellitus, chronic renal failure, syphilis, tuberculosis, obesity, gonorrhea, trychinososis, typhoid fever, systemic malignant diseases, rheumatoid arthritis, ankylosing spondylitis, systemic lupus erythematosus, hemodialysis and hyperparathyroidism⁹.

Smoking had never been mentioned in connection with distal biceps tendon tears. Safran et al⁹ analyzed 14 patients with distal biceps tendon tears and found a 7.5 higher risk of sustaining tears in smokers than in non-smokers, with this result being statistically significant. The authors state that since the three distal-most centimeters of the biceps tendon are a hypovascular area, tobacco could cause repeated hypoxia and thus a tear. Nonetheless, they found no statistically significant relationship between obesity and distal biceps tendon tears. Some authors like Karunakar et al⁷ had claimed that patients typically afflicted with tears of this tendon were middle-aged men between 40 and 50. The fact that they relate age with tendinous tears is due to the fact that the tensile properties of connective tissue diminish with age. However, a statistically significant direct relationship between both factors has not been demonstrated as yet with other criteria like the patient's activity levels could play a role. Some authors like Rantanen and Orava¹ indicated that athletes had a higher risk of sustaining an injury, but others like Safran and Graham⁹ disagree and, conversely, claim that individuals with physically undemanding jobs might be more prone to tears.

We assessed different papers that compare the results obtained in the surgical repair of distal biceps tendon tears carried out by an anterior approach and with two incisions.

El-Hawary et al¹² studied 19 tears, 10 operated with a two-incision approach and 9 with an anterior approach, with a 4-year follow-up. They had a high complications rate (44%) in patients operated with a single incision approach (although around 20% of these were just transient paresthes-

sias and dysesthesias) as compared with 10% for two-incision patients. They did not use harpoons.

Pereira et al¹³ used 12 pairs of cadaver elbows in order to establish a direct comparison between harpoon-based sutures performed by means of an anterior approach and two-incision repairs with bone tunnels. The authors conclude that the two-incision technique with its bone tunnels achieves a more consistent and rigid repair in relatively young patients, as compared with suture with a single harpoon.

No study has shown any differences regarding strength and ROM in patients operated with one single incision or with two. It would seem plausible to think that the introduction of harpoons, given their ease of use and their less frequent need for tissue dissection, should lead to a lower complications rate, although we have not found any studies comparing complications of distal biceps tendon suturing using an anterior approach with and without harpoons.

We made a bibliographical review of the results obtained by several studies dealing with the repair of distal biceps tendon tears through a single anterior approach and harpoon-based reattachment. Kobayashi et al¹⁴ studied 15 tears with a mean 50-month follow-up and observed that the most frequent complication was persistent pain, which required a new surgery. Balabaud et al¹⁵ assessed 9 tears in 8 patients, with a mean 2-year follow-up and found complications such as heterotopic ossifications in three patients and a 6% strength deficit. Mc Kee et al¹⁶ studied 53 patients operated by the same surgeon over an 8-year period. All were male, with a mean age of 42. All were operated by means of an anterior approach with 2 harpoons. Four complications were recorded (7.5%): one wound infection, two transient lateral cutaneous nerve paresthesias and one posterior interosseous nerve palsy. They observed no new tears, and no patient lost more than 5° flexo-extension or forearm rotation.

Our 13-case series was subjected to a medium/long-term follow-up (5 years) and has shown very few complications. We found no differences in terms of ROM or strength between longer brachioantibrachial splint immobilization and shorter immobilization with an articulated orthosis. We believe that the latter could be used more generally to permit earlier mobilization of the operated elbow. In the literature, there are surgeons who immobilize the injured arm for 2 weeks, and subsequently start passive mobilization^{14,16}, with or without articulated shoulder orthoses. Others keep it immobile for 5-6 weeks^{1,15}. Other authors like El-Hawary et al¹² start passive mobilization at the third day.

All patients in our series were male, in spite of the significant number of women involved in some kind of sport practice at the present time, a fact that in line with the data found in the literature^{1,2,7,9}. Furthermore, all injuries, except for the bilateral tear, occurred in the dominant arm.

Although this is a short series, the excellent results obtained and the few complications that ensued, would seem to indicate that we should continue performing harpoon-based sutures through an anterior approach.

To conclude, anatomical reattachment of the brachial biceps tendon conducted through an anterior approach with harpoons affords excellent functional results, with a low risk of complications.

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Conflict of interests

The authors have declared to have no conflict of interests.