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The results of primary repair after distal biceps tendon rupture

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Objective: The aim of the study was to present the long term results of primary tenodesis in the treatment of distal biceps tendon rupture.

Methods: Patients previously treated for distal tendon rupture were evaluated. In all cases anatomical reattachment with a single-incision through the anterior approach was performed with either a screw and washer (modified McReynolds technique) or a Mitek Anchor. Analysis was performed using clinical and radiological examination and DASH score at the end of 2011.

Results: Twenty-one patients (21 males; mean age: 47.5 years) were treated for distal biceps tendon rupture. Fixation was performed using the modified McReynolds technique in 11 and Mitek Anchor in 10 patients. The McReynold technique had excellent result in 63.6% of patients, a 9.1% risk of implant failure and a mean DASH score of 7.8. The Mitek Anchor technique had excellent result in 60% of patients, a 10% risk of implant failure and a mean DASH score of 7.4.

Conclusion: Operative treatment for distal biceps tendon rupture appears to be a safe and effective method and consistently yields good results.

Key words: Anatomical reattachment; distal biceps tendon rupture; single incision.

Distal biceps tendon rupture is a rare injury, first described by Acquaviva.[1] This injury represents approximately 3% of all tendon ruptures of the musculus biceps brachii, 96% of which are ruptures of the long head and 1% of the short head.[2] The biceps brachii tendon functions as an important elbow flexor and is the principal forearm supinator. When rupture of the distal tendon occurs, elbow flexion is still possible due to the intact musculus brachialis and musculus brachioradialis.

In line with our experience and the literature we prefer operative treatment in patients with a distal biceps tendon rupture.[3,4] We have started with the McReynolds method, modified it by adding a washer, and are currently employing the anchors.[5] The aim of this study was to present the results of surgical repair in patients with a distal biceps tendon rupture.

Patients and methods

This study was reviewed by the hospital's ethics committee and performed in accordance with the Declaration of Helsinki. All patients gave their informed consent prior to inclusion in the study.

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The study group consisted of 21 patients with a distal biceps tendon rupture who were treated with primary tendon reattachment between 1987 and 2007.

Diagnosis of biceps tendon rupture was made using history, physical examination and confirmed with ultrasonography in 5 patients and MRI in 2 patients. Injury was caused due to lifting of a heavy weight as stated by 11 patients. Eight patients described a forcible extension of a flexed elbow while attempting to break a fall from a tree or ladder. The exact mechanism of injury was unknown in 2 patients.

During physical examination, all patients demonstrated muscle deformity with the tendon palpable in the antecubital fossa, weakness of elbow flexion and forearm supination, and an abnormal hook test. We have been using this test in our department since the late 80s, and it was later described as the hook test.[6]

We advised surgical treatment in patients under 70 years of age and with a definitive diagnosis of distal biceps tendon rupture. In patients who accepted surgical treatment, we performed surgery as soon as possible, on an average time of 2.5 (range: 0 to 16) days after the injury.

Patients were operated under general anesthesia, in a supine position without a tourniquet. The injured extremity was placed on a side table. We used single-incision anterior approach to the elbow (extended Henry approach to the fossa cubitalis). With extra care to preserve the cubital veins, we were able to find the ruptured tendon and accompanying haematoma. We did not identify nervus cutaneus antebrachii lateralis and nervus radialis during the exposure. In all cases the tendon was not torn but more likely separated from its bony attachment.

We applied modified McReynolds method, using a washer with the screw for tendon reattachment, from 1987 till 2002. We were able to feel the area of the tuberositas radii as a small bump, where we placed a small tunnel. We prepared the area of original biceps tendon attachment at full supination. We freshened the ruptured tendon end and sutured it, approximated it to the tuberositas radii with the elbow flexed. Following drilling, we fixed the tendon to the bone with cortical screw of 4.5 or 3.5 mm in diameter, 14 to 18 mm of length with a washer (Medin a.s., Nové Město na Moravě, Czech Republic). After closing the operative wound we applied cast fixation with the elbow flexed and the forearm supinated.

After 2002 we started using anchors ((Mitek Anchors, DePuy Mitek, Inc., Raynham, MA, USA)) instead of screws. We have also modified postoperative care by changing cast fixation with shoulder and arm sling. We kept the sling for 4-5 weeks. Rehabilitation was started with passive then active exercises and patients were permitted application of heavier loads to the operated extremity 8 to 10 weeks after injury.

Clinical and radiological follow-up was performed at the 2nd and 6th postoperative weeks and the 3rd, 6th and 12th postoperative months. X-rays were checked for implant position and heterotopic ossification formation. In 5 patients operated with the modified McReynolds method, the implants were extracted on average 11 (range: 4-21) months after the operation due to pain, heterotopic ossification or patient desire.

We evaluated muscle strength based on Janda muscle test, compared elbow extension–flexion and pro-supination with the injured side and recorded the complications.[7,8] Until the end of 2011, we performed clinical examination in all 21 patients and recorded the DASH scores. We graded the outcomes as follows: excellent as a full return to work and sports with no pain; good as a full return to activities with some pain or discomfort on maximal exertion, and poor as being symptomatic during activities of daily living.

Results

Our study included 21 patients. All patients were male and had an average age of 47.5 (range: 28 to 69) years at the time of injury. The mean follow-up was 10 (range: 4 to 23) years. All injuries were one-sided. The right upper extremity was affected in 14 (13 dominant and 1 non-dominant) cases and the left in 7 (7 non-dominant); we have never recorded the injury of the left biceps of a left-handed person. Patients individually stated that 14 of them were highly physically active before the injury (Table 1).

Patients were diagnosed on average 0.9 (range: 0 to 6) days after the injury. The average hospitalization time was 4.6 (range: 2 to 16) days. We conducted operative treatment by modified McReynolds method from 1987 to 2002 a total of 11 times. We used Mitek Anchors in 10 patients. A single-incision anterior approach was used in all cases.

One patient experienced bleeding due to iatrogenic injury of the cubital artery and was treated by a vascular surgeon. An additional patient had difficult tendon preparation due to persistent fibroproductive changes of a rupture treated on the 16th day. Despite this, the tendon was not retracted and mobilization was possible. The use of other reconstruction techniques or allograft was not necessary.

One patient experienced superficial skin necrosis that was conservatively treated. Three patients had neurolog-

Table 1. Summary of patients, their activity before the injury, diagnostics, operation technique and follow-ups.

Case no.	Age	Side	Physical activity before injury	Diagnostics	Operation technique	Follow-up in years (until the end of 2011)
1	60	L	Heavy manual worker	Physical examination	Modified McReynolds	23
2	43	R	Farmer	Physical examination	Modified McReynolds	19
3	49	R	Medium active	Physical examination	Modified McReynolds	17
4	47	R	Medium active	Physical examination / ultrasonography	Modified McReynolds	14
5	39	R	Heavy manual worker	Physical examination	Modified McReynolds	13
6	50	L	Heavy manual worker	Physical examination	Modified McReynolds	12
7	28	R	Bodybuilder	Physical examination	Modified McReynolds	10
8	69	R	Heavy manual worker	Physical examination / ultrasonography	Modified McReynolds	10
9	44	R	Medium active	Physical examination	Modified McReynolds	10
10	44	L	Medium active	Physical examination / ultrasonography	Modified McReynolds	9
11	51	R	Farmer	Physical examination	Modified McReynolds	9
12	40	L	Heavy manual worker	Physical examination	Mitek anchors	9
13	47	L	Medium active	Physical examination / ultrasonography	Mitek anchors	9
14	37	L	Bodybuilder	Physical examination	Mitek anchors	8
15	47	R	Medium active	Physical examination / ultrasonography	Mitek anchors	8
16	44	L	Farmer	Physical examination	Mitek anchors	7
17	67	R	Farmer	Physical examination	Mitek anchors	7
18	45	R	Bodybuilder	Physical examination / MRI	Mitek anchors	6
19	52	R	Heavy manual worker	Physical examination	Mitek anchors	5
20	48	R	Medium active	Physical examination / MRI	Mitek anchors	4
21	46	R	Heavy manual worker	Physical examination	Mitek anchors	4

ical complications confirmed by electrophysiological testing; 2 with paraesthesia of the ramus dorsalis nervi radialis and 1 with paraesthesia of the nervus cutaneus antebrachii lateralis. In these patients, paraesthesia improved after 2 weeks to 3 months and no permanent disability such as touch sensitivity or peripheral paraesthesia remained. Implant failure occurred once in each group; the first a loosening screw 7 years after the operation accompanied by heterotopic ossification (Fig. 1), and the second during surgery in which two suture anchors failed (released from the bone) and a third had to be used for tendon fixation (Figs. 2 and 3). Clinical evaluation method showed muscle strength limitation in 8 patients (corresponding to the 4th degree of Janda muscle testing). We noted further complications in this group (Table 2).

Modified McReynolds technique provided excellent result in 7 patients (63.6%). Three patients in this group suffered early complications: transient nervus cutaneus antebrachii lateralis, ramus dorsalis nervi radialis paraesthesia and cubital artery injury, but all recovered fully at the time of final follow-up.

Other 3 patients (27.3%) were also satisfied with their results and had a good outcome, but they had some stiffness and weakness about the elbow joint and one of these 3 patients had heterotopic ossification.

One patient (9.1%) with implant failure was not satisfied with the result and had a poor outcome with heterotopic ossification, limited forearm rotations and pain after exercising.

The average DASH score of the patients in the modified McReynolds group was 7.8 (range: 0 to 22).

Mitek Anchor technique had excellent result in 6 patients (60%). Two of them had early complications – transient ramus dorsalis nervi radialis paraesthesia

Fig. 1. Radiographs of a 54 years-old patient 7 years after surgery. While there was heterotopic ossification and implant failure with migration of the screw and the washer, the reattachment was secure.

and skin necrosis, but were fully recovered at the time of last follow-up.

Four patients (40%) had late complications but were still satisfied with their overall good outcome. In 2 patients in this group, had elbow stiffness and elbow weakness. In one patient with anchor failure there was heterotopic ossification and stiffness. In one patient, there was pain and elbow weakness. The average DASH score of the Mitek group was 7.4 (range: 0 to 14).

Discussion

The treatment of distal biceps tendon rupture is controversial. Primary operative treatment with tendon reattachment is recommended based on biomechanical and clinical studies. The majority of these ruptures occur in the dominant extremity of male patients between the ages of thirty and sixty years.[9] The increasing amount of sport activities performed by some active men (army forces) may predispose to distal biceps tendon rupture.[10] Safran and Graham projected an incidence of 1.2 distal biceps tendon ruptures per 100,000 patients per year with an average age of 47 years at the time of injury,[11] consistent with the average age of the patients in our study (47.5 years). Previously reported results of conservative treatment were not satisfactory with limitation of flexion and forearm rotation,[12] although some newer articles describe acceptable outcomes with modestly reduced strength and limitation of especially supination.[13]

Various techniques of operative treatment have been described. Notable among these are a two-incision technique described by Boyd and Anderson, and a single-incision technique with the screw fixation described by McReynolds.[14,15] The first author to describe biceps tendon repair using suture anchors was Verhaven.[16] Newer fixation methods in operative anatomical reinsertion techniques have been updated to include bioabsorbable interference screws, bio–tenodesis screws and endobuttons.[17]

We use history and physical examination for the diagnosis, and if necessary we use ultrasonography or MRI for confirmation. The reported time to surgery varies among studies. Our results and complications are similar to a study where the patients were operated within two weeks after the injury.[3] Grewal et al. described four re-ruptures and 19 neuropraxias of the lateral antebrachial cutaneous nerve in group of 47 patients treated with suture anchors through a single incision.[18] There were 3 transient paraesthesias and 3 heterotopic ossifications in our 21 patients, which, in our opinion, may be due to the surgical approach and dissection. No infection or re-rupture occurred. Khan et al. reported 1 transient radial nerve palsy and 1 case of heterotopic ossification in 17 patients, McKee et al. reported 2 transient paraesthesias of the lateral antebrachial cutaneous nerve, 1 transient posterior interosseous nerve palsy and 1 wound infection in 53 patients treated with suture anchor tendon fixation through a single anterior inci-

Fig. 2. Anteroposterior radiograph of 46 years-old patient. Despite the failure of the two anchors the third anchor was sufficient to hold the reattachment.

Fig. 3. Lateral radiograph of the patient in Figure 2. Two anchors appear to be failed during the healing of the tenodesis.

Table 2. Results and complications ot the two used techniques (cases No. 1 to 11 - modified McReynolds technique, cases 12 to 21 - Mitek Anchors).

Case no.	Range of motion (degrees) of injured and uninjured side	Extension / Flexion	Pronation / Supination	Janda muscle test (degree)	Complications	DASH	Result
1	0-130/0-130	80-80	80-80	5th	None	10	Excellent
2	0-135/0-135	85-80	85-80	5th	None	10	Excellent
3	0-130/0-130	80-80	80-80	5th	N. cutaneus antebrachii lateralis paraesthesia (transient)	8	Excellent
4	0-110/0-130	70-75	75-85	4th	Implant failure (loosening) heterotopic ossifications reccurent, movement and muscle strenght limitation, pain	22	Poor
5	0-115/0-135	80-85	85-90	4th	Movement, muscle strenght limitation	8	Good
6	0-140/0-140	90-90	90-90	5th	None	6	Excellent
7	0-115/0-135	75-80	80-85	4th	Heterotopic ossifications, pain, movement, muscle strenght limitation	8	Good
8	0-135/0-135	80-85	80-85	5th	Latrogenic injury of cubital artery	4	Excellent
9	0-130/0-130	80-80	80-80	5th	None	6	Excellent
10	0-140/0-140	80-90	80-90	5th	Ramus dorsalis n. radialis paraesthesia (transient)	0	Excellent
11	0-115/0-135	70-80	75-85	4th	Movement, muscle strenght limitation	4	Good
12	0-140/0-140	90-90	90-90	5th	None	8	Excellent
13	0-120/0-140	80-85	85-90	4th	Movement, muscle strenght limitation	8	Good
14	0-130/0-130	80-80	80-80	5th	Superficial skin necrosis	6	Excellent
15	0-140/0-140	80-85	80-85	5th	None	4	Excellent
16	0-135/0-135	80-80	80-80	4th	Implant failure (loosening) heterotopic ossifications, movement and muscle strenght limitation, pain	14	Good
17	0-140/0-140	85-85	85-85	5th	Ramus dorsalis n. radialis paraesthesia (transient)	6	Excellent
18	0-120/0-140	80-85	85-90	4th	Movement, muscle strenght limitation, pain	12	Good
19	0-135/0-135	80-85	80-85	5th	None	0	Excellent
20	0-115/0-135	75-80	80-85	4th	Movement, muscle strenght limitation	10	Good
21	0-140/0-140	90-90	90-90	5th	None	6	Excellent

sion.[19,20] We recorded a poor result in only one out of 21 patients. John et al. recorded excellent results in 46 and good result in 7 out of their group of 53 patients.[21] In the current study, 10 of the 11 patients treated with the modified McReynolds technique and all of the 10 patients treated with suture anchors had excellent and good results. Results and complications in our study were similar to the studies mentioned above.

Mean DASH score recorded in our groups were 7.8 and 7.4 for the McReynolds and suture anchor techniques respectively. One patient scored 22 due to an ipsilateral rotator cuff tear and pain with relapsing ossifications, movement limitation and loss of muscle strength. These results are comparable to those in the literature. Eardley et al. reported an average DASH score of 6.97 in 14 patients,[22] McKee et al. reported a DASH score of 8.2 in patients,[20] Cill et al. reported a DASH score 3.6 in 21 patients using the two-incision technique.[23] In a retrospective view Khan et al. report a DASH score 14.45.[19]

Our study has some strengths, including the length of follow-up (up to 23 years), the fact that no patient was lost to follow-up and that the two treatment groups were evenly matched and consisted of males only. However, weaknesses included limited patient numbers due to the rareness of the injury and lack of comparison of conservative treatment with operative results due to the inability to treat patients non-operatively.

In conclusion, operative treatment for distal biceps tendon rupture appears to be a safe and effective method and consistently yields good results. However, as with almost all injuries, treatment may need to be adjusted according to the individual needs of each patient.

Conflicts of Interest: No conflicts declared.

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