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Original article

Treatment of primary total distal biceps tendon rupture using cortical button, transosseus fixation and suture anchor: A single center experience☆

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A B S T R A C T

Introduction: There remains as of yet no consensus on the optimal treatment for total or partial distal biceps tendon repairs. As such, the purpose of this study was to assess functional outcome, the impact of complications and cost effectiveness, in patients undergoing primary distal biceps tendon repair by either cortical button (CB), transosseous suture (TO) or suture anchor (SA).

Hypothesis: There is no difference in functional outcome and cost effectiveness, in patients undergoing distal biceps tendon repair.

Material & methods: A retrospective analysis was performed on prospectively collected data from 47 consecutive patients treated for total or partial distal biceps tendon rupture. Functional outcome was assessed by the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire. Strength measurements (e.g., flexion, supination and pronation) in the operated and non-operated extremities were recorded with the use of a dynamometer. Furthermore, all complications, as well as their impact on functional outcome and costs for surgical intervention were evaluated.

Results: Minimum follow-up time was 35 weeks, average 46.3 ± 13.8 weeks. The overall DASH score was 7.9 ± 4.7. There were no differences in functional outcome (i.e., DASH score) between CB, TO, SA (p = 0.32), nor were there differences in regards to strength (supination, flexion and pronation) (p = 0.60) and ability to return to work & sports activity. The total complication rate was 21.6%. Complications had a significant impact on functional outcome (p = 0.003). Re-rupture occurred 2 times in the SA group. In 5 patients, revisional surgery had to be performed. The shortest operation times and the lowest material costs were observed in the TO group (p = 0.004).

Discussion: All reported fixation methods for total or partial distal biceps tendon rupture yielded good functional results. However, transosseous suture fixation for total distal biceps tendon rupture, performed through a double incision approach by an experienced surgeon, seems to be a simple, inexpensive and successful method, offering satisfying clinical results.

Level of evidence: IV, a retrospective, comparative study.

1. Introduction

Distal biceps tendon rupture occurs mainly in male patients in the fourth to sixth decade of life, with an incidence of about 1.2 per 100,000 inhabitants per year [1,2]. Mechanisms of injury include the lifting of heavy weights (e.g., manual labor, strenuous sports), or in certain cases, an unexpected fall with a subsequent extension of the actively flexed elbow [1,3,4]. A long history of smoking, as well as a history of steroid abuse have been identified as main risk factors for distal biceps tendon rupture [1–5]. Diagnosis is confirmed either by sonography or, in certain cases, by MRI scans [6,7]. Surgical anatomic repair has proven superior to non-operative treatment – as the latter of which leads to loss of degree of supination and elbow flexion strength [8]. Surgery is performed using either a one- or two-incision approach, as well as an endoscopic technique [3,8,9]. Multiple fixation methods for distal biceps tendon repair have been developed, which include suture anchors, cortical buttons, bone transosseous suture repair technique and interference

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Table 1
Functional outcome of different treatment methods for distal biceps tendon rupture.

	TO	CB	SA
Number	17	11	19
Age (years)	43.9	49.2	45.9
Sex	17 m	11 m	19 m
Follow up (weeks)	47.6 ± 14.1	45.1 ± 10.1	46.2 ± 12.7
Dominant arm	13	7	14
Trauma mechanism			
Fall	1	3	
Lifting heavy weight	14	7	11
Gym	1	1	3
Arm wrestling	1	1	1
Leisure sports			2
MOVA			2
Imaging			
MRI	2	4	4
Ultrasound	15	7	15

screws [3,8,10]. To date, none of them have proven their superiority over the others and recent literature still offers no consensus on the optimal fixation method for distal biceps tendon rupture in active patients [4,8,10,11]. Therefore, the purpose of this study was to assess the functional outcome, impact of complications and cost effectiveness in patients undergoing primary distal biceps tendon repair via either cortical button, bone tunnel or suture anchor.

Hypothesis. There is no difference in functional outcome and cost effectiveness, in patients undergoing distal biceps tendon repair.

2. Material & methods

A retrospective comparative analysis was performed on prospectively collected data from 47 consecutive patients treated for total or partial distal biceps tendon rupture. All patients were treated between 2004 and 2014 at our Level I trauma center, with an average age at time of surgery was 45.7 ± 8.9 years. All patients were male. In 72.3% of the patients, the dominant arm was affected. In 26 patients, the right arm was affected and in 21 patients, the left arm was affected. Two patients had to be excluded from the study due to a chronic distal biceps tendon rupture, repair was performed using semitendinosus autografts from the ipsilateral upper leg. Another four patients were excluded due to partial rupture or a rupture 3–4 cm proximal to the enthesis of the distal biceps tendon.

2.1. Diagnosis and surgical management

A diagnosis of total or partial distal biceps tendon rupture was suspected after a detailed clinical examination was performed. X-rays in 2 planes were obtained to detect avulsion fracture. In ten patients, the diagnosis was confirmed by MRI scan and in 37 patients by an ultrasound of the affected arm, depending on the availability of imaging modalities and inconclusive clinical examination.

In 4 patients, the mechanism of trauma included a fall onto the affected arm. In a further 2 patients, the injury took place within the framework of leisurely sports activities and three patients due to arm wrestling. Two patients were injured in a motorbike accident. In 5 patients, tendon rupture was due to training at the gym and 31 patients were injured while laboring to lifting a heavy weight (i.e., not in a gym). None of the patients suffered a bilateral distal biceps tendon rupture. More details in Table 1.

There were eight different experienced surgeons performing distal biceps tendon repair. The repair technique chosen for each patient was based on surgeon preference at the time of surgery. Surgery was performed in the supine position either under general anesthesia or plexus anesthesia. A standard tourniquet was used to achieve a bloodless field. A single lazy-S-shaped incision over the antecubital fossa was made, and the torn biceps tendon was identified after blunt dissection. The condition of the distal biceps tendon was examined by the surgeon intraoperatively, corresponding to the results of previous imaging (MRI, ultrasound). Then preparation was continued along the tunnel of the tendon to the radial tuberosity. The bone was then prepared, depending upon the preferred fixation method. For the suture anchor technique (SA), a minimum of two unicortical holes were drilled at the site of the footprint for fixation with a Mitek® suture anchor (Depuy Synthes®, Zuchwil, Switzerland) or Corkscrew® suture anchor (Arthrex®, Florida, USA). Then, the tendon was fixated by suturing according to the Bunnell technique [12]. For the cortical bone technique (CB) using the BicepsButton® (Arthrex®), a guide wire was drilled from the center of the tuberosity, through both cortices. The guide wire was then overdrilled with a 4.5 mm cannulated drill bit to perforate the dorsal cortex. The volar cortex was overdrilled as deemed appropriate for the size of the distal biceps tendon. The arm was then supinated fully and the guide wire was pushed through the tunnel so as to thread trailing sutures through the skin on the posterior forearm. After this, the tendon was pulled into the tunnel – with the elbow flexed – and the button was flipped. Fluoroscopy confirmed the position of the flipped button. For the transosseous suture repair technique (TO), a modified two-incision approach was used. Initial preparation was performed as mentioned above. A minimum of two 2mm-sized bicortical holes were drilled. Subsequently, eyed guidewires with either Ethibond Excel® (Ethicon®, New Jersey, USA) or Fiberwire® (Arthrex®) sutures were passed through the tunnels. A small incision was made in the dorsal proximal forearm and the sutures were securely tied.

2.2. Rehabilitation

All patients underwent a similar rehabilitation protocol, under the observation of a skilled physical therapist. Passive and active range of motion therapy was started at 10–14 days following surgery. Lifting light weights (with a maximum of 5 kilograms) was allowed at 6 weeks after surgery. At 12 weeks after surgery, an increase in weight load was permitted.

2.3. Outcome assessment

The Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire was assessed postoperatively for each patient, as were functional outcome and range of motion (ROM), according to a standard protocol. Strength measurements (e.g., flexion, supination, pronation) in both the operated and non-operated extremities were recorded with the help of a dynamometer. The upper limb was positioned in 45° of shoulder flexion for elbow flexion tests and at 90° of elbow flexion for forearm supination/pronation tests. Five repetitions were performed for strength testing for affected and non affected arm. Isometric elbow flexion, forearm supination and pronation strength were examined and compared with the contralateral side – and a relative percentage was then calculated. This value was calculated by dividing the strength measured on the operated side by that of the uninjured side and then multiplying this by 100 so as to attain a "percentage of achieved strength".

For patients who were unable to be reached or refused to participate in the study, a chart review was also performed so as to assess complications and basic functional outcomes (i.e., DASH, ROM).

2.4. Complications

All surgical complications – such as implant failure, nerve damage, local infection, soft tissue damage, heterotopic ossification,

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