CHARLES UNIVERSITY IN PRAGUE

FACULTY OF PHYSICAL EDUCATION AND SPORTS

Department of Physiotherapy

Case study of physiotherapy treatment of a patient with the diagnosis of Total Knee Replacement of the right knee

Bachelor's thesis

Supervisor: Mgr. Ilona Kucerova **Author: Christos Stylianou**

Prague, 2019

Abstract

Title: Case study of physiotherapy treatment of a patient with the diagnosis of total knee replacement of the right knee.

Thesis aim: The aim of this thesis is to initially review the anatomy, kinesiology and biomechanics underlying the patient's condition, as well as demonstrate, analyse and evaluate the therapeutic units that were provided.

Clinical findings: This study is evaluating the state of a 58- year-old patient with the main diagnosis of total knee replacement of the right knee. The assessment showed reduced range of motion and mobility, with differentiation in the condition of the muscles.

Methods: All the used procedures were based on the literature given thought by the Charles University in Prague, Faculty of Physical Education and Sports.

Result: The patient made remarkable progress after only 7 sessions of therapy. The patient underwent great progress in terms of pain, range of motion and muscle imbalance in the area of knee. Furthermore, it is important to note that the therapies have shown to be very effective concerning the patient's diagnosis.

Conclusion: All in all, it is important to note that the therapies that were performed were effective in this patient's concrete diagnosis.

Keywords: Knee joint, treatment, movement, exercises, PIR, Osteoarthritis (OA), Posterior cruciate ligament (PCL), Anterior cruciate ligament (ACL).

Abstrakt

Název: Případová studie fyzioterapeutické léčby pacienta s diagnózou celkové náhrady kolena pravého kolena.

Cíl práce: Cílem této práce je zpočátku přezkoumat anatomii, kineziologii a biomechaniky, které jsou základem stavu pacienta, a zároveň demonstrovat, analyzovat a vyhodnocovat léčebné jednotky, které byly poskytnuty.

Klinické nálezy: Tato studie hodnotila stav 58 letého pacienta s hlavní diagnózou celkové náhrady kolena pravého kolena. Posouzení ukázalo snížení rozsahu pohyblivosti a pohyblivosti s diferenciací stavu svalů.

Metody: Všechny použité postupy byly založeny na literatuře, kterou uvažuje Univerzita Karlova v Praze, Fakulta tělesné výchovy a sportu.

Výsledek: Pacient dosáhl pozoruhodného pokroku po pouhých sedmi terapiích. Pacient udělal velký pokrok z hlediska bolesti, rozsahu pohybu a svalové nerovnováhy v oblasti kyčle. Kromě toho se terapie ukázaly být velmi efektivní, pokud jde o diagnózu pacienta.

Závěr: Terapie, které byly provedeny, byly účinné v konkrétní diagnóze tohoto pacienta.

Klíčová slova: Kolenní kloub, léčba, pohyb, cvičení, PIR, Osteoartróza (OA), Zadní zkřížený vaz (PCL), Přední zkřížený vaz (ACL).

Declaration

I hereby declare that this work is entirely individually done by myself and my own practice that took place at Rehabilitacne Nemocnice Beroun (RNB) from 7th of January 2019 until 18th of January 2019. My practice was under the supervision of my supervisors Mgr. Jan Dzvonik and by Mgr. Ilona Kucerova in Department of Physiotherapy in Faculty of Physical Education and Sport of Charles University in Prague.

I also state that all the information, examination and therapeutic procedures, presented in this dissertation, were based on my knowledge gained from books, journals, reports and by attending lectures and seminars that I have received and attended, from the professors of the Charles University in Prague at FTVS.

Lastly, I declare that no invasive methods were used during the practical approach and that the patient was fully aware of the procedures at any given time.

Prague, April 2019 **Christos Stylianou**

Acknowledgement

Firstly, I would like to express my deep gratitude towards my family for supporting and encouraging me through my whole studies in Czech Republic. I am really appreciate everything that my parents gave me provided me and continue to do, this I would really like to graduate and make them proud. Additionally, I want to express my thankfulness to my girlfriend who is next to me and offers me her help and support in every possible way.

Importantly, having the opportunity to study Physiotherapy in this University was quite fantastic and rather unique for me. I am really grateful for all the faculty staff for all the knowledge they provided me. I would also like to thank to the professors of Charles University in Prague. Their passion for physiotherapy, their great work in the classes and the knowledge that they shared with the students made me love even more this profession. Overall, I really appreciate the great effort of the whole department of Physiotherapy.

Finally, I would like to express my deepest thanks to my supervisor Mgr. Ilona Kucerova, who has helped me by giving me instructions and advice for the development of my Bachelor Thesis. Moreover, I would also like to express my gratitude and thankfulness to my supervisor Mgr. Jan Dzvonik at the Rehabilitacne Nemocnice Beroun in Prague, where my clinical practice took place, for the special knowledge I was able to gain from him.

Dedication

First of all, I dedicate this thesis to my wonderful family who have always been supportive of me throughout my whole life and most importantly for giving me the opportunity to study physiotherapy in Charles University and fulfil my dreams of becoming a physiotherapist. Without a doubt, they have always been there for me and without them I wouldn’t have been able to pursue my goals and my dreams.

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1. Introduction

The following thesis is about the rehabilitation of a patient after having done a total knee replacement. Particularly, my bachelor practice took place in Rehabilitacne Nemocnince Beroun in Prague. This practice started on Monday 7th of January 2019 and ended on Friday 18th of January 2019.

The reason why I have chosen to do this diagnosis for my Bachelor Thesis, is that this kind of operation is quite often done in elderly people and my personal desire was to have more knowledge, be more aware and have more experience about it. It is important to mention that, the patient participated in 7 sessions of physiotherapy with me to decrease the pain and swelling, to increase the ROM, to strengthen the operated knee joint and to improve her overall condition. On the first day, 08.01.2019, we were able to take the anamnesis, we also did the first examination of the patient and conducted some therapies. On the last day of the physiotherapy, 16.01.2019, we were able to do some examination and therapies, as well.

Furthermore, this thesis is divided into two parts; the theoretical parts and the practical parts. Firstly, the theoretical parts describe the anatomy, kinesiology, and biomechanics of the knee, but there is also a special chapter that includes the clinical presentation, pathogenesis, and intervention of the impaired joint. In the practical part, I analysed every procedure I have done with my patient, all the examinations, conclusions, therapies, results, goals, and evaluation of the effect of the therapy is also mentioned.

2. General Part

2.1 Knee joint

2.1.1 Anatomy of the knee joint

Firstly, the knee joint attaches the thigh bone (femur) and shin bone (tibia). The hyaline cartilage covers the articular surfaces of the bones which concur to the knee joint. These major surfaces include the two femoral condyles and the adjacent surfaces of the superior aspect of the tibial condyles. Nevertheless, the two condyles connect nearby surfaces on the posterior part of the patella, where the articular surfaces amongst the femur and patella are the V-shaped trench on the anterior surface of the distal end of the femur.

Thereafter, the stability of the joint is kept by four strong links, the medial collateral ligaments (MCL), the laterall collateral ligament (LCL), the anterior cruciate ligament (ACL) as well as the posterior cruciate ligament (PCL). [1,7]

2.1.2 Anatomy of the bones

2.1.2.1 Anatomy of Femur bone

To continue with, the femur is actually the bone of the thigh and it also constitutes the longest bone of our body. Also, its major weight-bearing articulation, at its distal end, is done with the tibia, and it also anteriorly articulates with the patella. Notably, the thigh is basically the area of the lower limb that is more or less located between the hip and knee joints. The thigh is divided into three territories:

First is the anterior compartment of the thigh which includes the muscles mostly extended to the leg at the knee joint.

Then there is the posterior compartment of the thigh which includes the muscles that are mostly extended to the thigh at the hip joint and flex the leg at the knee joint.

Lastly, there is the medial compartment of the thigh which includes the muscles that mostly adduce the thigh at the hip joint. Its nearest end is included by a head and neck and two large projections which are the greater and lesser trochanters, on the upper part of the axis. Specifically, the head of the femur is spherical and articulates with the acetabulum of the pelvic bone. Also, the neck of the femur is a cylindrical strut of bone which is able to associate the head of the shaft of the femur and the upper part of the shaft of the femur withstands a greater and lesser trochanter, which constitute attachment sites for muscles that move the hip joint. Importantly, the linea aspera is a major place of muscle connection in the thigh. [1]

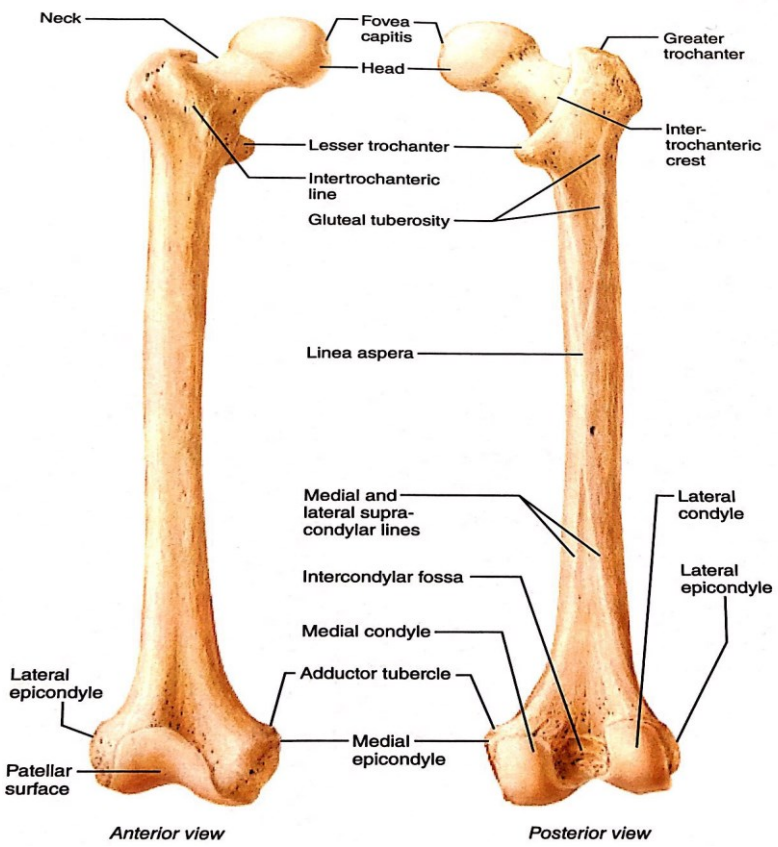

Figure 1: Anatomy of the femur bone (anterior-posterior view) [16]

2.1.2.2 Anatomy of Patella

The patella which is actually the knee cap constitutes the largest sesamoid bone, (a bone formed within the tendon of a muscle), in the body and is shapes inside the tendon of the quadriceps femoris muscle along its crossing from the anterior to the knee joint to insert on the tibia. It glides distally with flexion and proximally with extension, and it is situated in the patellar tendon which glides throughout the knee movements in a groove on the femur. [1,7]

To be more specific, the patellar is triangular. Firstly, its apex is pointed for attachment to the patellar ligament, where the patella is connected to the tibia. Additionally, its base is wide and dense for the connection of the quadriceps femoris muscle from above. Lastly, its posterior surface articulates with the femur and has medial and lateral facets, which are able to tilt away from an increased smooth ridge [1]

2.1.2.3 Anatomy of Tibia bone

The tibia is considered the largest one of the two bones of the leg and it is also the only one able to articulate with the femur at the knee joint. Also, it is the medial and weight-bearing bone. The proximal end of the tibia includes a medial condyle and a lateral condyle and it is expanded in the transverse plane in order for weight-bearing. What is more, the transcended surfaces of the medial and lateral condyles are articular and are also dissociated by an intercondylar region, where there are places of conncetion for strong links (cruciate ligaments) and interarticular cartilages (menisci) of the knee joint. Finally, a interosseous membrane connects the tibia and fibula as well their distal ends by a fibrous inferior tibiofibular joint, and there is slight movement occurring amongst them. [1]

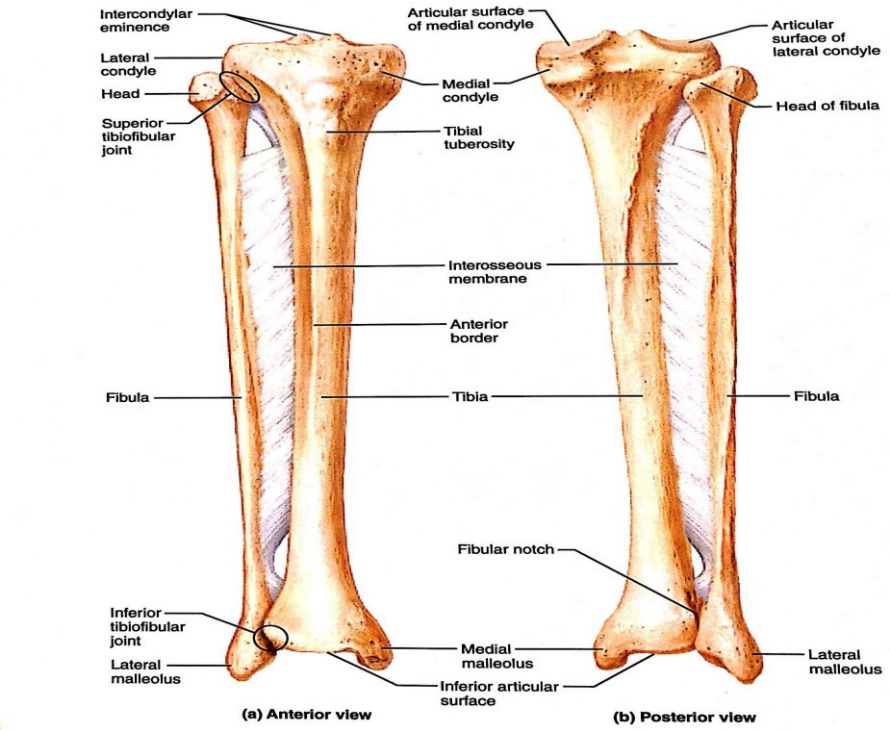

Figure 2: The tibia bone (anterior-posterior view) [16]

2.1.3 Menisci

The main function of the menisci is that it is able to even out the discrepancy between the sharply curved femoral condyles and almost flat tibial condyles.

Basically, there are two menisci, which are mostly C-shaped cartilages, in the knee joint. The one is medial (medial meniscus) and the other one is lateral (lateral meniscus).These two meniscus are both connected to each end to facets in the intercondylar region of the tibial plateau.

Furthermore, the two fibrocartilaginous menisci, one on each side between the femoral condyles and tibia are able to facilitate transitions in the shape of the articular surfaces throughout movements of the joint.

Comparing the medial meniscus with the lateral meniscus, it has a more lengthened C-shaped as the other one is more circular and wider as the posterior and anterior horns of the lateral meniscus are connected to the non-articular area of the tibia plateau, whilst the ones of the medial meniscus are clear of the plateau

anteriorly and posteriorly The meniscus has a thick convex periphery and a thin concave central marginal edge.

In addition to this, the medial meniscus is more or less 3,5 cm long. In specific, the anterior horn of the medial meniscus is connected to the anterior surface of the tibia. As a result, the anterior fibers of the ACL attachment blend with the transverse ligament, which is the ligament that attaches the anterior horns of the medial and lateral menisci. On the other hand, the posterior horn of the medial meniscus is tightly connected to the posterior aspect of the tibia which is exactly in front of the insertion of the PCL. Moreover, the medial meniscus is constantly connected throughout its periphery to the joint capsule, and in the middle of it the meniscus is very tightly connected to the femur and tibia through the MCL. In addition, comparing the medial meniscus to the lateral one, it is oval and more open and is attached around its margin to the capsule of the joint and to the tibial collateral ligament, whilst the other one is not attached to the capsule. As a result, the lateral meniscus can be more movable compared to the medial meniscus. The menisci are interconnected at the front by a transverse link of the knee.

On the other side of the coin, the lateral meniscus is both smaller and more enclosed with almost circular contour, as well as attached to the tendon of the popliteus muscle, which goes through superolaterally amongst this meniscus and the capsule to enter the femur. What is more, the menisci better the congruence among the femoral and tibial condyles throughout the phase of joint movements, when the surfaces of the femoral condyles articulate with the tibial plateau are able to alternate from the small curved surfaces in flexion to large flat surfaces in extension.

Finally, the lateral meniscus is nearly circular and it covers a great part of the tibia articular surface compared to the medial meniscus. Also, the anterior horn of the lateral meniscus is merged into the connection of the ACL, whilst the posterior horn connects exactly posteriorly the intercondylar eminence, which is usual to be bleeding into the posterior aspect of the ACL. [1,7]

2.1.4 Ligaments of the knee joint

Patellar ligament: Firstly, the patellar ligament is mostly the extension of the quadriceps femoris tendon inferior to the patella. Also, it is connected from above to the margins and apex of the patella and thereunder to the tibial tuberosity.

Collateral ligaments: As far as the collateral ligaments, there is one on each pleura of the joint, consolidating the hinge-like motion of the knee.

The *fibular collateral ligament* is mostly connected to the lateral femoral epicondyle exactly above the groove for the popliteus tendon. Nevertheless, it is also inferiorly connected to a prostration on the lateral surface of the fibular head. Finally, it is divided from the fibrous membrane by a bursa.

The *tibial collateral ligament* is connected from a big part of its deep surface with the subjacent fibrous membrane. Moreover, it is attached to the medial femoral epicondyle exactly above the adductor tubercle and dismounts at the front in order to connect to the medial margin and medial surface of the tibia above and posteriorly the connection of sartorius, gracilis, and semitendinosus tendons.

Cruciate ligaments: These two cruciate ligaments are situated in the intercondylar region of the knee and are able to interconnect the femur and tibia.

The *anterior cruciate ligament* (ACL) connects to a view on the previous part of the intercondylar area of the tibia and rises from behind in order to connect to a facet at the back of the lateral wall of the intercondylar fossa of the femur.

It is important to note that, the ACL is the most usual injury of the ligament injuries of the knee joint. The loss of the ACL function has as a result unusual kinematics (motion, movement patterns), as well as serious degenerative alterations in the knee joint throughout time, like OA. This ligament is creates to operate as a stabilizer when at the same time permitting the regular motion of the joint at the functional ROM. Furthermore, the ACL is mostly a well oriented connective tissue, which attaches the femur and tibia. Also, it has an estimated weight of 20g and length of 35mm. Importantly, it connects to the back part of the medial surface of the lateral femoral condyle, and it includes an anteromedial band which is tensed in the flexion of the knee and when the knee extended it is relaxes. It also consists of a posterolateral bundle that is firm in extension and relaxed in flexion.

Most importantly it constitutes an intra-articular link which is surrounded by synovial tissue. It is also vascularized in a good way, and it consists of nerve endings which are possible to have a proprioceptive function.

The *posterior cruciate ligament* (PCL) has an approximate width of 15mm and an approximate length of 40mm.Also, it is fan-shaped, as it is narrowest in the mid-porion and at the same time fanning out more superiorly and less inferiorly. What is more, it starts from the back surface on the tibia and goes through superiorly and anteromedially in order to enter on the parietal wall of the medial femoral condyle. It is crucial to be highlighted that the PCL is an intra-articular ligament which means it is inside the joint, but simultaneously it has an extra-articular, which is outside the joint, distal insertion on the tibia. Ultimately, it i connected to the back part of the intercondylar area of the tibia and rises up at the front in order to attach with the medial wall of the intercondylar fossa of the femur. [1,7]

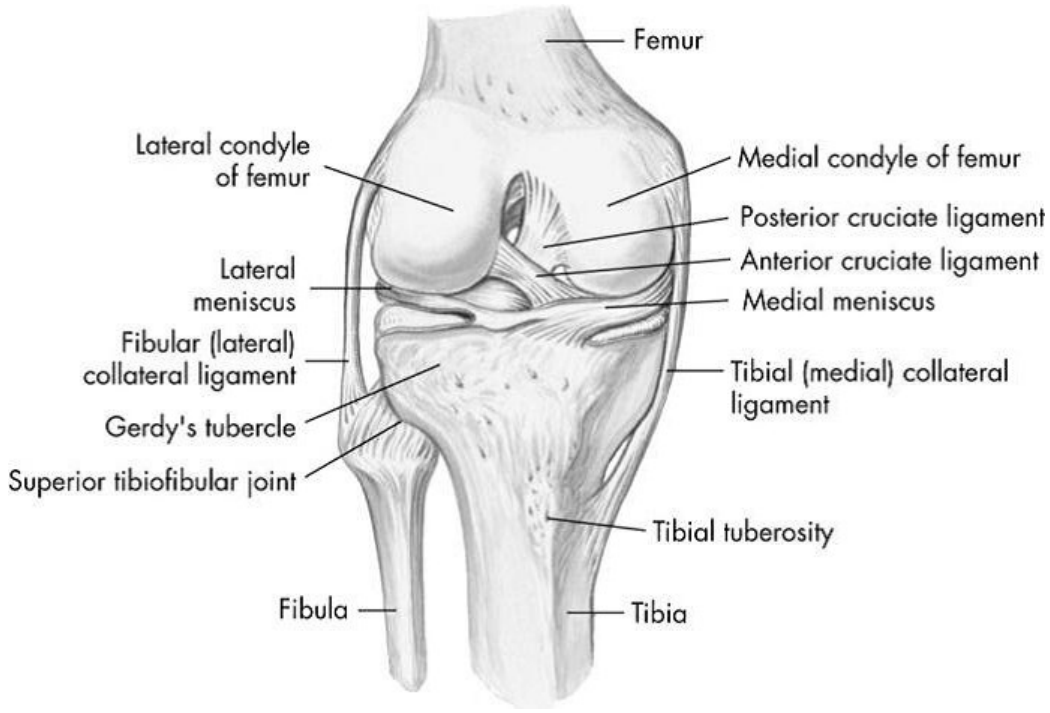

Figure 3: Ligaments of the knee joint (anterior view) [15]

2.1.5 Muscles, Anatomy, Innervation and Function

Muscle	Origin	Insertion	Innervation	Function
Biceps femoris	*Long Head:* tuberosity of ischium *Short Head:* lateral lip of linea aspera	Lateral side of head of fibula, lateral condyle of tibia	Sciatic (L5-S2)	Flexion-lateral rotation of the knee, long head extends and assists in lateral rotation of the hip
Semimembranosus	Tuberosity of ischium	Medial condyle of tibia	Sciatic (L2-L5, S1-S2)	Flexion-medial rotation of the knee, extension-medial rotation of the hip
Semitendinosus	Tuberosity of ischium	Medial surface of the tibia	Sciatic (L2-L5, S1-S2)	Flexion-medial rotation of the knee, extension-medial rotation of the hip
Rectus femoris	ASIS	Tibial tuberosity	Femoral L2-L3-L4	Extension of the knee, flexion of the hip
Vastus lateralis	Latetal lip of linea aspera Lateral lip of gluteal tuberosity	Tibial tuberosity	Femoral L2-L3-L4	Extension of the knee
Vastus medialis	Medial lip of linea aspera, tendons of the adductor longus and magnus	Tibial tuberosity	Femoral L2-L3-L4	Extension of the knee
Vastus intermedius	Anterolateral surface of femur	Tibial tuberosity	Femoral L2-L3-L4	Extension of the knee
Sartorius	ASIS	Medial surface of tibia	Femoral L2-L3-L4	Flexion-lateral rotation-abduction of hip, Flexion-medial rotation of knee

Pectineus	Superior ramus of the pubis	Pectineal line of femur	Femoral and Obturator L2-L3-L4	Flexion-adduction of the hip
Adductos magnus	Inferior pubis ramus, ramus of the ischium and ischial tuberosity	Gluteal tuberosity, middle of the linea aspera	Obturator L2-L3-L4 Sciatic L4-L5-S1	Flexion-extension of the hip
Adductos longus	Anterior surface of the pubis	Medial lip of the linea aspera	Obturator L2-L3-L4	Flexion-adduction of the hip
Adductor brevis	Inferior ramus of the pubis	Pectineal line, medial lip of linea aspera	Obturator L2-L3-L4	Flexion-adduction of the hip
Gracilis	Inferior half of the symphysis pubis	Medial surface of the tibia	Obturator L2-L3-L4	Flexion-medial rotation of the knee Adduction of the hip
Popliteus	Lateral condyle of femur	Soleal line on the posterior surface of the tibia	Tibial L4-L5-S1	Flexion of the knee Medial-lateral rotation of the tibia
Gastrocnemius	Medial condyle of femur Lateral condyle and posterior surface of femur	Calcaneus	Tibial S1-S2	Plantar flexion of the ankle Flexion of the knee
Soleus	Posterior surface of the head of fibula, medial border of the tibia	Calcaneus	Tibial L5-S1-S2	Plantar flexion of the ankle
Plantaris	Lateral supracondylar line of femur	Calcaneus	Tibial L4-L5-S1	Plantar flexion of the ankle Flexion of the knee

Table 1: Muscle, anatomy, innervation and function [1,2,5]

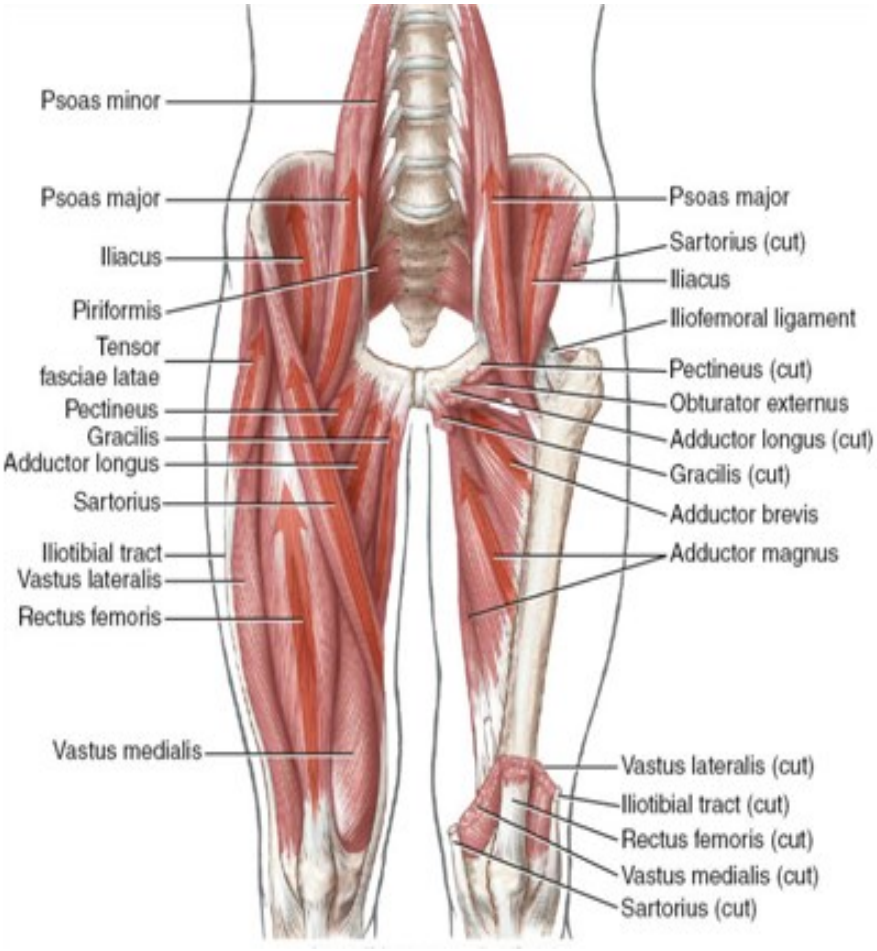

Figure 4: Muscles of the anterior part of the thigh [17]

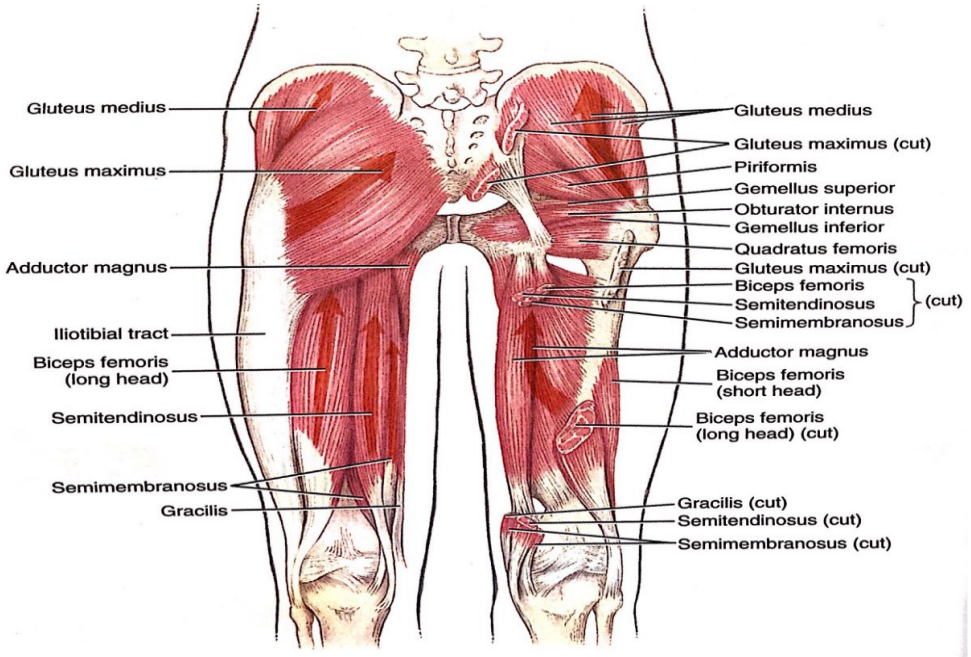

Figure 5: Muscles of the posterior part of the thigh [17]

2.2 Kinesiology of the knee joint

2.2.1 Introduction of kinesiology of the knee joint

First and foremost, the knee is considered the largest synovial and most complex joint in the human body. Also, its articulating bones involve the femur, tibia, and patella and their joint surfaces are covered by cartilage and the ball of the joint is shaped by the femoral condyles. Last but not least, the contact surfaces on the lateral and medial femoral condyles are anteriorly associated by a groove in which the patella glides.

Additionally, a major operation of the lower limbs is to back up the weight of the body with the minimal expense of energy possible. The organization of conjunctions at the hip and knee joints, along with the shape of the articular surfaces, accommodates the “locking” of these joints into position in the standing phase, thus restricting the muscular energy needed to keep a standing position.

To continue with, a second huge operation of the lower limbs is to move the body through space. For this to happen, there must be a completion of movements at all joints in the lower limb in order for the foot to be positioned on the ground and the body to be moved over the foot. During walking, many anatomical features of the lower limbs conduce to restrict fluctuations in the body’s center of gravity, so therefore lessen the amount of energy needed to keep the movement and generate a both slick and efficient gait.

Also, during the standing posture, the knee joint is locked into position, hence reducing the amount of muscle work required to keep the standing position.

Conclusively, the knee joint is a hinge joint that permits most importantly the flexion and extension. Additionally, two very strong ligaments (the cruciate ligaments) interconnect the adjacent ends of the femur and tibia and thus keep their opposed positions during movement. [1,3,5]

2.2.2 Movement in extension of the knee joint

It is crucial to highlight that extension is considered the movement in a previous direction to a position of straight alignment of the thigh and lower leg which is 0 degrees.

During the extension of the knee, the surfaces move to the wide and flat areas on the inferior aspects of the femoral condyles. As a result, the joint surfaces move in a more stable way in extension as they become larger. Moreover, another part of the locking mechanism is medial rotation of the femur on the tibia during extension. This medial rotation and full extension is able to tighten all the connected ligaments. Something else that is able to keep the knee extended in the standing position is that the body's center of gravity is located along a vertical line that passes prior to the knee joint. Thus, the popliteus muscle unlocks the knee with the induction of lateral rotation of the femur on the tibia. Due to the fact that the knee joint is involved in weight-bearing, it causes an effective "locking" mechanism in order to lessen the amount of muscle energy needed to maintain the joint extended whilst standing.

In case of full extension, the rotational movement is almost impossible due to the tension in almost all ligaments. The primary rotation, is hence combined with flexion in the first 5 degrees of movement, and the initial rotation relaxes the ACL. The specific movement is called "unlocking the knee". This happens with the axis of rotation running from the femoral head to the center of the lateral condyle, thus having the lateral condyle rotates and the medial condyle translates.

What is more, with having the foot fixated on the floor (closed kinetic chain), the femur spins externally. Although, with the foot not supported on the floor (open kinetic chain), the lower leg turns along with the foot, or tip of the toe inward. Extension begins by translator movement forward, continues by rolling motion of the femur on the condyles and ends with external tibial "terminal rotation" (hence, in the opposite direction than the original rotation), which brings the "re-locking" of the knee joint. In this case the ROM for knee extension is 5-10 degrees.

Along the knee extension procedure, the activity in the rectus femoris comes up first and is followed later by the vastus medialis, irrespective of plane of movement. The vastus medialis is active in the last 50 to 30 degrees of extension.

Also, the activity may be seen earlier in the adductors (synergists), and hamstring group (antagonists) for motions in the diagonal plane. Knee extension in a diagonal plane (120 degrees flexion to 0 degrees extension) is at the hip joint 10 degrees abduction with internal rotation to slight abduction and external rotation.

During knee extension in the sagittal plane, the rectus femoris and biceps femoris muscles indicate less activity in rapid movements than in slow movements, whilst the adductor and medial hamstring muscles (antagonists) indicate more activity. Whereas, in the extension phase, vastus medialis, rectus femoris, and biceps femoris muscles are more active altogether in the sagittal plane than in the diagonal plane. Resulting that only the adductor muscles have greater activity in the diagonal plane.

Ending with, in the phase of knee extension in the sagittal plane, the rectus femoris and biceps femoris muscles indicate less activity in more rapid movements than in slow movements, whilst the adductors and medial hamstrings muscles (antagonists) indicate higher activity. [3,5,19]

2.2.3 Movement in flexion of the knee joint

Flexion is movement in a posterior direction, approximating the posterior surfaces of the lower leg and thigh. During flexion, the movement of the knee is enabled by the cruciate ligaments, which obstruct not wanted translator motions. In this case the ROM for knee flexion is 120-150 degrees. Also, from the position of zero extension, the sequence of flexion is more or less 140 degrees. According to this range, the active flexion can be executed in a maximum of 140 degrees when the muscle gist of the thigh and calf stress in one another and movement are not able of continuing actively. The rest of 10 degrees of flexion can be passively executed, for instance, when squatting the weight of the body concentrates the muscle mass. Importantly, the tension in not only cruciate ligaments, but also the function of the posterior horns of both menisci permit flexion only to people with poorly developed musculature.

Moreover, the range of rotation rises with periodical flexion and this happens initially during the first 30 degrees of flexion. Additionally, rotation happens with flexion, joining movement amongst the tibia and the femur, so the sequence of rotation thence rises minimally. Between 45-90 degrees of flexion, there is a biggest range of rotational movement occuring. Also, flexion is completed with translatory movement of the condyles on the tibial plateau. Notably, in the final phase of flexion, the menisci surrounding the femur alternate their shape and move jointly with the condyles posteriorly on the tibia. Resulting to the fact that the terminal phase of flexion to be linked to "translatory" movement in the menisco-tibial joint.

It should also be highlighted that in movements from extension to flexion, the order of muscle emergence is as follows: 1. medial hamstrings and adductors 2. biceps femoris 3. vastus medialis and 4. rectus femoris.

In case of the knee flexed in a slow manner, the vastus medialis, rectus femoris and medial hamstrings muscles are more active in the sagittal plane compared to the diagonal plane. [3,5,19]

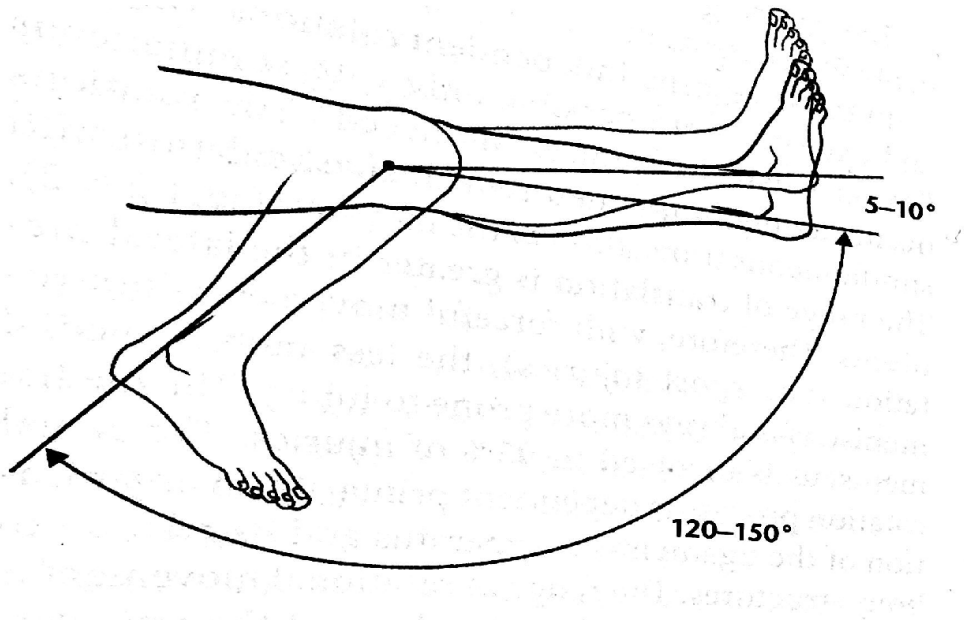

Figure 6: ROM of the knee joint in flexion and extension [3]

2.2.4 Movements in external-internal rotation

Firstly, the external and internal rotations constitute movements of a longitudinal axis. Nevertheless, the internal rotation is rotation of the anterior surface of the leg toward the midsagittal plane. Subsequently, the external rotation is rotation away from the midsagittal plane.

Only when there is simultaneous flexion and the joint is “unlocked” will the independent rotations (external and internal) be possible. Thus, the rotations happen mostly in the menisco-tibial articulation with simultaneous translation of the menisci and the range of the translation is bigger in the lateral meniscus. Therefore, with influential movements during rotation, the less mobile medial meniscus is always more inclined to events of injury. Also, the course of both the cruciate ligaments places an important moment during rotational movement,. Whilst the PCL runs almost vertical, the angle of the ACL is much greater, as well as the ROM for the external rotation is 30-40 degrees and internal rotation 10 degrees.

Adding to the above, the tibial external rotation range is initially defined by tension in the collateral ligament and the range of external rotation doubles, thence its partition.

Yet, during internal rotation, ACL has an important role, which is considered the initial stabilizer of tibial internal rotation. [3,5]

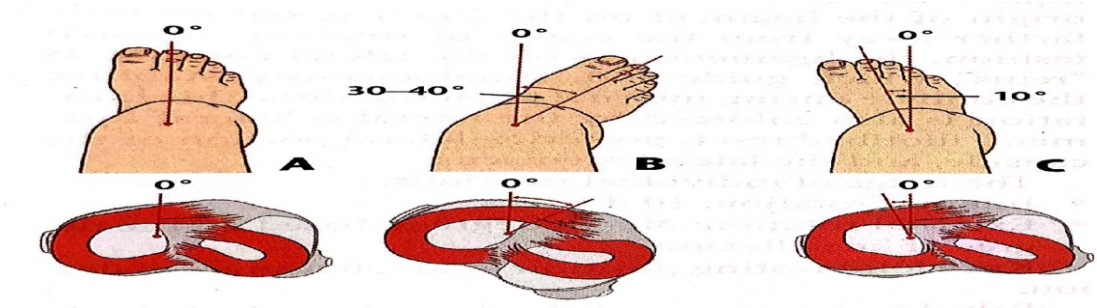

Figure 7: Rotation movements of the tibia in relation to the femur at 90 degrees knee flexion [3]

2.2.5 Hyperextension

Primarily, hyperextension is both an irregular or unusual movement above the zero position of extension and concludes in excess compression anteriorly and excess tension on muscles and ligaments posteriorly. As a result, there may be pain occurring in either area. Notably, the popliteus is a short muscle that practices in a way as a broad posterior knee joint ligament. Mainly, its action is to flex the knee and to rotate the leg medially on the thigh. Thus, in cases of being stretched by knee hyperextension, it permits the lower leg to rotate laterally on the femur in flexion or in hyperextension. If the knee is extended in few more degrees than it is normally expected to in order to allow for stability in standing, then it is considered to be hyperextended. [5]

2.2.6 Gait pattern

Generally, walking is considered to be the way people move from one place to another with their feet. On the other hand, gait is the process or the components of walking. More specifically, each person owns a unique style of walking which may alternate a bit according to mood. For instance, when people are happy, their step is lighter, and there may be a slight bounce in their walking. In contrary, when they are feeling sad or depressed, their step may be heavier than in other cases. Most importantly, walking needs balancing on one leg while the other leg moves forward. Thus, this requires movement of the legs, as well as the trunk and arms.

Additionally, the gait cycle is the activity that happens when one foot touches the floor and the time the same foot touches the floor again.

There are two phase of gait:

The first phase is the stance phase is the activity that happening when the foot touches the ground. The procedure is that the heel strike of one foot and ends when that foot leaves the ground. 60% of the gait cycle is accounted for this phase of gaiting.

The swing phase, which is the second phase, happens when the foot does not touch the ground. This phase begins as soon as the foot leaves the floor and ends when the heel of the same foot touches the floor again. Therefore, this swing phase makes up about 40% of the gait cycle.

Heel-strike: It is the phase that signals the start of stance phase. This starts with the moment the heel touches the ground. During this phase, the ankle is in a neutral position amongst dorsiflexion and plantar flexion and the knee starts to flex. Also, the hip is in about 25 degrees of flexion and the ankle dorsiflexors are active in setting the ankle in its original or normal position. Also at this point, the quadriceps, which have been priorly contracting concentrically, change to now contracting eccentrically in order to minimize the amount of knee flexion. Although the hip flexors have been active, they are starting to contract, hence maintaining the hip from flexing more.

Flat-foot: In this case, when the whole foot touches the ground, it happens slightly after heel strike. So, the ankle moves into about 15 degrees of plantar flexion with the dorsiflexors contracting eccentrically in order to maintain the foot from "slapping" down on the floor. Also, the hip moves into extension, whereas the knee moves into about 20 degrees of flexion.

Mid-stance: At this point, the body passes over the weight-bearing foot, and the ankle moves into slight dorsiflexion. Nevertheless, the dorsiflexors become inactive and the plantar flexors begin to contract.

Heel-off: In this phase the heel rises off the floor and the ankle dorsiflexes a bit, about 15 degrees, thus it afterwards starts to plantar flex. The knee is then extended and beginning to slightly flexion and hip hyperextension.

Toe- off: Importantly, the toes in this phase are in extreme hyperextension at the metatarsophalangeal joints. Also, the ankle moves into approximately 10 degrees of plantar flexion, and both the knee and the hip are flexing.

In a normal gait cycle, the knee undergoes a range of 60 degrees (0 degrees extension at initial contact or heel strike to 60 degrees at the end of initial swing). Additionally, there is some medial rotation of the femur during the extension of the knee at initial contact and just prior to heel-off.

What is more, during the gait cycle the stability is effectively controlled by the normal function of the muscles that attach at the knee.

Subsequently, the amount of knee flexion at initial contact and then extends the knee toward mid-stance are controlled by the quadriceps muscle. Again, it is controlled by the amount of flexion during pre-swing (heel-off to toe-off) and impedes the overmuch heel lift during initial swing. Thus, with the loss of quadriceps femoris function, the patient reels the trunk anteriorly at the original contact to move the COG anterior to the knee in order to be stable or rotate the extremity outward in order to lock the knee.

There are also the hamstrings muscles which initially control the forward swing of the leg during terminal swing. Although, the loss of operation could conclude to the knee snapping into extension at this period. There is also a provision from the hamstrings for a posterior support to the knee capsule in case the knee is extended during stance.

Last but not least, the soleus ankle plantarflexor muscle aids to control the amount of knee flexion at pre-swing through managing the forward movement of the tibia. However, the loss of function ends up in hyperextension of the knee at pre-swing (moreover loss of heel rise at the ankle and hence a lag or minor dropping of the pelvis on the particular side at the pre-swing phase).

Crucially, the gastrocnemius muscle procures tension lateral to the knee in the case it is in extension (end of loading response or flat foot and just prior to pre-swing or heel-off). Nevertheless, the loss of function then, concludes to not only hyperextension of the knee during these periods, but also the loss of plantaflexion during the pre-swing or toe-off phase. [12]

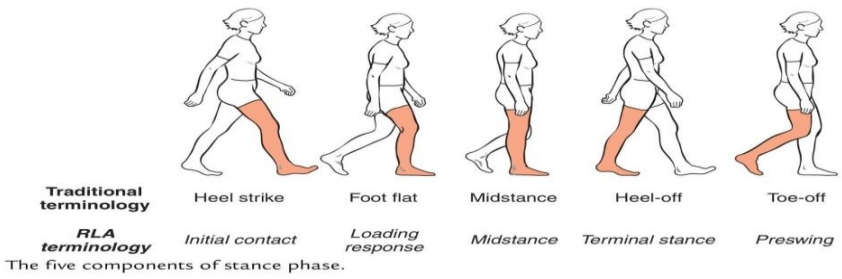

Figure 8: The five components of gait cycle [13]

2.3 Biomechanics of knee joint

2.3.1 Mechanical stress in the knee

To begin with, the bone as well as the cartilage of a joint are in general submitted to compression. To add upon, periarticular ligaments are fibrous structures capable of resisting big forces for a shorter period of time. As a result, stretching these structures produces tensile stresses in them. Also, muscles take part in generating all the stresses by their contractions. Thus, a prosthesis which replaces the knee and equipped with the appropriate strain-gauges would hence let the stress measurements, but such a prosthesis would change in a complete way the operation of the joint and thus the gait.

During symmetrical stance on both legs

To continue with, during the standing position on both legs, the knees then support the part of the body above them. The load acting on each knee is 43% of the body weight due to the symmetrical support on both of the legs. When the line of action of this part does not cross the knee, there must be an intervention of muscular forces in order for the balance to be kept. Hence, the COG which is situated on L3 vertebra, in the coronal plane the load is supported by the pelvis which transmits it to the ground through the thigh and leg bones, hips, knees, and ankles. In addition, the centres of these three joints are on the same straight line crossing the ground support which are projected in a coronal plane. Now, in regards to the sagittal plane the COG also lies on or near the vertical line crossing the centre of rotation of the hip, the flexion centre of the knee, and the centre of the ankle joint. In case that the support is symmetrical, then the load in L3 vertebra is distributed in an even way amongst both of the knees. Then, its direction is vertical.

In standing on one limb

In case of standing in one limb, then the loaded knee is backing up the head, the trunk, the upper limbs, the loaded thigh, and the opposite lower limb. As a result, the mass regarding this specific part of the body is concentrated in the centre of gravity.

During gait

During the walking procedure the knee is under more stress. In comparison to the standing position, each knee in this situation is backing up a greater load. During walking, mostly at the end of the stance, the knee works in positions close to extension. Thus, there is a greater weight-bearing area caused than the hip, in this position.Also, in this situation the line of action of the force of the body-mass is oblique. What happens is that it passes through the COG of the body and then crosses the supporting surface of the stance foot. After that, the action of the force of the body and the reaction of the ground are exercised lengthwise, although in opposite directions, so they come to balance each other. The centre gravity of the body is in front, behind, or medial to the foot. Additionally, during the stance phase, the same part of the body is supported by the knee, as when standing on one foot. [6]

2.3.2 Forces at the Tibiofemoral Joint

During daily activities, it can be clearly seen that the tibiofemoral joint is loaded in both compression and shear. Adding to this, the weight-bearing and tension development to the muscles that are crossing the knee, contribute to the previous mentioned forces, along with compression that is dominating when the knee found to be fully extended.

It has been reported that the compressive force at the tibiofemoral joint is a little greater than three times body weight during the stance phase of walking, which could be increased up to more or less four times body weight during climbing the stairs. In addition, the medial tibial plateau endures most of this load during stance when the knee is extended, with the lateral tibial plateau enduring more of the much smaller loads enforced during the swing phase. [14]

2.3.3 Forces at the Patellofemoral Joint

Importantly, the compressive force at the patellofemoral joint has been estimated to be half of the body weight during normal walking gait, raising then up to over three times body weight during climbing the stairs. What's more, the patellofemoral compression raises with the knee flexion during weight-bearing. As a result, the rise of the knee flexion causes increase to the compressive force acting at the joint. During the increase of flexion, in order for the knee to be prevented from buckling against gravity, a larger amount of quadriceps tension is required. 14]

2.3.4 Unstable knees (Varus –Valgus deformity)

The varus-valgus and valgus knee deformations are able to change the knee structure, and hence affect the knee joint stability and more crucially, change the mechanical conduction the accetabulum and femoral head which are the adjacent hip joint's biomechanical behaviours. Moreover, the varus and valgus knee deformities affect the limb alignment by transitioning the femur and tibia axis, therefrom then affecting the hip stress conduction site changes.

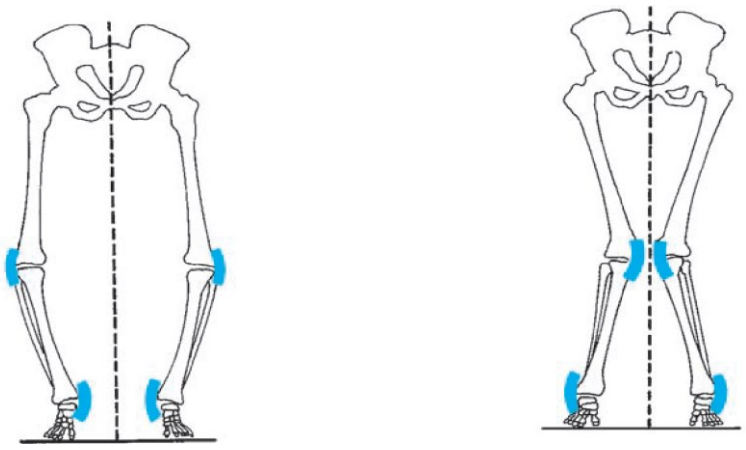

Figure 9: The five components of gait cycle [13]

As a result, with the different knee varus and valgus angle degrees, the average stress and the peak stress are different. The knee varus and valgus at 10 degrees are not statistically rather considerable, though at 20 degrees, the variations can be seen as significant, something that can be considered as key pathogenesis of hip arthritis caused by varus and valgus knee deformities.

Additionally, due to the stability of the knee, there is an ability of the joint to keep a position or to control movement under variating external loads. To continue with, it is believed that the active neuromuscular system (muscle strength and proprioception) and the passive restraint (ligaments and capsule), provide stability.

It is important to note that, the Varus-Valgus motion is an independent aspect of joint stability. Also, there is a minimal varus-valgus motion in a normal gait pattern. Consequently, an excessive varus-valgus motion of the knee during walking show instability of the joint.

More specifically, the knee is stable as long as the action of resultant R exists amongst the centers of curvature, O1 and O2, of the femoro-tibial articular surfaces.

Additionally, as soon as R becomes lateral to O2 or medial to O1, the femur would incline on the tibia, thus instability exists. Also, the femur is held only by the medial ligaments which are stretched and give away and it inclines on the tibia. As a result, the knee has become unstable and hence patient cannot walk without depending greatly on two crutches.

If such an event is the case, when standing on one foot, the centre of gravity of the supported part of the body is above the knee and the line of action of force P is located amongst the centres of curvature O1 and O2.

Conclusively, the instability occurs more usually in a knee with a valgus deformity than with a varus deformity, as well as the structures of the lateral muscles and ligaments of the knee are considered much stronger than the muscles on the medial side. [6,14,18,20,21,22,23]

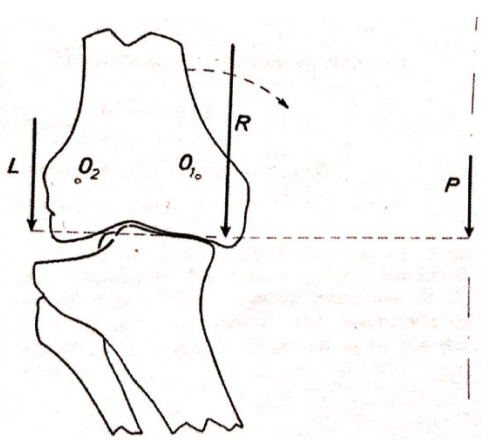

Figure 10: Unstable varus knee [6]

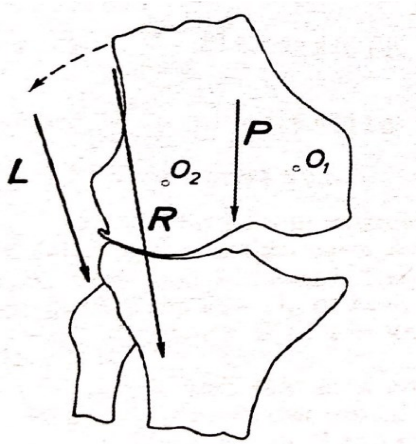

Figure 11: Unstable valgus knee [6]

2.4 Total Knee Replacement

2.4.1 Introduction of total knee replacement

The total knee replacement or in other words, total knee arthroplasty, is basically a surgical procedure in which the articulations surfaces of the knee joint are placed back in their proper position. Amongst the tibia and the femur there is a polyethylene piece that is placed. Nevertheless, in almost half of the procedures the patella is placed as well. Mostly, the goal of this replacement is to rehabilitate the extensor mechanism.

2.4.2 Medical management

The most important goal or outcome of a surgery is for the patient to be able to move again without any pain, having a full functioning joint, and recreating again a stable joint, having a full motion altogether. What is more, total knee arthroplasty is an option in situations where the patient is severely complaining or is experiencing functional restrictions. Also, the operation lasts about 60-90 minutes and it basically has to do with replacing a three-part prosthesis; a part of the femur, a part of the tibia, a polyethylene shock absorbing disc and in specific cases a patella replacement. It is important to mention that there is no perfect design, as each prosthesis is different according to the size and shape in a patient basis. Furthermore, a tourniquet may be used in some cases during the surgery to reassure less blood loss. Although, when not in use, there is less swelling and pain.

2.4.3 Indications for surgery

- ✓ Severe pain with weight bearing or motion that compromises functional abilities
- ✓ Extensive destruction of articular cartilage of the knee secondary to advanced arthritis
- ✓ Moderate or severe knee pain
- ✓ Marked deformity of the knee such as valgus-Varus
- ✓ Chronic knee inflammation and swelling that does not improve with rest of medications
- ✓ Gross instability or limitation of motion. [15]

2.4.4 Types of knee replacement surgery

- ✓ Total knee replacement – both sides of your knee joint are replaced.
- ✓ Partial (half) knee replacement – only one side of your joint is replaced in a smaller operation with a shorter hospital stay recovery period.

2.4.5 Pre-operative rehabilitation

First and foremost, the rehabilitation plan of care must be foregone by a prior detailed examination, involving kinesiological analysis, goniometric assessment and the quality assessment of their everyday life with the use of standardized questionnaires.

What is more, the pre-operative phase focuses on the treatment of the already affected joint – this has as an objective to correct the balance of the muscle in the area of the affected part and at the same time to lessen any contractures.

As a result, this may occur with gait training with lessened weight-bearing on the affected lower edge whilst using forearm crutches, axillary crutches or even assistance with grasping.

In addition, what could be also done is self-care training by the uninvolved limb, alternation of a breathing pattern, and progress in the overall fitness of the body.

Pre-operative physical therapy:

- ✓ Bed to chair transfers
- ✓ Bathroom transfers
- ✓ Tub transfers with tub chair at home
- ✓ Teach postoperative knee exercises as well as provide the patient with a handout.
- ✓ Teach movement with an assistive device. [3,9]

2.4.6 Post-operative rehabilitation

However, in the early post-operative phase, the standard care involves any positioning of the involved limb, breathing exercises, fitness exercises of the non-involved limbs, and prevention of thromboembolism. A more specific physical therapy is introduced with isometric exercises for the distant aspect of the leg. What is more, standing and subsequently moving are practiced with assistive devices and hence, according to the physician's guidelines, lessen the weight-bearing of the involved lower limb. Importantly, attention is paid to succeeding in and maintaining adequate knee extension. There must be an emphasize on the analgesic and anti-inflammatory effects of cryotherapy in order to forestall any complications thereafter. Moreover, the CPM equipment and assisted exercises are introduced.

The patient can reach the prone position when the cutting is then healed well enough or when the stitches have been removed. To continue with, the movement into flexion is gradually raised, although it is not forced past 90 degrees. Notably, the best thing is to perform the exercises in a slow manner two times a day with 5-10 repetitions of every exercise. In case the patient shows a good grip (and if not recommended by the surgeon), forearm crutches are recommended for lessened weight-bearing right after the surgery. Lastly, gradually leaving the crutches may be done according to the surgeon's recommendations. As a result, the best possible recovery is often achieved 3-6 months after surgery.

Continuation during hospitalization:

During hospitalization the fit of the crutches and the gait pattern should be addressed, as well as the correction of extremity length. Additionally, in this case, the treatment with the use of basic formalities helps in healing and limiting pain. Also, hematoma could be decreased with the use of a biolamp or laser. Lastly, cryotherapy is also introduced during the early post-operative period, as well as aquatic procedures only after the incision site completely heals.

Home care:

Now, regarding to home care, the patient should be in the position to be discharged from a medical facility only if being in stable condition not only satisfactory ROM of the replaced joint, but also sufficient independence to be

capable of staying home with no help of another person or with the help of any established assistance. Nevertheless, the patient should be provided with assistive devices. It is crucial to note that during the hospitalization, the patient is instructed in a home exercise program and is educated on which specific movements he should avoid and he is also told about the weight-bearing status of the involved joint. Although, if the patient is not in the position of being discharged to a home setting, he is then transferred to a specialized medical setting (i.e., rehabilitation institutions, assisted living facilities, or skilled nursing facilities). [3]

Goals of rehabilitation:

- ✓ Prevent dangers of bedrest (deep vein thrombosis, pulmonary embolism, pressure ulcers).
- ✓ Have the help with adequate and functional ROM (strengthen knee musculature, help patient in succeeding in functional independent ADLs.
- ✓ Independent movement with an assistive device. [9]

2.4.7 Recommended Long-term activities after Total Knee Replacement

Very good, highly recommended:

- ✓ Stationary bicycle
- ✓ Ballroom dancing
- ✓ Square dancing
- ✓ Golf
- ✓ Swimming
- ✓ Walking
- ✓ Weight lifting

Good, recommended:

- ✓ Bowling
- ✓ Fencing
- ✓ Rowing
- ✓ Speed walking
- ✓ Table tennis
- ✓ Weight lifting

Needs some skill, prior significant expertise:

- ✓ Cycling
- ✓ Canoeing
- ✓ Horseback riding
- ✓ Ice skating
- ✓ Rock climbing
- ✓ Downhill skiing

With care, ask your doctor:

- ✓ Aerobic exercise
- ✓ Calisthenics
- ✓ Jazz dancing
- ✓ Rock climbing
- ✓ Downhill skiing
- ✓ Tennis-doubles

Avoid:

- ✓ Baseball
- ✓ Basketball
- ✓ Football
- ✓ Softball
- ✓ Handball
- ✓ Jogging
- ✓ Racquetball/Squash
- ✓ Lacrosse
- ✓ Soccer
- ✓ Tennis-singles
- ✓ Volleyball [9]

2.4.8 Knee Orthosis

Regarding knee orthosis, the most simple one definitely involves infrapatellar straps, knee elastic reinforcing braces and knee orthoses with joint bars. Whether more strict stabilization is required, orthoses with continuous rigid flexion or orthoses with limited movement are the best option. Now, in serious combined instabilities and knee joint deformations, orthoses with tight construction are introduced and the talocrural joint is utilized as a secondary joint in order to stabilize the device. As a result, corrective knee orthoses affects the knee alignment based on a three-point principle. Also, most regularly they are equipped by lateral or medial bars with joint and adjustable straps. Conclusively, these knee orthoses can result to correct knee varus or valgus, or even a genu recurvate deformity.

To add upon, a knee-ankle-foot-orthosis is an option mostly in patients who need stabilization and movement control in the knee and ankle joints. What is more, the KAFO is a type of orthosis connection from the patient's thigh to the foot. Hence, this extent permits the function of the actual KAFO as well as allows the controlling of the knee joint in the sagittal and frontal planes. The most important benefits in this situation are firmness, durability and its light weight.

Moreover, a special KAFO is manufactured from light construction materials like carbon and titanium, according to the patient's atomic measurements. Nevertheless, there are also drawbacks which involve a rather lower connection area in the area of the orthoses arches, which because of possible intolerable pressure points does not permit any correction or stabilization of serious knee joint deformations.

It should be highlighted that the function of a KAFO is depended on the forms of joints used in its structure. One type of joint is the single axis knee joint which allows an unlimited flexion and extension in the sagittal plane. Therefore, this type of joint is appropriate for patients who show adequate muscle strength in order to keep stability in the stance phase, although simultaneously exhibit primary deformity of the knee joint: recurvate, valgus, or varum.

Additionally, a single axis knee joint with a lock, will then lock the joint in extension and hence give the knee a rigid stability in all planes. Resulting, this type of joint is appropriate for those patients who have a reduced capability to control the knee joint during the stance phase, and as a result leading to a sudden knee flexion along with gradual loading, both at the beginning and during the stance phase. On the other hand, the orthosis knee joint could be used to and locked at different degrees of knee flexion. This type of joint is used with patients who cannot extend the knee completely, such as in knee flexor contractures.

Lastly, the mechanical or microprocessor controlled knee joints in orthoses are considered some of the more complex mechanisms used with a KAFO knee joint and they react on the stance and swing phases of gait. Thus, this form of joint automatically locks when loaded during the first time the heel touches the floor and still remains locked throughout the whole stance phase, till it is unlocked instantly when the heel leaves the floor ending the stance phase. [3]

Figure 12: KAFO - special carbon orthosis [3]

2.4.9 Osteoarthritis of the knee joint

2.4.9.1 Introduction

To begin with, OA is often found in weight-bearing joints like the knees and hips and it can be a definition of a heterogeneous group of conditions that conclude to numerous of joint symptoms and signs which are connected with defective integrity of the articular cartilage. This happens also in cases of related changes in the underlying bone at the joint margins.

To continue with, there is an extinction of balance between the mechanical stress and the resistance of the articular surfaces. Nevertheless, this balance can be 'bothered' by several factors. Both the resistance of the articular can be lessened by metabolic causes with the mechanical stress staying normal and the mechanical stress can become unusually great because of a mechanical disturbance as the integrity of the tissue stays normal. The perturbation of the physiological equilibrium creates reactions in the tissues, hence causing OA. In case the source of the imbalance is metabolic and causes the tissue to lessen the resistance, OA will first and foremost affect the whole knee. If it is mechanical, the OA can affect the medial or lateral part of the femoro-tibial joint first.

What is more, the OA is usually distinguished as initial or idiopathic when there is no clear predisposing cause, and it is considered secondary when there is some obviously defined predisposing pathology. It is important to note that idiopathic osteoarthritis is the most usual type of arthritis and is a weakening progressive disease that affects 60% of men and 70% of women above the age of 65. The point where the OA ends is cartilage destruction that deteriorates the joint movement and causes severe pain. Moreover, as far as knee joints are concerned, the cartilage destruction has to do with or foregone by subchondral bone sclerosis. Last but not least, the joint destruction is also connected with joint blain, with the synovial membrane having an important role.

The risk of developing OA can be greatly increased by human knee injuries including ACL or meniscal tears, which risk can be increased with age at the time of injury and with the amount time that has blown over since the injury.

Nevertheless, the joint instability may contribute to secondary disease development. [3,6,8,18]

2.4.9.2 Risk factors

The OA in the past was taken into account as an inevitable consequence of old age because of wear and tear. It is without a doubt that aging is a huge risk factor for osteoarthritis and osteoporosis.

In general, patients have a stronger body build with bigger geometrical bone measurements; have raised bone mineral density and a greater peak bone mass. Their higher bone mass may serve as an explanation for osteoarthritis patients to have none or at least very low repercussion of osteoporotic fragility fractures. One more factor may be obesity, where the strike to cause joint overload is connected with radiographically denser bones. The developing adaptations to upright posture, that lead to redirection of loading forces all the way to the hips, knees, and lower back, could also be considered as risk factors. [8]

2.4.9.3 Abnormal loading

The normal joint is adapted in such a way in order to undergo physiologic loads, although unusual loading can raise the risk of OA. For instance, trauma, heavy manual labor, and obesity all have a higher risk of OA. Likewise, in obese men and women with a body mass index of 30 to 35, the risk of developing arthritic knees enhances approximately quadruple. Some factors that will also cause OA are physiologically normal loads practiced to a pathologically impaired joint, as well as subluxation, malalignment of the joint, and crystal deposition diseases. Importantly, former soccer players or football players have a raised predominance of knee OA; this has been ascribed to the high incidence of meniscectomy and cruciate ligament injuries. These kinds of injuries can cause unsteadiness or subluxation of the joint, as well as with unusual impact and load distribution. [8]

2.4.9.4 Clinical features

It is important to note that pain is the most common presentation of an osteoarthritic joint. Pain remains at rest and at night, due to the protective muscle splinting mechanism around the joint which has been lost. Morning stiffness typically accompanies pain and in most cases lasts no more than an hour. During the progression of the disease, a decreased ROM is noticed by the patient because of the joint space incongruity, the muscle spasm and contractures, capsular shrinkage, and mechanical block that comes as a conclusion from osteophytes or loose bodies.

It is typical for decreases in water to happen and proteoglycan content inside the cartilage. As a result, the cartilage becomes more fragile and more susceptible to mechanical disruption. Hence, the underlying bone becomes torn and it also thickens. In the joint where osteoarthritis occurs, the cartilage and bony tissues are involved in most cases. The typical findings include reduction in the joint space, irritation (joint sclerosis), osteophytosis (small bony outgrowths), and bony cyst formation. Throughout the progression of the disease, the joint may become maligned, severe limitation of movement, and severe pain whatsoever. The reasoning for this is not clear, but there are some connections, including genetic predisposition, increasing age (males are affected in a younger age than females do), overuse or underuse of joints, and nutritional and metabolic abnormalities. What is more, the historical findings of osteoarthritis consist of changes within the cartilage and the subchondral bone.

Further articular damage worsens these changes, which promote further unusual stresses on the joint. As the disease progresses the typical finding is pain, which is usually worse on rising from bed and at the end of a day's activity. Conclusively, stiffness and limitation of movement may be resulted. [8]

2.4.9.5 Macroscopic changes in the joints

First and foremost, the loss of cartilage from the weight bearing or previously traumatized area is often seen in a clearer way in osteoarthritic joints. This loss is often associated with a fall of the neighboring subchondral bone, resulting in an amorphous not regular articular surface. As a result, the osteophytes that are produced by revascularization of the remaining cartilage and articular stimulation are found at capsular or tendinous insertions exposed to chronic stretch.

Osteophytes are produced in the non-weight-enduring areas of the joint and may be so wide-spreaded that movement is limited. It should be highlighted that they are relatively softer than the native bone. Moreover, the osteophyte creation usually happens at the junction of the periosteum and the activated synovium. The osteophytes are found at the margin of cartilage and bone, but the bone content of osteophytes is greater and is considered stabilizing structures that redistribute biomechanical forces throughout the position of a person standing up during walking. Although, they limit the physical motion of the joint and have been connected with pain in the past.

Painful locking joints could be caused due to loose bodied because of fragmentation of the osteochondral surface. In the advanced stages of OA in it causes great destruction and distortion of the capsular ligaments. As a result it is lead to deformity, like flexion contractures found in the hip and knee, and to malalignment. The most demanding part of arthroplasty, as far as technique is concerned, is actually the correction of this soft tissue imbalance. [8]

2.4.9.6 Diagnostic procedures

Plain radiography: What are important are plain X-rays in all serious knee injuries, to exclude fractures, avulsions or to show defects of the bone lying under the articular cartilage. Hence, an X-ray indicates the bones of the knee joint and joint space height. Any soft tissue, like ligament, cannot be found on an X-ray.

The magnetic resonance imaging (MRI): the MRI is useful for examining the skeleton and soft tissues (ligaments, tendons, muscles, capsule, and meniscus). Such images can indicate swelling in the bone that goes with fractures as well as PCL ruptures pretty well.

Arthroscopy: It can be considered a widely used method for the assessment of damage of structures outside the joint, like bursae, tendons, and tendon sheaths. This method can be safely performed with local anesthesia, but in many places epidural or general anesthesia is used. [7]

2.4.9.7 Surgical intervention

In cases that medical therapy has failed then surgical intervention for OA has been traditionally used. The arthroscopic joint debridement and washout. In many cases this procedure is successful regarding mechanical symptoms such as locking of the joint or the joint giving way because of the presence of osteophytes and loose bodies.

Osteotomy with correction of bony malalignment can be used as a prophylactic measure in the prevention of OA. In these cases the goal is to restore the joint surfaces that remain at risk of OA from unusual mechanics. Something that is considered one of the biggest advancements of the treatment of OA is the joint replacement. Patients of all ages have the option of various designs of prostheses used safely and reliably. Notably, the newly designed prostheses cause minimal risk and provide maximum improvement in terms of the quality of life. Lastly, the patients are encouraged to walk on the first postoperative day, something which cannot be compares to the bed rest of 6 weeks advocated in the near past. [8]

2.4.9.8 Treatment

In the knee, the articular compressive stresses can be decreased either by lessening the load or by enlarging the articular weight-bearing surfaces. But the ideal treatment combines both possibilities to decrease the mechanical stress acting on the joint as much as possible. What is more, lessening the load and increasing the weight-bearing surfaces are importantly succeeded all by correcting any flexion contracture, by displacing the patella tendon anteriorly and by reentering the load.

At first treatment in the first includes change of lifestyle to prevent pain and simple analgesia. In the progression of the symptoms, As symptoms a joint replacement may be needful, while joint replacement appears to be the panacea for degenerative joint disease, it comes with its risks and complications which involve infection and failure both in the short and long term. Some demonstrative effects are weight reduction, proper exercise, and anti-inflammatory drug treatment. [6]

2.4.9.9 Rehabilitation

According to the disease, the rehabilitation treatment depends on the stage and activity of the disease.

Moreover, to avoid more atrophy from inactivity, isometric exercises of the abdominal, gluteal and thigh musculature are performed. Because of decreased weight-baring the PM in a sling or in the water are beneficial. With joint irritation, the focus is on releasing the short muscles and gradually increasing the use of active exercises.

When the lower excessive symptoms improve, active exercise is expanded. Things to be avoided should be joint overloading; painful end ranges of movement and swinging movements. Furthermore, the patellar mobility is important for the proper function of the quadriceps muscles so patellar mobilization is involved in the treatment program. Something else that needs to be implemented is hamsting muscle flexibility, active quadriceps strengthening, including the vastus medialis.

It should be highlighted that according to the type of involvement, the patient can use various types of braces, and some physical therapy crucial components are unstable surfaces and sensomotoric exercises.

In order to have the proper movement regimen, the most basic principle is to avoid over-loading of the affected joint and encourage the joint's unweighting. In addition, weight loss is another lifestyle change especially for patients who are obese.

To continue with, the aquatic therapy in the form of individual or group exercises gives permission for movement under unweighted conditions. The whirlpool decreases edema and works as an analgesic. In the chronic stage, heat therapy is indicated.

What is more, the orthotic aids ensure unweighting of the affected joint and orthopedic shoe inserts and orthopedic footwear changes are shown. In the later stages of arthritis affecting weight-bearing joints, the patients are given a single point cane or forearm crutches. [3]

2.4.9.10 Radiographic examination of the osteoarthritic knee joint

In a regular knee the radiographic examination indicates two flat cups of subchondral bone, raggedly symmetrical and of even thickness. One of the two flat cups is located under each tibial plateau.

Figure 13: Normal knee [6]

Moreover, a raised thickness of the dense bones underlying the medial plateau. As a result, it becomes progressively triangular near the medial edge of the plateau. This can be considered the first sign of OA of the knee and can be connected by an increase of density in the corresponding femoral condyle.

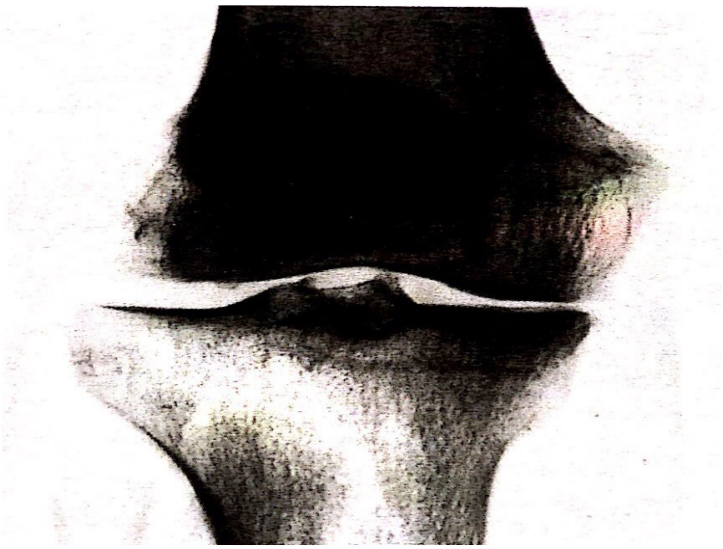

Figure 14: Dense triangle underlying the medial tibial plateau [6]

There is an increase in the thickness of the trabeculae more deeply located beneath the medial plateau until the whole area becomes a dense zone. The medial joint space closes down and it can even be completely disappear.

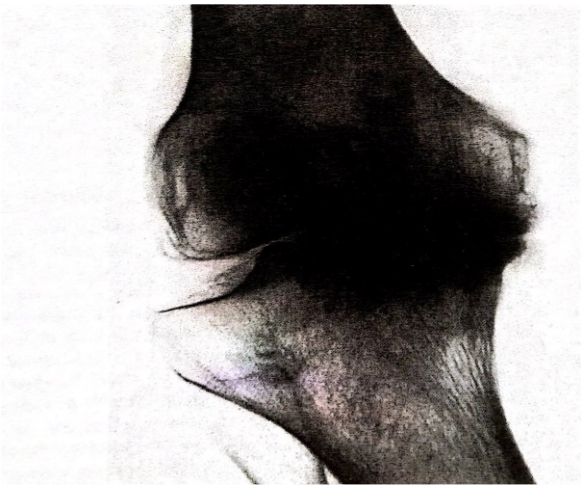

Figure 15: Larger triangle and narrowing of the joint spcace [6]

The edge of the tibial plateau becomes eroded and the femur is subluxated.

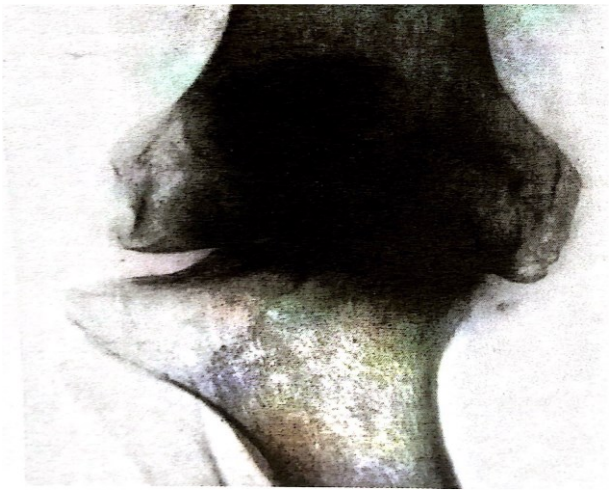

Figure 16: Sclerosis under the eroded medial tibial plateau and subluxation of the joint [6]

In the case of a lying position it can be indicated that the dense triangle beneath the medial tibial plateau although with an adequate joint space. Although, the varus deformity is not shown as crucial and the knee is very different with all the muscles at rest.

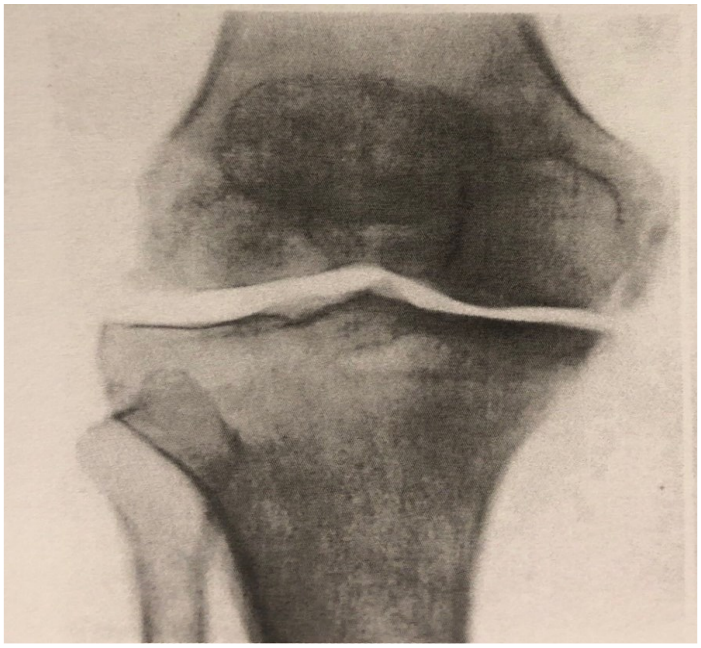

Figure 17: X-ray of a patient in lying position [6]

During the standing position, the medial joint space disappears, the varus deformity is much more shown.

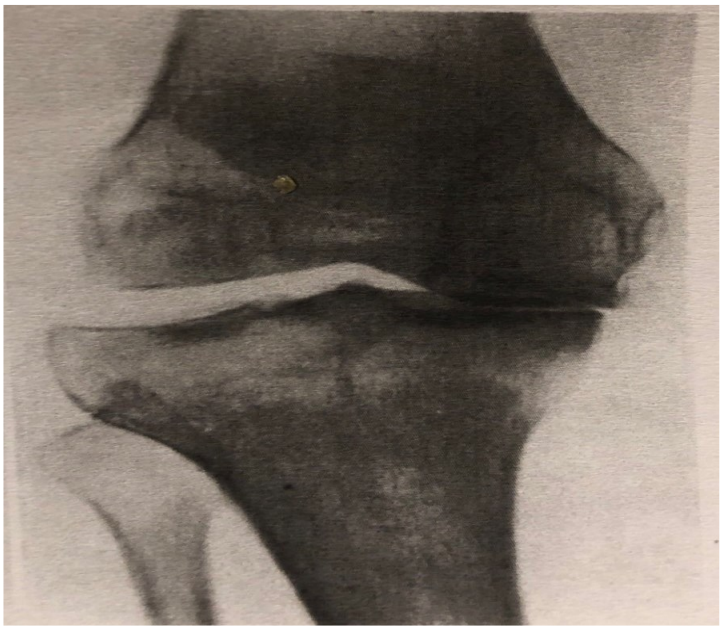

Figure 18: X-ray of a patient in standing position [6]

2.4.9.11 Use of a walking stick

Firstly, it can be noted that the pain in a lower limb usually causes a symptomatic change in gait. As a result it is asymmetrical by displacing the trunk toward the diseased limb its stance phase. Also, numerous OA patients count on supplementary support, with the use of a walking stick. There are also cases where there are patients who cannot walk without its help. Notably, the walking stick lessens the load on the affected limb and can either prevents limping or it can at lessen the displacement of the trunk to the diseased side throughout walking.

With the help of the stick a part of the body weight is transmitted to the ground. This happens with force *C* exercised on it by the upper limb acts with a lever arm *f*, which is the distance between stick and knee. In figure 7, *C* tends to be inclined to the left, which is the part of the body supported by the knee while the weight *P* of this part acting through a lever arm *a* tends to incline to the right.

On the other side of the coin, the stick increases the support. In a normal situation the last reacts to the surface of the foot or shoe in connection to the ground. With the use of the stick, the support area immediately takes the shape of a big

triangle with the side edge of the foot or shoe on the ground as a base and the tip of the stick as its apex. Hence, the support is greatly enlarged, thus the stick obviously ensures better equilibrium for the subject. In addition, the use of a stick lessens the load exercised on the knee and brings its action to be more vertical. What is more, it both greatly enlarges the support of the subject and ensures a better balance.

Lastly, the use of a stick and the limping both reduce the load exercised on an affected lower limb. Thus, they both decrease the moment of the force exercised by the mass of the body on the loaded knee. Also, the stick transmits a part of this force directly to the ground. As a result, the muscular forces that are important for equilibrating the remaining part are excessively lessened and also the size of the resultant force exercised on the joint is decreased. Moreover, the limping limits the lever arm of the force exercised by the mass of the body with a shit of the COG of the body to the loaded knee. As a result, the balance is thus ensured by a smaller muscular force, so the compressive force exercised on the knee is reduced. [6]

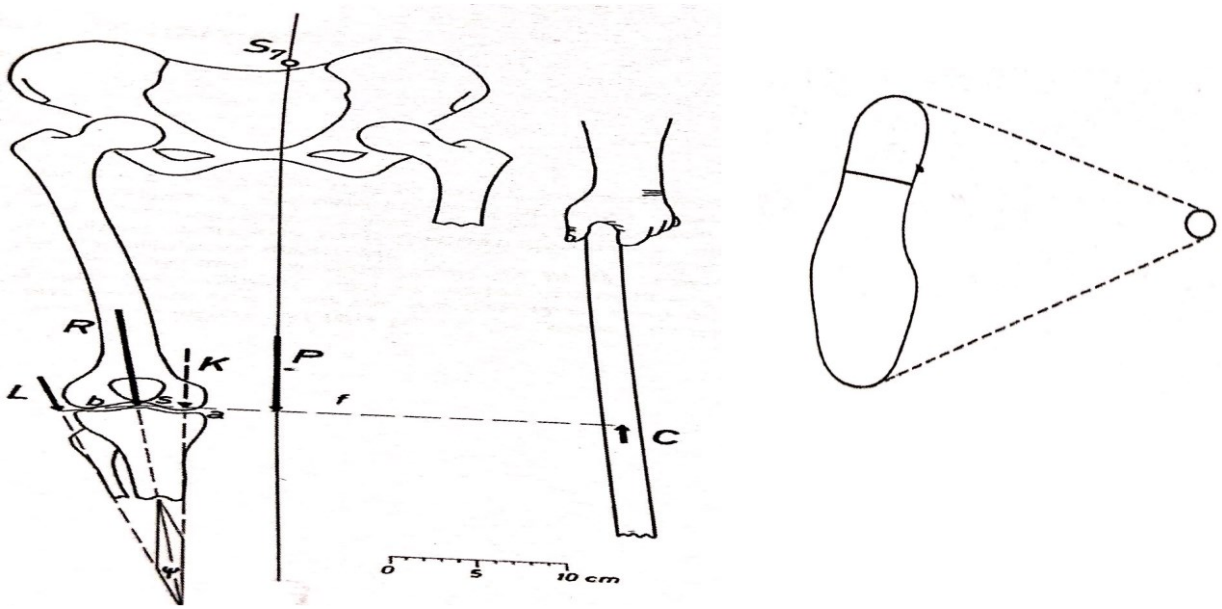

Figure 19: Use of walking stick [6]

3. Case study

3.1 Methodology

My bachelor practice took place in Rehabilitacne Nemocnice Beroun in Prague. This practice started on Monday 7th of January 2019 and ended on Friday 18th of January 2019 (10 days of practice). Each day had a duration of 8 hours. The total amount of hours of practice was 80 hours.

My clinical work placement was supervised by Mgr. Jan Dzvonik. The number of sessions with my patient was seven.

The therapeutic procedures were applied in an individual therapy and exercise room. In the therapies, we used soft tissue techniques, fascia techniques, joint play mobilization, muscle relaxation, stretching, and strengthening techniques, sensomotoric exercises, and general exercises. For the examinations, I also used instruments such as a goniometer, measurement tape, neurological hammer and plumb line.

My work has been approved by the Ethics Committee of the Faculty of Physical Education and Sport at Charles University.

3.2 Anamnesis (medical history)

3.2.1 Status presents:

3.2.1.1 Objective:

Examined person: S.V

Year of birth: 1961

Height: 1.60cm

Weight: 72kg

BMI: 24,2kg/m^2

Cognition: Excellent

Communication: Excellent

Glasses: Yes (not daily)

Crutches: Forearm crutches

3.2.1.2 Subjective*:*

The right knee was swollen but my patient was in a very good condition without feeling pain around the knee. The scar was 15cm without stitches.

3.2.1.3 History Anamnesis:

On 11th December my patient did a surgery of total knee replacement endoprosthesis of the right knee because of arthrosis in the knee. She came in the hospital on 2nd January and she started doing therapies on 4th January. The doctor said to walk without crutches and to put the whole weight after 6 weeks. She has amaurosis and glaucoma on her right eye since 1985. She also has varices in her right leg. After the surgery the patient had worn bandages to prevent thromboembolism.

3.2.1.4 *Injury Anamnesis:*

ACL injury and reconstruction of the right knee 6 years ago while she was skiing.

3.2.2 Surgery Anamnesis:

She did a surgery of (total knee replacement endoprosthesis) on right knee. Also at the same day she did a surgery of valgosity of her right knee to correct it. She did a surgery of her appendix in 1972.

3.2.3 Medical Anamnesis:

Detralex 500mg 2-0-0

Estrofem 0,1mg 1-0-0

Apo-ome 10mg 1-0-0 (after the operation).

3.2.4 Social Anamnesis:

She lives in a flat, on the 2nd floor and she uses stairs every day.

She lives with her son.

3.2.5 Occupational Anamnesis:

She is a doctor (cardiologist)

3.2.6 Allergy Anamnesis:

None

3.2.7 Hobbies:

None

3.2.8 Abuses:

She doesn't smoke, she drinks 1-2 glasses of vine every day.

3.2.9 Prior Rehabilitation:

Her first rehabilitation was on 4th January.

3.2.10 Excerpt from the patient's health care file:

None

3.2.11 RHB indications:

Doctor indicated to use sensory motor stimulation training, scar therapy, isometric exercise of quadriceps, lateral fixators and flexors of the hip, myofacial technique of quadrates lumborum, hamstrings, triceps surae, adductors, walking and breathing.

3.2.12 Differential balance:

My hypothesis for my patient who had total knee replacement is that her right knee will be swollen and restricted fascia around the knee and on the thigh too. She will probably have pain around the knee very often. Also, I expect weakness of gluteus muscles (gluteus maximus, gluteus medius and gluteus minimus), tensor facsia latae, quadriceps femoris (rectus femoris, vastus medialis, vastus lateralis, vastus intermedius), medial hamstrings (semitendinosus, semimembranosus), lateal hamstrings (biceps femoris), and hip adductors (adductor longus, adductor brevis, adductor magnus, gracilis, pectineus). There will be a limited ROM in knee joint in flexion and extension. Shortened muscles might be present (gastrocnemius, soleus, hip flexors of the hip, psoas major, psoas minor, iliacus, hamstrings, quadriceps femoris). It is possible that restricted joints will be found (Lisfranc's and Chopart's, talocalcaneoclavicular, talocrural joint, patella and fibula). Moreover my patient will have decreased stability because of the more weight-bearing in the left leg.

3.3 Initial Kinesiology Examination:

3.3.1 Observation:

Too much swelling on the medial and lateral part of the right knee.

The scar was on the anterior part of the knee and it is 15cm without stitches.

The knee was slight flexed and limited in ROM.

3.3.2 Postural Examination (static):

3.3.2.1 *Anterior view:*

Base of support – left side more weight than the right

Position of the feet – right foot slight in eversion

Shape and position of ankles – symmetrical

Position and shape of the toes – physiological (not pressed toes)

Shape and thickness of the Achilles tendon – symmetrical

Shape and position of the knees – right slight flexed, swollen, left was extended

Contour of the thigh muscles – right swollen and atrophy, left physiological

Gluteal muscles - symmetrical

Position of pelvis – lateral tilt, right side is slight higher

3.3.2.2 *Posterior view:*

Base of support – left side more weight than the right

Position of the feet – right foot slight in eversion

Shape and position of ankles – symmetrical

Position and shape of the toes – physiological (not pressed toes)

Shape and thickness of the Achilles tendon – symmetrical

Shape and position of the knees – right slight flexed, swollen, left is extended

Contour of the thigh muscles – right swollen and atrophy, left physiological

Gluteal muscles - symmetrical

Position of pelvis – lateral tilt, right side is slight higher

Cervical spines – ideal

Thoracic spines - in kyphosis with the top of the curve around Th3

Lumbar spines - slight Lordosis in the upper part of lumbar

Right scapula is slight more protract

3.3.2.3 *Side view:*

Weight distribution – more on the left side

Position of the feet – right foot slight in eversion

Shape and position of ankles – symmetrical

Position and shape of the toes – physiological (not pressed toes)

Shape and position of the knees – right slight flexed, swollen, left is extended

Contour of the thigh muscles – right swollen and atrophy, left physiological

Position of the pelvis – anterior tilt

Cervical spines – ideal

Thoracic spines - in kyphosis with the top of the curve around Th3

Lumbar spines - slight Lordosis in the upper part of lumbar

Shape of the abdominal muscles – prominent

Position of the head – slight protracted.

Right scapula was more protracted

3.3.3 Palpation of pelvis:

Right ASIS higher than the left

Right PSIS higher than the left

Right Iliac crest higher than the left

Both PSIS are higher than both ASIS

- *The patient has anterior tilt and lateral shift to the left side.*

3.3.4 Gait analysis:

- *The patient is walking with forearm crutches and she is using the 2 – point alternate gait.*

- Width base of support – small base of support
- Position of the shoulders – right slightly raised
- She has a slow walking speed and she doesn't put the whole weight on her right leg due to the reason that she is still a little bit scared
- The right knee was semi flexed
- She was stable during walking
- No movement of the head
- Slight bending forward of the trunk during walking
- She walks with short steps in the same length
- When she steps on the right foot she puts the heel first then full contact with the floor but there is no toe off
- The patient during walking was using around 20% loading with the operated leg.

3.3.5 Special Examination:

Vele test: R: Grade 1 L: Grade1

Two scales: R: 21kg L: 51

Romberg test (I- II- III): Negative

3.3.6 Anthropometric Measurements:

Lower Extremities:	**Right**	**Left**
Anatomical Length	82cm	82cm
Functional Length		
Asis- mall med:	91cm	90cm
Umb- mall med:	95cm	96cm
Thigh length:	34cm	36cm
Middle leg length:	43cm	46cm
Thigh circumference		
15cm above knee cap	47cm	44cm
10cm above knee cap	46cm	44cm
Knee circumference	43cm	37cm
Calf circumference	38cm	37cm
Ankle circumference	22cm	22cm
Foot circumference	22cm	22cm

Table 2: Anthropometric measurements of lower extremities (cm)

3.3.7 ROM examination by Janda (SFTR form):

Knee Joint				
Plane	**Left side**		**Right side**	
	Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S	5◦-0◦-120◦	5◦-0◦-125◦	0◦-15◦-80◦	0◦-15◦-85◦

Table 3: ROM (knee joint) by Janda (degrees) [4]

Ankle Joint				
Plane	**Left side**		**Right side**	
	Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S	20◦-0◦-30◦	20◦-0◦-30◦	20◦-0◦-30◦	25◦-0◦-35◦
R	20◦-0◦-30◦	20◦-0◦-30◦	20◦-0◦-30◦	25◦-0◦-35◦

Table 4: ROM (ankle joint) by Janda (degrees) [4]

Hip Joint				
Plane	**Left side**		**Right side**	
	Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S	10◦-0◦-120◦	10◦-0◦-125◦	5◦-0◦-110◦	10◦-0◦-115◦
F	40◦-0◦-20◦	45◦-0◦-25◦	35◦-0◦-15◦	40◦-0◦-20◦
R	45◦-0◦-15◦	50◦-0◦-20◦	45◦-0◦-15◦	50◦-0◦-20◦

Table 5: ROM (ankle joint) by Janda (degrees) [4]

3.3.8 Movement pattern:

Hip extension

R: During all the three times of hip extension the patient activated gluteus maximus, ischiocrural muscles, paravertebral muscles in lumbar area contralaterally and ipsilaterally, paravertebral muscles in thoracolumbar area contralaterally and ipsilterally and the shoulder girdle contralaterally. There was slight anterior tilt of the pelvis during the movement.

L: During all the three times of hip extension the patient activated gluteus maximus, ischiocrural muscles, paravertebral muscles in lumbar area contralaterally and ipsilaterally, paravertebral muscles in thoracolumbar area contralaterally and ipsilaterally and the shoulder girdle contralaterally. There was slight anterior tilt of the pelvis during the movement.

Hip abduction

R: In hip abduction the patient didn't activate gluteus minimus and medius but she used more tensor fasciae latae because she was raising her leg more in flexion and internal rotation. There was a good activation of quadrates lumborum and iliopsoas and also for rectus femoris but there was no so much visible in abdominal area.

L: In hip abduction the patient activated gluteus minimus and medius but she used more tensor fasciae latae because she was raising her leg more in flexion and internal rotation. There was a good activation of quadrates lumborum and iliopsoas and also for rectus femoris but there was no so much visible in abdominal area.

3.3.9 Fascia Examination:

Extremities

Right:

Around the thigh: Restriction in both medial and lateral directions.

Around the knee joint: Restriction in both medial and lateral directions and very restricted on the lower part.

Achilles tendon: Restriction in both medial and lateral directions.

Left:

Around the thigh: No restriction in both medial and lateral directions.

Around the knee joint: Restriction in both medial and lateral directions and slight restricted on the lower part.

Achilles tendon: No restriction in both medial and lateral directions.

3.3.10 Muscle palpation:

Lower extremities:		
	Left	Right
Gluteus Maximus:	Normal	Hypertonic
Iliopsaos:	Normal	Normal
Tensor fasciae latae:	Hypertonic	Hypertonic
Rectus femoris:	Normal	Hypertonic
Vastus medialis:	Hypotone	Hypertonic
Vastus lateralis:	Hypotone	Hypertonic
Adductors:	Hypertonic	Hypertonic
Biceps femoris:	Normal	Hypertonic
Gastrocnemius:	Normal	Hypertonic

Table 6: Tone of lower extremities [10]

3.3.11 Muscle length test (according to Janda):

- Gastrocnemius: R: 2 L: 0
- Soleus: R: 2 L: 1
- Hip flexors:

  One-joint muscles: R: 2 L: 1

  Two-joint muscles: R: 2 L: 2
- Adductors: R: 1 L: 0
- Tensor fascia latae: R: 2 L: 1
- Hamstrings: R: 2 L: 1
- Piriformis R: 1 L:1

3.3.12 Muscle strength test (according to Kendall):

Lower Extremities:		
	Left	Right
Gluteus Max:	4+	3
Iliopsoas:	3	3-
Tensor Fasciae L.:	4	4-
Quadriceps fem:	4	3+
Hip Adductors:	4	3-
Lateral Rotation:	3+	3+
Medial Rotation:	3+	3+
Lateral Hamstrings:	3	3
Medial Hamstrings:	4	3-

Table 7: Muscle strength test according to Kendall [5]

3.3.13 Joint play examination:

Lower extremities

- Knee joint: Restricted in both medial and lateral directions in the right knee, left knee isn't restricted
- Patellar joint: There was restriction just in cranial and caudal direction in left knee, in right knee was restricted in both cranial and caudal directions, and in medial and lateral directions too
- Tibiofibular joint: Restriction in ventrolateral and dorsomedial directions of both legs.
- Talocrural joints: Restriction only in right leg
- Talocalcaneoclavicular joint: Normal motions of the joint play, of supination and pronation of both right and left legs
- Chopart joint: No restriction in both legs
- Lisfranc joint: Both transverse tarsal joints were restricted.

3.3.14 Neurological examination:

3.3.14.1 *Superficial sensation:*

	Left	Right
Dermatome of L1 segment	Normal sensation	Normal sensation
Dermatome of L2 segment	Normal sensation	Normal sensation
Dermatome of L3 segment	Normal sensation	Normal sensation
Dermatome of L4 segment	Normal sensation	Normal sensation
Dermatome of L5 segment	Normal sensation	Normal sensation
Dermatome of S1 segment	Normal sensation	Normal sensation
Dermatome of S2 segment	Normal sensation	Normal sensation

Table 8: Neurological examination - dermatomes examination [11]

3.3.14.2 *Deep tendon reflexes:*

	Left	Right
Knee reflex	3	3
Achilles tendon reflex/ Medioplantar	3	3

Table 9: Deep tendon reflexes assessment according to DTR scale [11]

*Evaluation grades, according to Vele, where grade 3 it is consider a normal grade.

3.3.14.3 *Pyramidal lesion tests:*

Signs of Pyramidal	Right		Left	
	Positive	Negative	Positive	Negative
Extension response				
Babinski Reflex		●		●
Chaddock's Reflex		●		●
Oppenheim's Sign		●		●
Flexion response				
Rossolimo's reflex		●		●
Zukovsky-Kornilov		●		●

Table 10: Neurological examination of pyramidal signs [11]

3.4 Initial Examination Conclusion:

Concluding from all those examinations the patient looked in a very good condition without feeling pain. The main of her problem was that she had very limited ROM in knee flexion and extension and her thigh and knee was very swollen. During walking or standing the patient didn't feel any pain but she had slight pain when we asked her to perform some exercises on her operated knee especially in flexion and extension. The pain in these movements was on the lateral and sometimes on the medial side of the knee.

My patient's right knee was slight flexed during standing and walking and the weight-bearing was more on the left side. However, the pelvis was tilted to the left and right PSIS, ASIS and iliac crest were higher than the left and there was anterior tilt.

During gait examination my patient walked with 2 point – alternate gait and when she put her right foot on the floor, heel strike was in contact with the floor but there was no toe off. Fascia examination on the right leg especially on her thigh, knee and Achilles tendon were restricted and during palpation of muscles I noticed that more of her muscles are hypertonic (gluteus maximus, tensor fascia latae, rectus femoris, vastus medialis, vastus lateralis, biceps femoris, adductors, gastrocnemius). The strength test of the muscles around the leg showed that they are quite weak mostly on the right side. There were weak muscles but they are not in a very bad condition. In length test I saw that all of her muscles were shortened. Most of the examinations in joint play in her operated leg were restricted. Knee joint was restricted in all directions, patellar joint was restricted in cranial and caudal directions, tibiofibular joint restricted and talocrural and also Lisfranc joint restricted. My patient was able to perform movement pattern of hip extension and abduction. There was no pathological pattern. In hip abduction she didn't use gluteus medius and minimus but she used more tensor fascia latae because she performed the movement with more flexion and internal rotation.

3.5 Rehabilitation Plan

3.5.1 Short - term rehabilitation plan

- Decrease the pain
- Decrease the swelling
- Increase the ROM of the limited joints
- Relax the hypertonic muscles
- Improve the joint play of the restricted joints
- Improve muscle strength
- Stretch the shorted muscles
- Improve the stability
- Improve walking

3.5.2 Long – term rehabilitation plan

- Eliminate the pain
- Re – educate correct way of walking
- Education of self - therapeutic techniques for home rehabilitation
- Regain maximum ROM in knee joint as much as possible
- Improve walking

3.6 Therapy summary

The patient had 7sessions with me of physiotherapy to improve his overall condition. This took place in the hospital that I had my practice every day with my patient. On the first day, 08/01/2019, I took the anamnesis and did the examination of the patient and then I had the therapy. On the last day, 16/01/2019, I did the therapy first and then I did the final kinesiology examination of the patient. The comparison of the results was positive for the patient and also she understood how important the exercises and the therapies were. Our therapies usually were composed of some subjective feelings of the patient before the therapy, some objective findings as examinations, and then I used to set the goals of the day's therapy and proposed the therapy. Afterwards, by following our plan, I performed the therapy and later I asked questions and sometimes briefly examined to find out if our therapy was effective or not. Also, the patient had some self-therapy to do every day.

3.6.1 Day 1 – Tuesday 08.01.2019

Subjective feelings: The patient seemed in a good mood. She didn't feel any pain, but her knee was very swollen.

Objective findings: The initial examination was performed on the same day as the day of the therapy, so we didn't do any further examination for today's therapeutic unit.

Goals of today's therapy: To reduce the stiffness of some of the restricted soft tissue, to strengthen weak muscles.

Proposed therapy: STT with a soft ball, STT for the scar, isometric exercises, strengthening exercises.

Description of today's therapeutic unit:

- I started with STT with a soft ball as it can help to release some of the restricted tissues and increase the circulation of the lower extremities and accelerate the healing process. By applying moderate pressure through the soft ball to the skin I performed circular motion firstly on the thigh part of the body, from the distal to the proximal area of the lower extremities. I finished with the same pattern of movements with the ball from the knee to the most proximal part of the pelvis. When I finished with the ventral parts of both lower limbs, I moved to the dorsal side where I followed the same procedure.
- My second therapy for today was STT on the scar of the leg by engaging the barrier by holding the tissues in S shape for 30 seconds and releasing. I applied the same technique in all directions: medially, laterally, cranially and caudally.
- AM of the ankle – knee – hip:
  1. In supine position I instructed my patient to make active movements of the ankles in dorsi-flexion, plantar-flexion, inversion-eversion and circles. (10-12 times each movement)
  2. In prone positon I instructed my patient to make active movements of the knees in flexion as much as she can. (10-12 times)
  3. In supine position I instructed my patient to make active movements of the hip in flexion – abduction – adduction. (10-12 times each movement)

- The following exercises were isometric exercises:
    1. With the patient supine and her both knees flexed and feet in contact with the bed and a ball between her knees, I instructed the patient to press towards the ball and breath in and then relax and breath out. With this exercise I wanted to strengthen the adductors muscles of the hip. (adductor brevis, adductor longus, adductor magnus, gracilis, pectineus) (3 sets, 10 times)
    2. With the patient supine and her both knees flexed and feet in contact with the bed and a theraband around her knees, I instructed the patient to press against the theraband and breath in and then relax and breath out. With this exercise I wanted to strengthen the abductors of the hip. (gluteus minimus, gluteus medius, tensor fascia latae) (3 sets, 10 times)
    3. With the patient supine and a gym ball on the bed in front her legs, I instructed the patient to put her feet on the front side of the ball with her both knees flexed. Then I instructed my patient to press towards the ball with her legs one by one and breath in and then relax and breath out to strengthen gastrocnemius, hip flexors and hamstrings. (3 sets, 10 times)
- The last exercise was squatting. In standing position I placed a gym ball at the lower back against the wall. The patient was holding her forearm crutches to be supported. I instructed my patient to keep her feet at hip distance her feet forward and knees had to remain behind the toes when bent. I also instructed my patient to try to look forward and breath in every time she squatted and breath out in standing position.

Results of therapeutic unit: Today it was the first therapy so I didn't expect any big improvement. The scar was very restricted on the lower part of the knee.

Self – therapy:

- Isometric exercise for quadriceps femoris with a ball under the knee and press towards the ball. Hold 5 seconds, relax (3 sets – 10 repetitions) Strengthening exercise for quadriceps femoris with the patient in supine position and a ball between the knees. Make extension of the knee one by one and hold it for 5 second, relax (3 sets, 10 repetitions)

- Prone knee flexion: Lie on her stomach with her legs straight. Bend the knees and bring the heels toward your buttocks. Hold 5 seconds, relax (3 sets – 10 repetitions)
- Bridge exercise in supine and feet in contact with the bed. While raising up the pelvis breath in and then relax and breath out. (3 sets, 10 repetitions)
- AM of the ankle-knee-hip. (dorsi-flexion, plantar-flexion, inversion-eversion, circles, flexion of the knee, abduction-adduction-flexion-extension-external-internal rotation of the hip. (10-12 repetitions each movement)
- Application of ice-packs for 10mins, 3 times per day.

Notes: Patient looked very easy to cooperate with and she was always willing to do the exercises.

3.6.2 Day 2 – Wednesday 09.01.2019

Subjective feelings: The patient seemed in a good mood. She didn't feel any pain.

Objective feelings: I re-examined the strength of quadriceps femoris which was still the same on right leg. Additionally, I examined the scar where there was also no change since the previous examination.

Goals of today's therapy: To reduce the stiffness of some of the restricted soft tissue, to strengthen weak muscles, to relax the hypertonic muscles.

Proposed therapy: STT with a soft ball, STT for the scar, isometric exercises, strengthening exercises, PIR technique for the shorted muscles.

Description of today's therapeutic unit:

- I started with STT with a soft ball as it can help to release some of the restricted tissues and increase the circulation of the lower extremities and accelerate the healing process. By applying moderate pressure through the soft ball to the skin I performed circular motion firstly on the thigh part of the body, from the distal to the proximal area of the lower extremities. I finished with the same pattern of movements with the ball from the knee to the most proximal part of the pelvis. When I finished with the ventral parts of both lower limbs, I moved to the dorsal side where I followed the same procedure.

- My second therapy for today was STT on the scar of the leg by engaging the barrier by holding the tissues in S shape for 30 seconds and releasing. I applied the same technique in all directions: medially, laterally, cranially and caudally.
- AM of the ankle – knee – hip:
    1. In supine position I instructed my patient to make active movements of the ankles in dorsi-flexion, plantar-flexion, inversion-eversion and circles. (10-12 times each movement)
    2. In prone positon I instructed my patient to make active movements of the knees in flexion as much as she can. (10-12 times)
    3. In supine position I instructed my patient to make active movements of the hip in flexion – abduction – adduction. (10-12 times each movement)
- AM of the hip with a weight on the ankle:
    1. In supine position I instructed my patient to make active movements of the hip in flexion – abduction – adduction. (10-12 times each movement)
- The following exercises were isometric exercises:
    1. With the patient supine and her both knees flexed and feet in contact with the bed and a ball between her knees, I instructed the patient to press towards the ball and breath in and then relax and breath out. With this exercise I wanted to strengthen the adductors muscles of the hip. (adductor brevis, adductor longus, adductor magnus, gracilis, pectineus) (3 sets, 10 times)
    2. With the patient supine and her both knees flexed and feet in contact with the bed and a theraband around her knees, I instructed the patient to press against the theraband and breath in and then relax and breath out. With this exercise I wanted to strengthen the abductors of the hip. (gluteus minimus, gluteus medius, tensor fascia latae) (3 sets, 10 times)
    3. With the patient supine and a gym ball on the bed in front her legs, I instructed the patient to put her feet on the front side of the ball with her both knees flexed. Then I instructed my patient to press towards the ball with her legs one by one and breath in and then relax and breath out to strengthen gastrocnemius, hip flexors and hamstrings. (3 sets, 10 times)

- Bridge exercise in supine with a big ball – I instructed my patient to put the heels on the ball in order the legs being extended and to raise the pelvis and then bring both knees towards the chest and breathing in and then back and breathing out. (3 sets, 3 repetitions)
- Strengthening exercise for quadriceps femoris with the patient in supine position and a ball between the knees. I instructed the patient to put both feet on the bed. Then try to keep the ball between her knees and with the other leg to do extension of the knee and breath in and then relax in flexion and breath out. (3 sets – 10 repetitions)
- Strengthening exercise for hamstrings with the patient in prone position and a ball between the ankles. I instructed the patient to keep the ball between her knees and to flex both knees as much as she can. (3 sets – 10 repetitions)
- Strengthening exercise for gluteus maximus with the patient in prone position. I instructed the patient to flex the knee and then to raise the leg and breath in and then relax and breath out. At fact, I helped my patient to raise the leg and at the same time I was fixing her sacrum. (3 sets – 10 repetitons)
- The next exercise was squatting. In standing position we placed a gym ball at the lower back against the wall. The patient was holding her forearm crutches to be supported. I instructed my patient to keep her feet at hip distance, her feet forward and knees had to remain behind the toes when she bent. I also instructed my patient to try to look forward and breath in when squats and breath out in standing position.
- PIR technique, by Lewit for biceps femoris with the patient supine. I raised patient's leg, bringing it into internal rotation and adduction to take up the slack. In this position I asked the patient to exert slight pressure with her foot into external rotation against my resistance, breathing in and to hold it for 5-10 seconds and then breathing out and relax.
- PIR technique, by Lewit for rectus femoris with the patient supine and her right leg hangs over the edge of the treatment table. I helped the patient to flex the left leg at the hip and knee to draw it up toward her chest using her hands. Then I asked the patient to extend the right leg against my resistance to breathing in and hold it for 10-15 seconds and then breathing out and relax

Results of therapeutic unit: The scar was very restricted on the lower part of the knee. The strength of the muscles was still decreased.

Self – therapy:

- Isometric exercise for quadriceps femoris with a ball under the knee and press towards the ball. Hold 5 seconds, relax (3 sets – 10 repetitions)
- Strengthening exercise for quadriceps femoris with the patient in supine position and a ball between the knees. Make extension of the knee and hold it for 5 second, relax. (4 sets, 10 repetitions)
- Prone knee flexion: Lie on her stomach with her legs straight. Bend the knees and bring the heels toward your buttocks. Hold 5 seconds, relax (3 sets – 10 repetitons
- Bridge exercise in supine and feet in contact with the bed. While raising up the pelvis breath in and then relax and breath out. (3 sets, 10 repetitons)
- AM of the ankle-knee-hip. (dorsi-flexion, plantar-flexion, inversion-eversion, circles, flexion of the knee, abduction-adduction-flexion-extension-external-internal rotation of the hip. (10-12 repetitions each movement)
- Application of ice-packs for 10mins, 3 times per day.

Notes: Patient looked very easy to cooperate with and she was always willing to do the exercises. This can help the therapy and increase the efficiency of our overall healing plan. Also, my patient did some exercises in the swimming pool, and she worked on CPM. These procedures took 30 minutes each.

3.6.3 Day 3 – Thursday 10.01.2019

Subjective feelings: The patient was feeling pain on the lateral side of the knee especially in flexion and extension. The swollen on her knee was slightly reduced.

Objective feelings: I re-examined the strength of quadriceps femoris, adductors and abductors of the hip which was still the same on right leg. Additionally, I examined the scar where there was also no change since the previous examination.

Goals of today's therapy: My goal for this therapy was to decrease the pain and reduce the swelling, and to stretch shorted muscles. I also had to avoid any exercise in flexion and extension that would be unpleasure for my patient.

Proposed therapy: STT with a soft ball, STT for the scar, isometric exercises, PIR for the shorted muscles, sensomotoric stimulation.

Description of today's therapeutic unit:

- I started with STT with a soft ball as it can help to release some of the restricted tissues and increase the circulation of the lower extremities and accelerate the healing process. By applying moderate pressure through the soft ball to the skin I performed circular motion firstly on the thigh part of the body, from the distal to the proximal area of the lower extremities. I finished with the same pattern of movements with the ball from the knee to the most proximal part of the pelvis. When I finished with the ventral parts of both lower limbs, I moved to the dorsal side where I followed the same procedure.
- My second therapy for today was STT on the scar of the leg by engaging the barrier by holding the tissues in S shape for 30 seconds and releasing. I applied the same technique in all directions: medially, laterally, cranially and caudally.
- The following exercises were isometric exercises:
    1. With the patient supine and her both knees flexed and feet in contact with the bed and a ball between her knees, I instructed the patient to press towards the ball and breath in and then relax and breath out. With this exercise I wanted to strengthen the adductors muscles of the hip. (adductor brevis, adductor longus, adductor magnus, gracilis, pectineus) (3 sets, 10 times)
    2. With the patient supine and her both knees flexed and feet in contact with the bed and a theraband around her knees, I instructed the patient to press against the theraband and breath in and then relax and breath out. With this exercise we wanted to strengthen the abductors of the hip. (gluteus minimus, gluteus medius, tensor fascia latae) (3 sets, 10 times)
    3. With the patient supine and a gym ball on the bed in front her legs, I instructed the patient to put her feet on the front side of the ball with her both knees flexed. Then I instructed my patient to press towards the ball with her legs one by one and breath in and then relax and breath out to strengthen gastrocnemius, hip flexors and hamstrings. (3 sets, 10 times)

- Strengthening exercises for the toe flexors with patient sitting on the bed and legs 90 degrees in flexion and hands on the table for support. I instructed the patient to flex the toes of both feet and go forward. (3 sets, 10 repetitions)
- PIR technique, by Lewit for biceps femoris with the patient supine. I raisesd patient's leg, bringing it into internal rotation and adduction to take up the slack. In this position I asked the patient to exert slight pressure with her foot into external rotation against my resistance, breath in and to hold it for 5-10 seconds and then breath out and relax.
- PIR technique, by Lewit for rectus femoris with the patient supine and her right leg hangs over the edge of the treatment table. I helped the patient to flex the left leg at the hip and knee to draw it up toward her chest using her hands. Then I asked the patient to extend the right leg against my resistance to breath in and hold it for 10-15 seconds and then breath out and relax.
- The last exercise was sensomotoric exercises according to Janda & Vavrova. First of all, I stimulated the plantar surface of the foot but this time we did it with a wobble spikes board in an upright sitting position. Then I continued with the small foot in sitting position. I started with passive modeling, the plantar surface was on the ground and the toes look forward. I placed one hand behind the heel and with the other, I was holding and slightly squeezing together the metatarsals from above, after that, I did vibratory movements to shorten and lengthen the sole, and I repeated four times. Later I tried again to do it semi-active - with the help of the patient. This time I could feel some more contraction while I was palpating. I repeated five times.

Results of therapeutic unit: After the therapy the patient was still feeling pain and the knee was still swollen. I was not able to see any performance.

Self – therapy: Application of ice packs for 10 min, 3 times per day. I didn't let her to do the other exercises that she used to have for self-therapy. I let her to rest for one day.

Notes: At the end of the therapy my supervisor and I recommended to put lymphatic tape around the knee to reduce the swelling and the pain. The patient should keep the lymphatic tape for 4-5 days. Also, my patient worked on CPM, had group therapy and she also did some exercises in the swimming pool. All these procedures took 30 minutes each.

3.6.4 Day 4 – Friday 11.01.2019

Subjective feelings: She came today and told me that she put the ice pack as I said her and that the pain of the knee was slightly reduced.

Objective feelings: I re-examined the fascia around the thigh, the ROM of the knee joint and the joint play of the restricted joints of the ankle and patella.

Goals of today's therapy: To reduce the swelling, to increase the joint play of the joints that have restriction, to strengthen weak muscles, to improve the ROM, to teach the patient how to walk correctly, to stretch shorted muscles

Proposed therapy: STT with a soft ball, STT for the scar, STT for fascia according to Lewit, AM of the ankle-knee-hip, AM of the hip with weight, manual therapy techniques according to Lewit, strengthening exercises, sensomotoric stimulation walking training.

Description of today's therapeutic unit:

- I performed fascia techniques according to Lewit on the restricted fascia of the thigh. I held the fascia, I engaged the barrier by performing rotation about a longitudinal axis and then I was treating them by a wringing movement with both hands in opposite directions.
- Then I applied STT with a soft ball as it can help to release some of the restricted tissues and increase the circulation of the lower extremities and accelerate the healing process. By applying moderate pressure through the soft ball to the skin I performed circular motion firstly on the thigh part of the body, from the distal to the proximal area of the lower extremities. I finished with the same pattern of movements with the ball from the knee to the most proximal part of the pelvis. When I finished with the ventral parts of both lower limbs, I moved to the dorsal side where I followed the same procedure.
- My second therapy for today was STT on the scar of the leg by engaging the barrier by holding the tissues in S shape for 30 seconds and releasing. I applied the same technique in all directions: medially, laterally, cranially and caudally.

- I continued with the metarsal joints by performing the fan-wise mobilization as well. After I moved on Lisfranc joint. I tried to mobilize the tibiofibular joint which was mobilized in ventrolateral and dorsomedial directions. After that, I continued with the patellar joint and mobilization in cranial and caudal directions as well as slight to the medial and lateral directions.
- Active movements of the ankle – knee – hip:
    1. In supine position I instructed my patient to make active movements of the ankles in dorsi-flexion, plantar-flexion, inversion-eversion and circles. (12-15 times each movement)
    2. In prone positon I instructed my patient to make active movements of the knees in flexion as much as she can. (12-15 times)
    3. In supine position I instructed my patient to make active movements of the hip in flexion – abduction – adduction. (12-15 times each movement)
- Active movements of the hip with a weight on the ankle:
    1. In supine position I instructed my patient to make active movements of the hip in flexion – abduction – adduction. (12-15 times each movement)
- The following exercises were isometric exercises:
    1. With the patient supine and her both knees flexed and feet in contact with the bed and a ball between her knees, I instructed the patient to press towards the ball and breath in and then relax and breath out. With this exercise I wanted to strengthen the adductors muscles of the hip. (adductor brevis, adductor longus, adductor magnus, gracilis, pectineus) (4 sets, 15 times)
    2. With the patient supine and her both knees flexed and feet in contact with the bed and a theraband around her knees, I instructed the patient to press against the theraband and breath in and then relax and breath out. With this exercise I wanted to strengthen the abductors of the hip. (gluteus minimus, gluteus medius, tensor fascia latae) (4 sets, 15 times)
    3. With the patient supine and a gym ball on the bed in front her legs, I instructed the patient to put her feet on the front side of the ball with her both knees flexed. Then I instructed my patient to press towards the ball with her legs one by one and breath in and then relax and breath out to strengthen gastrocnemius, hip flexors and hamstrings. (4 sets, 15 times)

- The patient was in side-lying position with a theraband around the ankle. I asked the patient to raise her leg into abduction. (4 sets, 5 repetitons)
- Flexion using overball below the Achilles tendon. The patient was supine with her leg extended and an overball under the Achilles tendon. She pushed the heel on the overball and slightly bending the knee. Then she completely bent her knee while her foot was on the overball and breathing in, and then return back into the default position and breathing out. (4 sets, 15 repetitions)
- Bridge exercise in supine with a big ball – I instructed my patient to put the heels on the ball in order the legs being extended and to raise the pelvis and then bring both knees towards the chest and breath in and then back and breath out. (4 sets, 5 repetitions)
- Strengthening exercise for quadriceps femoris with the patient in supine position and a ball between the knees. I instructed the patient to put both feet on the bed. Then try to keep the ball between her knees and with the other leg to do extension of the knee and breath in and then relax in flexion and breath out. (4 sets – 15 repetitions)
- Strengthening exercise for hamstrings with the patient in prone position and a ball between the ankles. I instructed the patient to keep the ball between her knees and to flex both knees as much as she can. (4 sets – 15 repetitions)
- Strengthening exercise for gluteus maximus with the patient in prone position.
  I instructed the patient to flex the knee and then to raise the leg and breath in. At fact, I helped my patient to raise the leg and at the same time I was fixing her sacrum. (4 sets – 15 repetitions)
- Strengthening exercises for the toe flexors with patient sitting on the bed and legs 90 degrees in flexion and hands on the table for support. I instructed the patient to flex the toes of both feet and go forward. (4 sets, 15 repetitions)
- The next exercise was squatting. In standing position I placed a gym ball at the lower back against the wall. The patient was holding her forearm crutches to be supported. I instructed my patient to keep her feet at hip distance, her feet forward and knees had to remain behind the toes when bent. I also instructed my patient to try to look forward and breath in when squats and breath out in standing position.
- PIR technique, by Lewit for biceps femoris with the patient supine. I raised patient's leg, bringing it into internal rotation and adduction to take up the slack. In this position I asked the patient to exert slight pressure with her foot into external

rotation against my resistance, breath in and to hold it for 5-10 seconds and then breath out and relax.

- PIR technique, by Lewit for rectus femoris with the patient supine and her right leg hangs over the edge of the treatment table. I helped the patient to flex the left leg at the hip and knee to draw it up toward her chest using her hands. Then I asked the patient to extend the right leg against my resistance to breath in and hold it for 10-15 seconds and then breath out and relax.
- Sensomotoric exercises according to Janda & Vavrova. First of all, I stimulated the plantar surface of the foot but this time we did it with a wobble spikes board in an upright sitting position. Then I continued with the small foot in sitting position. I started with passive modeling, the plantar surface is on the ground and the toes look forward. I placed one hand behind the heel and with the other, I was holding and slightly squeezing together the metatarsals from above, after that, I did vibratory movements to shorten and lengthen the sole, and I repeated four times.

  Later I tried again to do it semi-active - with the help of the patient. This time I could feel some more contraction while I was palpating. I repeated five times.
- I instructed our patient to try to be in upright position as much as possible when walking by using 2-point alternate gait. I walked with patient up and down the stairs.

Results of therapeutic unit: After the therapy the patient didn't feel pain as in the previous therapy. The knee was still swollen but not as in the previous therapy. I could see that it started decreasing.

Self – therapy:

- Isometric exercise for quadriceps femoris with a ball under the knee and press towards the ball. Hold 5 seconds, relax (4 sets – 15 repetitions)
- Strengthening exercise for quadriceps femoris with the patient in supine position and a ball between the knees. Make extension of the knee one by one and hold it for 5 second, relax (4 sets, 15 repetitions)
- Prone knee flexion: Lie on her stomach with her legs straight. Bend the knees and bring the heels toward your buttocks. Hold 5 seconds, relax (4 sets – 15 repetitions)
- Bridge exercise in supine and feet in contact with the bed. While raising up the pelvis breath in and then relax and breath out. (4 sets, 15 repetitions)

- AM of the ankle-knee-hip. (dorsi-flexion, plantar-flexion, inversion-eversion, circles, flexion of the knee, abduction-adduction-flexion-extension-external-internal rotation of the hip. (12-15 repetitions each movement)
- Application of ice-packs for 10mins, 3 times per day.

Notes: Patient looked very easy to cooperate with and she was always willing to do the exercises. Also, my patient had lymph drainage, she had group gym, she worked on CPM and she did some exercises in the swimming pool. All these procedures took 30 minutes each.

3.6.5 Day 5 – Monday 14.01.2019

Subjective feelings: After the walking therapy that we did in the previous day the patient told me when she went to her room she was feeling a little pain around the thigh. She took out the lymphatic tape and the swelling was reduced. Also, the scar on the lower part of the knee was more flexible.

Objective feelings: I re-examined the fascia around the thigh which was more movable, the ROM of the knee joint and the joint play of the restricted joints of the ankle and patella. I also re-examined the strength of the quadriceps femoris, abductors and adductors.

Goal of today's therapy: To reduce swelling, to reduce the stiffness of some of the restricted soft tissue, to increase the joint play of the joints that have restriction, to strengthen weak muscles, to improve the ROM, to stretch shorted muscles, to relax hypertonic muscles, to teach the patient how to walk correctly.

Proposed therapy: STT for fascia according to Lewit, STT with a soft ball, STT for the scar, manual therapy techniques according to Lewit, isometric exercises, PIR technique for the shorted muscles, stretching shorted muscles, sensomotoric stimulation, walking training.

Description of today's therapeutic unit:

- I performed fascia techniques according to Lewit on the restricted fascia of the thigh. I held the fascia, I engaged the barrier by performing rotation about a longitudinal axis and then I treated them by a wringing movement with both hands in opposite directions.

- Then I applied STT with soft ball as it can help to release some of the restricted tissues and increase the circulation of the lower extremities and accelerate the healing process. By applying moderate pressure through the soft ball to the skin I performed circular motion firstly on the thigh part of the body, from the distal to the proximal area of the lower extremities. I finished with the same pattern of movements with the ball from the knee to the most proximal part of the pelvis. When I finished with the ventral parts of both lower limbs, I moved to the dorsal side where I followed the same procedure.
- My next therapy for today was STT on the scar of the leg by engaging the barrier by holding the tissues in S shape for 30 seconds and releasing. I applied the same technique in all directions: medially, laterally, cranially and caudally.
- I continued with the metarsal joints by performing the fan-wise mobilization as well. After I moved on Lisfranc joint. I tried to mobilize the tibiofibular joint which was mobilized in ventrolateral and dorsomedial directions. After that, I continued with the patellar joint and mobilization in cranial and caudal directions as well as slight to the medial and lateral directions.
- Active movements of the ankle – knee – hip:

1. In supine position I instructed my patient to make active movements of the ankles in dorsi-flexion, plantar-flexion, inversion-eversion and circles. (10-12 times each movement)
2. In prone positon I instructed my patient to make active movements of the knees in flexion as much as she can. (10-12 times)
3. In supine position I instructed my patient to make active movements of the hip in flexion – abduction – adduction. (10-12 times each movement)

- Active movements of the hip with a weight on the ankle:

1. In supine position I instructed my patient to make active movements of the hip in flexion – abduction – adduction. (10-12 times each movement)

- The patient was in side-lying position with a theraband around the ankle. I asked the patient to raise her leg into abduction. (3 sets, 3 repetitons)
- The following exercises were isometric exercises:

1. With the patient supine and her both knees flexed and feet in contact with the bed and a ball between her knees, I instructed the patient to press towards the ball and breath in and then relax and breath out. With this exercise I wanted to strengthen

the adductors muscles of the hip. (adductor brevis, adductor longus, adductor magnus, gracilis, pectineus) (3 sets, 10 times)

2. With the patient supine and her both knees flexed and feet in contact with the bed and a theraband around her knees, I instructed the patient to press against the theraband and breath in and then relax and breath out. With this exercise we wanted to strengthen the abductors of the hip. (gluteus minimus, gluteus medius, tensor fascia latae) (3 sets, 10 times)
3. With the patient supine and a gym ball on the bed in front her legs, I instructed the patient to put her feet on the front side of the ball with her both knees flexed. Then I instructed my patient to press towards the ball with her legs one by one and breath in and then relax and breath out to strengthen gastrocnemius, hip flexors and hamstrings. (3 sets, 10 times)

- Flexion using overball below the Achilles tendon. The patient was supine with her leg extended and an overball under the Achilles tendon. She pushed the heel on the overball and slightly bending the knee. Then she completely bent her knee while her foot was on the overball and breathing in, and then return back into the default position and breathing out. (3 sets, 10 repetitions)
- Bridge exercise in supine with a big ball – I instructed my patient to put the heels on the ball in order the legs being extended and to raise the pelvis and then bring both knees towards the chest and breath in and then back and breath out. (3 sets, 3 repetitions)
- Strengthening exercise for quadriceps femoris with the patient in supine position and a ball between the knees. I instructed the patient to put both feet on the bed. Then try to keep the ball between her knees and with the other leg to do extension of the knee and breath in and then relax in flexion and breath out. (3 sets – 10 repetitions)
- Strengthening exercise for hamstring with the patient in prone position and a ball between the ankles. I instructed the patient to keep the ball between her knees and to flex both knees as much as she can. (3 sets – 10 repetitions)
- Strengthening exercise for gluteus maximus with the patient in prone position.
  I instructed the patient to flex the knee and then to raise the leg and breath in. At fact, I helped my patient to raise the leg and at the same time I was fixing her sacrum. (3 sets – 10 repetitions)

- Strengthening exercises for the toe flexors with patient sitting on the bed and legs 90 degrees in flexion and hands on the table for support. I instructed the patient to flex the toes of both feet and go forward. (3 sets, 10 repetitions)
- The next exercise was squatting. In standing position I placed a gym ball at the lower back against the wall. The patient was holding her forearm crutches to be supported. I instructed my patient to keep her feet at hip distance, her feet forward and knees had to remain behind the toes when bent. I also instructed my patient to try to look forward and breath in when squats and breath out in standing position.
- PIR technique, by Lewit for biceps femoris with the patient supine. I raised patient's leg, bringing it into internal rotation and adduction to take up the slack. In this position I asked the patient to exert slight pressure with her foot into external rotation against my resistance, breath in and to hold it for 5-10 seconds and then breath out and relax.
- PIR technique, by Lewit for rectus femoris with the patient supine and her right leg hangs over the edge of the treatment table. I helped the patient to flex the left leg at the hip and knee to draw it up toward her chest using her hands. Then I asked the patient to extend the right leg against my resistance to breath in and hold it for 10-15 seconds and then breath out and relax.
- Sensomotoric exercises according to Janda & Vavrova. First of all, I stimulated the plantar surface of the foot but this time we did it with a wobble spikes board in an upright sitting position. Then I continued with the small foot in sitting position. I started with passive modeling, the plantar surface is on the ground and the toes look forward. I placed one hand behind the heel and with the other, I was holding and slightly squeezing together the metatarsals from above, after that, I did vibratory movements to shorten and lengthen the sole, and I repeated four times. Later I tried again to do it semi-active - with the help of the patient. This time I could feel some more contraction while I was palpating. I repeated five times.
- I instructed our patient to try to be in upright position as much as possible when walking by using 2-point alternate gait. I walked with patient up and down the stairs.

Results of therapeutic unit: I could see that the strength of the muscles was increased. The ROM of the knee, the fascia around the thigh and the restricted joints had a big improvement.

Self – therapy:

- Isometric exercise for quadriceps femoris with a ball under the knee and press towards the ball. Hold 5 seconds, relax (3 sets – 10 repetitions)
- Strengthening exercise for quadriceps femoris with the patient in supine position and a ball between the knees. Extend the knee and hold it for 5 second, relax (4 sets, 15 repetitions)
- Prone knee flexion: Lie on her stomach with her legs straight. Bend the knees and bring the heels toward your buttocks. Hold 5 seconds, relax (3 sets – 10 repetitions)
- Bridge exercise in supine and feet in contact with the bed. While raising up the pelvis breath in and then relax and breath out. (4 sets, 15 repetitions)
- AM of the ankle-knee-hip. (dorsi-flexion, plantar-flexion, inversion-eversion, circles, flexion of the knee, abduction-adduction-flexion-extension-external-internal rotation of the hip. (10-12 repetitions each movement)
- Application of ice-packs for 10mins, 3 times per day

Notes: Patient looked very easy to cooperate with and she was always willing to do the exercises. Also, my patient had lymphodrainage, she had group gym and she did some exercises in the swimming pool. All these procedures took 30 minutes each.

3.6.6 Day 6 – Tuesday 15.01.2019

Subjective feelings: The patient seemed in a good mood. She didn't feel any pain.

Objective feelings: I re-examined the fascia around the thigh which was more movable, the ROM of the knee joint and the joint play of the restricted joints of the ankle and patella. I also re-examined the strength of the quadriceps femoris, abductors and adductors.

Goals of today's therapy: To reduce the swelling, to reduce the stiffness of some of the restricted soft tissue, to increase the joint play of the joints that have restriction, to strengthen weak muscles, to improve the ROM, to stretch shorted muscles, to relax hypertonic muscles, to teach the patient how to walk correctly.

Proposed therapy: STT for fascia according to Lewit, STT with a soft ball, STT for the scar, manual therapy techniques according to Lewit, isometric exercises, strengthening exercises, PIR technique for the shorted muscles, stretching shorted muscles, sensomotoric stimulation, walking training.

Description of today's therapeutic unit:

- I performed fascia techniques according to Lewit on the restricted fascia of the thigh. I held the fascia, I engaged the barrier by performing rotation about a longitudinal axis and then I treated them by a wringing movement with both hands in opposite directions.
- I started with STT with the soft ball as it can help to release some of the restricted tissues and increase the circulation of the lower extremities and accelerate the healing process. By applying moderate pressure through the soft ball to the skin I performed circular motion firstly on the thigh part of the body, from the distal to the proximal area of the lower extremities. I finished with the same pattern of movements with the ball from the knee to the most proximal part of the pelvis. When I finished with the ventral parts of both lower limbs, I moved to the dorsal side where I followed the same procedure.
- My next therapy for today was STT on the scar of the leg by engaging the barrier by holding the tissues in S shape for 30 seconds and releasing. I applied the same technique in all directions: medially, laterally, cranially and caudally.
- I continued with the metarsal joints by performing the fan-wise mobilization as well. After I moved on Lisfranc joint. I tried to mobilize the tibiofibular joint which was mobilized in ventrolateral and dorsomedial directions. After that, I continued with the patellar joint and mobilization in cranial and caudal directions as well as slight to the medial and lateral directions.
- Active movements of the ankle – knee – hip:

1. In supine position I instructed my patient to make active movements of the ankles in dorsi-flexion, plantar-flexion, inversion-eversion and circles. (12-15 times each movement)
2. In prone positon I instructed my patient to make active movements of the knees in flexion as much as she can. (12-15 times)
3. In supine position I instructed my patient to make active movements of the hip in flexion – abduction – adduction. (12-15 times each movement)

- Active movements of the hip with a weight on the ankle:

1. In supine position I instructed my patient to make active movements of the hip in flexion – abduction – adduction. (12-15 times each movement)

- The following exercises were isometric exercises:

1. With the patient supine and her both knees flexed and feet in contact with the bed and a ball between her knees, I instructed the patient to press towards the ball and breathing in and then relax and breathing out. With this exercise I wanted to strengthen the adductors muscles of the hip. (adductor brevis, adductor longus, adductor magnus, gracilis, pectineus) (4 sets, 15 times)
2. With the patient supine and her both knees flexed and feet in contact with the bed and a theraband around her knees, I instructed the patient to press against the theraband and breath in and then relax and breath out. With this exercise I wanted to strengthen the abductors of the hip. (gluteus minimus, gluteus medius, tensor fascia latae) (4 sets, 15 times)
3. With the patient supine and a gym ball on the bed in front her legs, I instructed the patient to put her feet on the front side of the ball with her both knees flexed. Then I instructed my patient to press towards the ball with her legs one by one and breath in and then relax and breath out to strengthen gastrocnemius, hip flexors and hamstrings. (4 sets, 15 times)

- Flexion using overball below the Achilles tendon. The patient was supine with her leg extended and an overball under the Achilles tendon. She pushed the heel on the overball and slightly bending the knee. Then she completely bent her knee while her foot was on the overball and breathing in, and then return back into the default position and breathing out. (5 sets, 10 repetitions)
- The patient was in side-lying position with a theraband around the ankle. I asked the patient to raise her leg into abduction. (5 sets, 10 repetitions)
- Bridge exercise in supine with a big ball – I instructed my patient to put the heels on the ball in order the legs being extended and to raise the pelvis and then bring both knees towards the chest and breath in and then back and breath out. (4 sets, 15 repetitions)
- Strengthening exercise for quadriceps femoris with the patient in supine position and a ball between the knees. I instructed the patient to put both feet on the bed. Then to

try to keep the ball between her knees and with the other leg to do extension of the knee and breath in and then relax in flexion and breath out. (5 sets – 10 repetitions)

- Strengthening exercise for hamstring with the patient in prone position and a ball between the ankles. I instructed the patient to keep the ball between her knees and to flex both knees as much as she can. (4 sets – 15 repetitions)
- Strengthening exercise for gluteus maximus with the patient in prone position. I instructed the patient to flex the knee and then to raise the leg and breath in. At fact, I helped my patient to raise the leg and at the same time I was fixing her sacrum. (4 sets – 15 repetitions)
- Strengthening exercises for the toe flexors with patient sitting on the bed and legs 90 degrees in flexion and hands on the table for support. I instructed the patient to flex the toes of both feet and go forward. (4 sets, 15 repetitions)
- The next exercise was squatting. In standing position I placed a gym ball at the lower back against the wall. The patient was holding her forearm crutches to be supported. I instructed my patient to keep her feet at hip distance, her feet forward and knees had remain behind the toes when she bent. I also instructed my patient to try to look forward and breath in when squats and breath out in standing position.
- PIR technique, by Lewit for biceps femoris with the patient supine. I raised patient's leg, bringing it into internal rotation and adduction to take up the slack. In this position I asked the patient to exert slight pressure with her foot into external rotation against my resistance, breath in and to hold it for 5-10 seconds and then breath out and relax.
- PIR technique, by Lewit for rectus femoris with the patient supine and her right leg hangs over the edge of the treatment table. I helped the patient to flex the left leg at the hip and knee to draw it up toward her chest using her hands. Then I asked the patient to extend the right leg against my resistance to breath in and hold it for 10-15 seconds and then breath out and relax.
- Sensomotoric exercises according to Janda & Vavrova. First of all, I stimulated the plantar surface of the foot but this time we did it with a wobble spikes board in an upright sitting position. Then we continued with the small foot in sitting position. I started with passive modeling, the plantar surface is on the ground and the toes look forward. I placed one hand behind the heel and with the other, I was holding and slightly squeezing together the metatarsals from above, after that, I did vibratory

movements to shorten and lengthen the sole, and I repeated four times. Later I tried again to do it semi-active - with the help of the patient. This time I could feel some more contraction while I was palpating. I repeated five times.

- I instructed our patient to try to be in upright position as much as possible when walking by using 2point alternate gait. I walked with patient up and down the stairs.

Results of therapeutic unit: I could see that the strength of the muscles was increased. The ROM of the knee, the fascia around the thigh and the restricted joints had a big improvement.

Self – therapy:

- Isometric exercise for quadriceps femoris with a ball under the knee and press towards the ball. Hold 5 seconds, relax (4 sets – 15 repetitions)
- Strengthening exercise for quadriceps femoris with the patient in supine position and a ball between the knees. Extend the knee and hold it for 5 second, relax (4 sets, 15 repetitions)
- Prone knee flexion: Lie on her stomach with her legs straight. Bend the knees and bring the heels toward your buttocks. Hold 5 seconds, relax (5 sets – 10 repetitons
- Bridge exercise in supine and feet in contact with the bed. While raising up the pelvis breath in and then relax and breath out. (5 sets, 10 repetitions)
- AM of the ankle-knee-hip. (dorsi-flexion, plantar-flexion, inversion-eversion, circles, flexion of the knee, abduction-adduction-flexion-extension-external-internal rotation of the hip. (12-15 repetitions each movement) Application of ice-packs for 10mins, 3 times per day

Notes: Patient looked very easy to cooperate with and she was always willing to do the exercises. Also, my patient had group gym, she worked on CPM and she did some exercises in the swimming pool. All these procedures took 30 minutes each.

3.6.7 Day 7 – Wednesday 16.01.2019

Subjective feelings: The patient seemed in a good mood. She was satisfied about her the scar on the lower part of the knee because it was more flexible and the swelling was much decreased. She realized that the ROM of her knee was also increased and her strength of her muscles was increased too.

Objective findings: The final examination was performed on the same day as the day of the therapy. I checked the ROM of the knee in which I succeeded. I also saw a big difference on her muscle strength, on her scar which was more flexible and more movable even more than the previous therapy.

Goals of today's therapy: To reduce the stiffness of some of the restricted soft tissue, to increase the joint play of the joints that have restriction, to strengthen weak muscles, to improve the ROM, to stretch shorted muscles, to relax hypertonic muscles, to teach the patient how to walk correctly.

Proposed therapy:, STT for fascia according to Lewit, STT with a soft ball, STT for the scar, manual therapy techniques according to Lewit, isometric exercises, PIR technique for the shorted muscles, sensomotoric stimulation, walking training.

Description of today's therapeutic unit:

- I performed fascia techniques according to Lewit on the restricted fascia of the thigh. I held the fascia, I engaged the barrier by performing rotation about a longitudinal axis and then I treated them by a wringing movement with both hands in opposite directions.
- I started with STT with the soft ball as it can help to release some of the restricted tissues and increase the circulation of the lower extremities and accelerate the healing process. By applying moderate pressure through the soft ball to the skin I performed circular motion firstly on the thigh part of the body, from the distal to the proximal area of the lower extremities. I finished with the same pattern of movements with the ball from the knee to the most proximal part of the pelvis. When I finished with the ventral parts of both lower limbs, I moved to the dorsal side where I followed the same procedure.

- My next therapy for today was STT on the scar of the leg by engaging the barrier by holding the tissues in S shape for 30 seconds and releasing. I applied the same technique in all directions: medially, laterally, cranially and caudally.
- I continued with the metarsal joints by performing the fan-wise mobilization as well. After I moved on Lisfranc joint. I tried to mobilize the tibiofibular joint which was mobilized in ventrolateral and dorsomedial directions. After that, I continued with the patellar joint and mobilization in cranial and caudal directions as well as slight to the medial and lateral directions.
- Active movements of the ankle – knee – hip:

1. In supine position I instructed my patient to make active movements of the ankles in dorsi-flexion, plantar-flexion, inversion-eversion and circles. (12-15 times each movement)
2. In prone positon I instructed my patient to make active movements of the knees in flexion as much as she can. (12-15 times)
3. In supine position I instructed my patient to make active movements of the hip in flexion – abduction – adduction. (12-15 times each movement)

- Active movements of the hip with a weight on the ankle:

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- The following exercises were isometric exercises:

1. With the patient supine and her both knees flexed and feet in contact with the bed and a ball between her knees, I instructed the patient to press towards the ball and breathing in and then relax and breathing out. With this exercise I wanted to strengthen the adductors muscles of the hip. (adductor brevis, adductor longus, adductor magnus, gracilis, pectineus) (5 sets, 10 times)
2. With the patient supine and her both knees flexed and feet in contact with the bed and a theraband around her knees, I instructed the patient to press against the theraband and breath in and then relax and breath out. With this exercise I wanted to strengthen the abductors of the hip. (gluteus minimus, gluteus medius, tensor fascia latae) (5 sets, 10 times)
3. With the patient supine and a gym ball on the bed in front her legs, I instructed the patient to put her feet on the front side of the ball with her both knees flexed. Then I instructed my patient to press towards the ball with her legs one by one and breath in

and then relax and breath out to strengthen gastrocnemius, hip flexors and hamstrings. (5 sets, 10 times)

- Flexion using overball below the Achilles tendon. The patient was supine with her leg extended and an overball under the Achilles tendon. She pushed the heel on the overball and slightly bending the knee. Then she completely bent her knee while her foot was on the overball and breathing in, and then return back into the default position and breathing out (5 sets, 10 repetitions)
- The patient was in side-lying position with a theraband around the ankle. I asked the patient to raise her leg into abduction. (5 sets, 4 repetitons)
- Bridge exercise in supine with a big ball – I instructed my patient to put the heels on the ball in order the legs being extended and to raise the pelvis and then bring both knees towards the chest and breath in and then back and breath out. (5 sets, 4 repetitions)
- Strengthening exercise for quadriceps femoris with the patient in supine position and a ball between the knees. I instructed the patient to put both feet on the bed. Then to try to keep the ball between her knees and with the other leg to do extension of the knee and breath in and then relax in flexion and breath out. (5 sets – 10 repetitions)
- Strengthening exercise for hamstring with the patient in prone position and a ball between the ankles. I instructed the patient to keep the ball between her knees and to flex both knees as much as she can. (5 sets – 10 repetitions)
- Strengthening exercise for gluteus maximus with the patient in prone position.
  I instructed the patient to flex the knee and then to raise the leg and breath in. At fact, I helped my patient to raise the leg and at the same time I was fixing her sacrum. (5 sets – 10 repetitions)
- Strengthening exercises for the toe flexors with patient sitting on the bed and legs 90 degrees in flexion and hands on the table for support. I instructed the patient to flex the toes of both feet and go forward. (5 sets, 10 repetitions)
- The next exercise was squatting. In standing position I placed a gym ball at the lower back against the wall. The patient was holding her forearm crutches to be supported. I instructed my patient to keep her feet at hip distance, her feet forward and knees had remain behind the toes when she bent. I also instructed my patient to try to look forward and breath in when squats and breath out in standing position.

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- PIR technique, by Lewit for rectus femoris with the patient supine and her right leg hangs over the edge of the treatment table. I helped the patient to flex the left leg at the hip and knee to draw it up toward her chest using her hands. Then I asked the patient to extend the right leg against my resistance to breath in and hold it for 10-15 seconds and then breath out and relax.
- Sensomotoric exercises according to Janda & Vavrova. First of all, I stimulated the plantar surface of the foot but this time we did it with a wobble spikes board in an upright sitting position. Then we continued with the small foot in sitting position. I started with passive modeling, the plantar surface is on the ground and the toes look forward. I placed one hand behind the heel and with the other, I was holding and slightly squeezing together the metatarsals from above, after that, I did vibratory movements to shorten and lengthen the sole, and I repeated four times. Later I tried again to do it semi-active - with the help of the patient. This time I could feel some more contraction while I was palpating. I repeated five times.
- I instructed our patient to try to be in upright position as much as possible when walking by using 2point alternate gait. I walked with patient up and down the stairs.

Results of therapeutic unit: On the last day I saw a big improvement for my patient. The ROM of the knee was increased, the scar was more movable, and the strengthening of the muscles was increased.

Notes: Today was the last day for the final examination and the last therapy. The patient left the next day 17.01.2019. For long term self - therapy I said to my patient to do daily all the self – therapies exercises as I set in every therapy. For example, bridge exercises, exercise with a theraband, isometric exercise for the quadriceps femoris, ice packs, and AM for the ankle-knee-hip.

3.7 Final Kinesiologic Examination

3.7.1 Observation:

The swelling was decreased on the medial and lateral part of the right knee.

The scar was on the anterior part of the knee and it is 15cm without stitches.

The flexion of the knee was decreased, and the ROM of the right knee joint was increased.

3.7.2 Postural Examination (static):

3.7.2.1 *Anterior view:*

Base of support – left side sligh more weight than the left

Position of the feet – right foot slight in eversion

Shape and position of ankles – symmetrical

Position and shape of the toes – physiological (not pressed toes)

Shape and thickness of the Achilles tendon – symmetrical

Shape and position of the knees – flexion of the right knee decreased, slight swelling, left was extended

Contour of the thigh muscles – no atrophy, left physiological

Gluteal muscles - symmetrical

Position of pelvis – lateral tilt, right side is slight higher

3.7.2.2 *Posterior view:*

Base of support – left side slight more weight than the left

Position of the feet – right foot slight in eversion

Shape and position of ankles – symmetrical

Position and shape of the toes – physiological (not pressed toes)

Shape and thickness of the Achilles tendon – symmetrical

Shape and position of the knees – flexion of the right knee decreased, slight swelling, left is extended

Contour of the thigh muscles –no atrophy, left physiological

Gluteal muscles - symmetrical

Position of pelvis – lateral tilt, right side is slight higher

Cervical spines – ideal

Thoracic spines - in kyphosis with the top of the curve around Th3

Lumbar spines - slight Lordosis in the upper part of lumbar

Right scapula is slight more protracted

3.7.2.3 *Side view:*

Weight distribution – more on the left side

Position of the feet – right foot slight in eversion

Shape and position of ankles – symmetrical

Position and shape of the toes – physiological (not pressed toes)

Shape and position of the knees – flexion of the right knee decreased, slight swelling, left is extended

Contour of the thigh muscles – no atrophy, left physiological

Position of the pelvis – anterior tilt

Cervical spines – ideal

Thoracic spines - in kyphosis with the top of the curve around Th3

Lumbar spines - slight Lordosis in the upper part of lumbar

Shape of the abdominal muscles – prominent

Position of the head – slight protracted.

Right scapula was slight more protracted

3.7.3 Palpation of pelvis:

Right ASIS slight higher than the left

Right PSIS slight higher than the left

Right Iliac crest slight higher than the left

Both PSIS are higher than both ASIS

- *The patient has anterior tilt and lateral shift to the left side.*

3.7.4 Gait analysis:

- *The patient is walking with forearm crutches and she is using the 2 – point alternate gait.*

- Width base of support – small base of support
- Position of the shoulders – right slightly raised
- She has a slow walking speed due to the reason that she is still a little bit scared
- Flexion of the knee was decreased
- She was stable during walking
- No movement of the head

  Bending forward decreased, the patient is able to keep an erect position of the trunk during walking
- She walks with short steps in the same length
- When she steps on the right foot she puts the heel first then full contact with the floor but now there is toe off
- The patient during walking was using around 30% loading with the operated leg.

3.7.5 Special Examination:

Vele test:	R: Grade 1	L: Grade1
Two scales:	R: 27kg	L: 45
Romberg test (I- II- III):	Negative	

3.7.6 Anthropometric Measurements:

Lower Extremities:	Right	Left
Anatomical Length	82cm	82cm
Functional Length		
Asis- mall med:	91cm	90cm
Umb- mall med:	95cm	96cm
Thigh length:	34cm	36cm
Middle leg length:	43cm	46cm
Thigh circumference		
15cm above knee cap	45cm	44cm
10cm above knee cap	44cm	44cm
Knee circumference	41cm	37cm
Calf circumference	38cm	37cm
Ankle circumference	22cm	22cm
Foot circumference	22cm	22cm

Table 11: Anthropometric measurements of lower extremities (cm)

3.7.7 ROM examination by Janda (SFTR form):

Knee Joint				
Plane	**Left side**		**Right side**	
	Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S	5◦-0◦-120◦	5◦-0◦-125◦	0◦-10◦-85◦	0◦-5◦-90◦

Table 12: ROM (knee joint) by Janda (degrees) [4]

Ankle Joint				
Plane	**Left side**		**Right side**	
	Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S	20◦-0◦-30◦	20◦-0◦-30◦	25◦-0◦-35◦	30◦-0◦-40◦
R	20◦-0◦-30◦	20◦-0◦-30◦	25◦-0◦-35◦	30◦-0◦-40◦

Table 13: ROM (ankle joint) by Janda (degrees) [4]

Hip Joint				
Plane	**Left side**		**Right side**	
	Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S	10◦-0◦-120◦	10◦-0◦-125◦	10◦-0◦-115◦	15◦-0◦-120◦
F	40◦-0◦-20◦	45◦-0◦-25◦	40◦-0◦-20◦	45◦-0◦-25◦
R	45◦-0◦-15◦	50◦-0◦-20◦	50◦-0◦-20◦	55◦-0◦-25◦

Table 14: ROM (hip joint) by Janda (degrees) [4]

3.7.8 Movement pattern:

Hip extension

R: During all the three times of hip extension the patient activated gluteus maximus, ischiocrural muscles, paravertebral muscles in lumbar area contralaterally and ipsilaterally, paravertebral muscles in thoracolumbar area contralaterally and ipsilaterally and the shoulder girdle contralaterally. There was slight anterior tilt of the pelvis during the movement.

L: During all the three times of hip extension the patient was still activated gluteus maximus, ischiocrural muscles, paravertebral muscles in lumbar area contralaterally and ipsilaterally, paravertebral muscles in thoracolumbar area contralaterally and ipsilaterally and the shoulder girdle contralaterally. There was slight anterior tilt of the pelvis during the movement.

Hip abduction

R: In hip abduction the patient started activating more gluteus minimus and medius and she didn't use tensor fasciae latae because she was raising her leg more in flexion and external rotation. There was a good activation of quadrates lumborum and iliopsoas and also for rectus femoris but there was no so much visible in abdominal area.

L: In hip abduction the patient activated gluteus minimus and medius but she used more tensor fasciae latae because she was raising her leg more in flexion and internal rotation. There was a good activation of quadrates lumborum and iliopsoas and also for rectus femoris but there was no so much visible in abdominal area.

3.7.9 Fascia Examination:

Extremities

Right:

Around the thigh: Very slight restriction in both medial and lateral directions

Around the knee joint: Slight restriction in both medial and lateral directions and very restricted on the lower part

Achilles tendon: No restriction in both medial and lateral directions

Left:

Around the thigh: No restriction in both medial and lateral directions

Around the knee joint: Restriction in both medial and lateral directions and slight restricted on the lower part

Achilles tendon: No restriction in both medial and lateral directions

3.7.10 Muscle palpation:

Lower extremities:		
	Left	Right
Gluteus Maximus:	Normal	Normal
Iliopsaos:	Normal	Normal
Tensor fasciae latae:	Hypertonic	Hypertonic
Rectus femoris:	Normal	Normal
Vastus medialis:	Normal	Normal
Vastus lateralis:	Hypotone	Hypotone
Adductors:	Normal	Normal
Biceps femoris:	Normal	Hypotonic
Gastrocnemius:	Normal	Hypertonic

Table 15: Tone of lower extremities [10]

3.7.11 Muscle length test (according to Janda):

- Gastrocnemius: R: 1 L: 0
- Soleus: R: 1 L: 1
- Hip flexors:

  One-joint muscles: R: 1 L: 1

  Two-joint muscles: R: 1 L: 1

- Adductors: R: 0 L: 0
- Tensor fascia latae: R: 1 L: 1
- Hamstrings: R: 1 L: 1
- Piriformis R: 1 L: 1

3.7.12 Muscle strength test

Lower Extremities:		
	Left	Right
Gluteus Max:	4+	4
Iliopsoas:	3	3+
Tensor Fasciae L.:	4	4
Quadriceps fem:	4	4
Hip Adductors:	4	4
Lateral Rotation:	3+	4
Medial Rotation:	3+	3+
Lateral Hamstrings:	3	4
Medial Hamstrings:	4	4

Table 16: 1 Muscle strength test according to Kendall [5]

3.7.13 Joint play examination:

Lower extremities

- Knee joint: Slight restricted in both medial and lateral directions in the right knee, left knee wasn't restricted
- Patellar joint: There was slight restriction just in caudal direction in left knee, in right knee there was no restriction in both cranial and caudal directions, and in medial and lateral directions too
- Tibiofibular joint: Slight restriction in ventrolateral and dorsomedial directions of both legs.
- Talocrural joints: Restriction only in right leg
- Talocalcaneoclavicular joint: Normal motions of the joint play, of supination and pronation of both right and left legs
- Chopart joint: No restriction in both legs
- Lisfranc joint: Both transverse tarsal joints were not restricted.

3.7.14 Neurological examination:

3.7.14.1 *Superficial sensation:*

	Left	Right
Dermatome of L1 segment	Normal sensation	Normal sensation
Dermatome of L2 segment	Normal sensation	Normal sensation
Dermatome of L3 segment	Normal sensation	Normal sensation
Dermatome of L4 segment	Normal sensation	Normal sensation
Dermatome of L5 segment	Normal sensation	Normal sensation
Dermatome of S1 segment	Normal sensation	Normal sensation
Dermatome of S2 segment	Normal sensation	Normal sensation

Table 17: Neurological examination - dermatomes examination [12]

3.7.14.2 *Deep tendon reflexes:*

	Left	Right
Knee reflex	3	3
Achilles tendon reflex/ Medioplantar	3	3

Table 18: 1 Deep tnedon reflexes assessment according to DTR scale [12]

*Evaluation grades, according to Vele, where grade 3 it is consider a normal grade.

3.7.14.3 *Pyramidal lesion tests:*

Signs of Pyramidal	**Right**		**Left**	
	Positive	Negative	Positive	Negative
Extension response				
Babinski Reflex		●		●
Chaddock's Reflex		●		●
Oppenheim's Sign		●		●
Flexion response				
Rossolimo's reflex		●		●
Zukovsky-Kornilov		●		●

Table 19: Neurological examination of pyramidal signs [12]

3.8 Final Examination Conclusion:

Checking the results, I could see that the therapy was effective. We succeeded in reducing the swelling and pain of the right knee and also in increasing the ROM of flexion and extension of the knee. In standing my patient's knee was not very flexed as in the first examination. During the gait examination the patient steped on her foot with the heel first and then flat foot, heel off, toe off. She increased 10% loading on the operated leg. However, the PSIS, ASIS, and iliac crest were sligh higher than the left.

The scar that she had and the fascia of the lower extremity were not so restricted anymore. The patient started using her gluteus medius and minimus more during hip abduction. The strength test of her muscles increased and they were in a very good condition. The joint play examination of the right knee was still restricted in both medial and lateral directions, the patella was not restricted anymore, the tibiofibular was slight restriced.

During practice at the hospital, I gained valuable experiences, which are going to help me in y whole life.

3.9 Evaluation of the effect of the therapy

As a general result, the condition of the patient has been getting better throughout our therapies. We succeeded in reducing the swelling and pain on the right knee. We managed to increase the ROM in the knee joint of the lower extremities in flexion and extension. During the gait examination the patient stepped on her foot with the heel first and then flat foot, heel off, toe off. She increased 10% of loading on the operated leg and so, the right PSIS, ASIS, and iliac crest are slight higher than the left. Some muscles that used to be much shorter, after the therapy techniques that we performed, got a little bit more elongated but they will need many therapies to increase and maybe some muscles will reach a good length. Also, the joint play of the lower extremities is restored in most of the joints. The fascias of the lower leg aren't restricted. The surgical scar on the right knee is more flexible and more movable.

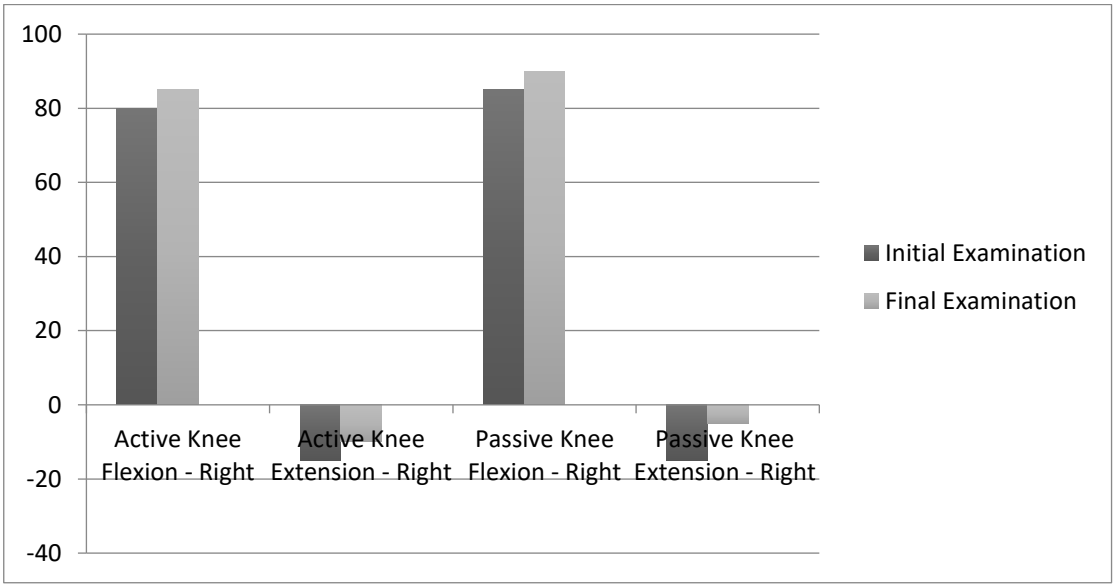

Table 20: Knee ROM comparison. Data from Initial and Final examination (degrees)

4. Conclusion

To conclude with, during my practice at Rehabilitacne Nemocnice Beroun, I could understand that therapy was effective in various ways. The most important factor was the patients were healing and felt better as the days were passing. What is more, all of the goals were achieved and all the proposed therapies were being performed. Basically, in just a two weeks period of time, a lot were achieved. Specifically, we succeeded in correcting the muscle imbalances, increase ROM, relax and strength the muscles, as much as possible. The therapy that I performed was effective and my patient was pleased. Those significant results may not have been achieved if my patient was not cooperating, therefore I am thankful that my patient was so active and ready for exercising.

During the practice, I gained a lot of how to deal with the patients with different disorders. The experience was valuable and by being able to practice every day my theoretical and practical knowledge was confidence for further independent work. I was using various techniques that we have learned at university and also, my supervisor Mgr. Jan Dzvonik was ready to aid me, guide me and review everything with me the entire time. He directed me through various techniques and ways to approximate various challenges and problems.

Overall, I consider this experience as a valuable one and by being able to practice every day my theoretical and practical knowledge provided me with confidence for further independent work.

5. Bibliography:

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6. Supplements

6.1 Table of figures

6.2 Table of tables

6.3 List of abbreviations

ACL- Anterio Cruciate Ligament

ADLs- Activites of Daily Living

AM - Active movements

ASIS- Anterior Superior Iliac Spine

BMI-Body Mass Index

COG- Centre of Gravity

CPM- Continuous Passive Motion

DTR- Deep tendon reflexes

KAFO- Knee-Ankle-Foot-Orthoses

LCL- Laterall Collateral Ligament

MCL- Medial Collateral Ligament

OA- Osteoarthritis

O1- Centre of curvature

O2- Centre of curvature

PCL- Posterior Cruciate Ligament

PIR- Post Isometric Relaxation

PM- Passive Movement

PSIS- Posterios Superior Iliac Spine

ROM- Range of Motion

SFTR- Sagittal- Frontal, Transverse, Rotation method

STT- Soft tissue techniques

6.4 Ethical Board

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

Application for Approval by UK FTVS Ethics Committee

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

The title of a project: Case Study of Physiotherapy Treatment of a patient with the Diagnosis of Total Knee Replacement

Project form: Bachelor Thesis

Period of realization of the project: January 2019

Applicant: Christos Stylianou

Main researcher: Christos Stylianou

Workplace: Rehabilitacni Nemocice Beroun

Co-researcher(s): Mgr.Ilona Kucerova

Supervisor: Mgr. Jan Dzvonik

Project description: Physiotherapeutic rehabilitation plan for a patient after total knee replacement of the right knee. All the methods and therapeutic procedures which are used or applied are according to hospital's preventive regimes for post-operative care. The methods that are used from the researcher are based on the knowledge which was obtained during the three years of bachelor study of physiotherapy program in UK FTVS, Prague. The methods which are used are: Non-invasive assessment, clinical examinations, short and long term rehabilitation plan, differential diagnosis, and non-invasive physiotherapeutic methods including joint play, passive movements, PNF, PIR relaxation techniques, soft tissue techniques and respiratory physiotherapy.
Characteristics of participants in the research: My examined patient is a woman at the age of 58 years old with diagnosed of total knee replacement of the right knee. My patient is ready to perform the physiotherapeutic rehabilitation procedures.
Ensuring safety within the research: For this particular researcher doesn't use any invasive methods. The research is taking place in physiotherapy department Rehabilitacni Nemocnine Beroun building E. All the precautions and risk prevention are followed according to the specific hospital rules, policies and signed documentation. All of the rehabilitation regimes were designed, prescribed and implemented procedures including assessments, therapy, discussions and any kind of communication between patient and researcher were in front of the physical presence of the responsible supervision of Mgr. Jan Dzvonik. Risks of therapy and methods will not be higher than the commonly anticipated risks for this type of therapy.
Ethical aspects of the research: All the members and, or, participants in particular research project are adults and non-vulnerable. all data obtained during the research will strictly be used only for the Bachelor thesis and possible further research at UK FTVS. The Bachelor thesis will contain no data leading to the identification of the patient used in the research. After anonymity the personal data will be deleted. No photos or videos will be taken during the research. I shall ensure to the maximum extent possible that the research data will not be misused.
Informed Consent: attached

It is the duty of **all participants of the research team** to protect life, health, dignity, integrity, the right to self-determination, privacy and protection of the personal data of all research subjects, and to undertake all possible precautions. 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, 10/01/2019 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: 012/2019

Date of approval: 14.1.2019

UK FTVS Ethics Committee reviewed the submitted research project and **found no contradictions** with valid principles, regulations and international guidelines for carrying out research involving human subjects.
The applicant has met the necessary requirements for receiving approval of UK FTVS Ethics Committee.

UNIVERZITA KARLOVA
Fakulta tělesné výchovy a sportu
José Martího 31, 162 52, Praha 6

Stamp of UK FTVS

Signature of the Chair of
UK FTVS Ethics Committee

6.5 INFORMOVANÝ SOUHLAS

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

INFORMOVANÝ SOUHLAS

Vážená paní, vážený pane,

v souladu se Všeobecnou deklarací lidských práv, 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 ....., 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 .....

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..... 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 .....

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