CHARLES UNIVERSITY IN PRAGUE

FACULTY OF PHYSICAL EDUCATION AND SPORTS

Department of Physiotherapy

Case study of physiotherapy treatment of a patient after Achilles tendon rupture

Bachelor's thesis

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Abstract

Title:

Complete Achilles tendon rupture

Thesis aim:

The purpose of this bachelor thesis is to express the overall view of complete Achilles tendon rupture. The thesis consist of two parts:- firstly, the theoretical part which is concern about the anatomical structure of ankle joint, biomechanice and kinesiology followed by detailed description of the nature of injury (etiology,epidemiology,pathogense,and dignosis); next is the suggested treatment option. After that, physicaltherapy approch in case of Achilles tendon rupture. Secondly, the special part "case study" focus on the evaluation and the assessment of patient after Achilles tendon rupture during REH a period of two weeks .Finally, determine the measurment outcome of the suggested treatment.

Clinical findings:

The most imporant clinical finding was pain during ambulation where patient is not able to preform complete toe off during gait. Secondary, limited ROM in right ankle joint during DF,PF,IN and EV. Finally reduced muscle power specially on gastrocnemius , soleus (tricep surae) and tibialis anterior on the injured foot which leads to overall decrease in quality of muscle of L.E on right side and ankle joint function.

Methods:

The rehabilitation aim was primarily focused on reducing the pain and swelling on right ankle joint, increase ROM in ankle joint, and relaxing hypertonic muscles by using PIR and soft tissue techniques. Improve muscle strength of gastrocnemius and soleus muscles as well as all the L.E muscles in general, by applying isometric strengthening exercise, close chain exercise with resistance and PNF in 2^{nd} diagonal extension. Lastly, regain normal gait while using crutches and apply sensomotoric exercises which will not only improve ankle joint function but also the stability and balance during walking

Result:

Major improvements were in gait, patient ambulation improved from "swinging to gait" to walk for short distance without the help of crutches while preforming partial toe off. Next, increase ROM of ankle joint approximately 5° in DF, PF, IN and EV. Release of restricted joint play on both feet. Muscle strength test improved by 1- degree on the right foot muscles

on planter flexor, tibialis anterior tibialis posterior and by 2-degree increase on flexor and extensor of small foot intrinsic muscle

Conclusion:

Patient progressed positively from therapy, every day. He is satisfied and can feel the improvement himself, he is more confidant while walking and more importantly stable. The fact, that he is a sport men makes it easier to achieve the optimal result by continuing the same exercises and introducing more challenging exercise régime which helped to restore ankle joint stability and function; now the patient is able to ambulate independently without the help of crutches.

Keywords:

Sport injury, ankle joint, Ankle joint rupture, rehabilitation of Achilles tendon rupture

Declaration

I hereby declare that this work is entirely my own, individual work based on knowledge gained from books, journals, reports and by attending lectures and seminars at FTVS.
I also declare that no invasive methods were used during the practical approach and that the patient was fully aware of the procedures at any given time.

Prague, April 2017

Acknowledgement

I am truly greatful for everyone who believed in me, blessed me with love and support throughout my journey.Mostly, special thanks to my supervisor, Mgr. Helena vomackova for her knowledge and guidnace throughout my thesis work

Sincerely,

MAE EL Hamoud

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Introduction:

Achilles tendon rupture is one of the most frequently injured tendon of the extremity, with incidence estimated about 18 per 100,000 people. In 1575 was the first attempt to treat Achilles tendon rupture by French surgeon Ambroise Pare, he covered injured ankle with bandage that is immersed in wine and spices (Ronel et al. 2004).

Before the 20th century management of Achilles tendon rupture frequently treated non-operatively, it has been documented successful increase of non-operative management yet, operative treatment is most popular choice nowadays. However, AT rupture is accidental in nature, but micro-trauma in the tendon might contribute to injury.

Our thesis compromised of two main parts, the first part which is the theoretical part it explains the anatomical structure of ankle joint, innervation, blood supply and muscles that act on ankle joint. Followed by biomechanics of ankle joint; gives a general view of mechanical aspect and forces act up on ankle joint as well as highlighting the main characteristic which make the Achilles tendon prone to injury.

Next part, is the most important part which is the "case study". This section is mainly concern about the physical therapy approach which will help the reader to get a better understanding in physical therapy assessment in case of Achilles tendon rupture the my bachelor thesis work took place at C.L.P.A (Centrum léčby pohybového aparátu). Firstly, the initial kinesiological examination of 30 years old male patient who has a complete Achilles tendon rupture on his right foot, he had six sessions in total. Followed by recording day by day therapy and noting any improvement. Finally, the assessment of the final kinesiological examination, by comparing outcome of both assessments which lead to final conclusion.

GENERAL PART

1.1 Anatomy of normal Achilles tendon:

1.1.1 Bones:

Ankle joint (talocrural joint) is a synovial joint located in the lower limb which consist of consist of twenty-six bone of the foot in addition to the articulation between tibia, fibula and talus bone (Gray H 2009). Functionally it is a hinge type joint allowing dorsi flexion and planter flexion movement. The term foot refers to all the tarsal bone and the joint distal to the ankle, the bone of the foot are divided into three region the rear foot (hind foot) consist of talus, calcaneus and subtalar joint; the midfoot consist of the remaining tarsal bones, including transfer tarsal joint and the smaller distal intertarsal joint; and the forefoot consist of metatarsal and phalanges including all joint distal to ankle (figure1)

1.1.2 Ligaments:

Consist of two sets of ligaments (figure 2), originating from each malleolus. The **medial ligament** (or deltoid ligament) is attached to the medial malleolus. It consists of four separate ligaments, which spread out from the malleolus, attaching to the talus, calcaneus and navicular bones. The primary action of the medial ligament is to resist over-eversion of the foot. The **lateral ligament** originates from the lateral malleolus. It resists over-inversion of the foot. It is comprised of three distinct and separate ligaments:

1. Anterior talofibular: extend between the lateral malleolus and lateral aspect of the talus.
2. Posterior talofibular: extend between the lateral malleolus and the posterior aspect of the talus.
3. Calcaneofibular: extend between the lateral malleolus and the calcaneus.

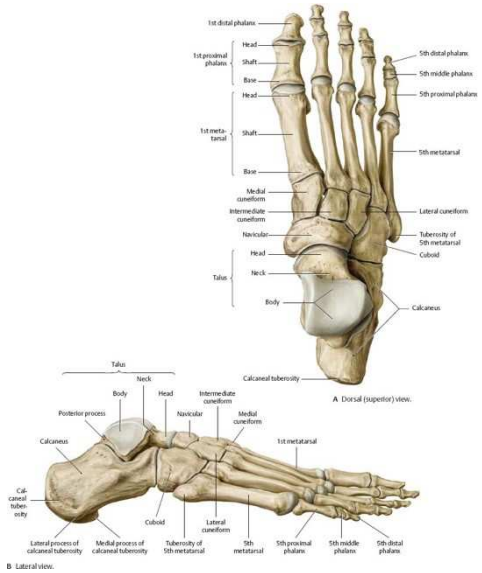

Figure 1- **Bone of the foot**

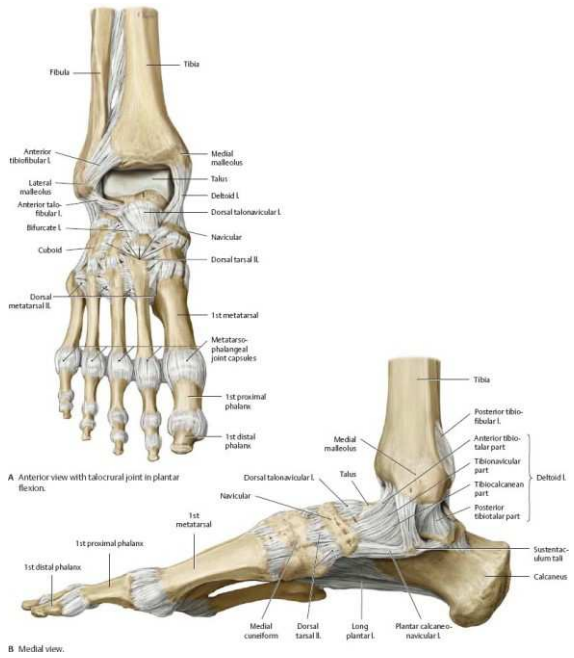

Figure 2- **Ligaments of the foot**

1.1.3 Muscles:

Achilles tendon is formed by gastrocnemius and soleus muscles. Gastrocnemius muscle consist of two head that originated from femoral condyles these two heads are fused together to form single muscle belly which lay superficially at the posterior surface of lower leg their insertion into Achilles tendon which form a wide Apo neurosis at the distal part of muscle belly (Doral MN et al, 2010). A third head of gastrocnemius muscle is found in 3-5.5% of people which is associated with the medial head As for soleus muscle which originate entirely below the knee for the most part from tibia and fibula and their tendinous contribution to Achilles tendon is thicker but shorter (Bergmann RA et el,1996). Together with gastrocnemius it formed three-headed triceps surae,(figure 3) which act as planter flex the ankle joint via their tendon; Achilles tendon lastly, plantaries muscle which small and thin originate at the popliteal surface of the femur Its tendon insert into medial part of calcaneum anterior to the Achilles tendon sometimes it absents in 8% of individual (O'Brien 2005).

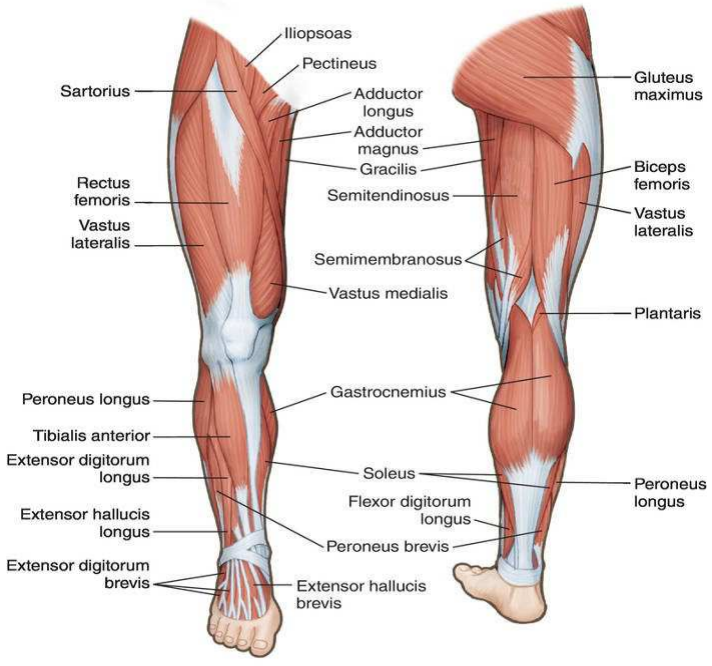

Figure 3- Muscle of the lower limb

1.1.4 Blood supply:

The blood supply arises from musculotendinous junction, the Achilles tendon contain three main vascular area: the peroneal artery which supply the midsection, while the posterior tibia artery supply the proximal and distal section. Typically, poor vascularization of the mid-substance of the tendon might be the reason for the frequent pathology at this area (Chen TM et al. 2009).

1.1.5 Nerve supply:

The arterial supply is derived from the malleolar branches of the anterior tibial, posterior tibial and fibular arteries. Innervation is provided by tibial and deep fibular nerves (figure4) (Gray 2009).

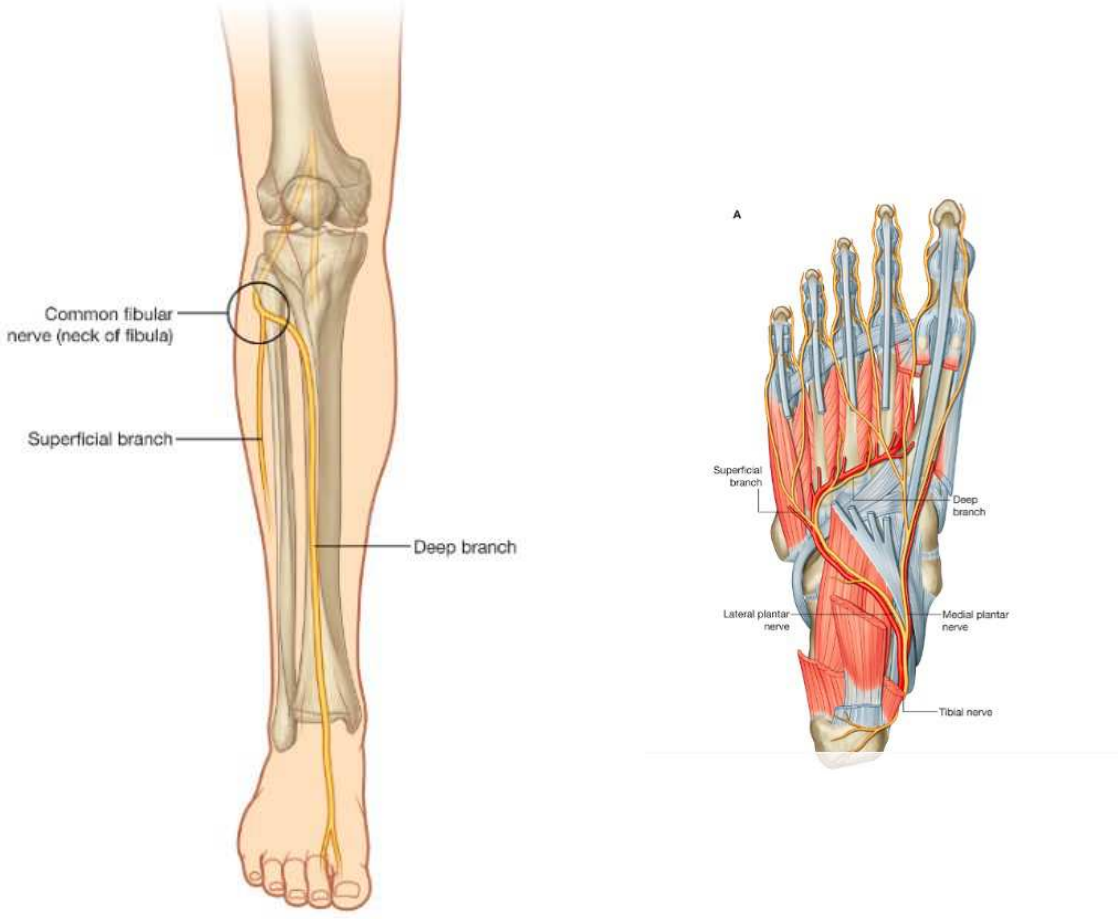

Figure 4- **Nerve supply of lower limb and foot**

1.1.6 Tendon structure:

Achilles tendon considered the largest and thickest tendon in human body Achilles tendon is 15cm in length ranging from (11-26 cm) and 6.8 in width average (4.5-8.9 cm) as the as the Achilles tendon descend the width at midsection is about 1.8 cm Usually, the distal part of the tendon does not overreach 7mm in thickness and any value greater than that consider pathological (Sadro C, Delinka M. 2000). The tendon tend to be flat at the insertion site about 3cm wide and 2-3 mm thick. Achilles tendon lack a true synovial tendon sheath but has a false sheath ”paratenon” which form an elastic sleeve allowing the tendon to glide relative to adjacent structure .The peritenon which is defined as connective tissue sheath surrounding Achilles tendon it rich in blood vessels and nerves end it can stretch 2-3 cm as the tendon moves (figure5)(Chen TM ..ET el. 2009&Benjamin M, McGongle D. 2001).

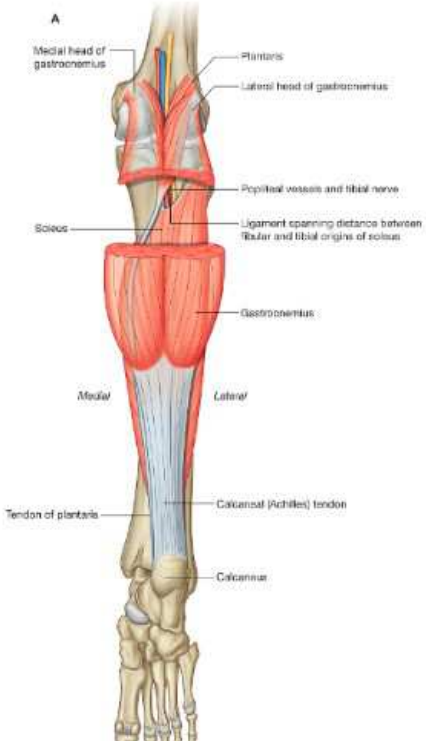

Figure 5- Posterior view of the leg

1.1.7 Functional Anatomy:

Ankle planter flexor of one joint muscle soleus and plantarus, and two joint muscle gastrocnemius (Grumbine NA, Santoro JP, 1990). Moreover, gastrocnemius is engaged During walking, jumping and running. It is primarily consist of type II (Fugl-Meyer AR .. et al. 1979) muscle fiber “fast twitch”. On the other hand the soleus muscle stabilize the foot while standing and composed of type I muscle fiber “slow twitch” (Garrett WE ..Et al. 1984). In addition, soleus muscle is more prone to atrophy compared to gastrocnemius muscle thus any injury or denervation manifested in soleus muscle atrophy (Booth FW, 1997).

1.2 Biomechanics of the Achilles tendon:

Generally, the foot act as shock-absorption during gait, it transmits forces between the ground and lower limb in order to allow stable ambulation and stance. Achilles tendon is dominated by type I collagen, which accounts for its considerable tensile strength created by gastrocnemius and soleus muscles to the heel bone (Kvist. 1987). Achilles tendon generate high forces within normal daily activities about 600N in cycling up to 9kN (11kN\cm) in running at speed of 6m\sec (komi ...et al. 1992). Thus makes it capable of deform and restore it is original length. Obviously, loading the tendon tissue gives linear stress-strain curve (figure 6) at less than 4% strain as the collagen fiber deform within their capacity after loading on tendon with value less than 4% of strain all fiber recovers their wavy figure and no damage occur in simple words, higher strain deform linearly prior to yield and rupture. Typically, Achilles tendon is known to be viscoelastic material containing elastic and viscos such material store and release energy during loading to protect soft tissue from damage. "A recent evidence in humans suggest that its elastic prosperities dominated. These elastic spring-like properties allow the Achilles tendon to deliver explosive propulsion during ambulation as they may bear up to 3500 N before rupture" (Pelton J.. et al. 2013)

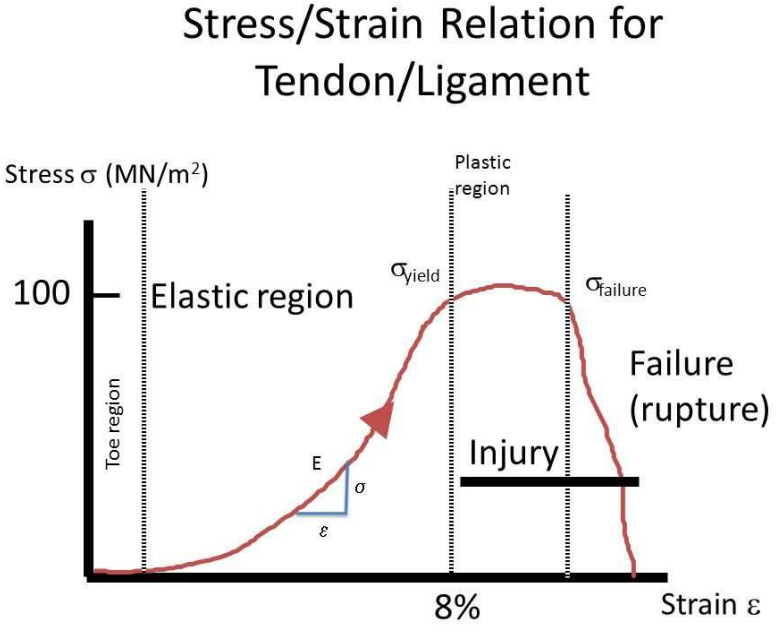

Figure 6- **Stress - strain curve**

1.2.1 Factors makes Achilles tendon more vulnerable to injury:

I. The right angle between foot and leg which is formed by the upright posture of human where the Achilles tendon on posterior part of foot which produce a heavy torque. The human has the largest angle between tibia and calcaneus long axis among any mammal.

II. Muscle act on Achilles tendon has different function as well as different physiological prosperities (postural muscle vs. physic muscle)

III. The attachment site of Achilles tendon on calcaneus bone influenced other joint such as subtalar, knee and ankle joint. If we take a look on the axis of subtalar joint which runs upward and medially from posteriolateral corner of calcaneus (Manter JT. 1941). Where triceps surae supinate the foot (Barfred T. 1973) thus, makes stress distribution along the medial and lateral side of Achilles tendon uneven

IV. Achilles tendon found to be twisted since human development thus, cause the rotation of limb bud in adult for that when a tendon placed under load it's subjected to wringing action this complex rotatory action is further compounded by the shape of the talus. The shape emphasis the fact that there is a subtle change in the position of the axis of the ankle joint relative to the Achilles tendon during dorsi and plantar flexion. Slight passive rotation occurs (Hicks JH,1953)

V. The force transmitted by Achilles tendon during running is equal seven time of bodyweight This generate a great force that act during standing which is about half of bodyweight (Ker RF..Et al, 1987).

1.2.2 Osteokinematics:

The talocrular joint has one degree of freedom, motion occur around axis of rotation that passes through the body of talus and the tip of both malleoli as result of the position of lateral malleolus which tends to be inferior and posterior to the medial malleolus. The axis of rotation departs from pure medial-lateral axis. The axis of rotation is incline slightly superiorly and anteriorly as it passes laterally to medially through the talus and both malleoli The axis deviate about 10° in frontal plan and 6° in horizontal plane. Because of the pitch of the axis of rotation the dorsiflexion is associated with slight abduction and eversion, and planter flexion with slight adduction and inversion, therefor talocrular joint produce movement of supination and pronation. Because the axis of rotation deviate from pure medial-lateral axis (Neumann, D.A ...ET al.2010). The 0°(neutral) position at the talocrural joint is defined by foot positioned at 90° to the leg from this position talocrular joint permit about 15 t-25° of dorsi flexion and 40-55° of planter flexion. Complete ankle dorsiflexion provides only 11° of internal tibial rotation. Propulsion during toe-off requires 19° of rotation. Hence, some subtalar motion is necessary for normal gait. Congenital fusion of the subtalar joint can result in re-modelling of the tibiotalar joint to a ball and socket joint. This joint configuration affords sufficient internal tibial rotation to allow a propulsive gait (Ramachandran M, 2001).

1.2.2.1 **Motion of the ankle joint**:

The movement occur in ankle joint is

Planter flexion and dorsiflexion in sagittal plane where abduction and adduction take place in transfer plane finally, inversion\eversion occur in frontal plane. The talus is 2.4 mm wider anteriorly than posteriorly (wright DG ...et al, 1964) Surly, stability during dorsi flexion is duo to mortis shape 3D motion occurs cross subtalar and tibiotalar as result of Combining these motion which refer to as

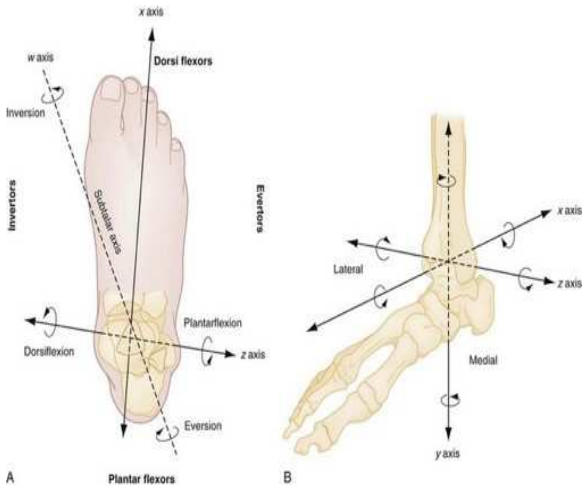

Figure 7- **Motion axis of ankle joint**

supination and pronation (figure 7)

1.2.2.2 Motion of the subtalar joint:

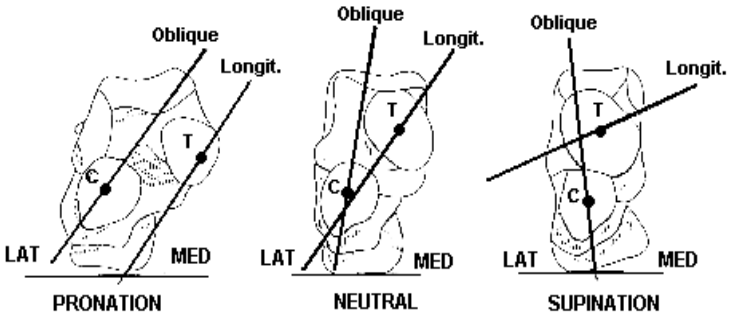

Figure 8- **Motion axis of subtalar joint**

The effect of tibiotalar motion on the subtalar joint manifested as tibial rotation is transformed into pronation and supination of the forefoot by the combined motion of the subtalar and transverse tarsal joints. External tibial rotation results in subtalar supination whilst internal tibial rotation results in foot pronation thus, subtalar joint is able to invert by 20° and Evert by 5° in normal foot. This is reduced in patients with flat feet and may be reduced to around 12° (Nordin M&Frankel V, 2001). In normal feet1° of tibial rotation results in 1° of subtalar motion (figure12). The presence of a flatfoot deformity increases this relationship so a single degree of tibial rotation results in > 1 of subtalar motion (figure 8).

1.2.2.3 Motion of the transverse tarsal (Chopart's) joint:

Transverse tarsal motion is essential to movement between flexibility and rigidity of the mid-foot during gait. For instance, the axes of the talonavicular and calcaneocuboid lie in parallel in the frontal plane when the subtalar joint is everted. The talonavicular joint or acetabula Pedis behaves as a ball and socket with its axis running through the talar neck. The calcaneocuboid joint is saddle-shaped with its axis through the calcaneal body. These configurations allow flexion and extension of the mid-foot relative to the hind-foot. When the subtalar joint is inverted the axes diverge, increasing the rigidity of the foot and facilitating force transfer to the forefoot (Elfman H, 1960). During the swing phase the subtalar joint is held in slight supination but at heel-strike there is rapid pronation as the heel contacts the ground slightly lateral to the longitudinal axis of the lower limb. During the first 15% of the stance phase the lower limb internally rotates. This has the effect of pronating the foot, which allows it to become flexible. Here the foot is able to adapt to uneven ground. As the body-weight passes over the planted foot in late stance the heel inverts, supinating the

forefoot and locking the mid-tarsal joints. This makes the mid-foot more rigid and allows effective transmission of force from the forefoot to the ground (Ramachandran M, 2011).

1.2.2.4 Motion tarsometatarsal (Lisfranc's) joint and intertarsal joint:

The tarsometatarsal joints (TMTJ) effect mid-foot flexibility. The stability of Joint results from strong ligamentous support. The second metatarsal base is 'keyed' into its metatarsocuneiform joint, as the intermediate cuneiform lies slightly more proximal than the medial and lateral cuneiforms. This confers further bony stability. Lisfranc's ligament runs from the medial cuneiform to the second metatarsal and is a major stabilizer. Movement at the first and second TMTJ is reduced more than that at the fourth and fifth. One study described first TMTJ motion as 3.5° flexion/extension and 1.5° pronation/supination. This compared to 9° flexion/extension and 9° pronation/supination at the fourth and fifth TMTJ

1.2.2.5 Motion of the metatarsophalangeal joint:

The stability of the 1st metatarsophalangeal joint is strongly high to allow performance of different functions. The ROM is from 30° plantar flexion to 90° dorsiflexion. Achieving full dorsiflexion without pain is necessary for a normal toe-off during gait. The first metatarsophalangeal joint is stabilized by strong collateral ligaments but its congruency position dependent. In neutral there is 0.38 cm joint surface area whilst in full dorsiflexion this reduces to 0.04 cm, tangential gliding motion responsible for most joint motion, extreme dorsiflexion is achieved by joint compression. This the beam model for stability of the medial longitudinal arch. This model assumes arch stability from bony contact and ligamentous support. Predisposes to the formation of dorsal osteophytes which are common features of first metatarsophalangeal arthritis. Metatarsal break which is the plane from the first to fifth metatarsal heads which forms during toe-off. This is usually between 50º and 70º and represents the instant centers of rotation of each of the five metatarsophalangeal joints. Thus Metatarsophalangeal joint movement is essential during the third rocker of gait. As the proximal phalanx passes over the metatarsal head it depresses it. In hallux valgus deformity the ability of the proximal phalanx to depress the first metatarsal head is diminished. This results in transfer of weight to other metatarsal heads, which may result in callosities or 'transfer lesions' (Dawe, E.J & Davis.J. 2011).

1.2.2.6 Arch of the foot:

There are two longitudinal arches in the foot medial and lateral longitudinal arches. The medial longitudinal arch consists of the calcaneum, talus, and navicular, medial, intermediate and lateral cuneiforms and the first three metatarsals. The talus sits at the apex of the arch and confers stability by acting as a wedge between the calcaneum and navicular. The truss model for medial longitudinal arch provide support of half the body-weight passes through the apex of the arch whilst standing. The ends of the ach are cannot be separated due to the tight plantar fascia which connects them (dashed line). Hence arch height is maintained (figure 9).

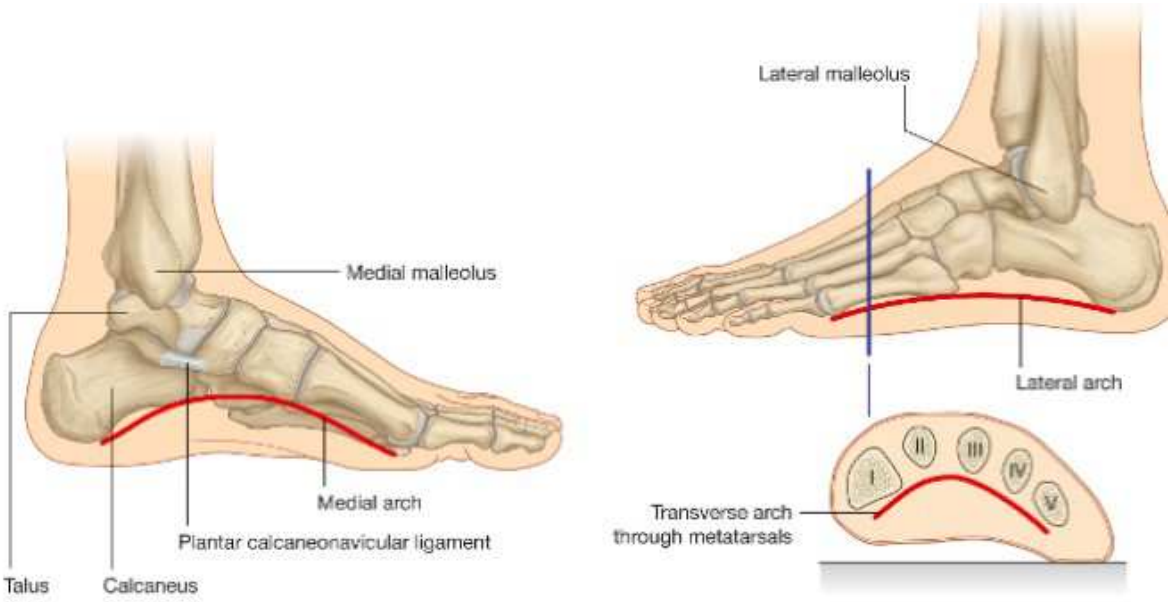

Figure 9- **Foot arch**

1.2.3 Arthrokinematics:

During dorsiflexion, the talus rolls forward relative to the leg as it simultaneously slides posterior thus, allows talus to rotate forward with only limited anterior translation Generally, any collateral ligament that become increasingly taught on posterior translation of the talus in addition to dorsiflexion. Maximal dorsiflexion elongates the posterior capsule and all tissues capable of transmitting planter flexion torque, such as Achilles tendon. During planter flexion, the talus roll posteriorly as the bone simultaneously slide anteriorly

Typically any collateral ligament that become taught during anterior translation of talus and planter flexion. Clearly, anterior talofibular ligament is stretched in full planter flexion where planter flexion movement stretch the dorsi flexor muscle and the anterior capsule joint.

1.2.4 Normal physiological gait:

Normal gait consists of stance phase (which make up 60% of the gait cycle), and swing phase (40% of gait cycle). However, normal gait has two period of double limb support which occupies (20% of gait cycle) initial double limb support occur at heel strike till the end of loading response phase. Where at mid-stance its merely single limb support. Finally, terminal double limb support occur from the beginning of terminal swing till the end of pre-swing (figure10) (Dawe, E.j&Davis, J. 2001).

Stabilization of the talucrular joint during gait:

The ankle joints rapidly planter flex after the initial heel contact during walking in order to lower the foot to the ground (0-5% of gait cycle) by eccentric contraction of the extrinsic anterior compartment muscles, the phase of the gait is complete as the foot is totally flat on the ground after, the leg start to rotate forward (dorsiflexion) over grounded foot. The foot continues to be in dorsi flexion till after heel off phase. The ankle joint become increasingly stable at this point of gait cycle thanks to the increased tension in many stretch collateral ligament, the dorsi flexed ankle is further stabilized as the wider anterior part of the talus wedge into tibiofibular component of mortis. The wedge effect cause the distal tibia and fibula to spread apart slightly. This action is resisted by tension in

distal tibiofibular ligament and interosseous membrane. At the initiation of the push off phase of walking (about after 40%of gait cycle). The fully ankle joint dorsi flexion as the COG of the body moves over the joint. Talocrural joint is well stabilized to accept compression forces that may reach over four-time bodyweight (Hamill, J., & Knutzen, K. 2009). The final third rocker occur as the metatarsophalangeal joint dorsi flex in order to process for toe-off hence, the windless mechanism is activated which will cause tension over the planter fascia and transform it into rigid lever which is able to conduct propulsive force into the ground. The eccentric activity of extrinsic planter flexor during terminal-stage of 3rd rocker while the concentric contraction of intrinsic planter flexor add more force and control to toe-off which take place at the end of 3rd rocker (figure 11). During the swing phase the anterior compartment muscles contract concentrically to allow foot clearance and prepositioning before the next heel-strike (Neumann D.A, 2010)

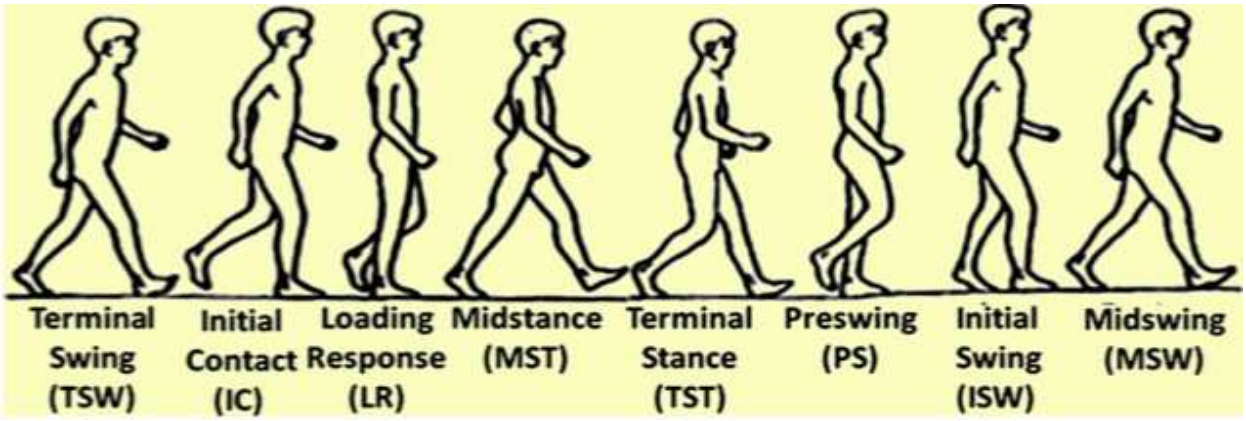

Figure 10- **Gait cycle**

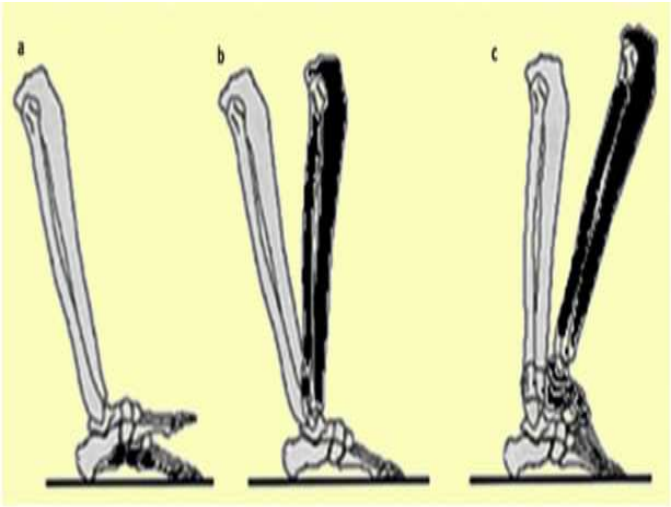

***Figure 11*- the three "rocker" phase of foot during gait**

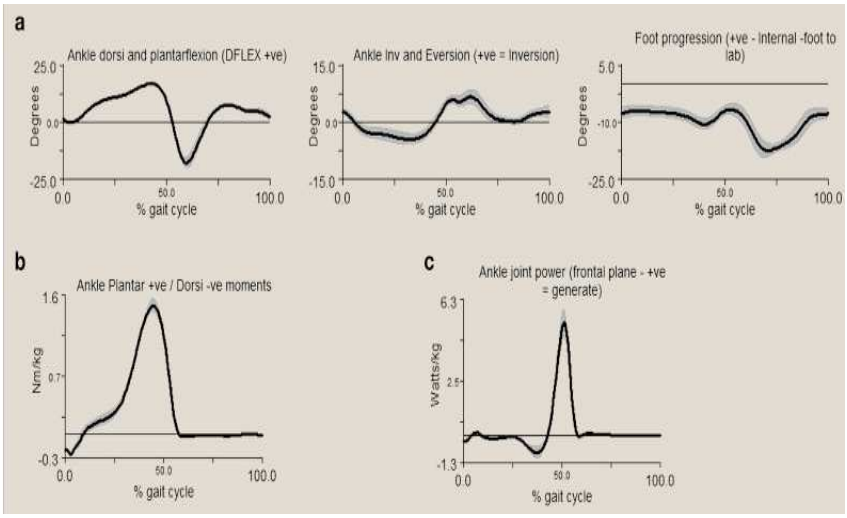

Figure 12- Output from gait analysis. A) represent ankle joint ankle complex rotation in sagittal, frontal and transverse planes (left to right, respectively); b) sagittal plane ankle moments and c) sagittal plane ankle power. The shaded area on all graphs represents ±1 standard deviation. Figure adapted from Visual 3D (C-Motion, Rockville, Maryland)

1.3 Achilles tendon rupture:

Achilles tendon known to be the largest and thickest tendon in human body anatomically positioned in the back of the ankle which connects the powerful calf muscles to calcaneus and serve as meditator in transmitting different forces to allow joint motion and enable muscle to remain at optimal distance from the joint in which it act on. Obviously, Achilles tendon is the most commonly injured tendon in human body, since 1980's the incidence of rupture is increasing rapidly. Frequently effecting male > female middle aged athlete from 30-39 years old. The main cause for Achilles tendon is sudden eccentric contraction of gastrocnemius and soleus muscle this mechanism is seen during recreational sports, (Flint et al, 2014). The rupture is typically occurring at the point proximal to the calcaneus because of this vascular impairment, nonspecific degeneration which lead to soft tissue necrosis. Athlete describe the incidence as audible "pop" sound and a feeling of being "kicked on the back", followed by pain and swelling of the lower leg a gap is felt 2 inches before the heel(figure13), the diagnosis is confirmed with positive Thompson test; patient is placed in prone position with knee flexed and foot relaxed, therapist firmly squeeze the calf muscle this should produce planter flexion of ankle joint which is absent in torn Achilles tendon. On the other hand, partial rupture "tendon tear but not completely" athlete may have symptom at the time but later as the tendon has cooled down they will be aware of pain. Acute intervention consist of ice application, with ankle immobilization in slight planter flexion and using crutches to unload the joint during ambulation. Conversional care of immobilization result in poor outcome for that, surgical repair either open or subcutaneous often has been treatment of choice. Next leg is placed either in planter flexor cast while gradually increasing planter flexion of the foot or more commonly, hinged ankle boot (Houglum, P. A. 2005).

Figure 13-**Photo illustrate Achilles tendon rupture occur 2 inches above calcaneus**

1.3.1 Epidemiology:

The frequency of Achilles tendon rupture in the general population is approximately 5 to 10 per 100,000, but incidence might be overall in some regions and populations Over 80 percent of ruptures occur during recreational sports. Approximately 10 percent of patients who sustain an Achilles tendon rupture had preexisting Achilles tendon problems (Leppilahti J, Orava S, 1998). Observational data suggest that competitive athletes have a lifetime incidence of Achilles tendinopathy of 24 percent, with 18 percent sustained by athletes younger than 45 years Kujala UM...et al, 2005). Tendon rupture occurs in 8.3 percent. Among competitive runners, the lifetime incidence of Achilles tendinopathy may be as high as 40 to 50%.

1.3.2 Etiology:

Incidence of Achilles tendon rupture has majorly increase since the first incidence reported in 1575 by Ambrose parè. Typically it found in individual preforming recreational and competitive sport. (Schepsis et al) reported 2 in 100 000 individual Achilles tendon injury rate in 1986 that increase six times in 1998 approximately 12 in 100 000. Accordingly, the male female ration of Achilles tendon rupture is range around 2:1 to 12:1, activity such as running, springing, and jumping. Typically, an injured individual report these symptoms such as sudden popping sound described as “kick from behind” or sudden snap in the calf muscles, rupture occur with explosive plyometric activities or a fast eccentric contraction. However, there is two type of AT rupture is either complete (entire tendon is torn usually require surgery) or partial (the tendon is not rupture completely). The most common mechanism of injury is excessive loading of tendon while foot is placed in inversion or eversion of the subtalar joint which considered. Pushing off the weight-bearing foot with extended knee(53% of Achilles tendon ruptures) , sudden dorsiflexion of the ankle(17% of AT rupture), and violent dorsiflexion of a plantar flexed ankle(10% of AT rupture) ,are the most common reported mechanisms for Achilles tendon rupture(Hess G,2009).

1.3.3 Pathogenesis:

A lot of factor contribute to Achilles tendon rupture such as medication (fluoroquinolones, corticosteroids), medical conditions (renal insufficiency, autoimmune

diseases, arteriosclerosis, hyperuricemia and genetic disorder of collagen) activities as can be concluded Achilles tendon is influenced by different aspects. Two theories have been concluded, the degenerative state theory describe that Chronic Achilles tendon Degeneration result in tendon tear at physiological load. Any excessive loading on the tendon, reoccurrence of micro trauma alteration in the physiological structure of the tendon can all lead to degenerative changes of Achilles tendon. The mechanical theory state as powerful contraction of the calf muscle might be enough to cause acute AT rupture this might be absolutely accurate in case of such athlete returning to activity after long period of inactivity(Kane, J.2015)

1.3.4 Clinical picture of Achilles tendon rupture:

Initially a popping sound is heard, followed by pain and swelling of the lower leg a gap is felt 2 inches before the heel Typically, during physical examination with an Achilles tendon rupture the common findings are weak planter flexor muscle thus utilized by preforming single heel rise also the ability to perform passive range of motion in dorsiflexion is greater compared to non-injured side usually, complete AT rupture result in positive Thompson test (Andrews, J.. et al. 2004)

1.3.5 Classification of Achilles tendon rupture:

The following classification according to Kuwada in 1904 and till this day this system is widely used to describe AT rupture (Popovic N & Lemaire R, 2000). Tear of Achilles tendon is divided into four categories with respect to severity (Maffulli, N., & Almekinders, L. 2007):

Type I: partial ruptures ≤50% (typically treated with conservative treatment)

TypeII: complete rupture with tendinous gap ≤ 3 cm (typically treated with end-end endanastomosis)

Type III: complete rupture with tendinous gap 3 to 6 cm (often requires tendon or synthetic graft)

Type IV: complete rupture with defect of >6 cm (often require tendon graft or gastrocnemius reconstruction)

1.3.6 Diagnosis of Achilles tendon rupture:

Initially, therapist observe patient gait when he first enters the clinic, from the gait pattern we can demonstrate that there is pain during ambulation “antalgic gait” and also no planter

flexion movement on the injured foot, over pronation of ankle joint on the effected leg and lack of push off in stance phase of the gait with noticeable dysfunction of triceps surae muscle (Simmonds 1957, Inglis et al. 1976, Carden et al. 1987). . After therapist pay close attention to the posture position and the way patient stand Next, we notice the muscles bulk, color of the skin any swelling around the ankle joint , presence of deformity on the lower limb and foot finally, therapist palpate the ankle joint and feel the gap of torn Achilles tendon (figure14).

Figure 14- **Photo illustrate the gap which can be palpable during examination**

1.3.7 Diagnostic methods:

1.3.7.1 *Special test:*

A. Thompson test:

This test is very effective in complete Achilles tendon rupture, patient lying in prone position with knee flexed and foot relaxed after, therapist apply firm squeeze of calf muscle this should produce ankle planter flexion . The test considered positive when there is no movement of the foot (Thompson & Doherty 1962).

B. Matles test:

Patient lying in prone position, he instructed to actively flex his knee over 90°. therapist observe ankle movement the following finding is observe in the tendon the foot should produce slight planterflexion.in contrast, foot fall into natural position or movement result in dorsiflexion. Typically Matles test show sensitivity of 0.88 unlike Thompson test for that test report positive result even in older tendon rupture (Kerr, J. 2007).

C. Achilles tendon total rupture score test:

The test consist of ten item in which patient is asked to respond using 11 grade scale Respectively zero score refer to patient has major limitation and difficulty and score of ten equivalent to patient has no limitation (Nilsson-Helander k, et al, 2007).

D. Real-time Achilles ultrasound Thompson test:

The test is similar to Thompson test in addition to using ultrasound modality for visualization (Griffin MJ, ET al.2016).

1.3.7.2 Radiology:

Recent study suggests that clinical examination itself quite sensitive in diagnosis AT rupture nearly, 100%. Moreover, advanced diagnosis such as MRI and ultrasound helps in pre-operative planning when surgery is required. Ultrasound known to have more advantage than MRI on the way of approximating the tendon edge and the ability of assessing the tendon dynamically (Kane, J.2015).

1.4 Clinical examination of Achilles tendon rupture:

1.4.1 Objectification examination:

- **Observation of overall postural alignments and body stability:**

  Important step initially to any examination. It give the therapist a general idea about the patient current condition and what he can expect during the assessment Therapist analyze patient gait, stability and coordination breathing pattern and patient psychology health and cooperation and observe any asymmetry of body alignment , joint deformities and finally looking at swelling and skin color.

- **Assessment of musculoskeletal function**

  By preforming view examination such as plump line test according to Kendell in standing to Evaluate posture alignment. Followed by Assessment of pelvic position and document any pelvic asymmetry, pelvic obliquity (if the result is positive further assessment is taken to measure leg length discrepancy), and ratio of ASIS to PSIS(pelvic tilt) further assessment is consider in case of SI joint pathology for

example (overtake phenomena and rosina test). Assessment of muscle length and document any muscle shortness according to Janda .Evaluation of muscle power (strength), and note any weakness

- **Assessment of gait pattern:**

  Observe overall walking stability, gait pattern and observe any pathological walking stereotype. Therapist evaluate gait during stance phase and swing phase. However he observe walking speed, movement UE and trunk rotation

- **Evaluation of basic movement pattern according to Janda:**

  The goal of this screening test is to evaluate faulty movement pattern and identify biomechanical problems, such as muscle imbalances, which may have caused or patient's pain or injury. the test consist of six movement Hip extension, hip abduction, trunk curl up, neck flexion, push up. Shoulder abduction.

- **Assessment of ROM of the lower limb according to Kendell:**

  Measuring ROM of joint of L.E using goniometer. The test include active ROM and passive ROM the patient must be relaxed and the joint is moved throughout it physiological axis. Normal ROM is important for functional activities.

- **Evaluation of neurological function:**

  Examination of dermatome to assist both superficial and deep sensation. And myotome the test is positive in cause of nerve root injury.

- **Assessment of joint play of foot according to Lewit**

  To determine how joint move freely and indicate any restriction of joint which will cause pain and effect gait function

1.4.2 Differential diagnose:

Differential diagnosis is important to determine the nature of the disease (Ferri, F. F. 2011)

Ankle sprain:

Commonly known as Twisted ankle which effect many people .it defined as to as tearing of the lateral ligament of ankle joint that because fibular collateral ligament is made up of three separate structure which are not strong enough compared to the medial ligaments thus, any sudden and forefeel eversion, inversion or rotation of the foot may tear the ligament.

Achilles bursitis:

Also known as retro calcaneal bursitis which is any inflammation or irritation of the bursa

(a sake filled with lubricating fluid anatomically its located between tissue such as bone, muscle, tendons the main function of bursa is to decrees friction. The mechanism of injury is best manifest as repeated micro-injury. Which decrees bursa optimal function. Any overuse of tendon might result of bursitis. Symptoms include pain at the posterior aspect of calcaneus specially during running uphill or walking on soft service and presence of tenderness and swelling.

Gastrocnemius muscle tear:

Also known as "tennis leg" that because of the prevalence in that sport torn calf muscle has similar symptoms as Achilles tendon rupture but occur higher up on the leg. Usually calf muscle tear occur in acceleration or sudden change in direction. Symptoms include sudden onset of pain, tenderness localized to the musculotendinous junction of the medial head of the gastrocnemius, defect of in the medial belly of the gastrocnemius during palpation just above the musculotendinous junction. Frequently injury in gastrocnemius muscle is associated with other pathology such as thrombophlebitis, soleus muscle tear, AT rupture.

Haglund deformity:

Also another term used is "Mulholland deformity", it is enlargement of calcaneus bone usually lead to bursitis. Typically in haglund deformity soft tissue around Achilles tendon become irritated

Partial Achilles tendon rupture:

The most common injury in athlete, partial torn of Achilles tendon which is mostly occur in sport requiring a sudden eccentric stretch of the tendon.

Tendinous xanthomas :

The occurrence of this disease consider rare and always associated with gyperlibedima

Characterized by a local concentration of lipid-laden macrophages, giant cells, and other inflammatory cells respectively to cholesterol deposition in tissues typically occur in skin specially, eyelid

Rupture Baker's cyst:

Defined as a benign swelling of the semimembranosus or more rarely some other synovial bursa found behind the knee joint.

1.5 Treatment of Achilles tendon:

There is different approach to consider when it comes to treating Achilles tendon rupture

That includes pharmacology, Surgical and conservative treatment, both propose strengths

and weaknesses for that, treatment option still controversial. Doctor assist patient individually according to their medical condition, age, overall health accordingly, further evaluation is carefully selected thus determine the treatment option. Medical therapy after AT rupture consist of rest, pain management, serial casting, and rehabilitation to increase function

1.5.1 Pharmacotherapy:

NSAID therapy

During the acute stage of Achilles tendon rupture, icing and anti-inflammatory drugs (NSAIDs) is recommended to decrease inflammation and pain (Marsolais, D..et al,2003)

Steroid injections

Steroid injection is helpful in pain management for short period of time however, argue about steroid injection still open to debate, thus, over use of steroid injection may result in tendon weakness therefor tendon rupture (Shrier, I ...et al, 1996).

Sclerosis of vessels

A small study supported the improvement in symptoms after the injection of a sclerosing agent (polidocanol) in painful Achilles tendinosis. That best manifested as sclerosant

Decrease neovascularization and pain (Ohberg, L. 2002).

Platelet injections

Platelet-rich plasma (PRP) injections which is best described as blood transfusion (plasma) typically blood contain WBC, RBC and plasma. The main function of platelets is in clotting the blood. However platelets contain growth factors (protein that's known to have healing properties). PRP is plasma contain many platelets than usually found in blood. The concentration of platelets and, therefore, the concentration of growth factors can be 5 to 10 times greater (or richer) than usual. To create a PRP initially, blood must be drawn from a patient. The platelets are separated from other blood cells and their concentration is increased during a process called centrifugation. After the increased concentration of platelets is combined with the remaining blood (Frank B. Kelly, MD, 2001).

Nitric oxide

Nitric oxide has been known to "stimulate collagen synthesis in fibroblasts" the majority of cell found in healing tendon tissue thus encourage tendon remodeling. Typically

Nitric oxide is used in the form of a nitroglycerin transdermal patch. One quarter of a 5-mg patch used daily for 12-24 weeks has been suggested. However, this should not be combined

with other drugs used to treat erectile dysfunction or pulmonary hypertension (e.g., sildenafil, tadalafil). In addition, precaution should be monitored with administration of rosiglitazone, certain drugs used to treat migraine headaches (ergot alkaloids such as ergotamine), and drugs that lower blood pressure including alpha blockers such as tamsulosin (Fox, A. J., & Murrell, G. A. 2007).

1.5.2 Conservative treatment:

Conversional care of immobilization result in poor outcome for instance; re-rupture of AT for that, surgical repair either open or subcutaneous often has been treatment of choice. Nevertheless, non-surgical treatment is best selected for elderly and inactive, patient with systemic illness those who are not suitable to undergo surgery as well patient with diabetes, wound healing problems, vascular disease, neuropathies, or serious systemic condition are best treated non-operatively because of the significant risks of operative treatment such as infection, wound problems, repair dehiscence, neurovascular injury. A series of progressively reduced planter flexion cast or hinged ankle boot (figure15), with immobilization of ankle joint crutches is used for ambulation to reduce weight bearing on affected leg the estimated value for weight bearing is week 2-3(25%), week 3-4(50%) week 4-5 (75%), week 5 and after(100%). The initial cast applied is a long-leg cast to approximate AT with knee flexion and ankle plantar flexion. The cast is changed in series, decreasing the plantar flexion and eventually moving toward short-leg casts in a neutral ankle position. This treatment lasts 6-12 weeks. Contracture of Achilles tendon might be duo to use of series casting after, heel lifts is applied. Next, depending on the current circumstances of AT shortness use of 1-2 inches heel lifts with gradual adjacent every week or every other week. Healing rate found to be similar to those undergo surgery yet return to activities is faster after surgery both treatment option disadvantage is the risk of DVT and tendon elongation in contrast, benefits of conservative treatment are no wound complications, lower in costs and decrease morbidity, and no exposure to anesthesia (Ecker, T. M ..Etal, 2016).

1.5.3 Surgical Treatment:

There is two type of surgeries, traditional open-repair by re-approximation of AT using medial longitudinal approach the advantage of using the medial approach is the direct visualization of the plantaris tendon and minimize the risk of injured sural nerve. However, midline incision is rarely used and that because of great chance of wound complication and adhesions. Secondly, mini-open repair which is refer to as “percutaneous repair” in which

the incision is made by small transvers incision at the level of Achilles tendon throughout a device which allows for sutures to be passed through the ends of the tendons to re-approximate the ends of the tendons indirectly. Advantage of using mini-repair manifested in incision is smaller in size and decrees the risk of wound problems and that because of no distribution of the paratenon. Conversely, risk includes higher rate of sural nerve injury and re-rupture. Percutaneous procedure tends to have weaker repair compare to open-repair (Miller, M. D. 2015).

1.5.4 Conservative vs. surgical treatment:

Both conservative and surgical treatment share the same risk factor of elongation of AT and formation of DVT. However, thy both share similar outcome such as ROM, strength, power, and functional levels as a reason for avoiding surgery. On the other hand full function is gained faster with surgical therapy than with conservative therapy, especially for athletic individuals. The surgical approach is manifested by a decrease rate of re-rupture, higher postoperative power, and decreased infection rate (Metz .R ...etal, 2007 &Nelsson-Helander K ...etal, 2010).

- A supporting systematic review by Erickson et al,2016 of Achilles tendon rupture meta-analyses demonstrate that surgical treatment has decrease rate of re-rupture and faster return to work than conservative therapy, while no operative treatment decrease the possibility of minor complications.
- A meta-analysis by Amendola of randomized controlled trials, 2010.Concluded that reoccurring of rupture is about 8.8% in no operative Achilles tendon rupture repair, incomparsion with 3.6% in patients undergo surgery, over a 10- to 36-month follow-up period. However, the no rupture complication of non-rupture rates seems to be higher in surgical repair than in no operative treatment

Table 1- **utilized complication rate between surgical and non-surgical treatment**

Complication type	Surgical treatment	Non-surgical treatment
Deep infection	2.36%	0%
Sural nerve sensory disturbances (pooled rate):	13.1%	0.62%
DVT	8.76%	0.78%

1.6 Physiotherapy:

Physical therapy for patients with complete Achilles tendon rupture consists of the following stages:

- Initial phase, Pain is used as indicator for the exercise intensities in the first and second phase.
- during intermediate phase, strengthening replaces active ROM, and neuromuscular control programs are recommended
- the third phase of rehabilitation, gradually increasing stress to allow the collagen to form adequately; as pain subside, stretching and active resisted motion are performed

During the first few weeks (0-4 week), the main treatment lye under managing the pain and protect the wound. Patient is wearing a splint and advice to immobilize the joint however, physical therapy and active ROM exercises are contraindication after week two patient might preform active DF with flexed knee to neutral position no active PF yet next, hip and knee strengthening exercise with the brace such as straight leg rise, hip abduction and joint mobilization. After 4-8 weeks the therapy aim to progress weight bearing as tolerated (in walker boot with 1 inch heel lift for two weeks, then decrease to 0.5 inch heel lift) and to increase ROM of the ankle joint by actively applying ROM in DF, EV, IN and passively stretching in PF direction by using PIR method and continuing knee and hip strengthening exercise. At 8-12 weeks full ROM should be achieved and beginning of light intensity ankle strengthening exercise in addition to Scar mobilization, wound management and swelling control, gradual resistance exercise for ankle joint (open-close chain, eccentric exercises for calf muscle as well as functional activities starting with theraband) followed by using modalities to control swelling (US, IFC with ice, Acupuncture, Light /Laser therapy). EMS to calf musculature with seated heel raises when tolerated. Gait training. Finally, sensory motoric training. Patients recommended to attend REH 2-3 times\week depending on patient schedule and degree of pain and swelling in the foot and ankle. Patient is able to return back to preform sport activities after 8-9 month (Freedman, J. A. & Cohen, R.S etal. 2003)

1.6.1 Orthotic:

Orthotic therapy in Achilles rupture consists of serial of casting followed by heel lift. In addition to that, conventional shoes are used by the patient eventually. Typically, orthotic devices most often are used bilaterally to prevent a gait imbalance (Lusardi, M. et al, 2013).

Figure 15- **Orthosis for AT**

Figure 16- **heel wedge used for walking boot**

Figure 17- **walking crutches**

1.6.2 Physical therapeutic modality:

Laser therapy:

Laser refer to as light amplification, of stimulated emission of radiation. Laser therapy establish in 1990 by a German physicist Max Planck. He explain how radiation transmit in form of quantities "quanta" it stream of particles "photons". During 1917 Enistein underline how laser is produced by quantum theory. Initially laser was used in medical field in 1960's mainly for tissue destruction and coagulation for that, some advantage has been seen when using low-energy laser. Electromagnetic energy contain wavelength that range from 100-10,000 nanometers within the electromagnetic spectrum, visible light wavelength range from 400(voilt)-700(red) nm, under the visual component of red light there is infrared and microwave on the other hand, beyond the voilt end there are ultraviolet , x-ray , gamma, and cosmic wave. However, atomic theory best used in describing laser therapy principle. Stimulation emission take place when the photon is release regardless to excited atom and promote the release of similar photon to be released from excited atom as well. Thus, a medium of excited atom must be produced in order to operate laser this is known as "population inversion" which is result when an external energy "pumping device" is exerted into a medium. Laser light has the consist of three manners each has different traits:

Monochromatic (single color or wave length), coherent (in phase) and collimated (minimal divergence).Laser has thermal and non-thermal effect with category such as (crystal or glass) as well gas, semiconductor, dye or chemical laser. Moving on, helium neon (HeNe) and gallium arsenide (GaAs) laser are both low-power laser which typically used for wound, soft tissue healing and reliving pain. HeNe laser convey red beam with wavelength equal 632. 8mn.The laser is conveyed in continuous wave with direct penetration of 2-5mm and non-direct penetration 10-15 mm, where GaAs, laser are invisible and have wave length about 904nm.The way beam delivered in pulse mode and contain average power output of 0.4 mW. This laser has direct penetration of 1 to 2 cm and indirect penetration to 5cm. laser therapeutic application in physical medicine aim to facilitate collagen synthesis, reduce in microorganism and elevate vascularization and decrease pain and inflammation. The application technique of laser is best describe as gentle contact with the skin surface and should be perpendicular to the target area. dosage play in important role when it comes to achieve the desired response but there is no exact dosimeter has been purposed therefor, dosage tend to fluctuate by different pulse frequency and treatment duration, laser is applied by developing an virtual gird over the target are. The gird is made up of square that approximately equal 1cm after laser is applied to each square for preselected time. Implementation of both trigger and acupuncture points are also useful in treating painful condition. Laser contraindication includes application over cancerous tissue, direct exposure into the eye and first trimester of pregnancy.

Interferential current:

Interferential current (IFC), commonly used in orthopedic physical therapy procedure, IFC produce electrical current of 4000HZ that pass through the target area IFC has the characteristic of deep penetration into soft tissue than any other electrical modality along with physiological effect that tend to have therapeutic value such as increase blood circulation which help blood flow to the injured site therefor reduction of swelling by clearing out edema fluid and damage tissue and carry nutrition that is necessary for healing obviously, IFC is known for two pain reduction theory which(pain gate theory) the ability to stimulate local nerve cell and potential blockage of transition of pain signal result in decreasing of the pain and secondly, (opioid mechanism)by stimulation of pain reduce endorphin. Stimulation of muscle contraction can be reach by using external application of an electrical current that able to conquer muscle inhibition cause by swelling and injury. IFC application is explain by

using four electrodes which are position in such way two current produce cross each other to the target area. IFC has been applied for many years and known to be safe. However, some contraindication must be conceded such as patient with pacemakers and close to the low back or abdomen of pregnant women. Also avoid the use of this modality in a body part where there is risk of metastasis.

Ultrasound

Ultrasound have been used since 1940's. The application of ultrasound is by describe as using a round-headed wand or probe that is put in direct contact with the patient's skin a gel is used during the application of ultrasound to reduce friction and help in conduct the ultrasonic wave Therapeutic ultrasound is in the frequency range of about 0.8-3.0 MHz

A piezoelectric effect caused by the vibration of crystals within the head of the wand/probe which result in wave generation. The transmission of sound waves through the skin cause a vibration of the local tissues. Thus, cause a deep heating locally without patient feeling any heat sensation during treatment. Usually in the acute stage where there is some presence of inflammation heating effect is not recommended. By using pulsed US instead of continuously transmitted is best in such causes. Ultrasound has not only potential heating effect but also improve tissue relaxation, increase local blood flow, and prevent scar tissue adhesion. Some studies suggested that US helps promote bone fracture healing. The intensity of US can be adjusted according to desired effect, by using greater power density (measured in watt/cm2) is best cases where prevention of scar tissue is the goal. Usually, treatment time is about 3-5 minutes depending on the size of the area being treated. In scar tissue therapy application time tend to be longer, during the treatment the head of the ultrasound probe is kept in constant motion. US Contraindications include local malignancy, metal implants below the area being treated, local acute infection, vascular abnormalities, and directly on the abdomen of pregnant women. It is also contraindicated to apply ultrasound directly over active epiphyseal regions (growth plates) in children, over the spinal cord in the area of a laminectomy, or over the eyes, skull, or testes (Prentice, W. E., 2011).

1.6.3 Occupation therapy:

Occupation therapy is very effective in promoting recovery after AT repair, by creating a good habit of work which contribute to patient gaining full confidence and enhance recovering after injury. frequently, after AT rupture patient may have some limitation when it comes in preforming certain movement specially toe off during ambulation therefore effect gait pattern in addition to ankle joint movement in DF, PF which tend to be challenging duo to the injury, sometime patient has difficult time completing everyday tasks, such as cooking while standing, normal walking without feeling fatigue, decrease the ability to drive a car and preforming sport. However, recovery time vary individually and depends on the severity of the injury. Occupational therapist can provide a proper rehabilitation that aim to prevent complication of injury as well as to promote patient confidence to adapt to life activity with injury. Accordingly, OT Evaluate patient injury following care by an orthopedist to coordinate treatment plans and carefully select the course of intervention. By analyze the patient environment at home and work to identify potential barriers to the patient performance. Invent a protective foot brace for the injured part of the foot and teach the patient how to manage daily activities while wearing the orthotic. Next by suggesting some techniques to help reduce swelling, prevent further injury, care for wounds, and improve movement. Recommending home exercise program that will facilitate healing and ideal use of the foot. OT can demonstrate the patient into how to safely complete activities and independently while the foot is still recovering. Finally, incorporate the patient's goals and desires into the treatment plan (AOTA, 2002).

1.6.4 Life style changes after Achilles injury:

Sport-related injury considered a public health issue. Accordingly, monitoring system is introduced to prevent injury by using safer equipment, and playing environment however, psychological factor are rarely considered as a part of sport injury prevention. A study by (Bramwell etal, 1975&Holmes, 1970) about how work influence stress-illness relationship, conducted that the higher the stress athletes is more prone to injury. Typically, after injury and patient being immobilize for period of time and being hospitalized in addition to some limitation he is facing because of the injury and being more dependent on other, all above mentioned factors effect patient psychology and might result in stress, frustration and depression, anger and isolation which influence overall recovery process as we know there

is a strong relationship between body health and mind. Never the less friend and family play a crucial part in motivation and sport (Arvinen-Barrow, M., & Walker, N. 2013).

1.6.5 Prognosis:

Patient had six sessions out of ten of individual physical therapy rehabilitation after right Achilles tendon rupture. Patient is determined to follow my instruction throughout our REH and cooperative during exercises. Overall patient was very educated and easy to work with he is very motivated to get back to preform sport. Above all patient must keep up with recommended strengthening exercises and sensorimotor functional training for more improvement.

SPECIAL PART
(CASE STUDY)

1.7 Methodology:

The clinical work practice took place at C.L.P.A. (Centrum léčby pohybového aparátu). It begin on Monday 30th of January 2017 , for a period of two weeks total work duration was eight hours\day moving on, my work was under the supervision of Mgr.zahir EL Ali. My patient had complete Achilles tendon rupture on the right foot, doctor prescribe ten individual physical therapy session. He start his first session with me and I was able to perform six session (3 session\week) My initial kinesiological assessment was on Monday 30th of January in addition to the therapy as for, last therapy which was on Thursday 9th of February and my final kinesiological examination was preform next day on 10th of February. Average therapy time is an hour, during patient examination which took place at the outpatient individual therapy room. I applied examination method as I was taught during my school years and used my own hand in palpating bony prominent and muscles. However, some instrument was used during assessment such as goniometer, scale (kg), measuring tape (cm) and hammer. As for therapy which was mainly at the fitness gym the equipment used was theraband, softball, Swiss ball and stationary balance board. In addition to some of the therapeutic modality such as laser device using pointed head. Each therapy session focused in increasing ROM, and promote scar elasticity and healing as well improve muscle strength specially of calf muscle, gait training and enhancing sensorimotor function.

In brief an assent form was signed by the patient and me. My clinical practice was approved by the Ethics Committee of the Faculty of Physical Education and Sport at Charles University, under the approval number 59/2017**.**

1.8 Anamnesis

Examine person: RA

Sex: male

Year: 19.06.1987

Age: 30 y\o

Diagnosis: achilles tendon Rupture suture on Right foot

Anamnesis (medical history):

The incident occurs 8 weeks ago patient over stretch his right Achilles tendon during preforming sport activity (parkour gymnastic style; a combination of jumping with fast flip). He heard a popping sound and the pain was unbearable he used ice and went to ambulance the result of doctor examination is complete Achilles tendon rupture. Surgery was performed next day on 1.12.2016, The method used is (open repair) after that, the leg was placed on brace for 5 weeks' period no movement is allowed during that time to allow tendon repair and protect the wound. Doctor checkup was on 4.1.2017; the result of his examination is right ankle joint (planter flexion = 15°).

He removed orthotics on 23.1.2017 doctor recommended that he gradually start loading his injured foot during walking. Today he starts his first session of physical therapy 30.1.2017.

Status present:

Objective:

Patient feel little stretch over his R Achilles tendon. There is no present of pain or any different sensation he states that he feels decreasing of temperature on injured foot (cold feet).

Table 2- **patient personal information**

Height	178 cm
Weight	72 kg
BMI	23
Dominant limb	Right
Assistive device	Using crutches
Other	He is using foot support (insoles) on right shoes

Subjective:

Personal anamnesis: Achilles tendon rupture on right ankle joint. he feels slight stretch over the R Achilles tendon (slight degree of pain) and greater pain is felt if he tries to engaging the injured foot during standing (which he avoids during ambulation, he uses swing to gait) The weight distribution on right foot mainly on the heel, the TMT is weight free. Normal weight distribution on left foot.

Family anamnesis: No history of diseases

Occupation anamnesis: Work as real estate broker

Social anamnesis: Live alone on first floor, constantly meeting with his friends

Functional anamnesis: Active person he is engaged in different sport activity such as acrobatic gymnastic, Break dancing, snowboarding...etc. He Practice sports 3-4 time\week

Allergy anamnesis: No allergies

Medication: Not using any

Injuries anamnesis: Injured his Right shoulder (rotator cuff tear|). 8 Years Ago

Past medical history: n\a

Past surgery: Shoulder orthoscopic on R shoulder

Sport leisure activities: Injuries R shoulder while snow boarding

Diet: Not engaged in any diet

Hobbies: Sport like gymnastic and photography

Prior rehabilitation: Shoulder REH for 3 weeks after orthoscopic surgery in 2009.

RHB indication: Individual physical therapy 10 session starting from 30.1.2017 also Electrotherapy 10 times. Sensory-motor stimulation.

1.9 Differential diagnosis:

Ankle sprain, Achilles bursitis, Calf injury, Fascia tear, Gastro soleus muscle strain or rupture (often tear of the medial head of the gastrocnemius), Haglund deformity, Inflammatory arthopathies, Partial Achilles tendon rupture, Tendinous xanthomas, Ruptured Baker cyst, Tennis leg and Vascular injuries

1.10 Initial kinesiological Examination:

Examination of physiotherapist:

1.10.1 Posture examination according to Kendall:

1.10.1.1 Inspection of patient:

The observation of our patient was made in standing. He was standing with the help of crutches. The type of breathing he is using is diaphragmatic Breathing (abdominal breathing) which is consider to be physiological. Ankle joint on right feet is slightly swollen and the skin color appear to be bluish compare to the left feet which is normal. Lower extremity is symmetrical.

1.10.1.2 Static posture (using crutches)

Anterior view:

- **Foot:** Narrow base of support, body weight is shifted more to the left side. Both Feet position straight (no physiological 5°of out toeing). TMT adducted on the left side. Right foot is slightly supinated and edema present on talus bone the color of skin on the entire foot is bluish (also cold during palpation). Normal toes shape on both feet. Right foot weight distributed on heel minimum to no weight bearing on TMT. Normal weight distribution on left foot; normal foot arch on both side.
- **Leg:** Tibialis Anterior muscle contour L>R. Calf muscle contort L>R
- **Knee:** Normal knee alignments on both legs
- **Thigh:** Normal quadriceps muscle contour on both side; vastus medialis on L>R
- **Pelvic:** Slightly rotate to left side
- **Trunk:** Centered umbilicus, normal abdominal muscle contours. Normal shape of chest; nipples are leveled.
- **Shoulder:** Left shoulder slightly protracted. right shoulder is normal
- **Head and neck:** Normal alignment of head and neck

Posterior view:

- **Foot:** Narrow base of support. Ankle valgus on Right side. Right foot is slightly forwarded. Normal shape of Achilles tendon on left side Presence of scare on Right Achilles tendon. The thickness of Achilles tendon is L>R (less prominent)
- **Leg:** Gastrocnemius muscle contours L>R. Hamstring muscle contour L>R. Popliteal line L>R
- **Knee:** Popliteal line is more higher on L>R
- **Trunk:** Lumbothoracic paravertebral muscle hyper tone on L>R. Normal spine shape. Normal scapulae alignment (prominent of scapulae muscle on right side more than left). Left shoulder slightly protracted
- **Head and neck:** Normal alignment of head and neck

Lateral view:

Left:

- Head is in neutral position
- Shoulder joint is slightly protracted
- Elbow joint is positioned in slightly flexion (duo to using crutches)
- Pelvic position is neutral
- knee in normal alignment
- Foot is in normal alignment.
- Ankle is valgus

Right:

- Head is in neutral position
- Shoulder joint is in normal alignment
- Elbow joint is slightly flexed
- Pelvic is slightly rotated forward. and Hip joint in slight degree of flexion
- knee joint is in semi-flexed position
- Foot is supinated (his weight placed on the lateral edge of the foot)

- Ankle is pes valgus

1.10.1.3 Dynamic Spine Examination: Not able to do

1.10.2 Pelvic Examination According to Lewit (Standing with crutches):

- **Pelvic obliquity:** iliac crest is higher on L>R
- **Pelvic tilt:** ASIS ratio to PSIS= < 4 cm (Normal)
- **PSIS:** R<L
- **ASIS:** L<R
- **Rosina test:** R= Absent L= Normal
- **Examination of overtake phenomena:** Not able to do

Conclusion:

The outcome according to the bony land mark measurement on pelvic area shows pelvic torsion. No sign of pelvic tilt and Rosina test might be not sufficient duo to weight bearing on non-injured side (left side).

1.10.3 Examination of Leg Length Discrepancy (using measuring tape\supine)

Table 3- **Leg length discrepancy**

	Anatomical Leg Length	Functional Leg Length
Right	93 cm	93 cm
Left	93 cm	97 cm

Conclusion:

There is a difference in functional leg length about 4 cm (right leg is shorter). The limb actually is the same length but because of the alignment it appears shorter this might be duo to (musculoskeletal imbalance, abnormal biomechanics of the foot) physiological difference should be not less than 3-degree difference. For instance; pelvic torsion might be the reason for that

1.10.4 Examination of gait according to Kendall:

The patient was instructed to walk in the room which is 50 meter. To observe his movement pattern. He is walking with crutches during his ambulation we observe that he is using swing

to the gait and move quite fast. He avoids using his injured foot (right foot). After that I instructed him to try to walk while loading his right foot (3-point alternative gait).

Base of support: Narrow base of support

Angle of position of feet: Normal foot angle position on left side, TMT Adduction (the front of the foot twisted inward). On the other hand, ankle on right foot is valgus and foot is supinated. Right foot position more forward.

Walk rhythm: Non-periodic

Walking speed: Major decrease in speed on the right side. Normal speed on the left side

Stride length: Decrease stride length on right foot. Normal stride length on the left foot

Movement of the foot:

***Right Foot*: Heel strike→** (small degree of DF 5°) **→Flat foot** (not appropriate, depending on the left foot for shock absorption, foot is supinated and normal foot arch) **→Loading response→** (the majority of weight disruption on right side is placed on the heels and little on TMT) **→Heel off** (absence of heel off) **→Toe off** (absence of toe off)

- ***Left Foot:*** **Heel strike→** (Normal DF 20°) **→Flat foot** (complete foot contact with the floor) **→Loading response→** (the weight disruption on the heel and later edge of the foot as well as on TMT end on big toe) **→Heel off** (foot pronation and prolusion of the toe) **→Toe off** (achieve by metatarsal bone of the hallux and flexion of all toes).

Axial position of the lower limb: Right Pes valgus

Movement and position of knee and hip:

Right side: Knee position in semi-flexion in mid-stance and terminal-stance. No hip extension

Left side: knee is flexed in (weight acceptance phase) and extended in (single limb support and limb advancement). No hip extension in (mid-stance), decreased hip extension in (terminal stance)

- **Position and movement of the pelvic:**
- Compensation on anterior tilt, rotation and lateral tilt approximately 4cm. less on right side

Movement of COG: Changed slightly higher than normal

Position and movement of trunk Major decreased of trunk movement on both side (limited with using 3-point alternative gait\crutches)

Activity of abdominal muscle and back muscle: Abdominal muscle are engaged during walking. Hyperactivity of paravertebral muscle on lumbar spine L>R

Position of the shoulder: Normal, slightly protracted (shrug) on the right shoulder

Position of head slightly Position on anterior-flexion (monitoring his steps)

Stability of walking: Overall walking seems to be stable but slow in speed

Conclusion:

Gait biomechanics is effected prior to Achilles tendon rupture on the right foot. He is using crutches (Swing to the Gait) bearing weight on left foot. Gait type is antalgic gait the following characteristic were observed

1. Decrease stance phase (20% of gait cycle). Decrease weight acceptance (mainly on heel, 3% on TMT). Decreased single leg support. Knee is semi -flexion in mid-stance and terminal stance only on Right foot.
2. Major decrees in stride length, absence of toe off on right foot
3. Lengthened swing phase
4. Decreased hip extension in mid-stance and terminal stance on left foot

1.10.4.1 Examination of modified gait:

Walking on tip toe: Not able to do duo to the injury and loading the lower limb

Walking up the stairs: Able to do

Walking backwards: Patient was not confidant and he is feeling pain

1.10.5 Examination of basic movement pattern according to Janda:

Each movement was preformed 3 time

I. Hip extension:

Physiological order: Contraction of gluteus maximums (ipsilateral) → hamstring (ipsilateral) → erector spinae L (contralateral) → erector spinae L (ipsilateral) → erector spinae THL (contralateral) → erector spinae THL (ipsilateral) → no activity of shoulder joint or trapezius muscle.

Left side

1. The patient was laying in prone position. The Sequence of hip extension movement was obtained firstly by contracting hamstring muscle (biceps femoris, semitendinosus, and semimembranosus). Then gluteus Maximus
2. erector spinae contralateral, After erector spinae ipsilateral
3. There is no shoulder elevation

Right side:

1. The patient was laying in prone position. The sequence of hip extension movement was obtained firstly by contracting hamstring muscle (biceps femoris, semitendinosus, and semimembranosus). Then gluteus Maximus
2. Erector spinae contralateral, after Erector spinae ipsilateral
3. There is no shoulder elevation

II. Hip abduction:

Physiological order: Contract of muscle gluteus medius and minimus → TFL → quadrates lumborum → iliopsoas and rectus femoris → abdominal and back muscles.

Left side:

1. The patient was in sideling position. The muscle initiated the movement are (gluteus meduis and gluteus minimus)
2. After he is using TFL Muscle
3. Engaging quadratus lumborum muscle which provide pelvic stability during the movement.

Right side:

1. The patient was in sideling position, the muscle initiated the movement are (gluteus meduis and gluteus minimus)
2. After he is using TFL Muscle
3. Engaging quadratus lumborum muscle which provide pelvic stability during the movement.

III. Trunk Flexion:

Physiological order: Initially, we observes the patient´s spontaneous pattern of sitting up and positive planter flexion.

Patient was in supine position. He is able to perform the movement spontaneously, there was no sign of anterior pelvic tilt. He planter flexed his foot during the curl up.

IV. Push up:

Left side:

The patient was in patient was in quadruped position. The movement is normal there is no excessive scapular abduction, adduction, elevation or Rotation.

Right side:

The patient was in quadruped position. There is slight degree of winging of scapulae which indicate serrates anterior muscle not adequately functioning.

V. Neck flexion:

The test was performed in supine position. Patient is able to perform neck flexion against resistance without hyper extension of cardiothoracic junction. This estimate the dynamic of cervical spine and normal interplay between deep neck flexor muscle and SCM muscle.

VI. Shoulder Abduction:

Left side:

The test was performed in sitting position. Patient is asked to abduct his shoulder while flexing the elbow joint to control undesired rotation. First the abduction occurs in Glenohumeral joint this is followed by rotation of scapulae and elevation of shoulder girdle 60°. There is no sign of trunk lateroflexion.

Right side:

The test was performed in sitting position. Patient is asked to abduct his shoulder while flexing the elbow joint to control undesired rotation. First the abduction occurs in Glenohumeral joint this is followed by rotation of scapulae and elevation of shoulder girdle 60°. There is no sign of trunk lateroflexion

1.10.6 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

Table 4- **Muscle length test acc. Janda**

Muscle	R	L
Gastrocnemius	0	1
Soleus	Not able	0
Hip flexor one joint (iliacus, posts maj)	0	1
Hip flexor two joint (rectus femurs, TFL)	1	1
Adductor	0	0
Hamstring	1	2
Paravertebral muscles	0	
Quadrates lumborum	0	0
Piriformis	0	0

1.10.7 Goniometer measurement:

(Using SFTR international form - According to Kendall)

Hip joint:

Table 5- **Hip joint ROM using SFTR form**

		R	L
Active	**Sagittal plane**	S=10°-0-125°	S=10°-0-125°
Passive		S=15°-0-130°	S=15°-0-130°
Active	**Frontal plane**	F= 45°-0-10°	F=45°-0-10°
Passive		F= 50°-0-10°	F= 50°-0-10°
Active	**Transfer plane**	T= 45°-0-45°	T=45°-0-40°
Passive		T= 45°-0-45°	T= 45°-0-45°

Knee Joint:

Table 6- **Knee joint ROM using STFR form**

		R	L
Active	**Sagittal plane**	S=0°-0-135°	S=0°-0-135°
Passive		S=0°-0-135°	S=0°-0-135°

Ankle joint:

Table 7- **Ankle joint ROM using STFR form**

		R	L
Active	**Sagittal plane**	S=5°-0-15°	S=20°-0-45°
Passive		S=5°-0-15°	S=20°-0-45°
Active	**Transfer plane**	T=15°-0-20°	T=25°-0-30°
Passive		T=15°-0-20°	T=25°-0-30°

Toes ROM (according to am. academy of orthopedic. surgeon)

Table 8 - **Toes ROM using STFR form**

	R	L
Big Toe MTP	S= 70°-0-45°	S= 70°-0-45°
IP	S= 0°-0-90°	S=0°-0-90°
2nd digiti MTP	S= 40°-0-40°	S= 40°-0-40°
PIP	S= 0°-0-35°	S= 0°-0-35°
DIP	S= 60°-0-30°	S= 60°-0-30°
3rd digiti MTP	S= 40°-0-40°	S= 40°-0-40°
PIP	S= 0°-0-35°	S= 0°-0-35°
DIP	S= 60°-0-30°	S= 60°-0-30°
4th digiti MTP	S= 40°-0-40°	S= 40°-0-40°
PIP	S= 0°-0-35°	S= 0°-0-35°
DIP	S= 60°-0-30°	S= 60°-0-30°
5th digiti MTP	S= 40°-0-40°	S= 40°-0-40°
PIP	S= 0°-0-35°	S= 0°-0-35°
DIP	S= 60°-0-30°	S= 60°-0-30°

1.10.8 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 = Fair (hold against gravity)

4 = Good (hold against moderate pressure)

5 = Normal (hold against strong pressure)

Table 9- **Muscle strength test**

R	Muscle	L
+4	**Hip flexor(Illiopsoas , sartorius , TFL, Rectus femoris)**	5
5	**Hip Adductor**	5
-4	**Hip Lateral Rotator**	+4
5	**Hip Internal Rotator**	5
5	**Quadriceps**	5
+4	**Gluteus Maximus**	5
5	**Gluteus Meduis**	5
4	**Gluteus minimus**	5
5	**TFL**	5
5	**Hamstring (Biceps femoris)**	5
5	**Hamstring(semitendinosus, semimembranosus**	5
3	**Gastrocnemius and soleus**	4
3	**Soleus**	5
+4	**peroneus Longus+ Brevis**	5
+4	**peroneus Tertius**	5
-4	**Tibialis Anterior**	5
+4	**Tibialis Posterior**	5
I= 4		I= 5
II= 3		II= 5

III= 3	**Flexor Digitorum Longus**	III= 5
IV= 3		IV= 5
V= 2		V= 5
I=4	**Flexor digitorum brevis**	I=5
II=3		II= 5
III= 3		III= 5
IV= 3		IV= 5
V= 3		V= 5
I=3	**Lumbricales**	I=4
II= 2		II=3
III=2		III= 3
IV=2		IV= 3
V= 2		V=3
I= 3	**Interossei**	I= 4
II= 3		II= 4
III= 3		III= 4
IV&V=3		IV&V= 4
2	**Flexor hallucis Longus**	3
3	**Flexor Hallucis brevis**	4
3	**Abductor Hallucis**	-4
1	**Adductor Hallucis**	3
4	**DIP Extensor**	5
5	**PIP Extensor**	5
I= 4	**Ext. digitorum longus+brevis**	I= 5
II= 3		II= +4
III= 3		III= +4
IV=3		IV= +4
V=3		V= +4

4 3	**Extensor hallucis longus+brevis**	+4 +4

1.10.9 Neurological examination:
Mental status: Patient is conscious.

1.10.9.1 Examination of dermatome (L1-S2):
The patient is asked to close his eye while preforming the test and tell us how he is feeling. Patient asked to report presence of sensation or if he experience different sensation between two examine parts. We also look for muscle wasting.

1.10.9.1.1 Examination of superficial sensation:
Light touch

The test was performed in supine and prone position. We examine lower extremity skin receptor (L1-S2). For this we apply light touch sensation the grading scale for this test is

→ L1 (hip and groin area): He feels the same sensation on both lower Limb

→ L2 (on anterior medial thigh): He feels the same sensation on both lower Limb

→ L3 (at the medial epicondyle of femur): He feels the same sensation on both lower Limb

→L4 (over the medial malleolus): He feels the same sensation on both lower Limb

→L5 (on the dorsum of foot): He feels the same sensation on both lower Limb

→ S1 (at the lateral aspect of calcaneus): He feels the same sensation on both lower Limb

→ S2 (at the midpoint of popliteal fossa): He feels the same sensation on both lower Limb

1.10.9.1.2 Examination of deep sensation:
Joint position:

The test was performed in prone position with closed eyes. The test gives information about proprioceptor function; these receptors located in muscles, tendons, ligaments and joints.

→ He is able to determine joint position when the Big toe of right foot was placed in extension. And he performed the same movement on the contralateral joint.

1.10.9.2 Examination of myotome:
The purpose of the test is to determine any nerve rout injury in lower Limb (L1-S2)

- L1 Myotome= Hip flexion
- L2 Myotome= Hip flexion (also hip adduction and internal rotation)
- L3 Myotome= Leg\ knee extension
- L4 Myotome= Ankle dorsiflexion

- L5 Myotome= Big toe extension
- S1 Myotome= Ankle planter flexion and eversion
- S2 Myotome= Ankle planter flexion and knee extension

→ He is able to perform movement against resistance (L1-S2)

1.10.9.3 Examination of deep tendon reflex:

Using the hammer to apply the test. Grading scale for the test is from 0 – 5. "Plus" (plus, brisk is for every reflex which is a bit higher than the normal rate):

5+ = Sustained clonus

4+ = Very brisk, Hyper reflexive with clonus

3+ = Brisk or more reflexive than normal

2+ = Normal

1+ = Low normal, diminished

0 = Absence

Table 10- **Deep tendon reflex**

Deep tendon reflex	R	L
Patellar tendon(L2-L4)	+2	+3
Achilles tendon (S1-S2)	Not able	+2

1.10.10Scar Examination:

The scar is 8 weeks old, 7cm in length, and vertical in shape and 1.6 cm in width. The location of the scar is on posterior service of calcaneus. As for scar character; the stitches is taken out. The scar is red in color and dark blue\ purple on the distal 2 cm at the end of the scar. There is noticeable difference in texture between the upper part of the scar and the bottom. The top part is smoother and the last 2 cm of scar proximal to calcaneus is slightly rough. However, the scar is mobilized in all direction (caudal, cranial, S shape and C shape) except the distal end which is slightly restricted on cranial direction and bigger restriction is found on caudal direction. No pain during scar palpation except presence of slight degree of pain while mobilization with S curve.

1.10.11Soft tissue palpation:

Normal skin color on left foot and normal temperature also nail shape is normal. Bluish skin color on right foot with decrease in temperature and normal nails shape. Palpation of edema on right ankle joint (talus bone); hard barrier, the scar is not painful during palpation except the distal end with firm service Foot

1.10.11.1 Capillary nail refill test: Normal on both legs

Table 11- **Soft tissue palpation**

		Right		Left	
		Dorsal	**Planter**	**Dorsal**	**Planter**
Skin	**Cranial**	Restricted	Restricted	Elastic	Elastic
Sub skin	**Caudal**	Elastic	Restricted	Elastic	Restricted
Fascia	**Medial**	Restricted	Elastic	Elastic	Elastic
	Lateral	Elastic	Restricted	restricted	Elastic
Legs		Tibialis anterior fascia is restricted on upper 1\3 of anterior medially on left foot and gastrocnemius muscle fascia is restricted on posterioanterior part below popliteal line on left foot. Peroneus muscle Fascia is restricted on cranial part of right foot			

1.10.12Examination of muscle tone (palpation):

Table 12- **Palpation of muscle tone**

Muscle	R	L
Trapezius	Hypertone (cranial part)	Normal
Levator Scapulae	Hypertone(toward muscle insertion)	Normal
Scalene	Normal	Normal
SCM	Normal	Normal

Paravertebral	Normal	Hypertone (on lumbar spine)
Rectus Femoris	Normal	Normal
Vastus Medials	Hypotone(most part specially upper part)	Normal
Vastus Lateralis	Normal	Hypertone(middle part of muscle, laterally)
Hip Adductor	Normal	Normal
TFL	Hypertone(toward the origin and middle part of muscle)	Normal
Gluteus meduis	Normal	Normal
Gluteus minimus	Normal	Normal
Hamstring	Hypertone(Biceps femoris muscle cranial part)	Hypertone(biceps femoris and semitendinosus muscles)
Gluteus Maximus	Normal	Normal
Pisiforms	Normal	Normal
Gastrocnemius	Hypotone(medial part)	Normal
Soleus	Hypotone(complete muscle)	Normal
Tibialis Anterior	Normal	Normal
Tibialis posterior	Normal	Normal

1.10.13Véle test: (using crutches)

Table 13- Vele test for stability

Right foot	Left foot
1	1

1.10.14Trendelenburg test:

The test is performed in standing with 90° flexion of hip and knee joint. We evaluate pelvic stability. The test is positive if there is any sign of (shift of pelvic, drop of pelvis contralateral to rise leg, trunk lateroflexion) which is related to weakness of hip abductor muscles

→ He is able to stand on non-injured leg (left leg). The test is normal

1.10.15Single leg stance:

- The test is performed in standing. Patient is instructed to stand with one leg for 10 second.
- → Patient is able to stand on non-injured leg (left leg) only. The test is Normal

1.10.16Two scale examination:

***Table 14*- Two scale examination**

	Right	**Left**
Standing in two scale (using crutches)	15 Kg	35 Kg
Total	50 Kg	

→ The difference is 20 kg which is about 50% difference. Body weight is shifted towards the left foot he is over loading joint on left leg thus, consider not physiological. The physiological ratio is 10% -15% of the total body weight

1.10.17Anthropometric measurement of lower extremity in cm:

Table 15- **Anthropometric measurement**

Length of Lower Extremity		
	R	**L**
Anatomical leg length	93	93
Functional leg length	93	97
Thigh length	51	45.5
Middle leg length	45	44
Foot length	30	30
Circumference of Lower Extremity		
CF of thigh (15cm testing quadriceps m**)**	44	47
CF of thigh (10cm testing vastus medialis	37	40
CF of knee	36	35
CF of calf	35	36
CF of ankle	29	26
CF of foot	23	25

1.10.18Joint play examination according to Lewit :

Table 16- **Joint play examination acc. Lewit**

Joint	Right	Left
Hip Joint ***IR*** ***ER***	 Normal Normal	 Normal Normal
Knee Joint ***Ventrodorsal\ (with knee flex)*** ***Laterolateral shifting medial\Lateral (with knee flex)*** ***Springing (with knee extended)***	 Normal Normal\ Normal Normal	 Normal Normal\Normal Normal
Patella ***Cranio-caudal*** ***Laterolateral***	 Normal Normal	 Normal Normal
Tibiofibular (supine- knee flexed)	Normal	Normal

Fibular Head ***(anterior-posterior)*** ***Rotation***		Normal Normal	Restricted in anterior and more on posterior direction Slightly restricted
Talocruler ***Ventro\dorsal*** ***Distraction***		Blockage Blockage	Normal Normal
Subtalar		Blockage	Normal
Chopart's		Blockage in dorsal direction	Blockage in dorsal direction
Lisfranc's		Blockage in dorsal direction	Blockage in dorsal direction
Cuboidum		Restriction in dorsal direction	Normal
Navicular		Restriction in dorsal direction	Normal
MTM	**I**	Normal	Normal
	II	Normal	Normal
	III	Normal	Normal
	IV	Normal	Normal
	V	Normal	Normal
PIP	**I**	Normal	Normal
	II	Normal	Normal
	III	Normal	Normal
	IV	Normal	Normal
	V	Normal	Normal
DIP	**I**	Normal	Normal
	II	Normal	Normal
	III	Normal	Normal

	IV	Normal	Normal
	V	Normal	Normal
Calcaneus to talus in medial rotation		Normal	Giving away
Calcaneus to talus in Lateral rotation		Normal	Normal

1.10.19Conclusion of overall initial examination:

To summarize this with, patient has injured his right Achilles tendon during sport activity while preforming a jump. Attempt of overly stretching Achilles tendon (forceful eccentric contraction of gastrocnemius muscle) with extended knee puts an enormous amount of stress on the tendon there for result in complete Achilles tendon rupture on the right foot. He undergoes surgery on 1.12.2016 (open repair procedure).obviously the muscle of lower leg on the injured side is weak appropriate exercise must be chosen carefully because of great chance of re-rupture.

In general patient has physiological breathing pattern. According to the skin color (bluish) on right foot and cold foot during palpation indicate poor blood circulations along with presence of swelling all contribute to the fact that joint mobility on the right foot are decreased. The scar is mobilized except for the caudal part (last 2 cm) is slightly restricted However, we can conclude that posture is influence by using the crutches Patient is not able to bear weight on his right foot (injured foot) completely and he relay on his left side for support. He has narrow base of support to compensate not only for shifted central of gravity but also for the functional leg length difference that equal 4 cm which result from musculoskeletal imbalance For example; This might affect patient quality of life in the future with greater chance to develop low back pain and hip joint pathology on the shorter limb in his case (right side), beside the presence of pelvic torsion(left forwarded) which might be the reason for muscle shortness(hip flexor and hamstring). Obvious decrees in ankle ROM on Right Foot resulting in Dorsiflexion = 5º (15 º difference from the norm), planter flexion =15º (30 º difference from the norm), inversion =20º (15 º difference from the norm) and eversion-15 º (5 º difference from the norm). On the other hand, decreased ROM of left foot in

inversion 25 º (10 º difference from the norm) is duo to the fact that the foot is already placed in slight degree of supination (TMT adduction).

Now, the effect of long period of immobilization of the right ankle joint result in restriction of joint play (talocrural, subtalar chopar and lisfranc). In contrast, blockage of Chopart and Lisfrant joint on the left foot is duo to overusing the joint especially with the injury he is more dependent on left lower extremity for weight support.

However, restriction of fibular head on left leg might be duo to presence of Trp in biceps femoris muscle. Clearly, there is no sign of neurological defect. The patient has semi-flexed knee during ambulation. The type of gait is antalgic gait for instance; the amount of time spent in stance phase is reduced (20% of their gait rather than 50%) and decrease stride length (absence of toe off- drop foot), so stride length on left side tend to be longer. Positive finding in examination of locomotion movement in push up might be duo to serratus anterior muscle weakness on right scapulae and prominence of scapular musculature; (trapezius and external rotation muscles) on right side might be duo to using crutches or duo to dominance of the right limb.

As can be expected muscle atrophy on right side because of immobilization specially (gastrocnemius and soleus muscles) with slight degree of soleus muscle shortness might be because of decreased muscle fiber elasticity after surgery. Weakness of small muscle of foot more on right side than left might be because he is not used to employ these muscles before injury and it is weak in nature.

1.10.20Goal of short term plane:

Rehabilitation 3- 4 time per a week, session duration not less than one hour

1. Pain control specially during dorsiflexion
2. Minimize the chance of reoccurrence of rupture by Avoid over-stressing the repair (avoid large movements in the sagittal plane; any forceful plantar flexion while in a dorsiflexion position; aggressive passive ROM; and impact activities)
3. Decrease swelling on right ankle joint (talus bone) by applying Ice, compression, elevation and active ROM on ankle joint (DF, PF and circumduction)
4. Thromboembolic prevention.
5. Improve blood circulation and lymphatic flow on lower extremity, especially on right foot (to increase temperature on right foot as well normalize skin color)
6. Improve soft tissue healing and Prevent scar adhesion (scar therapy, myofascial release)
7. Decrease muscle tightness on right foot by Active stretching in DF using thera-band and PIR (Triceps surae muscle, and hamstring), as well as (hip flexor muscles, gastrocnemius and hamstring) on the left foot. And Hydrotherapy, massage
8. Increase right ankle joint stability and function (balance exercise, strengthening ligament, tendon and muscles on leg and ankle joint, proprioceptor exercise)
9. Increase range of motion in dorsiflexion (15 º), planter flexion (30 º) eversion (5 º) and inversion (15 º) on right foot
10. Improve overall muscle strength in hip and knee joint of L.E. particularly, on the right foot (gastrocnemius, Flexor digitorum longus, brevis, lumbricals, interossei, flexor hallucis longus, brevis, Adductor hallucis, extensor digitorum longus, and Extensor hallucis) muscles. Using resistance isometric muscle strength exercises and PNF in 2nd diagonal extension of L.E (repeated contraction)
11. Mobilization of restricted joint play on right foot (talocrural, subtalor, Lisfranc and Chopart), also on the left foot (Chopart and Lisfranc)
12. Mobilization of restricted fibular head on Left leg. (mobilization technique according to Lewit and PIR of biceps femoris muscle on left leg)

13. Pain free isometric ankle inversion, eversion, dorsiflexion and sub-maximal planter flexion. (closed chain exercises) and also we could add red thera- band (medium resistance), starting with ×8 and he increase the repetition as he improve to × 10-12
14. Breathing exercises to improve deep core stabilizing system.
15. Correct faulty posture while using the crutches by (gait Training 3-point alternative gait pattern while gradually increase weight bearing on right foot as tolerated, strengthening of deep core stabilizing system, sensorimotor training).
16. Gait training and improve posture stability during walking (improve stance phase on right foot and loading on right foot joint as well as training toe off. Improve hip extension on both lower extremity and slowly advance the gait training for example; 2 point crutches, walking on narrow base of support, side walking, walking on smooth surface)
17. Improve sensory motor function for more stability of ankle joint on the right foot(in static, dynamic and functional assessment)

1.10.21Goal of long term plan:

Patient must continue the previous exercises and increase the weight bearing on affected foot and increase the resistance and difficulty of exercises as tolerated.

1. Normalized gait (remove crutches and independently walking, increase anti-gravity Achilles /calf strength)
2. Ankle strengthening exercise (increase resistive plantar/dorsiflexion exercises)
3. Calf and dorsiflexion stretch leaning against wall (avoid excessive calf stretch) – controlled slow eccentric exercises
4. Closed chain exercises: controlled squats and lunges; bilateral calf/toe raises, progressing to single leg raises and single leg balancing
5. Balance exercise (walking on rope, walking backward with stretch hand)
6. Advance isometric exercise (open chain exercises); Squat on rocker board, heel rise, standing on one leg. Exercising Ankle ROM in DF, PF with thera-band increasing resistance
7. Treadmill/track walking; progress to light jogging at 5 months if no symptoms
8. Improve right ankle joint stability and function (progress increase in strengthening, proprioceptive and balance training)

9. Regain full range of dorsiflexion and plantar flexion on right ankle joint. As well as regain full strength of calf muscle on right foot.
10. sensory-motor training (balance shoes, standing on rocker bored while catching a ball)
11. Return to normal sport at 8 – 9 months

1.10.22Proposed Therapy:

1. Soft tissue technique on right L.E to increase blood circulation
2. Strengthening of deep core stabilizing system using diaphragmatic breathing exercise
3. Post isometric relaxation (PIR) for hamstring muscle on both leg according to Lewit
4. PIR on triceps surae muscle on right foot to increase dorsiflexion ROM according to Lewit
5. Mobilization of restricted joint play on right foot (talocrural, subtalor, Lisfranc and Chopart), also on the left foot (chopart and lisfranc)
6. Pain free isometric ankle inversion, eversion, dorsiflexion and sub-maximal planter flexion. (closed chain exercises) and also we could add red thera band (medium resistance)
7. Gym exercise to train ankle joint stability and function using therapy balloon (walking forward while sitting on balloon open eye , walking backwards with open eyes walking with closed eyes) 8X3
8. Modified heel rise to strengthen gastrocnemius muscle (sitting on gym balloon) 8X3 on both leg
9. Isometric strengthen training of lower extremity ‘bridge exercise’ using cylindrical ball to work abdominal muscles, back muscles and pelvic floor muscle and extensor muscle on lower extremity and stretching tight hip flexor muscle 8X 3
10. Proprioceptor Neuromuscular facilitation (in 2nd diagonal extension of L.E-facilitation technique in repeated contraction).
11. Static balance exercise
12. Neurodevelopmental treatment (balance reaction exercise on both ankles joint according to Bobath)
13. Sensory motor training of intrinsic muscle of foot (foot fist according to Ihara and nakayama)

14. Gait training while using crutches (3-point alternative gait) and gradually increase weight bearing on right foot
15. Kinesiotaping taping on right foot on posterior Achilles tendon. For Achilles tendon correction and decrease tension on triceps surae muscle.
16. Physical Therapeutic modality such as laser bio-stimulation (localization: R Achilles tendon frequency: 10,5 [Hz], time: 10 min, dosage: 5,00 J /cm^2])
17. Hydrotherapy (warm bath 38° C) for 10-20 min if the edema is diminished. initial to individual therapy

1.10.23Therapy Done Today:

1. **<u>Soft tissue technique by Lewit:</u>**

   On right Achilles tendon (using soft ball moving on caudal-cranial direction, myofascial release of (anterior, posterior, lateral and medial compartment of leg) in caudal, cranial , medial and lateral direction, mobilization of soft tissue around the scar. Fan wise spreading of planter fascia and dorsal fascia of the foot and stretching the soft tissue between Achilles tendon and tibia in medial and lateral direction according to Lewit, using spiky ball to facilitation skin proprioceptor. total therapy time 5 min. Mobilization of scare (scar massage; pressing scar caudocranial direction, elongation of two end of scar, squeezing two end of scar and mobilization in S curve, C curve) total therapy time 5-7 min

2. **<u>PIR technique by Lewit:</u>**

   Ankle planter flexor muscle on right foot to increase ROM in dorsiflexion. Exercise consist of three set patient hold for 30 sec against resistance. PIR of Hamstring muscles (biceps femoris, semitendinosus and semimembranosus) on both legs to stretch shortened muscle and release restriction on left fibular head applied for X 3 and hold for 30 sec against resistance.

3. **<u>Joint play mobilization according to Lewit</u>**:

   Mobilization of fibular head on left foot (springing in anterior-posterior direction and rotation) till fibular head is not restricted approximately 20-30 rep. talocrural mobilization on right foot (traction of ankle joint and springing the joint distally) Subtalor (distraction of the posterior part) mobilization of Lisfranc and Chopart according to Sachse's (dorsal push) till the joint are unblocked app 20-30 rep.

4. **Gait training:**

Gait training using 3-point alternative gait while try to 20% weight loading on right foot, erect posture, elongation of stance phase on right foot and training hip extension on both side.

5. **Physicaltheraputic modality:**

Laser therapy (bio-stimulation localization: R Achilles tendon frequency: 10, 5 [Hz], time: 10 min, dosage: 5, 00 J /cm^2])

Result of today therapy:

Mobilization of scar is not painful; patient describe how he felt after therapy as good stretch over Achilles tendon (noticing mobility of right ankle joint after being immobilized for 8 weeks). PIR therapy of hamstring muscle on both legs were effective (increase stretching after patient relax and breathe out). Patient is exhausted after gait training, he refers to training level in general as moderate. Result of joint mobilization are the following **Left foot=** Springing of talocrural joint and fibular head **Right foot=** blocked of **(**talocrural, subtalor,) and springing of (Lisfranc and Chopart joint)

Self-therapy:

1. Training of correct walking with crutches using 3 alternative gait pattern.
2. Stretching gastrocnemius muscle of right foot using thera band (hold for 30-60 sec×8)
3. Active right ankle ROM in DF,PV,EV and IN ×8 advice to train in path tub under the water
4. Sensorimotor training of proprioceptor of sole of the foot (pressing 3 point on sole of foot, bring TMT head toward heal (increase arch of foot). Creeping motion of the toes on the ground). As demonstrated in the clinic.

1.11 Therapy progress

1.11.1 Therapeutic Unite 2: 1.2.2017

Time: 9 am

Duration: 1:30 hour

Objective stp.:

Today is patient second session. He entered the clinic using 3-point alternative gait instead of swing to the get. The walking speed is very slow and without complete toe off. I asked if he feel any pain or discomfort after last session on 30.1.2017, he reported that he is feeling no pain. ROM on right ankle joint: **S=** 5°-0-15° **T**=15°-0-20°. Joint play on right ankle joint**:** Talocrural = blockage, subtalar = blockage. The right foot skin color is still bluish and cold in temperature, there is slight reduction of edema on right ankle joint.

Subjective stp:

Patient feels better he reports no pain after last session, he notices slight improvement in his right ankle joint he describe it such as freer (loosening up) and he look forward to upcoming session for more improvement and return back to being able to perform sports.

Goal of today therapy:

The primary goal for today therapy is to reduce pain on right ankle joint in DF and PF pattern, also to Increase blood circulation and lymph flow in order to reduce edema on right ankle joint in the same way to Improve soft tissue healing and regeneration in addition to prevent scar adhesion. Secondary providing muscle energy technique (PIR) which not only going to help in increasing ankle ROM in DF but also in stretching tight hamstring muscle and help to release left fibular head restriction. Next mobilizing restricted joint play on the right foot talocrural, subtalar. Last but not least, sensorimotor training to improve ankle joint stability and function. Finally improve gait (3- point alternative gait).

Proposed therapy:

1. Soft tissue technique on right L.E to increase blood circulation
2. Strengthening of deep core stabilizing system using diaphragmatic breathing
3. Post isometric relaxation (PIR) for hamstring muscle on both leg according to Lewit
4. PIR on triceps surae muscle on right foot to increase dorsiflexion ROM according to Lewit
5. Mobilization of restricted joint play on right foot (talocrural, subtalor, Lisfranc and Chopart), also on the left foot (Chopart and Lisfranc)

6. Pain free isometric ankle inversion, eversion, dorsiflexion and sub-maximal planter flexion. (closed chain exercises) and also we could add red thera band (medium resistance)
7. Gym exercise to train ankle joint stability and function using Swiss ball (walking forward while sitting on balloon open eye , walking backwards with open eyes walking with closed eyes and bouncing on the ball)10X3
8. Modified heel rise to strengthen gastrocnemius muscle (sitting on gym balloon) 10X3 on both leg
9. Isometric strengthen training of lower extremity bridge exercise using cylindrical ball to work abdominal muscles, back muscles and pelvic floor muscle and extensor muscle on lower extremity and stretching tight hip flexor muscle 10X 3
10. Proprioceptor Neuromuscular facilitation (in 2 diagonal extension of L.E-facilitation technique in repeated contraction).
11. Static balance exercise (begin in 2-foot stand, then 2 foot stand on balance board or narrow base of support and gradually progress to single leg stand)
12. Neurodevelopmental treatment (Balance reaction exercise on both ankles joint according to Bobath)
13. Sensory motor training of intrinsic muscle of foot (foot fist according to Ihara and nakayama)
14. Gait training while using crutches (3-point alternative gait) and gradually increase weight bearing on right foot
15. Kinesiotaping taping on right foot on posterior Achilles tendon. For Achilles tendon correction and decrease tension on triceps surae muscle.
16. Physical Therapeutic modality for facilitate blood circulation and increase soft tissue healing and regeneration such as laser bio-stimulation (localization: R Achilles tendon frequency: 10, 5 [Hz], time: 10 min, dosage: 5, 00 J /cm^2])
17. Hydrotherapy (warm bath 38° C) for 10-20 min if the edema is diminished. initial to individual therapy

Implementation of the therapy:

1. Soft tissue technique by Lewit:

On right Achilles tendon (using soft ball moving on caudal-cranial direction, myofascial release of (anterior, posterior, lateral and medial compartment of leg) in casual, cranial , medial and lateral direction, mobilization of Soft tissue around the scar. Fan wise spreading of planter fascia and dorsal fascia of the foot and stretching the soft tissue between Achilles tendon and tibia in medial and lateral direction according to Lewit, using spiky ball to facilitation skin proprioceptor. total therapy time 5 min. Mobilization of scare (scar massage; pressing scar caudocranial direction, elongation of two end of scar, squeezing two end of scar and mobilization in S curve, C curve) total therapy time 5-7 min

2. PIR technique by Lewit:

Ankle planter flexor muscle on right foot according to increase ROM in dorsiflexion X 3 and hold for 30 sec against resistance. PIR of Hamstring muscles (biceps femoris, semitendinosus and semimembranosus) on both legs to relax muscles applied for X 3 and hold for 30 sec against resistance.

3. **Joint play mobilization according to Lewit**:

Mobilization of talocrural joint on right foot (traction of ankle joint and springing the joint distally), subtalor (distraction of the posterior part till the joint are unblocked app 20-30 rep.

4. Isometric strengthening exercise:

Exercise was preform in the gym, exercise to train ankle joint stability and function sitting on Swiss ball (walking forward while sitting on balloon with open eyes, walking backwards)10X3

5. Gait training:

Gait training using 3-point alternative gait while try to 20% weight loading on right foot Erect posture, elongation of stance phase on right foot and training hip extension on both side.

6. Balance and sensory motor training

Training of static balance exercises n sitting position (on Swiss ball) with shifting weight between heel and forefoot. Next erect sitting position on Swiss ball feet supported on the

ground patient try to press the 3 point (calcaneus bone, 1st metatarsal head and 5th metatarsal head after trying to increase foot arch by imagining to bring TMT towards the heel and try not to use flexor muscle tendon to participate in movement. Finally in the same previous position he bounce on Swiss ball and suddenly stop the movement

7. <u>Physicaltheraputic modality:</u>

Laser therapy (bio-stimulation localization: R Achilles tendon frequency: 10, 5 [Hz], time: 10 min, dosage: 5, 00 J /cm^2])

Self-therapy:

1. Training of correct walking with crutches using 3 alternative gait pattern.
2. Stretching gastrocnemius muscle of right foot using Theraband (hold for 30-60 sec×8)
3. Active right ankle ROM in DF,PV,EV and IN ×8 advice to train in path tub under the water

Effect of the therapy:

Skin and sub skin are more elastic on all direction except caudal direction of Achilles tendon of right foot planter fascia is no longer restricted on both leg. Successful PIR of hamstring muscles and planter flexor muscle on both leg (increase stretching after patient relax and breathe out). Springing of subtalar and talocrural joint on right foot still blocked. Increase performance quality of bridge exercise (he is able to hold for 60 sec).

1.11.2 Therapeutic Unite 3: 3.2.2017

Time: 9 am

Duration: 1:30 hour

Objective stp.:

Today is patient 3rd session. He entered the clinic using 3-point alternative gait with noticeable improvement of gait, he is not swinging into gait also there is an increase on weight loading on right foot in stance face (10% more). ROM on right ankle joint: **S=** 5°-0-15° **T**=15°-0-20° .The knee is no longer in semi-flexed position during ambulation as well as slight improvement of straight length still not able to perform toe off adequately. Joint play of right foot subtalar joint and Lisfranc and chopart are no longer blocked except for ankle joint (talocrural) still restricted.. Generally walking is stable. Joint skin color is still bluish and cold in temperature, there is slight reduction of edema on right ankle joint.

Subjective stp:

Patient in great mood and happy about how he is progressing he is feeling stronger, no sign of pain. He is preforming self-therapy

Goal of the therapy:

The primary goal for today therapy is to reduce pain on right ankle joint in DF and PF pattern, also to Increase blood circulation and lymph flow in order to reduce edema on right ankle joint as well as to improve soft tissue healing and regeneration in addition to prevent scar adhesion. Secondary providing post isometric muscle relaxation (PIR) which not only going to help in increasing ankle ROM in DF but also in stretching tight hamstring muscle. Next mobilizing restricted joint play on the right foot talocrural. Afterwards, strengthening weak muscles on right foot (gastrocnemius, soleus and tibialis anterior) by applying isometric strengthening exercise. Last but not least, sensorimotor training to improve ankle joint stability and function. Finally improve gait (3- point alternative gait).

Proposed therapy:

1. Soft tissue technique on right L.E to increase blood circulation
2. Strengthening of deep core stabilizing system using diaphragmatic breathing
4. Post isometric muscle relaxation (PIR) for Hamstring muscle on both leg according to Lewit
5. PIR on Triceps surae muscle on right foot to increase dorsiflexion ROM according to Lewit

6. Mobilization of restricted joint play on right foot (talocrural, subtalor, Lisfranc and Chopart), also on the left foot (chopart and lisfranc) in dorsal direction
7. Pain free isometric ankle inversion, eversion, dorsiflexion and sub-maximal planter flexion. (closed chain exercises) and also we could add red thera band (medium resistance)
8. Gym exercise to train ankle joint stability and function using Swiss ball (walking forward while sitting on the balloon open eye , walking backwards with open eyes walking with closed eyes)10X3
9. Modified heel rise to strengthen gastrocnemius muscle (sitting on gym balloon) 12X3 on both leg
10. Isometric strengthen training of lower extremity Bridge exercise using cylindrical ball to work abdominal muscles, back muscles and pelvic floor muscle and extensor muscle on lower extremity and stretching tight hip flexor muscle 10X 3
11. Proprioceptor Neuromuscular facilitation (in 2 diagonal extension of L.E- facilitation technique in repeated contraction).
12. Static balance exercise (begin in 2-foot stand, then 2 foot stand on balance board or narrow base of support and gradually progress to single leg stand)
13. Neurodevelopmental treatment (balance reaction exercise on both ankle joint according to Bobath)
14. Sensory motor training of intrinsic muscle of foot (foot fist according to Ihara and nakayama)
15. Gait training while using crutches (3 point alternative gait) and gradually increase weight bearing on right foot
16. Kinesiotaping Taping on right foot on posterior Achilles tendon. For Achilles tendon correction and decrease tension on triceps surae muscle.
17. Physical Therapeutic modality for facilitate blood circulation and increase soft tissue healing and regeneration such as laser bio stimulation (localization: R Achilles tendon frequency: 10, 5 [Hz], time: 10 min, dosage: 5, 00 J /cm^2])
18. Hydrotherapy (warm bath 38° C) for 10-20 min if the edema is diminished. initial to individual therapy for better blood circulation and lymphatic flow and myofascial relaxation

Implementation of the therapy:

1. **Soft tissue technique by Lewit:**

   On right Achilles tendon (using soft ball moving on caudal-cranial direction, myofascial release of (anterior, posterior, lateral and medial compartment of leg) in caudal, cranial , medial and lateral direction, mobilization of Soft tissue around the scar. Fan wise spreading of planter fascia and dorsal fascia of the foot and stretching the soft tissue between Achilles tendon and tibia in medial and lateral direction according to Lewit, using spiky ball to facilitation skin proprioceptor. total therapy time 5 min. Mobilization of scar (scar massage; pressing scar caudocranial direction, elongation of two end of scar squeezing two end of scar and mobilization in S curve, C curve) total therapy time 5-7 min

2. **PIR technique by Lewit:**

   Ankle planter flexor muscle on right foot according to increase ROM in dorsiflexion X 3 and hold for 30 sec against resistance. PIR of Hamstring muscles (biceps femoris, semitendinosus and semimembranosus) on both legs to stretch shortened muscle and release restriction on left fibular head applied for X 3 and hold for 30 sec against resistance.

3. **Joint play mobilization according to Lewit**:

   Mobilization of talocrural joint on right foot (traction of ankle joint and springing the joint distally), subtalor (distraction of the posterior part till the joint are unblocked app 20-30 rep.

4. **Isometric strengthening exercise(close chain exercise):**

   Modified heel rise to strengthen gastrocnemius muscle, patient is sitting on Swiss ball and try to raise his both feet. The exercise done in three set for 10 rep each 10X3

5. **Proprioceptor Neuromuscular facilitation**

   PNF in 2nd diagonal extension of right L.E using repeated contraction technique. The exercise preform 5 times in three set to help Functional training in eccentric control of movement

6. **Gait training:**

   Gait training using 3-point alternative gait while try to 25% weight loading on right foot, erect posture, elongation of stance phase on right foot and training hip extension on both side.

7. **Physicaltheraputic modality:**

   Laser therapy (bio-stimulation localization: R Achilles tendon frequency: 10, 5 [Hz], time: 10 min, dosage: 5, 00 J /cm^2])

8. **Kinesiotaping:**

   Applying kinesiology Tape on right leg (Triceps surae muscle), to minimize stress on right Achilles tendon as well to correct Achilles tendon on right foot

Self-therapy:

1. Training of correct walking with crutches using 3 alternative gait pattern.
2. Stretching gastrocnemius muscle of right foot using Thera band(hold for 30-60 min×8)
3. Active right ankle ROM in DF,PV,EV and IN ×8 with moderate resistance
4. Sensorimotor training of proprioceptor of sole of the foot (pressing 3 point on sole of foot, bring TMT head toward heal (increase arch of foot). Creeping motion of the toes on the ground). As demonstrated in the clinic

Effect of the therapy:

Improvement of gait, patient feel more confident to try loading the injured foot (right foot). The loading percent still small he is unable to perform complete toe off. Now by correcting the gait and start engaging the muscles the foot automatically unblocking restricted joint except talocrural joint.

1.11.3 Therapeutic Unite 4: 6.2.2017

Time: 10 am

Duration: 1:00 hour

Objective stp.:

Today is patient 4th session. ROM on right ankle joint: **S=** 5°-0-15° **T**=15°-0-20°

Patient is progressing no pain after last therapy, no sign of edema on right ankle joint.

Subjective stp:

Patient tried standing without crutches at home while cocking for small period. He feels no difference on right ankle joint after applying kinesiotype

Goal of the therapy:

The primary goal for today therapy is to reduce pain on right ankle joint in DF and PF pattern Also to increase blood circulation and lymph flow in order to accelerate soft tissue healing edema on right ankle joint. Secondary, prevent scar adhesion. Next, providing (PIR) which is not only going to help to increasing ankle ROM in DF but also in stretching tight hamstring muscle. After, mobilizing restricted joint play on the right foot Talocrural. Afterwards, strengthening weak muscles on right foot (gastrocnemius, soleus and tibialis anterior) by applying isometric strengthening exercise in addition to increase strength of overall muscle in L.E. Last but not least, improve coordination and quality of movement by sensorimotor training which help ankle joint stability and function. Finally improve gait (3- point alternative gait).

Proposed therapy:

1. Soft tissue technique on right L.E to increase blood circulation
2. Strengthening of deep core stabilizing system using diaphragmatic breathing
3. Post isometric relaxation (PIR) for Hamstring muscle on both leg according to Lewit
4. PIR on Triceps surae muscle on right foot to increase dorsiflexion ROM according to Lewit
5. Mobilization of restricted joint play on right foot (talocrural, subtalor, Lisfranc and Chopart), also on the left foot (Chopart and Lisfranc)

6. Pain free isometric ankle inversion, eversion, dorsiflexion and sub-maximal planter flexion. (closed chain exercises) and also we could add red thera band (medium resistance)
7. Gym exercise to train ankle joint stability and function using Swiss ball (walking forward while sitting on balloon open eye , walking backwards with open eyes walking with closed eyes)12X3
8. Modified heel rise to strengthen gastrocnemius muscle (sitting on gym balloon) 12X3 on both leg
9. Isometric strengthen training of lower extremity Bridge exercise using cylindrical ball to work abdominal muscles, back muscles and pelvic floor muscle and extensor muscle on lower extremity and stretching tight hip flexor muscle 12X 3
10. Proprioceptor Neuromuscular facilitation (in 2 diagonal extension of L.E- facilitation technique in repeated contraction).
11. Static balance exercise (begin in 2-foot stand, then 2 foot stand on balance board or narrow base of support and gradually progress to single leg stand)
12. Neurodevelopmental treatment (Balance reaction exercise on both ankles joint according to Bobath)
13. Sensory motor training of intrinsic muscle of foot (foot fist according to Ihara and nakayama)
14. Gait training while using crutches (3-point alternative gait) and gradually increase weight bearing on right foot
15. Kinesiotaping Taping on right foot on posterior Achilles tendon. For Achilles tendon correction and decrease tension on triceps surae muscle.
16. Physical Therapeutic modality for facilitate blood circulation and increase soft tissue healing and regeneration such as laser bio stimulation (localization: R Achilles tendon frequency: 10, 5 [Hz], time: 10 min, dosage: 5, 00 J /cm^2])
17. Hydrotherapy (warm bath 38° C) for 10-20 min if the edema is diminished. initial to individual therapy for better blood circulation and lymphatic flow and myofascial relaxation

Implementation of the therapy:

1. **Soft tissue technique by Lewit:**

   On right Achilles tendon (using soft ball moving on caudal-cranial direction, myofascial release of (anterior, posterior, lateral and medial compartment of leg) in caudal, cranial medial and lateral direction, mobilization of soft tissue around the scar. Fan wise spreading of planter fascia and dorsal fascia of the foot and stretching the soft tissue between Achilles tendon and tibia in medial and lateral direction according to Lewit, using spiky ball to facilitation skin proprioceptor. total therapy time 5 min. Mobilization of scare (scar massage; pressing scar caudocranial direction, elongation of two end of scar, squeezing two end of scar and mobilization in S curve, C curve) total therapy time 5-7 min

2. **PIR technique by Lewit:**

   Ankle planter flexor muscle on right foot according to increase ROM in dorsiflexion X 3 and hold for 30 sec against resistance. PIR of Hamstring muscles (biceps femoris, semitendinosus and semimembranosus) on both legs to stretch shortened muscle and release restriction on left fibular head applied for X 3 and hold for 30 sec against resistance.

3. **Joint play mobilization according to Lewit**:

   Mobilization of talocrural joint on right foot (traction of ankle joint and springing the joint distally), subtalor (distraction of the posterior part till the joint are unblocked app 20-30 rep.

4. **Isometric strengthening exercise(close chain exercise):**

   Modified heel rise to strengthen gastrocnemius muscle, patient is sitting on Swiss ball and try to raise his both feet. The exercise done in three set for 10 rep each 10X3. Next, bridge exercise using cylindrical ball to work abdominal muscles, back muscles and pelvic floor muscle and extensor muscle on lower extremity and stretching tight hip flexor muscle 12X 3

5. **Proprioceptor Neuromuscular facilitation**

   PNF in 2nd diagonal extension of right L.E using repeated contraction technique. The exercise preformed 5 times in three set to help Functional training in eccentric control of movement

6. **Deep core stabilizing system training:**

   Patient is lying supine on the mat, his L, E positioned in 90°flexion abduction and external rotation. After we placed a Swiss ball over his 90°flexed arm. Next he instructed to press the ball while maintaining the position in after we combined it with diaphragmatic breathing

7. **Gait training:**

   Gait training using 3-point alternative gait while try to 30% weight loading on right foot, erect posture, elongation of stance phase on right foot and training hip extension on both side.

8. **Physicaltheraputic modality:**

   Laser therapy (bio-stimulation localization: R Achilles tendon frequency: 10, 5 [Hz], time: 10 min, dosage: 5, 00 J /cm^2])

Self-therapy:

1. Training of correct walking with crutches using 3 alternative gait pattern.
2. Stretching gastrocnemius muscle of right foot using Thera band(hold for 30-60 sec×8)
3. Active right ankle ROM in DF, PV, EV and IN with moderate resistance ×8 Sensorimotor training of proprioceptor of sole of the foot (pressing 3 point on sole of foot, bring TMT head toward heal (increase arch of foot). Creeping motion of the toes on the ground).As demonstrated in the clinic

Effect of the therapy:

Springing of talocrural joint, patient felt fatigue after therapy he had not enough sleep and he thinks for that his performance on today exercises is reduced.

1.11.4 Therapeutic Unite 5: 8.2.2017

Time: 9 a.m.

Duration: 1:15 hour

Objective stp.:

Today is patient 5th session. ROM on right ankle joint: **S=** 5°-0-15° **T**=15°-0-20°

Patient is progressing gait stride length is increasing on the right foot and hip extension no pain after last therapy, except for skin color which has not change but it is no longer cold.

Subjective stp:

Patient report that he is using correct ambulation the whole day.

Goal of the therapy:

The main goal today is to increase right ankle joint ROM. Next to improve soft tissue elasticity and to prevent scar adhesion. After, relaxation of hamstring muscle and ankle planter flexor muscles by applying (PIR). Increase weak muscles strength on right foot (gastrocnemius, soleus and tibialis anterior) by applying isometric strengthening exercise in addition to increase strength of overall muscle in L.E. Last but not least, improve coordination and quality of movement by sensorimotor training which help ankle joint stability and function. Finally improve gait (3- point alternative gait).

Proposed therapy:

1. Soft tissue technique on right L.E to increase blood circulation
2. Strengthening of deep core stabilizing system using diaphragmatic breathing
3. Post isometric relaxation (PIR) for Hamstring muscle on both leg according to Lewit
4. PIR on Triceps surae muscle on right foot to increase dorsiflexion ROM according to Lewit
5. Mobilization of restricted joint play on right foot (talocrural, subtalor, lisfranc and chopart), also on the left foot (chopart and lisfranc)
6. Pain free isometric ankle inversion, eversion, dorsiflexion and sub-maximal planter flexion. (closed chain exercises) and also we could add red thera band (medium resistance)
7. Gym exercise to train ankle joint stability and function using Swiss ball (walking forward while sitting on balloon open eye , walking backwards with open eyes walking with closed eyes)12X3

8. Modified heel rise to strengthen gastrocnemius muscle (sitting on gym balloon) 12X3 on both leg
9. Isometric strengthen training of lower extremity Bridge exercise using cylindrical ball to work abdominal muscles, back muscles and pelvic floor muscle and extensor muscle on lower extremity and stretching tight hip flexor muscle 12X 3
10. Proprioceptor Neuromuscular facilitation (in 2 diagonal extension of L.E-facilitation technique in repeated contraction).
11. Static balance exercise
12. Neurodevelopmental treatment (balance reaction exercise on both ankle joint according to Bobath)
13. Sensory motor training of intrinsic muscle of foot (foot fist according to Ihara and nakayama)
14. Gait training while using crutches (3-point alternative gait) and gradually increase weight bearing on right foot
15. Kinesiotaping Taping on right foot on posterior Achilles tendon. For Achilles tendon correction and decrease tension on triceps surae muscle.
16. Physical Therapeutic modality such as laser bio stimulation (localization: R Achilles tendon frequency: 10,5 [Hz], time: 10 min, dosage: 5,00 J /cm^2])
17. Hydrotherapy (warm bath 38° C) for 10-20 min if the edema is diminished. initial to individual therapy

Implementation of the therapy:

1. **<u>Soft tissue technique by Lewit:</u>**

   On right Achilles tendon (using soft ball moving on caudal-cranial direction, myofascial release of (anterior, posterior, lateral and medial compartment of leg) in caudal, cranial , medial and lateral direction, mobilization of Soft tissue around the scar. Fan wise spreading of planter fascia and dorsal fascia of the foot and stretching the soft tissue between Achilles tendon and tibia in medial and lateral direction according to Lewit, using spiky ball to facilitation skin proprioceptor. total therapy time 5 min. Mobilization of scare (scar massage; pressing scar caudocranial direction, elongation of two end of scar, squeezing two end of scar and mobilization in S curve, C curve) total therapy time 5-7 min

2. **PIR technique by Lewit:**

   Ankle planter flexor muscle on right foot according to increase ROM in dorsiflexion X 3 and hold for 30 sec against resistance. PIR of Hamstring muscles (biceps femoris, semitendinosus and semimembranosus) on both legs to stretch shortened muscle and release restriction on left fibular head applied for X 3 and hold for 30 sec against resistance.

3. **Isometric strengthening exercise(close chain exercise):**

   Modified heel rise to strengthen gastrocnemius muscle, patient is sitting on Swiss ball and try to raise his both feet. The exercise done in three set for 10 rep each 10X3. Next, bridge exercise using cylindrical ball to work abdominal muscles, back muscles and pelvic floor muscle and extensor muscle on lower extremity and stretching tight hip flexor muscle 12X 3

4. **Proprioceptor Neuromuscular facilitation**

   PNF in 2nd diagonal extension of right L.E using repeated contraction technique. The exercise preformed 5 times in three set to help Functional training in eccentric control of movement

5. **Deep core stabilizing system training:**

   Patient is lying supine on the mat, his L, E positioned in 90°flexion abduction and external rotation. After we placed a Swiss ball over his 90°flexed arm. Next he instructed to press the ball while maintaining the position in after we combined it with diaphragmatic breathing

6. **Gait training:**

   Gait training using 3-point alternative gait while try to 30% weight loading on right foot, erect posture, elongation of stance phase on right foot and training hip extension on both side.

7. **Physicaltheraputic modality:**

   Laser therapy (bio-stimulation localization: R Achilles tendon frequency: 10, 5 [Hz], time: 10 min, dosage: 5, 00 J /cm^2])

Self-therapy:

1. Training of correct walking with crutches using 3 alternative gait pattern.
2. Stretching gastrocnemius muscle of right foot using Thera band (hold for 30-60 sec×8)
3. Active right ankle ROM in DF,PV,EV and IN with moderate resistance ×10
4. Sensorimotor training of proprioceptor of sole of the foot (pressing 3 point on sole of foot, bring TMT head toward heal (increase arch of foot). Creeping motion of the toes on the ground). As demonstrated in the clinic

Effect of the therapy:

Improvement of right ankle joint stability in balance exercises. Patient exercise performance is excellent there for I would like to increase resistance for next session

1.11.5 Therapeutic Unite 6: 9.2.2017

Time: 9 a.m.

Duration: 1:00 hour

Objective stp.:

Today is patient 6th session. ROM on right ankle joint: **S=** 5°-0-15° **T**=15°-0-20°

Patient walking speed is reduced, I will apply moderate to easy exercises today

Subjective stp:

Patient feel pain over right leg (he walk for long time yesterday in addition to the hard training exercise yesterday

Goal of the therapy:

The main goal today is to increase right ankle joint ROM. Next, to improve soft tissue elasticity and to prevent scar adhesion. After relaxing hamstring muscle and ankle planter flexor muscles by applying (PIR). Increase weak muscles strength on right foot (gastrocnemius, soleus and tibialis anterior) by applying isometric strengthening exercise in addition to increase strength of overall muscle in L.E. Last but not least, improve coordination and quality of movement by sensorimotor training which helps ankle joint stability and function. Finally improve gait and correct stance phase on right foot (3- point alternative gait).

Proposed therapy:

1. Soft tissue technique on right L.E to increase blood circulation
2. Strengthening of deep core stabilizing system using diaphragmatic breathing
3. Muscle energy technique (PIR) for Hamstring muscle on both leg according to Lewit
4. PIR on Triceps surae muscle on right foot to increase dorsiflexion ROM according to Lewit
5. Mobilization of restricted joint play on right foot (talocrural, subtalor, lisfranc and chopart), also on the left foot (chopart and lisfranc)
6. Pain free isometric ankle inversion, eversion, dorsiflexion and sub-maximal planter flexion. (closed chain exercises) and also we could add red thera band (medium resistance)
7. Gym exercise to train ankle joint stability and function using Swiss ball (walking forward while sitting on balloon open eye , walking backwards with open eyes walking with closed eyes)12X3

8. Modified heel rise to strengthen gastrocnemius muscle (sitting on gym balloon) 12X3 on both leg
9. Isometric strengthen training of lower extremity Bridge exercise using cylindrical ball to work abdominal muscles, back muscles and pelvic floor muscle and extensor muscle on lower extremity and stretching tight hip flexor muscle 12X 3
10. Proprioceptor Neuromuscular facilitation (in 2 diagonal extension of L.E-facilitation technique in repeated contraction).
11. Static balance exercise (begin in 2 foot stand, then 2 foot stand on balance board or narrow base of support and gradually progress to single leg stand)
12. Neurodevelopmental treatment (Balance reaction exercise on both ankle joint according to Bobath)
13. Sensory motor training of intrinsic muscle of foot(foot fist according to Ihara and nakayama)
14. Gait training while using crutches (3 point alternative gait) and gradually increase weight bearing on right foot
15. Kinesiotaping Taping on right foot on posterior Achilles tendon. For Achilles tendon correction and decrease tension on triceps surae muscle.
16. Physical Therapeutic modality as laser bio stimulation (localization: R Achilles tendon frequency: 10, 5 [Hz], time: 10 min, dosage: 5, 00 J /cm^2])
17. Hydrotherapy (warm bath 38° C) for 10-20 min if the edema is diminished. initial to individual therapy

Implementation of the therapy:

1. **<u>Soft tissue technique by Lewit:</u>**

   On right Achilles tendon (using soft ball moving on caudal-cranial direction, myofascial release of (anterior, posterior, lateral and medial compartment of leg) in caudal, cranial , medial and lateral direction, mobilization of Soft tissue around the scar. Fan wise spreading of planter fascia and dorsal fascia of the foot and stretching the soft tissue between Achilles tendon and tibia in medial and lateral direction according to Lewit, using spiky ball to facilitation skin proprioceptor. total therapy time 5 min. Mobilization of scare (scar massage; pressing scar caudocranial direction, elongation of two end of

scar, squeezing two end of scar and mobilization in S curve, C curve) total therapy time 5-7 min

2. PIR technique by Lewit:

Ankle planter flexor muscle on right foot according to increase ROM in dorsiflexion X 3 and hold for 30 sec against resistance. PIR of Hamstring muscles (biceps femoris, semitendinosus and semimembranosus) on both legs to stretch shortened muscle and release restriction on left fibular head applied for X 3 and hold for 30 sec against resistance.

3. Isometric strengthening exercise(close chain exercise):

Modified heel rise to strengthen gastrocnemius muscle, patient is sitting on Swiss ball and try to raise his both feet. The exercise done in three set for 10 rep each 10X3. Next, bridge exercise using cylindrical ball to work abdominal muscles, back muscles and pelvic floor muscle and extensor muscle on lower extremity and stretching tight hip flexor muscle 12X 3

4. Proprioceptor Neuromuscular facilitation

PNF in 2nd diagonal extension of right L.E using repeated contraction technique. The exercise preformed 5 times in three set to help Functional training in eccentric control of movement

5. Deep core stabilizing system training:

Patient is lying supine on the mat, his L, E positioned in 90°flexion abduction and external rotation. After we placed a Swiss ball over his 90°flexed arm. Next he instructed to press the ball while maintaining the position in after we combined it with diaphragmatic breathing

6. Gait training:

Gait training using 3-point alternative gait while try to 30% weight loading on right foot, erect posture, elongation of stance phase on right foot and training hip extension on both side.

7. Physical therapeutic modality:

Laser therapy (bio-stimulation localization: R Achilles tendon frequency: 10, 5 [Hz], time: 10 min, dosage: 5, 00 J /cm^2])

Self-therapy:

1. Training of correct walking with crutches using 3 alternative gait pattern.
2. Stretching gastrocnemius muscle of right foot using Thera band (hold for 30-60 sec×8)
3. Active right ankle ROM in DF, PV,EV and IN ×10 with moderate resistance
4. Sensorimotor training of proprioceptor of sole of the foot (pressing 3 point on sole of foot, bring TMT head toward heal (increase arch of foot). Creeping motion of the toes on the ground). As demonstrated in the clinic

Effect of the therapy:

He is feeling burning sensation on scar especially on distal 2 cm (the most restricted area) while preforming scar therapy (pressing the scar). Decrease in patient performance duo to pain which limit isometric resistance exercise on PNF 2 diagonal extension of L.E, he was not able to preform

.

1.12 Final Kinesiological Examination:

Examination was performed on 10.2.2017, we are going to apply different test and compare the new outcome with our first kinesiological examination we done on 30.1.2017

1.12.1 Static posture

Observation:

Patient is standing without crutches, overall patient is stable and he is able to maintain upright posture without depending on healthy side for support. Muscle bulk on right foot < left side. Edema diminished completely on right ankle joint

Anterior view:

- **Foot:** Normal base of support, body weight appears to be distributed equally on both side. TMT adducted on the left side. No sign of edema on talus bone, normal skin color on the right foot. Right foot weight distribution is placed on the heel and the lateral edge of foot. Normal weight distribution on left foot; normal foot arch on both side.
- **Leg:** Tibialis Anterior muscle contour left side slightly L>R. Calf muscle contort L>R
- **Knee:** Normal knee alignments on both legs
- **Thigh:** Normal quadriceps muscle contour on both side; vastus medialis on L>R
- **Pelvic:** Slightly rotate to left side
- **Trunk:** Centered umbilicus, normal abdominal muscle contours. Normal shape of chest; nipples are leveled.
- **Shoulder:** Left shoulder slightly protracted. right shoulder higher than left side
- **Head and neck:** Normal alignment of head and neck

Posterior view:

- **Foot:** Normal base of support. Ankle valgus on Right side. Right foot is slightly forwarded. Normal shape of Achilles tendon on left side Presence of scare on Right Achilles tendon. The thickness of Achilles tendon is L>R (less prominent)
- **Leg:** Gastrocnemius muscle contours L>R. Hamstring muscle contour L>R.
- **Knee:** Popliteal line is more higher on L>R
- **Trunk:** Lumbothoracic paravertebral Muscle Hypertone on L>R. Normal Spine Shape. Right scapulae slightly adducted, prominence of inferior angle on left scapulae
- **Head and neck:** Normal alignment of head and neck

Lateral view:

Left:

- Head is in neutral position
- Shoulder joint is slightly protracted
- Elbow joint is normal
- Pelvic position is neutral
- knee in normal alignment
- Foot is in normal alignment.
- Ankle is valgus

Right:

- Head is in neutral position
- Shoulder joint is in normal alignment
- Elbow joint is normal
- Pelvic position is normal
- knee joint is in semi-flexed position
- Foot is supinated (his weight placed on the lateral edge of the foot)
- Ankle is pes valgus

1.12.2 Dynamic spine examination: Not able to do

1.12.3 Pelvic examination according to Lewit:

- **Pelvic obliquity:** iliac crest is higher on L>R
- **Pelvic tilt:** ASIS ratio to PSIS= < 4 cm (Normal)
- **PSIS:** R<L
- **ASIS:** L<R
- **Rosina test:** R= Absent L= Normal
- **Examination of overtake phenomena:** Not able to do

Conclusion:

The outcome according to the bony land mark measurement on pelvic area shows pelvic torsion.

1.12.4 Examination of leg length discrepancy (using measuring tape\supine)

Table 17- **Final examination of leg length discrepancy**

	Anatomical Leg Length	Functional Leg Length
Right	93 cm	95 cm
Left	93 cm	97 cm

Conclusion:

There is 2 cm increase on functional leg length on the right side

1.12.5 Examination of gait according to Kendall:

The patient was instructed to walk in the room which is 50 meter. To observe his gait. He is able to walk without crutches for 15m we recommended using the crutches for precaution purposes

Base of support: Normal base of support

Angle of position of feet: Normal foot angle position on left side, TMT Adduction (the front of the foot twisted inward). On the other hand, ankle on right foot is valgus supinated. Right foot position slightly more forward.

Walking rhythm: periodic

Walking speed: slightly decrease in speed on the right side. Normal speed on the left side

Stride length: slightly Decrease stride length on Right foot. Normal stride length on the left foot

Movement of the foot:

Right Foot: Heel strike→ (degree of DF 10°) **→Flat foot** (foot is flat and in contact with the ground, normal foot arch) **→Loading response→** (weight disruption on right side is placed more on the heels and lateral edge of foot) **→Heel off** (able to perform but decreased, foot pronation and prolusion of the TMT) **→Toe off** (decreased)

- **Left Foot: Heel strike→** (Normal DF 20°) **→Flat foot** (complete foot contact with the floor) **→Loading response →** (the weight disruption on the heel and later edge of the foot as well as on TMT end on big toe) **→Heel off** (foot pronation and prolusion of the toe) **→Toe**

off (achieve by metatarsal bone of the hallux and flexion of all toes).

Axial position of the lower limb: Right Pes valgus

Movement and position of knee and hip:

Right side: Knee is flexed during weight acceptance phase and extended during mid-stance and terminal-stance. Decrease hip extension

Left side: knee is flexed in (weight acceptance phase) and extended in (single limb support and limb advancement). Hip extension in (mid-stance and terminal stance)

- **Position and movement of the pelvic:**
- Compensation on anterior tilt, rotation and lateral tilt approximately 4cm. less on right side

Movement of COG: Normal

Position and movement of trunk: Decreased of trunk movement on both side (limited with using 3-point alternative gait\crutches)

Activity of Abdominal muscle and back muscle: Abdominal muscle are engaged during walking R>L. Hyperactivity of paravertebral muscle on lumbar spine L>R

Position of the shoulder: Normal, slightly protracted on the left shoulder

Position of head slightly Normal alignment

Stability of walking: Overall walking seems to be stable

Conclusion:

There is an obvious improve of the quality of patient gait, he is able to walk without support for short distance while maintain a stable posture. He is loading the injured foot (right) more. In general stance phase 50% of gait cycle is improved on right side (complete FF without foot supination, placing body weight not only on heels but on TMT and he is able to extending his hip (partially) on mid-stance and terminal stance and completely on left side.

1.12.5.1 Examination of modified gait:

Walking on tip toe: Not able to do duo to the injury and loading the lower limb

Walking up the stairs: Able to do

Walking backwards: Able to do, movement was preformed slowly

1.12.6 Examination of basic movement pattern according to Janda:

Each movement was preformed 3 time

I. Hip extension:

Physiological order: Contraction of gluteus Maximus (ipsilateral) → Hamstring (ipsilateral) → erector spinae L (contralateral) → erector spinae L (ipsilateral → erector spinae THL (contralateral) → erector spinae THL (ipsilateral) → No activity of shoulder joint or Trapezius muscle.

Left side

The patient was laying in prone position. The Sequence of hip extension movement was obtained firstly by Contracting Hamstring muscle (biceps femoris, semitendinosus, and semimembranosus). Then gluteus Maximus .Erector spinae contralateral, after erector spinae ipsilateral there is no shoulder elevation

Right side:

The patient was laying in prone position. The sequence of hip extension movement was obtained firstly by contracting hamstring muscle (biceps femoris, semitendinosus, and semimembranosus). Then gluteus Maximus .Erector spinae contralateral, after erector spinae ipsilateral. There is no shoulder elevation

II. Hip abduction:

Physiological order: Contract of muscle gluteus medius and minimus → TFL → quadratus lumborum → iliopsoas and rectus femoris → abdominal and back muscles.

Left side:

The patient was in sideling position. The muscle initiated the movement are (gluteus meduis and gluteus minimus). After he is using TFL muscle

Engaging quadratus lumborum muscle which provide pelvic stability during the movement.

Right side:

The patient was in sideling position, the muscle initiated the movement are (gluteus meduis and gluteus minimus. After he is using TFL muscle Engaging quadratus lumborum muscle which provide pelvic stability during the movement.

III. Trunk Flexion:

Physiological order: Initially, we observes the patient´s spontaneous pattern of sitting up and positive planter flexion.

Patient was in supine position. He is able to perform the movement spontaneously, there was no sign of anterior pelvic tilt. He planter flexed his foot during the curl up.

IV. Push up:

Left side:

The patient was in patient was in quadruped position. The movement is normal there is no excessive scapular abduction, adduction, elevation or rotation.

Right side:

The patient was in quadruped position. Normal scapulae movement no excessive scapular abduction, adduction, elevation or rotation

V. Neck flexion:

The test was performed in supine position. Patient is able to perform neck flexion against resistance without hyper extension of cardiothoracic junction. This estimate the dynamic of cervical spine and normal interplay between deep neck flexor muscle and SCM muscle.

VI. Shoulder abduction:

Left side:

The test was performed in sitting position. Patient is asked to abduct his shoulder while flexing the elbow joint to control undesired rotation. First the abduction occurs in glenohumeral joint this is followed by rotation of scapulae and elevation of shoulder girdle 60°. There is no sign of trunk lateroflexion.

Right side:

The test was performed in sitting position. Patient is asked to abduct his shoulder while flexing the elbow joint to control undesired rotation. First the abduction occurs in glenohumeral joint this is followed by rotation of scapulae and elevation of shoulder girdle 60°. There is no sign of trunk lateroflexion

1.12.7 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

***Table 18*- Final muscle length examination**

Muscle	R	L
Gastrocnemius	0	1
Soleus	0	0
Hip flexor one joint (iliacus, posts maj)	0	0
Hip flexor two joint (rectus femurs, TFL)	1	1
Adductor	0	0
Hamstring	1	1
Paravertebral muscles	0	
Quadrates lumborum	0	0
Piriformis	0	0

Conclusion:

Decrease muscle shortness on left side one joint hip flexor and hamstring

1.12.8 Final goniometer measurement:

(Using SFTR international form - According to Kendall)

Hip joint:

Table 19- **Final Hip ROM using STFR form**

		R	L
Active	**Sagittal plane**	S=10°-0-125°	S=10°-0-125°
Passive		S=15°-0-130°	S=15°-0-130°
Active	**Frontal plane**	F= 45°-0-10°	F=45°-0-10°
Passive		F= 50°-0-10°	F= 50°-0-10°
Active	**Transfer plane**	T= 45°-0-45°	T=45°-0-40°
Passive		T= 45°-0-45°	T= 45°-0-45°

Knee joint:

Table 20- **Final knee ROM using STFR form**

		R	L
Active	**Sagittal plane**	S=0°-0-135°	S=0°-0-135°
Passive		S=0°-0-135°	S=0°-0-135°

Ankle joint:

Table 21- **Final ankle ROM using STFR form**

		R	L
Active	**Sagittal plane**	S=10°-0-20°	S=20°-0-45°
Passive		S=10°-0-20°	S=20°-0-45°
Active	**Transfer plane**	T=20°-0-25°	T=25°-0-30°
Passive		T=20°-0-30°	T=25°-0-30°

Toes ROM (According to AM. Academy of orthopedic surgeon)

Table 22- **Final toes ROM using STFR form**

	R	L
Big Toe MTP **IP**	S= 70°-0-45° S= 0°-0-90°	S= 70°-0-45° S=0°-0-90°
2nd digiti MTP **PIP** **DIP**	S= 40°-0-40° S= 0°-0-35° S= 60°-0-30°	S= 40°-0-40° S= 0°-0-35° S= 60°-0-30°
3rd digiti MTP **PIP** **DIP**	S= 40°-0-40° S= 0°-0-35° S= 60°-0-30°	S= 40°-0-40° S= 0°-0-35° S= 60°-0-30°
4th digiti MTP **PIP** **DIP**	S= 40°-0-40° S= 0°-0-35° S= 60°-0-30°	S= 40°-0-40° S= 0°-0-35° S= 60°-0-30°
5th digiti MTP **PIP** **DIP**	S= 40°-0-40° S= 0°-0-35° S= 60°-0-30°	S= 40°-0-40° S= 0°-0-35° S= 60°-0-30°

Conclusion:

ROM on right foot is improved about 5° increase in ROM in PF, DF, IN and EV

1.12.9 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 = Fair (hold against gravity)

4 = Good (hold against moderate pressure)

5 = Normal (hold against strong pressure)

Table *23*- Final muscle strength test

R	Muscle	L
+4	**Hip flexor(Illiopsoas , sartorius , TFL, Rectus femoris)**	5
5	**Hip Adductor**	5
+4	**Hip Lateral Rotator**	5
5	**Hip Internal Rotator**	5
5	**Quadriceps**	5
+4	**Gluteus Maximus**	5
5	**Gluteus Meduis**	5
4	**Gluteus minimus**	5
5	**TFL**	5
5	**Hamstring (Biceps femoris)**	5
5	**Hamstring(semitendinosus, semimembranosus**	5
4	**Gastrocnemius and soleus**	5
4	**Soleus**	5
+4	**peroneus Longus+ Brevis**	5
-4	**peroneus Tertius**	5
+4	**Tibialis Anterior**	5
5	**Tibialis Posterior**	5
I= 4		I= 5
II= 4		II= 5

III= 4	**Flexor Digitorum Longus**	III= 5
IV= 4		IV= 5
V= 4		V= 5
I=4	**Flexor digitorum brevis**	I=5
II=4		II= 5
III= 4		III= 5
IV= 4		IV= 5
V= 4		V= 5
I=+3	**Lumbricales**	I=4
II=+3		II=3
III=+3		III= 3
IV=+3		IV= 3
V= +3		V=3
I= -4	**Interossei**	I= 4
II= -4		II= 4
III= -4		III= 4
IV&V=-4		IV&V= 4
2	**Flexor hallucis Longus**	3
3	**Flexor Hallucis brevis**	4
3	**Abductor Hallucis**	-4
1	**Adductor Hallucis**	3
4	**DIP Extensor**	5
5	**PIP Extensor**	5
I= +4	**Ext. digitorum longus+brevis**	I= 5
II= +4		II= +4
III= 3		III= +4
IV=3		IV= +4
V=3		V= +4

4 3	**Extensor hallucis longus+brevis**	+4 +4

Conclusion:

Improve of muscle strength on R foot 1-degree increase on planter flexor, tibialis anterior tibialis posterior and 2-degree increase on flexor and extensor of small foot intrinsic muscle

1.12.10Scar examination:

The scar is 10 weeks old, 7cm in length, and vertical in shape and 1.6 cm in width. The location of the scar is on posterior service of calcaneus. As for scar character; the stitches is taken out. The scar is red in color and dark blue\ purple on the distal 2 cm at the end of the scar. There is noticeable difference in texture between the upper part of the scar and the bottom. The top part is smoother and the last 2 cm of scar proximal to calcaneus is slightly rough. However, the scar is mobilized in all direction (caudal, cranial, S shape and C shape) except the distal end which is slightly restricted restriction in caudal direction.no pain during scar palpation except presence of slight degree of pain while mobilization with S curve.

1.12.11Final soft tissue palpation:

Skin= Normal skin color on both side

Temperature= Normal skin temperature on both sides

Area of edema= Edema diminished completely

Nail shape is normal.

1.12.11.1 Capillary nail refill test: Normal on both legs

Table 24- **Final examination of soft tissue**

		Right		**Left**	
		Dorsal	**Planter**	**Dorsal**	**Planter**
Skin	Cranial	Elastic	Elastic	Elastic	Elastic
Sub skin	Caudal	Elastic	Restricted	Elastic	Restricted
Fascia	Medial	Restricted	Elastic	Elastic	Elastic
	Lateral	Elastic	Restricted	restricted	Elastic

Legs	Tibialis anterior fascia is restricted on upper 1\3 of anterior medially on left foot and gastrocnemius muscle fascia is moveable on posterioanterior part below popliteal line on left foot. Peroneus muscle Fascia is restricted on cranial part of right foot

1.12.12Palpation of muscle tone:

***Table 25*- Final examination of muscle tone**

Foot	**Right**	**Left**
Muscle	**R**	**L**
Trapezius	Hypertone (cranial part)	Normal
Levator Scapulae	Hypertone(toward muscle insertion)	Normal
Scalene	Normal	Normal
SCM	Normal	Normal
Paravertebral	Normal	Hypertone (on lumbar spine)
Rectus Femoris	Normal	Normal
Vastus Medials	Hypotone(most part specially upper part)	Normal
Vastus Lateralis	Normal	Hypertone(middle part of muscle, laterally)
Hip Adductor	Normal	Normal
TFL	Hypertone(toward the origin and middle part of muscle)	Normal

Gluteus meduis	Normal	Normal
Gluteus minimus	Normal	Normal
Hamstring	Normal	Normal
Gluteus Maximus	Normal	Normal
Pisiforms	Normal	Normal
Gastrocnemius	Hypotone(medial part)	Normal
Soleus	Hypotone(complete muscle)	Normal
Tibialis Anterior	Normal	Normal
Tibialis posterior	Normal	Normal

Conclusion:

Scar is more elastic on the distal 2 cm of right Achilles tendon in cranial direction skin color on right foot is no longer pale and the foot has normal temperature. Fascia on R side more elastic in cranial direction on dorsal and planter side. Gastrocnemius muscle fascia is moveable on posterior anterior direction. Normal muscle tone on hamstring muscles on both side

1.12.13Trendelenburg Test:

The test is performed in standing with 90° flexion of hip and knee joint. We evaluate pelvic stability.

→ He is able to stand on non-injured leg (left leg). He is able to stand on right side with support on the wall

1.12.14Single leg stance:

- The test is performed in standing. Patient is instructed to stand with one leg for 10 second.

→ Patient is able to stand on non-injured leg (left leg) only. He is not stable on right side duo to the effect of injury and muscle atrophy on right leg

1.12.15Two scale examination:

Table 26- **Final two scale examination**

	R	L
Standing in two scale	33 Kg	37 Kg
Total	70 Kg	

Conclusion:

→ The difference is 4 kg which considered physiological ratio is 10% -15% of the total body weight normal.

1.12.16Anthropometric measurement of lower extremity in cm:

Table 27- **Final anthropometric measurement**

Length of Lower Extremity		
	R	**L**
Anatomical Leg length	93	93
Functional leg length	95	97
Thigh length	51	45.5
Middle leg length	45	44
Foot length	30	30
Circumference of Lower Extremity		
CF of thigh (15cm testing quadriceps m**)**	44	47
CF of thigh (10cm testing vastus medialis	42	44

CF of knee	37	37
CF of calf	35	36
CF of ankle	25	26
CF of foot	23	25

Conclusion:

Obvious increase of vastus medialis muscle CF around 2 degree on right L.E and 4 degree on left L.E. However the CF of right ankle joint decrease 4 degree hence edema decreased

1.12.17Joint play examination according to Lewit:

Table 28- **Final joint play examination**

Joint	Right	Left
Hip Joint		
IR	Normal	Normal
ER	Normal	Normal
Knee Joint		
Ventrodorsal\ (with knee flex)	Normal	Normal
Laterolateral shifting medial\Lateral (with knee flex)	Normal\ Normal	Normal\\Normal
Springing (with knee extended)	Normal	Normal
Patella		
Cranio-caudal	Normal	Normal
Laterolateral	Normal	Normal
Tibiofibular (supine- knee flexed)	Normal	Normal

Fibular Head ***(anterior-posterior)*** ***Rotation***		Normal Normal	Normal Normal
Talocruler ***Ventro\dorsal*** ***Distraction***		Normal Normal	Normal Normal
Subtalar		Blockage	Normal
Chopart's		Normal	Normal
Lisfranc's		Normal	Normal
Cuboidum		Restriction in dorsal direction	Normal
Navicular		Restriction in dorsal direction	Normal
MTM	**I**	Normal	Normal
	II	Normal	Normal
	III	Normal	Normal
	IV	Normal	Normal
	V	Normal	Normal
PIP	**I**	Normal	Normal
	II	Normal	Normal
	III	Normal	Normal
	IV	Normal	Normal
	V	Normal	Normal
DIP	**I**	Normal	Normal
	II	Normal	Normal
	III	Normal	Normal
	IV	Normal	Normal

	V	Normal	Normal
Calcaneus to talus in medial rotation		Normal	Giving away
Calcaneus to talus in Lateral rotation		Normal	Normal

Conclusion:

No more joint play restriction on right foot that is duo to the fact patient is loading his right foot more during ambulation which result from unblocking along with therapy

1.12.18 Evaluation of the effect of the therapy:

A male client had injured his right Achilles tendon on 30th of November 2016. Accordingly, he undergo surgery (open repair) to repair the tendon he wore brace for 5 weeks, orthotics is needed after the operation to protect the wound and allow soft tissue healing. In addition to a period of immobilization. He started individual physical therapy on 30.1.2017 for two weeks period (3 session\week).

The result from the first initial kinesiological examination shows that there was muscular imbalance which effected the posture position, soft tissue and fascia restriction thus injury on right Achilles tendon influenced the gait and body support along with muscle atrophy on right L.E

Therapy outcome has positive impact on functional recovery and minimize the chance of tendon elongation and re-rupture. Functional evaluation result following Achilles tendon rupture Right ankle joint improve not only on increased ROM but also on calf muscle strength. Major improvement in gait he went from swing to gait to be able to walk for short distance without crutches as well as the quality of weight disruption which is equal on both L.E he is no longer overloading on one joint (left L.E) more than other therefore joint is no longer blocked on right foot and fascia around the right Achilles tendon is more elastic. PIR influenced relaxation effect on hyperon muscle (hamstring) and help relaxation of planter flexor muscle on right foot which result an increase ROM in DF (increase of 5° in DF)

Considering patient is an athlete he is more prone to improvement, he is progressing constantly overall posture appear to be physiological. Importantly, he is stable during standing and walking. In contrast, he still not mastering toe off “push off” during gait in addition to decreased walking speed

For the most part, close chain exercise using Swiss ball (bridge exercise) was the most effective in restoring muscle power specially gastrocnemius and soleus muscle on right L.E. along with PNF in 2nd diagonal extension of L.E. Finally, PIR helped in increasing ROM in dorsiflexion on right ankle joint as well as release fibular head restriction on left leg. Sensorimotor functional training helped achieve optimal motor performance

2. Bibliography

Publications:

1. Prentice, W. E. (2011). *Therapeutic modalities in rehabilitation*. New York: McGraw-Hill Medical.
2. Arvinen-Barrow, M., & Walker, N. (2013). *The psychology of sport injury and rehabilitation*. London: Routledge.
3. Ramachandran M. (2011). The Stanmore guide to basic orthopedic science
4. Nordin M, Frankel V. (2001).*Basic biomechanics of the musculoskeletal system*, vol. 3. Baltimore, MA: Lippincott Williams & Wilkins.
5. Gray H. (2009). *Gray's anatomy*: with original illustrations. Arcturus Publishing; by Henry Carter
6. Neumann, D. A., & Kelly, E. R. (2010). *Kinesiology of the musculoskeletal system: foundations for physical rehabilitation*. St. Louis: Mosby/Elsevier.
7. Ramachandran, M. (2007). *Basic orthopedic sciences: the Stanmore guide.* London: Hodder Arnold
8. Hamill, J., & Knutzen, K. (2009). *Biomechanical basis of human movement*. Philadelphia: Wolters Kluwer Health/Lippincott Williams and Wilkins
9. Houglum, P. A. (2005). *Therapeutic exercise for musculoskeletal injuries*. Champaign, Ill: Human Kinetics
10. Andrews, J. R., Harrelson, G. L., & Wilk, K. E. (2004). *Physical rehabilitation of the injured athlete*. Philadelphia: Saunders
11. Ferri, F. F. (2011). *Ferri's differential diagnosis: a practical guide to the differential diagnosis of symptoms, signs, and clinical disorders*. Philadelphia, PA: Mosby/Elsevier.
12. Maffulli, N., & Almekinders, L. (2007). *The Achilles tendon*. New York: Springer
13. Miller, M. D. (2015). *Delee & drez's orthopaedic sports medicine Principles and practice*. Philadelphia: Elsevier saunders.
14. Lusardi, M. M., Jorge, M., & Nielsen, C. C. (2013). *Orthotics & prosthetics in rehabilitation*. St. Louis, MO: Elsevier Saunders.
15. Doral MN, Alam M, Bozkurt M, et al. .(2010). Functional anatomy of the Achilles tendon. *Knee Surg Sports Traumatol Arthrosc* ;18:638–643

16. Chen TM, Rozen WM, Pan WR, Ashton MW, Richardson MD, Taylor GI. (2009). The arterial anatomy of the Achilles tendon: anatomical study and clinical implications. *Clin Anat* 22:377–385
17. Benjamin M, McGonagle D.(2001). The anatomical basis for disease localization in seronegative spondyloarthropathy at enthuses and related sites. *J Anat.* 199:503–526
18. O'Brien M.(2005). The anatomy of the Achilles tendon. *Foot Ankle Clin* 10:225–238
19. Grumbine NA, Santoro JP. (1990).The tendon Achilles as it relates to rear foot position. A new classification for evaluation of calcaneal stance position. *Clin Podiatr Med Surg*, 7:203–216
20. Fugl-Meyer AR, Nordin G, Sjostrom M, Wahlby L. (1979). Achilles tendon injury. 5. A model of isokinetic strength training using biofeedback. *Scand J Rehabil Med*, 11:37–44
21. Garrett WE, Califf JC, Bassett FH.(1984). Histochemical correlates of hamstring injuries. *Am J Sports Med*, 12:98–103
22. Booth FW. (1977). Time course of muscular atrophy during immobilization of hindlimbs in rats. *J Appl Physiol*, 43:656–661.
23. Manter JT. (1941). Movements of the subtalar and trans- verse tarsal joints. Anat Rec, 80:397–410.
24. Barfred T.(1973). Achilles tendon rupture. *Acta Orthop Scand,* 152:7–126.
25. Hicks JH. (1953). the mechanics of the foot. *J Anat,* 87:345–357.
26. Ker RF, Bennett MB, Bibby SR, Kester RC, Alex- ander RM.(1987). The spring in the arch of the human foot. Nature, 325:147–149.
27. Wright DG, Desai SM, Henderson WH.(1964). Action of the subtalar and ankle-joint complex during the stance phase of walking. J Bone Joint Surg Am, 46: 361e82.
28. Elftman H. (1960). The transverse tarsal joint and its control. Clin Orthop, 16: 41e6.
29. Peltonen J, Cronin NJ, Stenroth L, Finni T, Avela J.(2013). Viscoelastic properties of the Achilles tendon in vivo. *Springerplus*, 2:212.
30. Kvist M, Jozsa L, Jarvinen MJ, Kvist H. (1987). Chronic Achilles paratenonitis in athletes: a histological and histochemical study. Pathology, 19:1–11.
31. Broin ES, Earley MJ, Smyth H & Hooper ACB (1995) Absorbable sutures in tendon repair. A comparison of PDS with prolene in rabbit tendon repair. *J Hand Surg,*

20:505– 508.

32. Komi PV, Fukashiro S & Järvinen M (1992) Biomechanical loading of Achilles tendon dur- ing normal locomotion. *Clin Sports Med* 11:521–531.
33. Dawe, E. J., & Davis, J. (2011). (vi) *Anatomy and biomechanics of the foot and ankle*. *Orthopedics and Trauma, 25*(4), 279-286.
34. Flint, James H., et al.(2014).Defining the Terms Acute and Chronic in Orthopaedic Sports Injuries. A Systematic Review. *The American journal of sports medicine,*42(1), 235-241
35. Popovic N, Lemaire R.(1999). Diagnosis and treatment of acute ruptures of the Achilles tendon. Current concepts review. *Orthop Belg*, 65 (4): 458-71
36. Leppilahti, J., Puranen, J., & Orava, S. (1996). Incidence of Achilles tendon rupture. *Acta Orthopaedica Scandinavica, 67(3)*, 277-279.
37. Suchak AA, Bostick G, Reid D, Blitz S, Jomha N. (2005). The incidence of Achilles tendon ruptures in Edmonton, Canada. Foot Ankle Int , 26:932–936
38. Huttunen, T. T., Kannus, P., Rolf, C., Felländer-Tsai, L., & Mattila, V. M. (2014). Acute Achilles tendon Ruptures. *The American Journal of Sports Medicine, 42(10*), 2419-2423
39. Sheth, U., Wasserstein, D., Jenkinson, R., Moineddin, R., Kreder, H., & Jaglal, S. B. (2017). The epidemiology and trends in management of acute Achilles tendon ruptures in Ontario, Canada. *Bone & Joint Journal, 99-B (1),* 78-86.
40. Hess GW. (2010). Achilles tendon rupture: a review of etiology, population, and anatomy, risk factors, and injury prevention. *Foot Ankle Spec*, (1):29-32
41. Hellmann DB. (2005). Chapter 20: Arthritis & musculoskeletal disorders. In: Tierney LM Jr, McPhee SJ, Papadakis MA (eds), *Current medical diagnosis & treatment, 44th edition, McGraw–* Hill Publishing Co., Philadelphia.
42. Smaill GB. (1961). Bilateral rupture of Achilles tendons. *BMJ* 10:1657–1658.
43. Carden DG, Jonathan N, Chalmers J, Lunn P & Ellis J (1987) Rupture of the calcaneal tendon. The early and late management. *J Bone Joint Surg* (Br) 69:416–420.
44. Thompson TC & Doherty JH (1962) Spontaneous rupture of tendon of Achilles: a new clinical diagnostic test. *J Trauma,* 2:126–129.

45. Kerr, J. (2005). Achilles tendon injury: assessment and management in the emergency department. *Emergency Nurse*, 13(2), 32-38.
46. Nilsson-Helander, K., Thomee, R., Gravare-Silbernagel, K., Thomee, P., Faxen, E., Eriksson, B. I., & Karlsson, J. (2006). The Achilles tendon Total Rupture Score (ATRS): Development and Validation. *The American Journal of Sports Medicine*, 35(3), 421-426.
47. Griffin, M. J., Olson, K., Heckmann, N., & Charlton, T. P. (2017). Realtime Achilles Ultrasound Thompson (RAUT) Test for the Evaluation and Diagnosis of Acute Achilles Tendon Ruptures. *Foot & Ankle International*, 38(1), 36-40.
48. Marsolais, D., Côté, C. H., & Frenette, J. (2003). Nonsteroidal Anti-Inflammatory Drug Reduces Neutrophil and Macrophage Accumulation but Does Not Improve Tendon Regeneration. *Laboratory Investigation,83*(7), 991-999
49. Shrier, I., Matheson, G. O., & Kohl, H. W. (1996). Achilles Tendonitis. *Clinical Journal of Sport Medicine, 6*(4), 245-250.
50. Ohberg, L. (2002). Ultrasound guided sclerosis of neovessels in painful chronic Achilles tendinosis: pilot study of a new treatment Commentary. *British Journal of Sports Medicine, 36*(3), 173-175.
51. Fox, A. J., & Murrell, G. A. (2007). Nitric Oxide and Tendon Healing. *Techniques in Orthopedics, 22*(1), 14-19.
52. Ecker, T. M., Bremer, A. K., Krause, F. G., Müller, T., & Weber, M. (2016). Prospective Use of a Standardized Nonoperative Early Weightbearing Protocol for Achilles Tendon Rupture. *The American Journal of Sports Medicine, 44*(4), 1004-1010.
53. Metz, R., Kerkhoffs, G. M., Verleisdonk, E. M., & Heijden, G. J. (2007). Acute Achilles tendon rupture: minimally invasive surgery versus non operative treatment, with immediate full weight bearing. Design of a randomized controlled trial. *BMC Musculoskeletal Disorders, 8*(1).
54. Nilsson-Helander, K., Silbernagel, K. G., Thomee, R., Faxen, E., Olsson, N., Eriksson, B. I., & Karlsson, J. (2010). Acute Achilles Tendon Rupture: A Randomized, Controlled Study Comparing Surgical and Nonsurgical Treatments Using Validated Outcome Measures. *The American Journal of Sports*

Medicine,38(11), 2186-2193.

55. Erickson, B. J., Mascarenhas, R., Saltzman, B. M., Walton, D., Lee, S., Cole, B. J., & Bach, B. R. (2015). Is Operative Treatment of Achilles Tendon Ruptures Superior to Nonoperative Treatment? *Orthopaedic Journal of Sports Medicine, 3*(4), 232596711557918.
56. Willits, K., Amendola, A., Bryant, D., Mohtadi, N. G., Giffin, J. R., Fowler, P., . . . Kirkley, A. (2010). Operative versus Nonoperative Treatment of Acute Achilles Tendon Ruptures. *The Journal of Bone and Joint Surgery-American Volume, 92*(17), 2767-2775.
57. CHILDRESS, M& BEUTLER, MD. (2013).mangement of chronic tendon injury.ANTHONY Uniformed Services University of the Health Sciences, Bethesda, Maryland. *Am Fam Physician*1;87(7):486-490
58. Cohen, R. S., & Balcom, T. A. (2003). Current Treatment Options for Ankle Injuries. *Current Sports Medicine Reports, 2*(5), 251-254.

Electronics Articals:

1. (n.d.).Tendon injuries. Retrieved March 29, 2017, from http://www.aota.org/About-Occupational-Therapy/Patients-Clients/Work/Tendon.aspx
2. Achilles tendon Rupture. (n.d.). Retrieved March 22, 2017, from http://www.aofas.org/PRC/conditions/Pages/Conditions/Achilles-Tendon-Rupture.aspx
3. Xanthomas. (2017, January 10). Retrieved April 04, 2017, from http://emedicine.medscape.com/article/1103971-overview
4. Platelet-Rich Plasma (PRP)-OrthoInfo - AAOS. (2011, September 01). Retrieved March 28, 2017, from http://orthoinfo.aaos.org/topic.cfm?topic=A00648
5. Freedman, J. A. (n.d.). Achilles tendon repair rehabilitation protocol. Retrieved March 28, 2017, from http://orthodoc.aaos.org/jasonfreedmanmd/Achilles%20tendon%20repair.pdf
6. pajala A. (2009). achilles tendon rupture. *The New York Times*. Retrieved March 28, 2017, from http://www.nytimes.com

7. Bergmann RA, Afifi AK, Miyauchi R.(1996). Illustrated Encyclopedia of Human Anatomic Variation. Retrieved March 28, 2017, from http://www.uh.org/Providers/Texbooks/

Lectures:

1. Pavlů, D. (2016). *Examination and basic therapeutic methods III: Eevaluation of basic movements patterns.* Lecture`s notes. Charles University in Prague
2. Vomackova, H & Vlačilova I. (2015). *Examination and basic therapeutic methods II: Gait examination.* Lecture`s notes. Charles University in Prague.
3. Vomackova, H & Vlačilova I. (2015).*Examination and basic therapeutic methods II: Muscle length test.* Lecture`s notes. Charles University in Prague.
4. Vomackova, H & Vlačilova I. (2015). *Examination and basic therapeutic methods III: Changes of muscle tone and musculoskeletal dysfunction.* Lecture`s notes. Charles University in Prague.
5. Vomackova, H & Vlačilova I. (2015).*Examination and basic therapeutic methods I: Anthropometric measurements.* Lecture`s notes. Charles University in Prague
6. Vomackova, H. (2014). *Introduction to rehabilitation: Physiatric examination.* Lecture`s notes. Charles University in Prague.
7. Vomackova, H. (2014). *Introduction to rehabilitation: Physiotherapist and patient`s past history.* Lecture`s notes. Charles University in Prague.
8. Vomackova, H. (2014).*Examination and basic therapeutic methods I: Postural examination and muscle balance.* Lecture`s notes. Charles University in Prague.
9. Vomackova, H. (2014).*Examination and basic therapeutic methods I: Spine. Lecture`s notes.* Charles University in Prague.

Figures:

1. Ankle Foot Orthoses (AFO). (n.d.). Retrieved March 28, 2017, from http://www.islandorthotics.org/treatment/ankle_foot.php
2. (n.d.). Retrieved March 28, 2017, from http://www.boneschool.com/lower-limb/foot-and-ankle/tendoachillies/t-ach-rupture
3. Gray H. (2009). *Gray's anatomy*: with original illustrations. Arcturus Publishing; by

Henry Carter

4. Wainwright, S. A. (1982). *Mechanical design in organisms. Princeton*: Princeton University Prague
5. Wright DG, Desai SM, Henderson WH. (1964). Action of the subtalar and ankle-joint complex during the stance phase of walking. J Bone Joint Surg Am, 46: 361e82
6. Nordin M, Frankel V. (2001).*Basic biomechanics of the musculoskeletal system*, vol. 3. Baltimore, MA: Lippincott Williams & Wilkins.
7. Neumann, D. A., & Kelly, E. R. (2010). *Kinesiology of the musculoskeletal system: foundations for physical rehabilitation*. St. Louis: Mosby/Elsevier.
8. Orthopedic trauma. (2016). Online, available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4994968/

3. List of abbreviation:

ASIS: Anterior superior iliac spine

AT: Achilles tendon

CF: Circumference

COG: Center of gravity

DF: Dorsi-flexion

DIP: Distal-inter-phalangeal joint

DVT: Deep vein thrombosis

EMS: Electro-muscle stimulation

EV: Eversion

IFC: Interferential current

IN: Inversion

L: Left

L1: Lumbar vertebrae number one

L2: Lumbar vertebrae number two

L3: Lumbar vertebrae number three

L4: Lumbar vertebrae number four

L5: Lumbar vertebrae number five

Min: Minute

MTP: Meta-tarsal-phalangeal joint

NSAID: Non-steroid anti-inflammatory drugs

OT: Occupational therapy

PF: Planter-flexion

PIP: Proximal-inter-phalangeal joint

PRP: Platelet-rich-plasma

PSIS: Posterior superior iliac spine

R: Right

RBC: Red blood cells

REH: Rehabilitation

Rep: Repetition

ROM: Range of motion

S1: Sacral vertebrae number one

S2: Sacral vertebrae number two

Sec: Second

STFR: Sagittal, transfer, frontal and rotation

TFL: Tensor fascia latae

THL: Thoracolumbar spine

TMTJ: Tarso-metatarsal joint

US: Ultrasound

WBC: white blood cells

4.Supplements:

Patients photos during initial kinesiological examination compared to final kinesiological examination; photo shows improvement of skin color, swelling and posture stability during standing as well not using crutches while standing

Initial kinesiological examination

Final kinesiological examination