Charles University

Faculty of Physical Education and Sport

A Case Study of Physiotherapy Treatment of Achilles Tendon Rupture

Bachelor Thesis

January 2014, Prague

Author: Niki Klarouda

Advisor: PhDr. Edwin Mahr PhD.

Supervisor: Mgr. Ivana Jelínková

Abstract

Title:

Case study of physiotherapy treatment of patient with Achilles tendon rupture.

Goal:

The goal of this thesis is to present the information and the rehabilitation plan for Achilles tendon rupture that the patient went under with, in the theoretical and the practical part. In the theoretical part is presented the historical data, the anatomy of lower extremities, kinesiology and biomechanics of ankle joint, types of injuries and rehabilitation, etiology and clinical picture and last a special test for this type of injuries. In the practical part is presented the case study of a female patient, 38 years old, in a period of 2 months and 20 days of post operated state of Achilles tendon rupture. The goal from the practical part is to present the examinations, the therapeutic approach and the conclusions that were made after the rehabilitation process of the patient.

Methods:

Methods used for the rehabilitation of the patient were focused on soft tissue techniques, isometric exercises, sensomotoric, balance and breathing exercises and muscle strengthening and stretching. They were made eight therapy sessions with each one lasting form 30-60 minutes and two additional sessions for initial and final kinesiologic examination.

Results:

During a period of two weeks, the patient showed a remarkable increase of the active and passive range of motion of the ankle joint, and most importantly the patient stated a decrease of the level of the pain and her ability to walk more sufficient.

Conclusion:

According to the finding of the initial kinesiologic examination, the therapy that was provided and the final kinesiologic examination, the patient showed a great improvement, even though time was not by her side and the results went as they were planned to. She was fully active, cooperating at all times and she had the will to improve her state and her ankle's functionality.

Key words:

Rehabilitation, Achilles tendon rupture, Ankle joint, Kinesiology.

Declaration

I declare that this Bachelor Thesis is my own work written independently with information and sources taken from literature which I have stated and based on knowledge gained from the lectures during my academic studies in Fakulta Telesné Výchovy a Sportu, Univerzita Karlova v Praze.

Neither the thesis nor any other part of it has already been submitted or presented for the obtainment of any other degree.

Prague, April 2014

Acknowledgments

At this point, I would like to thank first of all my family for all the support, the effort and the understanding that they have shown to me throughout my studies and especially my father, for the great inspiration that he was to me all these years, and my mother which despite all the difficulties they are standing still by my side every step of the way.

Also, I would like to thank PhDr. Edwin Mahr PhD. for the guidance, the help, the knowledge and the trust that he offered to me during my practice in the clinic and gave me the chance to prove myself in practice.

Additional thanks I will give to my supervisor Mgr. Ivana Jelínková for her instructions and advices concerning my Bachelor thesis and for guiding me through the entire process with her experience, patience and wisdom.

Of course, I could never forget to mention and give particular gratitude to Mgr. Miroslava Jalovcová, who was the first professor that I had in the faculty and believed in me. Also I would like to show my greatest appreciation and thankfulness to Mgr**.** Kateřina Puchmertlová for her kindness, help and support towards me during my studies.

Likewise, I would like to thank my friends for their support and their help when I needed it, and specifically Afro, Mitso and Noof whom have been there for me from the beginning of my "journey".

Last but not least, I would like to ascribe my gratefulness to a special person, Ambrose, which supported me and help me go through the last year, which has been critical for me, and was lighting and cheering up my days when I mostly needed it.

Thank you all

Niki Klarouda

Prague, April 2014

Contents

1. INTRODUCTION

A ruptured Achilles tendon typically occurs as an injury of acceleration, for example after a strong push or jump. Generally, patients report feeling similar with a kick on the ankle.

To diagnose it, we palpate the gap on the tendon and perform a specific test which is described later on, and there is no physiological reflex reaction of the patient.

The treatment is divided in surgical or non- surgical. The non- surgical procedure involves immobilization of the extremity in plaster for 8 weeks with the foot to point downwards.

Some surgeons believe that a surgery in a tendon is directly beneficial. The surgical procedure is less likely to create recidivism (re-rupture of the tendon) in the future but has adverse bleeding and infections.

Most cases of Achilles tendon rupture are caused by injury at the age of about 30 years old, with 20 times greater possibility of the incidence in men.

The intake of some antibiotics, steroid injections and the increased load in training are aggravating factors for such an injury, that is why it is not surprisingly the fact that most of the patients of Achilles tendon rupture are athletes.

The return of the patient into action depends on the success of the therapeutic manipulation and of the physiotherapy.

1.1. Historical data

Its name, Achilles tendon, comes from Achilles, an ancient Greek hero of the Trojan War. According to ancient Greek mythology, Achilles was the greatest warrior of the Trojan War. His exploits were recorded in Homer's Iliad, in one of the first major epic poems of Western civilization. Achilles was son of Peleus and Thetis.

The mother of Achilles, Thetis was one of the fifty Nereids. The Nereids were friendly women living in the Mediterranean Sea along with Neptune (Olympian god of the sea), and were helping the sailors by using the help of dolphins and sea turtles during the rough sea conditions. They were Also predicted the future.

Peleus, Achilles's father, was the king of the Myrmidons of Fthia (Thessaly) and one of the partners of Jason's search for the Golden Fleece.

All gods except Eris (goddess of conflict) were guests at the wedding of Peleus and Thetis. Eris, which she did not like to be excluded, sent a golden apple on the wedding party. The apple was characterized as the most beautiful and created disagreement between Hera, Athena and Aphrodite, the ones that contributed to the onset of the Trojan War.

There are two versions of how Thetis tried to convert Achilles into immortal.

In the earlier version, Thetis anointed Achilles with ambrosia (a drink of gods that renew their immortality) and after put him into the fire so all the mortal members of his body will burn. Despite all, Peleus interrupted her and took Achilles out from the fire before his heel got burned.

In the later version, Thetis tried to make Achilles invulnerable, by dunking him in the waters of the Styx, but grabbing him by the heel, so she left him vulnerable at this part of his body.

In both of the versions, Achilles was invulnerable except for a spot of his body, the heel.

During the Trojan War, Achilles managed to get over more than 20 cities and kill many hordes of Trojan warriors.

Later on Paris, who started the Trojan War by stealing Helen from Greece, shot an arrow in Achilles heel, so after many adventures and victories Achilles was killed by the arrow struck on his heel, the only vulnerable part on his body.

As a result of the legend of Achilles, the expression Achilles heel symbolizes the fatal weakness of a person, the sensitive point of his, and the tendon that connects the heel to the triceps muscles is named after him, Achilles tendon.

2. GENERAL PART

2.1. Anatomy of the lower extremity

Bones

The lower extremity includes the pelvis girdle and the free limb (Fig. 1).
The pelvic girdle is formed by the sacrum and the two hip bones that are attached on each side left and right, are bonded on the pubic symphysis and it has a supportive and protective action for the whole lower body. (1)

The hip bone is formed from the illium, the ischium and the pubis bone.
After birth hyaline cartilage is attached in order to join the bones together and this procedure is completed approximately at the age of 20 to 25 years old.
At the center of these three connected bones a socket shape cavity, the accetabulum, it is formed which in connection with the head of the femur bone they form the hip joint.(1)

The ilium is hosting on its body from the front, the anterior superior iliac spine and the anterior inferior iliac spine which provides for tendons and ligaments attachment on it, and from the back, the posterior superior iliac spine and the posterior inferior iliac spine, which in turn points out the notch's greater sciatic superior end.(1)

The ischial spine at the posterior side of the ischium offers attachment for ligaments.
The ischial tuberosity, which is located on the ischium and its inferior end, is responsible for the weight bearing of the body during sitting position and for the muscle attachment of the posterior sides of the thighs.(1)

The pubis bone tenders the muscle attachment of the medial sides of the thighs and its body frames the pubis crest which in turn is the place responsible for abdominal muscles splice.
The pubic tubercles are located at the lateral ends of the crest and grand major section of inguinal ligaments.(1)

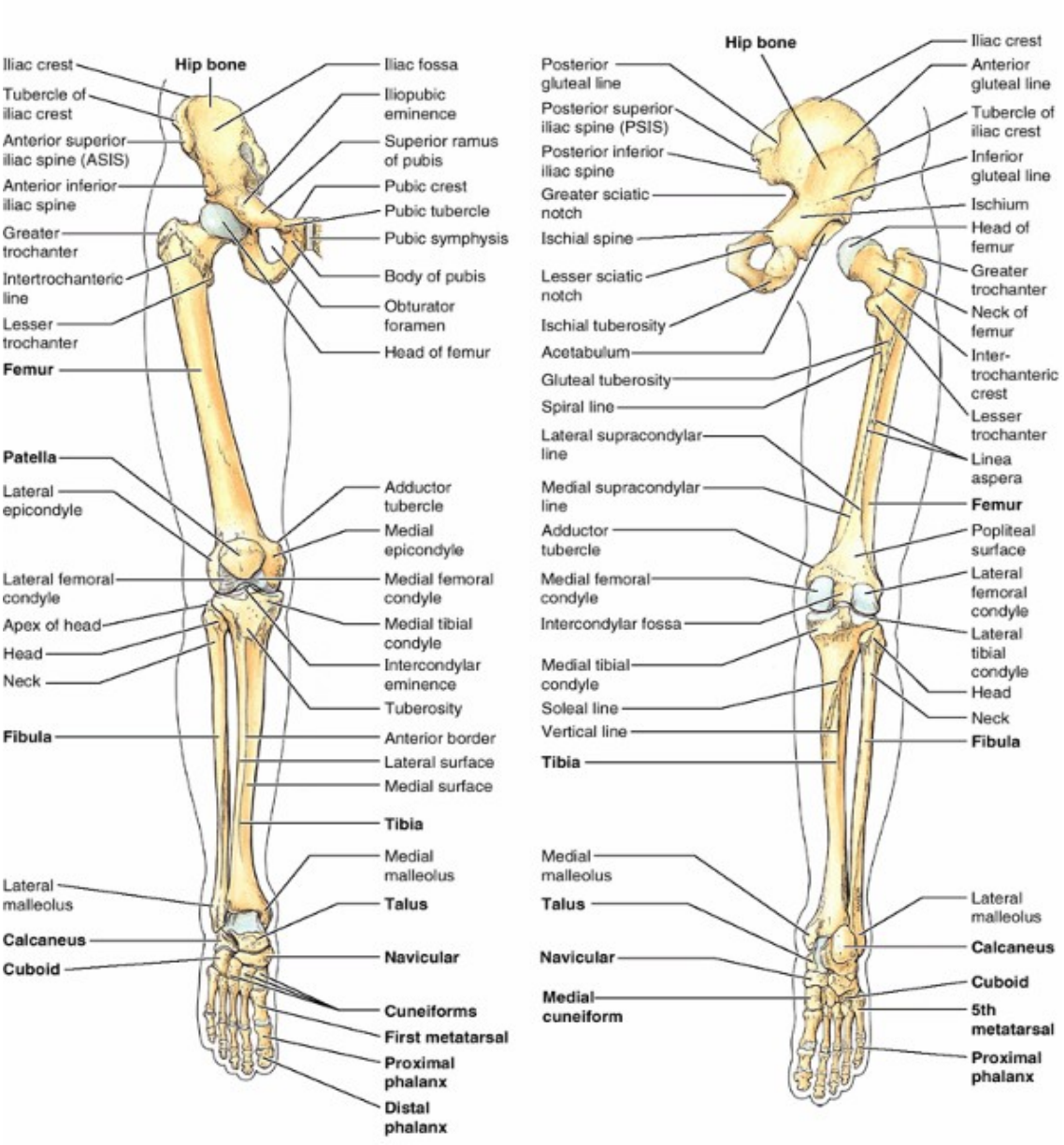

Figure 1: Bone anatomy of lower extremities in anterior (A) and posterior (B) view, from Encyclopaedia Britannica, Inc., 2007

The bone that has the highest length, approximately 1 / 4 of a person's height, and the biggest weight in the body is the femur.

It consists of the head, the neck, the greater trochanter, the lesser trochanter, the body and the distal end with the lateral and medial epicondyles.

The rotators and the abductors of the thigh are attached on the greater trochanter.

Iliopsoas muscle, which is the main muscle for flexion in the thigh is clinged on the lesser trochanter.

The tibia bone is formed by the lateral and medial condyles superiorly, the body and

the medial malleolus inferiorly.

It utters proximally with the femur's condyles and distally with the talus bone with which deputes the body weight.

The tibial tuberosity at the superior part offers the connection for the patellar ligament.(1)

The fibula bone, which is parallel with the tibia bone, has as a role muscle attachment but the greatest of all is the importance of the ankle joint stability that offers.

It consist of the head, the body and in the distal end the lateral malleolus.(1)

The foot bones are divided into 3 categories (Fig. 2), the tarsus with seven tarsal bones, the metatarsus with five metatarsal bones and the fourteen phalanges at the last one.(1)

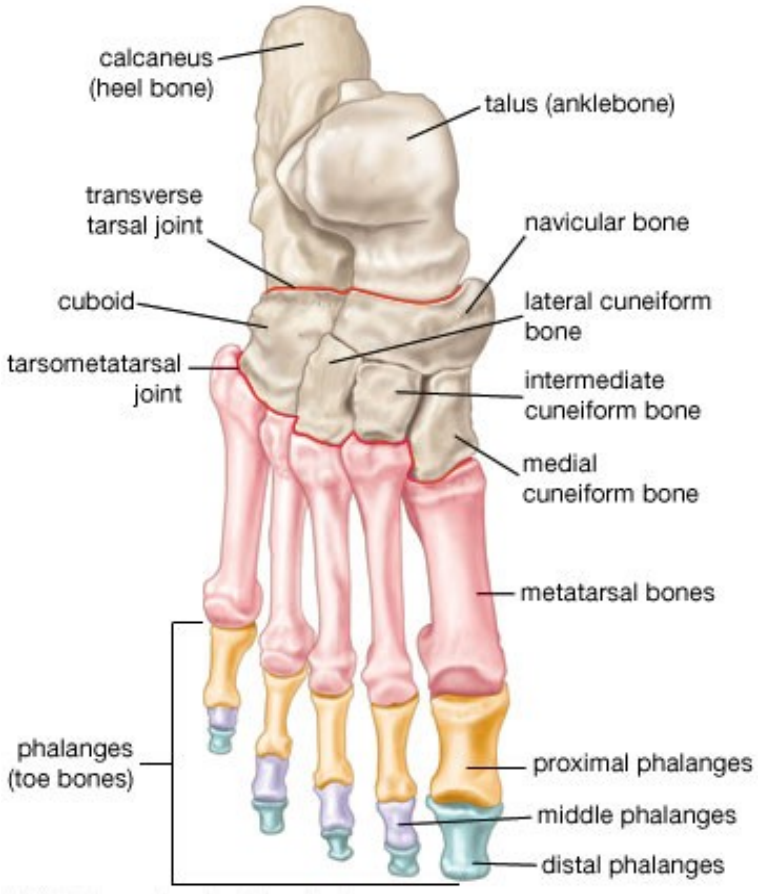

Figure 2: Dorsal anatomy view of the foot bones, from Encyclopaedia Britannica, Inc., 2007

In the first category are included the talus, the calcaneus, the cuboid, the navicular and last but not least the three cuneiforms.(1)

The talus bone is the only one attached with the upper leg bones and is responsible for transferring the body weight from the tibia bone through its body, known as trochlea, to the calcaneus bone.
Its posterior process creates a channel for flexor hallucis longus tendon.(1)

The calcaneus bone, also known as heel bone, is responsible for transferring the body weight from the talus bone to the terrain and includes the form of fibular trochlea that is in between the fibularis brevis and fibularis longus tendons which are responsible for the eversion of the foot.(1)

The navicular bone, which is located in between the talus and the three cuneiforms, forms in the medial side a tuberosity that is called navicular, a significant tendon's attachment location, and last but not least it creates the longitudinal arch of the foot.(1)

The cuboid bone is formed by the cuboid tuberosity and the tendon channel for the peroneus (fibularis) longus muscle.(1)

The cuneiform bones are attached with the metatarsals distally, the navicular bone proximally and the lateral one is attached with the cuboid bone.(1)

In the second category, the five metatarsal bones form proximally the tarsometatarsal joint, with the second metatarsal to be the longest and the first to be the shortest.
The first and the fifth metatarsals proximally, form a tuberosity for attachment of tendon.(1)

In the last category the fourteen phalanges are divided into , the great toe (1^{st} digit) with
two phalanges , the proximal and the distal and all the other digits have three phalanges each , including also the middle phalanx .(1)

Muscles

The sum of all the muscles of the body constitute the muscular system, of which the most basic tissue is the muscular tissue. Characteristic nature of the cells of the muscle tissue (muscle) is contractility.
There are three types of muscle tissue characterized by peculiarities in the structure and in the function of cells from which they are composed.(2)

Skeletal muscle tissue is found in skeletal muscle and consists of relatively long cylindrical muscle fibers, which bearing striations (Fig. 3).
Skeletal muscles adhere to bone and are independent institutions that obey our will as their contraction as well is done by our will.

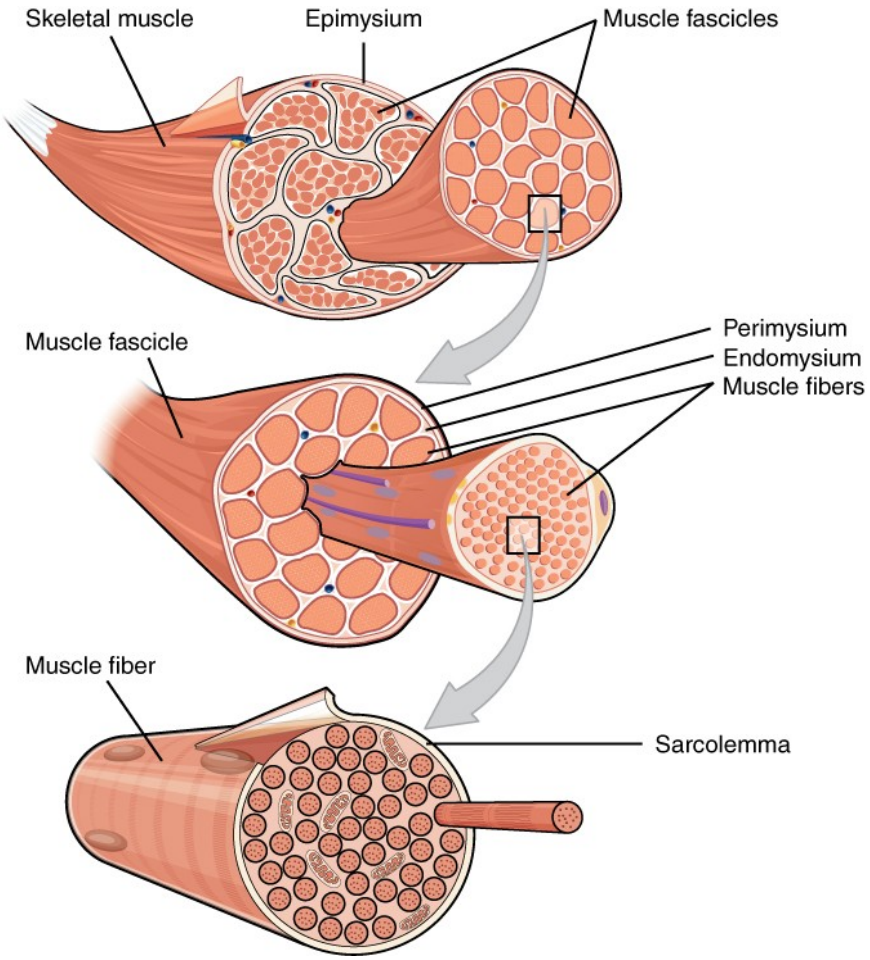

Figure 3: Anatomy of skeletal muscle, from OpenStax College, Anatomy & Physiology, 2013

Each striated muscle may be comprised of many thousands of muscle fibers, which are not added together in a random manner, but arranged in bundles (bundles of muscle), which are surrounded by dense connective tissue. Muscles are also surrounded by dense connective tissue.(2)

The striated muscles, depending on their morphology, distinguished clamps (clamp mouth), open (latissimus dorsi) and long (triceps brachii). Generally a skeletal muscle has long fusiform shape and consists of a central part, the belly and two ends, the adhesions. Each grip usually consists of connective tissue, the tendon, which connects the muscle to bone (Fig. 4). One of the end is the insertion, attached to the bone that the muscle moves, while the other, the outgrowth, attached to the bone that does not move.(2)

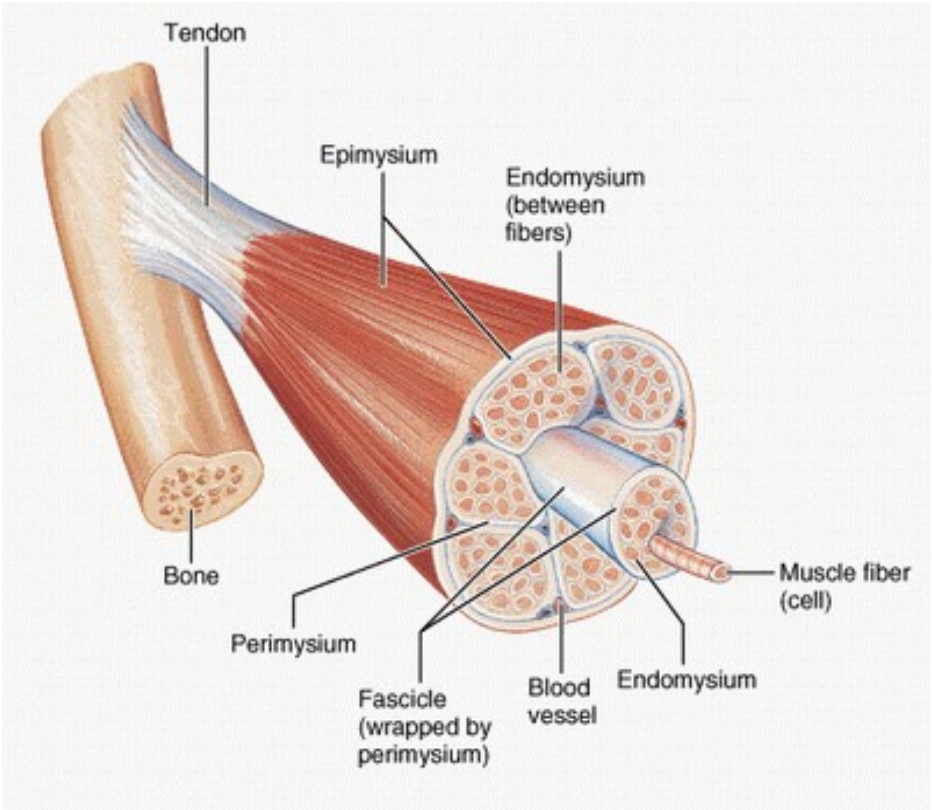

Figure 4: Muscle fiber connection and attachment to the bone, from http://andreacollo.wordpress.com/2013/11/06/muscle-contraction-and-emg-analysis/, 2013

Anterior muscles of the thigh (Fig. 5)

The pectineus muscle is located on the medial side of the thigh proximally attached in pubis and distally attached just above into the lesser trochanter and is responsible for flexion (F) and adduction (ADD) of the lower extremity (LE) and assisting in internal rotation (IR) as well.(2)

The iliopsoas muscle which is proximally attached on the transverse processes of the lumbar vertebreas through the pelvis and distally on the femur's lesser trochanter, is the main muscle for providing flexion of the thigh and also plays a fixating role.(2)

The tensor fascia latae muscle is attached proximally in anterior superior iliac spine and distally in tibia's lateral condyle, is a co-worker with iliopsoas and rectus femoris for producing thigh flexion, also co-operates with gluteus max. and min. for producing abduction (ABD) and IR and has a supporting role for femur in the tibia while standing if swaying laterally occurs.(2)

The sartorius muscle is producing hip flexion and helps in knee flexion, also helps in thigh's ABD and external rotation (ER) but acts mostly as a synergist. Is proximally attached in anterior superior iliac spine and proximally on the upper medial part of tibia bone.(2)

The quadriceps femoris is one of the strongest muscle and consists of four muscles, the rectus femoris, the vastus medialis, the vastus intermedius and the vastus lateralis. His basic role is the extension of the LE and fixation of the knee during bend actions and sports and is a strong flexor of the thigh as well.
The rectus femoris muscle which is proximally attached on the anterior superior iliac spine and distally, through the pateral ligament, into the tibia bone. It helps in the flexion of the hip and the extension of knee joint.[1](2)

[1] *Research's have made clear that dysfunction of this muscle may lead to a reduction of strength of flexion of the thigh muscle up to 17%.*

The three vastus muscles are located and proximally attached around the femoral bone area and distally into tibia bone. Vastus medialis lies on the thigh from the medial side, lateralis lies on the lateral side and intermedius lies between the two of them deep into rectus femoris. Their function is difficult to be isolated but we can say they help into the extension of knee joint.(2)

The adductor muscle group consist of adductor longus, brevis, and magnus, gracilis and obturator externus. Adductor longus is proximally attached on the anterior side of pubis and expands all over the femur bone.
Adductor brevis is proximally attached into pubis and distally into superior part of femur.
Adductor magnus is proximally attached in the pubis (inferior ramus) and proximally expanded into the whole body of femur.
Gracilis is as well attached proximally on the body of pubis but distally on the medial side of tibia bone and is a synergist for thigh ADD, knee F and IR with flexed knee.
Obturator externus is expanded from its membrane all around the acetabulum and femur's neck to the greater trochanter.
Their major action is to turn the thigh internally although the adductors longus, brevis and magnus are responsible for every movement which include thigh ADD.
They also stabilize the body during standing and correcting the trunk in any lateral shifting that may happen. Their final contribution is in E or F of the thigh when the opposite action exists.[2](2)

The tibialis anterior muscle originates from the upper half of surface of the tibia and overgrown in the medial cuneiform and the base of the first metatarsal.
It is providing the dorsal flexion and inversion (IN) of the ankle joint.(2)

[2] *Even though they consist of a huge amount of muscle mass it has been proved that even if a 70% function reduce will happen , it is not going to affect significant the hip function (Markhede and Stener , 1981) .*

The extensor digitorum longus muscle originates from the medial part of fibula, the condyle of later tibia, to the lateral side of each phalanx on the four toes.
Its work is to extend (E) the four toes and DF the ankle joint.
The extensor hallucis longus originates from the middle part of fibula and outgrowths to the upper base of the distal phalanx of the great toe. It is responsible for the E of great toe and the DF of ankle joint.(2)

The peroneus (fibularis) longus muscle originates from the upper part of the lateral side of the fibula and finishes in the medial cuneiform and in the base of the first metatarsal bone. Its function is to provide eversion (EV) and slightly helps plantar flexion (PF) of the ankle joint.(2)

The peroneus (fibularis) brevis muscle is attached proximally on the inferior part of the lateral side of the fibula and distally on the base of the fifth metatarsal from the lateral side. Its function is the same with the peroneus longus muscle above.(2)

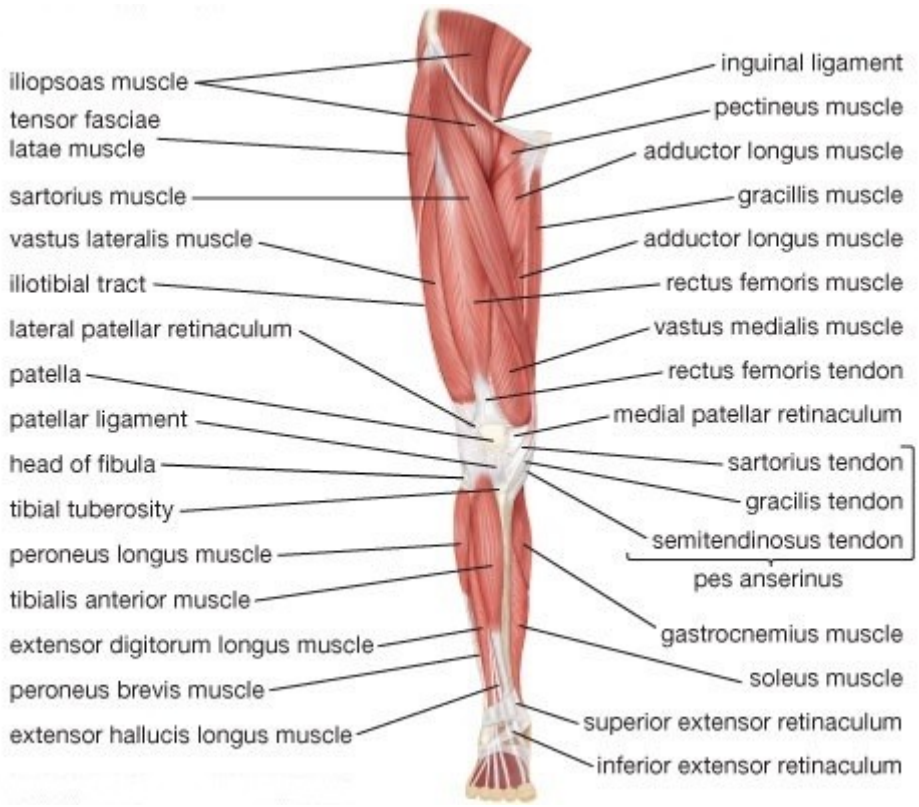

Figure 5: Anterior view of the muscles on the LE, from Encyclopaedia Britannica, Inc., 2008

Posterior muscles of the thigh (Fig. 6)

The gluteus max. muscle originates from the coccyx and sacrum on the dorsal side and attach distally into the tibia's lateral condyle. It provides E and ER of the thigh and also helps into verticalization from sitting to standing position as well.[3] (2)

The gluteus med. and min. originate from the external part of ilium in between the gluteal lines into the femur's greater trochanter on the lateral and anterior side respectively. They provide ABD and IR in the thigh.(2)

The piriformis muscle is proximally attached on the anterior part of the sacrum and distally on the upper margin of the femur's greater trochanter. Its work is to provide ER with extended thigh and ABD with flexed thigh.(2)

The hamstrings group consist of three muscles, the semitendinosus, the semimembranosus and the biceps femoris. All of them originate from the ischial tuberosity and are distally attached into the medial side of the upper part of tibia, into the subsequent part of tibia's medial condyle and into the parietal side of fibula's head respectively. [4]
The semitendinosus and the semimembranosus muscles are responsible for providing IR and F of the leg with flexed knee, and also for E of the thigh.
The biceps femoris is providing E of the thigh, F and ER of the leg with flexed knee.(2)

The popliteus muscle originates from the parietal edge of the lateral meniscus and the femur's lateral condyle and outgrowth into the subsequent edge of tibia bone. Its work is to provide help into F of the knee joint and IR of tibia bone.(2)

[3] *If paralysis on this muscle occurs, it does not affect significantly the walking in normal terrain.*
[4] *If paralysis on this muscle occurs, the person will incline onward due to gluteus max. inability to retain proper muscle tone for outrighting.*

The plantaris muscle is attached proximally on the substandard edge of the femur's lateral supracondylar line and distally through the calcaneal tendon into the calcaneus subsequent surface. It is providing assistant in gastrocnemius muscle during PF of ankle joint.(2)

The gastrocnemius muscle (lateral head) originate from the lateral edge of the femur's lateral condyle, (medial head) from femur's popliteal surface just upper from the medial condyle, and is distally attached into the subsequent surface of calcaneus just like plantaris muscle. Its work is to provide PF of the ankle joint, heel raising during walking and also assists into F of knee joint.(2)

The soleus muscle is proximally attached into fibula's head posterior edge and into the middle part of tibia's bone from medial direction and distally attached, as well as the two previous muscles, into the subsequent surface of calcaneus. It is responsible for PF of the ankle joint.(2)

The last two muscles, gastrocnemius and soleus, combined together are forming the Achilles tendon or else calcaneal tendon which is proximally attached into the calcaneal tuberosity and distally into the calcaneus. Its action it is to provide heel rising during walking, running or jumping.(2)

The flexor hallucis longus muscle originate from the lower half of the fibula's posterior surface and is attached distally to the base of the great toe's distal phalanx. The action that is providing is F of the great toe, slightly assists into PF of ankle joint and finally supports the longitudinal foot arch on the medial side.(2)

The flexor digitorum longus originate from the middle of tibia's posterior surface and attaches into the lateral side of the bases of the distal phalanges of the four digits. The action that is providing is F of the lateral side of the four digits, providing assistant in PF of the ankle joint and is supporting the foot's longitudinal arches.(2)

The tibialis posterior originate from the subsequent surface of fibula and tibia bone and is distally attached into the cuboid's, cuneiform's and navicular's tuberosity and into the bases of the second, third and forth metatarsal bones. Its action is IN of the foot and assists on the PF of the ankle joint.(2)

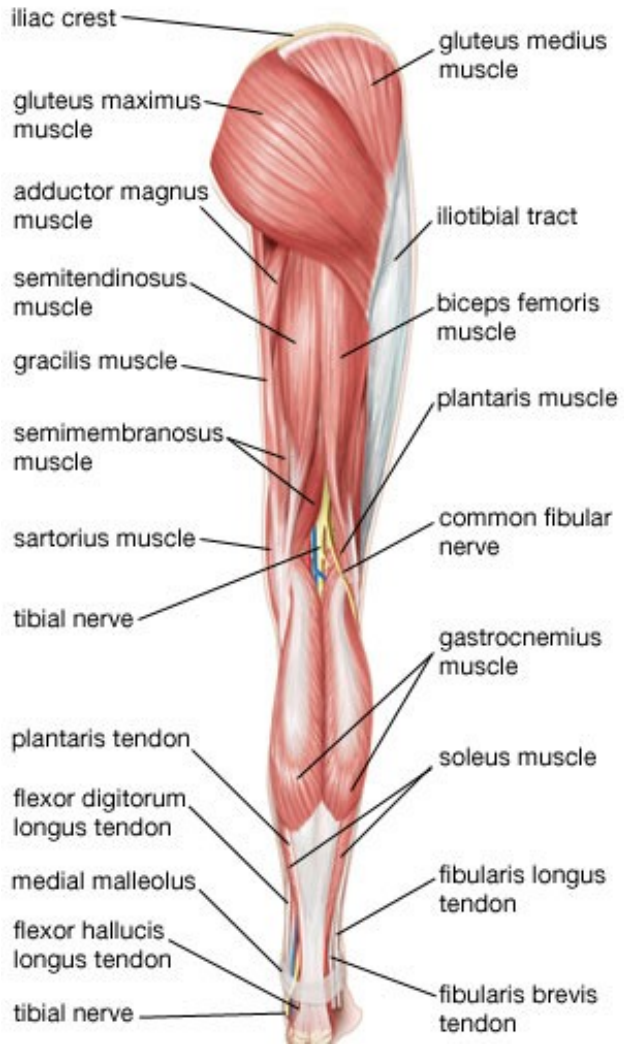

Figure 6: Posterior view of the muscles on the LE, from Encyclopaedia Britannica, Inc., 2007

The tables below are providing a summary for the muscle (primary mover, synergist, antagonist) action for every movement on each joint on the LE's.

Hip Joint

	F	E	ABD
Move	Psoas	Gluteus max.	Gluteus med.
Synergists	Iliacus Tensor fascia latae Rectus femoris Adductors (pectineus, sartorius)	Biceps femoris (long head) Semitendinosus Semimembranosus Adductor magnus	Gluteus max. (superior fibers) Gluteus min. Tensor fascia latae Sartorius Vastus lateralis
Antagonists	Gluteus max. Biceps femoris (long head) Semitendinosus Semimembranosus Adductor magnus (posterior head)	Iliopsoas Tensor fascia latae Rectus femoris Adductors (pectineus, Sartorius)	Adductor magnus Pectineus Adductor brevis Adductor longus Gracilis Gluteus max. (inferior fibers) Quadratus femoris

Table 1: Muscles used in F, E and ABD in hip joint

	ADD	IR	ER
Mover	Adductors	Gluteus min.	Piriformis
Synergists	Gluteus max. (inferior fibers) Quadratus femoris Semitendinosus Semimembranosus	Gluteus med. (anterior fibers) Tensor fascia latae Semitendinosus Semimembranosus Adductors (anterior)	Deep rotators Gluteus max. Gluteus med. (porterior fibers) Biceps femoris (long head) Adductor magnus (posterior head) Sartorius
Antagonists	Gluteus max. (superior fibers) Gluteus med. Gluteus min. Tensor fascia latae Sartorius Vastus lateralis	Gluteus max. Gluteus med. (posterior fibers) Biceps femoris (long head) Adductor magnus (posterior head) Deep rotators Sartorius	Gluteus med. (anterior fibers) Gluteus min. Tensor fascia latae Semitendinosus Semimembranosus Adductors (anterior)

Table 2: Muscles used in ADD, IR and ER in hip joint

Knee Joint

	F	E
Mover	Biceps femoris Semimembranosus Semitendinosus	Quadriceps (vastus lateralis, vastus medialis, vastus intermedius, rectus femoris)
Synergists	**P**opliteus Gastrocnemius Gracilis Sartorius	Gluteus maximus Soleus (can be called as synergists in closed chain mechanics)
Antagonists	Quadriceps (vastus lateralis, vastus medialis, vastus intermedius, rectus femoris)	Biceps Femoris Semimembranosus Semitendinosus Popliteus Gastrocnemius Gracilis Sartorius

Table 3: Muscles used in F and E in knee joint

Ankle Joint

	PF	DF	IN	EV
Mover	Soleus Gastrocnemius	Tibialis anterior	Tibialis anterior Tibialis posterior	Fibularis longus Fibularis brevis
Synergists	Fibularis longus Fibularis brevis Tibialis posterior Flexor hallucis longus Flexor digitorum longus Plantaris	Extensor digitorum longus Extensor hallucis longus Peroneus tertius	Medial gastrocnemius Flexor hallucis longus Flexor digitorum longus Extensor hallucis longus	Fibularis tertius Soleus Lateral gastrocnemius Extensor digitorum longus Plantaris

Antagonists	Tibialis anterior Extensor digitorum longus Extensor hallucis longus Peroneus tertius	Soleus Gastrocnemius Fibularis longus Fibularis brevis Tibialis posterior Flexor hallucis longus Flexor digitorum longus Plantaris	Soleus Lateral Gastrocnemius Fibularis longus Fibularis brevis Fibularis tertius Extensor digitorum longus Plantaris	Tibialis anterior Tibialis posterior Medial gastrocnemius Flexor hallucis longus Flexor digitorum longus Extensor hallucis longus

Table 4: Muscles used in PF, DF, IN and EV in ankle joint

Ankle Joint (Combined Movements)

	DF / IN	PF / EV
Mover	Tibialis anterior	Soleus Gastrocnemius (lateral side)
Synergists	Extensor hallucis longus	Fibularis longus Fibularis brevis Plantaris
Antagonists	Soleus Gastrocnemius (lateral side) Fibularis longus Fibularis brevis Plantaris	Tibialis anterior Extensor hallucis longus

Table 5: Muscles used in DF / IN and PF / EV combination in ankle joint

2.2. Kinesiology of the ankle joint

The ankle joint (talocrural joint) is formed from the tibia and the two malleoli, which welcome the talus trochlea. It consists of a strong ligament on the medial side, the deltoid, and a weaker one on the lateral side which is the one that gets injured the most. The movements that take part in coronal or frontal plane are PF with physiological ROM in 45^0 - 50^0 and DF with 10^0 – 30^0 (Fig. 7). It also possible to provide circumduction as well.

Its physiological ROM for IN is 35^0 – 50^0 and for EV 15^0 – 30^0 (Fig. 8).

The ankle joint is very important for walking so it plays a major role in gait cycle.

The gait cycle (Fig. 9) is divided into the stance phase (which includes the 60 % of the gait cycle) and the swing phase (with the rest 40 % of the cycle) for one lower extremity.

The stance phase begins with an initial contact with the heel striking the ground (DF of the ankle joint), after we have the phase of the loading response (flat foot), the midstance with support on this lower extremity at this point, after follows the terminal stance where the heel it starts to be off the ground (PF of the ankle joint) and lastly we have the pre-swing phase with support from both of the lower extremities, and this is point where the toes go off the ground and provide propulsory force.

The swing phase begins when the toes are off the ground and ends when the heel strikes to the ground. It is provided with a single support of the ipsilateral lower extremity, and is the point that the body weight it has already been transferred into that side.(8)

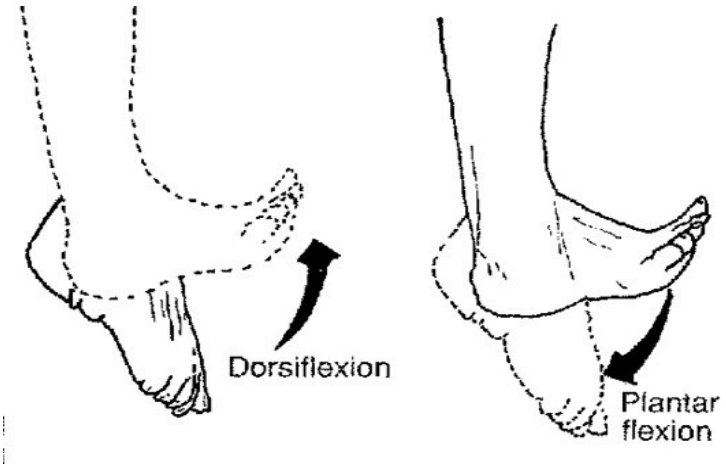

Figure 7: DF and PF movements of ankle joint, from Aipa Project LLC, 2013

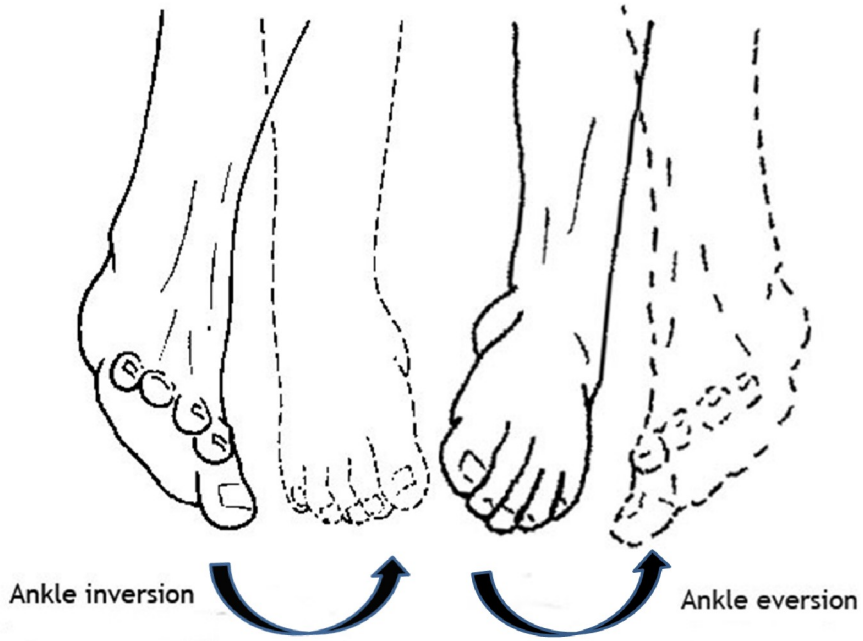

Figure 8: IN and EV movements of ankle joint, from EpicSki, 2014

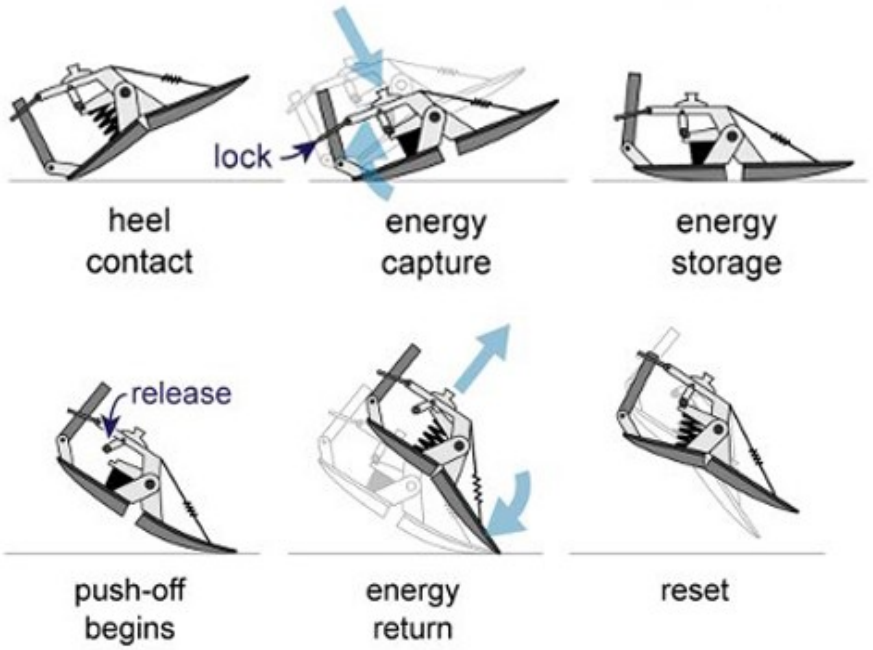

Figure 9 : Presentation of gait cycle in ankle joint , from EnviroGadget , 2010

2.3. Biomechanics of the ankle joint

Biomechanics of both the foot and ankle , is complex mechanisms and intricate connected. The foot is an essential mechanical part of the lower extremity necessary for a smooth and steady pace . The ankle carry weight from all around the lower end of the foot , and affects the orientation of foot with the ground.

The foot consists of 28 bones whose movements are interdependent . Besides acting as structural supportive platform able to withstand repeated loads multiplied of body weight , the cluster – foot ankle must also be capable of being adapted to different terrain and varying speeds . The unique properties of foot allow it to be rigid when necessary , like to dance on tiptoe in ballet , or flexible enough , as in walking barefoot in the sand . The change from a surprisingly absorbent platform to a promoted hard lever front motion happens in every action of gait cycle .

The talus articulates with the facet on tibiofibular formation of talocrural joint to structure the ankle joint. The ankle structure consists of talocrural , the subtalar and tibiofibular structure (Fig. 10).

The ankle structure is an unstable joint , the stability of which depends on the harmonic bone articulations mentioned above and from the anterior inferior tibiofibular ligament , anterior talofibular ligament , posterior talofibular ligament and the calcaneofibular ligament.(6)

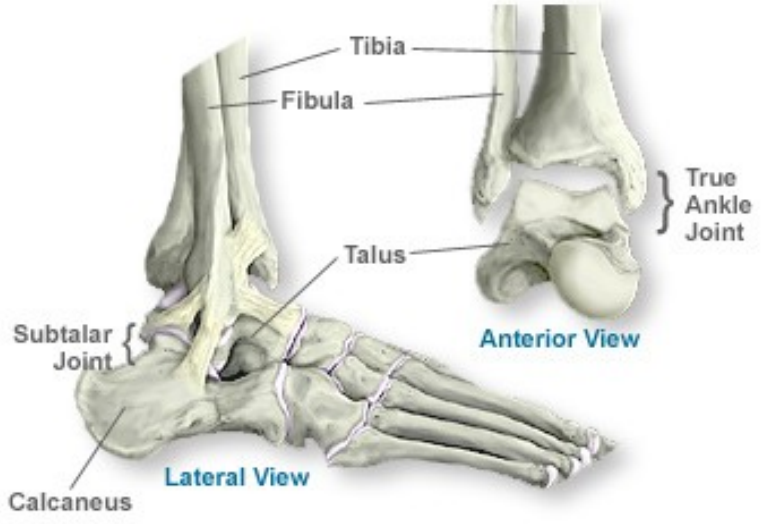

Figure 10 : Ankle structure in lateral and anterior view ,
from Southern California Orthopedic Institute , 2014

Above , on the Kinesiology of lower extremities session , are mentioned the moves made in the ankle structure and joints of the foot in various phases of Gait walking and in extreme movements. Also referred to as a close interplay between the movement of the ankle structure and orientation of the foot in place . Also , it has been studied the interaction of strength of the soil to the foot and the distribution of forces on the plantar surface of the foot . Reference is made to the effect of forces applied through the tibiofibular structure , the ankle structure and in expansion around the whole foot .

Furthermore , mentioning the role of ligaments and muscles supporting the longitudinal arch .

Finally , outlined the movement of the ankle structure and stability of the joints .(20)

Any abnormal change in the structure or movement of the foot or in the ankle structure , however small it may be , has obvious effect in cushioning , promoting and stability of ankle and foot edge . Clinical correlation of changes in biomechanical function shown in various studies-cases . The footwear in western society can range from a tough ski boot to a soft moccasin . These external restrictive materials can alter the physiological biomechanics function of ankle and foot and eventually contribute to the development of some pathological conditions such as abnormal deviation of the big toe .(6)

As it comes to the Achilles tendon, histological is dense connective tissue, that contains a high proportion of collagen type I gene , few differentiated cells , minimum matrix , proteoglycans and elastin .

It is for fact the strongest tendon in the human body and its ribbon shape is containing anatomical formation in large proportion of collagen fibers and resulting from the combination of gastrocnemius and soleus muscles overgrown up to the heel . It is formed halfway from the calf and down , as a prolongation of the flat aponeurosis , where the endings of gastrocnemius finish .

Soleus fleshy fibers are received superiorly from the aponeurosis , straight up on its surface but thicken as the fibers of the soleus are becoming tendinous distally .

The tendon on its cathode creates a spiral 90^0 angle , so the soleus fibers can be attached medially while the gastrocnemius fibers can be attached laterally.

This magnificent formation allows the elastic ability of the tendon to imbibe shock and

bound , setting free the energy as component of the propulsive force it drills .

Although , noticeable is the part that the two muscles , gastrocnemius and soleus , despite their property they are able to work alone . (20)

2.4. Types of injuries

Common disorders of the Achilles tendon are tendonitis , tendinosis , bursitis and finally rupture of the tendon . These disorders are a typical result of excessive use and can occur both in adolescence and in older age (Fig. 11).

Tendonitis

The Achilles tendonitis is inflammation , irritation and swelling of the tendon . The sensation of pain felt by the person is the outcome from small slits and inflammation in the tissue of the tendon . Tendonitis is usually developed just above from the point of attachment of the heel . The area around the Achilles tendon can become irritated by repeated friction . This situation is common in athletes , such as tennis players , and in dancers .

Running produces force eight times the body weight , giving with this way repetitive and intense pressure on the tendon for prolonged duration .

The tendonitis in athletes is usually the result of wrong manipulations that occur during training , such as running in wrong techniques or the use of inappropriate footwear .

Nevertheless has a direct connection from the cluster of muscles of the ankle joint . Abnormal biomechanical , internal friction or external pressure , considered as another reason for the symptoms .

One study showed that 56 % of track and field athletes with Achilles tendonitis , discontinued any athletic activity for at least four weeks in order to help the restore . The delay or failure of diagnosis of the Achilles tendon rupture is also common , with a percentage of 23 % of the patients , that they were given a mistakenly first diagnosis .

In many cases , the failure of diagnosis of a trauma of a tendon is due to the presence of hematoma . Therefore , all people with pain in the rear surface (heel) , should be considered for Achilles tendonitis .(5)

Tendinosis

It is a disorder of the Achilles tendon , which is caused by adiffuse thickening of the tendon without some histological evidence with presence of inflammation . This disturbance is common in people over 35 years and is gradually developing as a result of minor traumas that occur in the region , with the increasing of age or with a combination of all the above factors .

The pure tendinosis without other tendon injuries , is most likely not going to present any clinical symptom , feeling of pain or a sore clot in Achilles tendon .

The cycle of tendinosis began with the increase of requirements of the Achilles tendon , when more energy is required .

Factors such as age effects or increased requirements of exercises in participating in some activity , result in incomplete recovery of the tendon . This cycle is leading to the attenuation of power products , thereby result in increasing the predisposition of injury and microslits that can occur in the tendon .(11)

Bursitis

The bursa is filled with serous fluid and is close to joints , in places that soft tissue abrasion occurs . There are over 150 bursa on the body. These little bags with serous fluid in between the bones , the muscles and the tendons associated with the bones , facilitate movement by reducing the friction . The bursitis is inflammation and irritation of the follicle .

Inflammation can occur in bursa between the calcaneus and the Achilles tendon . This inflammation comprises the area where the Achilles tendon is connected to the calcaneus bone (heel) .(15)

Rupture

Sometimes , some injuries even if they are treated immediately after the injury , the restoration is incomplete . In these cases , there may be some complications . The worst complication that can happen is rupture of the Achilles tendon . This happens for the reason that the tendon because of the inflammation , is abnormal and weak . Continuing its various activities , the result will be , the tendon to be ruptured due to weakness .

In case of rupture of the Achilles tendon , the recovery occurs only surgically . Damage to the tendon will occur when the load will be exerted on it , either once or repeated , or it will overcome its resistibility .

During running , it has been measured , that the tendon receives load as many as eight times the body weight . The rupture of the Achilles tendon usually occurs in men aged 30-50 years old and the probability is getting higher with exercise . Most fractures occur during strenuous and high activity levels , particularly in basketball , tennis and football . (18)

Sudden rupture occurs in older ages . The rupture can be partial or complete .

Partial rupture (Fig. 12) occurs more frequently on the transition point of the gastrocnemius muscle in tendon fate . The central fibers of the Achilles tendon , rupture without interrupting the continuity of the tendon .

In such patients , the Thompson test[5] is negative and the tendon has a delicate , fusiform swelling medially .

The complete break (Fig. 12) is usually located approximately 5 cm from the insertion of the tendon , in the middle . The perfect ruptured tendon is rare and occurs most often in middle aged people with very good development of muscular system and parallel reduction of tissue elasticity and particularly the binders . From the history anamnesis , we see that the patient felt strong pain behind the ankle joint , the moment that started some exercise . After the injury and the retreat of the pain , the possibility of PF observed , is mainly due to the common flexor of the fingers and the long flexor of the great toe . The support , however , on the heads of the metatarsals is impossible . The Thompson test will be positive , because the fascial sheath is ruptured .(13)

[5] *The Thompson test is described on the section 2.7. Thompson test.*

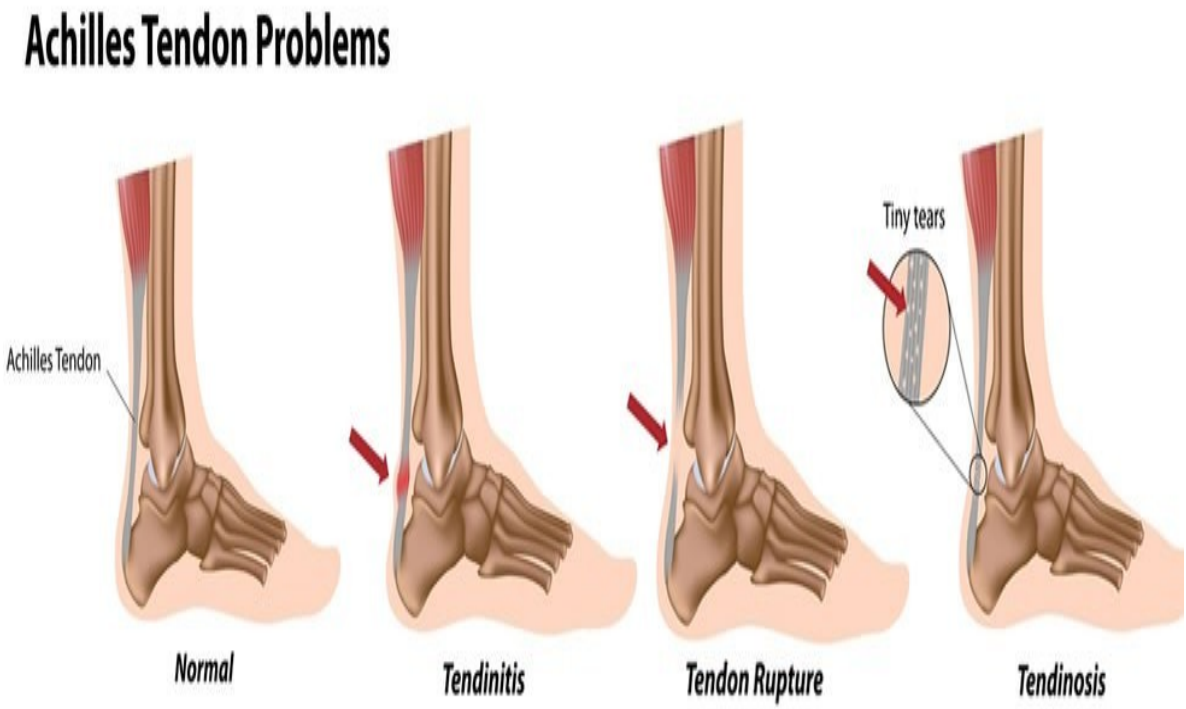

Figure 11 : Achilles tendon disorders,
from Excel Physical Therapy, 2014

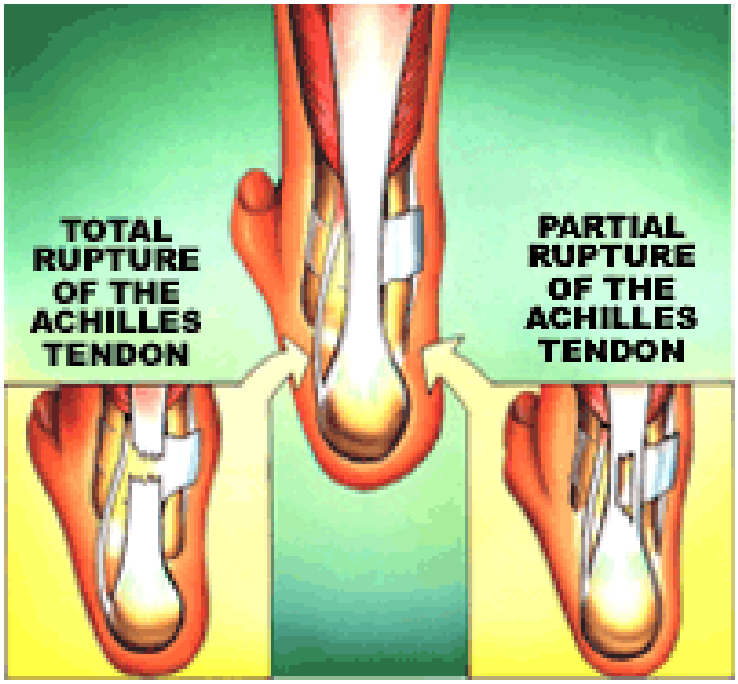

Figure 12 : Achilles tendon total and partial ruptures ,
from Runner's World, 2002

2.5. Types of rehabilitation

Unfortunately it does not exist a structured protocol based in indications for the treatment of rupture of the Achilles tendon . There is a big controversy among attending physicians for the selection of appropriate therapy .

In international literature , the last decade , clinical studies with results of *surgical* and *non- surgical* treatment of the rupture are increased .

Modern methods of non- surgical rehabilitation seems to bring good results with acceptable levels of complications .

From the other hand , the defenders of surgical therapeutic approaches rely that they achieve stronger restoration with fewer new rifts .

Newer studies show that the restore of functionality is fast and safe when the functional recovery is integrated properly in a non- invasive or invasive therapeutic model .(17)

The factors that have to be taken into account when selecting the appropriate treatment are:

- the professional and energetic activity of the individual
- the age (surgical treatment is indicated in young people)
- the general state of health (presence of concomitant disease)
- the degree of damage (partial or total rupture)

Therefore , in each case , the way of therapeutic approach should be individualized according to the health status and the needs that each patient has .

Non- surgical rehabilitation

Chosen to be presented is the non -invasive therapeutic model of Weber , as discussed in the comparative study of his research group .

Phase of Achilles Tendon fixation

The patient is placed in prone on the examination table and bring the ankle in an angle of 20° of PF .

The convergence of the two stumps of the tendon should be full or nearly full (less of 5 mm) at palpation , which it can be detected by ultrasonography .

We place a bandage from almost rigid plaster in an angle of 20° of PF .

The plaster is applied in its place while the patient is in an upright position and rest on a stand of 20° supporting totally his weight. Then the foot is placed at a special " boot " (Fig. 13) which carries the point of the heel a built- soled with height 1 cm .

Inside the boot are placed two elevated plantar supports 2 cm each .(10)

Walking is permitted up to the point that is permissible by the patient.

Thromboembolic prevention is administrated for 10-14 days and the gypsum is removed after 7 days , when the swelling subsides greatly. The healing of the tendon is controlled by specifying the restore cohesion of the tendon by the method of palpation , the Thompson assay and the isometric activation of triceps muscle .

The ankle joint is repositioned in plaster with PF in 20° . After changes are made in plaster at intervals of 10-14 days , mainly for reasons of hygiene . Patients wear the boot throughout during the day and are allowed to take it out during night but it is forbidden to walk without it because the plaster alone is not able to provide them with adequate protection .(12)

In six weeks the cast is removed , and the plantar support is decreased at 2 cm for 2 more weeks . By 8^{th} week the whole support is removed and the patient continues to wear the boot for 4 additional weeks . After this time, the patient can wear normal shoes but with plantar support of 8.5 mm .

Immediately after the immobilization process , physiotherapy and rehabilitation process began . Specifically, from the 2^{nd} to 3^{rd} day after the lesion, and if the patient begins to feel comfortable with the application of the " boot " , exercises are performed related to walking at various levels , with support on one foot , isometric exercises and stationery bicycle .(16)

After 6 weeks , ankle mobility exercises are added on the program . By the 8^{th} week ,

the emphasis is on strengthening of the gastrocnemius muscle and at 12th week the patient stops wearing the " boot " , is running and doing jumps on level ground and the exercises for lifting the heel on one foot began .

After a period of 16 weeks along with the running exercises , there is a beginning of specific exercises depending to the type of sport that the patient may did , before the injury .

After 6 months , the patient is able to deal with sports that involve the risk of uncontrolled movements of ankle joint as football , volleyball and basketball .(14)

Figure 13 : VACOped boot,
from WordPress, 2012

Surgical treatment

Recent studies reinforce the preference of surgical treatment of acute rupture of the Achilles tendon to physically active individuals by using open or percutaneous method.

While surgical repair appears to provide beneficial results in restoration of functionality , and lower incidences of new tears compared to the conservative treatment , the incidence of postoperative complications is still puzzling the scientific community . Is reported that these complications occur in 7 - 42 % of cases relating to difficulties in healing of the wound , in skin necrosis , infection , new rupture and loss of sensation .

The choices of surgical treatment is *open surgery rehabilitation* and *percutaneous surgical repair* .(17)

Open surgery rehabilitation

In open surgery the patient is in prone position under general or spinal anaesthesia . Followed by longitudinal incision within 1 cm from the tendon inwardly with maintaining minor saphenous vein and the sural nerve . The course of the cross section follows the " paratenon " of the tendon , thus creating a thick flap from the section in between the tendon and the " paratenon " . This is how it is recognized the point of rupture and the two stumps slightly isolated from foreign bodies . The reparation of the tendon is achieved by applying one of the two methods , Bunnell or the modified method of Kessler with non- absorbable sutures number 5 and an absorbable suture is placed over the tendon .

The careful repair of the " paratenon " is necessary . The surgery ends with the closure of the subcutaneous tissue and skin and the application of gypsum in PF in 20° .

In the fifth to seventh postoperative day , the plaster is removed and the incision of the patient is controlled . If and when the incision is in good situation , the patient wears the boot with lifting brackets . The brackets are removed in 3 - 4 weeks in order to achieve a neutral position of the heel .

Patients are instructed in the rehabilitation process for performing isometric contractions of the gastrocnemius and soleus . Physical therapy continues and focuses on stretching and strengthening exercises and gently run which is allowed after 3 - 4 months .

In case that have achieved satisfactory levels of empowerment , only then , the patient can freely return to its original sporting activities (approximately 4 - 6 months after the surgery) .(19)

Percutaneus surgical repair

Percutaneous suturing , originally described by Ma and Griffith , is done under local anaesthesia and postoperative functional restoration and seems to bridge the gap between the two previous methods , by combining their advantages .

However this method is criticized by several specialists because it provides about 50 % of the initial strength provided by the open surgery , endangering the sural nerve damage (up 60 %) and have higher recurrence rates of rupture of the open surgery . On the other hand , there are no large , prospective , comparative studies with large number of patients operated transdermally .

Industrial studies show that a new method of percutaneous approach provides approximately duplicate empowerment after the rehabilitation compared with the conventional method and which is described below (Andrej Cretnik , 2005) .

The patient is placed in prone position having the injured leg in PF in 25° under local anaesthesia without the use of tourniquet . Is not given antibiotic or antithrombotic prophylaxis on the patient .

Before starting the process , identification of the rupture and the gap that has been created occurs . (19)

Subsequently , on the center (approximately 5 cm) and distally (in 4 cm) around the vacuum palpable , the skin and the subcutaneous tissue , is filtered lidocaine solution of 15 ml (without noradrenaline) through 8 holes , which are later used for the entry of the needle and are getting magnified . The patient is not receiving other drugs or nervous inhibitors during the surgery . Attention is given to the lateral side and

especially centrally where the sural nerve lies beside the Achilles tendon , which he crosses .

The patient is asked to declare any changes or feeling of pain during the puncture or the filtration. And so the tendon is repaired with the new amended provision by using Vicryl, number 2 .

The process starts and terminates inwardly and distally . First a suture in a long , semi-curved needle passes transversely to the length of the tendon , followed by a diagonal seam. It is more convenient to use two needles (one for each suture) , so the needle is not moved from one point to another . If both needles are used simultaneously , you can avoid possible damage to splicing because only the needle (metal) could be hit on the length of the tendon. On each side of the entrance / exit of the needle , the incision is widening in longitudinal direction , so that the surgeon can overdo the subcutaneous suture . Then the thread is directed to the longitudinal axis , subcutaneous and outside of the tendon and the next stitching on the tendon is being made centrally. Then the two ends of the filament are driven externally and distally of the tendon back to the second and third symmetrical hole and pulled back until the two stumps of the torn tendon brought together perfectly and the fault is no longer possible to be palpated .

After the convergence of the two ends , the outboard end of the yarn passes inwardly after the final tensioning of the two ends , the suture is tied . The knots are covered by the subcutaneous tissue in the second insider hole .

The whole process has left visible only 8 small incisions. The convergence is verified by ultrasonography .

Postoperatively , a similar immobilization program is followed as described above .(17)

2.6. Etiology and Clinical picture

Etiology

The causes of the Achilles tendon rupture are many and are distinguished in the over the years sporting activity mostly in professional athletes but it happens to normal people that exercise as well , the surge activity (duration , distance , intensity) that some exercise request , the reduce of the rehabilitation time , some alternations of the surface of the training and also the footwear changes that people do very often .

We also have some causes due to structural changes on the body such as excessive pronation in the ankle, the muscle weakness of gastrocnemius, poor elasticity of the ligaments , the reduced mobility of the ankle and also the lack of muscle coordination that the patient may have .

Also bouncing or a direct blow during an activity, or during speed running are factors responsible for the Achilles tendon rupture .(3)

Clinical picture

In the rupture of the Achilles tendon , initially you hear a snapping noise while the patient feels an intense stabbing pain just above the heel , like they have throw a stone to him . This injury without contact is the most common that happens .

The most important clinical feature is the inability of the patient to walked on the toes of the injured foot .

In recent cases is found that by palpation you feel a gap at the point where the rupture is , which is later covered by swelling . Squeak or creak they may exist , but they may not as well .(4)

2.7. Thompson test

The control of the Achilles tendon for rupture with the method of pressure in gastrocnemius was first described by Simmonds (1957) . Thompson (1962) observed the results two years earlier in 1955 .

It has been recognized that the Thompson test (Fig. 14) is pathognomonic for the complete rupture of the Achilles tendon, but its mechanics are not pure.

To provide the test of Thompson the patient is placed in prone position with the foot out of the edge of bed . The examiner applies pressure in the middle of the sural fate by controlling at the same time the toes . Originally the toes are pointing downwards .

In case that there is no rupture of the Achilles tendon , normally with the pressure will be caused PF of the ankle , while the fingers will be pointing backwards .

According to the Thompson test , when the gastrocnemius of the affected extremity with complete rupture of the Achilles tendon is depressed normally is expected not to show any movement (PF) .

Sometimes is required ultrasound to confirm the diagnosis .(7)(9)

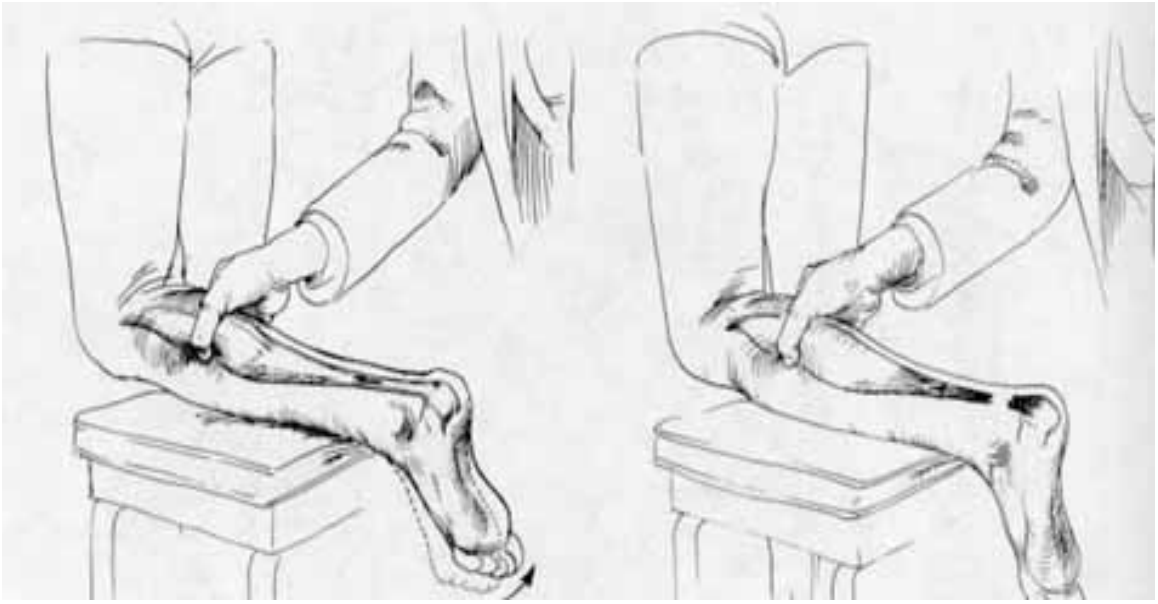

Figure 14 : Thompson test,
from Connecticut Center for Orthopedic Surgery, LLC, 2014

3. SPECIAL PART

3.1. Methodology

This case study took place at the Centrum Léčby Pohybového Aparátu Vysočany, a medical center which is based in Sokolovska 810/304, PC 19061, Prague.
My practice was made from the 06/01/14 until the 17/01/14.
The clinic is specialized in orthopaedics and rehabilitation.
The care that the clinic offers varies from all kind of Orthopedics and Surgery to General / Sport Injury Rehabilitation and accommodates inpatients in special rooms, with two beds on each mostly, for after the surgery and out patients with ambulances that are working during morning hours.
It offers a big range of therapeutical techniques and methods, including electrotherapy, hydrotherapy, massage and a fully equipped fitness room and the equipment that they use is the latest on the market.

They provide all the means of therapy including:

- electrotherapy (shockwave , magnetotherapy)
- hydrotherapy (whirlpool , under water massage for whole body / upper extremities / lower extremities , spa program)
- gym (bicycles , muscle strengthening machines , sensomotoric training equipment [wobble boards , posturomed] , therabands , overballs , treadmills)

My supervisor was PhDr. Edwin Mahr PhD. and all the examinations and the therapeutical procedures that were provided they were under his supervision and his cooperation.

My patient was informed from the beginning for the purpose of the Bachelor's thesis case protocol and the work has been approved by the Ethics Committee of the Faculty of Physical Education and Sport at Charles University, Prague.

3.2. Anamnesis

Examined person: H.F. (female)

Date of birth: 1976

Diagnosis: Achilles Tendon Rupture (left lower extremity)

Present state (Status presents):

Height: 1.69 cm

Weight: 61,5 kg

Body Mass Index: 21.5 (normal weight)

Today is my first contact with the patient, she is on the 2nd day of physiotherapies.

She does not feel any pain or dizziness, her face has normal color, and today she is in a really good mood because she does not feel pain on the ankle.

She needs to regain as much function as it is possible on her lower extremity so she can adjust herself to her daily routine again.

Anamnesis/History:

The patient was injured on the 18th of October as she was playing badminton.

As she stated she did not do any stretching before she started playing and she provoke the injury the moment she run fast to the net in order to hit the shuttlecock.

She immediately had severe pain and fall dawn on the ground.

She was operated for Achilles tendon rupture in the same day in the next 7 hours in Všeobecná fakultní Hospital in which she stayed for 2 days.

After the surgery they put cast on her leg and then the next day they took it out and put VACOped boot which they finally took out on the 28th of November.

The ankle in the VACOped was for 4 weeks in PF after it was for 3

days in neutral position and finally for 2 weeks in DF.

Her ankle was painful after the surgery for the first days.

The surgery lasted about 60 min. with local anaesthesia and she did not have any complications.

For 7 weeks she was having both crutches and then for 3 days she had only 1 crutch.

After orthesis was out the first 2 times they applied kinesiotape into her ankle.

Previous rehabilitation (RHB): There was no previous rehabilitation.

Personal anamnesis: Common childhood diseases

Family anamnesis: No diseases connected to this orthopaedic state.

Hobbies-Activities of Daily Living: Beach-volleyball, Ice-skating, Skiing (beach-volleyball → x 3 times a week / ice-skating and skiing → only during winter time, once every two weekends [not professional training without warm-up, stretching some times after training for few seconds])

Social anamnesis: The patient is living in a family house with her husband, and there is no lift so she needs to go up and down 15 stair-steps.

Occupation: Office worker/ Assistant (mostly sitting in office)

Allergic anamnesis: None

Gynaecological anamnesis: Normal menstruation/ No pain/ On time, Contraception pills

Operation anamnesis: Appendix → 1983 (5 cm long, 7 years old)

Pharmaceutical anamnesis:

Gluteal painkiller injections → for 2 days (during hospitalization)

Normal painkillers → for 1 week / 1 pill every night

Abuses: Social drinker / Non smoker / Coffee only twice per week during weekends

Statement from the patient's medical documentation: None

Indication of rehabilitation:

Medical doctor's indication of rehabilitation:

The patient must follow a specific RHB program under the standards after Achilles tendon rupture surgery.

Isometric exercises (soleus, gastrocnemius, tibialis anterior and tibialis posterior)

Exercises for prevention of the thromboembolic complications.

Walking with crutches

Breathing exercises

Exercises to increase Range of Motion (ROM) and strengthening the weak muscles (soleus, gastrocnemius, tibialis anterior and tibialis posterior)

Differential diagnosis:

There can be multiple reasons for an Achilles tendon rupture but the most common include the sudden activation of the muscles or the tendons during sports or a prolonged period of inactivity or muscle atrophy. It can also be caused from fallen arches, flat feet, overpronation or even from often usage of high heels because of stress that is caused on the Achilles tendon.

Inflammatory arthropathies, Tennis leg (plantaris tendon tear), different calf and ankle injuries or syndromes, ankle osteoarthritis, Achilles tendonitis or bursitis, or Haglund deformity, are all often causes and reasons for this type of injuries.

3.3. Initial kinesiologic examination

Examination by observation of the patient (According to Kendall):

The examination of our patient was made in standing.

The type of breathing that she is using is lower thoracic, which is physiological, the color of her skin is also normal and her lower extremities are symmetrical.

Anterior View:

- Slightly flat feet (on the right more)
- Eversion on right foot + slightly valgus Heel
- Medial malleolus is higher on the right lower extremity
- External rotation in both knee joints
- Quadriceps on the right lower extremity are hypertrophic
- Internal rotation in hip joint (more in left side)
- Torsion on the pelvis
- Umbilicus is more at the left side
- Difference on the distance between the two arms and the intercostals (the distance on the right arm is bigger)
- Arms very close to body
- Left forearm is external rotated
- Difference on the clavicles (left one is prominent)
- Right shoulder is lower than the left one
- Distance between left ear and shoulder is shorter than the right

Posterior View:

- Valgosity on right heel
- More weight bearing in medial side
- Hypertrophy in distal part of calf in the right leg
- Knees externally rotated
- Calf muscles and hamstrings on the right lower extremity are hypertrophic
- Right gluteal muscle is elevated higher
- Posterior superior iliac spines are not symmetrical
- Torsion of pelvis

- Distance between upper extremity and trunk in right side is bigger than in the left side
- Distance between right scapula and spine seems to be bigger than the left one
- Left shoulder elevated (scapula)
- Hypertrophy in the left upper trapezius
- Head is lateral flexed in the right side

Lateral View:

- Lordotic-Kyphotic posture
- Hyperextented knees
- Soldier-like posture (hands forward, slightly medial rotation)
- Anterior tilt
- Head forward
- Abdominals slightly prominent

Observation of the scar and palpation of the area around the scar:

The scar is 10 cm long, the scar shape is not that meticulous and the stitches are taken out.

There is red colour on the scar and the area around and also swelling is present.

Although there is no liquid secretion but there is a hard feeling / stiffness of the tissue because of skin restriction.

Palpation of the muscles:

The muscles that were examined in both lower extremities are the below:

	Right	*Left*
Vastus lateralis	Hypertone	Hypotone
Vastus medialis	Normal	Normal
Tensor fascia latae	Normal	Normal
Hamstrings	Hypertone	Hypertone
Gastrocnemius	Normal	Hypotone

Soleus	Normal	Hypotone
Tibialis anterior	Hypertone	Hypotone

Table 6: Palpation of muscles for both LE's

The examination was made in supine and prone position by both hands and by this examination we checked if there is a range of differences on each lower extremity.

→ There are some differences in each lower extremity because of the rupture on the Achilles tendon.

Anthropometry measurements:

Circumferences

	Right	*Left*
Thigh: (15 cm above knee cap for whole quadriceps)	52 cm	48 cm
(10 cm above knee cap for vastus medialis)	48 cm	44 cm
Above knee:	39,5 cm	37,5 cm
Knee cap:	37,5 cm	39 cm
Below knee:	34,5 cm	34,5 cm
Calf:	35,5 cm	32,5 cm
Ankle:	25,5 cm	29,5 cm

Table 7: Circumference measurements for both LE's

Functional length:

Right	*Left*
85 cm	85 cm

Table 8: Functional length measurement for both LE's

Anatomical length:

Right	*Left*
83 cm	83 cm

Table 9: Anatomical length measurement for both LE's

ROM examination (According to Kendal):

Hip Joint:

	Right	*Left*
Flexion:	125^0	120^0
Extension:	15^0	10^0
Internal Rotation:	30^0	30^0
External Rotation:	45^0	45^0
Abduction:	45^0	40^0
Adduction:	30^0	25^0

Table 10: ROM examination in hip joint for both LE's

Knee Joint:

	Right	*Left*
Flexion:	135^0	130^0
Extension:	0^0	0^0

Table 11: ROM examination in knee joint for both LE's

Ankle Joint:

	Right	*Left*
Plantar Flexion:	45^0	10^0
Dorsal Flexion:	20^0	5^0
Inversion:	45^0	20^0
Eversion:	30^0	15^0

Table 12: ROM examination in ankle joint for both LE's

Toes:

	Right	*Left*
Big toe: (proximal phalanx)	75^0	75^0
(distal phalanx)	5^0	5^0
2nd digit: (proximal)	70^0	70^0
(distal)	5^0	5^0
3rd digit: (proximal)	70^0	70^0
(distal)	5^0	5^0
4th digit: (proximal)	70^0	70^0
(distal)	5^0	5^0
5th digit: (proximal)	70^0	70^0
(distal)	5^0	5^0

Table 13: ROM examination of Flexion in toes for both LE's

Basic movement patterns (According to Janda):

Hip abduction:

The patient for providing the movement was using the gluteus minimus and medius and afterwards the tensor fascia latae.

Pelvis was stabilized so she is using quadrates mechanism.

Hip extension:

The patient during the examination for providing the movement was using first the hamstrings (semimembranosus, semitendinosus, biceps femoris), after the gluteal muscles, and then the erector spinae muscle.

There was no elevation of the opposite shoulder.

GAIT examination (According to Kendall):

We asked from the patient to walk on the hall from one door to the other so we can observe her movement pattern.

During her walking we noticed that she can walk in a fluent way and quite fast.

She was walking using slightly ER on the left lower extremity, with lateral tilt of pelvis to the left and we can clearly say that she was very confident when she was walking.

- Asymmetry of shoulders
- Lateral tilt of pelvis especially to the left side
- Trunk is not stiff
- Visible vertical motion of pelvis up and down
- Internal rotation in right hip
- More pressure on the right foot
- She is standing longer on the right foot (more lateral side on the left lower extremity)
- Overlapping knees
- Motion on arms / she is moving more the left upper extremity than the right one
- Right upper extremity seems to have extension in shoulder joint / left upper extremity seems to have flexion
- Rotation of trunk to the right / lateral flexion to the left
- Head-cervical spine is not moving
- Head to the right
- The first contact with the floor is with the heel and then the sole of the foot
- Heel more to the lateral side
- Walking without curving the feet → just in two phases (heel → whole foot)
- Extension of whole toes → because of flat feet
- Right step is longer than the left
- Slow walking

Heels: -

Tip toes: Bigger instability in lumbar spine

Squat: Not able to provide because of pain in the operated ankle

With closed eyes: There is a small change but she still controls her movements.

She is having bigger motion on the toes, she is walking faster and she mentioned that there is no pain during the walking.

Backward: -

- ✓ Walking on heels : the patient could not walk (she was walking more to the right side) / quite painful
- ✓ Walking on tip toes : the patient could walk but not with confidence / slightly painful
- ✓ Squats walking : could not provide it / painful
- ✓ Walking with eyes closed : the patient was not that stable
- ✓ Walking backward or star walking: the patient was not able to provide it / painful

Standing with:

Feet together: small instability, able

Right knee flexed: small instability, able

Left knee flexed: small instability, able

➔ With this examination we can find out the type of walking that the patient has such as Antalgic walking (protective / avoiding walking), Flat Feet walking (clap sound on the floor), the leg loading (partial, full or without loading) and the coordination-synkinesis.

Two Scale examination:

Physiological difference in loading is up to 5 kg, approximately 10-15% of body weight. Bigger difference indicate imbalance.

	Right	*Left*
Total: 61,5 kg	34 kg	27,5 kg

Table 14: Differentiation of weight loading in LE's with the Two Scale examination

The difference in this case is 6,5 kg which is not physiological so we can conclude that the patience has imbalance.

Muscle strength test (According to Kendall):

The grading scale for this test is from 0 - 5 with:

0 = Zero (no muscle contraction)

1 = Trace (contraction felt but no movement)

2 = Poor (partial movement but in horizontal position)

3 = Fair (hold against gravity)

4 = Good (hold against moderate pressure)

5 = Normal (hold against strong pressure)

Lower extremity:

	Right	*Left*
Gluteus maximus:	4	4
Gluteus medius:	4	4
Gluteus minimus:	4	4
Lateral rotators of hip joint: (Piriformis, quadratus femoris, obturator internus, obturator externus, gemellus superior, gemellus inferior)	4	4
Hip adductors: (Pectineus, adductor magnus, gracilis, adductor brevis, adductor longus)	4	4
Tensor fasciae latae:	4	4
Sartorius:	4	4
Iliopsoas:	4	4
Quadriceps femoris: (Rectus femoris, vastus laterallis, v.intermedius, v.mediallis)	4	4

Biceps femoris:	4	4
Semimembranosus:	4	4
Semitendinosus:	4	4
Popliteus:	4	4
Plantar flexors: (Gastrocnemius, plantaris)	4	2
Soleus:	4	2
Peroneus longus and brevis:	4	3
Tibialis posterior:	4	2
Tibialis anterior:	4	2
Extensor digitorum longus and brevis:	4	4
Flexor digitorum longus:	4	4
Flexor digitorum brevis:	4	4
Dorsal interossei:	4	4
Extensor hallucis brevis:	4	4
Extensor hallucis longus:	4	4
Flexor hallucis longus:	5	5
Flexor hallucis brevis:	5	5
Abductor hallucis:	5	5

Table 15: Muscle strength test evaluation for both LE's

Abdominal muscles:

Upper abdominal muscles:	5
Lower abdominal muscles:	5
External and internal oblique:	5

Table 16: Muscle strength test evaluation for abdominal muscles

Back muscles:

Erector spinae:	4

Table 17 : Muscle strength test evaluation for back muscles

Muscle length test (According to Janda):

The grading scale for this test is from 0 - 2 with:

0 = no muscle shortness

1 = moderate shortness

2 = marked shortness

Lower extremity:

	Right	*Left*
Abdominal wall:	0	
Erector spinae:	0	
Quadratus lumborum:	1	1
Iliopsoas:	1	1
Rectus femoris:	0	0
Tensor fascia latae:	0	0
Short hip adductors:	1	1
Gluteus maximus:	0	0
Minimus:	0	0
Medius:	0	0
Piriformis:	1	1
Hamstrings:	1	1
Tibialis anterior:	0	2
Soleus:	1	2
Gastrocnemius:	1	2

Table 18: Muscle length test evaluation for both LE's

Muscle tone examination:

Lower extremity:

	Right	*Left*
Gluteus maximus:	Normal tone	Normal tone
Hip adductors: (Pectineus, adductor magnus, gracilis, adductor brevis, adductor longus)	Hypertone	Hypotone
Quadriceps femoris: (Rectus femoris, vastus laterallis, v.intermedius, v.mediallis)	Hypertone	Hypotone
Biceps femoris:	Hypertone	Normal tone
Semimembranosus:	Hypertone	Hypotone
Semitendinosus:	Hypertone	Hypertone
Soleus:	Hypertone	Hypotone
Abductor hallucis:	Hypertone	Normal tone
Hamstrings:	Hypertone	Hypertone

Table 19: Muscle tone evaluation for both LE's

Abdominal muscles:

Upper abdominal muscles:	Normal tone
Lower abdominal muscles:	Normal tone
External and internal oblique:	Normal tone

Table 20: Muscle tone evaluation for abdominal muscles

Back muscles:

Erector spinae:	Hypotone

Table 21: Muscle tone evaluation for back muscles

Joint Play examination (According to Lewit):

When there is restriction present that means that the joint is blocked.

	Right	*Left*
Lumbar spine: (all directions)	Present	Present
Sacroiliac joint: Ventral	Present	Present
Dorsal	Present	Present
Hip joint:	Present	Present
Knee joint:	Present	Slightly restricted
Patella:	Present	Slightly restricted
Head of fibula:	Present	Restricted
Talocrural:	Slightly restricted	Restricted
Subtalar joint: Supination	Slightly restricted	Restricted
Pronation	Slightly restricted	Restricted
Transverse tarsal joint: (Chopart joint)	Present	Restricted
Tarsometatarsal joints: (Lisfranc joints)	Present	Restricted
Metatarsophalangeal joints: (1^{st},2^{nd}, 3^{rd}, 4^{th}, 5^{th})	Present	Restricted

Table 22: Joint play examination evaluation for lumbar spine and both LE's

NEUROLOGICAL EXAMINATIONS:

Sensation in dermatomes:

The patient must have closed eyes in order to make more sufficient the examination. We touch her with the hands first on the thigh of one lower extremity and then on the second one. The patient must inform us if she feels the touch and if there is any difference between both lower extremities.

→ She had the same feeling in both sides

Afterwards we continue with the whole lower extremity from the medial side until the biggest toe, then we touch it from the lateral side until the first three toes and we ask her if she feels the touch and if it is the same in both lower extremities.
(we provide this examination from centre to peripheral)

→ She had the same feeling in both sides

Deep tendon reflex:

The grading scale for tendon reflexes is from 0-4 "plus" (plus, brisk is for every reflex which is a bit higher than the normal rate):

0 = Absent

1 = Hypoactive

2 = Normal

3 = Hyperactive without clonus

4 = Hyperactive with clonus

	Right	*Left*
Patella (L2-4):	3+	3+
Achilles tendon (L4-5):	2+	Not examined
Medial plantar (L5-S2):	2+	2+

Table 23: Deep tendon reflex evaluation for both LE's

Surface sensation (L4-S1):

L5 (from outside to inside) → same feeling on both sides
L4 (from inside to outside) → same feeling on both sides
S1 (in hamstrings) with bend knees → same feeling on both sides

Deep sensation:

Test for Ataxia:
-opened arms at the sides → closed eyes → the patient is touching her nose
-the patient must touch her left knee till the ankle with the right heel and then the opposite

➔ The patient is able to provide it.

Babinski sign:

➔ No reaction / Negative

Sensory examination:

Pin Prick:
The patient was feeling the same touch in both lower and upper extremities.

Sharpness of pain:
The patient could successfully feel the feeling of the pin on her body in the same level in lower and upper extremities.

Temperature:
Same successfully results we had on this test, the patient was able to feel the same temperature level.

Trendelnburg test:

The patient has to stand with one lower extremity with hip and knee flexed.

Right knee: Pelvis go down in the beginning of the motion but then returns → R of the trunk to the right in order to balance herself, small instability, able
Left knee: Was more stable but R of the trunk to the left for balancing, able

Rhomberg test:

-I = negative
-II (feet together) = negative
-II (eyes closed) = negative

- Stand on one lower extremity : More stable with the right extremity
- Eyes closed : With the left she looses her balance slightly
  - The patient is quite stabilized.

3.3.1. Conclusion

Conclusion of examination:

The patient, after the operation of Achilles tendon rupture that she had, has the left lower extremity weak (quadriceps, gastrocnemius, soleus, tibialis anterior muscles) which is fairly common and normal after such an operation.

Thus her right lower extremity is in total in hypertonicity mostly because of the overuse she is doing as she works it more than the left one and she is loading it more as well.

There is no abnormal pain and the patient is in good mood in general.

The patient need to work on her left lower extremity in order to regain the strength that is decreased because of the rupture that happened.

We can also conclude that the average of her muscles, gastrocnemius, soleus, tibialis anterior, are in hypotonicity and that is obviously caused by the disbalance from the accident .

The ROM of all the joint in both of her lower extremities are physiological except the left ankle joint which has a significant differentiation due to the operation she was under , with difference of the left of 35^0 in plantar flexion, 15^0 in dorsal flexion, 25^0 in inversion and 15^0 in eversion. It is also noticeable a 5^0 difference in left hip joint as well in flexion, extension, abduction and adduction and also on the flexion of left knee joint. Although, these differences are physiological after such an operation.

The shortness of the calf muscles it will be solved as long with the healing of the scar under the physiotherapy sessions.

There is visible presence of swelling and the colour on the scar area is red.

She is able to walk, not sufficiently though, with small restriction and with slight deficiency. The squat and heel walking that she was not able to provide is because of the ROM restriction and the shortness of the calf muscle as well, but along with the therapy we will see that she is going to be able to provide them.

Both lower extremities have the same length so we do not have to worry about any other complication in that level that may be connected with the rupture.

3.4. Short-term and long-term rehabilitation plan

Short-term:

We must target in increasing the ROM in ankle joint in all directions as much as possible in order to rich patient's previous condition. We also have to increase the proprioception and the stability and strengthening the weak muscles on the left lower extremity that caused from the state after the operation.

By applying the below:

Sensomotoric training → for improving the stability in ankle joint
Posturomed → for improving the stability in ankle joint
Balance lens → for improving the stability in ankle joint
Walking on rope → for improving the stability in ankle joint
Stability training → for improving the general body stability
Isometric exercises → gastrocnemius, soleus, tibialis anterior
Exercises to increase ROM → in ankle joint (PF, DF, IN, EV)

Cycling for warm up → is goof for ROM (5 mins)
Isometric contraction → quadriceps, gastrocnemius, soleus, tibialis anterior
Stepping up on toes → for strengthening calf muscles (x 20 repetition)
Providing PF, DF, IN, EV exercises → (each x 20 repetitions)
Scar care → for scar healing

Active ROM exercises for ankle joint must be continued
Breathing exercises for correcting the posture
Thromboembolic exercises → for thromboembolic prevention
Walking training → for improvement of walking pattern
Patient must continue exercising for strengthening the ankle joint in general

Long-term:

In long-term rehabilitation plan the patient must continue with the same exercises and keep the same motive as in the short-term rehabilitation plan except thromboembolic

exercises as the patient will be moving.
Must be noticed that she must be informed about the importance of the exercises and the strengthening of her ankle to prevent any further injury.
Also swimming in crawl and back crawl style is a very good proposed exercise because of the movement pattern of the feet that is needed.

Also we need to apply:
Stimulation of calf muscles/ soft massage on the calf muscles
Massage on the scar
Stability exercises for better balance
Strengthening exercises for weak muscles (gastrocnemius, soleus, quadriceps)
Breathing for improving the posture

Must be noticed that she should avoid overloading the left lower extremity at the moment, and she must be also trained on walking up and down into the stairs
Must be also used more intense exercises for strengthening of calf muscles and the ankle joint.

Goals of therapy:
Healing of the Achilles tendon
Minimizing the pain
Minimizing the swelling
Minimizing the inflammation
Increasing ROM
Increasing balance
Strengthening weak muscles
Stretch/elongate short muscles
Restoring the Achilles tendon into its original state
Restoring the muscles into their original state (including strength and flexibility)
Return into patient previous condition, life style and training level

3.5. Therapy progress

Date: 7/1/2014

Status present: ROM in ankle joint → PF = 10^0 , DF = 5^0 , IN = 20^0 , EV =15^0

Subjective: we will work on the ROM in ankle in order to increase it

Objective: the patient was in a good mood, confident about the therapy procedure and she would like to see improvement on the ankle's joint ROM

Goal of today's therapy unit:

Minimize the swelling on the ankle

Increase Passive ROM in ankle joint in PF, DF, IN, EV directions

Procedure:

Hydrotherapy (Warm bathing)→ in Achilles tendon area (10 mins, 38^0 C) for myorelaxation before manipulation and mobilization, soft tissue technique, reducing swelling and providing better blood flow that allow better healing

Lazer (polarised light)→ for antiedematic and analgetic effect of the scar, vasodilatation and biostimulation for collagen production (2mins/ beam area 3.00 [J / cm^2] / frequency 10.5[Hz])

Magnetotherapy → for vasodilatation, analgesia, anti-inflammatory effect and myorelaxation (25mins/ dose 3[T^2/s]/ magnetic induction 90[mT]/ frequency 15[Hz])

Scar care → for better blood flow, circulation on the scar / soft tissue techniques

- Massage the area of the scar from the end to the start using S shape
- Pressing the scar
- Massaging the surrounding area

Mobilization → of ankle joint (also any other restricted joints in both LE)

Stretching → in supine position with the help of a theraband for hamstrings (F of the hip), adductors (ABD of the hip), tensor fascia latae/ abductors (ADD of the hip), gastrocnemius and soleus (DF of the ankle), in prone position for quadriceps (F of the knee in 90^0 with the theraband crossed on the ankle joint) and in standing for tibialis anterior (DF of the ankle)

Sensomotoric training → simple walking on the wobble boards for stability training for the ankle joint (x 10 repetitions)
Posturomed → stepping up with one leg, stay for some seconds and try to balance and then back down (x 10 repetitions)
Isometric exercises → for gastrocnemius, soleus and tibialis anterior muscles
Exercises to increase ROM → PF, DF, IN, EV in ankle joint with the help of a theraband (x 20 repetitions)

Results: The scar was restricted on the distal part. There was blockage in all of the joints of her left ankle and also a restriction on both fibula's. She provided most of the exercises properly but there was a visible instability present overall.

Date: 8/1/2014

Status present: ROM in ankle joint → PF = 10^0, DF = 5^0, IN = 20^0, EV =15^0
Subjective: we will work on the ROM in ankle in order to increase it
Objective: the patient was in a good mood, confident about the therapy procedure and she would like to see improvement on the ankle's joint ROM
Goal of today's therapy unit:
Increase Passive and Active ROM in ankle joint in PF, DF, IN, EV movements
Decrease pain / swelling that is present on the ankle

Procedure:
Hydrotherapy (Warm bathing)→ in Achilles tendon area (10 mins, 38^0 C) for myorelaxation before manipulation and mobilization, soft tissue technique, reducing swelling and providing better blood flow that allow better healing
Lazer (polarised light)→ for antiedematic and analgetic effect of the scar, vasodilatation and biostimulation for collagen production (2mins/ beam area 3.00 [J / cm^2] / frequency 10.5[Hz])

Magnetotherapy → for vasodilatation, analgesia, anti-inflammatory effect and myorelaxation (25mins/ dose 3[T^2/s]/ magnetic induction 90[mT]/ frequency 15[Hz])

Scar care → for better blood flow, circulation on the scar / soft tissue techniques

- Massage the area of the scar from the end to the start using S shape
- Pressing the scar
- Massaging the surrounding area

Mobilization → of ankle joint (also any other restricted joints in both LE)

Stretching → in supine position with the help of a theraband for hamstrings (F of the hip), adductors (ABD of the hip), tensor fascia latae/ abductors (ADD of the hip), gastrocnemius and soleus (DF of the ankle), in prone position for quadriceps (F of the knee in 90^0 with the theraband crossed on the ankle joint) and in standing for tibialis anterior (DF of the ankle)

Sensomotoric training → simple walking on the wobble boards for stability training for the ankle joint (x 10 repetitions) / walking on the wobble boards while holding a ball (x 10 repetitions) - for increasing the level of difficulty-

Posturomed → stepping up with one leg, stay for some seconds and try to balance and then back down (x 10 repetitions) / stepping up and down with one leg after the other (x 10 repetitions)

Isometric exercises → for gastrocnemius, soleus and tibialis anterior muscles

Exercises to increase ROM → PF, DF, IN, EV in ankle joint with the help of a theraband (x 20 repetitions)

Results: The scar was restricted on the distal part. There was blockage in all of the joints of her left ankle and also a restriction on both fibula's. She provided most of the exercises properly but there was a visible instability present overall.

The patient is in a good mood and very confident.

She provide most of the exercises in a proper pattern and she is quite good but with no visible improvement since the last session.

Date: 9/1/2014

Status present: ROM in ankle joint → PF = 15^0, DF = 10^0, IN = 25^0, EV =15^0

Subjective: we will work on the ROM in ankle in order to increase it

Objective: the patient was happy, confident about the therapy procedure and she would like to see bigger improvement on the ankle's joint ROM

Goal of today's therapy unit:

Increase Passive and Active ROM in ankle joint in PF, DF, IN, EV movements

Decrease pain / swelling that is present on the ankle

Training for good body position in standing and walking

Procedure:

Hydrotherapy (Warm bathing)→ in Achilles tendon area (10 mins, 38^0 C) for myorelaxation before manipulation and mobilization, soft tissue technique, reducing swelling and providing better blood flow that allow better healing

Lazer (polarised light)→ for antiedematic and analgetic effect of the scar, vasodilatation and biostimulation for collagen production (2mins/ beam area 3.00 [J / cm^2] / frequency 10.5[Hz])

Magnetotherapy → for vasodilatation, analgesia, antiinflamatory effect and myorelaxation (25mins/ dose 3[T^2/s]/ magnetic induction 90[mT]/ frequency 15[Hz])

Scar care → for better blood flow, circulation on the scar / soft tissue techniques

- Massage the area of the scar from the end to the start using S shape
- Pressing the scar
- Massaging the surrounding are

Cycling → for warm up (5 mins)

Stretching → in supine position with the help of a theraband for hamstrings (F of the hip), adductors (ABD of the hip), tensor fascia latae/ abductors (ADD of the hip), gastrocnemius and soleus (DF of the ankle), in prone position for quadriceps (F of the knee in 90^0 with the theraband crossed on the ankle joint) and in standing for tibialis anterior (DF of the ankle)

Isometric contraction → in supine with pressing an overball (for quadriceps, gastrocnemius, soleus, tibialis anterior)

Sensomotoric training → simple walking on the wobble boards for stability training for

the ankle joint (x 10 repetitions) / walking on the wobble boards while holding a ball (x 10 repetitions) / walking on the wobble boards while holding a ball, throw it on the air and catch it again (x 10 repetitions) -for increasing the level of difficulty-
Posturomed → stepping up with one leg, stay for some seconds and try to balance and then back down (x 10 repetitions) / stepping up and down with one leg after the other (x 10 repetitions) / stepping sideways, stay with the knee and hip joints in semi flexion and then down from the same side (x 10 repetitions)
Isometric exercises → for gastrocnemius, soleus and tibialis anterior muscles
Exercises to increase ROM → PF, DF, IN, EV in ankle joint with the help of a theraband (x 20 repetitions)

Results: There is improvement since previous session in PF, DF and IN of 5^0 in each of them. The patient is very confident from seen the ROM increasing.
The scar was still restricted on the distal part. She provided all of the exercises properly and there was a smaller instability present overall. The patient is in a good mood and very confident because she provide most of the exercises in a proper pattern and she can feel the improvement since the first therapy session.

Date: 10/1/2014

Status present: ROM in ankle joint → PF = 20^0, DF = 10^0, IN = 25^0, EV = 20^0
Subjective: we will work on the ROM in ankle in order to increase it and strengthen the weak muscles
Objective: the patient was happy, confident about the therapy procedure and she would like to see bigger improvement on the ankle's joint ROM
Goal of today's therapy unit:
Increase Active ROM in ankle joint in PF, DF, IN, EV movements
Decrease pain / swelling that is present on the ankle
Training for good body position in standing and walking

Increase body balance

Minimize scar inflammation

Strengthening weak calf muscles

Procedure:

Hydrotherapy (Warm bathing)→ in Achilles tendon area (10 mins, 38^0 C) for myorelaxation before manipulation and mobilization, soft tissue technique, reducing swelling and providing better blood flow that allow better healing

Lazer (polarised light)→ for antiedematic and analgetic effect of the scar, vasodilatation and biostimulation for collagen production (2mins/ beam area 3.00 [J / cm^2] / frequency 10.5[Hz])

Magnetotherapy → for vasodilatation, analgesia, antiinflamatory effect and myorelaxation (25mins/ dose 3[T^2/s]/ magnetic induction 90[mT]/ frequency 15[Hz])

Scar care → for better blood flow, circulation on the scar / soft tissue techniques

- Massage the area of the scar from the end to the start using S shape
- Pressing the scar
- Massaging the surrounding are

Cycling → for warm up (5 mins)

Stretching → in supine position with the help of a theraband for hamstrings (F of the hip), adductors (ABD of the hip), tensor fascia latae/ abductors (ADD of the hip), gastrocnemius and soleus (DF of the ankle), in prone position for quadriceps (F of the knee in 90^0 with the theraband crossed on the ankle joint) and in standing for tibialis anterior (DF of the ankle)

Isometric contraction → in supine with pressing an overball (for quadriceps, gastrocnemius, soleus, tibialis anterior)

Sensomotoric training → simple walking on the wobble boards for stability training for the ankle joint (x 10 repetitions) / walking on the wobble boards while holding a ball (x 10 repetitions) / walking on the wobble boards while holding a ball, throw it on the air and catch it again (x 10 repetitions) / walking on the boards and catching the ball at the same time that I am throwing to her once at the right side and once at the left side (x 10 repetitions) -for increasing the level of difficulty-

Posturomed → stepping up with one leg, stay for some seconds and try to balance

and then back down (x 10 repetitions) / stepping up and down with one leg after the other (x 10 repetitions) / stepping sideways, stay with the knee and hip joints in semi flexion and then down from the same side (x 10 repetitions) / stepping up and squatting on it (x 10 repetitions)
Isometric exercises → for gastrocnemius, soleus and tibialis anterior muscles
Exercises to increase ROM → PF, DF, IN, EV in ankle joint with the help of a theraband (x 20 repetitions)

Results: Slightly improvement of 5^0 in PF and EV. The other motions are with stable degrees in today's therapy.
The scar was still restricted on the distal part but the redness is evacuating the area slowly. She provided all of the exercises properly and there was a better stability present overall. The patient is in a good mood and very confident because she provide most of the exercises in a proper pattern, she can feel the improvement since the first therapy session so she mentioned that this is a motivating factor for her to continue working with this rhythm. She is very confident about her rehabilitation.

Date: 13/1/2014

Status present: ROM in ankle joint → PF = 25^0, DF = 15^0, IN = 30^0, EV = 20^0
Subjective: we will work on the ROM in ankle in order to increase it and strengthen the weak muscles
Objective: the patient mentioned that during the weekend she continue to exercise in the same manner as in every of our therapy sessions because she felt comfortable with the rehabilitation program that was given
Goal of today's therapy unit:
Increase Active ROM in ankle joint in PF, DF, IN, EV movements
Decrease pain / swelling that is present on the ankle

Training for good body position in standing and walking

Increase body balance

Minimize scar inflammation

Strengthening weak calf muscles

Being able to return to her daily activities

Procedure:

Hydrotherapy (Warm bathing)→ in Achilles tendon area (10 mins, 38^0 C) for myorelaxation before manipulation and mobilization, soft tissue technique, reducing swelling and providing better blood flow that allow better healing

Lazer (polarised light)→ for antiedematic and analgetic effect of the scar, vasodilatation and biostimulation for collagen production (2mins/ beam area 3.00 [J / cm^2] / frequency 10.5[Hz])

Magnetotherapy → for vasodilatation, analgesia, antiinflamatory effect and myorelaxation (25mins/ dose 3[T^2/s]/ magnetic induction 90[mT]/ frequency 15[Hz])

Scar care → for better blood flow, circulation on the scar / soft tissue techniques

- Massage the area of the scar from the end to the start using S shape
- Pressing the scar
- Massaging the surrounding are

Cycling → for warm up (5 mins)

Stretching → in supine position with the help of a theraband for hamstrings (F of the hip), adductors (ABD of the hip), tensor fascia latae/ abductors (ADD of the hip), gastrocnemius and soleus (DF of the ankle), in prone position for quadriceps (F of the knee in 90^0 with the theraband crossed on the ankle joint) and in standing for tibialis anterior (DF of the ankle)

Isometric contraction → in supine with pressing an overball (for quadriceps, gastrocnemius, soleus, tibialis anterior)

Sensomotoric training → walking on the wobble boards while holding a ball, throw it on the air and catch it again (x 10 repetitions) / walking on the boards and catching the ball at the same time that I am throwing to her once at the right side and once at the left side (x 10 repetitions) / walking on the colored wobble boards (more difficult to balance on them), bounce a tennis ball on the ground as you are standing with flexed knee and hip, catch it and continue walking (x 10 repetitions) -for increasing the level of

difficulty-

Posturomed → stepping sideways, stay with the knee and hip joints in semi flexion and then down from the same side (x 10 repetitions) / stepping up and squatting on it (x 10 repetitions)

Balance lens → stepping in one leg and try to balance (x 10 repetitions)

Ankle disk → stepping up and try to balance (x 3 repetitions)

Stability training (Trampoline) → stepping at sides and then stop immediately (x 6 repetitions)

Walking on the rope → try to walk on it from heel to toes with one foot connected with the other at each step (x 3 repetitions)

Isometric exercises → for gastrocnemius, soleus and tibialis anterior muscles

Exercises to increase ROM → PF, DF, IN, EV in ankle joint with the help of a theraband (x 20 repetitions)

Results: Improvement is steady and the rehabilitation program goes very well.

She is able to provide the exercises without any problem and she is confident about her rehabilitation as the ROM is increasing in this rate.

We observe improvement of 5^0 more in PF, DF and IN but the EV today was the same in 20^0.

The scar is still persisting to be restricted on the distal part. She provided all of the new exercises properly and we can clearly say that there is a better stability present overall.

The patient is in a good mood and very confident because she learn new exercises and manage to provide them in a proper manner. She can feel the improvement since the last therapy session so she mentioned that this is a motivating factor for her to continue working more intense.

She is very confident about the new exercises added to her rehabilitation.

Date: 14/1/2014

Status present: ROM in ankle joint → PF = 30^0, DF = 15^0, IN = 35^0, EV = 25^0

Subjective: we will work on the ROM in ankle in order to increase it and strengthen the weak muscles

Objective: the patient mentioned that she felt better after the therapy session, she really liked and enjoy the new exercises because she felt comfortable with the rehabilitation program and that she would like to work more on the ROM of her ankle joint

Goal of today's therapy unit:

Increase Active ROM in ankle joint in PF, DF, IN, EV movements

Decrease pain / swelling that is present on the ankle

Training for good body position in standing and walking

Increase body balance

Minimize scar inflammation

Strengthening weak calf muscles

Being able to return to her daily activities

Strengthening weak calf muscles

Stretching short muscles

Procedure:

Hydrotherapy (Warm bathing)→ in Achilles tendon area (10 mins, 38^0 C) for myorelaxation before manipulation and mobilization, soft tissue technique, reducing swelling and providing better blood flow that allow better healing

Lazer (polarised light)→ for antiedematic and analgetic effect of the scar, vasodilatation and biostimulation for collagen production (2mins/ beam area 3.00 [J / cm^2] / frequency 10.5[Hz])

Magnetotherapy → for vasodilatation, analgesia, antiinflamatory effect and myorelaxation (25mins/ dose 3[T^2/s]/ magnetic induction 90[mT]/ frequency 15[Hz])

Scar care → for better blood flow, circulation on the scar / soft tissue techniques

- Massage the area of the scar from the end to the start using S shape
- Pressing the scar
- Massaging the surrounding are

Cycling → for warm up (5 mins)

Stretching → in supine position with the help of a theraband for hamstrings (F of the hip), adductors (ABD of the hip), tensor fascia latae/ abductors (ADD of the hip), gastrocnemius and soleus (DF of the ankle), in prone position for quadriceps (F of the knee in 90^0 with the theraband crossed on the ankle joint) and in standing for tibialis anterior (DF of the ankle)

Isometric contraction → in supine with pressing an overball (for quadriceps, gastrocnemius, soleus, tibialis anterior)

Sensomotoric training → walking on the wobble boards while holding a ball, throw it on the air and catch it again (x 10 repetitions) / walking on the boards and catching the ball at the same time that I am throwing to her once at the right side and once at the left side (x 10 repetitions) / walking on the colored wobble boards (more difficult to balance on them), bounce a tennis ball on the ground as you are standing with flexed knee and hip, catch it and continue walking (x 10 repetitions) -for increasing the level of difficulty-

Posturomed → stepping up and squatting on it (x 10 repetitions)

Balance lens → stepping in one leg and try to balance (x 10 repetitions) / stepping on both feet and providing semi-squat (x 10 repetitions)

Ankle disk → stepping up and try to balance (x 3 repetitions)

Stability training (Trampoline) → stepping at sides and then stop immediately (x 6 repetitions) / swing back and front and the stop immediately (x 6 repetitions)

Walking on the rope → try to walk on it from heel to toes with one foot connected with the other at each step (x 3 repetitions) / walk side to side (x 3 repetitions) / walk backwards in the same manner as at the front (x 3 repetitions)

Isometric exercises → for gastrocnemius, soleus and tibialis anterior muscles

Exercises to increase ROM → PF, DF, IN, EV in ankle joint with the help of a theraband (x 20 repetitions)

Results: The improvement of ROM is steady and improving in all movements overall. In today's session we had an increase of 5^0 in PF, IN and EV movements as the DF was stable in 15^0.

She is able to provide the new and more intense exercises without any problem and she is optimistic for her rehabilitation.
Improvement is steady and the rehabilitation program goes very well.
The scar is still persisting to be restricted on the distal part but the swelling is decreasing. She provided all of the new exercises with better stability present overall.
The patient is in a good mood and very confident because she learn more intense exercises and manage to provide them in a proper manner. She can feel the improvement since yesterday's therapy session so she mentioned that there is no problem with working more intensively.
She is very confident about the new exercises added to her rehabilitation.

Date: 15/1/2014

Status present: ROM in ankle joint → PF = 35^0, DF = 20^0, IN = 40^0, EV = 25^0
Subjective: we will work on the ROM in ankle in order to increase it and strengthen the weak muscles
Objective: the patient mentioned that she felt better after the therapy session, she really liked and enjoy the new exercises that have been adding in the rehabilitation program and that she would like to work more on the ROM of her ankle joint so she can regain the full ROM on it
Goal of today's therapy unit:
Increase Active ROM in ankle joint in PF, DF, IN, EV movements
Decrease pain / swelling that is present on the ankle
Training for good body position in standing and walking
Increase body balance
Minimize scar inflammation
Strengthening weak calf muscles
Being able to return to her daily activities
Strengthening weak calf muscles
Stretching short muscles
Restoring Achilles tendon into its original state

Procedure:

Hydrotherapy (Warm bathing)→ in Achilles tendon area (10 mins, 38^0 C) for myorelaxation before manipulation and mobilization, soft tissue technique, reducing swelling and providing better blood flow that allow better healing

Lazer (polarised light)→ for antiedematic and analgetic effect of the scar, vasodilatation and biostimulation for collagen production (2mins/ beam area 3.00 [J / cm^2] / frequency 10.5[Hz])

Magnetotherapy → for vasodilatation, analgesia, antiinflamatory effect and myorelaxation (25mins/ dose 3[T^2/s]/ magnetic induction 90[mT]/ frequency 15[Hz])

Scar care → for better blood flow, circulation on the scar / soft tissue techniques

- Massage the area of the scar from the end to the start using S shape
- Pressing the scar
- Massaging the surrounding are

Cycling → for warm up (5 mins)

Stretching → in supine position with the help of a theraband for hamstrings (F of the hip), adductors (ABD of the hip), tensor fascia latae/ abductors (ADD of the hip), gastrocnemius and soleus (DF of the ankle), in prone position for quadriceps (F of the knee in 90^0 with the theraband crossed on the ankle joint) and in standing for tibialis anterior (DF of the ankle)

Isometric contraction → in supine with pressing an overball (for quadriceps, gastrocnemius, soleus, tibialis anterior)

Sensomotoric training → walking on the colored wobble boards (more difficult to balance on them), bounce a tennis ball on the ground as you are standing with flexed knee and hip, catch it and continue walking (x 10 repetitions) / walking on the colored wobble boards with carrying a heavy ball and pass it along her trunk and her arms while she is standing in one leg (x 10 repetitions) -for increasing the level of difficulty-

Posturomed → stepping up and squatting on it (x 10 repetitions)

Balance lens → stepping on both feet and providing semi-squat (x 10 repetitions)

Ankle disk → stepping up and try to balance while providing squat (x 3 repetitions)

Stability training (Trampoline) → stepping at sides and then stop immediately (x 6 repetitions) / swing back and front and the stop immediately (x 6 repetitions) / "walk" on point with the knees being high and hold when one leg is on the air (x 6 repetitions)

Walking on the rope → walk on it backwards from heel to toes with one foot connected

with the other at each step (x 3 repetitions) / walk side to side (x 3 repetitions)
Isometric exercises → for gastrocnemius, soleus and tibialis anterior muscles
Exercises to increase ROM → PF, DF, IN, EV in ankle joint with the help of a theraband (x 20 repetitions)

Results: Steady improvement in ROM of ankle joint overall.
In today's session we had again an increase of 5^0 in PF, DF, IN but EV was stable in 25^0.
She is able to provide the new and more intense exercises without any problem and she is optimistic for her rehabilitation.
Improvement is steady and the rehabilitation program goes very well.
The scar is still persisting to be restricted on the distal part but the swelling is decreasing. She provided all of the new exercises with better stability present overall.
The patient is in a good mood and very confident because she learn more intense exercises and manage to provide them in a proper manner. She can feel the improvement in every days therapy session so she mentioned that there is no problem with the new exercises that have been added and are more intensive and she is very confident about her ankle's state concerning the rehabilitation program.

Date: 17/1/2014

Status present: ROM in ankle joint → PF = 40^0, DF = 20^0, IN = 45^0, EV = 25^0
Subjective: since is the last therapy we will provide mobilization in ankle joints again in order to see if there is any restriction present, and we will continue to work on the ROM in ankle in order to increase it and strengthen the weak muscles
Objective: the patient mentioned that she is feeling better in general and more confident during walking as she has already regain most of the ROM in her ankle joint
and she liked and enjoy the new exercises that have been adding in the rehabilitation program and that she would like to work more on the ROM of her ankle joint so she can regain the full ROM on it

Goal of today's therapy unit:

Increase Active ROM in ankle joint in PF, DF, IN, EV movements

Decrease pain / swelling that is present on the ankle

Training for good body position in standing and walking

Increase body balance

Minimize scar inflammation

Strengthening weak calf muscles

Being able to return to her daily activities

Strengthening weak calf muscles

Stretching short muscles

Restoring Achilles tendon into its original state

Procedure:

Hydrotherapy (Warm bathing)→ in Achilles tendon area (10 mins, 38^0 C) for myorelaxation before manipulation and mobilization, soft tissue technique, reducing swelling and providing better blood flow that allow better healing

Lazer (polarised light)→ for antiedematic and analgetic effect of the scar, vasodilatation and biostimulation for collagen production (2mins/ beam area 3.00 [J / cm^2] / frequency 10.5[Hz])

Magnetotherapy → for vasodilatation, analgesia, antiinflamatory effect and myorelaxation (25mins/ dose 3[T^2/s]/ magnetic induction 90[mT]/ frequency 15[Hz])

Scar care → for better blood flow, circulation on the scar / soft tissue techniques

- Massage the area of the scar from the end to the start using S shape
- Pressing the scar
- Massaging the surrounding are

Mobilization → of ankle joint (talocrural and subtalar joint)

Cycling → for warm up (5 mins)

Stretching → in supine position with the help of a theraband for hamstrings (F of the Hip), adductors (ABD of the hip), tensor fascia latae/ abductors (ADD of the hip), gastrocnemius and soleus (DF of the ankle), in prone position for quadriceps (F of the knee in 90^0 with the theraband crossed on the ankle joint) and in standing for tibialis anterior (DF of the ankle)

Isometric contraction → in supine with pressing an overball (for quadriceps, gastrocnemius, soleus, tibialis anterior)
Sensomotoric training → walking on the colored wobble boards with carrying a heavy ball and pass it along her trunk and her arms while she is standing in one leg (x 10 repetitions) / walking on the colored wobble boards and catching a heavy ball after me throwing it and pass it along her trunk and her arms while she is standing in one leg (x 10 repetitions)
Posturomed → stepping up and squatting on it (x 10 repetitions)
Balance lens → stepping on both feet and providing semi-squat (x 10 repetitions)
Stability training (Trampoline) → stepping at sides and then stop immediately (x 6 repetitions) / swing back and front and the stop immediately (x 6 repetitions) / "walk" on point with the knees being high and hold when one leg is on the air (x 6 repetitions) / jumping alternately in one leg at a time and then stop immediately (x 6 repetitions)
Walking on the rope → walk on it backwards from heel to toes with one foot connected with the other at each step (x 3 repetitions) / walk side to side (x 3 repetitions)
Isometric exercises → for gastrocnemius, soleus and tibialis anterior muscles
Exercises to increase ROM → PF, DF, IN, EV in ankle joint with the help of a theraband (x 20 repetitions)

Results: Today is our last session of therapies and we have reached the maximum reachable point of ROM for this state on the patient's ankle joint.
Steady increase of 5^0 in PF and IN but in DF and in EV it was again stable in 20^0 and in 25^0 respectively. We can say that overall, both ankles are slightly symmetrical now.
The patient was able to provide the new and more intense exercises without any problem and she very happy for the results from her rehabilitation.
The scar is still persisting to be restricted on the distal part but swelling and redness have disappeared. She provided all of the new exercises with better stability present overall.
The patient is in a good mood and very confident because she learn more intense exercises, manage to provide them in a proper manner and as she mentioned, she will continue to provide this exercises at home as much as she can. She felt the improvement so she is very confident about her ankle's state concerning the rehabilitation.

3.6. Final kinesiologic examination

Examination by observation of the patient:

Anterior View:

- Slightly flat feet (on the right more)
- Eversion on right foot + slightly valgus Heel
- Medial malleolus is higher on the right lower extremity
- External rotation in both knee joints
- Quadriceps on the right lower extremity are slightly hypertrophic
- Internal rotation in hip joint (more in left side)
- Torsion on the pelvis
- Umbilicus is more at the left side
- Difference on the distance between the two arms and the intercostals (the distance on the right arm is bigger)
- Arms very close to body
- Left forearm is external rotated
- Difference on the clavicles (left one is prominent)
- Right shoulder is lower than the left one
- Distance between left ear and shoulder is shorter than the right

Posterior View:

- Valgosity on right heel
- More weight bearing in medial side
- Hypertrophy in distal part of calf in the right leg
- Knees externally rotated
- Calf muscles and hamstrings on the right lower extremity are hypertrophic
- Right gluteal muscle is elevated higher
- Posterior superior iliac spines are not symmetrical
- Torsion of pelvis
- Distance between upper extremity and trunk in right side is bigger than in the left side
- Distance between right scapula and spine seems to be bigger than the left one
- Left shoulder elevated (scapula)
- Hypertrophy in the left upper trapezius
- Head is lateral flexed in the right side

Lateral View:

- Lordotic-Kyphotic posture
- Hyperextented knees
- Soldier-like posture (hands forward, slightly medial rotation)
- Anterior tilt
- Head forward
- Abdominals slightly prominent

Observation of the scar and palpation of the area around the scar:

The situation on the scar is better, pinkish colour on the scar and the area around and also swelling has been increased.

But there is still a hard feeling / stiffness of the tissue because of skin restriction.

- **Palpation of the muscles :**

We examined on both lower extremities as on the Initial Kinesiologic examination the muscles below:

	Right	*Left*
Vastus lateralis	Hypertone	Normal
Vastus medialis	Normal	Normal
Tensor fascia latae	Normal	Normal
Hamstrings	Hypertone	Hypertone
Gastrocnemius	Normal	Normal
Soleus	Normal	Normal
Tibialis anterior	Normal	Normal

Table 24: Final palpation of muscles for both LE's

- **Anthropometry measurements: Circumferences**

	Right	*Left*
Thigh: (15 cm above knee cap for whole quadriceps)	52 cm	50 cm
(10 cm above knee cap for vastus medialis)	48 cm	47 cm
Above knee:	39,5 cm	38 cm
Knee cap:	37,5 cm	38 cm
Below knee:	34,5 cm	34,5 cm
Calf:	35,5 cm	34 cm
Ankle:	25,5 cm	27 cm

Table 25: Final circumference measurements for both LE's

- **Functional length:**

Right	*Left*
85 cm	85 cm

Table 26: Final functional length measurement for both LE's

- **Anatomical length:**

Right	*Left*
83 cm	83 cm

Table 27: Final anatomical length measurement for both LE's

❖ **ROM examination (According to Kendall):**

Hip Joint:

	Right	*Left*
Flexion:	125^0	125^0
Extension:	15^0	15^0
Internal Rotation:	30^0	30^0
External Rotation:	45^0	45^0
Abduction:	45^0	45^0
Adduction:	30^0	30^0

Table 28: Final ROM examination in hip joint for both LE's

Knee joint:

	Right	*Left*
Flexion:	135^0	135^0
Extension:	0^0	0^0

Table 29: Final ROM examination in knee joint for both LE's

Ankle Joint:

	Right	*Left*
Plantar Flexion:	45^0	40^0
Dorsal Flexion:	20^0	20^0
Inversion:	45^0	45^0
Eversion:	30^0	25^0

Table 30: Final ROM examination in ankle joint for both LE's

Toes:

	Right	*Left*
Big toe: (proximal phalanx)	75^0	75^0
(distal phalanx)	5^0	5^0
2nd digit: (proximal)	70^0	70^0
(distal)	5^0	5^0
3rd digit: (proximal)	70^0	70^0
(distal)	5^0	5^0
4th digit: (proximal)	70^0	70^0
(distal)	5^0	5^0
5th digit: (proximal)	70^0	70^0
(distal)	5^0	5^0

Table 31: Final ROM examination in toes for both LE's

- **Basic movement patterns (According to Janda):**

Hip abduction:

The patient for providing the movement was using the gluteus minimus and medius and afterwards the tensor fascia latae.

Pelvis was stabilized so she is using quadrates mechanism.

Hip extension:

The patient during the examination for providing the movement was using first the hamstrings (semimembranosus, semitendinosus, biceps femoris), after the gluteal muscles, and then the erector spinae muscle.

There was no elevation of the opposite shoulder.

❖ GAIT examination

The pattern of the patients walking in general it was the same with the initial observations.

The changes were made clearly from the healing of her ankle joint.

- Asymmetry of shoulders
- Lateral tilt of pelvis especially to the left side
- Internal rotation in right hip
- More pressure on the right foot
- She is standing longer on the right foot / (more lateral side on the left lower extremity)
- Overlapping knees
- She is moving more the left upper extremity than the right one
- Right upper extremity seems to have extension in shoulder joint / left upper extremity seems to have flexion
- Rotation of trunk to the right / lateral flexion to the left
- Head-cervical spine is not moving
- The first contact with the floor is with the heel and then the sole of the foot

- ✓ Walking on heels : the patient could provide it (not weight bearing to the left that much), not that painful
- ✓ Walking on toes : the patient could walk with confidence
- ✓ Squats walking : could provide it but the asymmetry of lower extremities were still slightly visible as well as small restriction on the movement
- ✓ Walking with eyes closed : There was slightly imbalance but able to provide it in a good manner
- ✓ Walking backwards: able to provided it but no sufficiently, no E on hips

❖ **Two Scale examination:**

Physiological difference in loading is up to 5 kg, approximately 10-15% of body weight. Bigger difference indicate imbalance.

	Right	*Left*
Total: 61,5kg	32,5kg	29kg

Table 32: Final two scale examination evaluation for weight bearing in LE's

The difference has decreased into 3,5 kg which is physiological.

❖ **Muscle strength test (According to Kendall):**

The grading scale for this test is from 0 - 5 with:

0 = Zero (no muscle contraction)

1 = Trace (contraction felt but no movement)

2 = Poor (partial movement but in horizontal position)

3 = Fair (hold against gravity)

4 = Good (hold against moderate pressure)

5 = Normal (hold against strong pressure)

Lower extremity:

	Right	*Left*
Gluteus maximus:	4	4
Gluteus medius:	4	4
Gluteus minimus:	4	4
Lateral rotators of hip joint: (Piriformis, quadratus femoris, obturator internus, obturator externus, gemellus superior, gemellus	4	4

inferior)		
Hip adductors: (Pectineus, adductor magnus, gracilis, adductor brevis, adductor longus)	4	4
Tensor fasciae latae:	4	4
Sartorius:	4	4
Iliopsoas:	4	4
Quadriceps femoris: (Rectus femoris, vastus laterallis, v.intermedius, v.mediallis)	4	4
Biceps femoris:	4	4
Semimembranosus:	4	4
Semitendinosus:	4	4
Popliteus:	4	4
Plantar flexors: (Gastrocnemius, plantaris)	4	3
Soleus:	4	3
Peroneus longus and brevis:	4	4
Tibialis posterior:	4	4
Tibialis anterior:	4	4
Extensor digitorum longus and brevis:	4	4
Flexor digitorum longus:	4	4
Flexor digitorum brevis:	4	4
Dorsal interossei:	4	4
Extensor hallucis brevis:	4	4
Extensor hallucis longus:	4	4
Flexor hallucis longus:	5	5
Flexor hallucis brevis:	5	5
Abductor hallucis:	5	5

Table 33: Final muscle strength test evaluation for both LE's

Abdominal muscles:

Upper abdominal muscles:	5
Lower abdominal muscles:	5
External and internal oblique:	5

Table 34: Final muscle strength test evaluation for abdominal's

Back muscles:

Erector spinae:	4

Table 35: Final muscle strength test evaluation for back muscles

- **Muscle length test (According to Janda):**

The grading scale for this test is from 0 - 2 with:

0 = no muscle shortness

1 = moderate shortness

2 = marked shortness

Lower extremity:

	Right	*Left*
Abdominal wall:	0	
Erector spinae:	0	
Quadratus lumborum:	1	1
Iliopsoas:	1	1
Rectus femoris:	0	0
Tensor fascia latae:	0	0
Short hip adductors:	1	1
Gluteus maximus:	0	0

Minimus:	0	0
Medius:	0	0
Piriformis:	1	1
Hamstrings:	1	1
Tibialis anterior:	0	1
Soleus:	1	1
Gastrocnemius:	1	1

Table 36: Final muscle length test evaluation for both LE's

- **Muscle tone examination:**

Lower extremity:

	Right	*Left*
Gluteus maximus:	Normal tone	Normal tone
Hip adductors: (Pectineus, adductor magnus, gracilis, adductor brevis, adductor longus)	Hypertone	Normal tone
Quadriceps femoris: (Rectus femoris, vastus laterallis, v.intermedius, v.mediallis)	Hypertone	Normal tone
Biceps femoris:	Hypertone	Normal tone
Semimembranosus:	Hypertone	Normal tone
Semitendinosus:	Hypertone	Hypertone
Soleus:	Normal tone	Normal tone
Abductor hallucis:	Hypertone	Normal tone
Hamstrings:	Hypertone	Hypertone

Table 37: Final muscle tone evaluation for both LE's

Abdominal muscles:

Upper abdominal muscles:	Normal tone
Lower abdominal muscles:	Normal tone
External and internal oblique:	Normal tone

Table 38: Final muscle tone evaluation for abdominal muscles

Back muscles:

Erector spinae:	Hypotone

Table 39: Final muscle tone evaluation for back muscles

- **Joint Play examination (According to Lewit):**

When there is restriction present that means that the joint is blocked.

	Right	*Left*
Lumbar spine: (all directions)	Present	Present
Sacroiliac joint: Ventral	Present	Present
Dorsal	Present	Present
Hip joint:	Present	Present
Knee joint:	Present	Present
Patella:	Present	Present
Head of fibula:	Present	Slightly restricted
Talocrural:	Present	Slightly restricted
Subtalar joint: Supination	Present	Slightly restricted
Pronation	Present	Slightly restricted
Transverse tarsal joint: (Chopart joint)	Present	Restricted
Tarsometatarsal joints: (Lisfranc joints)	Present	Restricted
Metatarsophalangeal joints: (1^{st},2^{nd}, 3^{rd}, 4^{th}, 5^{th})	Present	Restricted

Table 40: Final joint play examination evaluation for L spine and LE's

❖ NEUROLOGICAL EXAMINATIONS:

Sensation in dermatomes:

The patient must have closed eyes in order to make more sufficient the examination. We touch her with the hands first on the thigh of one lower extremity and then on the second one. The patient must inform us if she feels the touch and if there is any difference between both lower extremities.

→ She had the same feeling in both sides

Afterwards we continue with the whole lower extremity from the medial side until the biggest toe, then we touch it from the lateral side until the first three toes and we ask her if she feels the touch and if it is the same in both lower extremities.
(we provide this examination from centre to peripheral)

→ She had the same feeling in both sides

Deep tendon reflex:

The grading scale for tendon reflexes is from 0-4 "plus" (plus is for every reflex which is a bit higher than the normal rate):

0 = Absent

1 = Hypoactive

2 = Normal

3 = Hyperactive without clonus

4 = Hyperactive with clonus

	Right	*Left*
Patella (L2-4):	3+	3+
Achilles tendon (L4-5):	2+	2+
Medial plantar (L5-S2):	2+	2+

Table 41: Final deep tendon reflex evaluation for both LE's

Surface sensation (L4-S1):

L5 (from outside to inside) → same feeling on both sides

L4 (from inside to outside) → same feeling on both sides

S1 (in hamstrings) with bend knees → same feeling on both sides

Deep sensation:

Test for Ataxia:

-opened arms at the sides → closed eyes → the patient is touching her nose

-the patient must touch her left knee till the ankle with the right heel and then the opposite

➔ The patient is able to provide it.

Babinski sign:

➔ No reaction / Negative

Sensory examination:

Pin Prick:

The patient was feeling the same touch in both lower and upper extremities.

Sharpness of pain:

The patient could successfully feel the feeling of the pin on her body in the same level in lower and upper extremities.

Temperature:

Same successfully results we had on this test, the patient was able to feel the same temperature level.

Trendelnburg test:

The patient has to stand with one lower extremity with hip and knee flexed.

Right: Pelvis go down in the beginning of the motion but then returns → R of the trunk to the right in order to balance herself, small instability, able
Left: Was more stable but R of the trunk to the left for balancing, able

Rhomberg test:

-I = negative
-II (feet together) = negative
-II (eyes closed) = negative

- Stand on one lower extremity : More stable with the right extremity
- Eyes closed : With the left she looses her balance slightly
  - The patient is quite stabilized.

3.6.1. Conclusion

Conclusion of Examination:

By observation we can definitely conclude that the ROM in the patients ankle joint was increased at a big range and also the swelling was decreased during the whole period of the therapies.
There was a joint play restriction in the lower part of her operated LE but the restriction is reducing as the time passes by with the active therapies that are being made.
The patient is able to provide all the exercises with efficiency and after the examinations that have been made we can conclude that the Achilles tendon will heal without any problem involved.
From the conclusions we have the image of her progress and we could result that the therapy was effective as it was with all the exercises included, passive or active and with the assistive ones like hydrotherapy, magnetotherapy and lazer therapy for the scar healing.
The status of the tone of her muscles has improved (she is loading the left LE so she is now overusing that much the right one anymore), as well the status of the muscle strength in quadriceps, gastrocnemius, soleus, and tibialis anterior on her operated lower extremity, the breathing stereotype she is using and the body stability in general.
The walking pattern became more efficient and at this stage she can provide squat and heel walking but with light pain.
The shortness of the calf muscles is solved but the stiffness of the scar is still present.
The present ankle's conditions is sufficiently better than when she first came into the clinic with an incredible progress that manage to regain fully the ROM back to its physiological state in DF with 20^0 and IN with 45^0 but there is still a difference of 5^0 in PF and in EV which need to be gained but there is no doubt about the sufficient functionality of the ankle joint at this point.
Both lower extremities have the same length so we do not have to worry about any other complication in that level that may be connected with the rupture.
The patient has also return to her independency and she is not facing any other issue due to her ankle state.

3.7. Therapy effect evaluation, Prognosis

The patient has been informed about the importance of strengthening, the self-therapy and the care that she has to follow in order to avoid any further damage on her lower extremity and especially her ankle or provoking a new one.

The self-therapy will be introduced from the doctor right before her last check up session but it will include the exercises performed at her rehabilitation sessions.

The patient should continue the basic program or the rehabilitation plan in order to maintain her ankle's ROM.

She need to continue exercising, in the pattern of Achilles tendon rupture program as it was executed during the therapies.

Usage of bandage, elevation of lower extremity in order to relief it especially from some overuse or long time-distance walking and ice pack for 5 mins before she go to bed or in case of swelling are things recommended for her and it will be wise to follow them.

Her ankle's joint ROM has been increased since her first rehabilitation session as mentioned from the patient herself.

The main concern of the patient remained the increase of the ROM on her ankle joint through the whole rehabilitation process, so we had to measure it at the beginning of every session with the help of a goniometre.

On our first session the measurements of the ankle joint were, PF = 10^0, DF = 5^0, IN = 20^0 and EV =15^0 and on the last one they were, PF = 40^0, DF = 20^0, IN = $45^0$and EV = 25^0.

This results can highlight the effectiveness of the therapy that was provided for each session.

In addition, the comparison of the other examinations from the initial and the final kinesiologic examination show further improvement into the muscular condition, the joint play but also in gait and posture examination concerning the ankle joint.

Through the scale test we can see that the weight bearing was changed and became under the physiological rate. The results from muscle palpation changed as well.

Nevertheless, the examination that highlights overall the improvement is the joint mobility and the ROM of the ankle joint.

Her prognosis is pretty good and her ankle will fully recover from the injury without any further problem.

4. CONCLUSION

The choice of my patient happened straight away because she was in the beginning of her therapy plan in the clinic and this gave me the chance to observe the progress from the start and work with her closely and in a hard manner.

When she first visited the clinic she was complaining for pain in the ankle area but she was not in a very bad shape.

You could clearly see the ROM restriction in all motions in ankle joint, especially into PF and DF. This condition was critical and preventing her from providing simple activities of daily living so she was furious because of that reason and she could not be as independent as possible. Therefore, the therapy plan was made based in increasing the ROM of the ankle joint and decreasing the pain from the ankle area.

At the Centrum Léčby Pohybového Aparátu Vysočany, Prague, which I was having my practice, it was common to provide similar therapy execution like the one I instructed for such a type of case. My rehabilitation program was based on her incredible restriction on the ROM of her ankle so I choose to focus on that, increase it and bring it back to its original state as much as it was possible. The blockages that she had on her operated ankle joint they were normal after this kind of operation.

Thinking what is the best for my patient and under the discussion with her and her needs I decide to follow this type of therapy also for the reason that my patient would like to have as faster rehabilitation as possible and because after I finish my practice she would probably be coming back to the clinic for new sessions I did not want to make her undergo a different type of therapy program so I stayed in the motive of the clinic's rehabilitation program.

Taking everything into consideration, I think that this was the best option to proceed with my patient's treatment.

Although, I provided some techniques for muscle relaxation, in order to release the tension and the hypertonus on muscles founded on the initial examination.

When you compare the initial and the final kinesiologic examinations, you can clearly observe and see a huge improvement and increase on the degrees of ROM in the ankle joint. The restricted joint play in ankle was eliminated and her ability to perform the ankle movements functionally it was significant. These are considered as the most important parameters in this patient, as from the beginning the goal of therapy was to increase the ROM and allow the patient to be more independent. An improvement was expecting but the specific one was probably caused from the intensity of the therapy, the chronological timing of the session and the patient's effort as well, and all these lead to a very succeed and high quality therapy.

Bigger muscle strength on the operated LE is non questionable, but the patient's interest was on regaining the full functionality of the ankle, and so we did, because she is a strong willing person and she will be able to work on the muscle strength herself.

As for future therapy reference, I have already instruct her that she will need to increase her stabilization system through the exercises we have already go through on the therapy sessions, such as posturomed and wobble boards.

At this point I would like to mention that it is very important for her at this stage to continue the instructed therapy for some time, so that the ankle will continue been as functional as it is at the moment and the patient can continue improving her balance training in order to correct also the body posture as well. The patient is already motivated for the self therapy, and she will be able to be as active as it is possible.

Considering the two weeks therapy as whole, I can say that it was successful and applied with the maximum possibility offered. The patient was positive and very optimistic in the entire rehabilitation period, she was excited with new exercises that were given, she was fully cooperative and able to follow any instruction without any problem.

5. LIST OF LITERATURE

1. Moore, K., Dalley, A., Agur, A. Clinical Oriented Anatomy. Sixth Edition. *Bones Section*, 2008, Retrieved 4 February 2014
2. Drake, R., Wayne A., Mitchell A., Tibbitts, R., Richardson, P., Gray's Atlas of Anatomy, *Anatomy of muscles,* 2007, Retrieved 23 February 2014
3. Brian, A. Jacobs, MD, Family Medicine of South Bend Marian High School .Achilles *Tendon Rupture*. 10 Oct. 2012, Retrieved 25 January 2014 from http://emedicine.medscape.com/article/85024-overview
4. Angelo, D., Otto, C., Maffulli, N.. Achilles tendon: *functional anatomy and novel emerging models of imaging classification.* [online] Dec 20, 2012. Retrieved 26 January 2014, from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3609991/
5. Dijk,C., Wiegerinck, J., Karlsson, N., *Terminology for Achilles tendon related disorders.* [online] online Jan 11, 2011 .Retrieved 1 February 2014 ,from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3076576/
6. Waugh, A J Blazevich, T Korff. *Age-related changes in mechanical properties of the Achilles tendon*. J Anat. Feb 2012; 220(2): 144-155. Retrieved 3 February 2014, from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3275769/#!po=2.27273
7. Miller, J., Achilles Tendon*, Tendonitis/Tendinitis.* Retrieved 5 February 2014, from http://physioworks.com.au/injuries-conditions-1/achilles-tendonitis-tendinitis
8. Brookbush, B., *Kinesiology of the Ankle*. [online] September 17, 2011. Retrieved 10 February 2014 ,from http://brentbrookbush.com/kinesiology-of-the-ankle/
9. Johnston, R., Achilles tendon: *Tendinitis and Tears*. Retrieved 7 February 2014, from http://www.hughston.com/hha/a_15_1_5.htm
10. Anish, R., Kadakia, K., Myerson. M., Rehabilitation After Acute Ruptures. *Achilles tendon*. Retrieved 10 February 2014, from http://books.google.com.sa/books?id=6OXb-TPTgVoC&pg=PA94&dq=achilles+tendon+rupture&hl=en&sa=X&ei=ts1SU92mF8mx0QXRoYHgDA&redir_esc=y#v=onepage&q=achilles%20tendon%20rupture&f=false
11. Maffulli, N., Leadbetter. W., Tendon Injuries.1st ed. 2005. Retrieved 12. February 2014, from ttp://bookshop.blackwell.co.uk/jsp/id/Tendon_Injuries/9781849968775
12. Steven, S., Bhimji, M., *Achilles Tendon Rupture* .Retrieved 15. February 2014 ,from http://www.medicinenet.com/achilles_tendon_rupture/article.htm
13. James, A., Nunley, K., *The Achilles tendon*. November 2008. Retrieved 18. February 2014 ,from http://www.ebooks.com/418097/the-achilles-tendon/nunley-james-a/

14. Maffulli, N., Almekinders, L., *The Achilles tendon*. Jan 1, 2007 .Retrieved 20. February 2014 ,from http://books.google.com.sa/books?id=1uZSskDDqCAC&dq=achilles+tendon+rupture&hl=en&sa=X&ei=ts1SU92mF8mx0QXRoYHgDA&redir_esc=y
15. Monroe, L., Cameron, M., *Physical Rehabilitation: Evidence Based Examination, Evaluation and Intervention.* s.l. : Saunders Elsevier, 2007. pp. 223-230. ISBN 978-0-7216-0361-2. [Online] February 7, 2009. [Cited: February 23, 2014.]
16. Michael, F., Mazzone, M., American Academy of Family Physicians. Vol. 65(9) (May 1, 2002). *Common Conditions of the Achilles Tendon*. Retrieved 20. February 2014
17. Jacob, K., Paterson, R., Surgical repair followed by functional rehabilitation for acute and chronic achilles tendon injuries: excellent functional results, patient satisfaction and no reruptures. ANZ J Surg. 2007 Apr;77(4):287-91
18. Elstrom, J.,Walter, W., Virkus, A., Pankovich, M., *Handbook of fractures.* s.l. : The McGraw-Hill Companies, Inc, 2006. 0-07-144377-0.
19. Stannard, P., Andrew, H., Schmidt, P., Kregor, H., *Surgical treatment of orthopeadic trauma.* New York : Thieme Medical Publishers, Inc., 2007. 1-58890-307-9.
20. N.Berme. *Biomechanincs in normal and pathological human articulating joints.* Dordrecht : Martinus Nijhoff, 1985. 90-247-31642.

6. SUPPLEMENT

6.1. Patient's photos

Photo 1: Posterior view of patient's LE's, on the first therapy session

Photo 2: Anterior view of patient's LE's, on the first therapy session

Photo 3: Left lateral view of patient's LE's, on the first therapy session

Photo 4: Posterior view of patient's LE's, on the last therapy session

Photo 5: Anterior view of patient's LE's, on the last therapy session

Photo 6: Left lateral view of patient's LE's, on the last therapy session

6.2. List of abbreviations

ABD = abduction

ADD = adduction

E = extension

ER = external rotation

EV = eversion

F = flexion

IN = inversion

IR = internal rotation

LE = lower extremity

L4 = lumbar vertebra number 4

L5 = lumbar vertebra number 5

R = rotation

RHB = rehabilitation

ROM = range of motion

S1 = sacrum

6.3. List of tables

6.4. List of figures

Informovaný Souhlas

V souladu se Zákonem o péči o zdraví lidu (§ 23 odst. 2 zákona č. 20/1966 Sb.) a Umluvou o lidských právech a biomedicíně č. 96/2001, Vás žádám o souhlas k vyšetřeni a následné terapii. Dála Vás žádám o souhlas k nahlížení do Vaší dokumentace osobou získávající způsobilost k výkonu zdravotnického povolání v rámci praktické výuky a s uveřejněnim výsledků terapie v rámci bakalářské práce na FTVS UK. Osobní data v této studii nebudou uvedena.
Dnešního dne jsem byla odborným pracovníkem poučena o plánovaném vyšetřeni a následné terapii. Prohlašuji a svým dále uvedeným vlastnoručnim podpisem potvrzuji, že odborný pracovník, který mi poskytl poučeni, mi osobně vysvětlil vše, co je obsahem tohoto písemného informovaného souhlasu, a měla jsem možnost klást mu otázky, na které mi řádně odpověděl.
Prohlašuji, že jsem shora uvedenému poučeni plně prozuměla a výslovně souhlasím s provedením vyšetření a následnou terapií.
Souhlasím s nahlížením níže jmenované osoby do mé dokumentace a s uveřejněním výsledků terapie v rámci studie.

Datum: ……..
Osoba, která provedla poučení : ……
Podpis osoby, která provedla poučení: ……
Vlastnoručni podpis pacienta/tky: ……..