



Surgical treatment of partial and full distal biceps tendon ruptures

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This study presents a series of cases with surgically treated partial distal biceps tendon ruptures. The results of full distal biceps tendon rupture repair are also presented and a comparison is made between the two groups.

Between 2001 and 2015, patients with partial and full ruptures of the distal biceps tendon were surgically repaired. At follow-up, the elbow function of the patients was assessed using the Oxford Elbow Score and maximum flexion and supination forces were measured.

Forty-eight elbows in 43 patients returned to the follow-up visit. There was no statistically significant difference between the two groups in terms of function and strength.

In this study, there were no statistical differences in outcome between the partial and the full distal biceps tendon groups. Surgical repair seems to be a valuable treatment option for partial distal biceps tendon ruptures.

Keywords : distal biceps tendon ; rupture ; repair ; full ; partial

retracted proximally (i.e. the biceps crease interval test (7)) and nonreactive to pronation (passive flexion pronation test (12)). Additionally, ultrasound and MRI can reliably confirm the diagnosis (8,14).

Partial ruptures and chronic lesions can be more difficult to diagnose at clinical examination and imaging studies have a more important role in these lesions. MRI is considered the gold standard for differentiating complete from partial ruptures, to assess the degree of retraction and the degeneration of the tendon (10). These lesions are considered to be uncommon and most of the literature is limited to case reports. Most reports present a surgical treatment, but frequently after an initial conservative treatment with immobilization, anti-inflammatory drugs and physiotherapy with several months duration (3,5,9,13,16,20).

Conservative treatment of complete ruptures results in significant functional impairment with loss of 40-50% of supination strength and 20% of flexion strength (4,10,21). In addition, delay of

INTRODUCTION

Distal biceps tendon ruptures occur typically in middle-aged men during excessive eccentric force on the elbow of the dominant arm (4). In case of a complete rupture, active elbow flexion and supination strength are reduced and a palpable defect is commonly felt at the elbow at clinical examination (10,6). The biceps muscle belly may be

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surgical treatment often results in further proximal retraction of the biceps tendon, which makes the repair more difficult. Surgical repair results in good recovery of strength and has become the standard of care (21).

This paper presents the results of the surgical treatment of partial distal biceps tendon ruptures operated between 2001 and 2015 in a single center. Patients who underwent surgical repair of a full distal biceps tendon rupture are also included in this study and used as a reference for comparison of the clinical results between partial and full distal biceps tendon repairs.

MATERIALS AND METHODS

Between 2001 and 2015, all patients that were diagnosed with partial (group 1) or full (group 2) distal biceps tendon ruptures were treated with surgical repair within 2 weeks after the diagnosis was made. In all patients, the diagnosis of a full or partial tendon tear was confirmed pre-operatively with ultrasonography and/or MRI scan. After approval from the Institutional Review Board, all patients were contacted for retrospective examination. Every patient was informed about the purpose of the study and was asked to sign the informed consent.

Surgical technique and rehabilitation protocol

All patients were treated by 2 fellowship-trained elbow surgeons. Through a single-incision approach, the tendon was reattached to the radial tuberosity with the use of a transcortical suspension technique. In case of a partial tear, the tear was completed sharply and any degenerative tissue was debrided. The footprint of the biceps tendon on the radial tuberosity was carefully prepared, a bone tunnel was drilled and the suspension device was passed through the bone tunnel. Postoperatively, an above-elbow cast was applied for 1 week, followed by protected progressive mobilization with an elbow brace.

Assessment of function

In the follow-up visit, the patients were asked to complete the Oxford Elbow Score questionnaire,

which assesses the elbow on three domains : elbow pain, elbow function and social-psychological effects (11). Range of motion and elbow flexion and forearm supination forces were measured using the MicroFET 2™ dynamometer (Hoggan Health Industries, Salt Lake City, UT, USA).

The data were statistically compared between the two groups using a Student's t-test or a Wilcoxon non-parametric test depending on the statistical distribution of the data

RESULTS

A total of 83 procedures were performed in 73 patients between 2001 and 2015. This original group contained 36 full and 47 partial ruptures. Forty-eight cases (43 patients) were able to return to our clinic for additional testing. The other 35 cases could not participate because they had moved away, could not be reached, had died or had no time to visit the clinic. The average time to follow-up was $6,8 \pm 4,1$ years.

Of the included patients, 20 had a full biceps tendon rupture, whereas 28 had a partial tendon tear. In the partial tendon tear group, 8 cases suffered from a chronic degenerative tear, whereas 20 cases had symptoms after a clear traumatic event. One case in the full rupture group had a recurrent rupture after earlier repair (before the study period) which needed augmentation with a semitendinosus tendon graft for repair. Another patient in the full rupture group had a recurrent rupture after two years within the study period. One patient in the partial rupture group had some temporary numbness at the radial forearm. Forty-three patients were male, whereas 5 patients were female (all in the partial tear group). This was a borderline non-significant finding (Fisher's exact test $p=0,066$). The mean age at surgery was $51,3 \pm 10,7$ years. This differed significantly between the groups : $48,4 \pm 12,1$ years in the full rupture group vs. $53,5 \pm 9,2$ years in the partial rupture group ($p = 0,029$). The left arm was affected in 25 patients and the right arm in 23 patients. Five patients were left-handed and 43 were right-handed. There was no association between the injured arm and the dominant arm (Fisher's exact test $p = 1,0$). Twenty-eight patients were manual

laborers and 12 were self-employed. The other 8 cases had less physically active jobs.

All but 2 patients (1 in the full rupture group and 1 in the partial rupture group) could continue the same job after rehabilitation. The mean sick-leave period was $9,4 \pm 5,8$ weeks in the full tear group vs. $6,8 \pm 5,4$ weeks in the partial tear group, which was non-significantly different ($p = 0,09$).

Range of motion did not differ significantly between groups using the non-parametric Wilcoxon rank-sum test. These results are displayed in table I.

Table I. — Range of motion*

| | Full tear | Partial tear | p |
|------------|-----------------------------|-----------------------------|------|
| Flexion | $139,7^\circ \pm 3,8^\circ$ | $140,6^\circ \pm 3,9^\circ$ | 0,56 |
| Extension | $0,8^\circ \pm 3,4^\circ$ | $-1,2^\circ \pm 4,9^\circ$ | 0,20 |
| Pronation | $76,8^\circ \pm 8,3^\circ$ | $75,9^\circ \pm 11,4^\circ$ | 0,99 |
| Supination | $90,7^\circ \pm 7,6^\circ$ | $86,5^\circ \pm 10,3^\circ$ | 0,21 |

*The means \pm standard error of the maximum flexion, extension, pronation and supination are displayed.

The force measurements in flexion and in supination differed non-significantly in both groups, although the maximum flexion force was higher in the full rupture group than in the partial rupture group (table II). Exclusion of the female patients ($n = 5$) (which were only present in the partial rupture group) further diminished the statistical difference between the groups.

The mean Oxford Elbow Score in the full tear group was $45,8 \pm 4,6$ points (median 48 points), whereas in the partial tear group the mean score was $43,6 \pm 6,6$ points (median 46 points). This difference was non-significant ($p = 0,198$).

DISCUSSION

Partial distal biceps tendon ruptures are initially treated conservatively in most cases and surgical repair is only rarely considered. However, there are increasing numbers of case presentations that show good results of surgical treatment of this pathology. In contrast, surgical treatment of full distal biceps tendon ruptures has been shown to yield very good results and is considered the gold standard (4,21). This study presents the clinical results of a large series of surgically treated partial ruptures and compares these data to the results of surgically treated full ruptures at the same institution.

The age of the patients with partial ruptures had the tendency to be higher than the patients with full ruptures. Ruch et al. (17) mentioned the same finding, however it did not reach statistical significance. This may be due to the chronic nature of partial ruptures and the insidious onset of symptoms. Often, there is an important time delay between the onset of symptoms and the correct diagnosis because it may be difficult to recognize the condition. There may be some factors that can explain the prolonged onset of degenerative tears. The central zone of the tendon insertion, which consists of fibrocartilage, contains less blood vessels and may be prone to degeneration (4,18). From a mechanical perspective, an impingement syndrome may occur at the level of the radial tuberosity (4). The radioulnar space narrows by 50% from supination to full pronation, which may result in friction at the distal biceps tendon. Other predisposing factors may be present such as prolonged steroid therapy, hyperparathyroidism, metabolic acidosis, smoking and chronic inflammatory disease (10).

Table II. — Resistance force (N)^o

| | Full | Partial | p | p (females excluded (n=5)) |
|-----------------------------------|------------------|-------------------|------|----------------------------|
| Flexion | $301,3 \pm 58,4$ | $271,51 \pm 65,9$ | 0,07 | 0,40 |
| Flexion ratio injured/opposite | $0,99 \pm 0,08$ | $0,94 \pm 0,15$ | 0,13 | 0,11 |
| Supination | $58,5 \pm 16,3$ | $48,5 \pm 14,8$ | 0,13 | 0,46 |
| Supination ratio injured/opposite | $1,1 \pm 0,4$ | $0,9 \pm 0,2$ | 0,34 | 0,35 |

^o The means \pm standard error of the maximum resistance force for flexion and supination are displayed. In addition, the measurements were compared with the opposite side and is shown as the ratio between the injured and the opposite side. The results after exclusion of female patients are shown in a separate column.

Dellaero et al. (5) mentioned the uncertainty about how many patients with partial distal biceps tendon tears recover with conservative management. Symptoms may vary between patients and thus varies the likeliness of being referred to an orthopaedic surgeon with complaints consistent with a partial biceps tendon tear. A higher suspicion with patients presenting with anterior elbow pain may raise the detection rate of this pathology. As is shown in this paper, the results of surgery are comparable to the known satisfactory outcomes of full biceps tendon ruptures. Subsequently, patients with partial biceps tendon ruptures may be helped earlier and confidently offered a surgical repair.

This study has some limitations. First, of all treated patients, there were no female cases of full ruptures of the distal biceps tendon. In literature, full ruptures in female patients were only described occasionally in some case reports (1,19,22). This finding suggests that male patients suffer more frequently from a full traumatic rupture, whereas female patients experience more partial and degenerative ruptures. Although the unbalanced distribution of the female cases did not exceed statistical significance, it could possibly bias the force measurements. Therefore a second analysis was made, excluding the female patients. This erased the possible higher maximum force in the full tear group.

Second, due to the longer follow-up period, many patients had changed their contact details and could not be reached to return to our clinic for additional testing. This resulted in a rather small number of cases studied, although this remains one of the largest series presented in literature.

Third, there is a considerable variety between the follow-up periods of the different patients. This is inherent to the combination of the retrospective design of this study with the infrequency of the condition.

In conclusion, the results of this study indicate that surgical management of partial distal biceps tendon ruptures yields satisfactory outcomes.

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