



RBO

REVISTA BRASILEIRA DE ORTOPEDIA

www.rbo.org.br



Original Article

Functional evaluation of patients with injury of the distal insertion of the biceps brachii muscle treated surgically^{☆,☆☆}



Alberto Naoki Miyazaki, Marcelo Fregoneze, Pedro Doneux Santos, Luciana Andrade da Silva*, Guilherme do Val Sella, Denis Cabral Duarte, Sergio Luiz Checchia

Department of Orthopedics and Traumatology, School of Medical Sciences, Santa Casa de São Paulo, São Paulo, SP, Brazil

ARTICLE INFO

Article history:

Received 11 January 2013

Accepted 20 May 2013

Available online 27 March 2014

Keywords:

Elbow/surgery

Elbow/injuries

Treatment outcome

ABSTRACT

Objective: to functionally evaluate patients with injury of the distal insertion of the biceps brachii muscle that was treated surgically.

Methods: between April 2002 and June 2011, 15 elbows of 14 patients underwent surgical treatment performed by the Shoulder and Elbow Surgery Group, Department of Orthopedics and Traumatology, School of Medical Sciences, Santa Casa de São Paulo. The minimum follow-up was six months, with a mean of 28 months. The patients' ages ranged from 28 to 62 years, with a mean age of 40 years. All the patients were male and the dominant arm was affected in 64.2%. The clinical evaluation on the results was conducted using the criteria of the American Medical Association (AMA), as modified by Bruce, with evaluation of the joint range of motion (flexion–extension and pronosupination), the presence of pain and the patient's degree of satisfaction.

Results: from the AMA criteria, as modified by Bruce, we obtained 100% satisfactory results, of which 85.7% were considered to be excellent and 14.3% good. We observed that when distal injuries of the biceps brachii muscle affected young and active patients, surgical treatment was a good option.

© 2014 Sociedade Brasileira de Ortopedia e Traumatologia. Published by Elsevier Editora Ltda. All rights reserved.

Avaliação funcional dos pacientes com lesão da inserção distal do músculo bíceps braquial tratados cirurgicamente

RESUMO

Objetivo: avaliar funcionalmente os pacientes com lesão da inserção distal do músculo bíceps braquial tratados cirurgicamente.

Palavras-chave:

Cotovelo/cirurgia

[☆] Please cite this article as: Miyazaki AN, Fregoneze M, Santos PD, Silva LA, Val Sella G, Duarte DC, Checchia SL. Avaliação funcional dos pacientes com lesão da inserção distal do músculo bíceps braquial tratados cirurgicamente. Rev Bras Ortop. 2014;49:129-133.

^{☆☆} Work performed in the Shoulder and Elbow Group, Department of Orthopedics and Traumatology, School of Medical Sciences, Santa Casa de São Paulo, Fernandinho Simonsen Wing, São Paulo, SP, Brazil.

* Corresponding author.

E-mail: ombro@ombro.med.br, lucalu@terra.com.br (L.A. da Silva).

2255-4971/\$ – see front matter © 2014 Sociedade Brasileira de Ortopedia e Traumatologia. Published by Elsevier Editora Ltda. All rights reserved. <http://dx.doi.org/10.1016/j.rboe.2014.03.015>

Cotovelo/lesões
Resultado de tratamento

Métodos: entre abril de 2002 e junho de 2011, 15 cotovelos de 14 pacientes foram submetidos a tratamento cirúrgico pelo Grupo de Cirurgia de Ombro e Cotovelo do Departamento de Ortopedia e Traumatologia da Faculdade de Ciências Médicas da Santa Casa de São Paulo. O seguimento mínimo foi de seis meses, com média de 28. A idade variou de 28 a 62 anos, com média de 40. Todos os pacientes eram do sexo masculino e o membro dominante foi acometido em 64,2%. A avaliação clínica dos resultados foi feita pelos critérios da American Medical Association (AMA), modificados por Bruce, pelo grau de amplitude articular (flexoextensão e pronossupinação), pela presença de dor e pelo grau de satisfação do paciente.

Resultados: pelos critérios da AMA, modificados por Bruce, obtivemos 100% de resultados satisfatórios, 85,7% considerados excelentes e 14,3% bons. Observamos que quando as lesões distais do músculo bíceps braquiais acometem pacientes jovens e ativos, o tratamento cirúrgico é uma boa opção.

© 2014 Sociedade Brasileira de Ortopedia e Traumatologia. Publicado por Elsevier Editora Ltda. Todos os direitos reservados.

Introduction

Traumatic injuries of the distal insertion of the tendon of the biceps brachii muscle (TBBM) are uncommon¹ and an incidence of 1.24 cases per 100,000 inhabitants has been reported.² If the biceps brachii muscle is considered in its entirety, only 3% if its injuries affect the distal portion and 1% the short head, while the great majority (96%) affect the long head.³

Tearing of the TBBM is attributed to degeneration, hypovascularization and/or friction on the tendon.^{4,5} Morrey suggested that inflammation of the deep radial bursa could contribute toward tendon degeneration,⁶ and also that bone irregularities at the tuberosity of the radius could cause rubbing in the distal portion of the TBBM, thereby contributing toward tearing it.⁵ This region has a hypovascular zone and a zone of fibrocartilaginous tissue that, on average, is located 2.14 cm from the distal region.⁷

Smokers present greater predisposition toward tendon avulsion,² along with athletes who used anabolic steroids.^{8,9}

It generally occurs in men between their fourth and sixth decades of life.^{7,10} The commonest injury mechanism is abrupt flexion of the elbow against resistance, with the forearm in supination.⁷ Patients usually report that there was an audible sound of something snapping and palpable retraction of the biceps tendon.¹ The initial symptoms are pain, edema, ecchymosis, changes to the relief of the arm (Fig. 1) and diminished elbow supination and flexion strength.¹¹ If there is still any doubt about the diagnosis, ultrasonography (US) and/or magnetic resonance imaging (MRI) are the preferred examinations.¹²

In the literature, several different types of conservative and/or surgical treatment have been reported, and there is still much controversy with regard to which treatment option is best.⁷ Patients who are treated conservatively present strength and function deficits in various activities.⁷ Surgical treatment by means of a single extended route or a double route has shown the best results, but complications often occur.^{3,7,10}

The aim of the present study was to evaluate the clinical and functional results from patients with traumatic injuries of the distal insertion of the TBBM who were treated surgically.



Fig. 1 – Clinical image showing tearing of the distal tendon of the biceps (arrow).

Sample and methods

Between April 2002 and June 2011, the Shoulder and Elbow Group of the Department of Orthopedics and Traumatology of Santa Casa de Misericórdia de São Paulo, Fernandinho Simonsen Wing, operated on 15 elbows of 14 patients with injuries to the distal insertion of the TBBM. The inclusion criteria were that all the patients needed to be adults who underwent surgical treatment for reinsertion of the TBBM and who had been followed up for at least six months after the operation. Patients whose follow-up had been less than this duration were excluded. Thus, the reevaluations were conducted on 14 elbows of 13 patients (Table 1).

All the patients were male, with a mean age of 40 years and a range from 28 to 62. The dominant limb was affected in nine cases (64.2%) (Table 1). Regarding the trauma mechanism, all the patients reported that their elbow had been flexed and that they had been exerting force against resistance. Their forearm had then been subjected to abrupt extension as the trauma mechanism.

All the patients underwent radiography on the injured elbow (frontal and lateral views); ten (71.4%) underwent MRI on the elbow (Fig. 2); and four (28.6%) underwent ultrasonography on the elbow, for diagnostic confirmation.

Table 1 – Epidemiological data on patients with distal injury of the tendon of the biceps brachii muscle.

	Initials	Age (years)	Sex	Dominant limb
1	PTP	50	M	+
2	CMA	32	M	
3	FE	34	M	+
4	ETJ	56	M	+
5	CM	33	M	
6	CM	34	M	+
7	ECIPR	28	M	+
8	DN	32	M	+
9	ACGS	51	M	
10	CO CJ	45	M	+
11	AOM	39	M	
12	GAG	38	M	+
13	MVS	34	M	+
14	GION	62	M	

Source: Hospital medical files.

The mean length of time between the date of the trauma and the surgery was 17 days, with a range from six to 120. All the patients underwent their operations in the horizontal dorsal decubitus position, with the affected limb supported on a hand access table. A double access route was used in 12 cases (85.7%) (Fig. 3) and an extended anterior route in two cases (14.3%) (Table 2).

Elbow mobility was measured by means of goniometry, using the parameters of the American Academy of Orthopaedic Surgeons (AAOS).¹³ The length of the postoperative follow-up ranged from six to 98 months (mean of



Fig. 2 – MRI of the elbow (sagittal slice), showing tear (arrow) with retraction of the insertion of the tendon of the biceps muscle.

28 months). The patients were evaluated with regard to the degree of joint range of motion (flexion–extension and pronosupination), presence of pain and degree of satisfaction. All the patients were reassessed six months later using the criteria of the American Medical Association (AMA), as modified by Bruce et al.¹⁴ Radiographs produced at this late postoperative stage were used to evaluate the presence of heterotopic ossification and/or proximal radioulnar synostosis.

The present study was initially submitted for appraisal by the hospital's research ethics committee and was approved.

Results

All the patients were satisfied with the treatment. Twelve cases (85.7%) were considered to present excellent results and two (14.3%) were considered to be good, according to the criteria of the AMA, as modified by Bruce et al.¹⁴ None of the patients reported having any pain and all of them returned to their normal daily activities.

The joint range of motion remained unchanged in comparison with that of the unaffected limb, and no clinical changes to muscle strength were observed. There was no clinical or radiographic evidence of heterotopic ossification or radioulnar synostosis after six months of evolution.

Complications occurred in five cases (35.7%). In case 1, during the operation, there was an iatrogenic injury to the brachial artery and an intervention by the vascular surgery team became necessary, in which an end-to-end repair was performed using an inverted saphenous vein graft. The patient evolved with a good result. In case 2, the injury to the distal tendon of the biceps had occurred 120 days earlier and it was necessary to use a graft from the ipsilateral long palmar tendon. This patient presented partial injury of the lateral cutaneous nerve of the forearm and evolved with paresthesia on the lateral face of the forearm, which improved over the course of the follow-up. In case 5, the patient evolved with a large hematoma in the immediate postoperative period, with the need for drainage, which did not interfere with the final result. In case 12, the patient evolved with a small skin adherence in the surgical wound. In case 14, the patient presented transitory paresthesia of the medial cutaneous nerve of the forearm (Table 2).

Discussion

It is known that distal injuries of the TBBM are uncommon.^{1,2} The average number of such cases seen at our service is 1.6 cases per year, and this is concordant with the literature.^{1,2,4,7,10,15} This injury is also observed predominantly in males, who formed 100% of our sample.^{1,2,4,7,10,15} These injuries generally occur between the fourth and sixth decades of life.^{1,2,4,7,10,15} The mean age in our study was 40 years, with a range from 28 to 62.

The trauma mechanism most commonly reported has been abrupt flexion of the elbow against resistance, with the forearm in supination.⁷ This mechanism of eccentric force was observed in all the patients treated by our group. Although use of anabolic steroids has been associated with avulsion of the TBBM,^{8,9} none of our patients reported using them.

Table 2 – Treatment data on patients with distal injury of the tendon of the biceps brachii muscle.

	Initial	ΔT (days)	Surgery	Access route	Complications
1	PTP	15	PT	D	Brachial artery injury
2	CMA	120	PT + PL	D	Partial lateral cutaneous nerve injury
3	FE	15	PT	A	
4	ETJ	8	PT	D	
5	CM	7	PT	D	Hematoma
6	CM	8	PT	D	
7	ECIPR	14	PT	D	
8	DN	7	PT	A	
9	ACGS	9	PT	D	
10	COCJ	10	PT	D	
11	AOM	8	PT	D	
12	GAG	7	PT	D	Skin adherence
13	MVS	6	PT	D	
14	GION	14	PT	D	Paresthesia of medial cutaneous nerve

Source: Hospital medical files.

Legend: D, double access; A, extended anterior access.

The biceps brachii muscle functions as an important flexor of the elbow and is the main supinator of the forearm. Surgical repair should be indicated mainly in cases of young patients, manual workers and athletes, especially when the dominant side is affected.^{3,9} In 1985, Morrey et al.¹⁶ found through isometric tests on three patients who had been treated conservatively that they had lost 31% of their flexion strength and 40% of their supination strength, whereas

six patients who had been treated surgically presented losses of 6% of flexion strength and 19% of supination strength. Our sample did not present any losses of flexion and supination strength. However, we used subjective criteria based on information from the patients and the evaluations were performed by means of manual measurements, without a dynamometer, which can be considered to be a deficiency of this study.



Fig. 3 – Surgical technique: (a) longitudinal anteromedial incision in the distal third of the arm, with the tendon of the biceps brachii muscle repaired (arrow); (b) incision “from inside to outside” made in the tuberosity of the biceps (arrow); (c) preparation of the bone bed for reinsertion of the tendon using transosseous stitches, in the tuberosity of the biceps (arrow); (d) passage of repaired tendon from the proximal incision to the distal incision; (e) final clinical image of the suture in the forearm.

Anatomical repair of the distal insertion of the TBBM has now become the preferred procedure for traumatic injuries, particularly because good results have been reported in the great majority of studies with regard to restoration of supination and flexion, and this was also our experience.

The various techniques that were developed over the years were directed toward reducing the complications associated with repairs. Historically, surgical treatment for the distal insertion of the TBBM started by means of a single extended anterior incision. However, some cases of injury to the posterior interosseous nerve have been reported.^{17,18} In our sample, we made an extended anterior access route in two cases and did not have any neurological injuries. Our two cases of neurological injuries (8.3%) affected the lateral and medial cutaneous nerves of the forearm and occurred when we used a double access.

The double access route technique was described by Boyd and Anderson¹⁸ in 1961. Although it presents favorable results, it evolves with heterotopic ossification and proximal radioulnar synostosis as complications in some cases. In 1990, Failla et al.¹⁹ reported on four cases of radioulnar synostosis, of which only two recovered movement after the resection. In 1985, Morrey et al.¹⁶ modified this technique by dividing the dorsal musculature and avoiding subperiosteal dissection of the ulna along the interosseous membrane to the radial tuberosity. These modifications led to diminution of the rates of heterotopic bone formation and synostosis. Over the last few years, several techniques and various fixation methods have been described. However, there is still no consensus regarding the best route and the best technique to use in these cases. We used the double access technique described by Boyd and Anderson, as modified by Morrey et al.,¹⁶ in 12 cases and did not observe any proximal radioulnar synostosis or heterotopic ossification in our sample.

During the 1990s, with the development of suture anchors, the anterior single incision via Henry's access route was reintroduced.^{3,10} In 2000, Bain et al.²⁰ published a technique using *Endobutton* for fixation of the tendon of the biceps at the tuberosity of the radius and showed favorable results. In 2009, Fenton et al.¹ published a technique using fixation with biotenodesis screws and Gregory et al.¹⁵ described fixation using anchors under endoscopic viewing.

In 2007, Mazzoca et al.¹⁷ conducted a biomechanical study in which they compared four techniques for distal biceps repair. *Endobutton* showed better results than suture anchors, transosseous stitches or interference screws. Nonetheless, we chose to use transosseous stitches in all of our patients, without loss of fixation in any case.

Conclusions

We observed that surgical treatment is a good option for distal injuries of the TBBM when young and active patients are affected, since we found that 85.7% of the results were excellent and 14.3% were good.

Conflicts of interest

The authors declare no conflicts of interest.

REFERENCES

1. Fenton P, Qureshi F, Ali A, Potter D. Distal biceps tendon rupture: a new repair technique in 14 patients using the biotenodesis screw. *Am J Sports Med.* 2009;37(10):2009-15.
2. Safran MR, Graham SM. Distal biceps tendon ruptures: incidence, demographics, and the effect of smoking. *Clin Orthop Relat Res.* 2002;(404):275-83.
3. Lintner S, Fischer T. Repair of the distal biceps tendon using suture anchors and an anterior approach. *Clin Orthop Relat Res.* 1996;(322):116-9.
4. Peeters T, Ching-Soon NG, Jansen N, Sneyers C, Declercq G, Verstreken F. Functional outcome after repair of distal biceps tendon ruptures using the endobutton technique. *J Shoulder Elbow Surg.* 2009;18(2):283-7.
5. Seiler 3rd JG, Parker LM, Chamberland PD, Sherbourne GM, Carpenter WA. The distal biceps tendon. Two potential mechanisms involved in its rupture: arterial supply and mechanical impingement. *J Shoulder Elbow Surg.* 1995;4(3):149-56.
6. Morrey BF. *The elbow and its disorders.* 2nd ed. Philadelphia: Saunders; 1993.
7. Chillemi C, Marinelli M, De Cupis V. Rupture of the distal biceps brachii tendon: conservative treatment versus anatomic reinsertion - clinical and radiological evaluation after 2 years. *Arch Orthop Trauma Surg.* 2007;127(8):705-8.
8. Visuri T, Lindholm H. Bilateral distal biceps tendon avulsions with use of anabolic steroids. *Med Sci Sports Exerc.* 1994;26(8):941-4.
9. D'Alessandro DF, Shields Jr CL, Tibone JE, Chandler RW. Repair of distal biceps tendon ruptures in athletes. *Am J Sports Med.* 1993;21(1):114-9.
10. Chakkour I, Lopes EI, Gomes MD, Filho JDL, Costa AC, Fernandes MS. Lesão do tendão distal do músculo bíceps braquial: tratamento com o uso de âncoras ósseas. *Rev Bras Ortop.* 1998;33(3):195-8.
11. Louis DS, Hankin FM, Eckenrode JF, Smith PA, Wojtys EM. Distal biceps brachii tendon avulsion. A simplified method of operative repair. *Am J Sports Med.* 1986;14(3):234-6.
12. Weiss C, Mittelmeier M, Gruber G. Do we need MR images for diagnosing tendon ruptures of the distal biceps brachii? The value of ultrasonographic imaging. *Ultraschall Med.* 2000;21(6):284-6.
13. American Academy of Orthopaedics Surgeons: *Joint Motion. Method of measuring and recording.* Chicago: AAOS; 1965.
14. Bruce HE, Harvey JP, Wilson Jr JC. Monteggia fractures. *J Bone Joint Surg Am.* 1974;56(8):1563-76.
15. Gregory T, Roure P, Fontès D. Repair of distal biceps tendon rupture using a suture anchor: description of a new endoscopic procedure. *Am J Sports Med.* 2009;37(3):506-11.
16. Morrey BF, Askew LJ, An KN, Dobyns JH. Rupture of the distal tendon of the biceps brachii. A biomechanical study. *J Bone Joint Surg Am.* 1985;67(3):418-21.
17. Mazzocca AD, Burton KJ, Romeo AA, Santangelo S, Adams DA, Arciero RA. Biomechanical evaluation of 4 techniques of distal biceps brachii tendon repair. *Am J Sports Med.* 2007;35(2):252-8.
18. Boyd JB, Anderson LD. A method for the reinsertion of the distal biceps brachii tendon. *J Bone Joint Surg Am.* 1961;43:1041-113.
19. Failla JM, Amadio PC, Morrey BF, Beckenbaugh RD. Proximal radioulnar synostosis after repair of distal biceps brachii rupture by the two-incision technique. Report of four cases. *Clin Orthop Relat Res.* 1990;(253):133-6.
20. Bain GI, Prem H, Heptinstall RJ, Verhellen R, Paix D. Repair of distal biceps tendon rupture: a new technique using the *Endobutton*. *J Shoulder Elbow Surg.* 2000;9(2):120-6.