



INTERNATIONAL ASSOCIATION OF SPORT KINETICS

Library series: Vol. 39

Coordination Abilities in Physical Education, Sports and Rehabilitation

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Published by Józef Piłsudski University of Physical Education in Warsaw
Faculty of Physical Education and Sport in Biała Podlaska
Poland

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PhD DSc Associate Professor Jan Konarski


PROOFREADER:
Mariusz Buszta

PROJECT OF COVER:
Wojciech Szucki, Przemysław Kizeweter

MONOGRAPHY

ISBN 978-83-61509-36-3

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Józef Piłsudski University of Physical Education, Warsaw,
Faculty of Physical Education and Sport,
Akademicka 2
21-500 Biała Podlaska, Poland

PRINTED AND BOUND IN:
 Mazowieckie Centrum Poligrafii
ul. Słoneczna 3C, 05-270 Marki
www.c-p.com.pl

LIMB REHABILITATION AFTER ACHILLES TENDON RUPTURE. CASE STUDY

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Introduction

This article presents the impact of intensive exercises on leg rehabilitation after Achilles tendon rupture. This kind of injury is quite common with athletes and people leading a sedentary lifestyle, particularly in situations where a sudden movement is needed (rapid bounce, landing, turn, leap). The essence of the discussed tendon rupture rehabilitation is the repetition of series of exercises, therefore, motion (in this case, application of intensive exercises) has undeniable effects even in seriously injured people.

The review of available literature shows that the effectiveness of mobility rehabilitation largely depends on cooperation with the patient and kinds of exercises applied, their repetitiveness, duration and intensity of their application, the patient's motivation and physiotherapist's experience (Przeździak et al., 1993, p. 34, Radwańska, 2001, p. 113; Kiwerski and Krasucki 1995, p. 20; Ronikier, 1988, p. 9, 1959, p. 118, Szot 2003, p. 128, 2013, pp. 25, 199).

Material & methods

The purpose of this study is to show the way the person with Achilles tendon rupture must go through. Therefore, we formulated a few questions to which we tried to find answers.

- Is full leg rehabilitation possible after total Achilles tendon rupture in a 50-year-old person? The reason for this question is the fact that the doctor in charge stated there would be no problem with obtaining a disability pension, as the patient who underwent surgical operation was a PE teacher and would be unable to run practical classes where demonstrating gym exercises is necessary.
- How long will leg rehabilitation take? Data provided by the rich literature prove that healing is slow at the age of 50, and the older the patient the longer the healing process.

- How many repetitions and loads must be performed to restore the leg to its normal mobility?

Hypothesis: With the application of a large number of repetitive exercises and significant training loads, the leg will be restored to its full mobility in a relatively short time. This thesis is justified by medical practice which shows that physical exercises speed up injury healing, but it is not known how long the healing process takes for individual age categories or whether it is at all possible for a person advanced in years to fully recover from such an injury.

Research material: The analysis of an individual case of a 50-year-old person whose left leg tendon was totally ruptured. It is the thickest tendon in human body and after its total rupture it requires surgery. The patient's history: a 50-year-old athlete, no addictions (cigarettes, drugs), no medications. The physician in charge stated explicitly that after surgery the patient must be granted a disability pension due to his leg insufficiency and limited capacity to practice his profession.

The whole rehabilitation process was divided into 4 stages, scheduled for about 6 months and carried out consistently.

Results of ruptured tendon rehabilitation

Rehabilitation, stage one – stay in hospital (7 days)

This period was characterised by a small number of exercise repetitions. It included dynamic exercising of arms and the right leg, not injured (raises and lowerings with a 4 kg weight). The purpose of these exercises was to provide the cerebral cortex with appropriate stimuli and strengthen the muscles of arms and right leg.

Within the 7 days, the patient, lying on his back, raised his arms 892 times with a 4 kg weight (total load 3,568 kg). At the same time, the number of right leg raises was 262 with the same weight (1,048 kg). Isometric tension of the left calf muscles was an important determinant of Achilles tendon rehabilitation. On the day following the surgery, 8 tensions were performed, each to pain threshold and held for 6-10 seconds, on day five – 2,500 tensions. In total, during the 7-day stay in hospital, the patient performed 4,923 tensions of calf muscles and walked with crutches the 7-metre length of the room 194 times. The purpose of these exercises was a better blood supply to the left leg to speed up its healing without damaging the stitched wound.

Rehabilitation, stage two – after the leg was immobilized (48 days)

This stage included double plaster cast application: with dorsi and plantar flexion of the foot. An approximate load for one repetition was determined. This way we tried to quantify the work done during locomotor system rehabilitation.(Diagram 1)

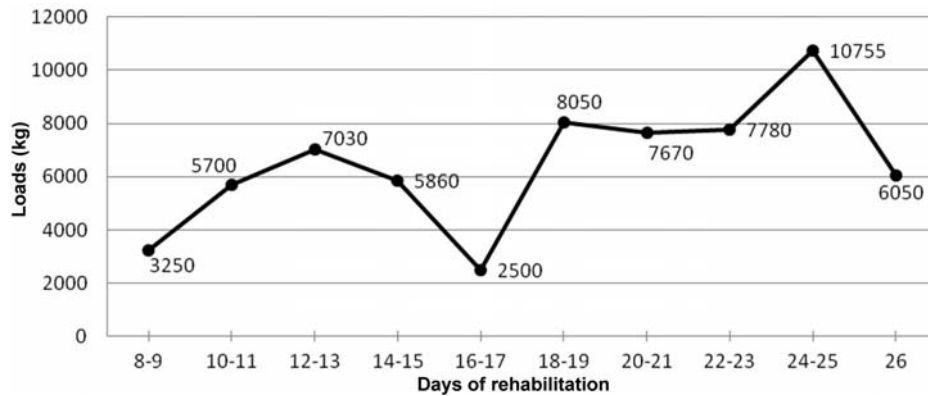


Diagram 1. Body load with nine exercises of Achilles tendon during 19 days of rehabilitation (kg, $\Sigma=64,645$, one-day average 3,402 kg).

The data in the diagram show that exercise load kept increasing to reach 10,755 kg during two penultimate days. Adding up the work done within 19 days, we found that the patient loaded his body with 64,645 kg. Each arm tension and extension in a prone position (“push-up”) was estimated 40 kg (which means that the patient performed the work of 400 kg doing 10 push-ups). Other approximate volumes of other exercises were: lying on the back with legs kept overhead – 10, spreading left leg with plaster cast – 15, torso raises – 30, single-leg knee bends – 60, rotation of leg in a cast – 15, arm bend with chair support – 15, pull-ups and reverse-grip pull-ups – 60 kg.

At the same time, calf muscle tensions were performed; the number of tensions was increased within subsequent 20 days of rehabilitation (Diagram 2).

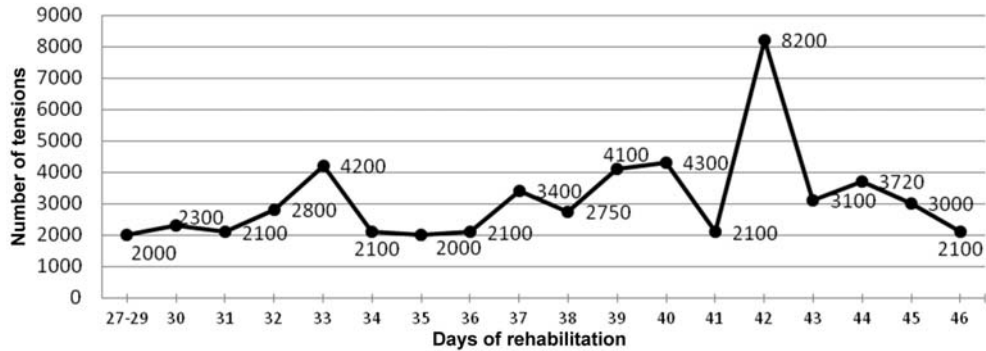


Diagram 2. Number of calf muscle (triceps surae) tensions under the plaster cast within 20 days of rehabilitation ($\Sigma=54370$)

The above data show that the total number of calf muscle tensions amounted to 54,370 repetitions within 20 days of rehabilitation. Further rehabilitation with so many tension repetitions resulted in pain incidents: the first occurred on the 33rd day (4,200 repetitions), another on the 42nd day (8,200 repetitions); therefore, the number of repetitions was radically reduced within the following days. It must be pointed out that reaching such a large volume of exercises was possible due to numerous muscle tensions in earlier periods.

Rehabilitation, stage three – exercises intensified (20 days)

In this stage, a large number of loads continued and the patient performed a large number of standing calf raises (with a table top as a support). Additionally, 12 hydro massages, 15 manual massages and 12 iodine iontophoresis treatments were applied. Diagram 3 shows the intensity of exercises performed in the period from 47th to 66th day of rehabilitation.

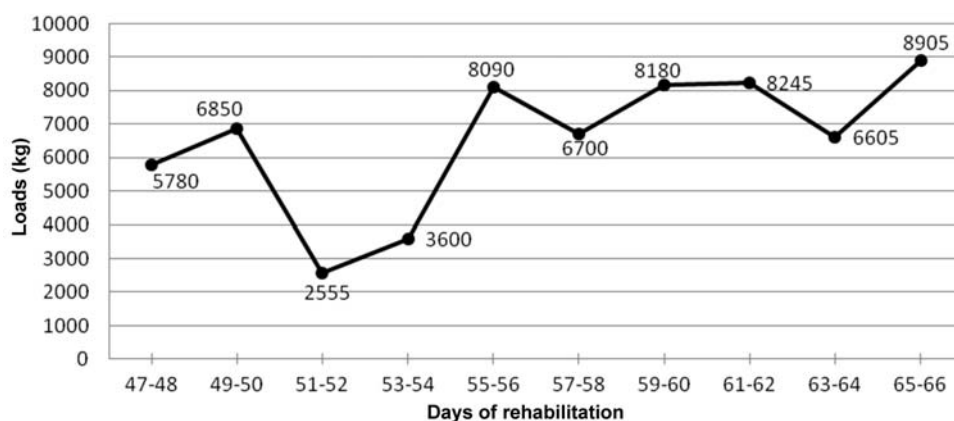


Diagram 3. Body load with left leg exercises during Achilles tendon rehabilitation within 20 days of rehabilitation ($\Sigma=65,510$)

The above data show that the total load in gymnastics was 65,510 kg, and an average body load in one day was 3,275 kg. It must be pointed out that after 10 days of exercises, the intensity of loads increased during the subsequent days: from 8,090 to 8,905. These loads were similar to those applied in the previous period of rehabilitation. At this point, the process of the improvement of body efficiency ended; however, because thigh muscle circumference decreased significantly (large muscular dystrophy of the front group – extensors of the knee joint, back group – calf flexors, medial group – thigh adductor), it was necessary to rehabilitate these muscles, as some of them are necessary for the leg to function properly: e.g. the quadriceps femoris, attached to shin bone tuberosity, is a strong knee joint extensor, and the rectus femoris flexes hip joint. Therefore, special exercises were used to restore the tissue of thigh muscles.

In order to produce an appropriate effect in the quadriceps femoris (as the main activator extending the knee joint), the foot was loaded with a 4 kg weight. This way, the load was increased to the knee joint and thus to the group of muscles cooperating with the quadriceps; therefore, within 20 days, the patient performed 8,655 extensions, which means he put a lot of effort to restore the quadriceps femoris (Diagram 4)

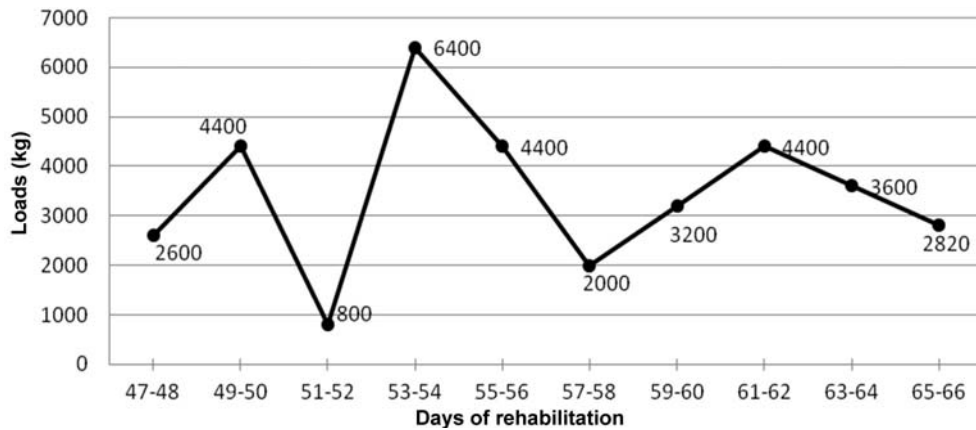


Diagram 4. The total load of left calf extensions and lowerings between the 47th and 66th days of rehabilitation ($\Sigma=34620$)

These data were obtained by multiplying the number of calf extensions (8,655) by 4 kg. Therefore, in the third stage of rehabilitation, the quadriceps femoris's workload was 34,620 kg, which means that an average of exertion was 1,731 kg each single day. It was a significant workload of muscle fibre, resulting in muscle growth, which also means higher muscle strength.

In order to restore an appropriate strength of the Achilles tendon so that it could function properly, special exercises imitating its tension were applied as early as at the beginning of the third stage of rehabilitation (59th day); the purpose of these exercises was to enable the patient to make the first step on his own sooner, and consequently to walk. A simple exercise was used: standing calf raises with a table as a support. In this exercise, a considerable part of body weight was shifted to arms, and then gradually more and more weight was shifted to the Achilles tendon. This part of rehabilitation was applied for 39 days, i.e. until the 106th day of exercises. Everyday calf raises, with "protecting" the tendon by shifting body weight to arms, went smoothly, oscillating between 500 and 2,650 raises a day.

The patient performed independent walking (without crutches) on 11th June, i.e. on the 104th day of rehabilitation, after 3,650 raises with support. The gait was not steady yet, just first slow, highly controlled steps. After that, between the 105th and 123rd days of rehabilitation, calf raises were continued.

In total, the rehabilitation of the Achilles tendon and triceps surae encompassed 7,800 raises, which enhanced its restoration to the condition before the surgery. These exercises concluded the basic phase of the recovery of the ruptured Achilles tendon. In order to restore the ruptured tendon to its original condition, field exercises were added to prepare – comprehensively, on various planes and axes – the tendon to function without a danger of another rupture.

Rehabilitation, stage four – mobility of many planes (10 days)

In this stage, rehabilitation included a 10-day stay in the mountains to restore the foot's function in all possible planes and axes (bending, extending, rotating, raising, jumping, leaping, hopping, lunging, shifting etc.). It was decided that the Karkonosze, relatively low mountains with a variety of landforms, provided the best terrain for this task.

At the beginning of convalescence, walking in varied terrain was used so as to adjust the leg to setting the foot before the thought process kicked in. The area chosen was in Szklarska Poręba, around the lower station of Szrenica ski lift, and Karpacz, diversifying terrain from easy to difficult.

Summary

In the studied case of Achilles tendon rupture, undeniable impact of motor stimuli in rehabilitation was confirmed. Surgeon Prof. S.M. stated that a person this age was entitled to a disability pension, because it was impossible for him to carry on his duties as a teaching practitioner. However, the patient's determination was so strong that during the 162 days of rehabilitation he loaded his body with exercises of 169,391 kg, with muscle tensions and raises of the total number of 67,093, including as many as 54,370 under plaster cast. The rehabilitation was supplemented with a 10-day stay in the mountains, where the patient performed walking for the total of 50 hours in varied terrain. Most often, the convalescents and their therapists settle for the stage where the injury seems fully healed, as they are able to walk. Nothing could be further from the truth, because only comprehensive mobility of joints guarantees full physical ability. An instance of the patient's determination can be the fact that he performed 8,200 muscle tensions on the 42nd day of rehabilitation. It was an enormous physical effort. The final effect of the four stages of rehabilitation was that the patient was able to perform squat vault across 5 parts of the box, run skiing classes for students (11 months after the injury) and another 4 unifications for instructors.

The description of the case presented in this article fills the gap in rehabilitation by providing the number of exercises performed, the number of tensions and implementation including the final stage where the function of the leg was being improved in varied terrain.

In conclusion, it must be said that the body can be restored to its full physical ability by applying the method of repetitive exercises. The hypothesis was confirmed that people advanced in years can be brought to full physical ability in a relatively short time by applying considerable workload and isometric tensions.

Conclusions

- The essence of effective rehabilitation is the patient's awareness of the necessity to make an effort in a long period of time.
- In order to maintain fitness of muscles under plaster cast it is necessary to tense them up to the brink of pain.
- Taking down the number of exercise repetitions is an important factor in rehabilitation.
- Consistent implementation of the planned motion programme is the essence of effective rehabilitation.
- A practical conclusion is that motion should be included in the education programmes of rehabilitation institutions to a larger extent.

References

1. Kiwerski J., Krasucki M., 1995, Pathomechanics of Spine Injuries in the Youth. «*Postępy Rehabilitacji*», Warsaw, Vol. IX/ 2.
2. Przędziak B., Honik-Rusakiewicz M., Pilawska L., Tokarski M., Pilarski P., 1993, Difficulties in Rehabilitation of Patients after Spinal Cord Injuries. «*Postępy Rehabilitacji*», Warszawa, Vol. VII/2, See: Cabak A., 2000, Kinetic and Physical Prowess of Children with Musculoskeletal Disorders. «*Postępy Rehabilitacji*», Warsaw, Vol. XIV/3, pp. 81-87.
3. Radwańska A., Seyfried A., Pathomechanics of Stature and Walking Function in Early Stage of Myopathy, 2001, «*Postępy Rehabilitacji*», Warszawa, Vol. XV/4, See: Bromboszcz J., Nowobilski R., Wierzbicki J., 1995, Multimedia w fizjoterapii – program audio – zalecenia zindywidualizowanych ćwiczeń oddechowych. «*Postępy Rehabilitacji*», Warsaw, Vol. IX/1, p. 99.

4. Ronikier A., 1988. Kinetic Correction, Compensation and Rehabilitation of People Requiring Special Care. Report for the Committee of Rehabilitation, Physical Education and Social Integration of the Polish Academy of Sciences. Postępy Rehabilitacji, Warsaw, Vol. II.
5. Ronikier A., 1999. Sports Activity as an Element of Improving Health and Prowess for People with Disabilities. Postępy rehabilitacji, Warszawa, t. XII.
6. Szot Z., 2013, Motion and its Application in Therapy and Rehabilitation. Wyższa Szkoła Informatyki i Umiejętności w Łodzi. Wydział Pedagogiki i Promocji Zdrowia.