

Original article

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Acute distal biceps repair using double incision technique: results of a standardized home rehabilitation protocol

Reparación aguda del bíceps distal mediante técnica de doble incisión: resultados de un protocolo estandarizado de rehabilitación domiciliaria

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ABSTRACT. Introduction: Distal biceps tear can lead to loss in flexion and supination strength. Early repair in active patients is recommended. Postoperative rehabilitation varies according to surgeon experience and surgical technique used. The aim of this study is to present the results of a series of patients using a standardized home rehabilitation protocol after a distal biceps repair with double incision technique. **Material and methods:** This is a retrospective case study. We registered 21 patients with distal biceps tear, surgically treated using a double incision technique and transosseous suture fixation, followed by a home-based exercise program. Patients were evaluated using MEPS score, DASH questionnaire, and the subjective/objective scoring system of Andrews and Carson. Radiographic assessment was done for heterotopic bone formation. **Results:** Mean MEPS was 95 (range 70 to 100), DASH score 0.4 (range 0 to 4.2), and subjective and objective Andrews and Carson score was 99 (range 90 to 100). Two patients developed heterotopic ossifications. Range of motion was recovered in every patient. All patients went back to their previous surgical activities. **Conclusions:**

RESUMEN. Introducción: Las lesiones del bíceps distal pueden generar pérdida de fuerza de flexión y supinación. En pacientes activos, se recomienda la reparación temprana. La rehabilitación postoperatoria varía de acuerdo con la experiencia del cirujano y la técnica quirúrgica utilizada. El objetivo del estudio es presentar los resultados de una serie de pacientes utilizando un protocolo de rehabilitación estandarizado posterior a la reparación del bíceps distal mediante la técnica de doble abordaje. **Material y métodos:** Este es un estudio retrospectivo. Se registraron 21 pacientes con lesión del bíceps distal, que fueron tratados quirúrgicamente utilizando un doble abordaje y fijación transósea con suturas, seguido de un programa de ejercicios en el domicilio. Los pacientes fueron evaluados utilizando el score de MEPS, el cuestionario DASH y el puntaje subjetivo/objetivo de Andrews y Carson. Se realizaron radiografías para evaluar osificaciones heterotópicas. **Resultados:** La media del MEPS fue 95 (rango de 70 a 100), del DASH 0.4 (rango 0 a 4.2) y del score de Andrews y Carson fue 99 (rango 95 a 100). Dos pacientes desarrollaron calcificaciones heterotópicas. El rango de movilidad se recuperó en todos los pacientes. Todos volvieron a sus actividades previas

Level of evidence: IV

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Patients treated with double incision repair for distal biceps tear can undergo a home rehabilitation protocol, expecting normal range of motion and strength recover.

Keywords: Distal biceps, sports medicine, double incision, rehabilitation, heterotopic ossification.

Introduction

Acute distal biceps rupture has an estimated incidence of 1.2 to 5.35 per 100,000 patient-years.^{1,2} An untreated distal biceps rupture may lead to an average 30% loss in flexion peak torque and up to 60% loss in supination strength, whereas normal or near to normal strength can be expected after acute repair.^{3,4,5,6} Overall literature supports early repair in active patients with consistent and reliable results.^{3,7} There is debate regarding whether a single incision or a double incision approach is best for patients. Both have potential risks. The most common reported complication in the single-incision group is lateral antebrachial cutaneous nerve neurapraxia, while the double-incision group has greater rates of heterotopic ossification.^{8,9} Fixation methods are also variable, ranging from transosseous sutures, anchors, interference screws and cortical buttons.^{8,10} Despite

a la cirugía. **Conclusiones:** Los pacientes que fueron tratados mediante un doble abordaje por lesiones del bíceps distal pueden realizar un protocolo de ejercicios en su domicilio, siendo esperable un rango de movilidad normal y recuperación de la fuerza muscular.

Palabras clave: Bíceps distal, medicina deportiva, doble incisión, rehabilitación, osificación heterotópica.

approach and fixation differences, functional results are similar allowing surgeons to choose their preferred approach and fixation methods according to their own surgical criteria and experience.⁹

Our surgical preference is a double incision approach and transosseous fixation technique. It provides a reproducible anatomic fixation of the distal biceps. It is a low-cost procedure with no implant related complications.^{8,11} There is no standardized guideline to postoperative rehabilitation for distal biceps tendon repair. Experienced surgeons vary immobilization time and rehabilitation methods according to their own preference and experience. Some allow for immediate active range of motion, others immobilize patients and keep them in braces for a determined period, and some refer patients to physical therapy.^{9,12,13,14,15}

The purpose of this study is to present the results of a series of retrospectively evaluated patients after repair

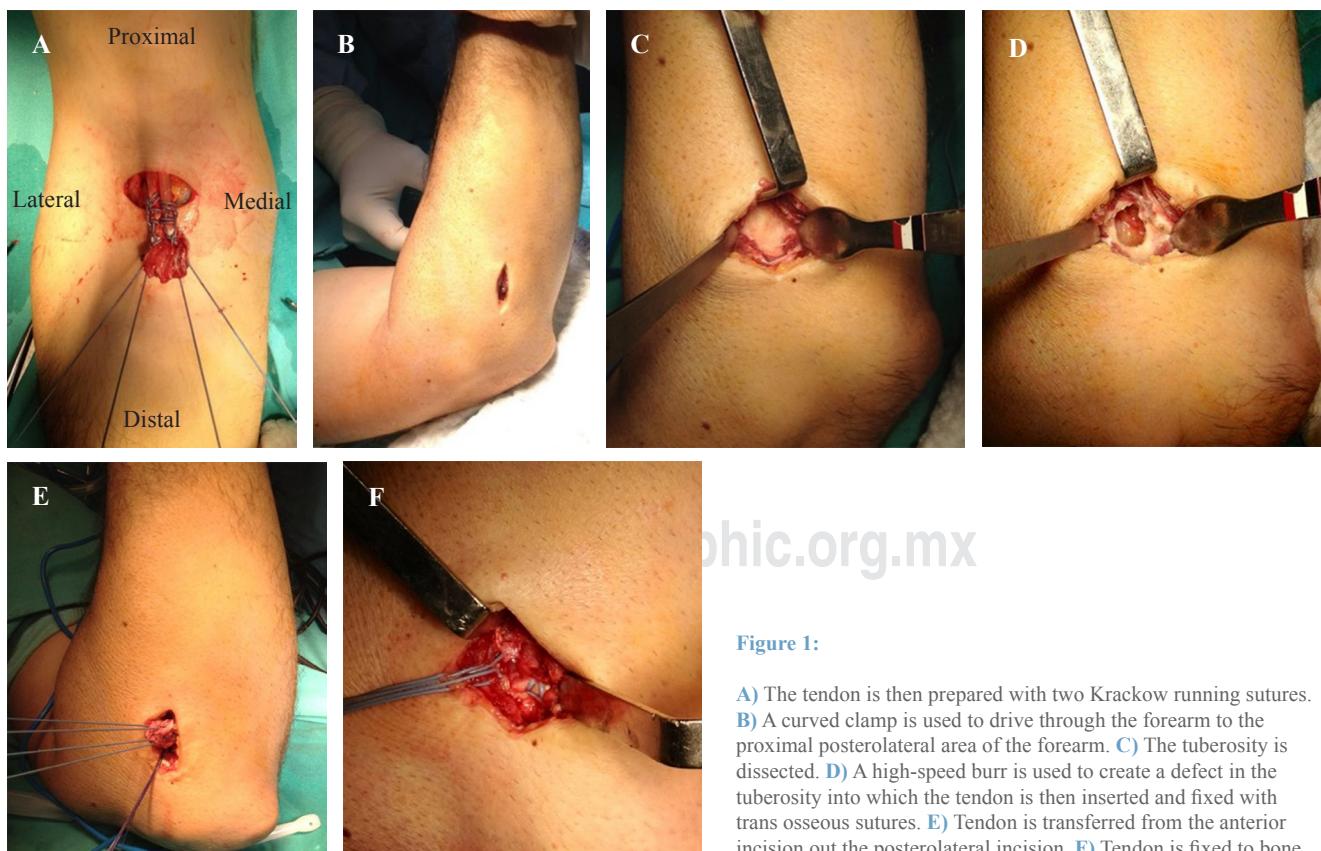


Figure 1:

A) The tendon is then prepared with two Krackow running sutures. **B)** A curved clamp is used to drive through the forearm to the proximal posterolateral area of the forearm. **C)** The tuberosity is dissected. **D)** A high-speed burr is used to create a defect in the tuberosity into which the tendon is then inserted and fixed with trans osseous sutures. **E)** Tendon is transferred from the anterior incision out the posterolateral incision. **F)** Tendon is fixed to bone.

Table 1: Demographic information.					
Case	Age	Elbow (side)	Dominant side	Sex	Time to surgery (days)
1	37	Right	No	M	8
2	38	Left	No	M	6
3	36	Left	No	M	8
4	35	Right	Yes	M	5
5	46	Left	No	M	6
6	53	Right	Yes	M	16
7	32	Right	Yes	M	9
8	56	Left	No	M	8
9	21	Left	No	M	13
10	64	Right	Yes	M	13
11	53	Left	Yes	M	7
12	40	Left	No	M	9
13	54	Left	No	M	3
14	43	Right	Yes	M	14
15	47	Left	No	M	14
16	45	Right	No	M	14
17	50	Right	Yes	M	18
18	43	Left	No	M	11
19	45	Left	No	M	9
20	46	Right	Yes	M	8
21	49	Right	Yes	M	7

M = Male.

of acute distal biceps lesions using a standardized self-rehabilitation protocol. The main outcomes assessed were clinical function, heterotopic ossification findings (radiological and clinical) and return to previous activities.

Material and methods

This is a retrospective case study of the outcome of a series of patients with a complete distal biceps tear repaired with double incision technique and bone tunnel fixation. Exclusion criteria were partial thickness tears, previous elbow surgery or previous elbow fractures and less than 12 months follow up. All patients referred a history of sudden pain and asymmetry at the bicep's muscle bulk after an eccentric contraction of the elbow with the forearm in full supination. The hallmark clinical finding for all patients was an abnormal hook test.¹⁶

Surgical technique: our surgical technique is based on the two-incision modified Mayo technique.¹⁷ A 3 cm transverse incision is made at the center of the elbow crease. The lateral antebrachial cutaneous nerve is identified and protected. The distal tendon biceps sheath is opened and the distal end of the biceps tendon is identified. Any adhesions are carefully released, and the tendon is delivered from the wound. The tendon is then prepared with two Krackow running stitches using nonabsorbable sutures (5 Ethibond Excel, Ethicon INC) leaving four free strands of suture (Figure 1A).

A curved clamp is used to drive through the forearm within the remaining biceps sheath or tract passing immediately medial to the biceps tuberosity with the

forearm in supination. As the elbow is flexed and the forearm is pronated, the tip of the clamp is advanced tenting the skin in the proximal posterolateral area of the forearm. A 4 cm skin incision is done, and the tuberosity is dissected (Figure 1B-C). A high-speed burr is used to create a defect in the tuberosity into which the tendon is then inserted and fixed with trans osseous sutures (Figure 1D-F).⁴ Thorough irrigation is used while working on the tuberosity.

Postoperative regimen: after surgery, patients are immobilized for two weeks with a posterior splint at 90° of elbow flexion and neutral forearm position. For prevention of heterotopic ossification formation, all patients are encouraged to take indomethacin 75 mg per day for two weeks as tolerated.^{18,19} Initial follow up visits are held at two, four, eight and 12 weeks. At two weeks, stiches and splint are removed. Patients are instructed for passive range of motion exercises, gravity assisted motion and gentle stretching with the other hand. Patients are encouraged to do passive stretching exercises which consisted of maximum flexion, extension, supination and pronation until discomfort followed by holding the discomfort position for 30 seconds. Two sets of exercises with 10 repetitions per day. At four weeks postop, free range active motion is allowed with a weight restriction of lifting nothing heavier than a cell phone or a cup of tea. Patients can use their hand actively for personal hygiene, dressing and feeding. Aerobic physical activity is limited to stationary bicycle to avoid any sudden muscle contracture and avoid a fall. Scapular posture and shoulder girdle range of motion is emphasized to avoid any shoulder pain and stiffness. At eight weeks, isometric shoulder girdle exercises are allowed and jogging or running. Patients are advised not to lift heavier objects than 2 kilograms at this point. At 12 weeks postop strengthening activities are progressed such as return to gym (weightlifting) and swimming if the patient was used to that activity prior to surgery. Patients are educated in avoiding abrupt eccentric contraction of the repaired tendon. Contact sports or racket playing sports involving the injured arm are delayed until six months postop. No patient is referred to physiotherapy.

Outcome assessment: clinical outcome was assessed based on return to normal activities and the following scores: Mayo Elbow Performance Score (MEPS), Disabilities of Arm Shoulder and Hand (DASH) scores and objective and subjective Andrews and Carson score at the latest follow up visit. Patients were asked if there was any difficulty in following postoperative protocol. Radiographic assessment was done with front and lateral view x-rays obtained at one-year follow-up for heterotopic bone formation according to Hastings' classification.²⁰ Descriptive statistics included absolute counts and percentages for categorical data and means and ranges for continuous data.

Results

Patient population: twenty-eight patients were screened for eligibility. After applying exclusion criteria 21

patients formed the basis of this study. Sixteen patients had postoperative x-rays at 12 months or later for heterotopic bone assessment. Demographic information is summarized in *Table 1*. The mean age at the time of surgery was 44 years (range, 21-64). Sixteen patients (76%) were age 50 or less. All patients were male. Eleven cases were right elbows (52%) and nine cases (43%) involved the non-dominant arm. Mean follow up time was 32 months (range 12 months to four years). Mean time between injury and surgery was nine days (range 3 to 18). Mean surgical tourniquet time was 58 minutes (range 47 to 67).

Outcomes: outcome score results are summarized in *Table 2*. Mean MEPS was 95 (range 70 to 100). Based on the MEPS, 16 patients had an excellent score; 4, good; and 1, fair. Mean DASH score was 0.4 (range 0 to 4.2). Mean objective and subjective Andrews and Carson score was 99 (range 95 to 100) giving all excellent results. Two patients developed minimal radiographic heterotopic ossification (HO) at the biceps tuberosity, with no resultant loss of elbow or forearm rotation (Hastings class I). All patients were back to their previous work related activities without any restrictions by three months postop (*Figure 2*). No patient had any problems or difficulty in following postoperative instructions.

There was one complication (no further surgical treatment required) related to the surgical procedure. One patient had a transient lateral antebrachial cutaneous nerve dysesthesia for two months which resolved spontaneously.

Discussion

Multiple repair techniques and postoperative protocols are described for distal biceps tendon injuries. There are overall good to excellent outcomes for any technique applied properly. Whenever there are several techniques with the same outcome available, it is our preference to use the least expensive one. In our medical setting, transosseous suture fixation does not generate any added cost to the patient (in contrast to using fixation devices). Nonetheless, transosseous suture fixation requires a bigger working space than fixation with most devices, thus requiring a double incision. The posterolateral approach provides direct exposure to the biceps tuberosity allowing for a comfortable and anatomic transosseous fixation. The main downside of the double incision technique is the increased risk of HO as opposed to a single anterior approach with risk of forearm synostosis. In our series we had 12.5% of our patients presented with minimal and asymptomatic HO.

Epidemiological data in our study is similar to the rest of the published papers on distal biceps tendon ruptures.¹¹ Average age of injury is usually between 40 and 50 years after a forceful eccentric extension of a flexed elbow. This age group involves healthy and active patients which are eager to recover strength and endurance. Surgery in this setting is recommended. Interestingly, hand dominance is not a predictor of injury as in most cases, 50% of the injured side is the dominant one. This pathology is almost exclusive for male patients. Reports of distal biceps tendon tears in women are extremely rare where age and mechanism of injury is different to that of men.²¹

All patients studied in this series returned to their daily activities with no restrictions as prior to injury. No patient required referral to physical therapy, and they all found the postoperative regimen easy and simple to follow. One of the greatest features of this postoperative approach is that it is low cost and efficient. There is no orthotics (except for the postoperative splint) nor referrals required. Patients go along as symptoms allow with limited and clear restrictions such as passive motion and stretching from week two till week 12.

There are limited studies that outline a specific postoperative program. Most are variable and some use repair specific physical therapy. Logan CA and colleagues¹² presented a detailed rehabilitation protocol following distal biceps repair. This rehabilitation program progresses through phases with objective criterion requirements in a stepwise fashion. Though useful and effective, it requires a treating therapist supervision and protective brace. Is referral to a physical therapist necessary? Spencer EE and colleagues¹⁵ presented a retrospective review comparing patients with supervised therapy and unsupervised therapy after two weeks of splinting for distal biceps repair using a button device fixation technique. The final outcome was the same but there was a significant difference favoring full range of motion more rapidly in the unsupervised. If the

Table 2: Outcomes.

Case	DASH	Anderson			
		Subjective	Objective	MEPS	HO
1	0	100	100	100	0
2	0	100	100	100	I
3	0	100	100	100	0
4	0.8	95	100	85	0
5	0	100	100	100	0
6	0	100	100	100	0
7	0	100	100	100	0
8	0	100	100	100	0
9	0	100	100	100	0
10	4.2	95	100	70	0
11	0	100	95	100	0
12	0.8	95	100	100	UN
13	0	100	100	100	0
14	0	100	100	100	0
15	0	100	100	100	I
16	1.7	95	100	85	0
17	0	100	100	100	0
18	0	95	95	85	UN
19	0	100	100	100	UN
20	0	100	100	100	UN
21	0.8	95	95	85	UN

DASH = Disabilities of Arm Shoulder and Hand; MEPS = Mayo Elbow Performance Score; HO = Heterotopic Ossification (Hastings classification); UN = Unavailable data.



Figure 2: Six weeks postoperative range of motion and cosmetic skin incisions.

patient is engaged in high performance sports activity, he/she might benefit from physical therapy to maintain the rest of the body in shape. But the operated elbow itself in our opinion, can be self-rehabilitated if the patient is compliant and follows instruction.

Recommended time to start motion after surgery varies from surgeon to surgeon. There is published data on immediate elbow mobilization. Smith JR¹³ reported on 22 distal biceps tendon repairs using an anterior single incision and cortical button system fixation. Immediately after surgery, patients were encouraged to engage in active flexion/extension and pronosupination of the elbow and referred to physiotherapy. There were no wound complications or fixation failures. Grewal R and his team¹⁴ presented a randomized clinical trial of patients treated with single and double incision technique. They also encouraged motion within the first few days postoperatively, but with an extension limit depending on the intraoperative tension at the tendon repair and a resting splint for six weeks.

It is our preference to protect patients in a splint for two weeks rather than letting them move immediately. The rationale behind this is, is so that: 1) postoperative pain is kept to a minimal. Patients are comfortable during soft tissue healing and confident when the motion phase starts. 2) By starting with a short period of immobilization, patients are also aware that recovery consists of a series of phases and time instances that must be respected. Tendon re-rupture rates range from 0.04% to 5%.^{8,9,14,22} Although re-rupture rates are low, they tend to occur during early phases of rehabilitation so patients must be counseled to take care and comply with restrictions.¹¹

There are limitations to our study. Several patients were lost to follow up which is a risk factor for sample bias. There is a low number of cases and the analysis of

our data is retrospective. It is our personal experience that after three months follow up, patients feel well, are back to daily activities and are less likely to come back for follow up visits. Nevertheless, our patient population data and final outcomes are similar to those of larger published series, so we feel comfortable in drawing conclusions from our study series of patients.

Conclusions

Patients treated for a distal biceps tendon tear using a double incision technique and transosseous suture fixation can undergo a home rehabilitation protocol. It is safe and easy to follow, although it requires compromise. Patient must understand and comply with restrictions and the treating surgeon must be able to have a one-on-one chat with the patient and reassure understanding. Follow up visits at two, four, eight and 12 weeks are required with no braces or physical therapist intervention.

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