CHARLES UNIVERSITY

FACULTY OF PHYSICAL EDUCATION AND SPORTS

Physiotherapy Department

Case study of physiotherapy treatment of a patient with distortion of ankle joint

Bachelor Thesis

Supervisor:

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Prague, April 2022

Declaration

I declare that I have written this bachelor thesis all by my self and I have cited all literature and information sources that I have used in writing my thesis. This work or its important chapters have not been used to achieve different or same academic title.

In Prague: _____ _____

Author's signature

Acknowledgments

My very great gratitude belongs to Mgr.Kateřina Maršáková not only due to helping me with writing my work and spending her time reading it, but also for three years of teaching me the knowledge that physiotherapist needs and how to think and incorporate my knowledge in treating the patients as best as possible. Other gratitude belongs to others who have thought me the techniques and basic principles of physiotherapy. Last but not least my greatest appreciation belongs to my family which has supported me through out this journey.

Abstract

Author: Filip Hulinský

Title of the thesis:

Case study of physiotherapy treatment of patient with distortion of ankle joint

Supervisor: Mgr. Kateřina Maršáková

Objectives:

The goal of this Bachelor's thesis is to gather and present theoretical knowledge about ankle joint and distortion of this joint. This theoretical information's with addition of practical examination are collaborated to create patients specific case study.

Summary:

In this bachelor thesis I give attention towards the ankle joint. It is separated into two distinct parts which are theoretical and practical part. First is the theoretical part in which I introduce and present the anatomical, biomechanical, kinesiological, and overall functional structures and aspects of the ankle joint. Further more I dive into reasoning of different types of distortions, its reasoning behind why they occur, and possibilities of treatment. The second part is the practical where you may read about my experience in Centrum léčby pohybového aparátu (CLPA) where I worked with a patient that has suffered the ankle joint distortion. Practical part includes: methodical work, initial kinesiological examinations, treatment plan, day to day therapy where I explain step by step the methods of treatment that I have used and why, and final kinesiological examination with conclusion of my therapies. Lastly I have created therapy effect evaluation with tables comparing initial and final examination results.

Key words:

Case study, Physiotherapy, Ankle joint, Talocrural joint, Treatment of distortion, Traumatology

Abstrakt

Autor: Filip Hulinský

Název práce:

Kazuistika fyzioterapeutické péče o pacienta s diagnózou distorze hlezenního kloubu

Vedoucí práce: Mgr. Kateřina Maršáková

Cíle:

Cílem mé bakalářské práce je získání teoretických informací o distorzi hlezenního kloubu. Tyto získané informace v kombinaci s praktickými zkušenostmi jsou zkombinovány k vypracování kazuistiky u pacienta s touto diagnózou.

Shrnutí:

V této bakalářské práci se věnuji hlezennímu kloubu. Tato práce je rozdělena do dvou částí které jsou teoretická a praktická. Jako první se věnuji teoretické části ve které předkládám anatomické, biomechanické, kineziologické, a funkční aspekty hlezenního kloubu. Také jdu více do hloubky ohledně různých typech, odůvodněních, a možných rehabilitačních plánů pro léčbu distorze hlezenního kloubu. Dále v druhé praktické části se věnuji mé zkušenosti v CLPA kde jsem pracoval s pacientem po distorzi hlezenního kloubu. Praktická část obsahuje: metodiku práce, vstupní vyšetření, léčebný plán, každodenní terapeutické jednotky kde vysvětluji metody které jsem aplikoval a zdůvodnění, a v neposlední řadě výstupní vyšetření. Po výstupním vyšetření jsem porovnal výsledky terapií a sepsal závěr vyšetření s tabulkami které zhodnocují efekt terapií.

Klíčová slova:

Kazuistika, Fyzioterapie, Hlezenní kloub, Talocrurální kloub, Léčba distorze, Traumatologie

Table of content

1 Introduction

Distortion of the ankle joint is characterized mostly by injury to the soft tissues. During the action of distortion one or more joints in the ankle are distracted for short period of time from their position. It is classified as the most common injury to the LE and may be referred to as sprained ankle. Most common cause of distortion is unsuspected fast paced step onto uneven surface or quick change of direction in where rapid rotation occurs. In both cases the lateral aspect of the foot and soft tissue such as tendons, ligaments, and muscles are put under stress, causing a subsequent reaction of pulling on the joint capsule. Treatment could be divided into surgical and conservative, in which most of ankle distortions may be treated conservatively. Surgical treatment is mostly used solely in cases of complete ligament rupture or if distortions are occurring frequently causing the luxation of the joint. The goal of this bachelor thesis is to gather and present theoretical knowledge about ankle joint and distortion of this joint. This information with practical examination are collaborated to create patients specific case study. The case study has been made and processed during January 2022 while attending clinical practice at Centrum léčby pohybového aparátu (CLPA).

2 Theoretical part

2.1 Anatomical structures of ankle joint

Ankle joint also known as the talocrural joint is a specific type of joint called hinge synovial joint, meaning that it primarily allows motion in one plane (Gupton & Terreberry, 2019). In the case of the ankle joint its primary movement is plantar and dorsal flexion which occurs in the sagittal plane. As a whole the joint is formed by articulation of the talus, tibia, and fibula bones (Physiopedia contributors, 2022). On the other hand, slight inversion and eversion is allowed in the joint with combination of subtalar joint. The main purpose of the ankle joint structure is during gait. In which it has two objectives: shock absorber as the heel strikes the ground first, and flexion to increase the angle between the ground and Tibia. The joint capsule it self is weak and in order to keep the joint in place there are ligaments and muscles holding it in place, preventing it from distortions, luxation, or subluxation (JC physiotherapy, n.d).

2.1.1 Muscles of Ankle joint

There are five key muscles that are responsible for proper function of the ankle joint. We may separate them into three groups based on the place where they attach: anterior, posterior, and lateral. The anterior part key muscle is m.Tibialis anterior which inserts into medial cuneiform and base of first metatarsal providing the dorsiflexion of the foot. Posterior part has m.Triceps Surae consisting of three muscles m.Soleus, m.Gastrocnemius medialis, and m.Gastrocnemius lateralis. All of these three muscles insert into Achilles tendon and provide plantar flexion. The last group which is lateral is made out of two muscles m. Peroneus longus and m. Peroneus brevis inserting into medial cuneiform and first metatarsal. The lateral group helps the posterior to plantar flexion of the foot and in subtalar joint it provides eversion (Sendić, 2022).

2.1.2 Ligaments

As mentioned above in introduction the joint capsule by it self is fairly weak, due to this fact function of the ligaments and tendons primarily serve to prevent misplacement of the ankle. We may divide the ligaments into three groups based on anatomical position: lateral, deltoid which are on medial aspect, and ligaments of the tibiofibular syndesmosis. These ligaments

are strengthening the lateral, medial, anterior, and posterior aspects of the joint. This means that they work to maintain stability in the joint and the longitudinal arch of the foot (Rayner, 2017).

The lateral collateral ligament complex consists of three ligaments: Anterior talofibular ligament (ATFL), Calcaneofibular ligament (CFL), and posterior talofibular ligament (PTFL). The ATFL works to stabilize and strengthen the anterolateral aspect of the joint capsule by inserting into Talus bone. (Figure 2.) Due to its insertion the greatest stretch is during plantar flexion. CFL ligament attaches to lateral aspect of the calcaneus and greatest pressure on this ligament is during dorsal flexion. PTFL is the strongest of these three but also the shortest by originating on malleolus medialis and inserting into posterior process of Talus. The lateral ligaments are most commonly injured out of the three ligaments groups. Particularly due to the fact that distortion occurs by plantar flexion and inversion of the foot (Nyska & Mann, 2002).

The Deltoid ligaments have a triangular shape which connects the anterior and posterior aspect of medial malleolus. In case of this group of ligaments we may separate them into superficial and deep layer (Hacking & Weerakkody, 2020).

Superficial layer is consisting of four ligaments: Tibionavicular, tibiospring, tibiocalcaneal, and superficial posterior tibiotalar ligaments. The deep layer is covered by synovium which is a soft-tissue membrane which connects the lines of inner surface of synovial joint capsule. The ligaments are anterior tibiotalar ligament (ATTL) and deep posterior tibiotalar ligament (DPTTL) (Figure 1.), (Physiopedia contributors, 2021). Ligaments of tibiofibular syndesmosis are located as the name suggests between distal end of fibula and tibia. These ligaments are least prone to injuries the percentage being 1-11% of all reported ankle sprains (Rayner, 2017). The three ligaments are: anterior inferior tibiofibular ligament (AITFL), posterior inferior tibiofibular ligament (PITFL), and interosseous tibiofibular ligament (ITFL). As the other two groups of ligaments even this group acts to increase and strengthen the stability of the ankle joint (Golanó, 2010).

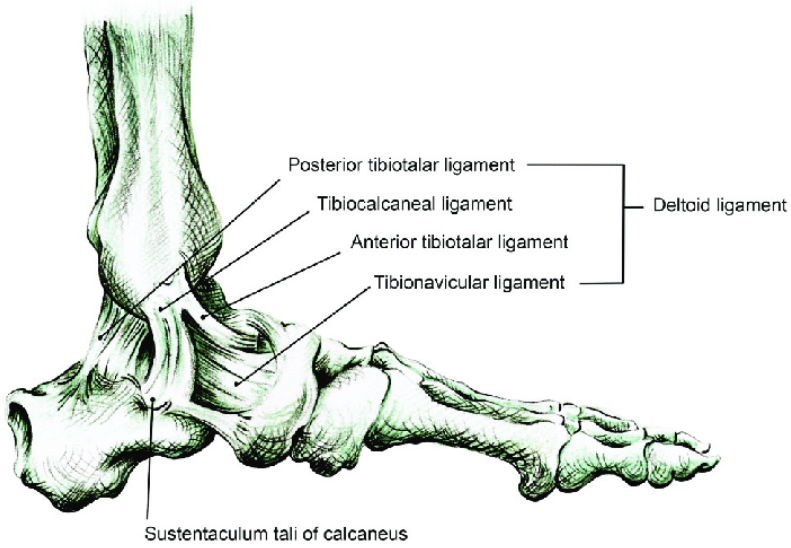

Figure 1 - Deltoid ligaments (Al-mohrej, 2016)

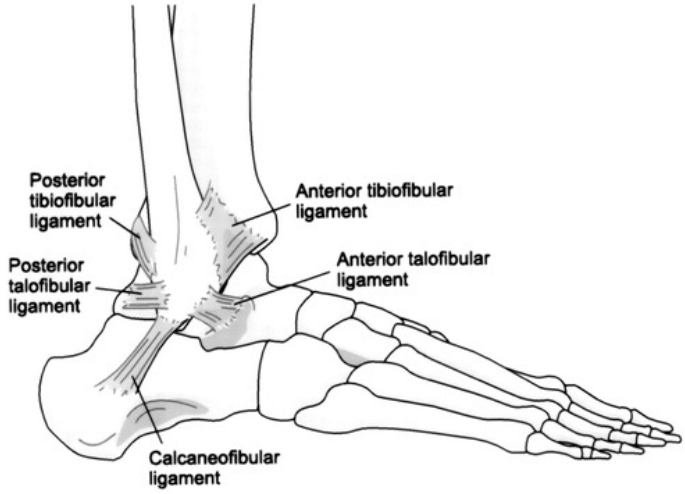

Figure 2 - Drawings of the normal anatomy of the lateral collateral ligaments of the ankle (Muhle, 1999)

2.1.3 Tendons

Tendons similarly as ligaments are soft connective tissues and they allow movement of the person by improving the stability between the muscle to bone and bone to bone. The greatest difference is that tendons attach muscle to bone and serve to move the bone. On the other hand, ligaments have both the insertion and origin on the bone and act more on stabilizing the bone/structure in its place. Keeping the joint centered and stable (Vorvick, 2020).

Tendons in the ankle are especially important for normal functioning of the human being as they are the ones attaching muscles to the bones of a foot that provide plantar and dorsal flexion of the foot which is the principle of gait. We have Achilles tendon, peroneal tendons, and anterior and posterior tibialis tendon in the foot (Your practice online, 2022).

Achilles tendon is the largest and strongest tendon out of them. It inserts posteriorly onto calcaneus. It is important due to the fact that the plantar flexor m.Triceps surae attaches to the tendon, meaning that without this tendon the muscles wouldn't be able to provide this function.

There are two peroneal tendons in which one of them runs behind malleolus lateralis and inserts into fifth toe and the second one runs same direction but attaches to the inside of the foot arch (Penn Medicine, 2020).

2.1.4 Bone structures

The ankle is composed of two joints: talocrural and subtalar. The talocrural joint is composed of three bones which are tibia, fibula, and talus. This joint is also referred to as true ankle joint. Subtalar joint is placed under the talocrural joint and it consists of two bony structures: talus and calcaneous. You may say that these two joints consist of total of four bone structures. (Southern California orthopedic institute, 2022)

2.1.5 Nerve supply

The nerve supply to the muscles of the ankle joint consists of n.tibialis and n.fibularis profundus. From these two supplies there are multiple branches that innervate the muscles (Bain & Neto, 2016).

The tibial nerve originates as a branch from sciatic nerve in the level of apex of popliteal fossa (Ferng, 2021). It receives fibers from L5-S2 spinal roots. Muscles innervated by n.tibialis are: m.Triceps surae, m.plantaris, m.tibialis posterior, m.flexor digitorum longus, and m.flexor hallucis longus. It innervates the dorsal/posterior aspect of the leg. Damage to the nerve may cause pain in toes, weakness of ankle and toe flexors, numbness, tingling, or burning sensation (St. Luke's hospital, n.d.).

Nervus fibularis profundus has also a second name which is deep peroneal nerve. This nerve is a branch sciatic nerve and originates between m.fibularis longus and neck of fibula. Muscles innervated by this nerve are: m.tibialis anterior, m. extensor hallucis longus, m.extensor digitorum longus, and m.fibularis tertius. This nerve is responsible for innervation of the anterior aspect of the leg. During non proper function of this nerve either being entrapped or compressed is leading to paralysis of the muscles of the anterior compartment of

leg which has clinical picture of dropped foot, with inability do provide dorsiflexion (May, 2020).

2.2 Biomechanics of ankle joint

The main aim of structure of ankle joint is to propel the body forward. It plays a key role in walking, running, jumping, and overall activities of daily living (ADL) for which the body has to be in vertical position. It is not only responsible for locomotion but it also provides stability and base of support for the whole human body. Due to the type of joint that it is, the fast adaptability to different types of terrain is possible, which as a result has effect on balance and stability of a person. Non proper function of ankle joint has a crucial role on persons' stability and so quality of life (Segal et al., 2018).

2.2.1 Biomechanics of ankle joint during standing

The hard anatomical structures by which I mean bones and joint are responsible for passive stability. The soft anatomical structures such as muscles, tendons, and ligaments are responsible for the active stability (Véle, 2006). Any dysfunction of hard or soft anatomical structures leading to decreased ROM has an effect on locomotion and stability during standing. To someone it may seem as that during standing the joint is in one position without any movement. That can not be further from the truth. In fact, it is a dynamic phase in which very slight and slow autonomic movement occurs, as the body weight distributes from the talocrural joint to talus and afterwards to calcaneous. All of the shocks from the surface are administrated by nociceptors and proprioceptors in soft tissues, which sends afferent impulses through CNS to the brain which has to react to changes of terrain and send efferent impulse back to the soft tissue of the leg to change based on the environment. That is where the structure of the ankle joint is so important as proprioceptors are located in joints, meanwhile the nociceptors, pressure receptors, and stretch receptors in the soft tissue.The base of support on feet should be distributed on three points: 1.Calcaneous, 2. Head of big toe metatarsal, 3. Head on pinky metatarsal. This forms an imaginary triangle in which the greatest balance and stability is present (Harrold & Abboud, n.d.).

2.2.2 Biomechanics of ankle joint during gait

As the ankle joint is surrounded by soft tissue and is a synovial joint it plays major role as a shock absorber in the gait pattern. There are four shock absorber mechanisms in human body being: Ankle plantar flexion when heel strikes the ground, subtalar pronation in which the friction between calcaneous and ground increases, knee flexion that is initiated by 1st shock

absorber mechanism as muscle contracts and pulls on insertion which creates forward motion of tibia, and lastly contralateral pelvic drop in which forces are absorbed by eccentric ipsilateral hip adduction (JC physiotherapy, n.d.). Out of these four mechanisms two occur in the ankle, from which you can see the importance of it, as it is capable to distribute the shock to other joints of the body. The movements in ankle joint occur in sagittal plane with plantar/dorsal flexion, frontal plane with adduction/abduction, and rotation with inversion and eversion. The normal ROM measurements based on Kendall are 45^0 plantar flexion, 20^0 dorsal flexion, 40^0 inversion, and 20^0 eversion (Kendall et al., 2005).

2.2.3 Biomechanics of ankle joint during phases of gait

Gait is not solely dependent on ankle joint, rather it is a collaboration of the whole body from the head all the way to the toes. If we look at only the lower extremity (LE) during gait, there are three main joints in which motion occurs: hip, knee, and ankle. Pathology in any of these joints leads to disturbed gait which may result in worsening of the ADL. In a proper gait cycle the heel strikes the ground first than planta of the foot and lastly the whole sole including toes. We separate gait into two main phases.

Stance phase is approximately 60% of the gait cycle. This phase is also described as static position. This phase starts when the heel strikes the floor and ends with prepared position of toes in a toe off phase. In between these actions the base of supports and weight of the body from calcaneous to planta→foot arch (foot flat)→midstance→ pushoff. In order for heel being the first to strike the ground dorsal flexion has to be made and at the end of this phase the foot must transition to plantar flexion for which the ankle joint is responsible. Muscles involved at beginning are m. peroneus longus and brevis and m. tibialis anterior preventing foot drop. Their activity decreases in order to make contact with sole and three point of support. In which m. soleus takes over the activity to stabilize in stance with help of m. gastrocnemius and m. tibialis posterior in which they are not acting only on ankle, but also helping stabilizing the knee joint. (Kharb et al., 2011)

Swing phase of the gait begins where the stance phase ends and so a position in which the toes lift off the ground and ends with heel strike. It is the dynamic phase as in this phase the body is propelled forward. Dorsal flexion and slight eversion must occur to bring the toes up to allow the heel strike first. Muscles that are responsible for it are of anterior compartment of the leg: m. tibialis anterior, m. extensor digitorum longus, m. extensor hallucis longus, and from lateral aspect for eversion m. peroneus longus. Muscles in the ankle joint work on

principle of agonist-antagonist pair. Meaning that when dorsal flexors activate the plantar flexors are relaxed.

During this phase the body and mainly the pelvis is under greater effort of keeping the correct posture and balance of the segments due to the fact that during dorsiflexion we loose two out of three points of support. The pelvis drops slightly on the side of the swing LE. In order to balance this pelvic drop the adductors of the stance leg activate and so does m. quadratus lumborum and m. iliopsoas on LE that is undergoing the swing (Véle, 2006).

2.2.4 Support phases of gait

We have three support phases to our stance phase of the gait.

1. Single support phase = one LE contact with ground. 60-72% of time of the cycle
2. Initial double support phase = both LE in contact with ground. 14-20% of time of cycle
3. Terminal double support phase = occurs when one LE is in foot on and second LE in toe off. 14-20% of time of cycle

These phases are only a sub division of the stance phase (Tekscan, n.d).

2.3 Distortion of ankle joint

Distortion of the ankle joint is one of the most common injuries of the LE with prevalence of inversion type of around 85% of cases (Ankle sprain, 2022). During distortion of the ankle distension or partial rupture of ligaments occurs in which the stability of the joint might or might not remain (Dungl et al., 2014). Even though ankle distortion is very common it is not necessarily talked about as a type of major injury. In common population there is an idea that you will rest for couple of days maybe put ice on it and in a week it will be all good, and so there is no need to visit a doctor about it. This thought can't be further from truth. With inappropriate treatment it may lead to repeated (sub)luxations or distortions as the ligaments never heal appropriately. This leads to chronic pain and feeling of instability. Overall chronic pain and instability leads to decreased level of everyday activities, but further more change of stereotype of movement which may be precursor for additional problems and injuries.

We separate ankle distortion into three grades based on the severity.

Grade 1 = Ligament stretch with mild stiffness and swelling, but you are able to walk with minimum pain.

Grade 2 = Ligaments incomplete tear with moderate pain, swelling, and bruising. Painful for touch and feels unstable and painful when walking.

Grade 3 = Ligament complete tear with severe swelling and bruising. Ankle is unstable and walking is not possible (Davine, n.d.).

2.3.1 Risk factors and reasoning behind distortion

Distortion belongs to injuries caused by trauma to the ankle joint, and so is dealt with in traumatology center. Much more common are injuries to the lateral ligaments which is caused by hyper inversion / supination of the ankle. There are many risk factors behind the distortions some of which you may influence and some of which you can't. In professional terminology the factors that come within the body are called intrinsic. Factors that come from outside of the body are are called extrinsic. Untreated previous ankle distortions is one common risk for the current ankle distortion as the soft tissue does not have the strength to hold the joint capsule in place (Delahunt & Remus, 2019).

2.3.1.1 Intrinsic risk factors

To intrinsic factors we also take in consideration the history of previous ankle distortion, where it showed that patients are twice as likely to get ankle distortion again. Body composition particularly overweight and obesity increases the chances of ankle distortion. On the other hand being underweight and not having adequate muscle composition (muscle weakness) also increases the chances of ankle distortion, due to the fact that the joint does not have strong support. Genetics are a great risk factor as person can be born with higher elasticity of ligaments which results in being more susceptible to luxations, or inborn joint deformity. Hypermobility is a risk factor due to the fact as Prof. Janda has claimed that hypermobility is the result of laxity of ligaments and gave great importance to central nervous system (CNS) which controls the muscle and therefore the movement (Page, 2005). Laxity of ligaments goes hand in hand with greater chance of joint luxation (Delahunt & Remus, 2019).

2.3.1.2 Extrinsic risk factors

Certain kind of competitive sport in which the competitor provides fast spin or turn of directions such as football, tennis, basketball or ice hockey. Contact sports such as rugby or American football in which trauma from contact takes place. Certain types of shoes that do not support the proper function of ankle joint may cause feeling of instability leading to distortion. Most common not only in professional sport is the overuse of soft tissue and anatomical structure, either by overtraining or wrong movement stereotype which puts exceeding pressure on structures of the joint. The overtraining may lead to small tears in ligaments, which when not treated and continue overusing it leads to major tear (Fong et al., 2009).

2.3.2 Clinical picture

There are few common signs for all three grades of severity such as: painful to touch, oedema, bruising/hematoma, and decreased range of motion in the joint. Then there are signs of 3rd grade distortion: inability to control movement in the ankle joint due to pain and ruptured ligament, inability to stand on the foot, patient might have heard or felt a popping sound in the ankle, and all of the signs occur immediately, meanwhile in grades 1 and 2 the signs become present after the physical activity (Kolář, 2009).

Oedema is type of defense mechanism of the human body as it limits the ROM preventing further injuries and also tell the person that something is not right. Pain on the other side is a product of increased number of chemical compounds of prostaglandins, bradykinins, and histamines which act on dendrites and axons of nerve cells.For treatment which I will talk more in 2.3.4 the first aim is to reduce the oedema and pain, as these two factors influence the therapeutical progression (Hnátová & Pavlů, 2010).

2.3.3 Methods of diagnoses

When the patient comes into hospital, he will be send to traumatology ambulance. In the ambulance they will provide three main diagnostic procedures: X-Ray, diagnostic ultrasound, and inspection with palpation by the doctor (Dungl et al., 2014). The doctor may assume the severity of distortion based on subjective pain or inability to walk and on objective such as

immediate creation of oedema, hematoma, or no control over the foot. Doctor must check his assumptions by the diagnostic methods.

X- Ray is in most cases done as first, this is due to the fact that with negative finding on the skeletal structure of ankle joint the distortion is treated without further investigation of severity of deformity of ligament structure. If there is a positive finding the patient is send to ultrasound (Dungl et al., 2014).

Diagnostic ultrasound is used to figure out which specific soft tissue has been damaged. It also shows whether there is a partial or complete rupture of the specific ligament.

In some cases the doctor may recommend magnetic resonance imaging (MRI), however this is very rare and used when there are suspected injuries to other parts of the body as well.

In sub acute phases where swelling is no longer present and pain has decreased the physical examination with specific tests may be used to determine the affected ligaments. Tests that are used are: Anterior drawer test which assesses laxity and strength of ATFL, talar tilt test which assesses ATFL and CFL, eversion stress test assessing deltoid ligament injury, external rotation test indicating syndesmotic sprain, and squeeze test in which pain indicates syndesmotic sprain (DiPreta, 2014).

2.3.4 Treatment plan according to stage of the injury

The first step of treatment is to assess the degree of severity of the injury, which is done by diagnostic methods described in 2.3.3. This is due to the fact that grade 1 and 2 have different treatment protocol to grade 3. The phases of injury have different goals as well. Described by Prof. Kolář we separate the rehabilitation into three phases (Kolář et al., 2009).

1st early post–traumatic: The main goal of this phase is reduction of oedema, and prevention of further injury to soft tissue. In the past protocol that has been done was described under acronym R.I.C.E. This technique should be provided in first 48-72 hours of injury, in which ice has been applied to the area of injury. In United states of America, they have used P.R.I.C.E, where “P” was protection (Therapist of MGH, n.d).

In todays day and age, the R.I.C.E protocol is being swapped by protocol named PEACE and LOVE which has been created in 2019 by Dubois and Esculier.

“P” stands for protection in which we restrict the movement of affected soft tissue for 1-3 days.

“E” stands for elevation. This is the same as in R.I.C.E protocol.
“A” stands for avoiding anti inflammatory modalities. This is due to the fact that inflammation is essential part of healing process and by taking anti inflammatory medication you are postponing the healing. Part of this is also no application of ice.
“C” stands for compression. Same as in R.I.C.E protocol.
“E” stands for education. This is different to the previous protocol as this part has not been included at all. It is necessary part to educate the patient as that may improve the healing process and possibly diminish risk factors that would lead to another injury.

LOVE is used after the first acute stage has passed. So after 3-5 days.
“L” stands for load. Active approach in which we slowly increase the load which builds up tissue tolerance to the load thus regaining the strength.
“O” stands for optimism. This is also a part that has not been included in the previous and that is the psychological aspect of healing progression. If the patient is negatively set up than the outcomes of an injury may pass on to the future and cause re-occurring problems.
“V” stands for vascularization. The cardiovascular system training has great importance in increased blood flow and thus improving nutrient transportation to the damaged tissue improving the healing.
“E” stands for exercise. Restoring mobility, strength, proprioception, and further more is reducing risk of recurring injury (Dubois & Esculier, 2019).

2nd late post traumatic: This phase is predominantly to improve and support the healing process of soft tissues. This counts into consideration slow and steady renewal of muscle and ligament activity with correlation of proprioceptive function. The proprioceptive function is important for the improvements of ankle stability. The protocol of treatment includes physical therapy such as magneto therapy, laser therapy, hydrotherapy, soft tissue techniques (STT), joint mobilization and joint play for which oedema must be minimalized, and lastly start incorporating basic active exercise in order to improve the sensomotorics, proprioception, balance, and strength of the muscles. In order for patient to move to the third phase there are criteria that he must successfully pass: normal walking stereotype, no oedema, no pain under load, and stability on affected LE (Niekerk, 2022).

3rd preparation for specific sport load: In this phase the patient is getting back to the activities that he has been used to in the past. It is a phase that is more specialized for sportsmen in getting back to their specific sport. We use strengthening exercises to get back the muscle strength and improve possible muscle dysbalances between both LE. Using special aid and

equipment such as theraband, overball, balance boards, bosu, TRX, posturomed, weights, and many more. We are mainly exercising in closed muscle chains, but we also incorporate dynamic exercises with coordination skills (Therapist of MGH, n.d).

2.4 Other injuries of ankle joint

Although distortion belongs to the most common injury of the ankle joint there are more serious injuries to the ankle joint. On other hand ankle distortion is a precursor to most of the other injuries, based on the effect of the ligament repeated (chronic) strain. The other most common injuries are tendon ruptures, subluxations, and luxations. We are not taking into consideration burns (Foot & ankle specialist, n.d).

2.4.1 Tendon rupture

This injury mostly occurs in professional sportsman where overtraining is a factor. Not only ligaments are susceptible to partial or complete tear, but also tendon. Ankle joint has one main tendon which is the Achilles. Tear occurs during overstretch of the tendon, in this case it's in direction of dorsal flexion. Pivoting, jumping, or sudden acceleration are the greatest risk factors in tendon rupture, however the greatest risk factor is overtraining without proper warmup in which the tension and stretch is so big that it ruptures. A complete rupture will need a surgical treatment and stitching of the tendon. Partial rupture is treated by application of cast or brace to restrict the ROM in order to allow the tendon to heal up.

Second tendon that can be affected in the ankle joint is the peroneal. Injuries to this tendon are common in people that have either job or plays sport with repetitive ankle motion.

In both cases physical therapy is essential to re-gaining strength, ROM, and stability in the ankle (Foot & ankle specialist, n.d).

2.4.2 Subluxation and luxation

In literature it may be described as dislocation but it means the same clinical problem. The process of subluxation and luxation involves elongation, tear, or an avulsion of tendon. In most cases the affected tendons are of the peroneal retinaculum which are located in the lateral aspect of the foot. Occurs when the tendon dislocates from retromalleolar groove which leads to the elongation or tear. We describe four grades of subluxation.

Grade 1: Retinaculum is stripped away from fibula which results in dislocation of tendons.

Grade 2: Superior peroneal retinaculum (SPR) and fibrocartilaginous ridge is avulsed from fibula.

Grade 3: Bony avulsion of the posterolateral aspect of the fibula containing the cartilaginous rim and a flake of bone permitting the tendon to slide beneath the periosteum

Grade 4: SPR is elevated from the heel bone which in medical terms is the calcaneous.

The conservative approach of treatment is immobilization for 4-6 weeks and letting the SPR to attach back to posterolateral aspect of fibula. Surgical treatment is possible as well in which the doctor sutures SPR back to its place, however the whole healing process is longer as the patient must have a non weight bearing cast for 4 weeks, which is then changed for weight bearing cast for another 2 weeks. After that physiotherapy may start (Martens, 2022).

2.5 Types of treatment for distortion

We have two options for treatment which are surgical and conservative treatment. The type used depends on grade of the distortion.
Grade 1: The ligament is stretched and as a result swelling, mild tenderness, and stiffness is present, however walking is possible with minimum pain.
Grade 2: Incomplete ligament(s) tear, patient presents moderate pain on touching the injured area. More severe bruising than in grade 1. Patient is able to walk but it is painful.
Grade 3: Complete ligament(s) tear. The ankle joint is unstable and walking is not possible.
In most cases distortion of grade 1 and 2 are treated conservatively and grade 3 requires surgical treatment. Nevertheless, physical therapy plays a great role in both cases. The physical therapy treatment starts after the swelling is eliminated, however some types of laser therapy and thermotherapy (cryotherapy) may be used to accelerate the process of oedema reduction (Davine, n.d.).

2.5.1 Surgical treatment

Surgical treatment is used in complete ruptures of ligaments and it is rare. Before surgical treatment the conservative treatment is being applied and only if distortions or even

dislocation are reoccurring the surgical treatment is applied. There are many surgical approaches and sutures that can be used to fix the ligaments and tendons. Few examples are: tenodesis, transosseous suture, and imbrication. The type of suture and technique used in the operation depends on the severity and type of the injury with combination of surgeon skills.

Arthroscopy: Surgery which leaves small scars are mostly used. Doctor removes loose fragments which are causing pain and problem in the ankle joint.

Reconstruction: It is more difficult and invasive operation. The torn ligament is sutured and if it is not possible the ligament is replaced by graft from another ligament. Then it is able to be stitched up. Following operation cast is applied to immobilize the ankle joint for two to four weeks. After cast removal rehabilitation is prescribed. The time of rehabilitation depends on the severity of surgery, but also the physical state that the patient was in pre-surgery (Haddad, 2016).

2.5.2 Physical therapy

In the acute phase we shall follow the PEACE and LOVE protocol which I have talked about in 2.3.4. In later stages a short term immobilization, local or systemic non-steroidal anti-inflammatory drugs, electrical stimulation, and physical therapy should be prescribed.
In second phase which lasts from the fourth day post injury up to two weeks the main goal is total elimination of swelling and reduction of pain. With elimination of swelling we may progressively improve the load bearing and slowly work with ROM in a pain free zone. Which means slight stretching just into pain, not over it. We as physiotherapist may provide Post isometric relaxation (PIR) with stretching in order to activate and stretch the muscles that have not been used for four days in order to prevent shortening. Another technique to use is joint play of blocked joints such as the metacarpo phalangeal (MCP) and head of fibula. Do not use it yet for subtalar joint due to possible even further strain of the ligaments. For active weight bearing we may stand in front of rail holding with hands and transferring the weight from one LE to another. This can be progressively getting harder by unstable surfaces such as soft pads or bosu.
In third phase which is from second to sixth week post injury we are working on regaining ROM, improve muscle strength and endurance, and working on gait stereotype without use of assistive aids. We incorporate joint mobilization techniques, proprioceptive and sensomotoric training with use of aids such as posturomed, rocker board, bosu, and ext. We keep working

with both the weights and human body weight. Using the stationary bike or stepper is a great way to start the therapy session as we warm up the body thus increasing the function of cardiovascular and pulmonary system which increases the blood flow and reducing risk of injury. Further more ankle plantar and dorsal flexion is present and may improve the overall ROM in the joint. Posturomed or other unstable surfaces such as soft pads and bosu shall be incorporated as it strengthens the muscles and ligaments around the ankle joint which help to stabilize the ankle in its capsule, thus also regaining patient trust in the affected LE. All of the gym aids that I have mentioned are improving proprioception, and thus the balance and stability which has a result in better gait performance. For proprioception improvement we also educate the patient about 3-point support of feet: heel, toe, pinky. Also working on small foot exercise and its modalities.

In fourth phase which is 6 weeks plus post injury we incorporate dynamic movements, weight training with bigger load, improve stability, speed, and the overall locomotor apparatus to work as before the injury. We may start incorporating jumping, single leg stances and hopping, side to side shuffling, stairmaster in which we work on endurance, strength, and stretch of the muscles of ankle joint. We may start progressively doing all exercises that are pain free. The loading on the joint should be increasing the intensity every therapeutical session, either by increasing the repetitions of exercises or incorporating more demanding modalities of the exercises. Example of modifying exercise can be squat. The easiest is to hold a rail, if that is easy we may use TRX which we still hold but is harder, then we can do squat without support of hands on stable surface, and last modification can be squat on unstable surface such as on bosu.

Prophylactic phase is the last phase. Rather than rehabilitation phase it is a prevention of ankle distortions or other injuries more in 2.4.2 and 2.4.3, because once ankle distortion occurs you are more likely to get it again due to elasticity of the ligaments. The phase consists of continuous strengthening, proprioceptive training, and education of patient about proper footwear, risk factors, and possible exercises for autotherapy (Therapist of MGH, n.d).

2.5.3 Hydrotherapy

It has been proven that hydrotherapy 2x a week in combination with exercises resulted in improvement of chronic ankle instability. There has been another study that focused on grade 2 of ankle distortion, in which instead of following R.I.C.E protocol they have applied saturated hydrogen rich water in first 24 hours post injury. The application was 30 minutes at

every 4 hours i.e. six sessions. The result was that patient pain has decreased, swelling dropped by 2.8%, and dorsal flexion improved by 27.9% (Javorac et al., 2020).

It has been well known that hydrotherapy in sub-acute stages and chronic stages helps with pain relief, but this study has also shown that it even might be helpful in acute stage.

Examples of types of hydrotherapy used in sub acute and chronic phases of ankle sprains are: priessnitz wrap and subaqual massage.

Prissnitz wrap: Helps with pain relief, absorption of oedema, and helps in treatment of inflammatory processes in joint, ligaments, and muscles. It overall speeds up the recovery as it increases circulation and so as well as nutrient transportation to the damaged tissue. The wrap is composed of three layers, where the first layer is soaked in cold water, second layer must fully cover the first layer and must be made out of material that is waterproof for example a plastic bag and last layer is dry cloth that covers both layers. By this the wrap will first cold the area where applied and then it will warm it.

Subaqual massage: Is used in chronic phase. The subaqual massage relaxes the soft tissue around ankle joint. The water temperature may be easily modified and might even be used as combination of hydrotherapy and thermotherapy (water temperature over 37^0 Celsius). In rehabilitation plan it is very often used in combination with physical therapy, where patient has 30-minute exercise session and then immediately goes for the subaqual massage for another 30 minutes (Ragab, 2020).

2.5.4 Thermotherapy

Positive thermotherapy is used in sub acute and chronic phases as the heat would increase the swelling in acute phase, due to vasodilation of capillaries. In at least first 72 hours no heat should be applied. Negative or in other words cryotherapy has been used in acute phases as it slows down the swelling due to vasoconstriction and also works in reduction of pain, that is reasoning behind its use in R.I.C.E protocol. However, based on the latest protocol of PEACE and LOVE no ice should be applied in acute stage, but may be used in sub-acute phase as analgesic factor and reduction of bruising. On other hand patient must watch out for possible burns from cold which would slow down the healing process. That is why cold should not be applied directly, but instead always be applied through cloth or towel. What has been found is that usage of contrast therapy in which cold and warm is being alternated works the best in sub acute phase stage of ankle distortion grade 1 and 2. It reduces pain, swelling and increases ROM. About the grades I talked about in section 2.5 (Weerasekara et al., 2016).

2.5.5 Electrotherapy

Electrotherapy might be used in sub acute and chronic phases of ankle distortion. Based on a study neuromuscular electrical stimulation (NMES) significantly improved the reduction of oedema. In the sub acute phases ultrasound is used and in chronic we use pulsed low frequency magnetotherapy. Even though ultrasound is used very often there are multiple studies that show no significant improvements in patient who have underwent ultrasound therapy and those who have not (Wainwright et al., 2019).

Pulsed low frequency electro magnetic field: The parameters are: Frequency 25Hz, Intensity 5-10 mT, step 2mT. The application is from 20-45 minutes. The benefits are promoting bone healing, treat inflammation, enhances healing process, and what is specific for this type is improving neurotransmission and correcting local immune pathology. Overall it shall improve the healing process (Poděbradský & Poděbradská, 2009).

3 EBM

As I have previously mentioned ankle sprains account for majority of cases in orthopaedic and traumatology departments. Based on this fact it is logical that many different types of approaches towards treatment have been developed and used. Multiple reports, trials, and tests were conducted to determine the best treatment protocol for treating the ankle distortion. The trials are ranging from comparing active exercise program versus immobilization or about the benefits of usage of electro and hydrotherapy in different stages of treatment.

One randomized trial looked at the different rate of improvement in patients who underwent functional treatment versus immobilization. The trial consisted of 100 male participants who have suffered ankle distortion of various degrees of injury. They were split into two groups each having 50 participants and variables that were compared were improvement in: ROM, pain, inflammation, joint tenderness, and the return to work environment. Data was taken on the 2^{nd}, 6^{th}, and 12^{th} week post injury.

The results showed that on the 2^{nd} week the group who underwent the functional treatment had a significantly greater improvement in pain reduction compared to the immobilization group. The same result was in element of decreased inflammation and improved ROM. Further more the patients from the functional treatment group were going back to their work regime, meanwhile the second group was not yet able to fully return.
In the report that was taken 12 weeks post injury no significant difference has been reported

between these two groups, in which everyone was able to return back to their work. On the other hand, it was said in this report that some variables such as muscle strength was not tested in this trial, but it is believed that the group with functional treatment would report greater strength. Further more the author comments that the severity (grade) of the ankle distortion has not been given consideration in this trial, but suggests that grade III which needs operation should undergo a short term immobilization (Mohammadi et al., 2012).

Another report created in 2020 has compared three different studies that were not older than 10 years. The aim of this report was to determine if exercise based rehabilitation in combination with manual therapy had greater improvements than exercise based rehabilitation it self. Important to say that compared to my first example this report searched for chronic ankle instability (CAI) and not acute state. Two out of the three randomized trials showed a significant difference level of improvement of outcomes in groups with incorporated manual therapy. One study showed no significant results between these two approaches. The study with no significant improvement have incorporated combination of calf stretching, ankle joint traction, joint mobilization and plantar massage as part of the manual therapy. The difference in the other two studies was that they included proprioceptive and neuromuscular training in addition to the mobilizations. It has been concluded that manual therapy which does not take in an account the proprioceptive training will not be beneficial to the treatment as a whole (Walsh et al., 2020).

If we dive into the physical therapies that are used worldwide for treatment of ankle distortions we may find different types of hydrotherapy, thermotherapy, electrotherapy, magnetotherapy, and balneotherapy meaning mainly the usage of mineral water and soil. In recent years' studies have been made to test the actual benefits of these therapies. One physical therapy that has been tested especially a lot is therapeutic ultrasound.

In the past it was believed that the therapeutical ultrasound reduces pain and swelling, with additionally improving ROM. There has been a study made which compared six randomized trials in which they all included ultrasound therapy and they also had the same criteria for recording outcome measurements which included improvement in pain, swelling, functional disability, and ROM. In total there has been 606 participants that took part in the trials. Five out of the six trials had a group of participants who received a placebo ultrasound and one group that received therapeutical ultrasound. Based on the results from the five trials no significant difference in outcome measurements have been recorded between the two groups.

Concluding the fact that there is no importance in usage of ultrasound in treatment of acute ankle sprains (Van den Bekerom, 2011).

There is one more frequently used method that is applied to ankle sprain injuries, which is kinesiotaping. It was and in some cases still is believed that kinesiotaping has many benefits such as reduction of: swelling and pain, and improvement of proprioception, ankle stability, and improvement ROM in long term application. For the effect of reduction of swelling in acute phase there was a study made that consisted of 36 participants with acute lateral ankle sprain. The participants were split into two groups, in which one group received the kinesio tape to treat swelling and the second group received inert kinesio tape. Results were made based on ankle circumference and were recorded before application, 3 days' post application, and 15 days' post application. The results showed that the application of the kinesio tape for reduction of swelling had minimum benefit compared to the inert taping, meaning that its usage for swelling reduction is not a solution (Nunes et al., 2015).

It is important to say that kinesio tape is not the only type of external support that is used. There are different types of bandages such as pressure bandages, elastic compression, lace-up support, and braces. In all of the above mentioned cases of external support the patient is able to provide motion in the ankle joint. There is a lot of data comparing the different types of external support to determine the one with greatest effect however, when we look at the studies thez have contradicting results. On the other hand, from a study that consisted of three meta analysis and sixteen prospective randomized trials, it was concluded that only grade III ankle sprains should be immobilized for short period of time. Furthermore, grades I and II should have semi rigid ankle brace as external support. This study also concluded with mentioning that the semi rigid brace is effective in prevention of ankle sprain (Petersen et al., 2013).

When we look at the benefits and downfalls of different types of conservative therapies it is also fair to look for those in a matter of surgical approach. As I have already said in chapter 2.5.1 there are multiple techniques and sutures that may be used in surgical treatment. The fact is that there is only limited evidence supporting that one technique would be superior to the others, as there are some types of limitations to every one of them (Cao et al., 2018).

Even more a meta-analysis was made which was composed of 834 patients who underwent surgical treatment and 930 patients who went through the conservative treatment. The analysis found out that patients who underwent the surgical approach had a greater incidence of complications, scare tenderness, sensory (proprioception) loss, and ankyloses compared to

the group which underwent the conservative treatment. The difference in ROM and chronic ankle instability or in other words recurrent ankle injury between the two groups had no significant difference (Liu, 2019).

There are multiple ways that one may choose for treating the patient with ankle distortion and no one can say which method is the best. That is simply due to the fact that every human is different and everyone is in different mental and physical condition before injury and even during the treatment. Also I have mentioned that in some cases placebo effects were used and they had the same or minimum difference compared to the real therapy, which is a very nice view on the body as it gives us idea how easily our mind can be tricked. Needed to say that psyche and overall mental state has an effect on the recovery as well. As a study of 668 participants was made to record the depression scores after injury. The scores were recorded one-month post injury and twelve months' post injury. The results showed that post injury depression predicted worse outcomes in patients full recovery (Kellezi et al., 2017).

4 Practical part

4.1 Work methodology

I have collected my data for this bachelor thesis during clinical practice which I have attended from 10.1.2022 until 4.2.2022 in Centrum léčby pohybového aparátu (CLPA). Throughout the whole practice I was working and consulting with my supervisor Bc. Tereza Lavingerová.

The content of my thesis is based on elaboration of physiotherapeutical care for patient with diagnose of distortion of ankle joint. Patient was in my care for four weeks, in which I was able to have eight sessions with him. In the first and last session the main focus was reserved for thorough kinesiological examinations. All therapies are 30 minutes long. The approval registration number of ethics committee is 041/2022.

The first session was the only session where my supervisor was present for the whole thirty minutes. She was later present for only one more session where she has shown me how to apply the kinesiotape. She was present in the first session due to the reason for patient being asked if he is willing to be my patient for making this thesis, by which I needed his informed consent and to also introduce him to the goals of therapies. I have submitted the signed informed consent to the ethics committee for them to accept it.

In initial and final kinesiological examination I have used: goniometer, neurological hammer, plumb line, measuring tape, and two scales.

During therapies I have used a lot of equipment luckily CLPA has a very well stocked gym. Equipment used were: foam ball, spike ball, overball, chestnuts, therabands, balane/rocker board, bosu, posturomed, stationary bike, ankle weights 1kg and 2kg, wide rope, and kinesiotape.

In the day to day therapies I have used methods that I was thought in university, but also some that were advised to me by physiotherapist working in CLPA: joint play and mobilization of joints of lower extremity, soft tissue techniques based on Lewit, DNS concept based on Prof. Kolář, Post isometric relaxation (PIR),PIR with stretching and reciprocal inhibition (RI) based on Janda, sensomotoric stimulation, Deep stabilization based on Prof. Kolář and Australian school approach, analytical strengthening, balance exercises on different types of surface, respiratory gymnastics, agistic-eccentric contraction based on Brügger, and proprioceptive neuromuscular facilitation (PNF) based on Kabat.

4.2 Anamnesis

Examined person: M.M, Male

Year of birth**:** 1963

Diagnosis:

- M2147 pes planus
- M2147 st.p distorsionem ATC I.sin

A) Objective :

a) Height (cm): 174cm
b) Weight (kg): 81kg
c) BMI, somatotype: 26,75, Endomorph
d) Blood pressure, Heart rate: 120/80mmHg , 80 beats/min
e) Dominant limb: Right

B) Subjective:

A) Chief complaint:

Problems with stability and balance on both feet. The distortion of the ankle is not so painful any more. During activity the pain is 5 and at rest it is 2 out of a 10-point scale. Range of motion in the ankle joint is limited into all directions particularly into inversion and dorsal FLX, which limits daily activities such as walking or driving as a result of it. The main complaint is motion to dorsal flexion. He also must walk a lot in his job and during longer periods of walking he feels pain in the ankle and knee. The distortion has occurred 5 weeks ago.

B) Personal anamnesis:

Normal child development, before current injury only other injury has been broken Tibia and Fibula on right leg in 1982.

C) family anamnesis:

No genetic transmitted diseases. Mother had a breast carcinoma but was treated. Father died in 2015.

D) Past injury anamnesis (NO):

In 1982 a falling tree has broken Tibia and Fibula on right LE. No operation was provided it has been only put in place and given into a cast for 5 weeks and later had splint for another 3 weeks. No other major injuries or operations has been undertaken, until now. 5 weeks ago patient has suffered left ankle distortion after falling/ stepping down from heavy machinery. Approximately height of 3 meters. The patient himself said that after the injury in 1982 he

started to use his left foot more and even started to put more weight on it. He has never gained back the confidence in his leg. Therefore, the gait stereotype and whole posture has changed and adapted to his new moving habits. He transferred from right dominant extremity to left side dominant. With the present injury being on left LE it's another shock for the body as he is not being able to apply weight on it without being in pain

E) Movement (gait) category of the patient: B.Limited

F) Medication anamnesis: Lecitin, Xyzal (during allergy season) , food supplements such as calcium,magnesium, zinc, and collagen

G) Allergies: Food allergies (nuts, shell fish, and lactose), pollen, penicillin

H) Abuses: None

I) Diet: Doesn't eat certain foods due to his allergies, otherwise normal diet

J) Social Anamneses: Lives with his wife in a two story house. There are 12 steps to second floor

K) Work anamnesis: Working for Zpráva Lesů, has to walk minimum 10km a day

L) Hobbies / sport : Hiking, football, reading, spending time with grandkids

Prior rehabilitation: After the fracture in 1982 he had rehabilitation for a month after he was allowed to put weight on his foot.

Therapy indications :

21 001 = Kinesiological examination

21 113 = Physical therapy II.

21 413 = Soft tissue techniques

21 221 = Individual Kinesiotherapy I.

21 225 = Individual Kinesiotherapy II.

21 003 = Control kinesiological examination

Hydrotherapy 8x

Magnetotherapy 8x

4.3 Initial kinesiological examination

First day of therapy 11.1.2022

4.3.1 Static postural examination

Plumb line test

A) Anterior view

The plumb line passes:

- Slightly to the dexter side of the feet
- Midway between the lower extremities
- Slightly lateral (left) side of umbilicus
- Slight lateral (left) side of sternum
- Middle of the face

B) Posterior view

- Midway between the heels
- Pes planus on both LE
- Midway the lower extremities
- Based on aspection there slight hypertrophy of calf muscles on left LE (is bigger)
- Right intergluteal line is lower than the left
- Passes midway through spine in Lumbar region, slightly sinister in thoracic region, midway through cervical spine
- Dynamics of spine is tilted to right
- Passes through the middle of the skull

C) Left Lateral view

- Passes through the outer lateral malleolus
- Posterior to the axis of the knee joint
- Slightly posterior to the axis of the hip joint
- Pelvis in anterior shift
- Passes through the sacral promontory
- Passes the bodies of lumbar vertebrae
- Through the elbow joint
- Slight posterior through the shoulder joint (shoulder protraction)

- Through the bodies of cervical vertebrae
- Posteriorly through the meatus acusticus externus (head protraction)

D) Right lateral view

- Passes through the outer lateral malleolus
- Slightly posterior to the axis of the knee joint
- Slightly posterior to the axis of the hip joint
- Passes through the sacral promontory
- Passes the bodies of lumbar vertebrae
- Through the elbow joint
- Slightly posterior through the shoulder joint (shoulder protraction)
- Through the bodies of cervical vertebrae
- Posteriorly through the meatus acusticus externus (head protraction)

4.3.2 Segmental evaluation of posture

A) Posterior view

Feet / Heel:

- Feet are turned in neutral position
- correctly aligned Achilles tendon
- Left ankle is visually bigger (oedema)
- Wide base of support
- Varus shape of ankle joints

Calf:

- Left has greater tonus and seems bigger

Knee

- Both knees are turned inwards however the right seems to have greater rotation
- Varus (varosity) shape

Thigh:

- Left thigh seems greater in circumference
- Intergluteal line is placed lower on right

Pelvis and hip:

- SIPS on left is placed higher
- Pelvis is shifted laterally to left side in combination with a tilt to the same side

Trunk:

- Tilted to right

Shoulder and scapula:

- Left shoulder is higher than right
- Left scapula superior angle is placed higher than right

Head and neck:

- Cervical lordosis

B) Anterior view

Feet / Heel:

- Wide base of support
- Neutral rotation
- Ankle varosity

Knee:

- Slight varosity

Thigh:

- Left thigh is clearly bigger and has normal tonus compared to the right which is hypotonus

Pelvis:

- Left SIAS is placed higher than the right as well as the iliac crest
- Anterior tilt and shift is also more visible than from posterior view

Trunk:

- Tilted to right

Shoulders:

- Left shoulder is higher

Neck and head:

- Slightly protracted forward

C) Left lateral view

Feet / Heel:

- After longer period of standing there is clear twitching of tendons (stability problems)

Knees:

- No oedema is present, semi flexion of both knees

Pelvis:

- Anterior tilt

Trunk:

- Due to the anterior tilt the belly is sticking out

Vertebrae:

- Hyper lordosis in lumbar region

Shoulder and scapula:

- Shoulders protracted
- Left scapula is sticking out more than the right

Head and neck:

- Head slightly protracted

D) Right lateral view

Feet / Heel:

- After longer period of standing there is clear twitching of tendons (stability problems)

Knees:

- No oedema is present, semi flexion of both knees

Pelvis:

- Anterior tilt

Trunk:

- Due to the anterior tilt the belly is sticking out

Vertebrae:

- Hyper lordosis in lumbar area
- Cervical lordosis

Shoulder and scapula:

- Shoulders protracted
- Left scapula is sticking out more than the right

Head and neck:

- Head protracted

4.3.3 Gait analysis

A) Anterior view

- Width of the base support = The width is greater than norm
- Position of the feet = Feet are in neutral position

- Axial position of the lower limb = Varosity shape of knee. Ankle has valgosity shape
- Position and movements of the pelvis = Stays the same throughout the whole gait pattern.
- Movement of centre of gravity = Remains constant (doesn't change)
- Position and movement of the trunk = The trunk is slightly tilted to right. This could be due to the fact that he got used to analgetic gait stereotype during his past injury.He doesn't apply as much pressure on the left foot and so he has to compensate for it by leaning towards the contralateral side.
- Position of shoulders = Protracted
- Positions and movements of the head = No extraordinary movement is observed. There is slight protraction
- Movements of upper extremity = Regular and consistent no hyper flexion/extension.

B) Posterior view

- Width of base support = The width is greater than norm
- Position of the feet = Feet in neutral position
- Axial position of the lower limb = Valgus shape of LE is more prominent than from Anterior view (collapsed)
- Movement and position of the knee and hip = Left hip is higher, knee varosity
- Position and movements of the pelvis = Shifted and tilted to left however keeps the position both in loading and swing phase.
- Movement of centre of gravity = Does not bounce lateral or cranio-caudal
- Position and movement of the trunk = Laterally to right side
- Position of spine = No scoliosis, slight hyperlordosis in Lumbar region, rest of the spine has physiological shape
- Activity of back muscles = Symmetrical bilaterally
- Position and movements of the head = No extraordinary movement is observed. There is slight protraction.
- Movements of upper extremity = Regular and consistent no hyper flexion/extension

C) Left lateral view

- Movement of the foot = Loading and swing phase are in norm, the speed of the gait is symmetrical on both LE, the length of the step is greater by the right foot

- Position and movement of the pelvis = Slight anterior tilt
- Position of shoulders = Protracted forward
- Movements of upper extremity = Normal no hyper flexion or extension
- Positions and movements of the head = No extra movement, however head in protraction

D) Right lateral view

- Movement of the foot = During the swing phase circumduction, landing on lateral side of foot loading phase is almost missing, meaning that plantar flexion and flexion of the toes are missing on the right foot. Doesn't propel his body forward through the use of toes.
- Axial position of the lower limb = Flexed and the whole foot is placed behind the left at the beginning of gait examination. The patient can't find balance with feet next to each other
- Position and movement of the pelvis = Slight anterior tilt.
- Position of shoulders = Protracted forward
- Movements of upper extremity = Normal no hyper flexion or extension
- Positions and movements of the head = No extra movement, however head in protraction

Common characteristics:

- Walking rhythm = Rhythm of the steps is symmetrical by both LE during initial, swing, and landing phase
- Walking speed = Slow speed effected by the right foot
- Stride length = Regular stride length, but takes longer step with RLE
- Stability of walking = Feels stable but I believe that is due to the fact that he got used to the gait stereotype.

Type of gait according to Janda:

I believe that it is the mix of distal and peroneal as my patient has some characteristics from both of them. My patient barely flexes the left ankle. I believe there are some parts from the distal gait pattern as my patient doesn't provide dorsal flexion and therefore during landing phase he lands his foot on the sole / toes and on medial side of the foot, instead of correct gait which is that heel touches first and then lateral side of the foot. Which is the result of plantar flexion but also an excessive lateral ankle rotation. That is why I believe that there is the mix of distal and peroneal pattern.

Gait modifications

- Walking on a narrow basis = Non possible
- Walking on soft surfaces = Possible, feels slight discomfort in left ankle during inversion of ankle
- Walking with eyes closed = Possible, the walking speed is much slower and patient deviates to the right
- Walk backwards = Possible, very unsure and the left ankle is in pain
- Walk with up-stretched arms = Possible but little unstable, walking speed is slower and stride length is shorter
- Walk on tiptoes = Possible, painful due to strength and limited ROM
- Walking on heels = Possible, but even more painful than on tiptoes
- Walking in squatting = Not possible the patient loses balance

Standing modification:

A) Standing on tiptoes = Possible to get on tiptoes, but loses balance in few seconds
B) Standing on heels = Possible, painful, loses balance in few seconds

Base of support : Unstable, wide base of support, single leg stance is unstable on both LE (it is not possible to hold for even 2s)

Locomotion: Walking on toes is possible,walkng on heels is possible but painful due to limited ROM of ankle, limping as more weight is transferred to right LE.

4.3.4 Spinal distances examination

- Shober's distance (5cm) = 3cm
- Stibor distance (7-10cm) = 7cm
- Otto's inclination index (3-4cm) = 3cm
- Otto's reclination index (2-3cm) = 2,5cm
- Cepojev's distance (2,5-3cm) = 3cm
- Forestier Fleche (0cm) = 1cm
- Cervical spine flexion (0cm) = 0cm
- Thomayer's test (0cm) = 18cm

- Latero flexion distance (20-25cm) =
  - Left : 22cm
  - Right : 23cm

4.3.5 Assessment of stereotype pattern of breathing

A) Sitting position:

Breathing type: Upper thoracic

B) Standing position:

Breathing type: Upper thoracic

C) Supine position:

Breathing type: Lower thoracic

D) Prone position:

Breathing type: Lower thoracic

E) Breathing rate: 1:2

4.3.6 Specific testing of posture

A) Two-scales standing:

Left leg: 45kg

Right leg: 36kg

Conclusion: On his left foot he weighted more by 9kg

B) Romberg test (I-III):

I) Positive = Patient has presented slight latero lateral shifting

II) positive = Patient has presented slight latero lateral shifting

III) positive = Latero lateral but also antero posterior shifting, tendons are ankle joint are twitching on both LE

C) Single-leg stance test:

A) OPENED EYES (lifted):

LLE: Not balanced

RLE: Not balanced

B) CLOSED EYES (lifted):

LLE: Not balanced

RLE: Not balanced

D) Trendelenburg test:

1.) Left leg in 90 flexion = Shaking, not being able to hold the position for more than 2 seconds and very painful. The test is not relevant due to the very short period of having the leg raised.

2.) Right leg in 90 flexion = Shaking, not being able to hold the position for more than 5 seconds. The test is not relevant due to the very short period of having the leg raised.

I can't say whether the pelvis drop occurred or not due to the very short time that patient was able to keep in that position.

E) Véle test = 2 on LLE, 1 on RLE

F) Anterior drawer test = Unable to do the test due to oedema

Talar tilt test = Unable to do the test due to oedema

G) Cranial nerve testing: Without pathologies

Anthropometric measurements of initial examination

Height	Length in cm - Left Extremity	Length in cm - Right Extremity	Length in cm
In standing	X	X	174
Anatomical length	82	82	X
Functional length	83	83	X
Circumference of the thigh 10cm above	45	43	X
Circumference of the knee joint	37	37	X
Circumferences of the tuberositas tibiae	31.5	31.5	X
Circumference of the calf	39	38	X
Circumference of the ankle joint	26	24	X
Circumference of the heel	32,5	32	X
Circumference of the foot	29	28	X

Table 1 - Anthropometric measurements

Muscle length test of initial examination based on Janda and Kendall

Part of body tested	Method according to	Muscles tested	Grade
Ankle plantar flexors	Janda	m. Triceps surae (m. Gastrocnemius, m. soleus)	RE - 1 LE – 2
Hip flexors muscles	Janda	One joint muscles (m. iliacus, m. pectineus, m. Adductors longus, m. brevis) Two-joint muscles (m. psoas major, m. Rectus femoris, m. Tensor fasciae latae, m. sartorius)	RE - 1 LE – 1
Hip adductor muscles	Janda	m. pectineus, m. Adductor brevis, m. Adductor longus, m. semitendinosus, m. semimembranosus, m. gracilis, m. biceps femoris)	RE - 1 LE- 1
Hamstring muscles	Janda	m. Biceps femoris, m. semimembranosus, m. Semitendinosus	RE -2 LE - 2
Posterior muscles	Kendall	Posterior muscles	Unable to touch toes
Paravertebral muscles	Janda	Paravertebral muscles	2
m. Quadratus lumborum	Janda	m. Quadratus lumborum	R - 1 L – 1
m. Piriformis	Janda	m. Piriformis	RE - 1 LE – 1

Table 2 - Muscle length test

Goniometry measurements of initial examination

Part of body tested	Motion	Right / Left	Active	Passive
Knee	Extension / Flexion	Right	S: 0-0-140	S: 0-0-145
		Left	S: 0-0-140	S: 0-0-145
Ankle	Extension (DO) /(PL) Flexion	Right	S: 25-0-50	S: 30-0-50
		Left	S: 10-0-30	S: 15-0-35
	Eversion / Inversion	Right	R: 20-0- 35	R: 25-0-40
		Left	R: 15 -0-20	R: 15 -0- 35
Toes	Extension / Flexion	Right MTP I	S: 50-0-30	S: 55-0-35
		Left	S: 50-0-30	S: 55-0-35
	ABD / ADD	Right MTP I	F: 20-0-20	F: 20-0-20
		Left MTP I	F: 20-0-20	F: 25-0-25
	(Hallux Valgus – valgosity)	Right	No Hallux	
		Left	No Hallux	

Table 3 – Measurement of range of motion (ROM)

Hypermobility testing of initial examination

Segment	**Direction of examination**	**Test according to**	**Results LLE and RLE**
Knee joint	EXT	Sachse	A
Knee joint	FLX	Janda	A
Hip joint	Rotation	Sachse	A

Table 4 - Hypermobility examination

Strength test of hip joint muscles by Janda in initial examination

LOWER EXTREMITY	GRADE - JANDA; BILATERALLY
Gluteus maximus	L: 4 R: 3
Iliopsoas	L: 4 R: 4
Sartorius	L: 4 R: 4
Tensor fasciae latae	L: 4 R: 4
Quadriceps femoris	L: 5 R: 4
Hip flexors	L: 5 R: 4
Hip adductores	L: 4 R: 4
Gluteus minimus	L: 4 R: 4
Gluteus medius	L: 4 R: 4
Lateral hip rotatores	L: 5 R: 4
Medial hip rotatores	L: 5 R: 4

Table 5 - Muscle strength test hip joint muscles

Strength test of hamstring and m.Triceps Surae by Janda in initial examination

LOWER EXTREMITY	GRADE - JANDA; BILATERALLY
Medial hamstrings	L: 5 R: 4
Lateral hamstrings	L: 5 R: 4
Popliteus	L: 4 R: 4
m. Gastrocnemius	L: 3 R: 4
Soleus	L: 3 R: 4
Ankle plantar flexor	L: 3 R: 4

Table 6 - Muscle strength test (hamstring + m.Triceps Surae)

Strength test of foot and ankle muscles by Janda in initial examination

LOWER EXTREMITY	Grade - Janda; bilaterally
Peroneus longus	L: 4 R: 4
Peroneus brevis	L: 4 R: 4
Tibialis posterior	L: 4 R: 4
Tibialis anterior	L: 3 R: 4
Extensor hallucis longus, brevis	L: 5 R: 5
Extensor digitorum longus, brevis	L: 5 R: 5
Peroneus tertius	L: 5 R: 5
Flexor hallucis longus	L: 5 R: 5
Flexor hallucis brevis	L: 5 R: 5
Flexor digitorum longus + quadratus plamtae	L: 5 R: 5
Flexor digitorum brevis	L: 5 R: 5
Planatar interossei	L: 5 R: 5
Dorasal interossei	L: 5 R: 5
Lumbricales	L: 5 R: 5
Abductor hallucis	L: 5 R: 5
Adductor hallucis	L: 5 R: 5

Table 7 - muscle strength test by Janda (foot + ankle)

Muscle tone palpation in initial examination

Muscle	Tonus
Iliacus	L: Hypertonic R: Hypertonic
Piriformis	L: Normal R: Hypertonic
Semimembranosus	L: Normal R: Normal
Semitendinosus	L: Normal R: Normal
Soleus	L: Hypertonic R: Hypertonic
Gastrocnemius	L: Hypertonic R: Hypertonic
Rectus femoris	L: Hypertonic R: Hypertonic
Tensor fascia latae	L: Normal R: Normal
Sartorius	L: hypertonic R: normal
Adductor longus	L: Normal R: Normal
Adductor brevis	L: Normal R: Normal
Adductor Magnus	L: Normal R: Normal / hypotonic
Biceps femoris	L: Hypertonic R: normal

Table 8 - Muscle tone palpation

4.3.7 Examination of reflex changes on lower extremity by Lewit

Skin: Increased sweating in area of left ankle, skin may be stretched

Sub skin: Physiological

Fascia: Possible to stretch fascia on hamstring in all directions, fascia on Quadriceps is limited bilaterally, in area of left ankle and calf fascia is limited with reflex changes, mostly in rotational direction

Muscles: Hypertonus m.Soleus, m. Illiacus, m.Gastrocnemius, and m. Rectus Femoris on both LE

4.3.8 Deep stabilization examination based on Prof. Kolář

In testing the intra abdominal pressure (IAP) test a disturbance was observed as the pressure created by the patient against my manual contact was weak and additionally umbilicus has moved cranially. Which is a sign of possible weakness of m. Transversus abdominis and diaphragm. These two muscles are part of the four main deep stabilization muscles the other two are m. Multifidus and pelvic floor.

5 Conclusion of Initial kinesiological examination

My patient base of support is wider than a norm which is a sign of stability problems. The position of the pelvis which has anterior tilt and shift to left side with rotation + (clockwise) has great effect on posture which from the pelvis is tilted to the right. The trunk is trying to compensate for the pelvic position and so is tilted to the right side. The protraction of shoulders is present as well with left shoulder being placed slightly higher. My patient pelvis tilt and shift has effect on rest of the body as it tries to balance out and adapt to the situation. Patient muscles of the left extremity are more developed. Reasoning for this is the injury suffered in 1982 to the right LE, as since then more pressure has placed on the LLE during the whole day.

Patient spinal distances showed that lumbar spine ROM is limited and head is protracted. Patients breathing pattern is mostly to thoracic area which has an effect on the deep stabilization system which is weaken. Patients balance is impaired on both LE, the only difference is that on LLE the injury is acute and so painful, meanwhile on RLE the injury is chronic, and therefore it should be better. Muscles responsible for the balance are very weak which was proven by the muscle strength tests, mainly the muscles of ankle joint. Surprising is that LLE is stronger than RLE even with the present injury. The anthropometric lengths are the same, difference is in the circumference of the muscles of LE in which on his left is greater. The LLE has greater shortness than the right in ankle plantar flexors, however the acute injury has an effect on it rather than actual shortness of the muscle. All my goniometry results were as I suspected them to be. All segments were of the average or below average based on Janda scale, only hard end feel was on left ankle. Patients muscle on left LE are mainly the ones that are in hypertone, which is not surprising as increased tonus is body protection reaction similarly to production of oedema which is present on left ankle.

What to focus on:

It is important to work on balance, stability, proprioception, sensomotorics, and strengthening with incorporated gait training in order to have successful therapeutic unit. I believe that by using these methods we will not only improve ROM, but also overall quality of life.

The goals of Short-term rehabilitation:

- Reduction of oedema around left ankle
- Pain reduction
- Relaxation of hypertonic soft tissue in both LE
- Stretching of shortened muscle groups on both LE
- Strengthening of weak muscle groups on both LE
- Improving the stability and ROM of left ankle joint
- Sensomotoric activation for improvement of both pes planus and overall stability
- Changing breathing pattern
- Improving gait stereotype
- Education of patient about self therapy exercises

The Short-term rehabilitation plan and techniques:

- Individual physiotherapy , 2x a week, focusing on balance, resistance, centration training, soft techniques, Sensomotoric activation, and oedema reduction
- Soft foam ball rolling of left ankle joint for reduction of the oedema
- From physical therapy there will be use of:
    a) Magnetotherapy 2x a week
    b) Hydrotherapy 2x a week
- Increase ROM in left ankle joint by active exercises and passive mobilizations with stretching of shortened muscles
- PIR and PIR with stretching to relax and stretch muscles
- Increase the muscle strength with the use of gym aids (overball, thera-band, posturomed, rocker boards, rope, bosu)
- Sensomotoric activation on the sole of both LE based on Janda (small foot)
- Kinesiotaping of left ankle joint for stabilization and pain reduction

The Long-term rehabilitation plan:

The long term plan is to continue with the rehabilitation that is stated for short term plan. The goal is to improve the balance distribution of both LE.

- Change the gait stereotype
- Improve trunk stability
- Improvement / correction of patients ADL and social life
- Dynamic exercises containing fast change of directions to improve function and stability of left ankle joint
- Improving the function of transverse and longitudinal axis of the feet on both LE

6 Day to day therapy

6.1 First session

Date: 11.1.2022

Stp. subj.: Pain around sinister ankle in area of lateral malleolus

Stp. obj.: Limping while walking with trunk lateral flexion to right

Goal of today's therapy unit:

Find out all the necessary information about the patient and patients history, in order to be able to propose therapies that will be beneficial for the patient health condition.

Proposed therapy:

- Collecting information about patient anamnesis
- Special examination for initial kinesiological examination
- Introduce the goals of rehabilitation to the patient

Procedure:

Initial kinesiological examination, Anamnesis of the patient, explaining what will be the therapy plan for next 4 weeks, Discussing the main issues and the goal he has at the end of the 4 week therapy plan, doing all the measurments (antropometry, muscle length,strength, ROM).

Possible mistakes: No possible mistakes

Self-therapy:

Patient was asked to prepare sport clothing and to buy kinesio tape for his next therapeutical session.

Results (of today's therapy unit) – obj.:

Plan has been made, dates have been scheduled, and patient agreed on being my patient for Bachelor thesis.

Results (of today's therapy unit) – subj.:

On asking the patient he said that he is looking forward to being my model, but further more is looking forward to finally deal with his problem on both LE.

6.2 Second session

Date: 13.1.2022

Stp. subj.:

Slight pain in ankle, when he steps on it with full weight.

Stp. obj.

Patient is limping and walking slow.

Goal of today's therapy unit:

Introduce patient to basic stability and strengthening exercises that he may even do at home. For me it was also important to find out information how the patients situation is, in order to make a plan of beneficial exercises. As I have to make exercises for future sessions that fit the patient (not too hard but not too easy). Further more check up the oedema of left ankle to determine if the patient will be able to provide the exercises

Proposed therapy (for today's unit):

- Foam ball rolling for treatment of oedema on left ankle
- Improve proprioception of the sole on both LE
- Posturomed exercises for improvement of stability and strength of LE and deep stabilization muscle
- Bosu exercises for strengthening of LE
- Balance board exercise to improve balance and stability
- Analytical strengthening of ankle flexors with use of therapeutical aids

Procedure :

- Foam ball rolling of the left ankle joint in order to reduce the oedema around the joint
- Sensomotoric activation of LE with rolling sole of the feet on a spike ball
- Starting with activation of sensomotorics and proprioception by exercises on posturomed.
- 1st exercise = Affected LE steps on posturomed. The knee is semi-flexed (not locked but also not over flexion). Second LE is placed on ground extended in hip and knee joint, with ankle in plantar flexion so that the heel is not touching the ground. Both feet are directed straight infront of the body. Back straight and head looking forward. The motion is to make posturomed move front and back, and then stop it by contracting the muscles of affected LE, so that the posturomed stops moving. During the movement patient is forced to stabilize the

body, however it also works on strength of abductors and adductors as the patient must keep the knee straight so that it doesn't fall to sides.

- 2nd exercise = Same as the first except this time the motion is latero-lateral instead of front and back.
- 3rd exercise = Dynamic step on bosu. Patient must land in middle of Bosu and stabilize the position. Position of the feet is same as in exercise 1 and 2. I tis great for dynamic stabilization as the ankle must react quickly and so do the core muscles. Further more all the collateral ligaments of the ankle joint must react as well by which we strengthen it.
- 4th exercise = Balance board exercises. We use a circular board with hemi circle bottom which means that the board is moving into all directions. We place both feet on the board and we transfer weight from tip toes → heels , and left to right side. This exercises works both the balance and is also working with stretching of the ankle joint soft tissue, making it less stiff and so improving ROM. The patient starts the exercise with holding a rail and once he feels confident he lets go off the rail.
- 5th exercise = Dorsal flexion with inversion against resistance. Theraband is tied up on a rail and other end is given around the patient dorsum of the foot. Patient is in supine with legs extended. Lying on a soft mat with support on elbows. He is asked to bring toes towards him and turn the feet towards his big toe. 10 repetitions of 3 sets. Switching legs between sets. The main muscle that we are targeting is the Tibialis anterior. The key point is to keep the legs extended all time and not flexing in knee or hip joint.
- 6th exercise = Plantar flexion against resistance. Overball is placed against the wall. Patient is sitting on a soft mat supporting himself with palms behind him. Patient is instructed to put his sole on the overball and asked to press against it. He is instructed to keep legs extended on the ground and to only use the motion of ankle joint to provide the power. 10 repetitions of 3 sets on each leg.

<u>Possible mistakes:</u>

- As I'm present throughout the therapy I correct the patient and instruct him immediately if I see a mistake. However, mistakes in exercises 1-4, are: knee movement sideways, not straight back (bended forward), and also falling off the bosu. In exercises 5 and 6 the possible mistakes are: not enough resistance in the theraband which means that strengthening will not be as effective, and using hip / knee joint muscles to pull the theraband taking away the effect of working the ankle flexors.

Self therapy:

- Buy kinesiotape
- Try one leg stance on ground exercise, in which patient will stand in front of a wall or something that is stable in case of needing to grab it and prevent from falling. Patient will slowly raise one lower extremity in front of himself trying to keep balance. Ideal is to reach 90 degrees flexion in hip joint and knee joint, but it is not necessary. Once the patient reaches the maximal position in which he is able to keep the position he counts to 10 and then put leg back down. Switch the legs and repeat the same steps. 4x each leg three to five times a day.

Result (of today's therapy unit) – obj.:

The result of exercises told me that the stability is impaired even during the everyday activities, so we have to work on that. The strength of plantar flexors is sufficient in providing functions of everyday activities, but the dorsal flexors are not. I must work on it with the patient so that ADL activities will be provided pain free and without limitations after the 4 weeks of therapy.

Result (of today's therapy unit) – sub.:

Patient was surprised of how much the stability is impaired. He is motivated to improve it and even told me that he will build his own balance board.

6.3 Third session

Date: 18.1.2022

Stp. subj.: The patient has built his own balance board and claims that he has been practicing on it. The pain is better but feels unstable when walking.

Stp. obj.: The patient has come in a good mood. The limping is still present but not in such a great extent as last week. The posture however is still tilted to the right side but it makes sense as he claims to feel unstable.

Goal of today's therapy unit:

- Check patient ability of providing self therapy exercises
- Work on balance and stability
- Strengthen m.Triceps Surae
- Decrease pain / improve ankle stability by applying the tape

Proposed therapy (for today's unit):

- Posturomed exercises for improvement of stability and strength of LE and deep stabilization

muscle

- Evaluation and correction of autotherapy exercises
- PIR with stretching m. Triceps Surae both side and m. Biceps Femoris sin
- m.Triceps surae strengthening.
- Apply kinesio tape to left ankle joint for pain reduction and improvement of stability

Procedure:

- Repeat exercises from posturomed from last week
- Added an exercise on posturomed in which he steps on it with one leg, then the other leg slowly lifts from the ground and is brought into 90 degree hip and knee flexion. In that position he must stabilize the posture, once he achieves that the board stops moving. After that he puts the leg that has been raised back on the ground and step off.
- I have checked the exercises on balance board that he is training at home. On the board we were transferring the weight from front to back , and from left to right. We also have tried to combine all the movements and make a circle but it was too much and he lost balance.
- Strengthening exercise for Triceps Surae, which were simple lifting of heels to tiptoes. 10 repetitions of 3 sets. This exercise is provided in standing position and holding a rail. The key to this exercise is to have a slow eccentric phase so that the muscle is under tension for longer time.
- PIR with stretching m. Triceps Surae both side and m. Biceps Femoris sin.
- A kinesio tape was applied to stabilize the ankle and reduce pain. It was made from three stripes of tape. 1st was applied from lateral malleolus → underneath the calcaneous → towards medial malleolus. 2nd stripe from metacarpophalangeal joint towards calaneous → around and underneath calcaneous → towards lateral malleolus. 3rd stripe from fifth metatarsal towards calcaneous → around and underneath calcaneous → from dorsal side to medial malleolus.

Possible mistakes:

- Wrong posture / pelvic tilt on posturomed
- In the “ankle pumps” calcenous valgosity or varosity
- During applying kinesio tape not asking patient to dorsiflex before applying or making wrinkles on the tape

Self therapy:

- Exercise on homemade balance board (latero,lateral directions)
- Training of walking on different surfaces (soft and hard)
- Ankle “pumps” in front of a mirror (raising heels off the ground on toes)

Result (of today's therapy unit) – Obj.:

- The exercises on posturomed were beneficial as I can see improvement in the stability and so we can do more demanding exercises next time. With slight corrections on the balance board the patient has been able to provide them with proper technique and so he may continue with them at home.

Result (of today's therapy unit) – Sub.:

- His legs and core muscles felt little bit sore as it was pretty energy demanding session. He sees improvement and so is happy how things are going. Very grateful for the kinesio tape and has told me that he will let me know on Thursday if he felt any relief of pain or difference.

6.4 Fourth session

Date: 20.1.2022

Stp. subj.: Patient is claiming to have less overall pain and doesn't feel limitation in his daily life. He also says that he definitely felt more stable while walking with the kinesiotape.

Stp. obj.: Patient is in good mood, he is clearly putting more weight on the leg as his COG during gait is not moving as much in latero lateral directions during gait

Goal of today's therapy unit:

- Check up the oedema and pain if it is getting better or worse
- Improve the transverse and longitudinal arch of the sole
- Increase stability while standing on one LE
- Improve strength of the muscles and ligaments around the ankle joint
- Coordination of activation of deep stability muscles with posture

Proposed therapy (for today's unit):

- Foam ball rolling of left ankle joint
- Sensomotoric improvement of both feet
- Strength and balance improvement of LE by one leg stance
- Stretching of shortened muscles with use of active movements
- Active movements of muscles of the soles

Procedure :

- Foam ball rolling around the left ankle joint, in order to speed up the oedema absorption
- Begin with proprioception and sensomotoric activation by rolling the soles on spike ball and small pebbles.
- 1st exercise = One leg stance on soft pad surface. In this exercise the patient must step on a

soft pad and raise the other lower extremity above the floor. This forces him to activate the stabilization muscles all the way from ankle to core muscles. The patient must stabilize it for 10s and afterwards relax. This is repeated five times and afterwards changes the legs.

- 2nd exercise = Walking over balance boards. There are six different balance boards of three types of leverage. The first leverage is circular meaning that the board moves in all directions. Second type leverage or pivot point is structured for forward and backward motion. Third type leverage or pivot point allows only sideways motion. The boards are placed in single line but the patient doesn't know the alignment of the boards so he must anticipate all the possible movements. Patient must step on the board with one leg and step on next board with the other leg. Keeping the back straight. He is also instructed to make sure to step with heel first.
- 3rd exercise = Walking on a rope. Rope is placed on a ground and patient must walk on it (one leg in front of the other). Working on balance but also strength.
- 4th exercise = Dorsal flexion + inversion against resistance. Patient is lying supine or lying on back with support on the elbows. Legs are extended and stay extended throughout the exercise. Theraband is fixed on a ladder or some other fixed point and the other end of the theraband is placed around patient metatarsals. The patient is asked to take up the slack or in other words to create a resistance in the band. Then to bring the toes towards him and turn the feet toward the thumb. It is important so that the knee is fully extended throughout the motion and the motion is coming from the ankle joint and not the whole leg. 10 repetitions 3 sets. At the last repetition of every set the patient holds the contracted position for 5 seconds. We are strengthening the dorsal flexor group and the supinators.
- 5th exercise = Pressing down on overball. Place a semi inflated overball on a ground against a wall. The patient sits on the ground with fully extended legs and one feet is placed against the overball. Patient is asked to press against the overball in downward direction. Here we are strengthening the ankle plantar flexors. 10 repetitions, 3 sets. At the last repetition of every set the patient holds the contracted position for 5 seconds. It is important to keep the knee on the ground which inhibits the other muscle groups from participating. Another important factor is also that the pressure is being forced only through ankle joint, by that I mean that no hip elevation shall be present.
- 6^{th} exercise = Patient is suffering from pes planus and so we decided to work on improving the arch of the foot, as that will help to improve the proprioception function which goes in hand with stability. The exercise was that he had to pick up chestnuts with his toes and transfer them to opposite side. It is provided by keeping heel on the ground, flexing the toes (grabbing the chestnuts) by which the longitudinal and transverse arch activates, lift the toes

and provide inversion in the ankle to drop the chestnuts on other side. Six chestnuts were used and he repeated the exercise four times.

Possible mistakes:

- Wrong posture / pelvic tilt on posturomed and soft pad
- Over exhaustion of the soft tissue around injury leading to inflammation

Self therapy:

- Exercises from DNS were shown to the patient under supervision of the supervisor. We chose this type of exercise in order to activate and strengthen the abdominal muscles. The 3 month old position in supine with legs and arms elevated. Hold position for 30 seconds and relax for 10 seconds repeat 5x at least 3x a day.
- Small foot training for improving the arch of the foot in sitting position

Result (of today's therapy unit) – obj.:

Patient is capable of providing harder and more demanding exercises, which is signaling me that his injury and health state is improving, Incorporating exercises for flat feet will be necessary as with collapsed arch we could reach only certain level of balance.

Result (of today's therapy unit) – sub.:

Without pain in the ankle. Feels improvements in the exercises which is motivating him to continue even at home. Feels a little pain in plantar aspect of the foot from the chestnut exercises.

6.5 Fifth session

Date: 25.1.2022

Stp. subj.: Patient had a brick of wood that has fallen on dorsum of the foot on Monday when he was at work. So he feels pain, furthermore it was the same leg as the injury of the ankle. Luckily no oedema is present only a bruise on the dorsum of the foot.

Stp. obj.: Walking slowly and clearly in pain based on his gait and facial expressions. I gave him a choice to not have a therapy session but he refused and so we agreed that no exercises will be planned for today but I will only provide soft tissue technique and MET. We also agreed on working on the breathing.

Goal of today's therapy unit:

- Check the improvements of ROM. Work on improving the ROM in limited directions
- Relax hypertonus muscles
- Improve the efficiency and stereotype of breathing

- Strengthen the weaker muscles of LE
- Improve old scar elasticity

Proposed therapy (for today's unit):

- Active / passive movements of LE muscle groups
- PIR for hypertonus muscles
- PIR with stretching on shortened muscles
- Soft tissue technique on left ankle joint and the scar from injury that occurred in 1982 which is on anterior part of right tibia. The scar begins five centimeters below knee joint and goes down ten centimeters.
- Respiratory gymnastics

Procedure:

- Active / passive movements of LE muscle groups. It is provided on therapeutical bed. The hip flexors, abductors, adductors, and knee flexors are tested in supine position so are the ankle plantar and dorsal flexors. Knee and hip extensors are tested in prone position. I don't only watch for ROM but I also ask the patient if any pain is present during the motion. For therapy repetitive passive motions to the barrier are provided with proper fixation. Minimum of ten repetitions and at the end of last repetition I wait ten seconds in maximal position of stretched fibers.
- PIR of knee flexors and extensors ankle plantar flexor muscle groups
- Sensomotoric activation by foam ball rolling the sole of the feet
- Checking and working on the scar from injury that occurred in 1982. The scar was stretched in "S" and "C" shape. Method used was reach the barrier → hold in the barrier → wait for the barrier to loosen up, and relax and move to other stiff part of the joint.
- Respiratory gymnastics using foam ball rolling in between costal spaces. Learning the breathing wave, which occurs in supine position with bent knees. We ask the patient to first inhale into abdomen then lower thoracic → upper thoracic and lastly to chest. Exhalation occurs in opposite direction.
- Teaching the patient to breath into abdomen. He is in the same position as for the breathing wave. He places his finger 5cm medially of his anterior superior iliac spine (ASIS) and during inhalation he tries to push the fingers up and lateral. Repeat 10x in a row then relax for 20s and repeat 2x more.
- Strengthening of Hamstring, Quadriceps, and gluteus (minimus,medius, and maximus) by analytical strengthening by Janda. Which has the same starting position as for testing the

muscle strength. 8-10x repetitions with 2 sets. All of the above strengthening is provided on therapeutical bed.

Possible mistakes:

- Wrong manual contact
- Wrong breathing pattern and uncoordinated muscle contraction synkinesis

Self therapy:

- Breathing exercises in supine position (breathing into belly)
- 3-month old baby position in supine from DNS to strengthen the core muscles
- Abduction of LE in side lying position to strengthen the hip abductors. Each leg 10-15 repetitions with 3 sets, 2-3x a day

Result (of today's therapy unit) – obj.:

- The old scar was very stiff and after the therapy I was able to release it a bit
- Hypertonic m. Triceps Surae was released and active ROM has improved
- The ROM in the ankle has improved 5-10^0 from our first therapy session
- The strength of the muscles of the left ankle has improved and is in greater balance with the right LE

Result (of today's therapy unit) – sub.:

- Didn't feel pain during the therapy on dorsum of the foot
- He claims to feel the improvement in strength of left ankle, and that it is almost as strong as the right LE
- Disappointed in himself that he has made a new injury as he couldn't do the exercises in gym today
- Looking forward to new therapy session and hoping that he will be able to do the exercises next time

6.6 Sixth session

Date: 27.1.2022

Stp. subj.: The injury he suffered last week is no longer painful and wants to repeat the exercises from previous weeks. The ankle stability feels better.

Stp. obj.: Patient is limping less and there is significant difference in walking as I can see better toe off and swing phase of the gait. The posture his also not so tilted.

Goal of today's therapy unit:

- Check up the oedema if it didn't get larger after the accident

- Improve ankle stability and mobility
- Improve coordination of movement between legs → arms , and legs→ posture
- Increase strength of m.Triceps Surae, m. Tibialis anterior, m.Biceps femoris, m.Semitendinosus, m.Semimembranosus, and m. Gluteus Maximus.
- Improve the arch of the foot

Proposed therapy (for today's unit):

- Manual methods of testing muscle length and joint ROM
- Strengthening the LE with the use of gym aids
- Sensomotorics activation, using uneven surfaces, foam ball, and bosu
- Stability and balance training on rocker board and bosu
- Kinesiotaping of the ankle

Procedure:

- Before starting exercises I have checked active and passive motions of ankle joint on a therapeutical bed. I have done that to check if there are improvements mainly by comparing the left and right lower extremity.
- 1st exercise = Sensomotorics activation and strengthening on a posturomed. Patient was told to place both legs on the posturomed. The knees are slightly flexed with arms alongside the body, back straight and looking forward. The patient is then instructed to raise one leg into 90 degrees' flexion in knee and hip joint. He is told to keep the body position throughout the motion: keeping knee position so that it doesn't turn inwards or outwards, trying to keep the back straight, and keep looking forward. The goal of this exercise is to stabilize the position so that the board moves as little as possible. He holds the position for 10 seconds and put the leg back down. Repeat five times and change the legs. In total of 3 sets.
- 2nd exercise = Walking over balance boards. We have done this exercise before and the patient was able to provide it with ease. So we added a component to make it more challenging. The component was a overball. I have given a overball to patient and instructed him to : Step on one balance board → raise the other leg as if he would do without the overball, but before he steps on next balance board he must pass the overball behind his back and under the leg. This forces the patient to stabilize for longer period of time making it harder plus the moving of the arm throws the balance off a little more as he is not able to stabilize with arms.
- 3rd exercise = Bosu training. We have turned the bosu upside down. The patient steps on it with both legs on the edges of the bosu. Toes are aiming forward, knees are flexed a little bit

and aiming forward. He is instructed to hold the rail and shift the weight forward and backwards, then latero-lateral. Very similar to balance board exercise that we have done in past, but it is harder to control the bosu then the balance board. When he feels stable let go off the rail.

- 4th exercise = Half squats on bosu. Patient has the same starting position as in previous exercise. He holds a rail that is a front of him and is instructed to do a half squat, by flexing the knees and hips, the gluteus move as if he was going to sit on a chair. By this we are not only strengthening the hamstrings and Gluteus maximus, but due to the fact that it is on unstable surface it is much more demanding on stabilization so that he doesn't fall. We did 8 repetitions of 3 sets.
- 5th exercise = Dorsal flexion + inversion against resistance. Patient is lying supine or lying on back with support on the elbows. Legs are extended and stay extended throughout the exercise. Theraband is fixed on a ladder or some other fixed point and the other end of the theraband is placed around patient metatarsals. The patient is asked to take up the slack or in other words to create a resistance in the band. Then to bring the toes towards him and turn the feet toward the thumb. It is important so that the knee is fully extended throughout the motion and the motion is coming from the ankle joint and not the whole leg. 10 repetitions 3 sets. At the last repetition of every set the patient holds the contracted position for 5 seconds. We are strengthening the dorsal flexor group and the supinators.
- 6th exercise = Pressing down on overball. Place a semi inflated overball on a ground against a wall. The patient sits on the ground with fully extended legs and one feet is placed against the overball. Patient is asked to press against the overball in downward direction. Here we are strengthening the ankle plantar flexors. 10 repetition , 3 sets. At the last repetition of every set the patient holds the contracted position for 5 seconds. It is important to keep the knee on the ground which inhibits the other muscle groups from participating. Another important factor is also that the pressure is being forced only through ankle joint, by that I mean that no hip elevation shall be present.
- 7th exercise = Patient is suffering from pes planus and so we decided to work on improving the arch of the foot, as that will help to improve the proprioception function which goes in hand with stability. The exercise was that he had to pick up chestnuts with his toes and transfer them to opposite side. It is provided by keeping heel on the ground, flexing the toes (grabbing the chestnuts) by which the longitudinal and transverse arch activates, lift the toes and provide inversion in the ankle to drop the chestnuts on other side. Six chestnuts were used

and he repeated the exercise four times.

- We applied kinesiotape the same way as previously.

Possible mistakes:

- Exercises being too hard which may cause inflammation and that is why I keep asking him if he feels too great of a pain.
- Bending knees during the dorsal and plantar flexors strengthening exercises
- Knees dropping in (valgosity) during the squats on bosu.

Self therapy:

- Hamstring and quadriceps stretching in supine position
- Training of the foot arch with the chestnuts

Result (of today's therapy unit) – obj.:

I see great improvements in ROM of left ankle joint. The stability and strength of the joint from the first time we exercised improved as well as the patient is able to do the exercises with greater ease and less pain. We are creating new harder exercises as the exercises we have done previously were now easy.

Result (of today's therapy unit) – sub.:

Feels tired but happy. He himself sees and feels improvements. He really enjoyed the squats as he felt his whole body working.

6.7 Seventh session

Date: 1.2.2022

Stp. subj.: Patient is happy with the progress and even claims that he no longer feels pain in his ankle while wearing his hard working shoe. He also definitely felt more stable while walking with the kinesiotape

Stp. obj.: Patient is in good mood so far as always during our therapy sessions, he is now putting more weight on his left leg as his COG during gait is not moving as much in latero lateral directions during gait. His posture also shifted to left (more centered than before as he used to be tilted to right)

Goal of today's therapy unit:

- Improve the transverse and longitudinal arch of the sole
- Increase stability while standing on one LE
- Improve strength of the muscles and ligaments around the ankle joint
- Coordination of activation of deep stability muscles with posture

- Improve arms – legs coordination
- Improve the posture tilt
- Make sure that patient knows the proper technique of exercises that he may do at home

Proposed therapy (for today's unit):

- Proprioception / sensomotoric training = smallfoot, chestnut picking, unstable surfaces training
- Strengthening of the deep stabilization system and muscles of LE = with help of a supervisor correcting exercise from DNS and all four position from Prof. Kolář deep stabilization tests
- Working on improving the stability of the ankle joint
- Small foot exercises

Procedure :

- Begin with proprioception and sensomotoric activation by rolling the soles on spike ball and small pebbles.
- 1st exercise = One leg stance on soft pad surface. In this exercise the patient must step on a soft pad and raise the other lower extremity above the floor. This forces him to activate the stabilization muscles all the way from ankle to core muscles. The patient must stabilize it for 10s and afterwards relax. This is repeated five times and afterwards changes the legs.
- 2nd exercise = Sensomotorics activation and strengthening on a posturomed. Patient was told to place both legs on the posturomed. The knees are slightly flexed with arms alongside the body, back straight and looking forward. The patient is then instructed to raise one leg into 90 degrees' flexion in knee and hip joint. He is told to keep the body position throughout the motion: keeping knee position so that it doesn't turn inwards or outwards, trying to keep the back straight, and keep looking forward. The goal of this exercise is to stabilize the position so that the board moves as little as possible. He holds the position for 10 seconds and put the leg back down. Repeat five times and change the legs. In total of 3 sets. It was the same exercise as last session and this time it was easier for the patient and so I created a modification. Which was giving the patient an overball and telling him to hold the ball with both hands and extend the arms in front of his body with simultaneously raising the leg. This variation makes it harder to stabilize the position and is working on arms legs coordination.
- 3rd exercise = Walking over balance boards. There are six different balance boards of three types of leverage. The first leverage is circular meaning that the board moves in all directions. Second type leverage or pivot point is structured for forward and backward motion. Third type leverage or pivot point allows only sideways motion. The boards are placed in single line

but the patient doesn't know the alignment of the boards so he must anticipate all the possible movements. Patient must step on the board with one leg and step on next board with the other leg. Keeping the back straight. He is salso instructed to make sure to step with heel first. He have done this exercise in past as well even with modification with overball. This time the overball modification was too easy so I made a new modification. That was with a 2kg medicine ball instead of overball. This time he was instructed to hold the ball in both hands and instead of going around his body to simultaneously extend his arms above his head with raising the leg and once leg is raised to move the extended arms in front of him, then flex in elbows (moving the ball towards his chest and step down. Repeat this over all six balance boards. He walked the balance board five times there and back.

- 4th exercise = Walking on a rope. Rope is placed on a ground and patient must walk on it (one leg in front of the other). Working on balance but also strength. I added a modification as we done it in past as well. That was walking backwards, this gets rid of visual control and so he must focus more on his proprioception in order to be able to walk and stay on the rope. We walked the rope three times in both directions. This time when walking forward he had an overball on the ground and on the side of the rope. Before every step he had to roll the overball over the rope to the other side, before stepping on the rope.
- 5th exercise = Dorsal flexion + inversion against resistance. Patient is lying supine or lying on back with support on the elbows. Legs are extended and stay extended throughout the exercise. Theraband is fixed on a ladder or some other fixed point and the other end of the theraband is placed around patient metatarsals. The patient is asked to take up the slack or in other words to create a resistance in the band. Then to bring the toes towards him and turn the feet toward the thumb. It is important so that the knee is fully extended throughout the motion and the motion is coming from the ankle joint and not the whole leg. 10 repetitions 3 sets. At the last repetition of every set the patient holds the contracted position for 5 seconds. We are strengthening the dorsal flexor group and the supinators. We have modified it as his strength improve by using a blue theraband instead of red one that we used previously. The blue provides greater resistance and so the patient must exert greater pressure in order to move it.
- 6th exercise = Pressing down on overball. Place a semi inflated overball on a ground against a wall. The patient sits on the ground with fully extended legs and one feet is placed against the overball. Patient is asked to press against the overball in downward direction. Here we are strengthening the ankle plantar flexors. 10 repetition , 3 sets. At the last repetition of every set the patient holds the contracted position for 5 seconds. It is important to keep the knee on the ground which inhibits the other muscle groups from participating. Another important factor is

also that the pressure is being forced only through ankle joint, by that I mean that no hip elevation shall be present. Again we had to modify it due to the greater strength so this time he did 15 repetitions of 3 sets in a combination with walking on tiptoes 10 meters before having rest in between sets. I tis so called super set.

- 7th exercise = Improving the arch of the foot, as that will help to improve the proprioception function which goes in hand with stability. Also it is one of many exercises that I have showed him that he can do at home, and so I wanted to see the technique to make sure that he is doing it correctly and if needed correct him. The exercise was that he had to pick up chestnuts with his toes and transfer them to opposite side. It is provided by keeping heel on the ground, flexing the toes (grabbing the chestnuts) by which the longitudinal and transverse arch activates, lift the toes and provide inversion in the ankle to drop the chestnuts on other side. Six chestnuts were used and he repeated the exercise four times. I told him that for modification to make it harder he may use smoother or smaller objects that are harder to grab such as dried lentils or pebbles.

Possible mistakes:

- Wrong posture / pelvic tilt on posturomed and soft pad
- Over exhaustion of the soft tissue around injury leading to inflammation
- Flexing knees and hips during dorsal and plantar flexion exercises
- When walking on the rope staring down instead of looking forward

Self therapy:

Repeat all exercises and stretching from previous weeks (the patient has written them down). Record any questions or comments about the exercise to ask me in our last session.

Result (of today's therapy unit) – obj.: Patient is capable of providing harder and more demanding exercises, which is signaling me that his injury and overall health state is improving, Incorporating exercises for home for the flat feet will be necessary in order to see further improvements.

Result (of today's therapy unit) – sub.: Without pain in the ankle. Feels improvements in the exercises which is motivating him to continue even at home. Feels a little pain in plantar aspect of the foot from the chestnut exercises.

6.8 Eight session

Date: 3.2.2022

Stp. subj.: Patient feels almost no pain in walking or working. He ranks the pain as 2 out of 10. He also doesn't feel pain in his lower back, which he felt for at least five years

Stp. obj.: Patient posture seems much better as he is not so tilted to right. Limping on the left foot is not so visible. It seems as a normal gait pattern

Goal of today's therapy unit:

- Creating a final kinesiological examination
- Make pictures of exercises and kinesiotaping for the patient

Proposed therapy (for today's unit):

- Making of tests that were provided in initial examination
- Letting the patient showing me the exercises for autotherapy
- Make photos for patient of applied kinesio tape

Procedure:

- Testing patients improvements from initial kinesiological examination
- Checking patient technique of exercises to do at home until the injury is fully recovered

Possible mistakes:

- Non making accurate measurements with the goniometer / measuring tape
- Wrong manual contact during examination of muscle strength and length

7 Final kinesiological examination

Trunk: The body posture is more symmetrical than at the beginning, protraction of shoulders is still present, skin to skin contact (scc.) alatae, hyperlosa, pelvis is in anterior shift, spine is no longer as tilted to right as it has been, dynamics of spine is more centered, abdominal wall has gotten stronger, Rotation in trunk is gone

Lower extremity: Normal tonus of calf muscles on both LE, pes planu on both feet but at the beginning I could only fit my one phalang underneath the foot and now two phalangs, active and passive movement ranges improved, tonus of the muscles on both LE are symmetrical, Achilles tendon palpation proved me that they both have normal elasticity
Base of support : much more stable, wide base of support, single leg stance is possible on both LE for longer than 10s.

locomotion: Walking on toes is possible, walkng on heels is possible and not painful , limping is not present any longer.

7.1 Static postural examination

a) Plumb line test

A) Anterior view

The plumb line passes:

- Slightly to the dexter side of the feet
- Midway between the lower extremities
- Slightly center of umbilicus
- Through sternum
- Middle of the face

B) Posterior view

- Midway between the heels
- Midway the lower extremities
- Right intergluteal line is little lower than the left
- Passes midway through spine in Lumbar region, thoracic region, and midway through cervical spine
- Passes through the middle of the skull

C) Left Lateral view

- Passes through the outer lateral malleolus
- Posterior to the axis of the knee joint
- Slightly posterior to the axis of the hip joint
- Passes through the sacral promontory
- Passes the bodies of lumbar vertebrae
- Through the elbow joint
- Slight posterior through the shoulder joint
- Through the bodies of cervical vertebrae
- Through the meatus acusticus externus

D) Right lateral view

- Passes through the outer lateral malleolus
- Slightly posterior to the axis of the knee joint
- Slightly posterior to the axis of the hip joint
- Passes through the sacral promontory
- Passes the bodies of lumbar vertebrae
- Through the elbow joint
- Slightly posterior through the shoulder joint
- Through the bodies of cervical vertebrae
- Through the meatus acusticus externus

7.2 Segmental evaluation of posture

A) Posterior view

Feet / ankle:

- Feet are turned in neutral position
- Correctly aligned Achilles tendon

Calf:

- Same tonus and circumference (I will check in my measurements)

Knee

- Both knees are turned slightly inwards, but it is same on both LE, and so it might be physiological for the patient
- No varosity or valgosity is present

Thigh:

- Left and right thigh have same normal tonus and circumference seems to be same (I will check in my measurments)
- Intergluteal line are symmetrical

Pelvis and hip:

- SIPS are same height
- Pelvis is slightly tilted to left

Trunk:

- Slight tilt to right side

Shoulder and scapula:

- Left shoulder is higher than right
- Left and right scapula are at the same height
- Trapezius, rhomboidei, short extensors of the head, and levator scapulae have normal tonus

Head and neck:

- Head is still in slight protraction, but when comparing with initial examination it has decreased

B) Anterior view

Feet / ankle:

- Wide base of support
- Neutral rotation

Knee:

- No varosity or valgosity is present

Thigh:

- Left and right have same normal tonus and shape seems symmetrical

Pelvis:

- ASIS are same height
- Very slight anterior tilt

Trunk:

- Minor tilt to right

Shoulders:

- Left shoulder is slightly higher (which is normal as with dominant limbs)

Neck and head:

- Neck flexors are in normal tonus

C) Left lateral view

Feet / Ankle:

- Normal shape, no redness or oedema is present
- Pes planus is still present

Knees:

- No oedema is present
- No hyperextension (recurvation)

Pelvis:

- Slight anterior tilt

Trunk:

- Due to the slight anterior tilt the belly is sticking out a little bit

Vertebrae:

- Normal “S” curved spine

Shoulder and scapula:

- Shoulders protracted
- The scapulas are not sticking out

Head and neck:

- Head very slightly protracted (less than in initial examination)

D) Right lateral view

Feet / Ankle:

- Normal shape, no redness or oedema is present
- Pes planus is still present

Knees:

- No oedema is present

Pelvis:

- Slight anterior tilt

Trunk:

- Due to the slight anterior tilt the belly is sticking out a little

Vertebrae:

- Normal "S" shape curve

Shoulder and scapula:

- Shoulders protracted
- Scapulas are not sticking out

Head and neck:

- Head slightly protracted

7.3 Gait analysis

Anterior view

- Width of the base support = Wider than norm. The norm is classified as space between extremities should be the length of a foot.
- Position of the feet = Feet are in neutral position
- Axial position of the lower limb = No varosity or valgosity shape of the knees and Ankles
- Position and movements of the pelvis = Stays the same throughout the whole gait pattern.
- Movement of center of gravity = Remains constant (doesn't change)
- Position and movement of the trunk = The trunk is straight. Which is a major difference to initial examination
- Position of shoulders = Protracted
- Positions and movements of the head = No extraordinary movement is observed
- Movements of upper extremity = Regular and consistent no hyper flexion/extension

Posterior view

- Width of base support = The width is greater than norm
- Position of the feet = Feet in neutral position
- Axial position of the lower limb = No varosity or valgosity shape of the knees and ankles
- Movement and position of the knee and hip = Left hip is higher, knee varosity
- Position and movements of the pelvis = Shifted and tilted to left however keeps the position both in loading and swing phase.
- Movement of center of gravity = Doesn't change
- Position and movement of the trunk = Centered position of a trunk with slight rotation
- Position of spine = No scoliosis, hyperlordosis is no longer present in Lumbar region, rest of the spine has physiological shape
- Activity of back muscles = Symmetrical bilaterally
- Position and movements of the head = No extraordinary movement is observed.
- Movements of upper extremity = Regular and consistent no hyper flexion/extension

Left lateral view

- Movement of the foot = Loading and swing phase are in norm
- Positions and movements of the head = No extra ordinary movement
- Position of shoulders = Protracted forward
- Movements of upper extremity = Normal no hyper flexion or extension
- Position and movement of the pelvis = Slight anterior tilt, based on the stomach that is hanging
- Axial position of the lower limb = In normal position with no extraordinary movement

Right lateral view

- Movement of the foot = During the swing phase circumduction, landing on lateral side of foot loading phase is almost missing, doesn't propel his body forward through the use of toes
- Positions and movements of the head = No extra movement, however head in protraction
- Position of shoulders = Protracted forward
- Movements of upper extremity = Normal no hyper flexion or extension
- Position and movement of the pelvis = Slight anterior tilt
- Axial position of the lower limb = Unlike in initial examination the patient feet were placed next to each other and no longer is one feet slightly in front of the other

Common characteristics:

- Walking rhythm = Rhythm of the steps is normal, same time spend in transitions between phases of gait on both LE.
- Walking speed = Normal speed of walking
- Stride length = Regular and normal for his body composition
- Stability of walking = Stable, he is able to walk straight without side deviation or tripping

Type of gait according to Janda:

- Distal gait based on Janda with wide base of support, feet externally rotated 10^0.

Gait modifications

- Walking on a narrow base = Non possible
- Walking on soft surfaces = Possible
- Walking with eyes closed = Possible
- Walk backwards = Possible
- Walk with up-stretched arms = Possible but little unstable
- Walk on tiptoes = Possible, painful due to strength and limited ROM
- Walking on heels = Possible, but even more painful than on tiptoes
- Walking in squatting = Not possible the patient loses balance

7.4 Spinal distances examination

- Shober's distance (5cm) = 4cm
- Stibor distance (7-10cm) = 9cm
- Otto's inclination index (3-4cm) = 3cm
- Otto's reclination index (2-3cm) = 2,5cm
- Cepojev's distance (2,5-3cm) = 3cm
- Forestier Fleche (0cm) = 0cm
- Cervical spine flexion (0cm) = 0cm
- Thomayer's test (0cm) = 12cm
- Latero flexion distance (20-25cm)
  - Left : 24cm
  - Right : 24cm

-

7.5 Assessment of stereotype pattern of breathing

A) Sitting position:

Breathing type: lower thoracic

B) Standing position:

Breathing type: upper thoracic

C) Supine postion:

Breathing type: abdominal

D) Prone position:

Breathing type: abdominal

E) Breathing rate: 1:2

7.6 Specific testing of posture

A) Two-scales standing:

Left leg: 41kg

Right leg: 40kg

Conclusion: The difference is only 1kg which is a massive improvement from initial 9kg.

B) Romberg test (I-III):

I) Negative = Patient is keeping stable position without deviation to sides

II) Negative = Patient is keeping stable position without deviation to sides

III) positive = Twitching of left ankle joint and slight trunk deviation to right

C) Single-leg stance test:

1) OPENED EYES:

(lifted)

LE: Balanced

RE: Balanced

2) CLOSED EYES (lifted):

LE: Balanced

RE: Balanced.

D) Trendelenburg test:

1.) Left leg in 90 flexion = Able to hold the position for more than 10 seconds and not painful.

2.) Right leg in 90 flexion = Able to hold the position for more than 10 seconds and no pain is present.

E) Véle test = 2 on left LE, 1 on right LE

F) Anterior drawer test = Negative on both LE

Talar tilt test = Negative on both LE

G) Cranial nerve testing: Without pathologies

Modification of standing:
Standing on tiptoes = Possible to get on tiptoes, balanced even after 10 seconds

Standing on heels = Possible, not painful, balanced even after 10 seconds

Anthropometric measurement of final examination

Height	Length in cm - Left Extremity	Length in cm - Right Extremity	Length in cm
In standing	X	X	174
Anatomical length	82	82	X
Functional length	83	83	X
Circumference of the thigh 10cm above	46	45	X
Circumference of the knee joint	37	37	X
Circumferences of the tuberositas tibiae	31.5	31.5	X
Circumference of the calf	39.5	39	X
Circumference of the ankle joint	24	24	X
Circumference of the heel	32	32	X
Circumference of the foot	28	28	X

Table 9 - Anthropometric measurement in final kinesiological examination

Muscle length examination of final examination based on Janda

Part of body tested	Method according to	Muscles tested	Grade
Ankle plantar flexors	Janda	m. Triceps surae (m. Gastrocnemius, m. soleus)	RE - 0 LE – 1
Hip flexors muscles	Janda	One joint muscles (m. iliacus, m. pectineus, m. Adductors longus, m. brevis) Two-joint muscles (m. psoas major, m. Rectus femoris, m. Tensor fasciae latae, m. sartorius)	RE - 1 LE – 1
Hip adductor muscles	Janda	m. pectineus, m. Adductor brevis, m. Adductor longus, m. semitendinosus, m. semimembranosus, m. gracilis, m. biceps femoris)	RE - 1 LE- 1
Hamstring muscles	Janda	m. Biceps femoris, m. semimembranosus, m. Semitendinosus	RE - 1 LE – 1
Posterior muscles	Kendall	Posterior muscles	Unable to touch toes
Paravertebral muscles	Janda	Paravertebral muscles	1
m. Quadratus lumborum	Janda	m. Quadratus lumborum	R – 1 L – 1
m. Piriformis	Janda	m. Piriformis	RE - 1 LE – 1

Table 10 - Muscle length examination in final kinesiological examination

Goniometry measurements of final examination

Part of body tested	Motion	Right / Left	Active	Passive
Knee	Extension / Flexion	Right	S: 0-0-145	S: 0-0-150
		Left	S: 0-0-145	S: 0-0-150
Ankle	Extension (DO) /(PL) Flexion	Right	S: 25-0-50	S: 25-0-50
		Left	S: 25-0-45	S: 25-0-45
	Eversion / Inversion	Right	R: 20-0-45	R: 25-0-50
		Left	R: 15-0-35	R: 20 -0-40
Toes	Extension / Flexion	Right MTP I	S: 50-0-30	S: 55-0-35
		Left	S: 50-0-30	S: 55-0-35
	ABD / ADD	Right MTP I	F: 20-0-20	F: 20-0-20
		Left MTP I	F: 20-0-20	F: 25-0-25
	(Hallux Valgus - valgosity)	Right	No Hallux	
		Left	No Hallux	

Table 11 - Measurement of ROM in final kinesiological examination

Hypermobility testing of final examination

Segment	**Direction of examination**	**Test according to**	**Results**
Knee joint	EXT	Sachse	A
Knee joint	FLX	Janda	A
Hip joint	Rotation	Sachse	A

Table 12 - Hypermobility examination in final kinesiological examination

Muscle strength examination of hip joint muscles in final examination based on Janda

LOWER EXTREMITY	Grade - Janda; bilaterally
Gluteus maximus	L: 5 R: 4
Iliopsoas	L: 5 R: 5
Sartorius	L: 5 R: 5
Tensor fasciae latae	L: 4 R: 4
Quadriceps femoris	L: 5 R: 5
Hip flexors	L: 5 R: 5
Hip adductores	L: 4 R: 4
Gluteus minimus	L: 4 R: 4
Gluteus medius	L: 4 R: 4
Lateral hip rotatores	L: 5 R: 5
Medial hip rotatores	L: 5 R: 5

Table 13 - Muscle strength examination in final kinesiological examination (Hip)

Muscle strength examination of hamstring and m.Triceps surae in final examination based on Janda

LOWER EXTREMITY	Grade - Janda; bilaterally
Meidal hamstrings	L: 5 R: 5
Lateral hamstrings	L: 5 R: 5
Popliteus	L: 5 R: 5
m. Gastrocnemius	L: 4 R: 4
Soleus	L: 4 R: 4
Ankle plantar flexor	L: 4 R: 4

Table 14 - Muscle strength examination in final kinesiological examination (Hamstring + m.Triceps Surae)

Muscle strength examination of foot and ankle muscles in final examination based on Janda

LOWER EXTREMITY	Grade - Janda; bilaterally
Peroneus longus	L: 4 R: 4
Peroneus brevis	L: 4 R: 4
Tibialis posterior	L: 4 R: 4
Tibialis anterior	L: 5 R: 5
Extensor hallucis longus, brevis	L: 5 R: 5
Extensor digitorum longus, brevis	L: 5 R: 5
Peroneus tertius	L: 5 R: 5
Flexor hallucis longus	L: 5 R: 5
Flexor hallucis brevis	L: 5 R: 5
Flexor digitorum longus + quadratus plamtae	L: 5 R: 5
Flexor digitorum brevis	L: 5 R: 5
Planatar interossei	L: 5 R: 5
Dorasal interossei	L: 5 R: 5
Lumbricales	L: 5 R: 5
Abductor hallucis	L: 5 R: 5
Adductor hallucis	L: 5 R: 5

Table 15 - Manual muscle strength test in final kinesiological examination (foot + ankle)

Muscle tone palpation in final examination

Muscle	Tonus
Iliacus	L: Normal R: Normal
Piriformis	L: Hypertonic R: Hypertonic
Semimembranosus	L: Normal R: Normal
Semitendinosus	L: Normal R: Normal
Soleus	L: Hypertonic R: Hypertonic
Gastrocnemius	L: Normal R: Normal
Rectus femoris	L: Normal R: Normal
Tensor fascia latae	L: Normal R: Normal
Sartorius	L: Normal R: Normal
Adductor longus	L: Normal R: Normal
Adductor brevis	L: Normal R: Normal
Adductor Magnus	L: Normal R: Normal
Biceps femoris	L: Hypertonic R: Hypertonic

Table 16 – Muscle tone palpation in final kinesiological examination

7.7 Examination of reflex changes by Lewit

Skin: Increased sweating in area of left ankle, skin may be stretched

Sub skin: Physiological

Fascia: Possible to stretch hamstring in all directions, Quadriceps limited bilaterally in caudal direction, in area of left ankle and calf fascia is limited in + rotation with reflex changes

Muscles: Hypertonus on both LE of muscles m.Soleus, m. Illiacus, m.Gastrocnemius, m. Rectus Femoris

7.8 Deep stabilization examination based on Prof. Kolář

In re-testing the IAP test a disturbance was observed as the pressure created by the patient was weak, but unlike in initial testing the umbilicus has not moved cranially which is an improvement point that gives me information about increased strength of m.Transversus abdominis.

8 Conclusion of final kinesiological Examination

My patient base of support has not changed compared with initial examination. On the other hand, the whole body posture has changed to better starting from correction of pelvis position all the way up to elimination of head protraction. Improvement of ROM, muscle strength, length, and most importantly the stability on both lower extremities. The ROM reached normal values based on Kendall measurements. Oedema was completely eliminated and pain reduced to grade 1 during activity. Based on the outcome of IAP test there is an improvement in the deep stabilization system. There has been persisting hypertonus in m. Soleus and m. Gastrocnemius on both LE, however I am not worried about it as of palpation no trigger point or taunt band was palpated and it wasn't painful for the patient when I touched it, neither was it red or warm so no inflammation was present. The hypertonus may be from overtraining and/or the body still adapting to its new situation.

9 Therapy effect evaluation

I evaluate the therapy as positive due to the fact that we were able to reach our short term goals that we have written down before the start of therapies. Mainly the oedema and pain has been resolved even though we did not give any extra focus on the oedema. I have twice provided foam ball rolling and applied kinesio tape, but otherwise from my perspective there were no other methods used for the reduction of the oedema. I give a lot of credit to the magneto and hydrotherapy that the patient absolved eight times in the duration of four weeks.

Based on the fact that the patient wasn't in much of a pain in the beginning of treatment allowed me to do exercises with active participation. Which at the end are more beneficial for treatment and speeding up the recovery process rather then if I would only be able to do manual therapy. My main goals were to improve the sensomotorics and muscle strength, as I supposed that these two improvements will have a secondary result in a matter of improved ROM, stability, deep stabilization system, posture, and even the body weight distribution.

This hypothesis has clearly worked out for me.

The ROM is improved which you may check in the table below where I compare the results from initial and final examination. With improved muscle strength in left ankle joint the stability improved as well which I believe is due to the greater mass of soft tissue that is holding the joint together. This improvement comes hand in hand with changes of gait and posture stereotype which the patient was able to change to more harmonious and physiological.

For these positive effects to stay and even get better in future it's necessary for the patient to keep exercising and rehabilitating. It is crucial for the patient to stay active in the exercises in order to prevent chronic ankle instability. The positive effect of therapies is all due to the patients' motivation to recover from this injury. He was active in all of the therapies, asked questions when he was unsure about something, and most importantly he was doing the autotherapy which isn't so frequent in patients. If he continues in autotherapy exercises at home and provides preventive risk factor elimination, he will be able to reach full recovery.

What didn't go so well was my patient pes planus. We have worked on it quite a bit, but yet the results aren't so great as I would like, because I'm sure that with greater arch of the foot the balance and stability would be even better. What has been a mistake from my part was that I haven't paid as much attention in educating my patient on possible behaviours to reduce the chances of spraining the ankle in his work environment.

Comparison of anthropometry measurements between initial and final examination

	Length in cm – initial examination		**Length in cm – final examination**	
	Left	Right	Left	Right
Circumference of the thigh 10cm above	45	43	46	45
Circumference of the calf	39	38	39.5	39
Circumference of the ankle joint	26	24	24	24
Circumference of the heel	32.5	32	32	32
Circumference of the foot	29	28	28	28

Table 17 - Changes in Anthropometry

Reduction of the circumference around the left foot and heal is the result of oedema absorption, meanwhile the increased circumference of the thigh and calf of both LE is a result of increased muscle strength. Both of these results are positive and prove the point that my treatment plan worked in benefit of my therapy goals.

Comparison of muscle length test between initial and final examination

Part of body tested	Method according to	Muscles tested	Grade initial Examination	Grade final examination
Ankle plantar flexors	Janda	m. Triceps surae (m. Gastrocnemius, m. soleus)	RE = 1 LE = 2	RE = 0 LE = 1
Hamstring muscles	Janda	m. Biceps femoris, m. semimembranosus, m. Semitendinosus	RE = 2 LE = 2	RE = 1 LE = 1
Posterior muscles	Kendall	Posterior muscles	Unable to touch toes	Finger tips touch toes
Paravertebral muscles	Janda	Paravertebral muscles	2	1

Table 18 - Changes in muscle length

The muscle length has improved based on the results on both LE. The fact that both LE have improved is an important factor to me and to the patient as it gives the body into better position to full recovery. The ankle plantar of the left LE have improved by one grade and again I give credit to the active exercises that we have been doing in the therapeutical sessions.

Comparison of LLE goniometry results from initial and final examination

LLE		Before therapy	After therapy
Knee	Extension / Flexion	S: 0-0-140	S: 0-0-145
Ankle	Extension (DO) /(PL) Flexion	S: 10-0-30	S: 25-0-45
	Eversion / Inversion	R: 15 -0-20	R: 15-0-35
Toes	Extension / Flexion	S: 50-0-30	S: 50-0-30
	ABD / ADD	F: 20-0-20	F: 20-0-20

Table 19 - Changes in goniometry of LLE

ROM of left ankle joint has improved in all directions, with knee flexion improvement by 5^0 as well. Here is nice example how the chain reaction works as when I was able to improve the ankle joint stability the gait stereotype has changed and therefore also the activation and relaxation of muscles changed and adapted. As example m.Rectus femoris which during flexion of a knee is stretched was more relaxed and as result I was able to achieve greater flexion. You can also see this in Table 16. where the tonus of m. Rectus femoris is in norm compared to initial examination where it was in hypertonus.

Comparison of RLE goniometry results from initial and final examination

RLE		Before therapy	After therapy
Knee	Extension / Flexion	S: 0-0-140	S: 0-0-145
Ankle	Extension (DO) /(PL) Flexion	S: 25-0-50	S: 25-0-50
	Eversion / Inversion	R: 20-0- 35	R: 20-0-45
Toes	Extension / Flexion	S: 50-0-30	S: 50-0-30
	ABD / ADD	F: 20-0-20	F: 20-0-20

Table 20 - Changes in goniometry of RLE

ROM of right ankle ankle joint improved in inversion by 10^0 and knee flexion improved the same way as the left by 5^0. The increase in knee flexion has the same reason as I mentioned above for LLE. The inversion of the ankle joint I give credit to the posturomed and bosu exercises as the ankle had to work in stabilization in all directions and therefore strengthening the ligaments but also improving the mobility and stability of the ankle.

Comparison of muscle strength between initial and final examination based on Janda

LOWER EXTREMITY	Grade - Janda; bilaterally initial examination	Grade - Janda; bilaterally final examination
Gluteus maximus	L: 4 R: 3	L: 5 R: 4
Iliopsoas	L: 4 R: 4	L: 5 R: 5
Sartorius	L: 4 R: 4	L: 5 R: 5
Quadriceps femoris	L: 5 R: 4	L: 5 R: 5
Hip flexors	L: 5 R: 4	L: 5 R: 5
Lateral hip rotatores	L: 5 R: 4	L: 5 R: 5
Medial hip rotatores	L: 5 R: 4	L: 5 R: 5
Meidal hamstrings	L: 5 R: 4	L: 5 R: 5
Lateral hamstrings	L: 5 R: 4	L: 5 R: 5
Popliteus	L: 4 R: 4	L: 5 R: 5
m. Triceps surae	L: 3 R: 4	L: 4 R: 4
Soleus	L: 3 R: 4	L: 4 R: 4
Ankle plantar flexor	L: 3 R: 4	L: 4 R: 4
Tibialis anterior	L: 3 R: 4	L: 5 R: 5

Table 21 - Changes in muscle strength based on Janda

As I have mentioned at the beginning of my evaluation the improving of muscle strength was one of my main goals. Majority of the exercises that were provided in therapies involved some part of strengthening component in them. Even rocker board exercises which main focus was stability training have involved the strength component. I believe that I have made a logical sequence of exercises during the therapeutical session. By this I mean that if one exercise had a heavy load on quadriceps, then following exercise would have been targeted on

different muscle group. Doing this allowed the muscles to have time to relax before getting under load again. That's one of the reasons why we were able to improve the muscle strength in such manner as when it was time for the muscle to work again it was rested and therefore was able to exert greater force for longer time which in the end resulted in more time under tension for the muscle.

10 Conclusion

The goal of my bachelor thesis was to introduce the pathology and the effects of distortion on ankle joint, to which I have created a therapeutic plan for a patient with this diagnose to which I have created a case study. In my theoretical part I have focused on the anatomical structure, biomechanics, kinesiological aspect, and possible treatment programs of the diagnose for a reader to later understand the reasoning behind my approaches in the therapies. As I have mentioned in my work above ankle distortion belongs to one of the most common injuries to LE and so there exists many articles, work, and books on it.

When studying those publications, I have figured out that there are hundreds of possibilities on making a therapeutical plan and nobody can 100% say which plan is the best for the patient as it differs from patient to patient, as there are variables such as: extent of soft tissue injury, patient participation in therapies, patient physical and mental state before the injury, and the final goal which patient wants to achieve at the end. At the end of the day this diagnose in most cases is not a threat to later normal use of the extremity, but if no therapy is undergone it could lead to life long lasting side effects which may be irreversible and will require surgical approach. A great example of complication is chronic ankle instability which in serious cases requires surgery due to the fact that the patient might not be even able to walk without ankle pain or even ankle luxations. In the case of my patient I believe in full recovery without any long lasting negative side effects.

11 List of literature

Al-mohrej, O. (2016). The medial ligament of ankle (deltoid ligament) [Online image]. Research gate. https://www.researchgate.net/figure/The-medial-ligament-of-the-ankle-deltoid-ligament_fig6_296330557

Bain, J., Neto, A. (2016). Ankle joint. *Radiopaedia.* https://doi.org/10.53347/rID-46957

Cao, Y., Hong, Y., Xu, Y., Zhu, Y., & Xu, X. (2018). Surgical management of chronic lateral ankle instability: a meta-analysis. *Journal of Orthopaedic Surgery and Research, 13.* https://doi.org/10.1186/s13018-018-0870-6

Davine, J. (n.d). *Varying degegrees of ankle sprains: how ankle sprains are graded, and how to treat the injury based on the severity.* https://www.rush.edu/news/varying-degrees-ankle-sprains

Dubois, B., & Esculier, J. (2019). Soft-tissue injuries simply need PEACE and LOVE. *British journal of sports medicine, 54*(2). http://dx.doi.org/10.1136/bjsports-2019-101253

Dungl, P., et. al. (2014). Bérec a hlezno. Poranění ligamentózního aparátu hlezna. In P. Dung & A. Podškubka. *Ortopedie: 2., přepracované a doplněné vydání* (2nd ed., pp. 897-932). Grada publishing a.s.lhttps://books.google.cz/books?id=aaV6BwAAQBAJ&pg=PA917&dq=distorze+hlezna&hl=en&sa=X&ved=2ahUKEwj1u76Z_r_2AhW8h_0HHVrrDZIQ6AF6BAgKEAI#v=onepage&q=distorze%20hlezna&f=false

DiPreta, A.J. (2014). The foot and ankle examination. In Palpaliodis, N.D., Vanushkina, A.M., Richardson, G.N., & DiPreta, A.J (Eds.), *Managing and treating common foot and ankle problems, an issue of medical clinics* (2nd ed., pp. 181- 196). Elsevier. https://books.google.cz/books?id=dxsJAwAAQBAJ&pg=PA327&lpg=PA327&dq=Soboroff+SH,+Pappius+EM,+Komaroff+AL.+Benefits,+risks,+and+costs+of+alternative+approaches+to+the+evaluation+and+treatment+of+severe+ankle+sprain.+Clin+Orthop+1984;+(183):+160%E2%80%938&source=bl&ots=IfnadQcykg&sig=ACfU3U3tFmq7wvFMd4m1ampuCMtj3lzdwA&hl=en&sa=X&ved=2ahUKEwi3mqHvvcL2AhVUt6QKHfMWDuAQ6AF6BAgCEAM#v=onepage&q=Soboroff%20SH%2C%20Pappius%20EM%2C%20Komaroff%20AL.%20Benefits%2C%20risks%2C%20and%20costs%20of%20alternative%20approaches%20to%20the%20evaluation%20and%20treatment%20of%20severe%20ankle%20sprain.%20Clin%20Orthop%201984%3B%20(183)%3A%20160%E2%80%938&f=false

Delahunt, E., Remus A. (2019). Risk factors for lateral ankle sprains and chronic ankle instability. *Journal of athletic training, 54*(6), 611-616. https://doi.org/10.4085/1062-6050-44-18

Ferng, A. (2021, October 28). *Tibial nerve.* https://www.kenhub.com/en/library/anatomy/tibial-nerve

Fong, D.T., Chan, Y.Y., & Mok, K.M. (2009). Understanding acute ankle ligamentous sprain injury in sports. *BMC Sports Science Medicine and Rehabilitation, 14.* https://doi.org/10.1186/1758-2555-1-14

Foot & ankle specialist. (n.d.). *Ankle tendon injuries.* Web to med. https://www.nefootdocs.com/ankle-tendon-injuries.html

Golanó, P., Vega, J., Leeuw J.P., Malagelada F., Manzanares M.C., Gotzens., & Dijk N.C. (2010). Anatomy of the ankle ligaments: a pictorial essay. *Knee surgery, sports traumatology, Arthroscopy, 18,* 557-569. https://doi.org/10.1007/s00167-010-1100-x

Gupton, M., & Terreberry, R. R. (2019). Anatomy, Hinge Joints. *StatPearls Publishing*. https://www.ncbi.nlm.nih.gov/books/NBK518967/

Hacking, C., Weerakkody, Y. (2020). Deltoid ligament of the ankle. *Radiopaedia.* https://doi.org/10.53347/rID-22829

Haddad, S. L. (2016, February). *Sprained ankle - orthoinfo - Aaos*. OrthoInfo. https://orthoinfo.aaos.org/en/diseases--conditions/sprained-ankle/

Harrold, F., Abboud, R.J. (n.d.). *Chapter 2 – Biomechanics of the foot and ankle.* https://musculoskeletalkey.com/chapter-2-biomechanics-of-the-foot-and-ankle/

Hnátová, I., & Pavlů, D. (2010). Léčba otoků a manuální lymfatická drenáţ v léčbě svalových zranění. *Rehabilitace a fyzikální lékařství* (4th ed., pp. 169 – 173).

Javorac, D., Stajer, V., Ostojic, S. (2020). Case report: Acute hydrotherapy with super-saturated hydrogen-rich water for ankle sprain in a professional athlete. *F1000Research, 1.* https://doi.org/10.12688/f1000research.22850.1

JC physiotherapy. (n.d.). *The 4 shock absorbers.* https://jcphysiotherapy.com/discussion-room/the-4-shock-absorbers/

Kallzi, B., Coupland, C., Morriss, R., Beckett, K., Joseph, S., Barnes, J., Christie, N., Sleney, J., & Kendrick, D. (2017). The impact of psychological factors on recovery from injury: a multicentre cohort study. *Social Psychiatry and Psychiatric Epidemiology, 52*(7), 855-866. https://doi.org/10.1007/s00127-016-1299-z

Kendall, P. F., McCreary K. E., Provance, G. P., Rodgers M. M., & Romani, A. W. (2005). Lower extremity. *Muscle testing and function with posture and pain fifth edition* (pp.

359 – 480). Lippincott Williams & Wilkins.

Kharb, A., Saini, V., Jain, K. Y, & Dhiman S. (2011). A review of gait cycle and its parameters. *International journal of computational engineering & management, 13.* https://www.researchgate.net/profile/Surender-Dhiman/publication/268423123_A_review_of_gait_cycle_and_its_parameters/links/582f259108ae138f1c035005/A-review-of-gait-cycle-and-its-parameters.pdf

Kolář, P., & et. al. (2009). *Rehabilitace v klinické praxi*. Galén.

Liu, F.Q., & Diao, N.C. (2019). Surgical therapy vs conservative therapy for patients with acute injury of lateral ankle ligament: A meta-analysis and systematic review. *International Wound Journal, 16*(4), 925-931. http://doi.org/10.1111/iwj.13120.

May, H. (2020). *The deep fibular nerve.* Teachmeanatomy. https://teachmeanatomy.info/lower-limb/nerves/deep-fibular/

Mertens, T. (Ed.). (2022, February 28). *Peroneal tendon subluxation*. Physiopedia. https://www.physio-pedia.com/index.php?title=Peroneal_tendon_subluxation&oldid=295879

Mohammadi, H., Ghafarian-Shiraz, H., Saniee, F., & Delaviz, H. (2012). Functional treatment comparing with immobilization after acute ankle sprain. *Zahedan Journal of Research in Medical Sciences, 15*(2), 28-31. https://www.researchgate.net/publication/233884816_Functional_Treatment_Comparing_with_Immobilization_after_Acute_Ankle_Sprain

Muhle, C., et al. (1999). Drawings of the normal anatomy of the lateral (a) and medial (b) collateral ligaments of the ankle [Online image]. Radio Graphics. https://pubs.rsna.org/doi/10.1148/radiographics.19.3.g99ma06673

Niekerk, W.V (Ed.). (2022). *Peace and love principle*. Physiopedia. https://www.physio-pedia.com/Peace_and_Love_Principle

Nunes, S.G., Vargas, Z.V., Wageck, B., Hauphental, P.D., Luz, M.C., & Noronha, M. (2015). Kinesio Taping does not decrease swelling in acute, lateral ankle sprain of athletes: a randomised trial. *Journal of Physiotherapy, 61*(1), 28-33. https://doi.org/10.1016/j.phys.2014.11.002

Nyska, M., Mann, G. (2002). Anatomy of the ankle and talar joints. In O'Brien M (Ed.), *The unstable ankle* (pp. 6-15). Human Kinetics. https://books.google.cz/books?id=ub_AakWtyAEC&printsec=frontcover&dq=ligaments+and+tendons+of+the+ankle+scholar+article&hl=en&sa=X&ved=2ahUKEwiAnuTn1rP2AhWu_rsIHSYfCgUQ6AF6BAgDEAI#v=onepage&q=ligaments%20and%20t

endons%20of%20the%20ankle%20scholar%20article&f=false

Page, P. (2005). Sensorimotor training: A "global" approach for balance trining. *Journal of bodywork and movement therapies, 10*(1), 77-84. https://doi.org/10.1016/j.jbmt.2005.04.006

Petersen, W., Rembitzki, I.V., Koppenburg, A.G., Ellermann, A., Liebau, C., Brüggermann, P.G., & Best, R. (2013). Treatment of acute ankle ligament injuries: a systematic review. *Archives of Orthopaedic and Trauma Surgery, 133*, 1129-1141. https://doi.org/10.1007/s00402-013-1742-5

Physiopedia contributors. (2022, February 15). *Ankle Joint.* https://www.physio-pedia.com/index.php?title=Ankle_Joint&oldid=294136

Physiopedia contributors. (2021, June 28). *Synovium & synovial fluid.* https://www.physio-pedia.com/index.php?title=Synovium_%26_Synovial_Fluid&oldid=277690

Physiopedia contributors. (2022, February 15). *Ankle sprain.* https://www.physio-pedia.com/index.php?title=Ankle_Sprain&oldid=294141

Penn Medicine. (2020). *Foot and ankle tendon injuries treatment.* https://www.pennmedicine.org/for-patients-and-visitors/find-a-program-or-service/orthopaedics/foot-and-ankle-pain/foot-and-ankle-tendon-injuries-treatment

Poděbradský, J., & Poděbradská, R. (2009). *Fyzikální terapie: manuál a algoritmy*. Grada Publishing, a.s.

Ragab, I. (2020). Aquatic therapy versus combined aquatic and land based therapy in the treatment of chronic lateral ankle sprain. *Egyptian journal of physical therapy, 2*(1), 16-23. https://doi.org/10.21608/EJPT.2020.32561.1008

Rayner, A. (2017, August 10). Anatomy 101: Ankle syndesmosis – distal tibiofibular joint. *Rayner & Smale.* https://www.raynersmale.com/blog/2017/7/23/anatomy-101-ankle-syndesmosis-distal-tibiofibular-joint#:~:text=The%20distal%20tibiofibular%20syndesmosis%2C%20between,interosseous%20tibiofibular%20ligament%20(ITFL)

Segal, D.A., Yeates, H.K., Neptune, R.R., & Klute, K.G. (2018). Foot and ankle joint biomechanical adaptations to an unpredictable coronally uneven surface. *Journal of biomechanical engineering, 140*(3). https://doi.org/10.1115/1.4037563

Sendić, G. (2022, February 16). *Ankle joint.* https://www.kenhub.com/en/library/anatomy/the-ankle-joint

Southern California orthopedic institute. (2022). *Anatomy of the ankle.* https://www.scoi.com/specialties/ankle-doctor/anatomy-ankle

St. Luke's hospital. (n.d.). *Tibial nerve dysfunction.* https://www.stlukes-stl.com/health-content/health-ency-multimedia/1/000792.htm

Tekscan. (n.d.). *The gait cycle: Phases, parameters to evaluate & technology.* https://www.tekscan.com/blog/medical/gait-cycle-phases-parameters-evaluate-technology#:~:text=Single%20support%20phase%20is%20also,phase%20to%20contralateral%20foot%2Doff

Therapist of MGH physical therapy services. (n.d.). *Physical therapy guidelines for lateral ankle sprain.* https://www.massgeneral.org/assets/MGH/pdf/orthopaedics/foot-ankle/PT-guidelines-for-ankle-sprain.pdf

Van den Bekerom, M.P.J., Van der Windt, D.A.W.M., Ter Riet, G., Van der Heijden, G.J., & Bouter, L.M. (2011). Therapeutical ultrasound for acute ankle sprains. *Cochrane Database of Systemic Reviews.* https://doi.org/10.1002/14651858.CD001250.pub2

Vorvick, J. L. (2020, August 13). *Tendons vs. ligament.* https://medlineplus.gov/ency/imagepages/19089.htm

VÉLE, F. (2006). Kineziologie. Přehled klinické kineziologie a patokineziologie pro diagnostiku a terapii poruch pohybové soustavy. Praha: Triton. ISBN 8072548379.

Wainwright, W.T., Brurgess, C. L., & Middleton, G. R. (2019). Does Neuromuscular Electrical stimulation Improve recovery following acute ankle sprain? A pilot randomised controlled trial. *Sage Journal. 12.* https://doi.org/10.1177/1179544119849024

Walsh, M.B., Bain, A.K., Grible, A.P., & Hoch, C.M. (2020). Exercise-based rehabilitation and manual therapy compared with exercise based rehabilitation alone in the treatment of chronic ankle instability: A critically appraised topic. *Journal of sport rehabilitation, 29*(5), 684-688. https://doi.org/10.1123/jsr.2019-0337

Weerasekara, R.M., Tennakoon, S.B., & Suraweera H.J. (2016). Contrast therapy and heat therapy in subacute stage of grade I and II lateral ankle sprain. *Sage journals, 9*(4), 307-323. https://doi.org/10.1177/1938640016640885

Williamson, J.B., George, T.K., Simpson, D.C., Hannah B., & Bradbury E. (1986).Ultrasound in the treatment of ankle sprains. *Injury, 17*(3), 176-178. https://doi.org/10.1016/0020-1383(86)90327-x

Your practice online. (2022). *Foot and ankle anatomy* [video]. https://www.ypo.education/orthopaedics/foot-ankle/foot-and-ankle-anatomy-t193/video

12 List of attachments

Attachment No. 1 - List of abbreviation

L = Left

R = Right

LE = Lower extremity

LLE = Left lower extremity

RLE = Right lower extremity

l.sin = Latero sinister

m. = Musculus

CNS = Central nervous system

ATFL = Anterior talofibular ligament

CFL = Calcaneofibular ligament

PTFL = Posterior talofibular ligament

ATTL = Anterior tibiotalar ligament

DPTTL = Deep posterior tibiotalar ligament

AITFL = Anterior inferior tibiofibular ligament

PITFL = Posterior inferior tibiofibular ligament

ITFL = Interosseous tibiofibular ligament

SPR = Superior peroneal retinaculum

CAI = Chronic ankle instability

PIR = Post isometric relaxation

MCP = Metacarpo phalangeal

Hz = Hertz

mT = milli tesla

n. = Nervus

IAP = Intra abdominal pressure

TrP = Trigger point

MET = Muscle energy technique

ADL = Activity of daily living

Attachment No.2 - List of tables

Attachment No.3 - List of figures

Attachment No.4 - Pictures of the patient kinesiotape

Figure 4 - Kinesio tape medial view

Figure 3 - Kinesio tape anterior view

Attachment No.5 - Ethics committee approval

CHARLES UNIVERSITY
FACULTY OF PHYSICAL EDUCATION AND SPORT
José Martího 31, 162 52 Prague 6-Veleslavín

Application for Approval by UK FTVS Ethics Committee

of a research project, thesis, dissertation or seminar work involving human subjects

The title of a project: Case Study of Physiotherapy in ankle distortion with ligament strain

Project form: Bachelor thesis

Period of realization of the project: January 2022 – August 2022

The research will be carried out in accordance with the valid epidemiological measures of the Ministry of Health of the Czech Republic.

Applicant: Filip, Hulinský, UK FTVS department of Physiotherapy

Main researcher: Filip, Hulinský, UK FTVS department of Physiotherapy

Workplace: Centrum léčby pohybového aparátu (CLPA)

Co-researcher(s):

Supervisor: Mgr. Kateřina Maršáková

Financial support: no financial support

Project description: Writing Bachelor's thesis based on my patient diagnoses. My patient had an ankle distorsion with strained ligamentus lateralis. Methods for therapy will include soft-tissue, manual methods, stability training, strength training, sensomotorics, and joint mobilizations. My therapies will include equipment such as: overball, different types of pads, theraband, stability bord, and posturomed.

Characteristics of participants in the research: There is 1 participant whos injury (ankle distorsion) I will treat. My patient is male and 58 years old. It is a patient that has been assigned to me in CLPA, which is a work placement where I'm doing by Bachelor's practice. Patients with acute (especially infectious) diseases do not participate in therapy.

Ensuring safety within the research: The patient will not be in any risk. All techniques that I will use are not dangerous for health of my patient, further more I will have my supervisor there with me to control my technique. The supervisor name is Bc. Tereza Lavingerová. Non-invasive methods will be used only. Risks of the research will not be higher than the commonly anticipated risks for this type of research.

Ethical aspects of the research: Data will be collected in line with the rules given by European Union no. 2016/679 and the Czech Act no. 110/2019 Coll. – on personal data processing.
The collected data will be anonymized within one week after the end of working with the patient. I understand that anonymization means that the text does not use any item of information or combination of Items that could lead to the identification of a person. I will be careful not to enable recognition of a person in the text of the thesis, especially within the anamnesis. After the text has been anonymized, any personal data still kept elsewhere will be deleted.
Photographs of the participant will be anonymized within one week after being taken by blurring the face, parts of the body or any characteristics that could lead to identification of the person. After anonymization any non-anonymized photographs will be deleted.
All collected data will be safely stored on a PC safeguarded by a keyword in a locked room, any data in paper form will be kept safely under lock and key in a locked room. The data will be processed, safely retained and published in an anonymous way in the bachelor thesis.
Photographs: Photographs of the participant will be anonymized within one week after being taken by blurring the face, parts of the body or any characteristics that could lead to identification of the person. After anonymization any non-anonymized photographs will be deleted.
All collected data will be safely stored on a PC safeguarded by a keyword in a locked room, any data in paper form will be kept safely under lock and key in a locked room. The data will be processed, safely retained and published in an anonymous way in the bachelor thesis.
I shall ensure to the maximum extent possible that the research data will not be misused.

Informed Consent: attached

It is the duty of **all participants of the research team** to protect life, health, dignity, integrity, the right to self-determination, privacy and protection of the personal data of all research subjects, and to undertake all possible precautions.

CHARLES UNIVERSITY
FACULTY OF PHYSICAL EDUCATION AND SPORT
José Martího 31, 162 52 Prague 6-Veleslavín

Responsibility for the protection of all research subjects lies on the researcher(s) and not on the research subjects themselves, even if they gave their consent to participation in the research. All participants of the research team must take into consideration ethical, legal and regulative norms and standards of research involving human subjects applicable not only in the Czech Republic but also internationally.
I confirm that this project description corresponds to the plan of the project and, in case of any change, especially of the methods used in the project, I will inform the UK FTVS Ethics Committee, which may require a re-submission of the application form.

In Prague, 13.01.2022 Applicant's signature:

Approval of UK FTVS Ethics Committee

The Committee: Chair: Doc. PhDr. Irena Parry Martínková, Ph.D.
Members: Prof. PhDr. Pavel Slepička, DrSc. Prof. MUDr. Jan Heller, CSc.
PhDr. Pavel Hrásky, Ph.D. Mgr. Eva Prokešová, Ph.D.
Mgr. Tomáš Ruda, Ph.D. MUDr. Simona Majorová

The research project was approved by UK FTVS Ethics Committee under the registration number: 04/2022
Date of approval: 14.1.2022

UK FTVS Ethics Committee reviewed the submitted research project and **found no contradictions** with valid principles, regulations and international guidelines for carrying out research involving human subjects.

The applicant has met the necessary requirements for receiving approval of UK FTVS Ethics Committee.

UNIVERZITA KARLOVA
Fakulta tělesné výchovy a sportu
José Martího 31, 162 52, Praha 6
Stamp of UK FTVS

Signature of the Chair of
UK FTVS Ethics Committee

Attachment No.6 - Informed consent

UNIVERZITA KARLOVA
FAKULTA TĚLESNÉ VÝCHOVY A SPORTU
José Martího 31, 162 52 Praha 6-Veleslavín

INFORMOVANÝ SOUHLAS

Vážená paní, vážený pane,

v souladu se Všeobecnou deklarací lidských práv, nařízením Evropské Unie č. 2016/679 a zákonem č. 110/2019 Sb. – o zpracování osobních údajů, Helsinskou deklarací, přijatou 18. Světovým zdravotnickým shromážděním v roce 1964 ve znění pozdějších změn (Fortaleza, Brazílie, 2013) a dalšími obecně závaznými právními předpisy Vás žádám o souhlas s prezentováním a uveřejněním výsledků vyšetření a průběhu terapie prováděné v rámci praxe na[1] ……., kde Vás příslušně kvalifikovaná osoba seznámila s Vaším vyšetřením a následnou terapií. Výsledky Vašeho vyšetření a průběh Vaší terapie bude publikován v rámci bakalářské práce na UK FTVS, s názvem[2] ……

Cílem této bakalářské práce je ……

Získané údaje, fotodokumentace, průběh a výsledky terapie budou uveřejněny v bakalářské práci v anonymizované podobě. Osobní data nebudou uvedena a budou uchována v anonymní podobě. V maximální možné míře zabezpečím, aby získaná data nebyla zneužita.

Jméno a příjmení řešitele ..... Podpis:.....

Jméno a příjmení osoby, která provedla poučení[3]..... Podpis:.....

Prohlašuji a svým níže uvedeným vlastnoručním podpisem potvrzuji, že dobrovolně souhlasím s prezentováním a uveřejněním výsledků vyšetření a průběhu terapie ve výše uvedené bakalářské práci, a že mi osoba, která provedla poučení, osobně vše podrobně vysvětlila, a že jsem měl(a) možnost si řádně a v dostatečném čase zvážit všechny relevantní informace, zeptat se na vše podstatné a že jsem dostal(a) jasné a srozumitelné odpovědi na své dotazy. Byl(a) jsem poučen(a) o právu odmítnout prezentování a uveřejnění výsledků vyšetření a průběhu terapie v bakalářské práci nebo svůj souhlas kdykoli odvolat bez represí, a to písemně zasláním Etické komisi UK FTVS, která bude následně informovat řešitele.

Místo, datum .....

Jméno a příjmení pacienta ..... Podpis pacienta: .....

Jméno a příjmení zákonného zástupce[4] .....

Vztah zákonného zástupce k pacientovi ..... Podpis: .....