REHABILITATION FOR THE POSTSURGICAL ACUTE ACHILLES TENDON RUPTURE - A CASE STUDY

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Abstract: Background & Purpose. Treatment options for an Achilles tendon rupture include surgical repair and conservative non surgical rehabilitation. Surgical repair is typically recommended for patients who expect to return to relatively high functional activities required of recreational athletics. Surgical repairs allow quicker mobilization and return to activity. The purpose of this case study is to apply postoperative rehabilitation protocol after an Achilles tendon total rupture and to assess the results on heel pain and function, joint mobility, strength and balance.

Case Description. Our subject was a 33-year-old male recreational athlete diagnosed with complete Achilles tendon rupture and subsequent repair. One week after removed plaster cast he presented to physical therapy with pain, muscle trophic modifications, calf atrophy, joint block and extreme compensation strategies during ambulation.

Outcome Measures. The subject underwent a functional evaluation that included: the heel pain intensity (VAS scale) articular testing (goniometric measurements), manual muscle test, static balance (The Unilateral Forefoot Balance Test), girth measurements and functional scale (LEFS). The rehabilitation treatment included the information and education of the patient, physical therapy, electrotherapy, criotherapy and assistive gait devices. Measurements were repeated at 1-month, 2-month and 4-month follow-up.

Results. The data shows an important difference in all parameters measured (VAS, ankle ROM, muscle strength, girth measurements, balance and functional abilities) comparing four stages of evaluation, where the intermediates and final evaluation provided a better results compared with the initial one.

Key words: Achilles tendon , rupture, rehabilitation

Introduction

The Achilles tendon also called the calcaneal tendon is a tough band of fibrous tissue that connects the calf muscles to calcaneus and is essential for walking, running and postural control. It is the largest, toughest and strongest tendon in the human body. The Achilles tendon originates from the two tendon portions formed by the extension of the gastrocnemius, with its medial and lateral head originating from the condyles of the femur, and the soleus muscle, and inserts into the calcaneal bone. The goal of the tendon is to transmit force of these muscles to the calcaneal bone. The calcaneal insertion is specialised to assist the dissipation of stress from the tendon to the heel bone.

Achilles tendon ***ruptures*** are ***partial*** or ***comple te.*** While a partial rupture can be completely asymptomatic or may cause a mild symptomatology, in the complete rupture the patient experience intense pain and sudden loss of strength and mobility of the affected leg. Ruptures can also be divided into acute traumatic ruptures and chronic or neglected ruptures when the injury has been left untreated for 4 weeks or more. Most Achilles tendon ruptures occur in male, recreational athletes between the ages of 30 and 40 years[1]. Ruptures not attributed to sports activity are usually caused by falls or stumbles that also require sudden acceleration or deceleration movements.

The pathogenesis is debated but it is commonly thought that ruptures are due to sudden overloading of the musculotendinous unit in a poorly conditioned individual.

The physiologic capacity of the Achilles tendon may be compromised by intrinsic or extrinsic factors. Extrinsic, mechanical forces may exceed the physiologic capacity of the Achilles when: a forcefully push off the forefoot while the knee is extending, a sudden dorsiflexion with full weightbearing, a sudden and intense dorsiflexion when jump from a height and landing on a plantar-flexed foot. Intrinsic risk factors include: hypovascularity, repetitive microtrauma and the associated inflammation and degeneration, endocrine function and nutrition.

Several studies demonstrate that the middle-portion of the tendon, approximately located 4-5 cm proximal to the calcaneal insertion is a relatively hypovascular area. This hypovascularity may account for the fact that most of the ruptures occur in this area[2]. Age is also considered an important risk factor

associated with Achilles tendon rupture; blood flow diminishing significantly with age.

Treatment options for an Achilles tendon rupture include surgical repair and conservative non surgical rehabilitation. Patients who have a neglected rupture and a functional deficit are managed optimally with surgery[3]. Decision making is based on age, past medical history, and desired level of functional return. Surgical repair is typically recommended for patients who expect to return to relatively high functional activities required of recreational athletics. Surgical repairs allow quicker mobilization and return to activity.

The purpose of this case study is to apply postoperative rehabilitation protocol after an Achilles tendon total rupture and to assess the results on heel pain and function, joint mobility, strength and balance.

CASE REPORT

History of Presenting Condition

Our subject was a 33-year-old male recreational athlete diagnosed with complete Achilles tendon rupture and subsequent repair. The surgery was performed 5 days after the injury. Following the repair, the patient was immobilized in a below-knee plaster cast with the ankle at a 90 degree angle for 6 weeks. Full weight bearing was allowed after 3 weeks. One week after removed plaster cast he presented to physical therapy with pain, muscle trophic modifications, calf atrophy, joint block and extreme compensation strategies during ambulation. Due to pain, swelling, associated with mobility impairments and indications for partial weight bearing the patient uses axillary crutches for ambulation. At the initial evaluation the patient presents the following: ankle AROM plantarflexion 18^0, dorsiflexion 5°, inversion 20^0 and eversion 14^0. Strength ankle DF: 3-/5, PF 3/5, INV 4/5, EV 4/5. Atrophy of the left quadriceps and gastrocnemius muscle. He ambulates with canes and antalgic gait pattern with decreased push-off on the left foot. The incision is clean and dry, with mild redness and warmth to palpation.

Physical therapy intervention

Physical therapy interventions were chosen according to the patient's function impairments, activity limitations, and participation restrictions. The rehabilitation treatment includes the information and education of the patient, physical therapy, electrotherapy, criotherapy and assistive gait devices. Therapeutic ultrasound and laser therapy have been used to shorten the time needed for correct lesion cicatrisation. The patient received physical therapy for 60 minutes, 3-4 times per week for 12 week and periodic visits for up to 24 weeks.

The physical therapy intervention based on Manual therapy (soft tissue mobilization, passive range of motion, joint mobilizations), Neuromuscular Reeducation to retrain lower extremity postural awareness, recruitment patterns, and balance, Gait training to decrease compensation and restore normal gait pattern and Therapeutic exercise to restore strength, range of motion and to reinforce proper movement patterns. A home exercise protocol was given the patient to supplement therapy on days.

The goals of therapy intervention:

- The management of pain and swelling with physiotherapy, criotherapy and elevation
- Improvement Range of motion through scar and soft tissue mobilization- triceps surae complex, plantar fascia and the Achilles tendon
- Improvement joint mobility restrictions utilized joint mobilizations to the talocrural and subtalar joint and the first metatarsophalangeal joint.
- Improvement strength of the muscle groups that have been damaged by immobilisation after surgical treatment.
- Strengthen ankle plantarflexors through full ROM and the gastrocnemius/soleus complex
- Restore normal walking ability
- Restore the dorsiflexion and plantar flexion of the ankle joints

6-8 WEEK AFTER SURGERY	
Joint mobilization Scar tissue mobilization Soft tissue mobilization -gastrocnemius/soleus, Achilles tendon	
Active ROM exercises for knee (flexion/extension), hip (flexion/extension, abduction/adduction), and toes	2-3 sets of 8-12 repetitions
Hip strength: gluteus medius/ abduction **(**Straight Leg Raises, Clam-	2-3 sets of 8-12 repetitions

shells)	
Isometric quadriceps contractions	10x6sec
Isometric knee extensions	10x6sec
Stretching of the hamstrings, gastrognemius, and quadriceps – straight leg lifts, hip abduction	2x30sec
Begin active dorsiflexion to neutral with passive plantar flexion	1-2 sets of 8-10 repetitions
Supine ankle Alphabet	1 set
Seated calf raises	2-3 sets of 8-12 repetitions
BAPS board in sitting	20x each direction
Progressive weight-bearing, using axillary crutches	

8-12 WEEK AFTER SURGERY	
Same exercises as last 2 week	
Joint mobilizations of the talocrural joint, both anterior and posterior, if needed	
Stretching Gluteus Maximus, Medius, Piriformis, Rectus Femoris	2x30sec
Gentle Gastroc/soleus stretching	3x15sec
Continue knee and hip range of motion exercises from phase 1	3 sets of 8-12 repetitions
Continue to strengthen all other area of the body	3 sets of 8-12 repetitions
Initiate active plantar flexion	2x8
Advance active dorsiflexion to neutral	2x8
Inversion/eversion ROM	2x10
Active range of motion exercises, isometric exercises, progressing to light resisted	2-3 sets of 8-12 repetitions
Exercises using tubing or manual resistance – to all weakened ankle and foot musculature	2 sets of 8-12 repetitions
Bridges bilateral (10 week)	3x8
Minisquats (bilateral)	3x8
Double leg standing	5x30sec
Bilateral concentric heel raises	2x10
Begin stationary bike with heel push only	10 min
Gait training – used the appropriate height heel lift, if necessary, to attain normal loading	

12- 20 WEEK AFTER SURGERY	
Same exercises as last 2 week	
Continue with active exercises, isometric and isotonic	
Calf muscles stretching, isotonic exercises with elastic bands.	2x30sec
Begin single leg stance on uninjured leg	5x10sec
Bridges unilateral	3 x8
Heel-raise exercises	3 x10
Functional movements: minisquats unilateral,lunges/ reverse lunges	3x10
Knee straight - gastrocnemius drop	3x8
Knee Bent- soleus drop	3x8
Balance exercises on balance board and one-leg exercises	2 sets of 10 repetitions
Single leg stance on half foam roler	5x10sec
Steps ups, steps downs	3x8
Sidestepping	theraband, 3x20 feet
Stationary bike	5 min
Elliptical (week 12)	5 min
Waking at the treadmill (week 14)	5 min
Jogging may start at week 16	

Outcome Measures

The design for this study was a pre-test post-test design. The subject underwent a functional evaluation that included: the heel pain intensity (VAS scale) articular testing (goniometric measurements), manual muscle test, static balance (The Unilateral Forefoot Balance Test), girth measurements and functional scale (LEFS).

Visual analogue scale (VAS) Pain was assessed using a visual analogical scale (VAS) [4]. The VAS consists of a 10-cm line, with the left extremity indicating "no pain" and the right extremity indicating "unbearable pain." The subjects were asked to mark the intensity of the heel pain that he felt at rest and level of heel pain following activity. Higher values suggest more intense pain.

The active range of motion (AROM) for talocrural and subtalar joint was measured and recorded in degrees using a goniometer which has been demonstrated to be a sufficiently reliable tool for measuring lower limb ROM [5].

The strength of the ankle was measured, recorded and graded by manual muscle testing on a five-point scale. (grade 5 - movement against gravity with full resistance; grade 4 - movement against gravity with some resistance; grade 3 - movement against gravity only; grade 2 - movement with gravity eliminated; grade 1 - visible and palpable muscle contraction but no movement and; grade 0 - no contraction). Manual Muscle Testing is an easily accessible and reliable method of determining the strength of individual muscles [6].

The static balance of the patient was measured with The Unilateral Forefoot Balance Test. This test is based on the single leg stance test but uses a reduced base of support. At this test the subject balances on the forefoot by placing the weight on the ball on the foot and lifting the heel just off the ground without raising it up high. The subject should not elevate the non-supporting leg beyond mid shin and it must not rest on the other leg. We recorded the time covered between the moment the person's heel cleared the ground and the moment when the elevated foot touched the ground[7].

Circumference of the superior medial malleolus and calcaneus was measured with a non-stretchable 150cm measuring tape. Circumferential girth measurements are commonly used to document atrophy or swelling in an extremity[8].

The Lower Extremity Functional Scale (LEFS) is a self-report, 20-item, uni-dimensional, region-specific measure that quantify the perceived difficulty of a variety of activities. Each item is scored on a 5-point scale (0-4). Item scores are summed to yield a total score ranging from 0 to 80, with higher scores repre-senting better functional status [9].

Results

The evolution of the subject had a positive trajectory registered noticeable improvements in almost all measured parameters, in the period between assessments.

The initial intensity of heel pain rest and following activity, assessed by VAS scale was moderate at rest (5/10) and severe after activity (8/10). Ten weeks after surgery the intensity decreases reaching 4/10 (VAS following activity) and 2/10, two months follow up as shown in table 1.

After the rehabilitation strategy significant increases were observed in ankle range of motion (plantar flexion, dorsiflexion, inversion and eversion). Total active motion angles of the ankle joint were increased progressively over time from 5^0 to 19^0 for dorsiflexion, (10^0 being sufficient for walking activity) from 18^0 to 42^0 for plantarflexion and for inversion/eversion from $20^0/14^0$ to $37^0/25^0$ (table2).

Table 1. Evaluation of VAS score

VAS Scale	8 weeks after surgery	10 weeks after surgery	2 months after surgery
VAS at rest	5/10	2/10	-
VAS **following activity**	8/10	4/10	2/10

Table 2. The measurements of ankle ROM

Ankle ROM	Pre-treatment	After 1month of treatment	After 2 months of treatment	After 4 months of treatment
Plantarflexion	18^0	25^0	38^0	42^0
Dorsiflexion	5^0	15^0	17^0	19^0
Inversion	20^0	26^0	32^0	37^0
Eversion	14^0	18^0	22^0	25^0

Gradually over the next four months, ankle strength improved considerable when comparing with initial moment. Re-evaluation of dorsiflexion, plantarflexion, inversion and eversion muscle performance revealed increased strength of the previously tested. After four month of rehabilitation, manual muscle test grades of 4+/5 and 5/5 were given for both ankle dorsi- and plantar-flexor. For ankle inversion and eversion, strength had improved to 5/5.

Girth measurements were also used to assess how much edema was still in the affected ankle. At first evaluation the value of difference between superior medial malleolus circumference of the affected leg and the normal leg was 3,4 cm. After one month of rehabilitation the difference between medial malleolus circumferences improved with 2 cm. The next evaluation showed an improvement of 1cm in the difference of medial malleolus circumference. After 3 months of rehabilitation treatment there was no difference between circumferences measured. Initially the calcaneus circumference of the uninvolved ankle was smaller than the involved ankle by 1,3 cm (table3).

Table 3. Evaluation of the girth measurements (cm)

Girth measurements(cm)*	Pre-treatment	After 1month of treatment	After 2 months of treatment
superior medial malleolus	3,4	1,4	0,4
calcaneus	1,3	0,7	0,2

* the value of difference between affected leg and the normal leg

After 2 weeks of rehabilitation we assessed static balance and we noticed that the patient was able to single-leg-balance only for 5 seconds. Satisfactory improvements were obtained at all evaluation moments as shown in table 4.

The LEFS score showed a better improvement after four months (table4). The LEFS score was 38 points after 1 month of rehabilitation therapy, which is 47% of maximal function if compared to 20

points (25%) before any rehabilitation treatment. After two months of rehabilitation the LEFS score showed 56 points (70% of maximal function) growing after 4 months at 74 points (92%).

Table 4. Evaluation of Unilateral Forefoot Balance Test and LEFS score

	Pre-treatment	After 1month of treatment	After 2 months of treatment	After 4 months of treatment
Unilateral Forefoot Balance Test(sec)	5`	15`	30`	90`
LEFS score	20/80	38/80	56/80	74/80

Discussion

Acute Achilles tendon rupture is a frequent and potentially disabling injury. Variations in functional treatment protocols are large and the efficacies of different rehabilitation protocols are unclear[9].Our patient was treated surgical repair with postoperative immobilization (6 weeks). After surgery, the important outcomes refer to recovery of full function and the ability to return to previous activities including sports without an increased risk of re-rupture and of developing other overuse injuries.

The patient completed the rehabilitation program consisting of exercises therapy and electrotherapy with no complications and there were no adverse events registered after our rehabilitation. Physical therapy intervention described in this case report focused on manual therapy, exercise therapy and gait training aimed to reduce pain and inflammation, restore strength, joint mobility, balance, to increase functioning and improve levels of activity.

The subject made steady progress in terms of regaining ROM and strength once he began physical therapy. Plantarflexion ROM returned more quickly than dorsiflexion ROM, perhaps suggesting that his Achilles tendon had slowly lengthened. Ankle ROM is usually used as an indirect measure of tendon elongation. Increased dorsiflexion after an Achilles tendon rupture is assumed to result from tendon lengthening. Plantarflexion and dorsiflexion strength was significantly impaired but made dramatic improvements toward the end of this bout of therapy. There were important differences for intensity of the heel pain and girth measurements in the different moments of evaluation during the therapeutic intervention. Between 2 months and 4 months post-surgery, the patient achieved a significant functional improvement compared with the first period of evaluation.

In addition, the patient improved his compliance with a home exercise program, which also may have factored into his enhanced.

Conclusion

The outcomes of this case report indicate that electrotherapy combined with a therapeutic exercise programs appears to be an effective means to improve functional capabilities following Achilles tendon repair. Furthermore, strong compliance with a home exercise program is favorable to enhance rehabilitation outcomes. The correlation of orthopedic-surgical intervention and rehabilitation measures, the earliness recovery measures enforcement can create the necessary support for obtaining a proper ant complete rehabilitation of the patient.

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