

Amateur sports activity in the course of traumatic injury to the Achilles tendon and its surgical treatment in a long-term observation period

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Abstract

Introduction: The Achilles tendon (AT) is the strongest, largest, and most commonly ruptured tendon in the human body.

Aim of the research: The long-term evaluation of the possibility of returning to amateur sports activity after injury and surgical treatment of the Achilles tendon.

Material and methods: 102 patients were analyzed. The mean observation time was 81 months (SD 26.45). Among amateur sports, during which the AT was injured, the most frequent was football – 43.1%, then volleyball – 10.8% and badminton – 7.8%. All the patients underwent surgery within 72 h from rupture. The study was based on functional scales – American Orthopedic Foot and Ankle Score (AOFAS), Takakura, Kofoed, HAQ (The Health Assessment Questionnaire) quality of life scale, VAS (Visual Analogue Scale) pain rating scale and structural assessment using ultrasound. The control group was a non-injured contralateral limb.

Results: Results of the assessment were as follows: AOFAS – mean 93.79 points (SD 6.06), Kofoed – mean 94.81 points (SD 7.44) and Takakura – mean 95.05 points (SD 7.62). In all of them a statistically significantly lower score compared with contralateral side was noted ($p < 0.001$). A statistically significant ($p = 0.002$) reduction in the calf circumference of the operated limb was found. The ultrasound examination performed after the surgery revealed statistically significant disturbances in the architecture of the fibers ($p < 0.001$). A functional deficit of 3–5% compared with the non-injured limb was found.

Conclusions: In the long-term observation period, it can be concluded that the surgical treatment of the Achilles Tendon Rupture does not limit amateur sports activities and allows to return to the previous level of advancement.

Introduction

Sports activity is closely related to broadly understood health, in particular to the proper function of the musculoskeletal system. This is only possible when all the elements work together [1, 2].

In the event of failure of any of them, functioning is limited or even impossible. One of the key elements of the entire system is the Achilles tendon (AT), which is the body's largest and strongest tendon [3].

In the case of its damage, in sports active people, there is a lack of consensus regarding the best treatment to get the athlete back to sport [4]. Return to play (RTP) to pre-injury levels is often impossible. According to Johns *et al.*, AT rupture prohibits nearly 25% of professional athletes from returning to their respective sport [5].

According to Danish reports, the epidemiology of AT injuries has a steady upward trend. According to Houshian *et al.* it was, respectively, 18.2/100,000 in 1984 to 37.3/100,000 in 1996, while as stated by Ganestam *et al.* in the years 1994 to 2013 this number increased

from 26.95/100,000 to 31.17/100,000 inhabitants [6, 7]. Also Lemme *et al.* observed a significant increase in the incidence of AT ruptures, from 1.8 per 100,000 person-years in 2012 to 2.5 per 100,000 person-years in 2016 [8]. A similar increasing trend was observed by Longo *et al.* and Strojek *et al.* [9, 10]. Despite the significant incidence of Achilles tendon rupture (ATR), according to Tarantino *et al.*, there are no universally accepted outcomes regarding the return to play (RTP) process. According to Johns *et al.*, returning to play (RTP) to pre-injury levels in professional athletes is often impossible [5, 11].

Aim of the research

The main goal of the study was the long-term evaluation of the possibility of returning to baseline or comparable levels of activity after traumatic injury and surgical treatment of the AT. Additional objectives were the assessment of functionality, structural imaging with ultrasound, and the analysis of quality of life and pain.

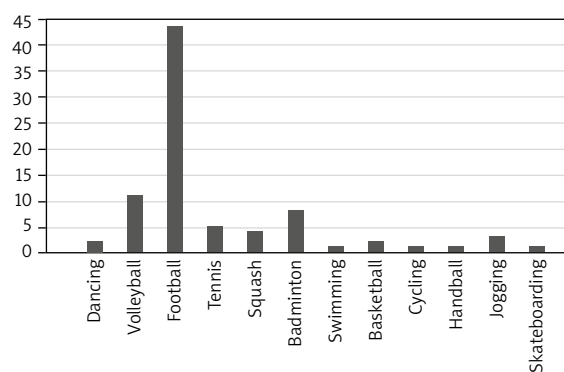


Figure 1. Type of amateur sports activity during which the injury occurred

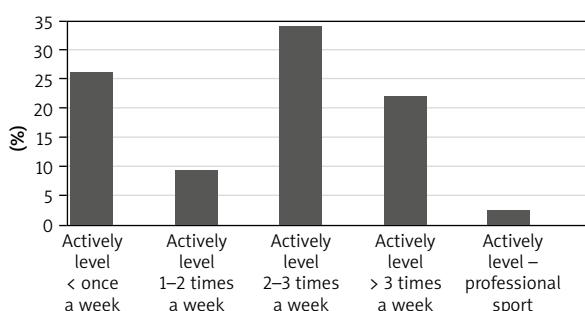


Figure 2. The frequency of the sports activity among the respondents before surgery

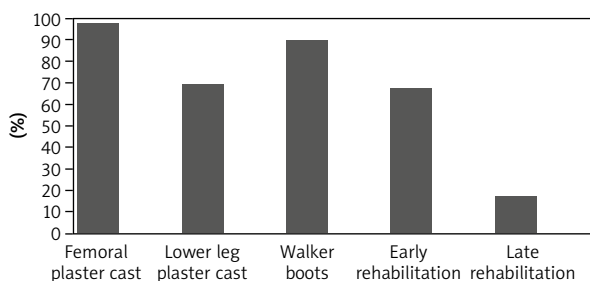


Figure 3. Immobilization and rehabilitation after the treatment

Material and methods

Characteristics of the research group

The research group included patients treated surgically at the Independent Public Provincial Hospital of Trauma Surgery in Piekary Śląskie in the years 2010–2015. In 81.4% of cases, the injury occurred during sports activity. Due to the routine nature of the research, a written confirmation was received that the study did not require the approval of the competent Bioethics Committee. Due to the nature of the hospital, 97% of the surveyed patients were recreationally competitive amateur sports participants (their income does not come from sport). 102 patients were analyzed, out of 290 patients, who were treated surgically during

this period. In the study, over 88% of patients were male and the mean age was 41 years (SD 8.87). The left side (58) was damaged more often than the right side (44). For the whole group, the mean body mass index (PRP) was 27.6 kg/m² (SD 4.11). The mean follow-up was 81 months, between 48 and 117 months (SD 26.45). Among the sports practiced by the respondents, during which the AT was injured, the most common was football – 43.1%, then volleyball – 10.8% and badminton – 7.8% (Figure 1).

The level of activity was divided into 5 groups (Figure 2).

The patients underwent surgical treatment in the early period after the injury (within 72 h). All of them were operated by experienced surgeons from the above-mentioned hospital. The operative method was suturing the damaged AT with a Kessler suture. In 34 cases, plasty with the “inverted lobe” was used. In addition, 29 patients received autogenous platelet-rich plasma (PRP). This was due to a better valuation of the procedure by the National Health Fund. All patients were immobilized after surgery and then rehabilitated (Figure 3) [12].

Methodology

The study was based on functional scales – AOFAS (American Orthopedic Foot and Ankle Score), Takakura, Kofoed, HAQ (The Health Assessment Questionnaire) quality of life scale, VAS (Visual Analogue Scale) pain rating scale and structural assessment of the AT using ultrasound. Additionally, the calf circumference was measured at the widest point of the shin and the symmetry of tendon reflexes was examined. The control group was a non-injured contralateral limb. Due to the insufficient number of data and the correlation to the AOFAS scale demonstrated by Kim *et al.* and Uselli *et al.*, the ATRS scale (Achilles Tendon Total Rupture Score) was not used in the evaluation process [13, 14].

Main scale: AOFAS, American Orthopedic Foot and Ankle Society (Ankle-Hindfoot Scale), proposed by Kitaoka *et al.* [15] and the Takakura and Kofoed scales, using subscales, define the range of motion, position of the tarsus, gait propulsion, use of orthopedic equipment, as well as possible pain. Another scale used to assess the level of pain intensity is the VAS scale, which is based on the subjective assessment of the patient and, as shown by Karcioğlu *et al.* is appropriate for clinical evaluation. To summarize overall well-being, the HAQ 20-point quality of life scale was used, which is defined as a scale that correlates well with the clinical picture [16]. Measurements were made using a centimeter ruler and goniometer. Tendon reflexes were elicited with a neurological hammer.

The ultrasound examination was an integral part of the follow-up visit and was performed using the same equipment (Hitachi Noblus with a 5–13 Mhz

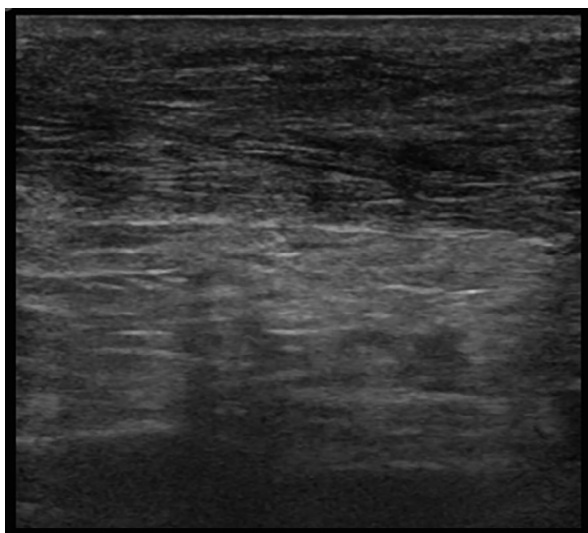


Figure 4. I degree disturbance in the fiber architecture (ultrasound examination)

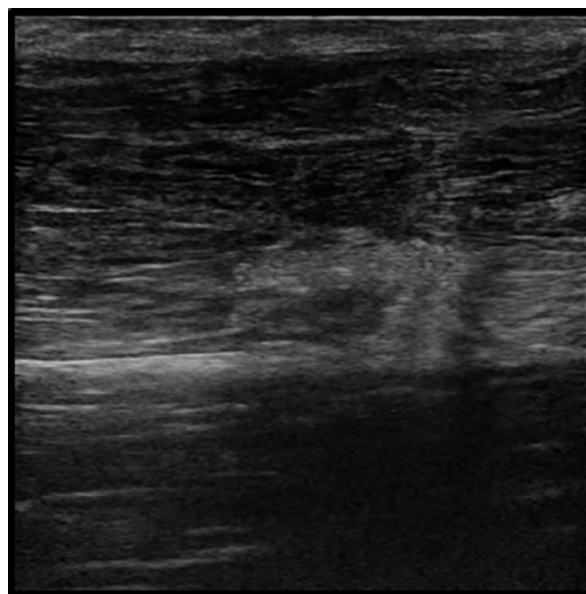


Figure 5. II degree disturbance in the fiber architecture (ultrasound examination)

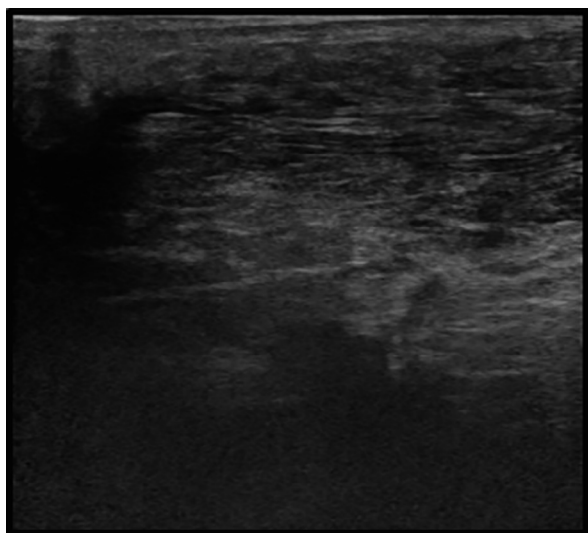


Figure 6. III degree disturbance in the fiber architecture (ultrasound examination)

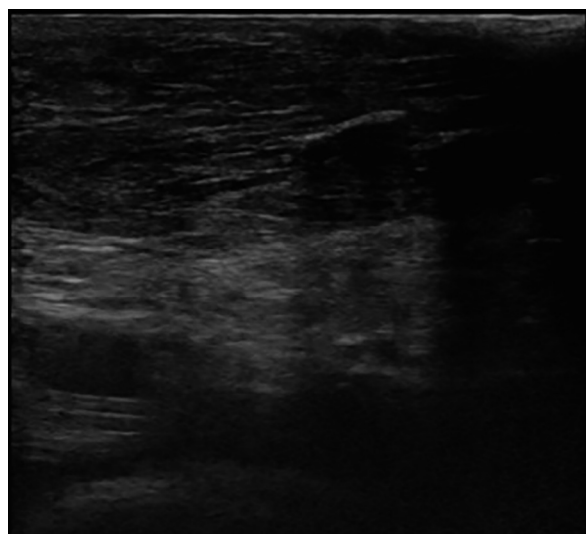


Figure 7. Remnants of the sutures (ultrasound examination)

linear probe) by one person, additionally the image was assessed using the Power Doppler function.

To assess architectural disturbances, a 3-point scale developed for the purposes of the study was used. Classifies according to the degree of disorders in the form of obliteration of the correct anatomical structure: I degree – up to 30% (Figure 4), II degree – between 30% and 50% (Figure 5) and III – above 50% (Figure 6). An additional element was the presence of sutures in the ultrasound image, regardless of the degree of disturbance in the fiber architecture (Figure 7).

We confirm that all methods were carried out in accordance with relevant guidelines and regulations. All the examined patients gave written informed

consent for their personal participation involved in the study protocols.

Statistical analysis

Statistica 12 PL and MS Excel 2016 were used for statistical analysis. Measurable variables were presented as the arithmetic mean with standard deviation (SD). Qualitative variables were shown as counts and percentages. The normality of the distribution was checked with the Shapiro-Wilk test, and the homogeneity of variance with the Levene's test. The *t*-test with independent estimation of variance or the Mann-

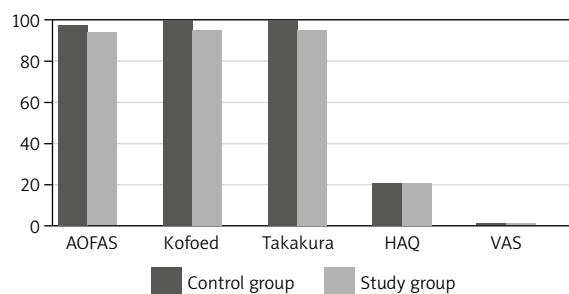


Figure 8. Scale results of the long-term observation of the study

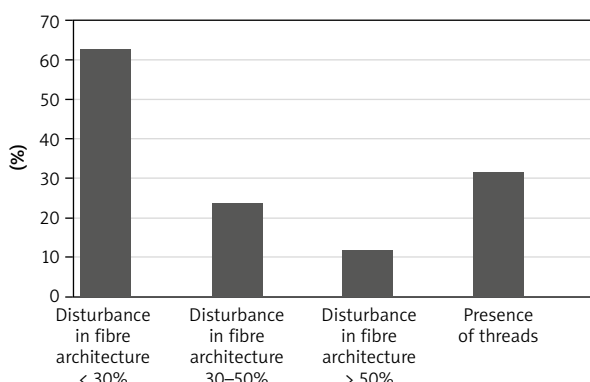


Figure 9. Achilles tendon ultrasound and power Doppler image

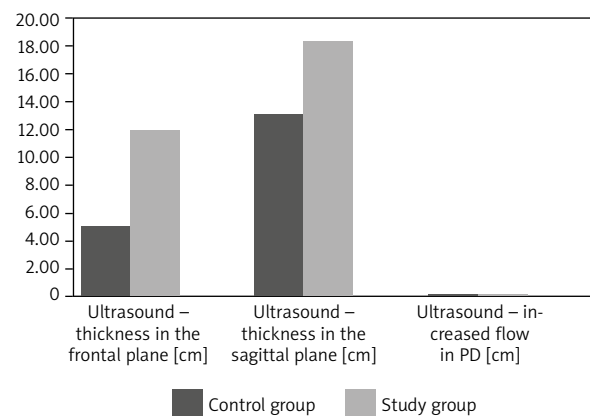


Figure 10. Achilles tendon size in the ultrasound and power Doppler image

Whitney *U* test was used to compare the control group and the study group. χ^2 statistics were used to evaluate the qualitative variables. The Spearman test was used to analyze the correlation. Changes at the significance level $p < 0.05$ were considered statistically significant.

Results

Obtained results of the clinical evaluation scales, during the last follow-up visit, were as follows: AOFAS – mean 93.79 points (SD 6.06), Kofoed – mean 94.81

points (SD 7.44) and Takakura – mean 95.05 points (SD 7.62). In all of them, a statistically significantly lower score was noted in relation to contralateral side ($p < 0.001$). There was a statistically significant ($p = 0.002$) reduction in the calf circumference of the operated limb, measured at the widest point of the shin, the mean was 37.86 cm (SD 2.92) in the area of the operated limb (SD 2.92) compared with the opposite limb – 39.00 cm (SD 2.87). The mean quality of life assessed with the HAQ scale was 21.02 points (SD 1.54). The mean level of pain in the VAS scale, ranged from 0 to 4 points, was 0.37 points (SD 0.94) (Figure 8). In the study group, the return to amateur sports was at the level of 81.9%.

In the ultrasound examination performed after the surgery, statistically significant disturbances in the architecture of the tendon fibers were found ($p < 0.001$). In addition, in all patients, thickening of the operated AT was observed, both in the frontal plane, mean 11.92 mm (SD 2.25) compared with the control group, mean 5.08 mm (SD 0.98) and in the sagittal plane, mean 18.27 mm (SD 2.70) compared with the control group, mean 13.09 mm (SD 1.92). Statistically, this means up to 135% thickening in the frontal plane and up to 40% in the sagittal plane. The presence of surgical sutures was found in 31% of cases, while the increased flow in the power Doppler study in 6.9% of patients, which in the study group was not statistically significant ($p = 0.09$). A comparative study of the tendon reflexes was not found to be statistically significant ($p = 0.3$) (Figures 9 and 10). In the study group, mean 90.2% of the reflexes were correct, for comparison, for the control group the mean was 94.1%.

Discussion

The use of surgical or non-operative treatment to return to practicing a given discipline is widely described in the literature as being at a similar level [17, 18]. However, on the basis of the obtained results, the authors lean towards surgical treatment as being a more predictable and shorter process of returning to sports activity [2]. Results obtained in the study group in the most common AOFAS scale, mean 93.79 points (SD 6.06), are similar to the reports of other researchers such as Rozis *et al.* (SD 96) and Yang *et al.* (SD 93.3) [19, 20]. Clinical analysis revealed deficiencies in the values of the scales only in the range from 3% to 5% in relation to the control group. This gives significant efficiency compared with the one before the injury. Moreover, ultrasound imaging of the AT shows a statistically significant disturbance in the architecture of the fibers compared with the control group and an increase in its dimensions in both planes. This means up to 135% thickening in the frontal plane and up to 40% in the sagittal plane. Just as in the opinion of Gumański *et al.*, diagnosed disturbances in the architecture of the tendon fibers does not affect the clinical

effect [21]. The mean results obtained in the HAQ scale was 21.02 points (SD 1.54) and VAS scale was 0.37 points (SD 0.94), which can also be found in the study by Jallageas *et al.* [22]. The quality of life and pain conditions remain at the pre-injury level. Despite the differences in the periods and types of immobilization in the long-term observation of the study, this did not affect the final result and time of return to sports activity. It was also noted by McCormack and Bovard [23]. However, whether in the case of immobilization or rapid early mobilization, there is still no specific rehabilitation protocol following the surgical treatment of an ATR [3, 24].

The method of surgical treatment and used rehabilitation protocol seem to be a good and repeatable method of treating patients with traumatic ATR. In the case of our study group, only slightly more than 18% of patients did not return to their previous level of sports activities, either because of a functional deficit or a psychological trauma. This is a significant difference from the data contained in the work of Trofa *et al.* concerning professional athletes, where over 30% of respondents were unable to continue their competitive sports activity [18]. In the long-term observation period, we found that surgical treatment of a traumatically injured AT does not limit amateur sports activity and allows to return to the previous level of advancement.

Conclusions

The surgical treatment of the ATR does not restrict amateur athletic activity and allows the patient to return to the previous level of advancement.

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Ethical approval

Not applicable.

Conflict of interest

The authors declare no conflict of interest.

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