

Return to physical activity after the surgical treatment of distal biceps tendon tears

Powrót do aktywności fizycznej po leczeniu operacyjnym zerwanego przyczepu dystalnego ścięgna mięśnia dwugłowego ramienia

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Abstract

Introduction. Distal biceps tendon tears remain relatively rare, representing 3% of all biceps injuries and having an incidence of 1.2 per 100,000. A distal biceps tendon tear is usually caused by an eccentric load to a flexed elbow and despite mostly affecting 40-50-year-old men, it also occurs in physically active patients at a younger age.

Aim. The purpose of this study was to analyze whether physically active patients return to a pre-injury level of activity after the surgical reconstruction of distal biceps tendon tears.

Materials and methods. The study included 20 patients treated surgically due to distal biceps tendon tears. The data from patients' medical histories were analyzed. The post operative outcome and the level of physical activity was assessed using the Author's Physical Activity Questionnaire (APAQ), Oxford Elbow Score (OES) and QuickDASH. A follow-up was conducted on average after 45.8 (± 14.52) months.

Results. All patients reported that they had returned to their pre-injury physical activity after surgery. Sixteen patients (80%) reached a pre-injury activity level, while 4 (20%) were unable to return to the same activity level. The reasons included fear of re-injury ($n=4$) and pain in the operated limb during physical activity ($n=2$). The most common physical activities were: weightlifting ($n=11$, 55%) and martial arts ($n=6$, 30%). Patients before the injury undertook physical exercise 4.32 (± 1.67) times a week, and post-injury 3.84 (± 1.95) times a week ($p=0.035$). The median time spent doing physical activity during the week decreased from 360 (IQR, 285-450) minutes pre-injury to 300 (IQR, 180-420) minutes post-surgery ($p=0.028$). The patients started returning to training sessions on average 12.05 (± 10.65) weeks after surgical treatment and a full return to physical activity was observed after 36 (± 33.87) weeks. In the Oxford Elbow Score, the average score was 46.74 (± 2.2), while the QuickDASH score was 1.58 (range, 0-6.8).

Conclusions. The surgical treatment of a distal biceps tendon tear allows patients to return to physical activity in most cases.

Key words: biceps tear; distal biceps surgery; return to sport; physical activity, sports injuries.

Streszczenie

Wstęp. Zerwanie dystalnego ścięgna mięśnia dwugłowego ramienia zdarza się stosunkowo rzadko, stanowi 3% wszystkich urazów bicepsa i występuje z częstością 1,2 na 100 000. Zerwanie dystalnego ścięgna bicepsa jest zwykle spowodowane ekscentrycznym obciążeniem w zgięciu stawu łokciowego. Dotyczy głównie mężczyzn w wieku 40-50 lat, ale występuje również u aktywnych fizycznie pacjentów w młodszym wieku.

Cel. Celem badań była analiza fizycznej aktywności chorych po chirurgicznej rekonstrukcji zerwanego dystalnego ścięgna mięśnia dwugłowego ramienia.

Materiał i metody. Badaniem zostało objętych 20 pacjentów leczonych operacyjnie z powodu zerwania dystalnego ścięgna mięśnia dwugłowego ramienia. Analizie poddano dane z historii chorób pacjentów. Wyniki pooperacyjne i poziom aktywności fizycznej oceniano za pomocą Autorskiego Kwestionariusza Aktywności Fizycznej (APAQ), Oxford Elbow Score (OES) i QuickDASH. Okres obserwacji wyniósł średnio 45,8 ($\pm 14,52$) miesięcy.

Wyniki. Wszyscy pacjenci zgłosili, że po operacji powrócili do aktywności fizycznej sprzed urazu. Szesnastu pacjentów (80%) osiągnęło poziom aktywności sprzed urazu, 4 (20%) nie było w stanie osiągnąć poziomu aktywności fizycznej sprzed urazu. Przyczynami były: strach przed ponownym urazem ($n=4$) oraz ból operowanej kończyny w czasie aktywności fizycznej ($n=2$). Najczęstszymi aktywnościami fizycznymi podejmowanymi przez pacjentów były: podnoszenie ciężarów ($n=11$, 55%) i sztuki walki ($n=6$, 30%). Pacjenci przed urazem podejmowali aktywność fizyczną 4,32 ($\pm 1,67$) razy w tygodniu, a po urazie 3,84 ($\pm 1,95$) razy w tygodniu ($p=0,035$). Mediana czasu spędzonego na aktywności fizycznej w ciągu tygodnia zmniejszyła się z 360 (IQR, 285-450) minut przed urazem do 300 (IQR, 180-420) minut po operacji ($p=0,028$). Pacjenci rozpoczęli powrót do treningów średnio 12,05 ($\pm 10,65$) tygodni po zabiegu operacyjnym, natomiast pełny powrót do aktywności fizycznej zaobserwowano po 36 ($\pm 33,87$) tygodniach. W skali Oxford Elbow Score średni wynik wyniósł 46,74 ($\pm 2,2$), natomiast w skali QuickDASH 1,58 (zakres, 0-6,8).

Wnioski. Chirurgiczne leczenie dystalnego zerwania ścięgna mięśnia dwugłowego ramienia w większości przypadków pozwala pacjentom na powrót do aktywności fizycznej.

Słowa kluczowe: zerwanie ścięgna mięśnia dwugłowego ramienia; chirurgiczna rekonstrukcja ścięgna mięśnia dwugłowego ramienia; powrót do sportu; aktywność fizyczna, urazy sportowe.

Introduction

The biceps (*musculus biceps brachii*) is a muscle associated with elbow flexion, but its main role is forearm supination [1]. Ruptures of the distal biceps tendon are manifested in sudden, severe pain, a deformation of the shoulder or tenderness in the upper arm and weakening of forearm supination strength. Distal biceps tendon tears (DBTT) are relatively rare, occurring usually with an eccentric load to the flexed elbow and account for 3-12% of all biceps injuries with an incidence of 1.2 per 100,000 persons per year [2]. These injuries are observed mainly in the dominant arm (86% of cases) and mostly affect 40-50-year-old men but also occur in athletes at a younger age [3]. The risk of biceps tendon rupture is increased by age, the use of anabolic steroids, obesity and smoking [4-6].

The surgical treatment of a distal biceps tendon tear is based on reconstructing the attachment of the distal tendon to the radius with anchors or buttons [7]. This method is especially recommended in athletes and active patients, due to the best possibilities for returning to physical activity [8]. Previous studies evaluated the return to sport and physical work, but also supination strength as well as the benefits and complications of available treatment methods. After the nonoperative treatment of a distal biceps tendon tear, patients reported a 40% loss of supination strength and a 30% loss of flexion strength [9]. For comparison, after surgical treatment, the return of supination strength to pre-injury level was observed in 78% of cases and the average level of flexion strength was 90%, compared to the non-operated side [10]. In addition, after distal biceps reconstruction, 89% of patients were able to fully return to physical work [11]. However, there are still no detailed studies on the return to physical activity of non-athletes but physically active patients after the surgical treatment of a distal biceps tendon tear. Therefore, the aim of the study is the functional assessment of patients treated surgically due to a distal biceps tendon tear and the assessment of the possibility of returning to physical activity, as well as the determination of what factors prevent patients from a full return to physical activity.

Materials and methods

The retrospective study included 20 patients treated surgically at a single institution by 2 board-certified orthopedic surgeons due to distal biceps brachii tendon tears. The dominant arm was involved in all cases. Exclusion criteria were: (1) no reported physical activity prior to injury; (2) a lingering rupture of the distal biceps >3 weeks; (3) disqualification from surgical treatment. A reconstruction of the distal biceps tendon was performed in

all patients using metal suture anchors/buttons fixed in the proximal part of the radius, to which the damaged tendon was sutured. The patients underwent follow-up visits in the orthopedic clinic 6 weeks and 6, 12 and 24 months post-surgery. The study was conducted in accordance with the Helsinki Declaration. All patients gave written informed consent to participate in the research study upon admission to hospital.

The patients' medical record was analyzed, from which the following data were collected: sex, age at the time of injury, the circumstances and mechanism of injury, the time from the moment of injury to surgical treatment and complications of surgical treatment. The level of physical activity of patients was measured using our physical activity questionnaire (APAQ) [Sup.1]. In addition, the functional outcome post-surgery was assessed using two scales: the Oxford Elbow Score (OES) and QuickDASH [12]. All patients were contacted by telephone to fill the questionnaire. A follow-up was conducted on average 45.8 (± 14.52) months post-surgery. We compiled the physical activity questionnaire on the basis of the International Physical Activity Questionnaire (IPAQ) and similar publications [13,14]. The APAQ consists of 14 questions and was divided into two main parts. The first one contained 3 open questions, in which, for the period prior to injury and, the type of physical activity, the frequency of training units per week (number/week) and the time spent on physical activity per week (min/week) were determined. The second part of the questionnaire contained 11 questions in which subjective experiences of patients post-surgery were checked. In this part, the patients were asked about the time needed to return to physical activity and after what time they returned to the same level of physical activity compared to pre-injury time. In addition, patients were asked whether it was easier for them to undertake physical activity post-surgery, more difficult or whether the procedure was irrelevant in terms of the possibility of undertaking physical activity. The APAQ also checked patient satisfaction with the outcome of the surgery, on a scale of 1 to 10 (0 = very low, 10 = very high).

The data was saved in a separate file in Microsoft Excel 2019 (Microsoft Corporation, Redmond, WA, USA). Statistical calculations were performed using the Statistica 13.0.2 program (StatSoft Poland, Cracow). The results from the physical activity questionnaire were checked for normality of data distribution (Shapiro-Wilk test). Then, the parameter - number of activities/week was compared in the period pre- and post-surgery using the student T test for related samples. The parameter - the amount of time devoted to physical activity/week in the period pre- and post-surgery was compared using the Wilcoxon test. A correlation matrix was also prepared for the collected data. The level of statistical significance was set at $p < 0.05$.

Results

The most common physical activities in the group were: weightlifting ($n = 11, 55\%$), martial arts ($n = 6, 30\%$), cycling ($n = 3, 15\%$), running ($n = 2, 10\%$) and tennis ($n = 1, 5\%$). In 11 cases (55%), the injury to the distal attachment of the biceps brachii occurred during training, and in the remaining 9 cases (45%) during work. Surgical treatment was performed on average after $7.35 (\pm 4.97)$ days. The average length of stay in hospital was: $2.15 (\pm 0.37)$ days (Table 1).

Table 1. Characteristics of the group.	
	$n = 20$
Age [mean, years] (SD)	$38.65 (\pm 9.05)$
Physical activity	
– Weightlifting	11 (55%)
– Martial arts	6 (30%)
– Cycling	3 (15%)
– Running	2 (10%)
– Tennis	1 (5%)
Place of injury	
– During training	11 (55%)
– During work	9 (45%)
Waiting time to surgery [mean, days] (SD)	$7.35 (\pm 4.97)$
Length of stay in hospital [mean, days] (SD)	$2.15 (\pm 0.37)$
Waiting time to begin physical activity [mean, weeks] (SD)	$12.05 (\pm 10.65)$
Waiting time to full level of physical activity [mean, weeks] (SD)	$36 (\pm 33.87)$
Oxford Elbow Scale [mean] (SD)	$46.74 (\pm 2.2)$
QuickDASH [mean] (range)	1.54 (0-6.8)

SD – standard deviation

In the Oxford Elbow Score (scale 0-48 points), the average score was: $46.74 (\pm 2.2)$ points, which indicates a satisfactory joint function. In the QuickDASH questionnaire, the mean score among the respondents was 1.54 (range, 0-6.8), suggesting no symptoms of the operated upper limb during certain activities. All patients reported that they returned to physical activity post-surgery. However, 16 patients (80%) reported returning to pre-injury levels of physical activity, while 4 patients (20%) were unable to return to their pre-injury level of activity. The reasons include: fear of re-injury ($n = 4$) and pain in the operated limb during physical activity ($n = 2$). After surgery, patients started physical activity on average after $12.05 (\pm 10.65)$ weeks. Return to a full level of physical activity took place on average $36 (\pm 33.87)$ weeks post-surgery. Most of the respondents ($n = 17, 85\%$) reported a subjective lack of difference in muscle strength between the operated and the healthy limb, however, 3 patients (15%) reported muscle weakness in the operated limb. Eight patients (40%) reported minor ailments from the operated limb in the questionnaire, among which the most frequently mentioned were: pain during physical activity ($n = 8, 40\%$), paresthesia ($n = 4, 20\%$) and discomfort ($n = 2, 10\%$). None of the patients felt pain in the operated limb at rest. Pain occurred during physical activity and in relation to the VAS scale in seven cases (87.5%). It was described as mild (VAS score 1-3) and in one case as moderate (VAS score 4-6). The average satisfaction with the surgery on a scale of 1-10 was 9.65 among the respondents. Most of the respondents chose a score of 10 ($n = 16, 80\%$), while one patient chose a score of 9 ($n = 1, 5\%$) and three patients chose a score of 8 ($n = 3, 15\%$) (Table 2). According to 16 patients (80%), the surgery did not adversely affect the ability to undertake physical activity, while according to 4 patients (20%), the injury and surgery slightly limited these possibilities (Fig. 1).

The impact of injury and surgery on the physical activity

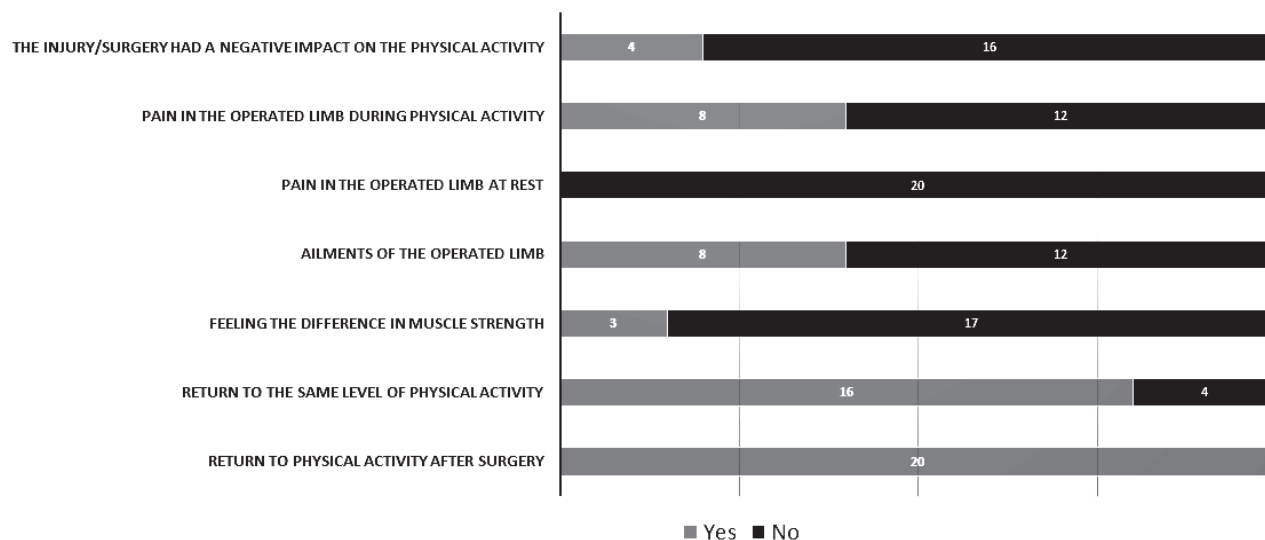


Fig. 1. The impact of injury and surgery on the physical activity.

On average, patients pre-injury undertook physical activity 4.32 (± 1.67) times a week, and post-injury 3.84 (± 1.95) times a week ($p = 0.035$). There was also a decrease in the amount of time spent on physical activity per week among patients. The median time spent on physical activity during the week decreased from 360 (IQR, 285-450) minutes prior to injury to 300 (IQR, 180-420) minutes post- surgery ($p = 0.028$) (Fig. 2). The performed correlation matrix showed a strongly positive correlation between the pre-injury and postoperative level of physical activity. Patients who showed a greater level of activity prior to the injury also maintained this trend post- surgery. The pre-operative physical activity frequency (number/week) was correlated with the post-operative outcome ($0.9787; p < 0.0001$). Similar results were obtained between pre-operative and post-operative time spent on physical activity (min/week) ($0.992; p < 0.0001$). In addition, it was shown that the earlier the patient returned to sports, the faster he returned to the level of physical activity reported

prior to the injury – a strong positive correlation between waiting time to the start of physical activity and waiting time to a full level of physical activity ($0.8113; p < 0.0001$).

Discussion

In our study, all patients post- surgical reconstruction of DBTT returned to the same level of physical activity performed before the injury. The majority (80%) of respondents did not reduce their activities after surgery. Similar results were reported by Gowd et al., where 93.4% of patients were able to return to sport, and 65.6% returned to the same level of activity, compared to the time prior to the injury. In addition, they reported that the mean time of returning to sport was 6.0 (± 2.8) months. For comparison, in our study, the patients returned to sports after about 3 months and to a full level of activity after about 9 months post- injury [15]. This difference may result from the fact that in previous studies the authors failed to differentiate the return to sports between full and partial. The above differentiation allows for a more accurate assessment of the return to sports activity and allows to determine after what time it is possible to safely return to training with a lower load level. Smith et al. in his study showed that immediate mobilization after a biceps tendon repair with a cortical button is possible, and it is not associated with repair failure repair, wound breakdown, or patient dissatisfaction [16]. Also, in our study, a quick return to physical activity (on average after 3 months) was not associated with a higher rate of re-injury of a distal biceps tendon and did not negatively affect both the level of patient satisfaction or the level of post-operative physical activity A large-scale study, which included 157 athletes, was conducted by Pitsilos et al., where 97.5% of patients returned to previously performed

Table 2. Reasons for not returning to full physical activity, reported complaints of the operated limb and satisfaction with the operation in the study group.

	n = 20 (%)
No return to full physical activity	n = 4 (20%)
– fear of re-injury	4 (100%)
– pain in the operated limb during physical activity	2 (50%)
Reported symptoms of the operated limb	n = 8 (40%)
– pain in the operated limb during physical activity	8 (100%)
– paresthesia	4 (50%)
– discomfort	2 (25%)
Level of pain during physical activity [VAS]	
– mild (1-3)	7 (87.5%)
– moderate (4-6)	1 (12.5%)
Satisfaction with surgery (1-10) [mean]	9.65
– 10	16 (80%)
– 9	1 (5%)
– 8	3 (15%)

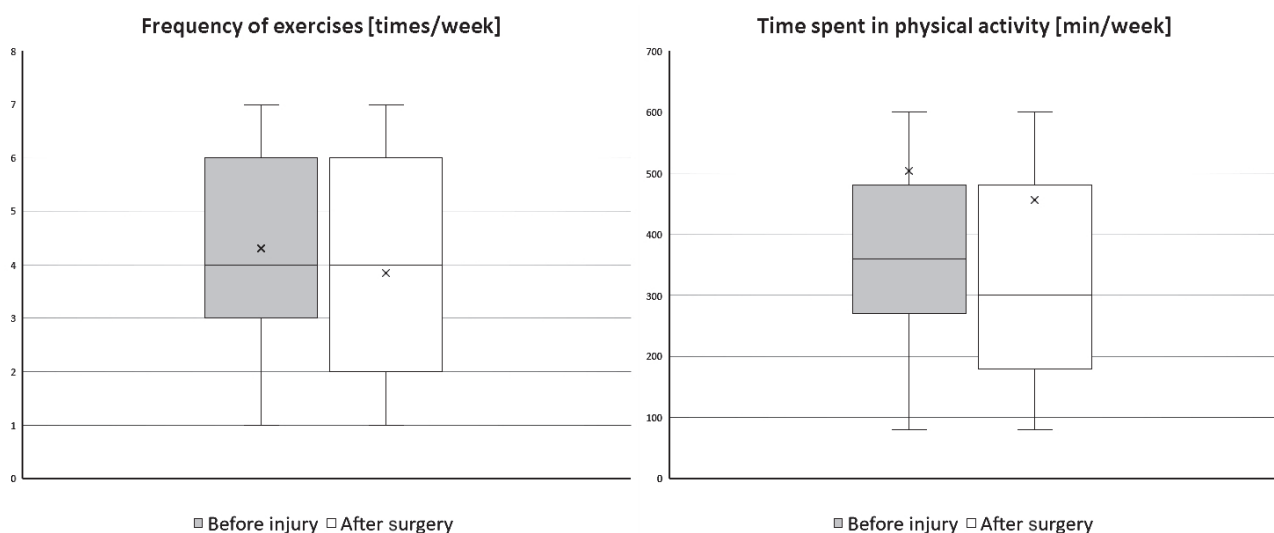


Fig. 2. Comparison of frequency of exercises and time spent in physical activity – before and after surgery.

physical activity post- surgical treatment of DBTT. The time of return to sport was 6.2 months from surgery [17]. These studies confirm our results suggesting that the vast majority of patients are able to return to physical activity after the surgical reconstruction of DBTT. In our study, however, we observed a decrease in the amount of time spent on physical activity per week from 360 to 300 minutes and also a decrease in the number of training sessions from 4.3 to 3.8 per week post- surgery. Therefore, despite the fact that all patients returned to their physical activity and most patients returned to a full load in training, a statistically significant reduction in the time spent on physical activity per week was observed. As shown by Pagani et al. in their study of National Football League players, approximately 84% of players were able to return to sports after a distal biceps tendon tear and surgical reconstruction. However, they confirmed that players who underwent the surgical repair of distal biceps tendon ruptures had significantly shorter post injury career lengths and played significantly fewer games per season post injury than the matched controls [18]. Although we did not evaluate professional athletes in our study, only physically active patients, it can be assumed that although most of them returned to full load during training, the injury and surgery may have had a slightly negative impact on the amount of time devoted to physical activity per week. Furthermore, a reduction in the frequency and overall duration of physical activity undertaken may be not linked to the injury. Our research has a long follow-up; therefore, some patients have limited their sports activities due to their life situation as a reason, e.g., the birth of a child or an increase in working hours. We observed that patients who were more active before injury also showed this trend after surgery. We did not observe that the surgery resulted in an increase in the level of physical activity in patients compared to the state before the injury. A rupture of the distal biceps tendon occurred most often in people who train weightlifting (55%) and martial arts (30%). Similarly, in the study conducted by D'Alessandro et al. eight out of ten patients train weightlifting [19]. In another study conducted by Beletsky et al. about 33% of the injuries involved the lifting of heavy objects, and 24% emerged during sport [20]. Our results indicated that almost half (45%) of the injuries were not related to sport. Thus, it can be hypothesized that micro-injuries of the distal biceps tendon occurred during sports, which can lead to a weakening of the tendon and an increase in the possibility of injury outside the gym, for example during physical work [21].

The results of our study confirm very good functional results after the surgical treatment of DBTT. In the Quick DASH questionnaire, which alongside the VAS scale, are popular instruments for assessing patients after surgery in the elbow region [22], we observed excellent upper limb functions (Score = 0) in 60% patients, with a mean score of 1.5. For comparison in the study conducted by Van der

Vis et al., more than 50% of patients reported excellent the upper limb function in the Quick DASH scale [23]. Schmidt et al. showed that when the time elapse from injury to surgery was more than 6 weeks the Quick DASH score was 6.6 (± 6.2) on average [24]. This difference in results may indicate how important time is from injury to the surgical reconstruction of a DBTT. In our practice, we recommend reconstructive surgery up to 3 weeks post-injury. This enables a quick return to physical activity and the achievement of very good functional results. Similarly, in the Oxford Elbow Score (OES), the average score in our study was: 46.74 (± 2.2) points, which indicates a satisfactory joint function. Razaiean et al. also showed the very good results of patients after the surgical treatment of a distal biceps tendon tear in the follow-up over 10 years, where the average OES score was 43.8 (± 10.56) points [25]. Similar results were found by Smith et al. in his study, where 22 patients treated surgically had an OES score of 46.9 [26]. The above results confirm the thesis that the vast majority of patients achieve very good functional results after the surgical treatment of DBTT. However, one of the most important problems in this group of patients is pain which mainly occurs during physical activity. In our study this ailment was observed quite frequently in as many as 40% of participants, but in only 2 patients (10%) was it the reason for not returning to full physical activity. In addition, only one patient defined pain as moderate on the VAS scale. A retrospective study about the complications after distal biceps tendon reconstruction reports complex regional pain syndrome in 0.6% of patients [27]. A systematic review of complications after distal biceps tendon reconstruction shows that chronic regional pain syndrome occurs at a rate of $<0.1\%$ [28]. Differences in results may be due to the subjectivity of each patient's pain assessment.

One of the limitations of our work is the relatively small number of patients and retrospective nature of research. In addition, the assessment of treatment results was performed on the basis of the subjective experiences of patients. However, these subjective feelings determine patient satisfaction after surgical treatment. Furthermore, the aim of our study was to assess the possibility of returning to physical activity, which is not possible without a patient's proper mental attitude. Therefore, data about the subjective experiences of patients in the long follow up post-surgery allow to determine the trend indicating the possibility of returning to physical activity even in a small group of patients. In addition, we found that regardless of the type and level of training after the reconstruction of distal biceps tendon ruptures, a return to sport is possible in almost 100% of patients. Also, the differences in time spent on physical activity pre- and post-operation, could be caused by a change in the patient's living situation that was not influenced by the injury.

Conclusions

Patients with distal biceps tendon tears can return to physical activity after surgical treatment in most cases. A vast majority of them were also able to return to their pre-injury level of physical activity. Most patients are satisfied with the results of the surgery and showed very good functional outcomes. However, some patients may experience chronic ailments of the operated upper limb, which intensify during exercises, which makes it impossible to return to a full level of physical activity. Part of the respondents were unable to return to their pre-injury level of activity due to fear of re-injury. Most patients do not experience a decrease in muscle strength of the operated limb, which suggests that surgical DBTT reconstruction allows for a complete return to pre-injury activity. Patients who showed a higher level of activity before the injury also maintained this trend after surgery.

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