CHARLES UNIVERSITY IN PRAGUE

FACULTY OF PHYSICAL EDUCATION AND SPORTS

Departement of Physiotherapy

Case Study of a Physiotherapy Treatment of a patient with Ankle fracture

Bachelor thesis

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Dedication

I dedicate this bachelor thesis to my wonderful family in Saudi Arabia my Father, My mother, my brothers and my beautiful twins sisters for their great support and understanding from all views. I dedicate it to a very special lady Violetta for changing my life and helping me to go throw my entire study. to my best friends, Ahmad, Irina and Tanja for them support and being my second family Also to Kafkova Marika for being not only a teacher but a mother in Prague. It is also dedicated to the university staff who were cooperating with students in a nice manner especially my professors for everything that they gave me during my study.

Abstract

Title:

A Case- Study of physiotherapy treatment of a patient who has experienced ankle fracture in his right leg.

Goal:

The main objective of this thesis is the discuss all information related to ankle fracture along with the rehabilitation plan to recover the ankle fracture, which will be discussed in the theoretical and practical section of this thesis. The theoretical part highlights the historical information, lower extremities anatomy, biomechanics and kinesiology of the ankle joint, different injury types and the rehabilitation plan. The clinical picture and the etiology of this fracture along with specific tests for ankle fractures will also be discussed. The practical part presents a male patient case study that recently experienced ankle fracture.

Methods:

The rehabilitation process of this patient majorly focused on the use of isometric exercises, soft tissue techniques, sensorimotoric exercises and muscle stretching and strengthening. It included a total of 8 therapy sessions where each session lasted for 30 minutes to 60 minutes along with two additional sessions where the initial and final kinesiologic examinations were performed.

Results:

During these two weeks of rehabilitation, the patient demonstrated considerable improvement in his ankle condition and had increased the active and passive range of motion in his broken ankle. He also reported a decrease in the pain intensity and was able to walk independently and smoothly.

Conclusion:

Based on the initial and final kinesiologic examination, it was evident that the patient demonstrated a high level of satisfaction with the improvement in his ankle condition. The rehabilitation therapies aided him in being fully active and independent.

Key words:

Ankle fracture, ankle joint, rehabilitation, kinesiology.

Declaration

I declare that this Bachelor Thesis is my own work written independently with information and sources taken from literature which I have stated and based on knowledge gained from the lectures during my academic studies in Fakulta Telesné Výchovy a Sportu, Univerzita Karlova v Praze. Neither the thesis nor any other part of it has already been submitted or presented for the obtainment of any other degree.

Prague, April 2017

Acknowledgments

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Contents

1. INTRODUCTION

Ankle Fractures are the commonest injuries that are treated by most orthopedic surgeons (Goost, et al., 2014). It has been the main subject of focus in numerous articles and research studies that discussed ankle fractures, its mechanism, classification of different types of fractures and their treatment modalities. The ankle is one of the strongest mortise joint (also known as the woodwork joints or the talocrural joint) in the body, which is the formation of a hinge joint by the lower end of the tibia and the fibula that articulates with the talus (American Academy of Orthopedic Surgeon, 2015). Ankle fractures occur when one or both sides of an ankle are completely or partially broken due to twisting injuries or falls or injuries experienced during play, or sports (DeAngelis, Eskander, & French, 2007). Most ankle fractures were more frequently reported among men under the age of 50 years while over the age of 50 years, most ankle fractures have been reported in women (Moseley, Beckenkamp, Haas, Herbert, & Lin, 2015).

The fracture type highly varies from simple fracture to complex fracture and might or might involve one or all the three bones of the ankle joint. Irrespective of the intervention methods, the primary goals of the orthopaedics are to restore the normal anatomy of the ankle. The complication associated with both the operative and non- operative management are the most important and primary consideration in the decision- making process (Bugler, White, & Thordarson, 2011). For certain types of fractures such as the undisplaced injuries, the most appropriate management is the non- operative treatment as the operative management of such injuries can expose the patients to unnecessary risks of operations/ surgeries and is also deemed by experts as “over treatment” (Costigan, Thordarson, & Debnath, 2007).

In cases of ligamentous injuries or fractures of the ankle, ankles become unstable due to its anatomical structure. Ankle fractures are treated with different

methods of internal fixation devices; however, the best possible implant as reported by experts can be only determined based on the anatomy of the ankle fracture (Lamontagne, Blachut, Broekhuyse, O'Brien, & Meek, 2002). However, the ankle mobilization protocol during the post- operative period has been a heated controversy. The outcomes of this type of fractures are of prime importance, as it is important that the treatment of the ankle fracture not only benefit the patients in the short- term but also in the long- run.

The treatment of the ankle fractures has its own challenges especially in cases where the co- morbid conditions such as the neuropathic conditions, peripheral vascular disease, and diabetes mellitus, which complicate the fracture condition as well as the treatment process. These conditions can also majorly influence the overall outcomes of the treatment process. Good results are expected only through a thorough understanding of the injury mechanism, ankle anatomy, radiograph injury and its adherence to the basic principles of management of the ankle fracture (Appleton & McQueen, 2006).

At present, the conventional management approaches during the rehabilitation ignore the impaired accessory movement roles that increase the recurrent injury susceptibility. Hoch (2010) recommended the use of manual therapy in case of restriction in physiological motion or range of accessory at the ankle is an experience. However, research studies related to the manual therapy usage for the talocrural joints have produced only controversial results. Studies have demonstrated that single mobilization technique application to the talocrural joint increases in loss of dorsiflexion (DF). Other manual therapy techniques such as High- Velocity Low Amplitude (HVLA) thrust and Still technique were also assessed and no change in the DF was reported (Greenman, 2003). The combination of multiple treatment techniques has also demonstrated considerable improvements in the DF post successive treatments.

Therefore, the restoration of the patient’s ankle anatomy and the ability of the patient to walk normally and independently again majorly depend on the success of the physiotherapy provided and on the therapeutic manipulation. (Evans & & Lucas, 2010)

1.1 Historical Data and Literature review

Lindsjo (1985) was the first to introduce different classifications for the ankle fracture. Following which, Bromer (1922) classified it as an external rotation leading to abduction and adduction injuries. Percival Pott was the first to develop the classification system for ankle fractures and described it in terms of the involved malleoli number, thereby classifying the injuries into unimallelor, bimalleolar, and trimalleolar (Pott, 1996). However, even though this system was easy to use when used with better intraobserver reliability, yet it fails to distinguish between injuries that are stable and unstable.

Later, Lauge Hansen's classification system became the pioneering system, which gave positive outcomes out of the conservative treatments provided. Later AO group had put forward the Danis Weber classification, which was first developed by Danis and then was modified by Weber (Weber, 1996). Today, there are two other types of classification system that tries to aid the distinction between the stable and unstable injuries: 1. The Weber classification system and 2. The Lange– Hansen system. The former categorizes the fractures based on the position of the distal fibular fracture with respect to the syndesmosis, while the later is a mechanistic classification method, where it firstly describes the foot position at the time of injury and secondly describes the ankle's deforming force to provide more information on the stability. The later also enables the physicians to make decisions for the kind of treatment that needs to be given to the patient. However, The Danis Weber classification was reported to be more beneficial or surgical treatments that the non- operative ones.

Joy (1947) later assessed the reduction obtained immediately after the post-operative period, the reduction adequacy and correlated it with the result. Different criterions were discussed and the Kristenson's criterion was adopted. Leeds (1984) assessed bimalleolar and trimalleolar fractures because of the supination external and pronation external rotation injuries in which syndesmotic injuries were present. He reported that the initial syndesmosis reduction and lateral malleolus fixing was ideal, thereby influenced the syndesmotic stability for a longer period, and prevent late arthritis. The syndesmosis reduction was important to achieve ankle stability in all

cases of pronation and supination external rotation injuries; however, it needs to be combined with the lateral malleolus fixation (Joy, 1974).

On the other hand, Lindsjo (1985) used the open reduction and internal fixation strategies to treat ankle fractures using the AO principle of internal fixation. The authors reported that the most decisive factors were reduction adequacy, fracture type, patient's sex, and rigid fixation, exact reduction, subsequent full weight- bearing walking, early post- operative exercises of the joint. However, this treatment led to arthrosis development post- fixation suggesting improper reduction. Bauer (1985) compared operative treatment with non- operative treatment and reported that the operative treatment was favorable; however, in the long- run the arthrosis incidence was common in the operative group than in the conservative group even if the anatomical reduction as achieved (Bauer, 1985) .

Segal (1985) later compared the ability to perform weight bearing walking in patients in both conservative and operative treatment. They reported that the patient could immediately mobilize at the end of the 1st week while the other group could mobilize by the end of the 5th week upon stable fixation. The functional brace further prevented rotational stress on the fractured ankle (Segal, 1985). Rowley (1986) when compared all the treated ankle fractures at their institute with closed immobilization and manipulation and those that were managed by surgical fixation found no difference in the gait and range of motion of the fractured ankle. Baird (1987) recommended open reduction and internal fixation of the lateral malleolus; however, the deltoid ligament is not necessary for clinical recovery. Bostman (1989) achieved medial malleolar fixation in their study using polylactide and polyglycolide and reported that bioabsorbable screws for shoed bony union and fixation and its reduction maintenance were comparable to that of the metallic implants, however, its major advantage was that it did not require removal.

Finsen (1989) when compared the bone mineral concentration in surgically fixed ankle fractures found that there was not much difference in between post-traumatic osteopenia and their selected groups and was natural and maximum in the initial seventy- six months post- trauma but it stabilized later and needed improvement. Marti (1990) studied the malunited ankle fractures treated with reconstructive osteotomies and reported that complete anatomical alignment restoration of the joint should be attempted irrespective of the amount of time elapsed and malunion. They further indicated that lateral or shortening rotation of the lateral

malleolus that resulted in the mortise widening and talus tilting was the commonest cause of malunion. Winkler (1990) proved that the antiglide plate fixation in lateral malleolus fixation in case of Weber fractures type B was bio- mechanically sound and recommended its use in case of osteoporotic bones.

Carrage (1991) reported that fractures that recovered fast and the fixation that was performed on emergency basis showed better outcomes that those that were delayed. Cimino (1991) reported that open reduction and internal fixation in patients allowed them to mobilize immediately after the patient was able to tolerate the partial weight bearing along with crutches without any complications. Pritsch (1993) reported that the pain post- arthroscopy was majorly due to distal tibiofibular joint adhesion. Bucholz (1994) recommended the use of bio- absorbable implants so as to prevent a repeat surgery from removing the metallic implants.

Schon (1995) suggested the need for neuroarthropathy presence in the dislocation of the ankle fracture when performing open reduction and internal fixation. They also further suggested that diabetes should not interfere with the surgery or post- operative care; however, mobilization was recommended to prevent neuroarthropathy. On the other hand, Cormack (1998) reported that the risk of complications was 42% in case of an operative group who had diabetes where wound infections were the commonest complication. Connolly (1998) later confirmed Carrage (1991) findings stating that early internal fixation with restricted weight bearing is a better option to prevent complications including swelling and hyperemia around the ankle. Bibbo (2001) reported that presence of diabetes in patients who have experienced ankle fractures increases their risks of developing infections, soft tissue complications, and delayed the healing process. The delayed healing might also result in impaired bone turnover and collagen syntheses.

Literature review of existing studies implies that there been a considerable amount research conducted on ankle fracture and its treatment owing to which now the ankle fractures can be treated and physicians and physiotherapists can aid the patients in recovering their ankle anatomy and normal functionality of their lower extremities.

2. GENERAL PART

2.1.1 Anatomy of the Ankle

The ankle joint is commonly known as the woodwork joint or the talocrural joint is technically a hinge joint that is formed by the distal surfaces of tibia and fibula articulating the talus (Dananberg, 2004; Magee, 2007). Usually, the movements that take place in this joint are in the sagittal plane and comprises of dorsiflexion and plantarflexion. The primary ankle fracture or injury mechanisms occur during the movements that occur in the non- sagittal planes including the subtalar joint that comprises eversion and inversion (Kisner, Colby, & Library, 2007).

The major muscles that span the ankle joint are plantarflexors (i.e., soleus and gastrocnemius in the lower limb's posterior compartment) and dorsiflexors (i.e., the anterior tibialis that are present in the lower limbs' anterior compartment) (Palastanga, Field, & & Soames, 2006). The ligaments support the lateral and medial sides of the distal tibiofibular joint and the ankle joints (Figure 1). On the medial side of the ankle, the medial collateral ligament reinforces the ankle capsule stability. The medial collateral ligament is also commonly known as deltoid, which is a strong ligament reinforced by double layers. On the lateral side of the ankle, the lateral collateral ligament protects the capsules that are formed by three different ligaments: anterior talofibular, posterior talofibular and calcaneofibular. The anterior displacement internal joint rotation and inversion are constrained by the anterior talofibular ligament. The calcaneofibular ligament of the ankle controls the subtalar and ankle joint eversion (Denegar, Hertel, & & Fonseca, 2002).

Lastly, the posterior talofibular ligaments then control the posterior joint displacement. Since, this joint is tightly attached thus it might result in fracture of the posterior malleoli avulsion upon application of the significant amount of force. The joint at the distal tibiofibular is also known as the syndesmosis and the stability of this joint id provided by the posterior and anterior inferior interosseous ligament and the tibiofibular ligaments (Hubbard & Wikstrom, 2010).

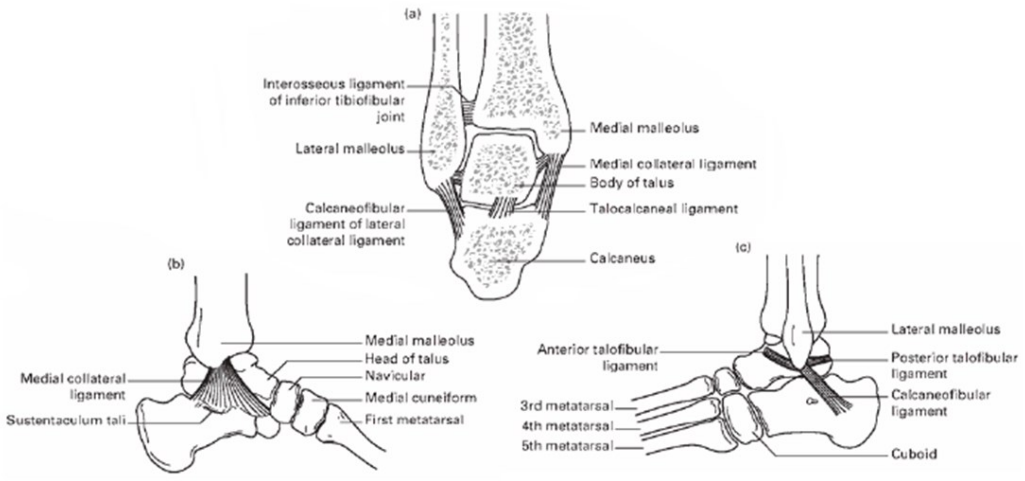

Figure 1. The ankle joint in (a) posterior view, (b) medial view, and (c) lateral view. Source: Ellis H, Mahadevan V. Clinical anatomy: applied anatomy for students and junior doctors: Wiley; 2013.[3]

2.1.2. Kinesiology of the Ankle Joint

The talocrural joint or the ankle joint is formed from the two malleoli and the tibia that receives the talus trochlea. It comprises a strong ligament that is present on the deltoid, medial side and a weak ligament on the lateral side. This weak ligament is the one that is most injured. The movements that occur on the frontal and the coronal plane are DF with 10^{o} - 30^{o} and PF with a range of motion in 45^{o} - 50^{o} (Figure 2). It is also possible to provide circumduction (Anish, Kadakia, & M., 2014).

Figure 2 . **DF and PF movements of ankle joint**
Source: Human Anatomy, AoF, 2016.

The physiological range of motion for EV is 15° to 30° and IN is 35° to 50° (Figure 3). The ankle joint is primarily important for walking and has a major role in the gait cycle, which is divided into the swing phase (which includes the 40% of the gait cycle) and the stance phase (which includes the 60% of the cycle) for one leg (Figure 4). The stance phase starts the moment the heel strikes the ground (i.e., the DF of the ankle joint), following the loading response phase (i.e., flat foot), midstance with the lower extremity support at this point followed by the terminal stance when the heel takes off from the ground (i.e., the PF of the ankle joint). The final stage is the pre- swing phase that needs both extremity support and this is the position where the toes lift off the ground and give propulsory force.

Figure 3. Inversion and Eversion movements of ankle joint. Human Anatomy, AoF, 2016

The swing phase then starts when the toes lift off the ground and it ends up striking the ground. This is done with the single support that it gets from the ipsilateral lower extremity. At this point, the body weight gets transferred to the side (Brookbush, 2011).

2.1.3 Biomechanics of the ankle joint

The biomechanics of both the ankle and the foot is very complex and intricately connected. The foot is the most important mechanical part of the body as it aids in walking and running with a steady and smooth pace. The weight of the whole body, as well as the lower end of the foot, is carried by the ankle and thus affects the foot orientation with the ground (Berme, 1985). The foot comprises 28 bones and the movements of each of these bones are interdependent. Apart from being a structural

supportive platform that withstands repeated multiplied loads of the body weight, the ankle is also capable of being adapted to varying and terrain speeds. The unique

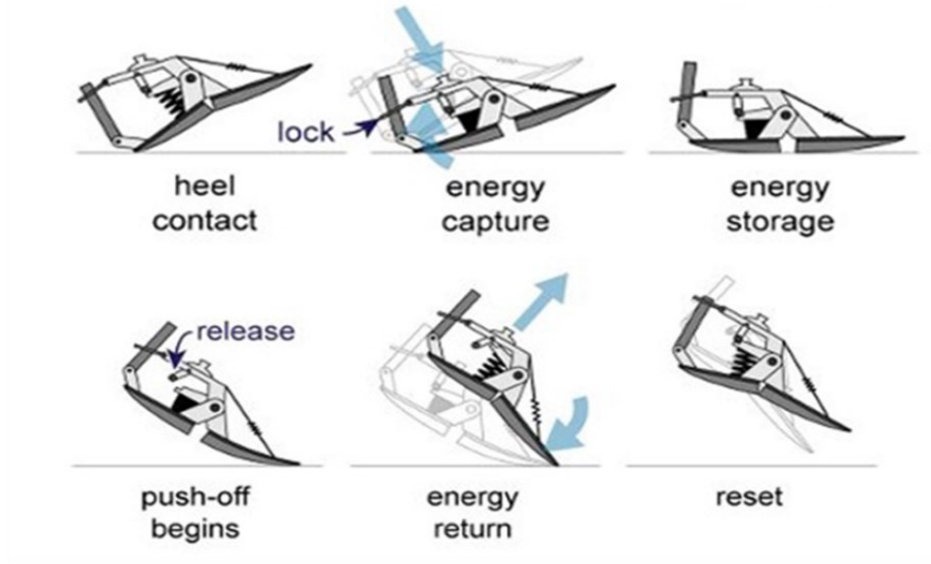

Figure 4 **Presentation of gait cycle in ankle joint , from EnviroGadget , 2010**

anatomy of the foot allows it to act rigid as well as flexible enough as and when required (Waugh, Blazevich, & Korff, 2012).

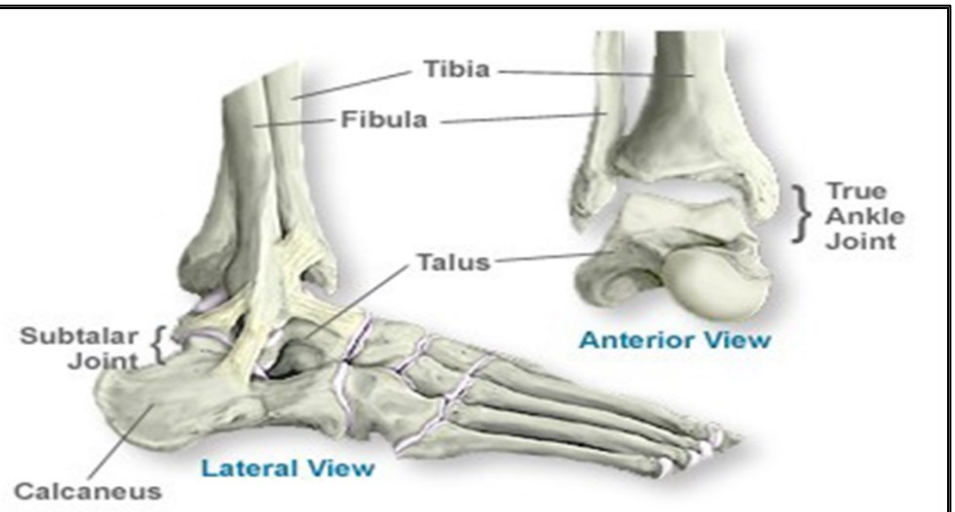

Figure 5 **Ankle structure in lateral and anterior view , from Southern California Orthopedic Institute, 2014**

The ankle joint structure is formed by the distal surfaces of tibia and fibula articulating the talus and the structure comprises a subtalar, talocrural and tibiofibular structure (Figure 5). The talocrural joint is a modified hinge; a uniaxial and synovial joint that is located in between the tibia's medial malleolus wedged shaped talus and

the fibulas' lateral malleolus (Berme, 1985). The hinge joint allows one- degree freedom of movement in both DF and plantar flexion. However, due to the talus plantarflexion shape, the DF needs to be described as a helical movement than a hinge swing movement. The structure of the joint is very unstable and its stability highly dependent on the articulation of the harmonic bone, anterior talofibular ligament, inferior tibiofibular ligament, calcaneofibular ligament and posterior talofibular ligament. The kinesiology part discussed above in section 2.1.2, has the details of the role of the ankle in various steps involved in the gait cycle. During the DF and plantarflexion, the relationship between the three joints is summarized in table 1.

Table 1. The component movements of dorsiflexion and plantarflexion

	Dorsiflexion	Plantarflexion
Proximal tibiofibular Joint	Fibula glides superiorly	Fibula glides inferiorly
Distal tibiofibular Joint	Superior glide of tibia and fibula	Inferior glide of tibia and fibula
Talocrural Joint	Talus posterior medial glide on tibia	Talus anterior lateral glide on tibia

Reproduced from Loudon and Bell (1996, p. 174) with permission from the Journal of Athletic Training.

Any kind of abnormal changes in the movement or structure of the ankle, irrespective of the degree of change, has an obvious impact on promoting, cushioning and ankle stability and edge of the foot. The change in the clinical correlation in the biomechanical function has been discussed in a number of case studies. In the Western Society, the footwear ranges from a soft moccasin to tough ski boot. The use of these external materials can further result in the alteration of the physiological biomechanics of the ankle function and the foot that eventually results in the development of different pathological conditions (Berme, 1985).

2.2. Ankle Injuries

Ankle injuries are very common and have been most reported among the young adults who are professionally and physically active (Fong, Hong, Chan, Yung, & Chan, 2007). This population accounts for approximately 10% of the total visits to

the emergency departments of the healthcare services (Walker, 2014). The commonest types of ankle injuries are ankle fracture and ankle sprain. For the majority of the cases of ankle fractures and ankle sprains, the injury mechanisms comprise a significant inversion force, which has been reported to most commonly occurring during any sports activity like, running, rugby, soccer, etc (Martin, Davenport, Paulseth, Wukich, & Godges, 2013).

2.2.1 Ankle Fractures

Ankle fractures have been reported to be very common among almost all age groups and are commonly reported in older women (i.e., 16- 20 individuals per 10,000 individuals per year) and in young men (i.e., 13- 28 individuals per 10,000 individuals per year) (Giannini, et al., 2013; Robertson, Wood, Aitken, & Court Brown, 2014). The annual incidence of ankle fractures overall has been reported to occur in every five individual per 10,000 individuals (Scott, 2010; Singer, McLauchlan, Robinson, & Christie, 1998). Most ankle fractures have been reported to occur mostly during sports activity, which accounts for approximately 7% of the total sports- related fractures (Court-Brown, Wood, & Aitken, 2008). As a whole, the prevalence of ankle fractures has increased by 25% in the past 15 years i.e., 1986 to 2010, especially among the older population, where women who have osteoporosis have been reported to be most susceptible (De Boer, Schepers, Panneman, Van Beeck, & Van Lieshout, 2014). Osteoporosis, obesity, diabetes, and history of ankle injury are some of the common risk factors that are associated with the fracture of the ankle.

Ankle fracture usually occurs as a result of excessive angular or rotational force on the foot that is in relation to the limbs that leads to an excessive inversion stress (Nightingale, Moseley, & Herbert, 2007). A fracture can be further classified into the stable fracture and unstable fracture, which is determined based on the whether or not the fragments were dislocated. If in case, the bone separation gap is greater than 3mm then the fracture is said to be significant clinically. In such scenario, the ankle injury will be treated as an ankle fracture (discussed in section 2.4), while on the other hand, the insignificant fractures will be treated as an ankle sprain (discussed in section 2.2.2). The fracture usually comprises of medial, posterior, or lateral malleolus, where 2 or more malleoli are considered as a severe type of

fractures (Figure 6). In the severe cases, the ankle fractures usually include the syndesmosis rupture between the distal fibula from the tibia (Stiell, et al., 1992).

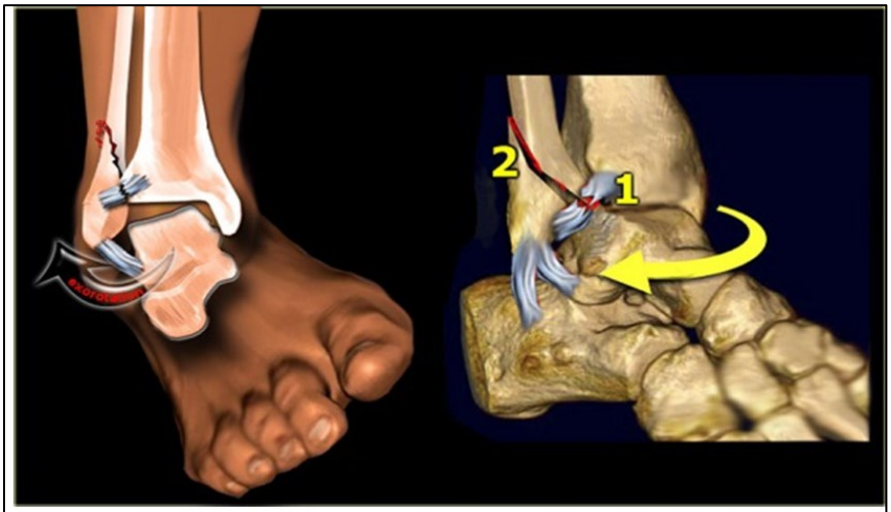

Figure 6: Ankle Fracture. Source: NewHealthAdvisor, 2015

2.2.2 Ankle Sprain

The ankle sprains are considered among the commonest type of musculoskeletal injuries that occurs in the lower limb where most injuries being reported to occur during exercise or sports activity (De Boer, Schepers, Panneman, Van Beeck, & Van Lieshout, 2014). The incidence of ankle sprain has been reported to occur in over 206 individuals per 100,000 individuals annually and is more common among young adults (i.e., 700 per 100,000 in individuals who are between 15 to 19 years of age). Approximately 85% of the ankle sprains comprises of lateral aspects of the ankle since most of it takes place during an inversion foot injury that occurs in a certain degree of plantarflexion (Solveborn, 2014). Usually, anterior talofibular is the first lateral ligament followed by the calcaneofibular that get affected or injured during a lateral ankle sprain. However, the involvement of the posterior talofibular ligament has been reported to be rare (Doherty, et al., 2014). The lateral sprains are further classified into Grade I, Grade II and Grade III. Usually, the Grade I ankle sprains does not demonstrate any ligament rupture, while the Grades II demonstrate partial and Grade III demonstrates complete rupture (Martin, Davenport, Paulseth, Wukich, & Godges, 2013 ; Lamb, Marsh, Hutton, Nakash, & Cooke, 2009).

Figure 7: Lateral Ankle Sprains. Source: AOFAS, 2016

However, the optimal mode of treating ankle sprains still remains unresolved. Such injuries are usually treated using the conventional, non- surgical methods and surgeries are considered only when the conventional treatment fails. The functional treatment guidelines for treating ankle sprain emphasizes on early bearing with support, using physical agents (such as electrotherapy and cryotherapy), using manual therapy modalities (such as joint manipulation and mobilization), sports- related activities and usual ankle exercises. In the case of severe ankle sprains, a short immobilization period has been indicated below the knee cast (Lamb, Marsh, Hutton, Nakash, & Cooke, 2009).

The functional treatment strategies usually include three different phases to biologically heal the ligament injury. In the 1st phase, the PRICE protocol (i.e., Protection, Rest, Ice, Compression, Elevation) is followed in the initial 4- 5 days to minimize the tissue inflammation and swelling. In the 2nd phase, the sprained ankle is immobilized using brace or tape to guard the ligament during the collagen proliferation phase on the 5th to 7th day. Lastly, in the 3rd phase, neuromuscular training and weight bearing training are provided to promote the orientation of the collagen fiber and also enable prevention of stiffness during the remodeling phase (Martin, Davenport, Paulseth, Wukich, & Godges, 2013).

2.3 Diagnosis of ankle injuries

Differential diagnosis of an ankle sprain and fractures are difficult because both exhibit similar mechanism of the injury that occurs because of a significant amount of inversion force that affects the lateral aspects of the ankle. The clinical presentation is also similar in acute injury and includes swelling, significant pain and tenderness in the lateral malleolus (Scott, 2010). The most common and obvious symptom upon a fracture is the inability to bear any kind of weight on the injured leg. Although it is difficult to distinguish between ankle fracture and ankle sprains, yet it is extremely important to know because the treatment process and management are very different for both. In the case of ankle sprains, it is essential to promote early mobilization and functional recovery while in the case of ankle fractures; early mobilization is difficult, as fractures require a longer time to heal. However, immobilization of the affected part for a longer period can result in ankle stiffness and limitation of the increased activity; therefore it is important to avoid unnecessary immobilization (Solveborn, 2014).

2.3.1 Medical Imaging

The gold standard for differentiating between an ankle fracture and an ankle sprain usually includes diagnostic imaging, including magnetic resonance imaging (MRI), radiography, ultrasonography, computed tomography (CT) scan, and radionuclide bone scanning. Upon experiencing a musculoskeletal trauma, the initial imaging that the patient is usually subjected to is the conventional radiography with an aim to exclude anatomic abnormalities such as identifying or determining the presence of fractures (Martin, Davenport, Paulseth, Wukich, & Godges, 2013). The complex anatomy of the injured leg is then visualized using the computed tomography and to assess any injuries in the soft tissues, the medical resonance imaging is used.

However, physicians perform radiological imaging based on the initial physical examination and patient's clinical history. The decision should consider that the radiography use can increase the time of patient stay in the emergency department and might expose the patient to unnecessary radiation and its various side- effects. It also increases the expenditure of the health system (McKinnins, 2014). Recently, the "Choosing Wisely" campaign has raised awareness among experts and practitioners about the importance of avoiding unnecessary procedure and tests. Furthermore, the

number of patients subjected to medical imaging is essential to preserve resources and improve patient safety. Moreover, the rules of clinical decision- making can be further used to determine if the medical diagnostic imaging is needed in a patient presenting signs and symptoms of an acute ankle injury (Volpp, Loewenstein, & Asch, 2012).

2.3.2 Ottawa Ankle and Midfoot Rules

The Ottawa Ankle and Midfoot rules are a set of rules that has been developed to identify patients who have a low probability of midfoot and/ or ankle fracture and doesn't require radiography imaging, thereby aiding in the clinical decision- making process. This set of rules were first introduced in the year 1992, which was later refined in the year 1993 (Stiell, et al., A study to develop clinical decision rules for the use of radiography in acute ankle injuries., 1992; Stiell, Greenberg, McKnight, & al., 1993). This rule, since then, has been implemented and validated to use in different settings and populations. The Ankle Rules indicates the need of radiography when the pain is present in the malleolar zone and in the following scenarios: 1) bone tenderness at the medial malleolus tip or at the posterior edge of the medial malleolus, 2) bone tenderness at the medial malleolus tip or at the posterior edge of the lateral malleolus, and 3) unable to bear weight immediately and when in the emergency department (Figure 8) (Spanos, Samdanis, Chytas, Beslikas, & Hatzokos, 2014; Leeflang, 2014). The rules were developed to be applied in the adults; however, theses can be used also in children above 5 years of age.

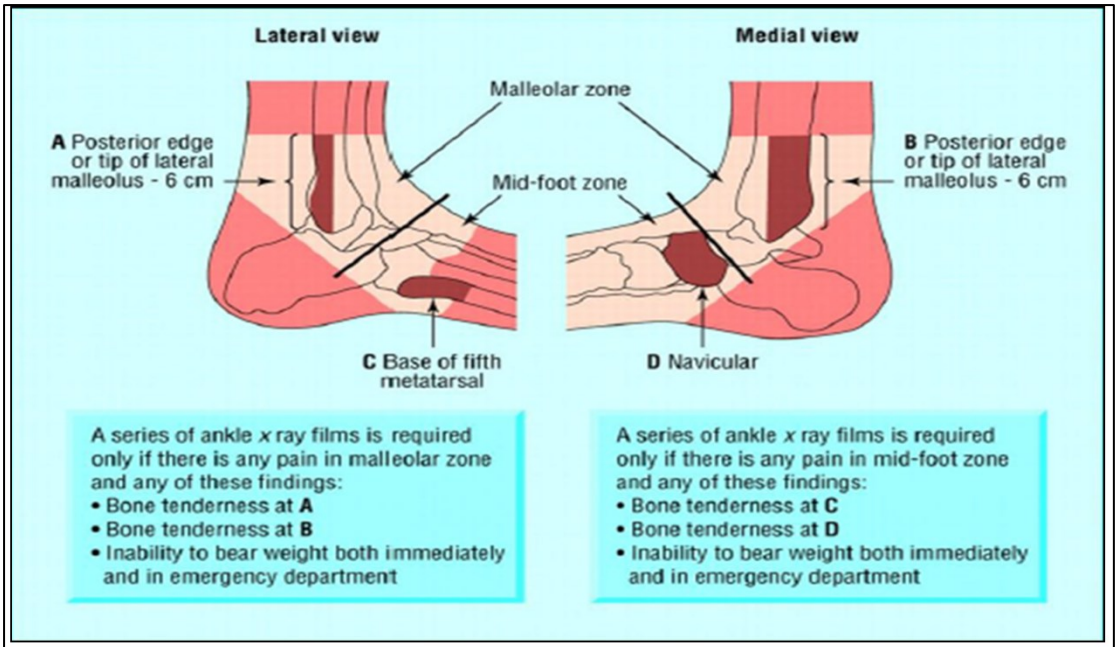

Figure 8: Ottawa Ankle and Midfoot Rules. Source: Bachmann L, Kolb E, Koller M, Steurer J, ter Riet G. Accuracy of Ottawa Ankle Rules to exclude fractures of the ankle and mid foot systematic review. BMJ. 2003;326:417-9

The accuracy and effectiveness of the diagnostic test can be measured by the sensitivity of the test (i.e., the probability of the affected individuals exhibiting positive test results) and specificity (i.e., the probability of the affected individuals exhibiting negative test results). In order to minimize the number of the missed fractures, the Ottawa Ankle and Midfoot Rules were calibrated to achieve high sensitivity, therefore, the rules give high sensitivity when are implemented on patients by practitioners in different hospital settings (Mallett, Halligan, Thompson, Collins, & Altman, 2012). However, the heterogeneity of the estimates of the specificity further prevented the pooling of earlier reviews.

Earlier reviews majorly focused on the accuracy of these rule when implemented and examined its efficacy in the emergency departments by the doctors. Nevertheless, the busy emergency departments require the participation of other healthcare professionals as well on the triage of injured patients with midfoot and ankle injuries (McClellan, Cramp, Powell, & Benger, 2010). Additionally, research studies have reported that several orthopaedic conditions can be managed appropriately in a primary care setting. Thus, these affected individuals can be triaged and provided with the initial care in different community settings so as to avoid

unnecessary visits to the emergency departments (Marinos, Giannopoulos, Vlasis, & al, 2008).

2.4 Management of Ankle Fractures

2.4.1 Orthopaedic Management

The goal of the orthopaedic management is the restoration of the anatomic alignment of the fracture of the ankle that is usually achieved either by surgical or by the non- surgical approach. However, evidence related to the beast approach is yet to be determined, yet the uncomplicated and undisplaced fractures, in general, are treated non- surgically in most cases by performing realigning the bone or closed reduction, while the displaced ones are treated using the open reduction approach using the internal surgical fixation using screws and plates (Bossuyt, Reitsma, Bruns, & al, 2004). Post- closed reduction, the ankle is placed in a below- knee brace or cast and is left immobilized for at least 4 – 6 weeks so that the bone fracture gets time to heal. Fractures with syndesmosis rupture require diastasis screw that needs to be removed post- 3 months of the surgery and patient is advised to restrict weight bearing during this period (Donken, Al-Khateeb, Verhofstad, & van Laarhoven, 2012).

2.4.2 Interventions during Immobilization

The ankle fracture immobilization is achieved with a removable brace or a cast and the patient is restricted to weight bearing on the injured leg for approximately 4- 6 weeks, depending on the stability of the fracture (Iyer, 2012). However, the most common complication associated with restricted weight bearing and immobilizations of the ankle treatment are stiffness and pain, which can result in limited activity. Thus, to address such issues, patients are provided with removable braces to enable them to practice exercises that allow a range of motion (Drakos & Murphy, 2014). Research studies report that removable braces are very advantageous from both functional and clinical aspects than casting.

2.4.3 Interventions following immobilization removal

Upon removal of immobilization for ankle fracture is done, patient experienced residual pain, decreased muscle endurance and strength, ankle stiffness and increased limitation of activity. Patients who are subjected to surgical fixation are

at higher risks of experiencing negative consequences of immobilization for a longer period. During the removal of immobilization or participating in the rehabilitation programs, that comprises exercise therapy, manual therapy and stretching post-removal of immobilization, the interventions tend to act as brief advice to address these consequences (Nightingale, Moseley, & Herbert, 2007).

Even though the impact of interventions during the immobilization phase is known, yet, there very few studies that have proved the effectiveness of the interventions post- removal of the immobilization (Donken, Al-Khateeb, Verhofstad, & van Laarhoven, 2012). A systematic search conducted found only 5 relevant articles that assessed interventions post- removal of immobilization and their outcomes are inconclusive (Psatha, Wu, Gammie, & al., 2012). However, studies proved the efficacy of the non- thermal shortwave diathermy in reducing swelling in the ankle while 4 other studies reported that combination of manual therapy, thermal shortwave diathermy, and passive stretch did not bring any advantage in the limitation of the activity, pain, and range of motion of the ankle. On the other hand, upon investigation, few other studies reported that they did not notice any difference on the limitation of the activity between patients receiving individual physiotherapy exercise program and the ones who received the standard care. However, the broad confidence interval demonstrates that the clinically valuable effect cannot be ruled out. Additionally, this particular study might have had underestimated the impacts of the intervention due to the maximum uptake of physiotherapy in the control group. This calls for the need for a well- designed trial to clarify the uncertainty (Nilsson, Jonsson, Ekdahl, & Eneroth, 2009).

Furthermore, the intervention program uptake majorly depends upon the cost-effectiveness and effectiveness of the given intervention by considering both the consumers' and healthcare perspectives. Only one study, so far, has evaluated the cost of rehabilitation post- removal of immobilization. The outcomes f the study indicated no difference in activity limitation in both the groups at the end of 4^{th} week of the removal of immobilization and further concluded that the costs associated with outpatient physiotherapy were considerably high post- 24 weeks of course where the health care costs were 38.6% and the out- of- pocket costs were 41.7%. However, the differences in the costs associated with the physiotherapists' advice during the

removal of immobilization and the comprehensive physiotherapy rehabilitation program are yet to be determined (Moseley, Herbert, Nightingale, & al., 2055).

Certain subgroups of patients with ankle fracture tend to be more benefitted from the rehabilitation programs. Studies have revealed that the impact of the interventions differs from one age group to another i.e., the effects were greater in the younger age group than the age group that included patients above 40- years (Lin, Moseley, Haas, Refshauge, & Herbert, 2008). The two probable groups that might majorly benefit from the rehabilitation programs post removal of immobilization are the older women and individuals with severe ankle fractures. Considering the probable reasons of why this group of patients receives maximum benefit from the rehabilitation program, it is important to further assess the outcomes by conducting an adequately powered and well- designed study (Seiger, 2009).

2.5 Etiology and Clinical Picture

2.5.1 Etiology

One of the major and common causes of ankle fractures are low- energy falls. Several research studies indicate that the percentage of ankle fractures reported is as a result fall ranges from 38 % - 80 % (Court-Brown, Wood, & Aitken, 2008). Following this, other most common causes include inversion injury that accounts for 31.5% of the ankle injuries, injury due to sports activity, which accounts for 10.2%, falling down stairs accounting for 8%, falling from the height accounting for 4.5% and injuries due to motor vehicle accidents accounting for 4.2% (Doherty, et al., 2014).

2.5.2 Clinical Picture

When one of any three bones that forms the ankle joint breaks due to an automobile accident or a weak fall or any other kind of trauma can result in ankle fracture. Some of the common signs that indicate that one has broken his/ her ankle are the initiation of severe pain immediately after the incident, swelling, tenderness when touched, bruising, and inability to walk or put weight on the injured foot, deformity in the dislocated or the fractured area. An ankle fracture can also result in ligament injury or damage (Bostman, 1989).

3. SPECIAL PART

3.1 Methodology

This case study had taken place at a medical center named Centrum Lecby Pohyboveho Aparatu Vysocany that is located at Sokolovska 810/ 304, PC 19061, Prague.

My practice with this patient started from 16/01/2016 and continued until 21/01/2017.

This clinic is specialized in both orthopedics and providing rehabilitation to the patients.

However, the care provided by the expert staff of this clinic offers a wide range of therapies that varies from all types of orthopedics and surgery to Sport injury/ General injury rehabilitation and also accommodates inpatients in special kind of rooms comprising of maximum 2 beds, for post- surgery and out- patients with ambulance services, which works and are available during the morning hours.

It provides a wide range of different therapeutical methods and techniques, including hydrotherapy, electrotherapy, massage along with fully equipped fitness room. The equipment used by the expert staff for rehabilitation therapies are latest in the market.

The facility also provides all the means of therapies comprising:

- electrotherapy (magnetotherapy, shockwave)
- hydrotherapy (under water massage for whole body/ lower extremities/ upper extremities, whirlpool, spa program)
- gym (muscle strengthening machines, bicycles, sensorimotoric training equipment, overballs, treadmills)

My supervisor for this study was PhDr. Edwin mahr PhD. and all the assessments and therapeutical procedures necessary for the patient were provided under his supervision and cooperation.

My patient was also informed prior to the initiation of his therapy that I will be using his case as a case study for my Bachelor's Degree Thesis and my work was

already approved by the Ethics Committee of the Faculty of Physical Education and Sport at Charles University, Prague.

3.2 Anamnesis

Examined person: J.M (Male).
Date of birth: 1996.
Diagnosis: Ankle fracture (Right lower extremity).

Present state (Status presents):
Height: 1,82cm
Weight: 63kg
Body Mass Index: 19.0 (normal weight)

Today is my first contact with the patient i.e., 16\01\2017. He is on his second day of his physiotherapy program. He did not complain of any dizziness or pain and his face color appeared to be normal. Today, he was in a good mood as he experienced a very little or negligible amount of pain in his ankle.

Mr. J.M needs to regain his ankle functioning as much as possible on his lower extremity so that he can adjust himself back into his daily routine again.

Anamnesis/ History:

The patient experienced an ankle fracture on the 21/11/2016 and thus visited the hospital named na Bulovce, on the same day for X- ray.
The X- ray report confirmed that he had an ankle fracture and thus had the surgery on the day after i.e., 22/11/2016 where he stayed for 3 more days there.
He came at the Centrum Lecby Pohyboveho Aparatu Vysocany clinic (CLPA) on the 16/1/2017 for his first day of physiotherapy treatment, which was 8 weeks after his surgery.
The injury took place when he was performing a back- flip while he was practicing cheerleading when he landed up in the wrong way which resulted in a fracture in his right ankle joint.

Immediately after landing in the wrong way, he experienced severe pain and was thus immediately taken to the hospital.

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

Personal anamnesis: Common childhood diseases

Family anamnesis: No diseases connected to this orthopedic state.

Hobbies-Activities of Daily Living: Rugby (which he stopped playing 3 years ago), Cheerleader was his main activity now.

Social anamnesis: The patient is living on the first floor with his family. There is an elevator but he prefers to walk up/down the stairs. He uses 10 stairs.

Occupation: The patient is a technician of medical equipment. He needs to drive for many hours per day.

Allergic anamnesis: Flowers, celia

Operation anamnesis: None

Pharmaceutical anamnesis: None

Abuses: None

Diet: Gluten free diet

Statement from the patient's medical documentation: None

Indication of rehabilitation:

Medical doctor's indication of rehabilitation:

The patient needs to follow a specific RHB program under the standards after fracture of ankle joint surgery.

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

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

Differential diagnosis:

An ankle fracture can occur due to various reasons as discussed above. In this case, the patient landed up in a wrong way while performing back flip during his cheerleading exercise.

After ankle fracture surgery I expect there is:

- Muscle weakness of lower extremity affected side
- Overload muscles on the non- affected side
- Shortness of the muscles on the affected side
- Blockage of the joint on the affected side more than the non- affected side
- Decrease of body balance
- Loss of sensation in the affected area
- Muscle tone imbalance
- Decrease of Range of motion on the affected side
- Hyper reflexes on affected side

3.3 Initial kinesiologic examination

Examination by observation of the patient (According to Kendall, 2005):

The examination of our patient was made in the standing position.

The type of breathing that he is using is abdominal (observation in the supine lying position).

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Anterior View:

- Lateral rotation of foot right side
- Edema on the right ankle joint
- Right knee rotated outwards (patella)
- Pelvis symmetrical both sides
- Abdominal muscles higher on the left side than the right side
- Left shoulder higher than the right one
- Difference on the distance between the two arms and the intercostals (the distance on the left hand is more than the right one)
- Left clavicle is higher than the right one
- Head shifted to the right side

Posterior View:

- Lateral rotation of feet right side more than the left side
- Edema on the right ankle joint (Achilles tendon not visible on the right side due to edema after the surgery)
- Hypotrophy of gastrocnemius muscle on the right side (affected side)
- Knees symmetrical
- Right scapula rotated outwards.

- The space from the right scapula to the spine is smaller than the left scapula.
- Left shoulder higher than the right one
- Head shifted to the right side

Lateral View: (Left side)

- Toes normal press and symmetrical
- Knees symmetrical
- Flat back posture
- Both scapulas are visible
- Shoulder protracted
- Head in normal position

Lateral View: (Right side)

- Lateral rotation of foot
- Ankle joint swollen
- Knees symmetrical
- Scapula not visible from this side
- Spine not visible from this side
- Head in normal position

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

The patient has two scars (One is on the medial side of the ankle joint 6cm and the other on the lateral side of the ankle joint 9cm) that have healed successfully.
The ankle joint was swollen; the skin around the scars was red in color and with increased temperature on the ankle area.

Anthropometry Measurements:

Circumferences:

	Right	Left
Thigh: (15 cm above knee cap for the whole quadriceps)	41cm	42cm
(10 cm above knee cap for vastus medialis)	37cm	37cm
Knee cap:	35cm	35cm
Calf:	33cm	36cm
Ankle:	28cm	24 cm

Table 2: Circumference measurements for both lower extremities (LE's)

Length of lower extremity in parts :

	Right	Left
Femur	39cm	39cm
Lower Leg	48cm	48cm
Foot	25cm	25cm

Table 3: Length of both the lower extremities in parts

Functional length:

Right	Left
103cm	103cm

Table 4: Functional length measurement for both LE's

Anatomical length:

Right	Left
87 cm	87 cm

Table 5: Anatomical length measurement for both LE's

ROM examination (According to Kendal):

Ankle Joint:

RIGHT	LEFT
S : 45 - 0 - 10 F : 5 - 0 - 20	S : 60 - 0 - 10 F: 10 - 0 - 25

Table 6: ROM Examination of the ankle joint for both LE's

Toes:

	Right	Left
Big toe: (proximal phalanx)	S : 50 – 0 – 80	S : 70 – 0 - 80

Table 7: ROM examination in the toes for both Lower Extremities (LE's)

Basic movement patterns (According to Janda, 2013):

Hip abduction:

During the examination of the hip abduction, the patient demonstrated the correct pattern. He first contracted:

- the gluteus medius and minimus
- tensor fascia latae
- quadrates lumborum.

Hip extension:

During the examination of the hip extension, the patient demonstrated a correct pattern. He first contracted:

- the gluteus maximus muscle
- the hamstrings
- the spinal extensors
- the shoulder girdle muscles.

GAIT examination (According to Kendall, 2005):

We asked the patient to walk in the room from one door to the other so that we can observe his gait movement.

During walking his walking we noticed that he was able to walk quite fluently and quiet fast. Other factors that we noticed during his walk are listed below:

- Heal strike wasn't presented due to pain
- Lateral rotation of the right ankle more than the left one
- Asymmetry of shoulders (left shoulder higher than the right one)
- Swinging his left hand more than the right one
- Slightly limping his right lower extremity (affected side)
- Putting more body weight during one leg stance on the left lower extremity
- No rotation in trunk

Gait modification:

- Walking on the heels: positive/ was painful for the patient but he could stand on his heels
- Walking on tip toes: positive/ was painful for the patient to walk but he could stand on tip toes
- Squats walking: positive/ was painful for the patient
- Walking with eyes closed: negative/ he was able to perform it without pain, he was stable
- Walking backward or stair walking: He was able to walk backward but during walking down the stairs he was experiencing pain and he has no problems with going up the stair.

Trendelenburg test:

The patient has to stand on one of his lower extremity and the other leg with flexion 90^{o} on hip and knee.
No pelvis drop on both side- stand.

Single leg stance:

Patient was asked to perform a simple stand on one leg.

Right leg: great balance but shaking a bit

Left leg: great balance without shaking better balance than the right one

Rhomberg test:

- (I) : standing with feet a parts and opened eyes
- (II) : feet together and opened eyes
- (III) : feet together and eyes closed

I = negative

II = negative

III = negative

Two Scale examination:

The physiological difference in loading is up to 5 kg, approximately 10% to 15% of body- weight. Bigger difference indicates an imbalance.

	Right	Left
Total:	33kg	30kg

Table 1 Amount of weight patient could bear on both his lower extremities (LRs)

Muscle tone examination:

Lower extremity:

	Right	**Left**
Gluteus maximus:	Normal tone	Normal tone
Hip adductors: (Pectineus, adductor magnus, gracilis, adductor brevis, adductor longus)	Normal tone	Normal tone
Quadriceps femoris: (Rectus femoris, vastus laterallis, v.intermedius,	Normal tone	Normal tone

v.mediallis)		
Biceps femoris:	Normal tone	Normal tone
Semi- membranosus:	Normal tone	Normal tone
Semi- tendinosis:	Normal tone	Normal tone
Soleus:	Hypotone	Hypertone
Hamstrings:	Hypotone	Normal tone

Table 9: Muscle tone examination of different parts of the Lower Extremities.

Muscle strength test (According to Kendall, 2005):

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

0 = Zero (no muscle contraction)

1 = Trace (contraction felt but no movement)

2 = Poor (partial movement but in horizontal position)

3 = Fair (hold against gravity)

4 = Good (hold against moderate pressure)

5 = Normal (hold against strong pressure)

Lower extremity:

	Right	Left
Gluteus maximus:	5	5
Gluteus medius:	5	5
Gluteus minimus:	5	5
Lateral rotators of hip joint:	5	5
Hip adductors:	5	5
Tensor fasciae latae:	5	5
Sartorius:	5	5

Iliopsoas:	5	5
Quadriceps femoris: (Rectus femoris, vastus laterallis, v.intermedius, v.mediallis)	5	5
Biceps femoris:	5	5
Semi- membranosus:	5	5
Semi- tendinosis:	5	5
Popliteus:	5	5
Plantar flexors: (Gastrocnemius, plantaris)	3+	4
Soleus:	3+	4
Peroneus longus and brevis:	4	4
Tibialis anterior:	4	4
Extensor digitorum longus and brevis:	4	4
Flexor digitorum longus:	4	4
Flexor digitorum brevis:	4	4
Dorsal interossei:	4	4
Extensor hallucis brevis:	3+	4

Table 10: Muscle strength scores of different parts of the Lower Extremities (LRs)

Muscle length test (According to Janda, 2013):

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

0 = no muscle shortness

1 = moderate shortness

2 = marked shortness

Lower extremity:

	Right	Left
Iliopsoas:	0	0
Rectus femoris:	1	0
Tensor fascia latae:	1	1
Short hip adductors:	0	0
Gluteus maximus:	0	0
Minimus:	0	0
Medius:	0	0
Piriformis:	0	0
Hamstrings:	0	0
Tibialis anterior:	1	0
Soleus:	1	0
Gastrocnemius:	1	0

Table 11: Muscle length scores of different parts of the Lower Extremities (LRs)

Joint Play examination (According to Lewit, 2009):

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

Joint name	Right	Left
Knee joint:	Not restricted	Not restricted
Patella:	Present	Not restricted
Head of fibula:	Not restricted	Not restricted
Talocrural:	Present	Not restricted
Subtalar joint: Supination	Present	Not restricted
Transverse tarsal joint: (Chopart joint)	Present	Not restricted
Tarsometatarsal joints: (Lisfranc joints)	Present	
Metatarsophalangeal joints: (1st,2nd, 3rd, 4th, 5th)	Present	Not restricted

Table 12: Assessment outcomes of the Joint Play Examination of different parts of the lower extremities (LRs)

NEUROLOGICAL EXAMINATIONS:

Sensation in dermatomes:

The patient was in supine lying position with his eyes closed in order to make a more accurate examination. We touch him with his hands on this thigh of the one lower

extremity and then on the other one. The patient was instructed to inform us if he could feel the touch and if there was any difference in between both the lower extremities.

Two types of examinations:

- First, the patient was asked to say yes when he feels the touch in different areas of his lower extremity.
- Second, the patient was asked to say yes if he feels the touch on the same level on both lower extremity

He had the same feeling on both sides; however, he reported less sensation sometimes only around the scar otherwise patient said that he was unable to understand if he feels any sensation or not around the scar on the lateral part.

Deep tendon reflex:

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

0 = Absent

1 = Hypoactive

2 = Normal

3 = Hyperactive without clonus

4 = Hyperactive with clonus

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

Table 13: Deep tendon reflex evaluation for the lower extremities (LRs)

Surface sensation (L4-S1):

L5 (from outside to inside): the patient had the same feeling on both sides
L4 (from inside to outside): the patient had the same feeling on both sides
S1 (in hamstrings) with bend knees: the patient had the same feeling on both sides

3.3.1. Conclusion

Conclusion of examination:

The patient visited our clinic right after recovering from his right ankle joint surgery. He was in a good mood and was ready to cooperate immediately. Thus, we performed few examinations on the patient in order to assess his current condition.

During anthropometry measurements, the right leg appeared to have less volume in calf muscles and had a greater number around the ankle due to edema. The patient also demonstrated less range of motion (ROM) in the direction to plantar flexion and eversion on the right ankle joint. He also displayed less ROM in the direction to plantar flexion of great toe on his right foot. He performed the basic movement pattern examination correctly with no pathology present.

During the gait and gait modification on the affected side, there were no heel strikes, lateral rotation of the right foot, and asymmetry of the shoulder. The patient was also able to stand on heels and tip- toes but was unable to walk on it, walking on squat and down stairs was also painful for him.

On the single leg stance examination, the patient performed with great balance but was bit shaking on the affected side (i.e., the right side). During the muscle tone examination, the soleus and hamstrings were observed to be hypotone on the right side while the left side soleus and hamstrings were observed to be hypertonic and therefore exhibited a normal tone.

Strength test examination demonstrated that the gastrocnemius, soleus and extensor hallucis had fair levels, which are 3+ while very low pressure was observed on the right side.

The length test examination demonstrated that the rectus femoris, TFL, tibialis anterior, gastrocnemius, and soleus had moderately shortened on the right side, and the left side TFL.

During the Joint play examination, the patella and the ankle joints were restricted to the right side.

The neurological examination showed that he had sensation on his right limb and had comparatively less sensation around the scar that was the lateral one. The deep tendon reflex showed that the right limb Achilles tendon reflex was hyperactive without any clonus.

We need to re- educate the patient about walking and his posture so as to help him restore his functionality as it was prior to the injury. We also further need to continue with the strengthening exercises and stretching exercises, especially on his shortened muscles. Lastly, to achieve better results, the patient needs to perform his exercises regularly and needs to follow all our instructions.

3.4. Short- term and long-term rehabilitation plan

Short term:

- Our goal is to reduce patient's edema
- Scar care
- Increase Range of Motion
- Unblocked the blocked joints
- Increase the proprioception
- Re- education of walking
- Decrease the instability

Long term:

- Re- education of walking
- Decrease pain
- Restore ROM
- Increase balance
- Increase patient confident about his ankle

Goals of therapy:

- Eliminate the pain
- Decrease the edema
- Increase of Rang of Motion
- Increase the stability
- Increase the sensation of the affected area

3.5. Therapy progress

Date: 16/01/2017

Status Present:

The patient is 8 weeks post- ankle fracture surgery. The scars have healed successfully but there is swelling in ankle joint on the right side of the right lower extremity, 1st therapy set.

Subjective:

The patient said that he still experiences pain in his ankle when he wakes up every morning and also when he is stepping on it.

Objective:

The patient is in a good mood and is willing to cooperate, it is his first day of treatment. Good communication, mentally normal, no assistive devices, left dominant limb. The patient has pain on his right ankle joint due to surgery and he has a limitation in the range of motion plus swelling.

Goals of today's therapy unit:

- Reduce pain/edema
- Scar care treatment
- Increase of sensation
- Gait re-education
- Increase range of motion
- Strengthening of weak muscles
- Stretching of shortened muscles
- Increase balance

Procedure:

Soft tissue techniques: First by hands then by a soft ball for increasing the blood circulation on the area, decreasing the pain and edema.

Scar therapy: Examination of the elasticity (elastic in all directions), massaging the scar (Kippler's fold, "S" shape, "D" shape, "C" shape, tapping, pressing on the scars and on the sides).

Increase Sensation: By providing touch therapy around the scar area.

Gait re-education: Starting from the heel strike ending by the tip-toes. We also corrected his posture during walking (Swinging in shoulders and hands, rotation of trunk).

Mobilization techniques of the ankle joint and also the Chopart's joint and Lisfranc to increase the range of motion in the ankle and Achilles tendon

Active exercises in the GYM in the standing position to strengthen the weak muscles around the ankle joint (calf muscle).

PIR technique: To relax and stretch the shortened muscles (gastrocnemius, soleus)

SMT: For increasing the balance and proprioception of the patient

Group of sensorimotoric exercises: on soft pad, with wobble boards and difficulties

- walking on a soft pad (forward, backward, and side walk both sides)
- Walk on wobbles boards
- Walk on the wobbles boards moving hands up and down
- Walk on the wobbles boards holding a ball throw it up and catch it again
- Walk on the wobbles boards and I throw him the ball, he catches it back and throws it back to me.

Group of sensor motoric exercises: balance board-posturomed

- Stand up with both legs on the board trying to balance moving forward and sideways. 5 repetitions
- Walking on board, standing in the middle of the board and then going down again. 5 repetitions
- Walking sideways, step with one leg up and then with the other staying on the board for 3 seconds and again down with one leg and then the other. 5 repetitions

Results:

Pain reduced, restoring the ROM by opening the blockage in ankle joint using traction technique.

Date: 17/01/2017

Status Present:

The patient is on his 2nd therapy set, feels pain in his ankle joint but less than the day before, no changes in ROM.

Subjective:

The patient said that he felt pain in the morning and could not move his right foot to the direction of plantar flexion. He also pointed out that he could not move, not because of the pain but because of the stiffness of the Achilles tendon.

Objective:

The patient is in a good mood and willing to cooperate, good communication, mentally normal, no assistive devices, left dominant limb. The patient has pain on his right ankle joint due to surgery and he has a limitation in the range of motion and there is also some swelling.

Goals of today's therapy unit:

- Reduce pain
- Scar therapy
- Restore ROM
- Increase balance
- Stretched shorten muscles
- Strengthening of weak muscles

Procedure:

Soft tissue techniques: First by hands and then by using soft ball for increasing the blood circulation in the area, decreasing both pain and edema.

Scar therapy: Examination of elasticity (elastic in all directions), massaging the scar (Kippler's fold, "S" shape, "D" shape, "C" shape, tapping, pressing on the scars and on the sides).

Increase Sensation: By providing touch therapy around the scar area.

Gait re- education: Starting from heel strike ending by the tip-toes. We also corrected his posture during walking (Swinging in shoulders and hands, rotation of trunk)

Mobilization techniques of the ankle joint also Chopart's joint and Lisfranc to increase the range of motion in the ankle.

Active exercises in the GYM in the standing position to strengthen the weak muscles around the ankle joint (calf muscle).

PIR technique: To relax and stretch the shortened muscles (gastrocnemius, soleus)

SMT : For increasing the balance and proprioception of the patient

Group of sensorimotoric exercises: on soft pad, with wobble boards and difficulties

- walking on a soft pad (forward, backward, and side walk both sides)
- Walk on wobbles boards
- Walk on the wobbles boards moving hands up and down
- Walk on the wobbles boards holding a ball throw it up and catch it again
- Walk on the wobbles boards and we throw him the ball, he catches it and then throws it back to us.

Group of sensor motoric exercises: balance board- posturomed

- Stand up with both legs on the board trying to balance moving forward and sideways. 5 repetitions
- Walking on board, standing in the middle of the board and then going down again. 5 repetitions
- Walking sideways, step with one leg up and then with the other staying on the board for 3 seconds and again down with one leg and then the other. 5 repetitions

For strengthening of the muscles: Exercise at the gym

Calf raise exercise: Patient stands in front of the mirror with hands support. He practices calf raise on his tiptoes using his both lower extremities. 3 sets of 6 repetitions.

Results:

Decrease pain, reduce swelling

Date:18/1/2017

Status Present:

The patient is on the 3rd therapy set after ankle fracture surgery. He also has swelling around the ankle joint

Subjective:

The patient said that he experiences pain in his ankle when he wakes up also when he is stepping on it but the pain is less than the previous days.

Objective:

The patient is in a good mood and willing to cooperate, it is his 3rd day of treatment. Good communication, mentally normal, no assistive devices, left dominant limb, no glasses

Goals of today's therapy unit:

- Reduce pain
- Scar care treatment
- Increase of sensation
- Gait re-education
- Increase range of motion
- Strengthening of weak muscles
- Stretching of shortened muscles

- Increase balance

Procedure:

Soft tissue techniques: First by hands then by a soft ball for increasing blood circulation on the area, decreasing pain and edema.

Scar therapy: Examination of elasticity (elastic in all directions), massaging the scar (Kippler's fold, "S" shape , "D" shape, "C" shape, tapping, pressing on the scars and on the sides).

Increase Sensation: By providing touch therapy around the scar area.

Gait re-education: Starting from heel strike ending by the tip-toes. We also corrected his posture during walking (Swinging in shoulders and hands, rotation of trunk)

Mobilization techniques of Achilles tendon and the ankle joint also Chopart's joint and Lisfranc to increase the range of motion in the ankle.

Active exercises in the GYM in standing position to strengthen the weak muscles around the ankle joint (calf muscle).

PIR technique: To relax and stretch the shortened muscles (gastrocnemius, soleus, hamstrings)

SMT: For increasing the balance and proprioception of the patient

Group of sensorimotoric exercises: on soft pad, with wobble boards and difficulties

- walking on a soft pad (forward, backward, and side walk both sides)
- Walk on wobbles boards
- Walk on the wobbles boards moving hands up and down
- Walk on the wobbles boards holding a ball throw it up and catch it again
- Walk on the wobbles boards and we throw him the ball, he catches it and throws it back to us .

Group of sensor motoric exercises: balance board-posturomed

- Standing up with both legs on the board trying to balance moving forward and sideways. 5 repetitions
- Walking on board, standing in the middle of the board and then going down again. 5 repetitions
- Walking sideways, step with one leg up and then with the other staying on the board for 3 seconds and again down with one leg and then the other. 5 repetitions

For strengthening of the muscles: Exercises at the gym

Calf raise exercise: Patient stands in front of the mirror with hands support. He practices calf raise on his tiptoes using his both lower extremities.3 sets of 8 repetitions.

Results:

Pain reduced, reduced swelling, stiffness reduced in Achilles tendon

Date:19/1/2017

Status Present:

The patient is on the 4th day of therapy set after ankle fracture surgery. There is also some swelling around the ankle joint.

Subjective:

The patient said that he experiences pain in his ankle when he wakes up and he couldn't provide plantar flexion because of stiffness in Achilles tendon also when he is stepping on it but the pain is less than before.

Objective:

The patient is in a good mood and willing to co- operate, it is his 4th day of treatment. Good communication, mentally normal, no assistive devices, left dominant limb, no glasses

Goals of today's therapy unit:

- Scar care treatment
- Increase of sensation
- Gait re-education
- Increase range of motion
- Strengthening of weak muscles
- Stretching of shortened muscles
- Increase balance

Procedure:

Soft tissue techniques: First by hands then by using a soft ball for increasing the blood circulation in the area so as to decrease pain and edema.

Scar therapy: Examination of elasticity (elastic in all directions), massaging the scar (Kippler's fold, "S" shape , "D" shape, "C" shape, tapping, pressing on the scars and on the sides).

Increase Sensation: By providing touch therapy around the scar area.

Gait re-education: Starting from heel strike ending by the tip-toes. We also corrected his posture during walking (Swinging in shoulders and hands, rotation of trunk)

Mobilization techniques of the ankle joint also Chopart's joint and Lisfranc to increase the range of motion in the ankle and to Achilles tendon.

Active exercises in the GYM in a standing position to strengthen the weak muscles around the ankle joint (calf muscle).

PIR technique: To relax and stretch the shortened muscles (gastrocnemius, soleus, hamstrings)

PNF technique: To strength and relax the calf muscle, and to strength and relax tibialis anterior 1st flexion and 1st extension diagonal lower extremities

SMT: For increasing the balance and proprioception of the patient

Group of sensorimotoric exercises: on soft pad, with wobble boards and difficulties

- walking on a soft pad (forward, backward, and side walk both sides)
- Walk on wobbles boards
- Walk on the wobbles boards moving hands up and down
- Walk on the wobbles boards holding a ball throw it up and catch it again
- Walk on the wobbles boards and then I throw him the ball, which he had to catch and throws it back to me.

Group of sensor motoric exercises: balance board-posturomed

- Stand up with both legs on the board trying to balance moving forward and sideways. 5 repetitions
- Walking on board, standing in the middle of the board and then going down again. 5 repetitions
- Walking sideways, step with one leg up and then with the other staying on the board for 3 seconds and again down with one leg and then the other. 5 repetitions

For strengthening of the muscles: Exercises at the gym

Calf raise exercise: Patient stands in front of the mirror with hands support. HeHe practices calf raise on his tiptoes using his both lower extremities. 3 sets of 10 repetitions.

Results: reduced pain , reduced swelling , reduced stiffness in Achilles tendon , patient can walk on tip toes and on heels with small pain but the calf muscles on right side still weak but stronger than before

Date: 20/1/2017

Status Present: patient is on the 5th day of therapy set after ankle fracture surgery also there is swelling around the ankle joint but the swelling is reduced now

Subjective: Patient said that he has a small pain in his ankle when he woke up and he could provide plantar flexion but not the full range of motion because of stiffness in Achilles tendon but the pain is less than all the days before.

Objective: The patient is in a good mood and willing to cooperate, it is his 5th day of treatment. Good communication, mentally normal, no assistive devices, left dominant limb, no glasses

Goals of today's therapy unit:

- Scar care treatment
- Increase of sensation
- Gait re-education
- Increase range of motion
- Strengthening of weak muscles
- Stretching of shortened muscles
- Increase balance

Procedure:

Scar therapy: Examination of elasticity (elastic in all directions), massaging the scar (Kippler's fold, "S" shape, "D" shape, "C" shape, tapping, pressing on the scars and on the sides).

Increase Sensation: By providing touch therapy around the scar area.

Gait re-education: Starting from heel strike ending by the tip-toes. We also corrected his posture during walking (Swinging in shoulders and hands, rotation of trunk)

Mobilization techniques of Achilles tendon and the ankle joint also Chopart's joint and lis franc to increase the range of motion in the ankle.

Active exercises in the GYM in a standing position to strengthen the weak muscles around the ankle joint (calf muscle).

PIR technique: To relax and stretch the shortened muscles (gastrocnemius, soleus).

PNF technique: To strengthen and relax the calf muscle, and to strengthen and relax. tibialis anterior 1st flexion and 1st extension diagonal lower extremities.

SMT: For increasing the balance and proprioception of the patient.

Group of sensorimotoric exercises: on soft pad, with wobble boards and difficulties

- walking on a soft pad (forward, backward, and side walk both sides)
- Walk on wobbles boards
- Walk on the wobbles boards moving hands up and down
- Walk on the wobbles boards holding a ball throw it up and catch it again
- Walk on the wobbles boards and we throw him the ball, he catches it back and throws it back to us.

Group of sensor motoric exercises: balance board-posturomed

- Stand up with both legs on the board trying to balance moving forward and sideways. 5 repetitions
- Walking on board, standing in the middle of the board and then going down again. 5 repetitions
- Walking sideways, step with one leg up and then with the other staying on the board for 3 seconds and again down with one leg and then the other. 5 repetitions

***For strengthening* of the muscles**: Exercises at the gym

Calf raise exercise: Patient stands in front of the mirror with hands support. He practices calf raise on his tiptoes using one lower extremity (his affected lower extremities). 3 sets of 6 repetitions.

Results: Reduced pain, reduced swelling, reduced stiffness in Achilles tendon, patient can walk on tip toes and on heels (no pain during performing) and the calf muscles on right side stronger than before.

Date:23/1/2017

Status Present:

The patient is on the 6th day of therapy set after ankle fracture surgery and there is still swelling around the ankle joint but has reduced.

Subjective:

The patient said that he experienced small pain in his ankle when he woke up and he could provide plantar flexion but not full range because of stiffness in Achilles tendon but the pain is less than before.

Objective:

The patient is in a good mood and willing to cooperate, it is his 6th day of treatment. Good communication, mentally normal, no assistive devices, left dominant limb, no glasses.

Goals of today's therapy unit:

- Scar care treatment
- Increase of sensation
- Gait re-education
- Increase range of motion
- Strengthening of weak muscles
- Stretching of shortened muscles
- Increase balance

Procedure:

Scar therapy: Examination of elasticity (elastic in all directions), massaging the scar (Kippler's fold, "S" shape, "D" shape, "C" shape, tapping, pressing on the scars and on the sides).

Increase Sensation: By providing touch therapy around the scar area.

Gait re-education: Starting from heel strike ending by the tip- toes. We also corrected his posture during walking (Swinging in shoulders and hands, rotation of trunk).

Mobilization techniques of the ankle joint also Chopart's joint and lis franc to increase the range of motion in the ankle.

Active exercises in the GYM in a standing position to strengthen the weak muscles around the ankle joint (calf muscle).

PIR technique: To relax and stretch the shortened muscles (gastrocnemius, soleus, hamstrings).

PNF technique: To strength the calf muscle first extension, and to relax tibialis anterior.

SMT: For increasing the balance and proprioception of the patient.

Group of sensorimotoric exercises: on soft pad, with wobble boards and difficulties

- walking on a soft pad (forward, backward, and side walk both sides)
- Walk on wobbles boards
- Walk on the wobbles boards moving hands up and down
- Walk on the wobbles boards holding a ball throw it up and catch it again
- Walk on the wobbles boards and we throw him the ball, he catches it and throws it back to us.

Group of sensorimotoric exercises: balance board- posturomed

- Stand up with both legs on the board trying to balance moving forward and sideways. 5 repetitions
- Walking on board, standing in the middle of the board and then going down again. 5 repetitions
- Walking sideways, step with one leg up and then with the other staying on the board for 3 seconds and again down with one leg and then the other. 5 repetitions

***For strengthening* of the muscles**: Exercises at the gym

Calf raise exercise: Patient stands in front of the mirror with hands support. He practices calf raise on his tiptoes using one lower extremity (his affected lower extremity).3 sets of 7 repetitions. Walking on tip toes to strengthen the calf muscles.

Results: Reduced pain, reduced swelling, reduced stiffness in Achilles tendon, the patient can walk on tip toes and on heels (no pain during performing) but the calf muscles on the right side are now stronger than before.

Date:24/1/2017

Status Present:

The patient is on the 7th therapy set after ankle fracture surgery and there is still swelling around the ankle joint but has reduced

Subjective:

The patient said that he has a small pain in his ankle when he woke up and he could provide plantar flexion but not full range because of stiffness in Achilles tendon but the pain is less than before.

Objective:

The patient is in a good mood and willing to cooperate, it is his first day of treatment. Good communication, mentally normal, no assistive devices, left dominant limb, no glasses.

Goals of today's therapy unit:

- Scar care treatment
- Increase of sensation
- Gait re-education
- Increase range of motion

- Strengthening of weak muscles
- Stretching of shortened muscles
- Increase balance

Procedure:

Scar therapy: Examination of elasticity (elastic in all directions), massaging the scar (Kippler's fold, "S" shape, "D" shape, "C" shape, tapping, pressing on the scars and on the sides).

Increase Sensation: By providing touch therapy around the scar area.

Gait re-education: Starting from heel strike ending by the tip-toes. We also corrected his posture during walking (Swinging in shoulders and hands, rotation of trunk)

Mobilization techniques of the ankle joint also Chopart's joint and lis franc to increase the range of motion in the ankle.

Active exercises in the GYM in a standing position to strengthen the weak muscles around the ankle joint (calf muscle).

PIR technique: To relax and stretch the shortened muscles (gastrocnemius, soleus, hamstrings)

PNF technique: To strength the calf muscle first extension, and to relax tibialis anterior

SMT: For increasing the balance and proprioception of the patient

Group of sensorimotoric exercises: on soft pad, with wobble boards and difficulties

- walking on a soft pad (forward, backward, and side walk both sides)
- Walk on wobbles boards
- Walk on the wobbles boards moving hands up and down
- Walk on the wobbles boards holding a ball throws it up and catch it again

- Walk on the wobbles boards and we throw him the ball, he catches it back and throws it back to us.

Group of sensor motoric exercises: balance board-posturomed

- Stand up with both legs on the board trying to balance moving forward and sideways. 7 repetitions
- Walking on board, standing in the middle of the board and then going down again. 7 repetitions
- Walking sideways, step with one leg up and then with the other staying on the board for 3 seconds and again down with one leg and then the other. 7 repetitions

***For strengthening* of the muscles**: Exercises at the gym

Calf raise exercise: Patient stands in front of the mirror with hand support. He practices calf raise on his tiptoes using one lower extremity (his affected lower extremities). 3 sets of 8 repetitions. Walking on tip toes to strengthen the calf muscles.

Results: Reduced pain, reduced swelling, reduced stiffness in Achilles tendon, no pain during walking and patient could perform walking in the squat (no pain during performing) and the calf muscles on right side stronger than before.

Date:25/1/2017

Status Present:

The patient is on the 8th day of therapy set after ankle fracture surgery and there is still some swelling around the ankle joint but is reduced.

Subjective:

The patient said that he has no pain in his ankle when he woke up and he could provide plantar flexion but not full range because of stiffness in Achilles tendon but the pain is less than before.

Objective:

The patient is in a good mood and willing to cooperate, it is his 8th day of treatment. Good communication, mentally normal, no assistive devices, left dominant limb, no glasses.

Goals of today's therapy unit:

- Scar care treatment
- Increase of sensation
- Gait re-education
- Increase range of motion
- Strengthening of weak muscles
- Stretching of shortened muscles
- Increase balance

Procedure:

Scar therapy: Examination of elasticity (elastic in all directions), massaging the scar (Kippler's fold, "S" shape, "D" shape, "C" shape, tapping, pressing on the scars and on the sides).

Increase Sensation: By providing touch therapy around the scar area.

Gait re-education: Starting from heel strike ending by the tip-toes. We also corrected his posture during walking (Swinging in shoulders and hands, rotation of trunk)

Mobilization techniques of the ankle joint also Chopart's joint and Lisfranc to increase the range of motion in the ankle.

Active exercises in the GYM in a standing position to strengthen the weak muscles around the ankle joint (calf muscle).

PIR technique: To relax and stretch the shortened muscles (gastrocnemius, soleus, hamstrings).

PNF technique: To strengthen the calf muscle first extension, and to relax tibialis anterior.

SMT: For increasing the balance and proprioception of the patient.

Group of sensorimotoric exercises: on soft pad, with wobble boards and difficulties

- walking on a soft pad (forward, backward, and side walk both sides)
- Walk on wobbles boards
- Walk on the wobbles boards moving hands ups and down
- Walk on the wobbles boards holding a ball through it up and catch it again
- Walk on the wobbles boards and we throw him the ball, he catches it back and through it again to us.

Group of sensor motoric exercises: balance board- posturomed

- Stand up with both legs on the board trying to balance moving forward and sideways. 7 repetitions.
- Walking on board, standing in the middle of the board and then going down again. 7 repetitions.
- Walking sideways, step with one leg up and then with the other staying on the board for 3 seconds and again down with one leg and then the other. 7 repetitions.

***For strengthening* of the muscles**: Exercises at the gym

Calf raise exercise: Patient stands in front of the mirror with hands support. He practices calf raise on his tiptoes using one lower extremity (his affected lower extremity). 3 sets of 10 repetitions. Walking on tip toes to strengthen the calf muscles.

Results: Reduced pain, reduced swelling, reduced stiffness in Achilles tendon, no pain during walking and the calf muscle on right side was stronger than before

3.6 Final kinesiologic examination:

Examination by observation of the patient:

Anterior View:

- Edema on the right ankle joint
- Right knee rotated outwards (patella)
- Pelvis symmetrical

- Abdominal muscles higher on the left side than the right side
- Left shoulder higher than the right one
- Left clavicle is higher than the right one

Posterior View:

- Same angle of feet rotation outward
- Edema on the right ankle joint (Achilles tendon more visible on the right side due to reducing edema resulting from therapy (after the surgery)
- Hypotrophy of gastrocnemius muscle on the right side (affected side)
- Knees symmetrical.
- The space from the right scapula to the spine is smaller than the left scapula.
- Left shoulder higher than the right one

Lateral View: (Left side)

- Toes normal press and symmetrical
- Knees symmetrical
- Flat back posture
- Both scapulas are visible
- Shoulder protracted a bit
- Head in normal position

Lateral View: (Right side)

- Lateral rotation of foot
- Ankle joint swollen
- Knees symmetrical
- Scapula not visible from this side
- Spine not visible from this side
- Head in normal position

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

Patient's scars healed successfully. The ankle joint is less swollen; the skin around the scars is pink in color and with slightly increased temperature on the ankle area.

Anthropometry Measurements:

Circumferences:

	Right	Left
Thigh: (15 cm above knee cap for the whole quadriceps)	45.5cm	46cm
(10 cm above knee cap for vastus medialis)	40cm	41,5cm
Knee cap:	35cm	35cm
Calf:	34cm	36cm
Ankle:	27cm	24 cm

Table 14: Final circumference measurements for both LE's

Length of lower extremity in parts :

	Right	Left
Femur	39cm	39cm
Lower Leg	48cm	48cm
Foot	25cm	25cm

Table 15: Final length of the lower extremity in different parts

Functional length:

Right	Left
103cm	103cm

Table 16: Final functional length measurement for both LE's

Anatomical length:

Right	Left
87 cm	87 cm

Table 17: Final anatomical length measurement for both LE's

ROM examination (According to Kendal):

Ankle Joint:

RIGHT	*LIFT*
S : 50 - 0 - 10 *F : 5 - 0 – 20*	*S : 60 - 0 - 10* *F: 10 - 0 - 25*

Table 18: Final ROM examination in ankle joint for both LE's

Toes:

	Right	Left
Big toe: (proximal phalanx)	S : 50 – 0 -	S : 70 – 0 -

Table 19: Final ROM examination in big toe for both LE's

GAIT examination (According to Kendall, 2005):

We asked the patient to walk in the room so we can observe his gate

During walking:

- Heal strike was present
- Less lateral rotation in the right ankle
- The symmetry of shoulders
- swinging both hands
- no limping
- rotation in the trunk (presented while walking by swinging upper extremities)

Gait modification:

- Walking on heels: negative / he were able to perform it without pain.
- Walking on tip toes: negative/ he was able to perform it without pain
- Squats walking: negative / was able to perform.
- Walking with eyes closed: negative /He was able to perform it without pain, he was stable.
- Walking backward or stair walking: negative / He was able to walk backward, also up\down stairs (upstairs no pain, downstairs less pain than before)

Trendelenburg test:

The patient has to stand on one lower extremity and the other leg with flexion 90^{o} on hip and knee.
No pelvis drop in both sides during standing.

Single leg stance:

- Patient was asked to perform a simple stand on one leg.
- Right leg: great balance without shaking.
- Left leg: great balance without shaking.

Rhomberg test:

- (I) : standing with feet a parts and opened eyes
- (II) : feet together and opened eyes
- (III) : feet together and eyes closed

I = negative
II = negative
III = negative

Two Scale examination:

The physiological difference in loading is up to 5 kg, approximately 10 % to 15 % of body weight. Bigger difference indicates an imbalance.

	Right	Left
Total:	33kg	30kg

Table 20: Physiological difference in loading weights in both lower extremities

Muscle tone examination:

Lower extremity:

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

Table 21: Final muscle tone test evaluation for both LE's

Muscle strength test (According to Kendall, 2005):

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

0 = Zero (no muscle contraction)

1 = Trace (contraction felt but no movement)

2 = Poor (partial movement but in horizontal position)

3 = Fair (hold against gravity)

4 = Good (hold against moderate pressure)

5 = Normal (hold against strong pressure)

Lower extremity:

	Right	Left
Gluteus maximus:	5	5
Gluteus medius:	5	5
Gluteus minimus:	5	5
Lateral rotators of hip joint:	5	5
Hip adductors:	5	5
Tensor fasciae latae:	5	5
Sartorius:	5	5
Iliopsoas:	5	5
Quadriceps femoris: (Rectus femoris, vastus laterallis, v.intermedius, v.mediallis)	5	5
Biceps femoris:	5	5
Semimembranosus:	5	5
Semitendinosus:	5	5

Popliteus:	5	5
Plantar flexors: (Gastrocnemius, plantaris)	4+	5
Soleus:	4+	5
Peroneus longus and brevis:	4	5
Tibialis anterior:	4	5
Extensor digitorum longus and brevis:	4	5
Flexor digitorum longus:	4	5
Flexor digitorum brevis:	4	4
Dorsal interossei:	4	4
Extensor hallucis brevis:	4	4

Table 22: Final muscle strength test evaluation for both LE's

Muscle length test (According to Janda, 2013):

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

0 = no muscle shortness

1 = moderate shortness

2 = marked shortness

Lower extremity:

	Right	Left
Iliopsoas:	0	0
Rectus femoris:	0	0
Tensor fascia latae:	0	0
Short hip adductors:	0	0
Gluteus maximus:	0	0
Minimus:	0	0
Medius:	0	0
Piriformis:	0	0
Hamstrings:	0	0
Tibialis anterior:	0	0
Soleus:	1	0
Gastrocnemius:	1	0

Table 23: Final muscle length test evaluation for both LE's

Joint Play examination (According to Lewit, 2009):

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

	Right	Left
Knee joint:	Not restricted	Not restricted
Patella:	Not Restricted	Not restricted
Head of fibula:	Not restricted	Not restricted
Talocrural:	Not Restricted	Not restricted
Subtalar joint: Supination	Not Restricted	Not restricted
Transverse tarsal joint: (Chopart joint)	Not Restricted	Not restricted
Tarsometatarsal joints: (Lisfranc joints)	Not Restricted	Not Restricted
Metatarsophalangeal joints: (1st,2nd, 3rd, 4th, 5th)	Not Restricted	Not Restricted

Table 24: Final joint play examination evaluation for L spine and LE's

NEUROLOGICAL EXAMINATIONS:

Sensation in dermatomes:

The patient was in supine lying position with his eyes closed. Two types of examinations were done:

- First, he was asked to say yes when he feels the touch in different areas of his lower extremity.

- Second, patient was asked to say yes if he feels the touch on the same level on both lower extremity

He had the same feeling on both sides but only around the scar, the sensation was less. Sometimes, the patient was unable to understand if he feels the touch or not around the scar lateral one but the patient mentioned that he feels better in sensation than when he came for the first examination.

Deep tendon reflex:

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

0 = Absent

1 = Hypoactive

2 = Normal

3 = Hyperactive without clonus

4 = Hyperactive with clonus

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

Table 25: Final deep tendon reflex evaluation for both LE's

Surface sensation (L4-S1):

L5 (from outside to inside): the patient had the same feeling on both sides

L4 (from inside to outside): the patient had the same feeling on both sides

S1 (in hamstrings) with bend knees: the patient had the same feeling on both sides

3.6.1. Conclusion

Conclusion of Examination:

The patient after the ankle surgery had clearly restriction in range of motion, the right ankle joint was swollen and painful, without sensation on the later part around the scar. He also had blocked joints, shortened muscles on the affected side, abnormal gait pattern. As soon as he visited our clinic we started the treatment and at the end of the treatment, we performed our final examinations.

During the anthropometry measurements, the right leg still had less volume in the calf muscles by 3 cm and greater number around the ankle due to edema but it was better than the first day of his treatment. He experienced less ROM in the direction to plantar flexion and eversion on the right ankle joint. He also had less ROM in the direction to plantar flexion of great toe of the right foot.

Patient performed all the basic movement pattern correctly and no pathology was present. During the gait plus gait modification on the affected side, during the final treatment day, he was able to perform the heel strike and had a symmetrical lateral rotation on both feet. In the end, there was no more asymmetry on the shoulders.

The patient was able to stand and walk on his heels and tiptoes. Squatting and climbing up and down the stairs was not painful anymore for him. The patient performed well in the single leg stance test and showed great balance without shaking. Muscle tone achieved normal strength test on gastrocnemius, soleus and extensor hallucis, which had good level 4+. The length test on the gastrocnemius and soleus were moderate and had shortened on the right side while the left side had no shortness. The joint play was without any restriction on the joints.

During the Neurological examination, the sensation on the right limb had less sensation around the scar on the lateral one but he experienced much more sensitivity than the first day of treatment.

For better results, the patient needs to perform his exercises regularly and to follow all of our instructions and recommendations.

3.7. Therapy effect evaluation and Prognosis

The patient provided feedback post the completion of the rehabilitation. In the feedback, he described the importance and the need for strengthening, expert care and the self- therapy, which he had to learn and follow during the therapy sessions in order to avoid further damage to his lower extremities and especially his injured ankle or provoking a new injury.

The Self- therapy was introduced to him by the doctor just prior to his last check- up session. The self- therapy included all the exercises he performed during the rehabilitation treatment sessions.

The patient was recommended to continue practicing the exercises he learned during the program and also follow the rehabilitation plan in order to maintain and achieve better ROM.

He needs to continue practicing his exercises in the ankle fracture program pattern as it was executed during the rehabilitation therapies. It would be wise to continue the sensomotoric exercises and practicing the gait movement and mobilization techniques to restore his previous ankle condition. In the case of swelling, massaging the scar would help him in getting some relief.

His ROM of the ankle joint had considerably increased since his first visit to the rehabilitation sessions as described by the patient himself.

However, the major concern yet remained for the patient, which was the increase in the ROM of the ankle joint during the rehabilitation process. Therefore, we measured it by using a goniometer at the beginning of every session. The final assessments of various parameters highlighted the effectiveness of the rehabilitation therapy, which was provided for each and every session.

Additionally, the comparison of the values of the initial and final kinesiologic examination further demonstrates considerable improvement in the muscular

condition, gait cycle, posture and the joint play upon examining the injured ankle joint.

The final assessments indicate an overall improvement in the ROM and joint mobility of the fractured ankle joint. His prognosis appeared to be very good and his ankle joint had fully recovered from the fracture without provoking any further issues.

4. Conclusion

I straight away choose my patient because he was in the beginning of his rehabilitation treatment plan at the clinic I worked in and thus it gave me an opportunity to observe the progress of the treatment and the improvement in his condition right from Day 1 and work with him closely and in an effective manner. When the patient first visited our clinic, he complained about pain in his injured ankle area and restricted range of motion; however, he was not in a very bad condition.

The restriction in the ROM was clearly visible in all the motions of the affected ankle joint, especially in the DF and PF. This issue was very critical and was preventing him from performing simple daily activities so he was a bit furious. Moreover, he was unhappy about the fact that he had become dependent on others. Thus, the rehabilitation treatment plan was designed based on his issues and with the goal of improving his gait, ROM, reducing his pain and swelling of the affected area.

The place where I worked, i.e., Centrum Léčby Pohybového Aparátu Vysočany, Prague, routinely and frequently provided similar kind of therapies (like the one that was provided to this patient by us) to patients' who come up with similar issues. The rehabilitation program planned by me with the help of my supervisor was based on the patient's ROM restriction, swelling, and pain. I chose to focus on these factors majorly so as to treat the ROM, and reduce the pain and swelling in the patient and restore his ankle condition and gait cycle back to the previous state before the injury. The issues that he was facing post- surgery were common in these kinds of surgeries.

Before initiation of the rehabilitation session, I discussed my treatment protocol with the patient as well as my supervisor to ensure all issues are considered and patient's needs were taken care of. This helped in fastening the recovery process, which further helped both of us in different ways i.e., the patient, could recover faster and start working and practice his daily activities independently and I could finish my thesis and practice.

I also applied some muscle relaxation techniques on him in order to release the hypertonus and tension n the muscles, which was found during the initial examination.

The outcomes of the initial and final kinesiologic examinations when compared showed positive and significant improvements along with increased ROM in the injured ankle joint. The restricted joint play was also restored with the help of the exercises and his ability to perform the ankle movements independently and the improvement was significant. These were considered to be the most significant parameters in this case, as from the initiation of the treatment protocol, the goal was to reduce swelling and pain and increase his ROM and improve his gait in order to help him to be more independent. Improvements in his health condition were expected; however, the actual improvement was seen as a result of the efficiency of the therapies provided to him, the chronological timing of each session and patient's cooperation and efforts to recover faster.

Too much of muscle strength or too much pressure on the ankle on the operated ankle was non- questionable; however, the patients' main interest was to recover as soon as possible so that he can join back at his work, perform his tasks independently, recover from the pain and swelling and start cheerleading again. Since the patient had a strong will power and showed positive attidute towards the therapies and put exceptional efforts to perform all tasks with excellence, we also made sure that he is able to work on his ROM and ankle movement all by himself.

For future reference, at the end of the sessions, I instructed him to continue practicing the exercises taught to him during the treatment sessions so as to continue improve his gait and restore back his functionality. It was noticed that the patient was already motivated to continue self- therapy and thus required no counseling from us and he promised to stay as active as possible.

After considering the total two weeks therapy, I can conclude that the treatment plan that I had made for this patient had successfully helped him in recovering from his fracture and regain his functionality and body posture. During the whole rehabilitation process, the patient appeared to be very active, enthusiastic and optimistic about performing new exercises and also cooperated well with us by following all our instructions without any issues.

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6. Supplement

6.1 List of Abbreviations

1. HVLA = High- Velocity Low Amplitude
2. DF = Dorsiflexion
3. PF = Plantarflexion
4. ADD = adduction
5. ABD = abduction
6. ER = external rotation
7. EV = eversion
8. F = flexion
9. IN = inversion
10. IR = internal rotation
11. LE = lower extremity
12. RHB = rehabilitation
13. ROM = range of motion

6.2 List of Tables

6.3. List of Figures

6.4. Ethecal bored

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 a physiotherapy treatment of a patient with diagnosis of ankle fracture

Project form: Bachelor
Period of realization of the project: January 2017
Applicant: Salman Alkhowildi
Main researcher: Salman Alkhowildi
Co-researcher(s):
Supervisor (in case of student's work): Mgr. Ilona Kucerova

Project description: Case study of physiotherapy treatment of a patient with diagnosis of ankle fracture is conducted under the expert supervision of an experienced physiotherapist to the orthopaedic department of Centrum lecby pohyboveho aparatu Vysocany. The methods which are used are in line with the hospital rules for post-operative care. The methods that are used from the researcher are based on the knowledge earned from Bachelor program in Physiotherapy in UK FTVS.

Ensuring safety within the research: For that particular research the researcher doesn't use any invasive methods. All the precautions and risk preventions are followed according to the specific rules, policies and procedures singed documentation. The rehabilitation regimes are designed, prescribed and approved from the responsible physician and under all of the implemented procedures including assessment, discussions, and any kind of communication with the patient are under the responsible supervision of PhDr. Edwin Mahr, Ph.D.

Ethical aspects of the research: All the members and, or participants in the research project are adults and non-vulnerable. All the personal data are anonymized and will be stored in anonymous form.

Informed Consent: attached

It is a 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. 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, 23 January 2017 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.
doc. MUDr. Jan Heller, CSc.
PhDr. Pavel Hrásky, Ph.D.
Mgr. Eva Prokešová, Ph.D.
MUDr. Simona Majorová

The research project was approved by UK FTVS Ethics Committee under the registration number: 041/2017
Date of approval: 26. 1. 2017

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
– 20 –
Stamp of UK FTVS

Signature of the Chair of
UK FTVS Ethics Committee

6.5. INFORMOVANÝ SOUHLAS

Vážená paní, vážený pane,

v souladu se Všeobecnou deklarací lidských práv, zákonem č. 101/2000 Sb., o ochraně osobních údajů a o změně některých zákonů, ve znění pozdějších předpisů, 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] ……

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: .....