

CHARLES UNIVERSITY
FACULTY OF PHYSICAL EDUCATION AND SPORT
DEPARTMENT OF PHYSIOTHERAPY

**CASE STUDY OF PHYSIOTHERAPY TREATMENT OF A PATIENT
AFTER TOTAL KNEE REPLACEMENT SURGERY**

BACHELOR THESIS

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Abstract

Title: Case study of physiotherapy treatment of a patient after total knee replacement surgery.

Thesis aim: Thesis is divided into two parts, the first part is theoretical and has aim to show an overview of anatomy, kinesiology and biomechanics of the knee joint and to show general information about the osteoarthritis and the patient's surgery. The second part is the case study where aim is to show the examinations and treatments that were provided to the patient and analyse the results.

Clinical findings: The patient was a 71 years old male with diagnosis of total knee replacement surgery, performed 7 days ago from the time we met. The patient had limited ROM in the operated leg into flexion and extension and the area around the knee was swollen and warm. Also, he had some weakness on the muscles of the operated leg.

Procedures: All the procedures that used were based on my knowledge acquired from Charles University in Prague, Faculty of Physical Education and Sport. These were post isometric relaxation, joint mobilisation, strength and length tests and strengthening exercises based on my knowledge.

Result: After 7 days of therapies the patient's operated leg had physiological mobility into flexion and extension, the muscles gained strength and oedema was reduced but not completely.

Conclusion: The therapeutic procedures that were used had positive effect on the patient's situation.

Keywords: Total knee replacement, knee joint, endoprosthesis, range of motion, muscle weakness, joint play, osteoarthritis.

Abstrakt

Název: Případová studie fyzioterapeutické léčby pacienta po operaci náhrady kolene.

Cíl práce: Práce je rozdělena na dvě části, první část je teoretická a má za cíl ukázat přehled anatomie, kineziologie a biomechaniky kolenního kloubu a shrnout obecné informace o artróze kolenního kloubu a používaných léčebných postupech. Druhou částí je případová studie, kde cílem je ukázat vyšetření a léčbu, která byla pacientovi poskytnuta, a analyzovat výsledky.

Metoda: Pacientem byl 71letý muž s diagnózou stav 7 dní po operaci náhrady kolenního kloubu. Pacient měl zejména omezení rozsahu pohybu v kolenním kloubu, který byl limitován i výrazným otokem a svalovým oslabením.

Postupy: Všechny použité postupy vycházely z poznatků získaných studiem fyzioterapie na Univerzitě Karlově v Praze, Fakultě tělesné výchovy a sportu. Mezi nejčastěji používané terapeutické postupy patřily post-izometrická relaxace, mobilizace kloubů, a posilující cvičení.

Výsledek: Po 7 dnech fyzioterapie došlo k návratu fyziologické pohyblivosti v kolenním kloubu, došlo k odstranění velké části otoku a došlo k posílení okolních svalů.

Závěr: Použité léčebné postupy měly pozitivní vliv na situaci pacienta a cíl práce byl splněn.

Klíčová slova: Náhrada kolenního kloubu, endoprotéza, rozsah pohybu, svalová slabost, osteoartrózy.

Declaration

I declare that this bachelor thesis was written by myself. I state that all the information, examinations and therapeutic procedures which are presented in this work were based on my knowledge acquired from professors of Charles University in Prague, Faculty of Physical Education and Sport.

I declare that no invasive methods were used during the practise and the patient was fully aware of procedures that were used.

Prague February 2019

Petrocheilos Stavros

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Contents

1	Introduction	5
2	General part	6
2.1	Anatomy of the Knee Joint	6
2.1.1	Bony Structures and Articular Surfaces.....	6
2.1.2	Joint Capsule.....	7
2.1.3	Menisci.....	7
2.1.4	Ligaments of the Knee.....	8
2.1.5	Bursae	9
2.1.6	Muscles, Innervation and Function Around The Knee.....	10
2.2	Kinesiology of the Knee.....	12
2.3	Biomechanics of the Knee	13
2.4	Special Chapter: Knee Osteoarthritis (OA).....	16
2.4.1	Pathophysiology.....	17
2.4.2	Classification of Gonarthrosis	18
2.4.3	Diagnosis and Clinical Picture.....	18
2.4.4	Non-Invasive Treatment	19
2.4.5	Surgical Procedures-Total Knee Replacement	20
2.4.6	Pre-operative rehabilitation.....	22
2.4.7	Post-operative Rehabilitation.....	23
3	Case study.....	25
3.1	Methodology	25
3.2	Anamnesis (medical history).....	25
3.2.1	Status present	26

3.2.2	History anamnesis.....	26
3.2.3	Injury anamnesis	27
3.2.4	Surgery anamnesis	27
3.2.5	Medical anamnesis.....	27
3.2.6	Family anamnesis	27
3.2.7	Social anamnesis.....	27
3.2.8	Occupational anamnesis	27
3.2.9	Allergy anamnesis.....	27
3.2.10	Pharmacological anamnesis.....	27
3.2.11	Hobbies	28
3.2.12	Abuses.....	28
3.2.13	Prior rehabilitation	28
3.2.14	Excerpt from patient’s health care file.....	28
3.2.15	RHB indications.....	28
3.3	Initial kinesiological examination.....	28
3.3.1	Postural examination.....	28
3.3.2	Palpation of pelvis	30
3.3.3	Breathing stereotype	30
3.3.4	Specific testing of posture.....	30
3.3.5	Modification of standing.....	31
3.3.6	Gait examination.....	31
3.3.7	Anthropometric measurements	31
3.3.8	Measurement of ROM	32
3.3.9	Muscle length examination.....	33

3.3.10	Manual muscle strength test (acc to Kendall).....	33
3.3.11	Muscle tone palpation.....	34
3.3.12	Examination of soft tissues (acc to Lewit).....	35
3.3.13	Movement stereotype.....	36
3.3.14	Neurological examination.....	36
3.3.15	Joint play examination (acc Lewit).....	37
3.3.16	Examination's conclusion:.....	38
3.4	Short term rehabilitation plan.....	39
3.5	Long term rehabilitation plan.....	39
3.6	Therapy progress.....	40
3.6.1	Day 1 st Date: 10/1/2019.....	40
3.6.2	Day 2 nd Date: 11/1/2019.....	42
3.6.3	Day 3 rd Date: 14/1/2019.....	45
3.6.4	Day 4 th Date: 15/1/2019.....	47
3.6.5	Day 5 th Date: 16/1/2019.....	50
3.6.6	Day 6 th Date: 17/1/2019.....	53
3.6.7	Day 7 th Date: 18/1/2019.....	55
3.7	Final kinesiological examination.....	58
3.7.1	Postural examination.....	58
3.7.2	Palpation of pelvis.....	60
3.7.3	Breathing stereotype.....	60
3.7.4	Specific testing of posture.....	60
3.7.5	Modification of standing.....	60
3.7.6	Gait examination.....	60

3.7.7	Anthropometric measurements	61
3.7.8	Measurement of ROM	61
3.7.9	Muscle length examination.....	62
3.7.10	Manual muscle strength test (acc to Kendall).....	63
3.7.11	Muscle tone palpation	64
3.7.12	Examination of soft tissues (acc to Lewit).....	65
3.7.13	Movement stereotype.....	65
3.7.14	Neurological examination.....	65
3.7.15	Joint play examination (acc Lewit).....	66
3.8	Evaluation of the effect of the therapy	67
4	Conclusion.....	70
5	Bibliography.....	71
6	Supplement.....	74
6.1	List of Pictures	74
6.2	List of Tables.....	74
6.3	List of Abbreviations.....	75
6.4	Informed consent.....	76
6.5	Approval by the Ethics Committee	77

1 Introduction

My work placement took place in Rehabilitační Nemocnice Beroun from 8/1/2019 to 18/1/2019. The aim of thesis is to provide theoretical background of anatomy, kinesiology, biomechanics of knee joint, information about total knee replacement surgery and information about osteoarthritis. Another aim is to show the therapies that were applied for this diagnosis and analyze the effectiveness after all the sessions.

The case study that I chose was total knee replacement, that was performed 7 days before I met the patient. I had 7 days of therapies with the patient and the first day that we met I did the initial examination. The goal of therapies was to increase mostly the ROM in the knee joint into flexion and extension, decrease swelling and improve the tone and strength of the muscles of operated leg. Patient was attending group exercises that had the same goals with my therapies. Patient was familiar with this procedure because he had the same surgery on the other leg.

2 General part

2.1 Anatomy of the Knee Joint

The knee joint is a hinge type of synovial joint, is the largest and one of the most important joints in the human body and also, one of the most easily injured joints. It takes all the weight of the body in horizontal and vertical directions, while running, walking or jumping. Is one of the most powerful joints in the body and allows the lower limb to be in different positions for any situation. In order to be stable, it is surrounded and consisted by ligaments, tendons, capsule, two menisci and bursae. [2,4]

2.1.1 Bony Structures and Articular Surfaces

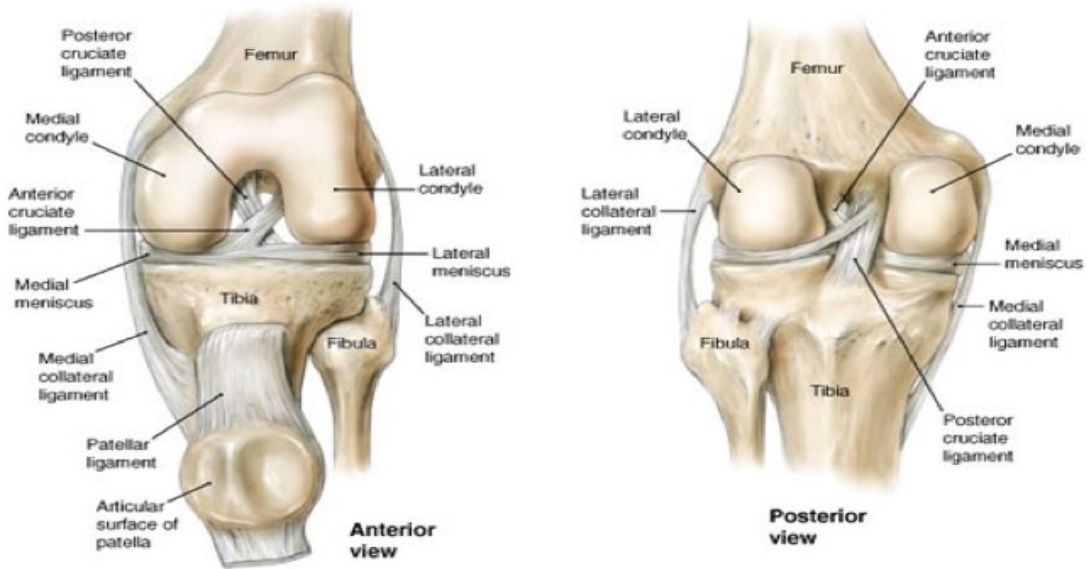
The knee joint consists of three different bones: the femur, the tibia and the patella. The femur or thigh bone is the largest, heaviest and strongest bone in the human body, at the proximal end articulates with pelvis through the head of femur and acetabulum. At the distal end articulates with tibia through lateral and medial condyles. [2,4]

Tibia or shin bone is a large bone that is responsible for weight bearing. It connects the knee with ankle joint which articulates at its lower end. At the proximal end there are the lateral and medial condyles of the tibia that are articulated with the femur. Inferior of the lateral condyle of tibia articulates the fibula. [2,4]

Patella or knee cap is the largest sesamoid bone that it is formed after birth. It is located between the condyles of femur and it articulates with femur.

So, the knee joint consists of three different articulations which are: medial femorotibial articulation between the medial condyles of femur and tibia, lateral femorotibial articulation between lateral condyles of tibia and femur, femoropatellar

articulation between patella and femur. [2,4]



Picture 1 Components of Knee Articulation [2]

2.1.2 Joint Capsule

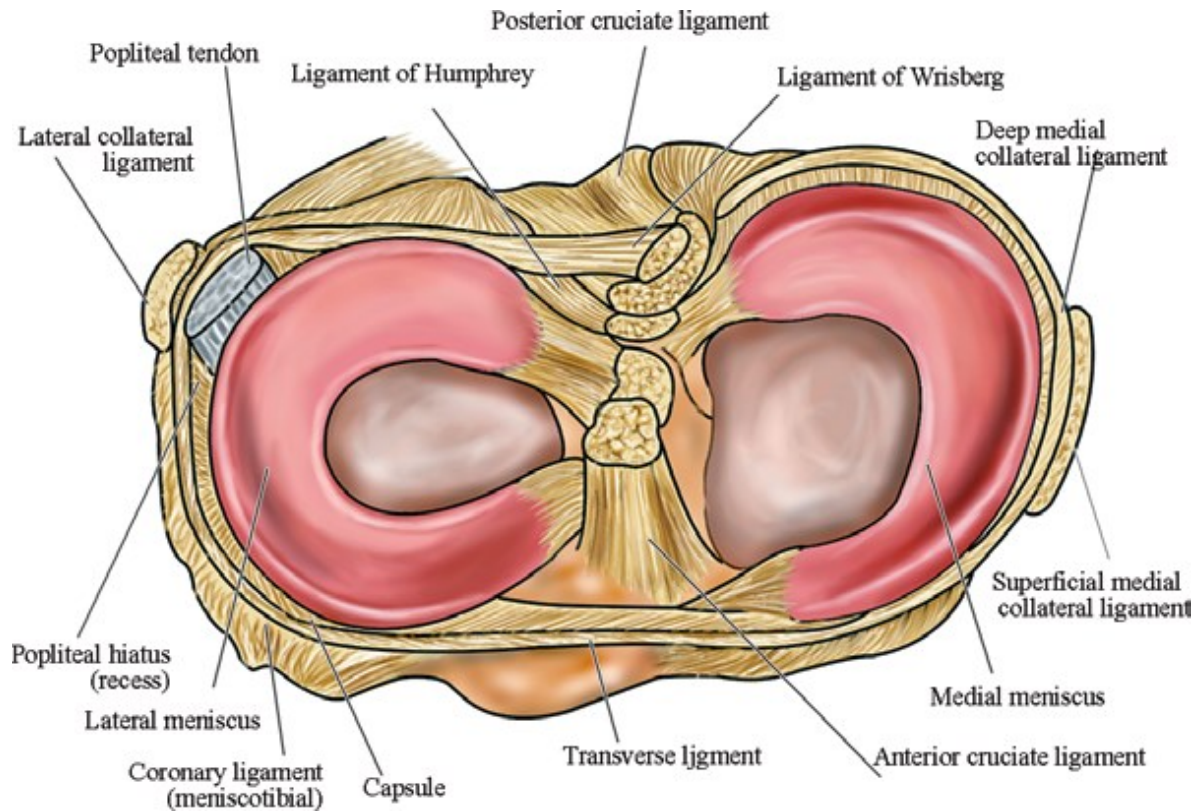
The joint capsule is a two layers sheath that surrounds the joint. The outside layer is made by ligaments, tendons and bursa that stabilizes the joint. The inside layer is synovial membrane that contains synovial fluid and keeps the joint lubricated and full of nutrients.

2.1.3 Menisci

The menisci are two crescent shape fibrocartilage discs found in the articulation between tibia and femur. They are divided into medial and lateral meniscus and both of them work as a shock absorber, they increase the support area between the condyles for better weight distribution, provide proprioception and they help in distribution of synovial fluid. [4]

Their shape is concave at the top and flat at the bottom where they attach to tibia. Medial meniscus is C-shaped and posterior is wider than anterior, in contrast lateral meniscus is almost circular and has bigger mobility. They are connected in the anterior part

by the transverse ligament of the knee. [4]



Picture 2 Menisci and Ligaments [4]

2.1.4 Ligaments of the Knee

There are several ligaments in the knee joint that together with menisci and other soft tissues provide stability and protect the articulation. [2,1,4]

Lateral or fibular collateral ligament is a strong, rounded and cord-like ligament that goes from lateral condyle of femur to lateral surface of head of fibula. It provides support to the knee for varus stress.

Medial or tibial collateral ligament is a strong flat band that goes from medial condyle of femur to medial condyle of and medial surface of tibia. It has parallel and oblique fibers at the midpoint where they attach to medial meniscus.

Popliteal ligaments provide stability mostly to the posterior part of the knee. The oblique popliteal ligament goes from medial condyle of tibia to posterior aspect of joint

capsule. The arcuate popliteal ligament goes from head of fibula to posterior surface of the knee joint.

Anterior cruciate ligament is the weaker of the two cruciate ligaments with the most injuries and originates from posterior part of medial side of the lateral condyle of femur and attaches at the anterior intercondylar area of tibia. It prevents anterior displacement of tibia against the femur and hyper-extension of knee.

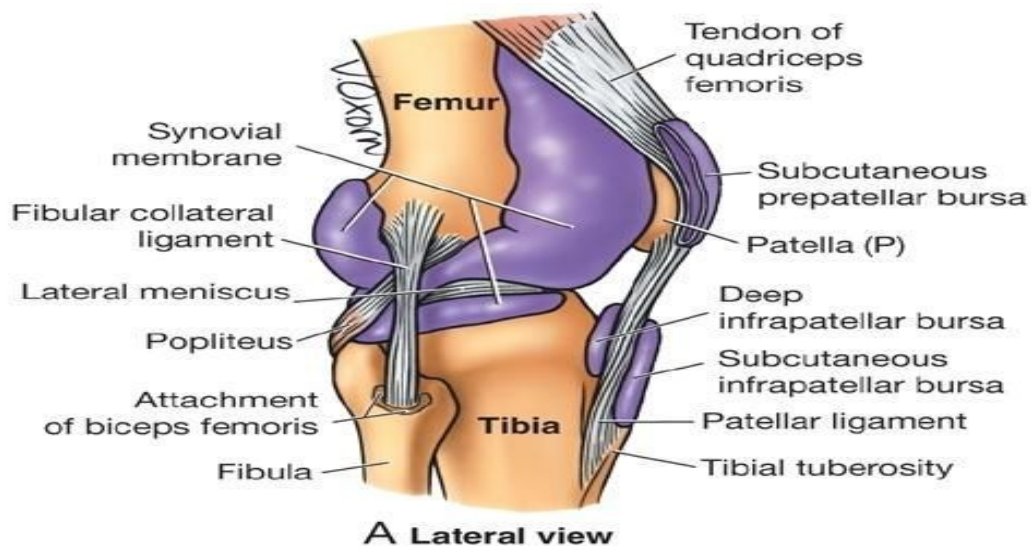
Posterior cruciate ligament is the stronger between the two and originates from anterior part of lateral surface of the medial condyle of femur and attaches at posterior intercondylar area of tibia.

Transverse ligament connects anteriorly the medial and lateral meniscus.

Patellar ligament is a strong thick fibrous band and is the expansion of quadriceps muscle. It connects the patella with the tibial tuberosity.

2.1.5 Bursae

There are 12 bursae around the knee joint because of the tendons and their attachment at the bones. These bursae are subcutaneous prepatellar bursa, infrapatellar bursa, suprapatellar bursa, popliteus bursa, anserine bursa, gastrocnemius bursa, semimembranosus bursa. [2]



Picture 3 Bursae and Ligaments of Knee [2]

2.1.6 Muscles, Innervation and Function Around The Knee

Muscle	Origin	Insertion	Innervation	Function
Rectus femoris (quadriceps)	Anterior inferior iliac spine	Tibial tuberosity	Femoral nerve	Extension of knee, flexion of hip
Vastus medialis (quadriceps)	Medial lip of linea aspera of femur	Tibial tuberosity	Femoral nerve	Extension of knee
Vastus lateralis (quadriceps)	Greater trochanter	Tibial tuberosity	Femoral nerve	Extension of knee
Vastus intermedius (quadriceps)	Anterior surface of femur	Tibial tuberosity	Femoral nerve	Extension of knee
Biceps femoris	Long head: ischial tuberosity Short head: lateral supracondylar line of femur	Head of fibula	Sciatic nerve	Extension of hip, flexion of knee, lateral rotation of leg
Gastrocnemius	Lateral head: lateral condyle of femur Medial head: medial condyle of femur	Calcaneus	Tibial nerve	Plantar flexion of ankle, assists in knee flexion

Gracilis	Inferior pubic ramus	Medial surface of tibia	Obturator nerve	Adducts thigh, flexes and medially rotates leg
Plantaris	Lateral supracondylar line of femur	Calcaneus	Tibial nerve	Assists gastrocnemius
Popliteus	Lateral condyle of femur	Soleal line of femur	Tibial nerve	Weak flexion of knee and medial rotation of tibia
Sartorius	Anterior superior iliac spine	Medial surface of tibia	Femoral nerve	Abducts, laterally rotates and flexes thigh, flexes knee joint
Semimembranosus	Ischial tuberosity	Medial condyle of tibia	Sciatic nerve	Flexes knee, extends thigh and medially rotates leg
Semitendinosus	Ischial tuberosity	Medial surface of tibia	Sciatic nerve	Flexes knee, extends thigh and medially rotates leg
Tensor fascia latae	Anterior superior iliac spine	Iliotibial tract that attaches to lateral condyle	Superior gluteal nerve	Abducts and medially rotates hip, helps to keep knee

		of tibia		extended
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Table 1 Muscles That Act on The Knee [1]

2.2 Kinesiology of the Knee

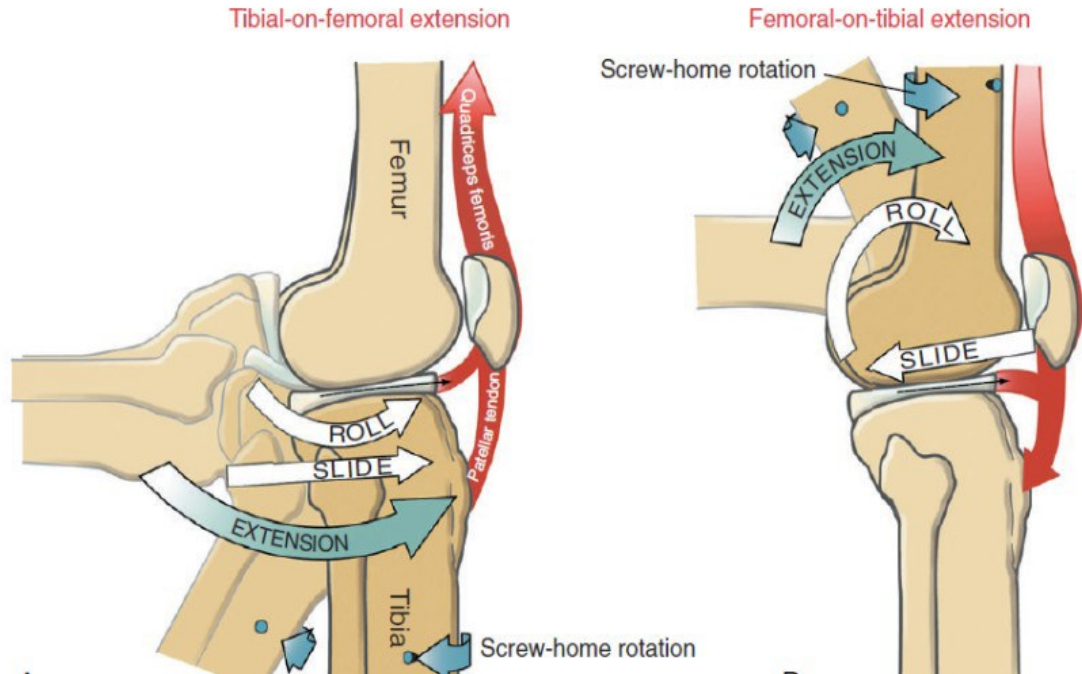
The knee joint has three main movements, the first one and the larger is in the sagittal plane that allows the knee to move into flexion and extension. The physiological range of motion for flexion is between 120°-150° but this varies according to authors. For extension the physiological range of motion is 0° but there is also possibility for hyper-extension 5° to 10° which is not pathological, everything above 10° can be a sign of pathology. The axis for these motions is not fixed but changes within the femoral condyles. [6]

The second motion is in the transverse plane that allows the knee to move in internal and external rotations. The range of motion for these movements varies and depends on the flexion of the knee which it's greater in 90° of flexion, with range of motion for external rotation to exceed internal for 2:1 and to be around 40°-45°. [5,6]

The third one is in frontal plane which allows the tibia to move into abduction and adduction in relation to the femur with only 5° of motion. Movements in the knee joint include more than one motions of the articulation.

The anatomical position and normal alignment of the knee is 0° of flexion and in this position the joint is “locked” or in “screw-home” position. This allows us to stand without using muscles and provide us stability. In this position any movement is blocked, in order the joint to be “unlocked” and to start the flexion a small internal rotation of tibia against femur need to be done in the first 5° to 30° of flexion depending on the author. The same mechanism is during extension where the joint in order to “lock” external rotation of tibia against femur need to be done. [6]

Moving from extension to flexion the knee joint does small internal rotation, as I mentioned above, then there is rolling motion of the femoral condyles on the plateau of tibia and then the end of the movement comes with translatory movement posteriorly of the femoral condyles on the tibia with the menisci to follow this backward movement. [5,6]



Picture 4 Knee Motion into Extension [6]

Moving from flexion to extension the movement is the opposite with the beginning to be translatory movement anteriorly of the femoral condyles. When there is an open kinematic chain tibia moves against the femur and the opposite happens in a close kinematic chain. The movement of the patella is gliding distally with extension and proximally with flexion. [5]

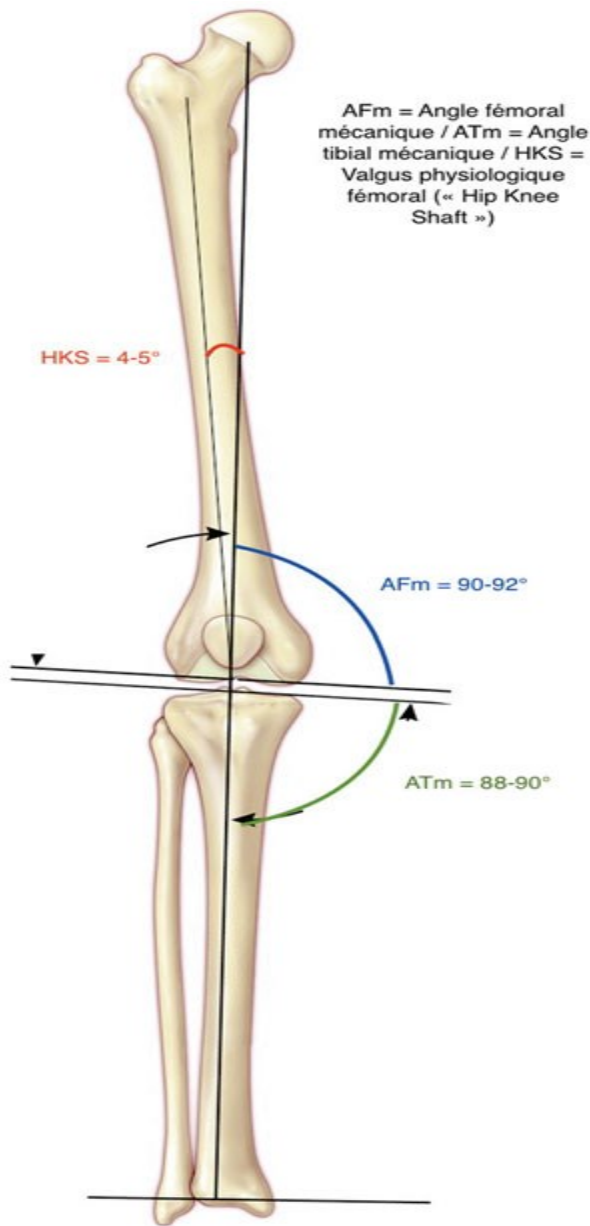
2.3 Biomechanics of the Knee

The knee gets compressive and shear forces that they are related to the weight of the person according to the activity. In single leg stance the force that goes to the knee is twice bigger than the weight of the person, during walking the force that goes to the knee is more than two times higher and while going up the stairs more than three times higher of the body weight. [6,15]

The meniscal cartilages have the major role of absorption of these compressive forces that act in the knee by increasing the contact area of the joint and distributing the weight to the lower part of the body in order to protect the cartilage. The shear forces are absorbed by the soft tissues around the knee joint and they are getting greater as the knee

goes into more flexion position. The mobility of menisci is crucial to the absorption and distribution of weight. [15]

The mechanical forces to the knee joint pass through the tibiofemoral mechanical



Picture 5 Normal Mechanical Axis of The Lower Limb [7]

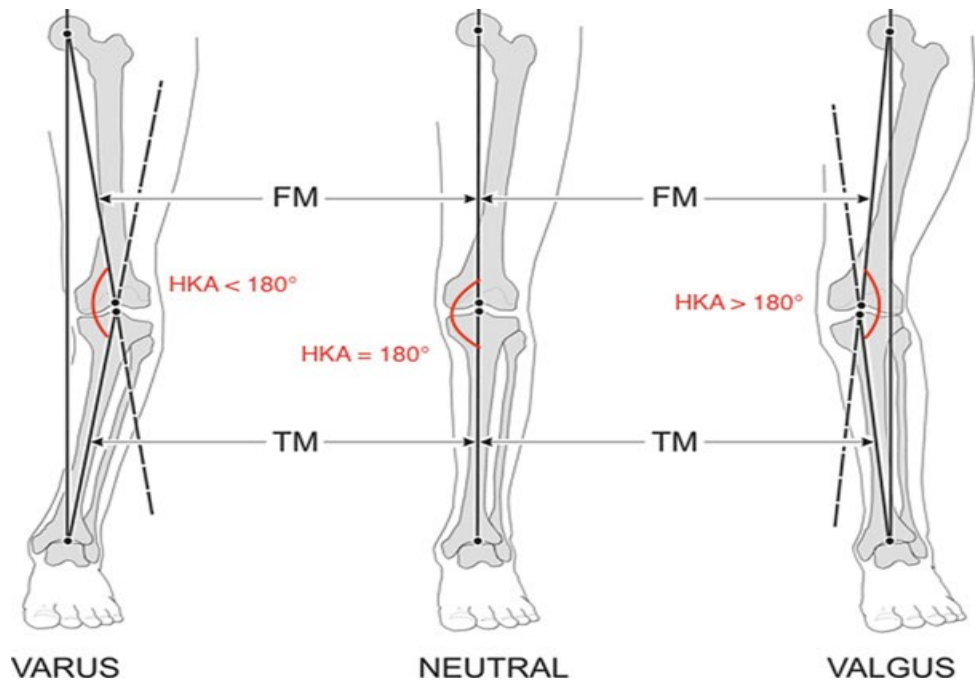
axis. The physiological mechanical axis of the lower limb is formed by a line drawn from the center of the femoral head to the ankle. This axis should pass from the middle of the knee joint. The joint line is not perpendicular to this axis but has an angle of 1° to 2° to slight downward medial direction [7]. So, the tibiofemoral or anatomical axis is in slight valgosity up to 6°. This has as result that 75% of the forces in standing position goes through the medial compartment of the knee. In sagittal plane the mechanical axis is in the middle of the knee joint and the forces are in the middle. [7]

Chronical overuse or congenital conditions can cause misalignments in the knee joint. These misalignments can be in to Varus direction that mean the knee goes in outward direction or valgus when the knee goes inward direction in frontal plane. When the knee is in varum misalignment or Genu varum the forces of the knee joint pass through the medial compartment of the joint that causes thinning of the cartilage in medial side

and lead to painful condition or osteoarthritis of knee joint. In situation of Genu valgum misalignment all the forces go through the lateral compartment of the knee and has the same results. The alignment of the knee joint is strongly connected with the muscles around

the joint and their force that apply to it, with the hip joint where the position of the hip affects the position of the knee. [6,7]

As I mentioned above meniscal injuries are the most common injuries in the knee joint and some studies have shown that athletes or people with meniscectomy or many meniscal injuries are more keen to develop osteoarthritis in the knee joint. [6]



Picture 6 Mechanical Axes and Misalignments [7]

Soft tissues provide active stability in the joint, the muscles alone provide dynamic stability and the ligaments, menisci provide passive stability. During the compressive forces the knee joint is more stable because the two bones come close to each other and the ligaments have no tension but, in any movement the ligaments get elongated and prevent further elongation of the joint. [23]

ACL protects from anterior translation of tibia, hyperextension and as secondary controls screw home and limits intern rotation and valgus direction. PCL limits posterior tibial translation and is most effective in mid flexion. MCL limits valgus motion, internal tibial rotation and secondary external tibial rotation. LCL restrains Varus motion and secondary to posterior translation of tibia. [23]

2.4 Special Chapter: Knee Osteoarthritis (OA)

Osteoarthritis (OA) is the most common degenerative joint disease that is characterized by degeneration and bony formation in the margin of the joint which usually



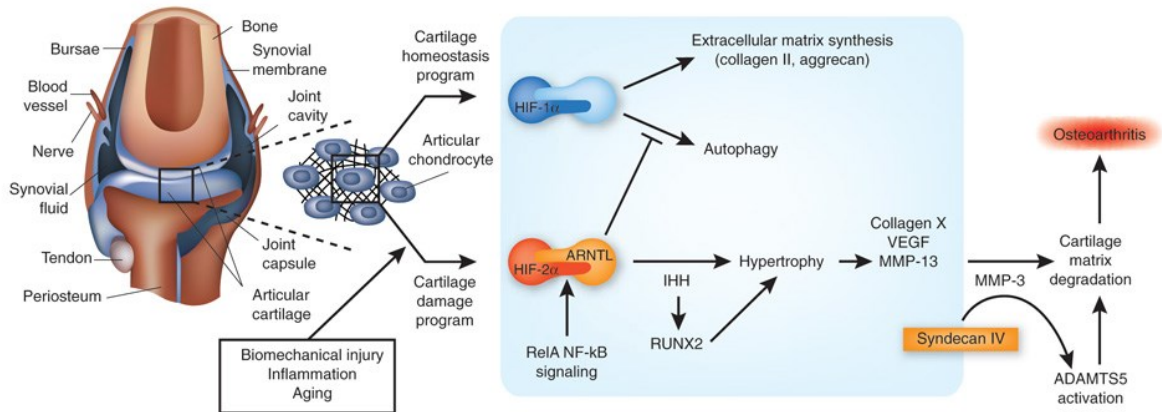
Picture 7 Healthy knee and knee with OA [25]

affects synovial joints and weight bearing joints. In the beginning starts the degeneration of the joint which includes first destruction of the articular cartilage and then as secondary effect comes the formation of bony structures at the margin of the joint that causes the reduction of joint space. As progress of the disease can be present synovitis. [13]

OA affects people around the age of 65 and affects women more than men. The most common joint that can be diagnosed with OA is the knee joint and is called gonarthrosis. There are two different types of OA which are according to the cause of it. The first type is primary-idiopathic OA in which the cause of it is unknown. Risk factors for idiopathic OA can be aging, obesity, genetics, abnormal weight distribution and loading, race, muscle weakness etc. The second type is secondary OA which the cause can be anatomical, traumatic, metabolic, inflammatory. [13,5]

2.4.1 Pathophysiology

The healthy cartilage is composed of matrix and chondrocytes. The matrix which is composed mostly of water protects these chondrocytes that they are the only cells in the articulation cartilage and they secrete matrix. In the articular cartilage also there is collagen type II, proteoglycans, noncollagenous proteins and glycoproteins. [13]



Picture 8 Degeneration of Matrix [11]

The function of this cartilage is to decrease the friction between the bones, to transfer and accept the nutrition in the joint and minimal weight absorption and distribution.

In the affected joint the first change is increasing the amount of water in the matrix that causes the rupture of it. Then proteoglycans together with water are diminished from the cartilage that causes greater compressive forces. Chondrocytes attempt to repair the matrix but after a while the degeneration causes the complete destruction of the cartilage and the narrow of joint space. [13,11]

As a result of cartilage damage there are changes in the subchondral bone. Increased bone density or in other words subchondral sclerosis creates cyst bone cavities and formation of osteophytes. This has as result the loss of joint mobility and pain in the joint usually during the movement. [13,14]

2.4.2 Classification of Gonarthrosis

The Kellgren and Lawrence classification is the most common used for OA and is according to radiograph:



Picture 9 Kellgren & Lawrence grading system [28]

- Grade 0: normal
- Grade 1: doubtful narrowing of the joint space and possible osteophytes
- Grade 2: definite osteophytes and absent or questionable narrowing of space
- Grade 3: moderate osteophytes and joint space narrowing, some sclerosis and possible deformity
- Grade 4: large osteophytes, marked narrowing of joint space, severe sclerosis and definite deformity

2.4.3 Diagnosis and Clinical Picture

The diagnosis for OA is according to the clinical picture of the patient and radiological findings or X-ray. Except of radiography the patient can undergo MRI which is not so common diagnostic procedure for OA, US diagnostic which allows to be visible the soft tissues and bony structure as well and CT. [6]

The examination from the physical therapist starts with the patient's history and then with the evaluation of the posture. Anthropometric measurements, ROM evaluation, muscle strength test, muscle length test, gait examination, balance, joint stability, examination of the soft tissues, evaluation of the movement in the joint.

The clinical picture of a patient with gonarthrosis is persistent knee pain usually during the movement that calms during resting and in most severe cases pain when the

movement starts. Joint stiffness that lasts less than 30 min and usually in the morning. Pain during walking or walking up the stairs and in severe cases pain during resting is present.

Restriction of joint ROM and reduction in general of the function of the joint. It can be present also, increased muscle tone of hamstrings and decreased contractile function of quadriceps and more specific of vastus medialis. Joint contour thickening with crepitus while moving the joint and decreased passive ROM [5].

2.4.4 Non-Invasive Treatment

Non-invasive treatments in the beginning consist education of the patient, self-management, weight loss, joint protection, rehabilitation and pharmacological therapy.

Pharmacological therapy has as goal to relief the pain. So, the patient is prescribed with analgesic oral drugs, NSAID and corticosteroid injections. Also, for local application some non-steroidal antiphlogistic ointments or gels are used. [13,5,12]

The rehabilitation strategies are to decrease pain, decrease edema, improve the ROM, improve joint stability, improve muscle strength and activation, improve gait and ADL activities.

The therapeutic procedures for non-surgical treatment can include:

- isometric exercises, strengthening exercises, stretching, passive and active exercises to increase general ROM
- quadriceps strengthening
- Gait training to avoid incorrect loading in the affected area
- mobilization techniques
- breathing exercises
- stability and coordination exercises to improve the sensorimotor system
- aerobic conditioning exercises
- ADL training to improve the self sufficiency
- STT can be applied in the area of the knee in order to decrease the edema, decrease pain and restore the mobility of the skin, sub-skin and fascia, to

increase the blood supply in the area and the nutrition coming inside the joint.

- Static bicycle in order to strengthen the joint without so much stress

Modalities for pain relief can be used as well, such as aquatic therapy in form of group training for movements in the water. Hydrotherapy in order to relieve from pain and edema. Electrotherapy can be used in the form of TENS for pain relief because studies has shown that application of this kind of electrotherapy is effective for patients with gonarthrosis [6]. Application of hot or cold modalities can also be effective with the heat application for superficial hyperemia and localized reduction of pain. Cold is for deeper hyperemia that comes after the vasoconstriction period and can be used also for analgesia and for edema reduction [6]. Ozone treatment is a new kind of minimal invasive treatment that has the same effect and is applied usually intraarticularly by injection and has to be combined with physiotherapy to be effective [30].

Orthotic equipment in order to prevent the joint from further deformities such as splints and in severe situations of arthritis where the joint weightbearing is impaired cane or crutches can be used to avoid incorrect loading. [5]

2.4.5 Surgical Procedures-Total Knee Replacement

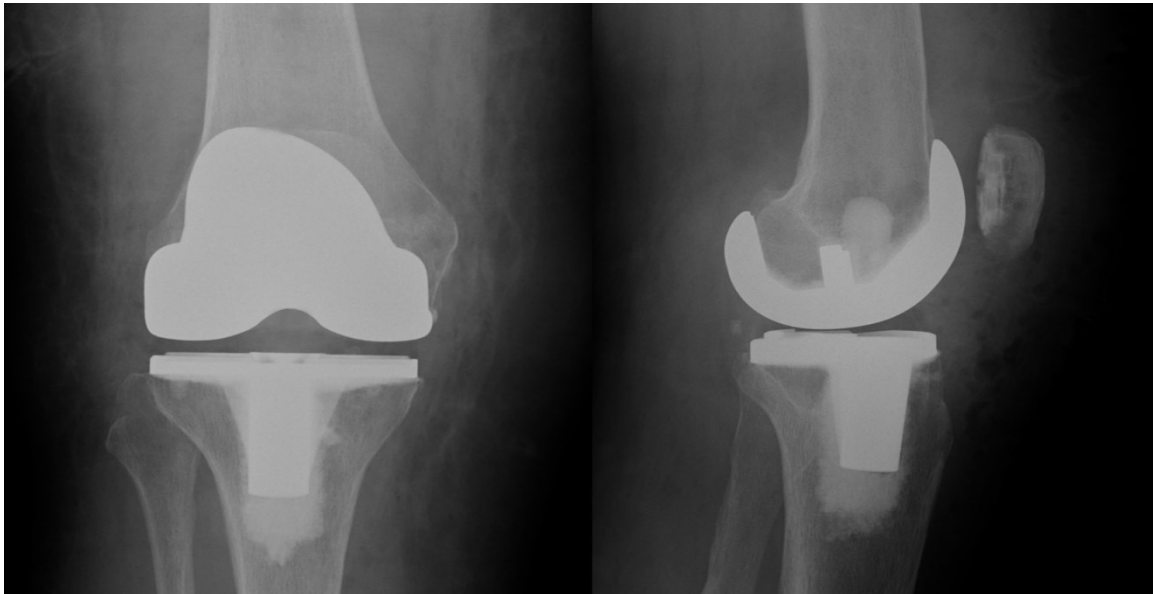
The surgical procedures are usually preferred when the rehabilitation and the previous treatments are not effective, and the patient continues to have problem with the affected knee joint.

In the first stages of the disease arthroscopic procedures can be provided in order to clean and treat the joint surface from osteophytes or other debridement. This includes two small rounded incisions, one for the arthroscope and one for the needed tools and the advantage is that there is not big trauma in the soft tissue and the recovery time is less. [10]

The most common surgical procedure for more difficult and severe cases is total knee replacement surgery or arthroplasty. The knee replacement is designed to reconstruct the destroyed articulation and its' compartments. During this procedure the lower part of femur and the upper part of tibia are replaced by implants made by metal or titanium. These

artificial components are called prosthesis. In between these prostheses it is placed a high-density plastic (polyethylene) in order to replace the joint cartilage. Patella can be replaced also with polyethylene plastic, but this depends on the surgeon. [8,9]

There are two types of this surgery according to the fixation, the one type is cement procedure where the implants are stabilized into the bones and here the patient can put pressure in the leg some days after the operation. The other procedure is non-cement procedure where the implants allow fixation by bony growth into porous metal surface, this procedure takes more time for recovery but the implants last longer in the bones and the patient is not allowed to put weight on the extremity for at least fifteen days. [8,9]



Picture 10 X-ray of Total Knee Replacement [24]

Another type of classification is according to the PCL whether is preserved or not in order to provide posterior stability. ACL in most of the cases is excluded while medial and lateral collateral ligaments usually are kept in the knee. [11]

The prognosis after TKR in theoretical point of view is quiet satisfactory because studies have shown that after the surgery the patient shows signs of improvement. ROM of the knee joint can be improved and the pain in most cases is eliminated. Crepitus and stiffness during the movement usually after one year of the surgery are absent and there is improvement of the muscle strength around the joint and especially of quadriceps.

Improvement in ADL activities and in physical performance of the patient in the first 12 weeks. [10,11]

Some complications can be after the surgery such as inflammation in the operated area, impairment in the ability to climb stairs because of the ROM of the knee and impairment in the strength of quadriceps even with the absence of pain. [13,21]

2.4.6 Pre-operative rehabilitation

The physiotherapist in order to prepare the patient for better and easier recovery after the surgery should first examine the patient and then according with the findings to provide the appropriate treatment and set the goals. [14]

The goals usually are to:

- Correct muscle imbalance in the affected area
- Decrease contractures
- Gait training that prepares the patient how will be after the operation
- Breathing training
- Improve fitness
- Education of patient for the surgery and the state after it
- Self-care training

The treatment can include:

- Strengthening exercises on the affected but also for the unaffected extremity
- Stretching, PIR for the shorted or hypertone muscles
- Gait education and training on even surface or walking up and down the stairs with the affected leg simulated as after operation
- Dynamic breathing exercises in order to improve breathing pattern and general fitness as well.
- Instruction to the patient for treatment of the scar and for the contraindicated movements after the surgery

2.4.7 Post-operative Rehabilitation

The therapist should assess the swelling around the operated knee joint, ROM passive and active the first day after the operation, mobility of the soft tissues around the scar and after the removal of the stitches the mobility of the scar. Also, the strength of the muscles around the knee and hip joints should be assessed in order to set the correct goals. Stability evaluation and walking with crutches in order to correct any pathological signs and the pain during movement or rest should be assessed as well. Length examination to understand if there is any restriction in the movement from the muscles and usually hamstrings limit the extension due to shortness. Muscle tone palpation should be done because usually quadriceps after operation are hypotone and the activation is not optimal in the whole or part of the muscle. Another examination that can be done is sensitivity test especially around the scar because complications after surgery can be present. After the examinations the correct goals should be set considering the findings. [12,13,14]

The main goals for the post-operative phase is to train the muscles in the operated joint without overloading, to decrease pain and edema, to prevent and correct the abnormal movement patterns and to improve the ROM.

In the beginning the therapist can provide breathing exercises, positioning of the operated leg, isometric exercises for strengthening of the muscles, vascular gymnastics for thromboembolic prevention, cryotherapy-compression-elevation for reduction of edema, passive- active movements and gait training with crutches. To the patient usually is provide CPM machine treatment and application of ice for edema and pain management. Also, STT can be provided with a soft-ball or by fingers in order to restore the mobility of the tissues around the scar and joint play treatment if we found any restriction. [14,12]

In a later stage of treatment or after the first three days more complexity movements can be added for strengthening, mobilization techniques, balance and sensorimotor training. After the removal of the stitches treatment of the scar can start with soft tissue massage, pressure techniques and application of ointments. In this stage to the patient can be provided PNF strengthening or relaxation techniques, according the goals, to increase the tone and power especially for quadriceps and general muscles around the knee joint.

Sensorimotor stimulation to improve balance of the patient and correct the general posture by stimulation of proprioceptors. [5]

Other type of treatment can be balneological therapy, but this is possible at least one year after the surgery [6]. The patient after that he will leave the hospital should be advised and provided with exercises that he should continue to do in order to keep the appropriate mobility and ROM of the knee joint. And other modality that can be used in neuromuscular electrical stimulation that helps the quadriceps and more specific vastus medialis for faster recovery. [5,6]

The recommended physical activities following TKR are stationary bicycle, swimming, walking, golf, table tennis, dancing, canoeing, bowling, aerobic but with low impact to avoid high mechanical load. [14]

3 Case study

3.1 Methodology

My bachelor's thesis practice took place at Rehabilitační Nemocnice Beroun and it began on 7th of January 2019 daily until 18th of January 2019. Each day I had practice for 8 hours so in total I had 80 hours of practice in the hospital.

During the practice my supervisors were Mgr. Ján Dzvoník and Vaclav Snuparek. I performed the initial examination of the patient on 9th of January and the first therapy was on 10th of January. The total amount of sessions was 7 and the final examination performed on 18th of January after the last session.

I performed my therapies in a therapy and exercise room. In the therapies I used soft tissue techniques, manual therapy, muscle relaxation, stretching, strengthening and conditioning exercises, sensomotoric and proprioceptive exercises. The instruments that I used for the examination were goniometer, neurological hammer and measuring tape. For the therapies I used instruments as TheraBand, gym ball, soft ball and over ball.

The patient signed an informed consent and my project of thesis approved from the Ethics Committee of the Faculty of Physical Education and Sport at Charles University.

3.2 Anamnesis (medical history)

Diagnosis

Total left knee replacement-endoprosthesis

Examined person

Name: J.H.

Year of birth: 1948

3.2.1 Status present

Objective

Height: 1.82 cm

Weight: 77 kg

BMI, somatotype: 23,2 normal somatotype

Glasses: only for reading

Cognition: physiological

Communication: physiological

Assistive devices: two forearm crutches

Dominant limb: right

Subjective

The patient after the surgery doesn't feel any pain or significant stiffness in the operated leg. He can walk with crutches with no pain during standing or putting weight on the leg. Sometimes he is experiencing some itching in the area of the scar but no pain. He has all the time compressive shocks and the scar is covered by plaster and because is still with stiches.

3.2.2 History anamnesis

The patient before the surgery he did X-ray and got diagnosed with osteoarthritis in the left knee, he had pain during walking that was forcing him to stop walking and sit down. In general, the pain was coming only when he was putting load on the affected extremity and he had no pain when he was sitting or relaxing.

He operated the left knee with total endoprosthesis and cemented type of surgery on 2/1/2019 in Horovice hospital. He came to Beroun nemocnice on 8/1/2019 for rehabilitation as an inpatient and he will stay until 20/1/2019.

The surgery was with no complications and the scar now is not infected or inflamed. The scar has stiches and is covered with plaster, the stitches will be removed on 15/1/2019.

3.2.3 Injury anamnesis

The patient didn't have any serious injuries in the past.

3.2.4 Surgery anamnesis

He had surgery for total knee replacement on the right knee in 2012

1996 right inguinal herniation surgery

2004 left inguinal herniation surgery

2017 colon cancer surgery

3.2.5 Medical anamnesis

He was diagnosed with cancer of the colon in 2017, also arterial hypertension, paroxysmal fibrillation of atrium in 2015(PAF) and with prostate hyperplasia in 2013.

3.2.6 Family anamnesis

His family is healthy with no serious medical condition.

3.2.7 Social anamnesis

He lives in a house with his wife and has only three stairs.

3.2.8 Occupational anamnesis

The patient is retired.

3.2.9 Allergy anamnesis

No allergies.

3.2.10 Pharmacological anamnesis

Betaloc, Telmistartan, Rhefluin, Pantomyl, Finpros, Tanys Eras, Warfarin.

3.2.11 Hobbies

No hobbies, only garden work

3.2.12 Abuses

No abuses

3.2.13 Prior rehabilitation

The patient did rehabilitation after the total knee replacement on the right side with focusing on the return of the physiological function of the knee. He was doing strengthening exercises and exercises to improve the complete ROM

3.2.14 Excerpt from patient's health care file

The patient had X-ray on the left knee and diagnosed with osteoarthritis.

3.2.15 RHB indications

The doctor prescribed scar treatment, stimulation of feet, patella, fibula head. Isometric exercises for quadriceps, lateral fixators, flexors of the hip. Myofascial techniques for hamstrings, triceps surae, adductors, quadriceps and walking training.

3.3 Initial kinesiological examination

3.3.1 Postural examination

Anterior view

- There is wide base of support
- The left foot is slight in external rotation with visible more weight on the right
- The arches of the feet are physiological
- There is physiological position of the toes
- The weight distribution is more on the right foot
- There is same contour of the calf muscles
- The left knee is in flexion and more swollen than the right

- The contour of quadriceps in the left leg is higher than the right and more visible close to patella
- The whole left leg is in slight external rotation
- The pelvis looks to be tilted to the right side
- The abdominals are symmetrical
- The left shoulder is higher than the right and both are slight protracted
- Physiologic position of the head

Posterior view

- The base of support is quite wide
- The shape and contour of the heels are symmetrical
- The calf muscles are symmetrical
- The left knee is slight flexed and in slight external rotation
- The thigh muscles are symmetrical
- Left leg is slight external rotated
- The right gluteal muscles are slightly more prominent
- The pelvis looks tilted to the right
- The left scapula is higher than the right
- Physiological position of head

Right lateral view

- The distribution of the weight is more on the right leg
- The right knee is in physiological position
- Physiological tilt of the pelvis
- Physiological curve of lumbar spine
- More kyphotic curve in thoracic spine with peak at the level of Th5
- Right shoulder is protracted
- Physiological position of head

Left lateral view

- The distribution of the weight is less on the left leg
- The knee is in slight flexed position and is swollen
- Left leg is slight external rotation
- Physiologic tilt of pelvis
- Physiologic curve of lumbar spine
- Kyphotic curve of thoracic spine with peak at the level of Th5
- Left shoulder is protracted
- Physiologic position of head

Conclusion of postural examination: the weight distribution is not physiological with more weight on the right leg. The left leg is slightly flexed, swollen and in slight external rotation. The pelvis seems tilted to the right side and the right shoulder is lower than the left. The weight of the body seems to be to the right side and in general he is tilted towards the right side.

3.3.2 Palpation of pelvis

- Anterior superior iliac spine on the left side is higher
- Posterior superior iliac spine on the left side is higher
- Iliac crest on the left side is higher
- Physiological tilt

Conclusion of palpation of pelvis: the pelvis presents obliquity towards the right side with no anteversion or retroversion.

3.3.3 Breathing stereotype

The patient has is using more the abdominal part of the body for breathing but the sternal part is also moving at the end of the breath.

3.3.4 Specific testing of posture

Two scales standing: right: 55kg left: 25kg not correct standing

Romberg test (I, II, III): negative

Vele test: grade 1

3.3.5 Modification of standing

Standing on tiptoes: able

Standing on heels: able

3.3.6 Gait examination

The patient is walking with two forearm crutches with 'two point' type of gait. There is no flexion of the left knee during walking and the left leg is in slight external rotation. On the left ankle also, there is no plantar flexion and there is no propulsion of the body through toe off phase, the foot performs heel strike, flat foot, loading response, heel off but not toe off phase because he lifts it at a whole. He is comfortable by walking with the crutches and during walking he looks straight with no looking down. Because of no flexion in the left knee he brings the leg forward by circumduction. The walking rhythm is periodic with physiological stride length and speed of walking. The upper extremities are moving together with the operated leg.

3.3.7 Anthropometric measurements

→ Leg length:	anatomical right: 86 cm	left: 86 cm
	Umbilicus right: 96 cm	left: 96 cm
	Functional right: 90 cm	left: 90 cm
→ Length of the thigh:	right: 45 cm	left: 45 cm
→ Length of the leg:	right: 44 cm	left: 44 cm
→ Circumference of the thigh:		
15 cm above the knee cap:	right: 41 cm	left: 48 cm
10 cm above the knee cap:	right: 39 cm	left: 45 cm
→ Circumference of the knee:	right: 37 cm	left: 41.5 cm
→ Circumference of the calf:	right: 31 cm	left: 32 cm
→ Circumference of the ankle:	right: 24 cm	left: 24cm

Conclusion of anthropometric measurements: the left leg is swollen mostly around the knee and around quadriceps. The calf is not affected in a serious grade and there is only 1 cm difference between the operated and healthy leg.

3.3.8 Measurement of ROM

Hip joint		Active	Passive
Right	S	10-0-110	15-0-120
	F	30-0-25	40-0-30
	R	30-0-20	35-0-30
Left	S	10-0-100	15-0-110
	F	30-0-25	40-0-30
	R	30-0-15	35-0-25
Knee joint			
Right	S	0-0-125	0-0-130
Left	S	0-5-100	0-5-115
Ankle joint			
Right	S	15-0-40	20-0-50
	R	20-0-40	30-0-45
Left	S	15-0-40	20-0-50
	R	15-0-30	20-0-35

Table 2 Measurement of ROM

Conclusion of ROM: the left knee when is relaxed is in 5 degrees flexion and active movement ROM is 100 degrees which shows impaired mobility. There is also slight

impaired ROM in the left hip in flexion by 10 degrees if we compare with healthy extremity and in inversion of the ankle joint.

3.3.9 Muscle length examination

Muscles	Right extremity	Left extremity
Gastrocnemius (acc. Janda)	G-0	G-0
Soleus (acc. Janda)	G-0	G-0
Hip flexors (acc. Kendall)		
One joint muscles	Normal	Normal
Two joint muscles	Slight shortness	Slight shortness
Adductors (acc. Janda)	G-0	G-0
Hamstring (acc. Janda)	G-2	G-2

Table 3 Muscle Length Examination

Conclusion of length examination: the patient has marked shortness of two joint hip flexors on the operated leg because there is impaired mobility and he is also afraid to let the leg completely free out of the treatment table, and grade 2 shortness of hamstrings.

3.3.10 Manual muscle strength test (acc to Kendall)

	Right lower extremity	Left lower extremity
Gluteus maximus	4	3+
Psoas major	5	4-
Tensor fascia latae	4+	4+
Sartorius	4+	4+
Quadriceps femoris	5	4-

Hip flexors as group	5	4-
Iliopsoas	5	4-
Hip adductors	5	4+
Gluteus minimus	4+	3+
Gluteus medius	4+	3+
Lateral rotators	5	4+
Medial rotators	5	4+
Medial hamstring	5	5
Lateral hamstring	5	5
Ankle plantar flexors	5	5
Soleus	5	5
Peroneus longus, brevis	5	5
Tibialis posterior	5	5
Tibialis anterior	5	5

Table 4 Manual muscle strength test (acc to Kendall)

Conclusion of muscle strength test: the patient has impaired strength of gluteal muscles mostly on the left side. In general, the left leg has less strength in some muscles but not with major difference with the healthy extremity.

3.3.11 Muscle tone palpation

	Right lower extremity	Left lower extremity
Rectus femoris	Normal tone	Hypo tone

Vastus medialis, lateralis	Normal tone	Hypo tone
Adductors	Normal tone	Normal tone
Tensor fascia latae	Hyper tone	Hyper tone
Semitendinosus Semimembranosus	Hyper tone	Hyper tone
Biceps femoris	Hyper tone	Hyper tone
Gluteus medius	Normal tone	Normal tone
Gluteus minimus	Normal tone	Normal tone
Gluteus maximus	Normal tone	Normal tone
Gastrocnemius	Normal tone	Normal tone
Soleus	Normal tone	Normal tone
Tibialis anterior	Normal tone	Normal tone
Erector spinae	Hyper tone	Hyper tone

Table 5 Muscle tone palpation

Conclusion of muscle tone palpation: quadriceps on the operated leg are hypo tone mostly at the lower end of the muscle with normal tone close to the hip joint. Hamstrings, erector spinae and tensor are hypertone in both sides.

3.3.12 Examination of soft tissues (acc to Lewit)

Skin and subskin: there is only restriction at the lateral side of the knee joint close to the scar towards medial direction. The area is swollen and warm but there is no other restriction.

Fascia: no restriction on both legs around longitudinal axis.

Scar: I couldn't see the scar in the initial examination.

The operated area has higher temperature than the healthy extremity.

3.3.13 Movement stereotype

- Hip extension: right: pathological. There is activation first of paravertebral muscles.
Left: pathological. Activation of paravertebral in the beginning of the movement.
- Hip abduction:right: physiological. Left: pathological. Tensor mechanism, the leg is raised with slight flexion of the hip joint probably because of hyper tone of tensor fascia latae.

3.3.14 Neurological examination

- **Lower limbs:**
- **Deep reflexes:**
- Patellar reflex: right: normal left: N/A
- Achilles tendon reflex: right: normal left: normal
- Mediolplantar reflex: right: normal left: normal
- **Lassegue's maneuver:** right: negative left: negative
- **Sensation (Dermatomes: L3, L4, L5, S1):**
- Tactile: right: normal left: normal
- Algic: right: normal left: normal
- Thermic: right: normal left: normal
- Position sense: flexion of the MTP big toe right: normal left: normal
extension of the MTP big toe right: normal left: normal
- Movement sense: flexion of the MTP big toe right: normal left: normal
extension of the MTP big toe right: normal left: normal
- Stereognosis on plantar side: right: normal left: normal
- Graphesthesia on plantar side: right: normal left: normal

3.3.15 Joint play examination (acc Lewit)

Examined joint	Right leg	Left leg
Tibiofibular	No restriction in any direction	No restriction in any direction
Talocrural	No restriction in any direction	Restriction in dorsal direction
Patella	No restriction in any direction	N/A
Subtalar	No restriction in any direction	No restriction in any direction
Talocalcaneonavicular	No restriction in any direction	Restriction in lateral and medial direction
Transverse tarsal (Chopart)	Restriction in ventral direction	Restriction in ventral direction
Tarsometatarsal (Lisfranc)	No restriction in any direction	Restriction in ventral direction
Metatarsophalangeal	No restriction in any direction	No restriction in any direction
Proximal interphalangeal	No restriction in any direction	No restriction in any direction
Distal interphalangeal	No restriction in any direction	No restriction in any direction

Table 6 Joint play examination (acc Lewit)

Conclusion of joint play examination: the joints with restriction in the operated leg were Lisfranc, Chopart, talocrural. I was not able to examine patella because the scar had still stitches.

3.3.16 Examination's conclusion:

According to the examination the patient is in a really good condition only 7 days after the operation. The knee is swollen and slight flexed when he is standing, and he is putting more weight on the healthy leg. The pelvis presents obliquity towards the right side, but this is because the patient is not putting enough load on the left leg. The whole body is tilted towards the right side, as is visible also from the position of the shoulders. He is using crutches during walking with 2-point gait, and he doesn't perform knee flexion on the operated leg. Also, there is no enough plantar flexion on the left ankle, and he doesn't propel the body through toe off phase, to bring the leg in the front he is doing slight circumduction. The patient breaths mostly with abdominal part of the body with movement of thoracic part at the end of the breath. The anthropometric measurements showed that the operated leg is swollen all around the knee joint with the calf region not to be affected as well the ankle joint. The ROM examination showed that the knee is flexed only 5 degrees in relaxed position and that flexion of the operated leg is 100 degrees which shows a good condition of the patient. Hamstrings are shorted in grade 2 in both lower extremities, two joint hip flexors on the left side are in mark shortness but this was because the patient couldn't relax completely and let the leg fall off the treatment table.

Gluteal muscles mostly on the left leg have impaired muscle power in comparison with healthy extremity with no other significant difference on the other tested muscles. Quadriceps are in hypo tone mostly at the lower end of the muscles, but this doesn't affect their function, hamstrings, erector spinae and tensor fascia latae are hyper tone in both sides. The soft tissues around the knee joint are impaired only under the knee joint towards medial direction, with no other significant impairment and there is the area around the operation is higher in temperature. During movement of hip extension, the patient was using firstly his paravertebral muscles but this in my opinion was because the gluteal muscles were weak in both sides. In hip flexion on the left side the patient showed pathology of tensor mechanism mostly because the muscle in in hyper tone and the gluteus

minimus, medius are weak according to the examination. The neurological examination was physiological with no impaired sensation on the area around the scar or the swollen area. Joint play was restricted at some joints of the foot with no impairment in tibiofibular, and I couldn't examine movement of patella because of the stiches.

The main limitation is the flexion of the knee which is 100°, the permanent flexion in 5°, weight distribution, tone of lower part of quadriceps and strength of gluteal. Despite that is only 7 days after the operation the patient's knee seems to be in good condition with no pain or stiffness. The scar is not visible and has stiches that will be removed on 15th of January.

3.4 Short term rehabilitation plan

- Reduce edema
- Increase ROM in the knee joint in to flexion
- Restore physiological extension of the knee
- Correction of gait with crutches
- Walking training with crutches on stairs
- Improve general strength of muscles of lower extremities with emphasize on gluteal muscles, hip flexors and quadriceps
- Release the restrictions of joint play in the left ankle
- Relax hyper tonic muscles with PIR (tensor fascia latae, hamstrings)
- Stretch of shorted muscles
- Improve the tone of quadriceps at the lower end close to the operation
- Improve mobility of soft tissues around the scar

3.5 Long term rehabilitation plan

- Correction of posture by correcting the weight distribution
- Balance training
- Sensomotoric training
- Continue to perform exercises for the lower extremities
- Scar treatment

- Improve general condition of the operated leg in order the patient to return in daily activities in the house or garden

3.6 Therapy progress

3.6.1 Day 1st Date: 10/1/2019

Session 1st (am)

Therapy duration: 30 min

Subjective feeling

The patient feels no pain, but he was feeling during the night itching on the scar area.

Objective feeling

The patient is in a good mood and he is smiling, the knee is swollen and warm in comparison with the healthy one. The flexion is 100° and is in 5° flexion in relaxed position.

Goals of today's therapy

- Release of restricted soft tissues with STT
- Joint play treatment
- Increase ROM in the knee joint into flexion and extension
- Decrease edema
- Strengthening exercises for quadriceps, hip flexors, gluteal muscles
- Conditioning exercises for adductors, abductors of the hip joint and hamstrings
- Stretch-relaxation of shorted muscles- two joint hip flexors, hamstrings

Therapy applied

- STT by putting sustained pressure to the restricted direction on the skin and sub skin until I felt release.

- Soft ball massage from distal to proximal direction and moderate pressure around the operated knee and quadriceps to reduce edema and increase blood circulation in the area.
- Joint play mobilization of talocrural in dorsal direction, talocalcaneonavicular in lateral and medial directions, Lisfranc in ventral direction, Chopart in ventral direction with technique according to Lewit.
- Strengthening, conditioning and ROM exercises
 - Isotonic contraction for strengthening of quadriceps, hip flexors, gastrocnemius and hamstrings and to increase ROM of knee into flexion and extension with over ball under the heel of the operated leg and patient supine, I asked the patient to flex and extend the leg by gliding the heel on the ball. 12 repetitions.
 - Isometric contraction for strengthening of quadriceps femoris and to increase ROM of knee into extension with over ball under the knee in supine position, I asked the patient to press the ball down to the bed and contract quadriceps by extending the leg and keep it for 5 sec. 12 repetitions
 - Isometric contraction for conditioning of hip adductors with over ball between the flexed knees in supine position, adduction of the legs by squeezing the ball between the knees, keep it for 5 sec and then relax. 12 repetitions
 - Isotonic contraction for conditioning of hip abductors with Thera band around the bended knees in supine position, abduction of the legs with Thera band resistance, keep it for 5 sec and then relax. 12 repetitions
 - Isotonic contraction for strengthening of hip extensors with emphasis on strengthening gluteal muscles and hamstring. Gym ball under the heels and calves of the patient that is supine, then by putting pressure on the heels, raise of the hip and pelvis over the bed for 5 sec and then relax. 10 repetitions
 - Isometric contraction for strengthening of gluteal muscles and hamstrings with the patient supine and plantar part of the foot on the gym ball. I was

keeping the gym ball and the patient was putting pressure on it with one leg each time. 12 repetitions in each leg

- Isotonic contraction for conditioning of hamstrings and to increase ROM of the knee into flexion and extension in prone position. Over ball between the heels and I asked the patient by keeping the ball to flex both legs as much as he can. 12 repetitions
- PIR for hamstrings and quadriceps by technique according to Lewit performed 3 times for each muscle.

Result of the therapeutic unit

- Objective: the activation of quadriceps was improved, and the activation of distal part of quadriceps could be seen at the end of the therapy. ROM was approximately the same after the therapy and the knee was warmer than the beginning.
- Subjective: the patient felt a little tired after the therapy, but he didn't feel any pain during the exercises.

Self-therapy

Ice, active flexion and extension of the knee on the bed, sustained pressure of the knee towards the bed into extension by contracting quadriceps for 10 sec and then relax.

Session 2

The patient was attending group exercise in the gym for 30 min session. The people in this group were with knee or hip surgeries and the goal was strengthening and general condition exercises of upper and lower extremities.

3.6.2 Day 2nd Date: 11/1/2019

Session 1st(am)

Therapy duration: 30 min

Subjective feeling

The patient didn't have any problem or pain during the day or night.

Objective feeling

The patient is in a good mood, the knee is swollen and warm, the flexion is 110° and is in 5° flexion in relaxed position. Joint play is still restricted in the operated leg.

Goals of today's therapy

- Release of restricted soft tissues with STT
- Joint play treatment
- Increase ROM in the knee joint into flexion and extension
- Decrease edema
- Strengthening exercises for quadriceps, hip flexors, gluteal muscles
- Conditioning exercises for adductors, abductors of the hip joint and hamstrings
- Stretch-relaxation of shorted muscles- two joint hip flexors, hamstrings

Therapy applied

- STT by putting sustained pressure to the restricted direction on the skin and sub skin until I felt release.
- Soft ball massage from distal to proximal direction and moderate pressure around the operated knee and quadriceps to reduce edema and increase blood circulation in the area.
- Joint play mobilization of talocrural in dorsal direction, talocalcaneonavicular in lateral and medial directions, Lisfranc in ventral direction, Chopart in ventral direction with technique according to Lewit.
- Strengthening, conditioning and ROM exercises
 - Isometric contraction for strengthening of quadriceps femoris and to increase ROM of knee into extension with over ball under the knee in supine position, I asked the patient to press the ball down to the bed and contract quadriceps by extending the leg and keep it for 5 sec. 12 repetitions
 - Isometric contraction for conditioning of hip adductors with over ball between the flexed knees in supine position, adduction of the legs by

squeezing the ball between the knees, keep it for 5 sec and then relax. 12 repetitions

- Isotonic contraction for conditioning of hip abductors with Thera band around the bended knees in supine position, abduction of the legs with Thera band resistance, keep it for 5 sec and then relax. 12 repetitions
 - Isotonic contraction for strengthening of hip extensors with emphasis on strengthening gluteal muscles and hamstring. Gym ball under the heels and calves of the patient that is supine, then by putting pressure on the heels, raise of the hip and pelvis over the bed for 5 sec and then relax. 10 repetitions
 - Isotonic contraction for conditioning of hamstrings and to increase ROM of the knee into flexion and extension in prone position. Over ball between the heels and I asked the patient by keeping the ball to flex both legs as much as he can. 12 repetitions
- PIR for hamstrings and quadriceps by technique according to Lewit performed 3 times for each muscle.

Result of the therapeutic unit

- Objective: the activation of quadriceps was improved, and the activation of distal part of quadriceps could be seen at the end of the therapy. ROM was approximately the same after the therapy and the knee was warmer than the beginning.
- Subjective: the patient didn't feel any pain during the exercises and the breath was physiological.

Self-therapy

Ice, active flexion and extension of the knee on the bed, sustained pressure of the knee towards the bed into extension by contracting quadriceps for 10 sec and then relax.

Session 2

The patient was attending group exercise in the gym for 30 min session. The people in this group were with knee or hip surgeries and the goal was strengthening and general condition exercises of upper and lower extremities.

3.6.3 Day 3rd Date: 14/1/2019

Session 1st(am)

Therapy duration: 30 min

Subjective feeling

The patient didn't have any problem or pain during the weekend.

Objective feeling

The patient is in a good mood, the knee is swollen and warm, the flexion is 110° and is in 5° flexion in relaxed position. Joint play is still restricted in the operated leg.

Goals of today's therapy

- Release of restricted soft tissues with STT
- Joint play treatment
- Increase ROM in the knee joint into flexion and extension
- Decrease edema
- Strengthening exercises for quadriceps, hip flexors, gluteal muscles
- Conditioning exercises for adductors, abductors of the hip joint and hamstrings
- Stretch-relaxation of shorted muscles- two joint hip flexors, hamstrings

Therapy applied

- STT by putting sustained pressure to the restricted direction on the skin and sub skin until I felt release.

- Soft ball massage from distal to proximal direction and moderate pressure around the operated knee and quadriceps to reduce edema and increase blood circulation in the area.
- Joint play mobilization of talocrural in dorsal direction, talocalcaneonavicular in lateral and medial directions, Lisfranc in ventral direction, Chopart in ventral direction with technique according to Lewit.
- Strengthening, conditioning and ROM exercises
 - Isometric contraction for strengthening of quadriceps femoris and to increase ROM of knee into extension with over ball under the knee in supine position, I asked the patient to press the ball down to the bed and contract quadriceps by extending the leg and keep it for 5 sec. 12 repetitions
 - Isotonic contraction for strengthening of quadriceps and to increase ROM of knee into flexion and extension with over ball between the flexed knees. I asked the patient from this position to extend one by one leg by keeping the ball between the knees. 10 repetitions in each leg.
 - Isometric contraction for conditioning of hip adductors with over ball between the flexed knees in supine position, adduction of the legs by squeezing the ball between the knees, keep it for 5 sec and then relax. 12 repetitions
 - Isotonic contraction for conditioning of hip abductors with Thera band around the bended knees in supine position, abduction of the legs with Thera band resistance, keep it for 5 sec and then relax. 12 repetitions
 - Isotonic contraction for strengthening of hip extensors with emphasis on strengthening gluteal muscles and hamstrings. Gym ball under the heels and calves of the patient that is supine, then by putting pressure on the heels, raise of the hip and pelvis over the bed for 5 sec and then relax. 10 repetitions
 - Isotonic contraction for strengthening of gluteus medius, minimus in side lying position. I asked the patient form this position to abduct the straight and slight in medial rotation upper leg. 12 repetitions

- Isotonic contraction for conditioning of hamstrings and to increase ROM of the knee into flexion and extension in prone position. Over ball between the heels and I asked the patient by keeping the ball to flex both legs as much as he can. 12 repetitions
- PIR for hamstrings and quadriceps by technique according to Lewit performed 3 times for each muscle.

Result of the therapeutic unit

- Objective: the activation of quadriceps was physiological, and the activation of the whole muscle could be seen. ROM was approximately at 120° and the knee was straight in relaxed position.
- Subjective: the patient didn't feel any pain during the exercises and the breath was physiological. After the therapy he was really happy with the progress he made.

Self-therapy

Ice, active flexion and extension of the knee on the bed, sustained pressure of the knee towards the bed into extension by contracting quadriceps for 10 sec and then relax. Instruction on how to use stationary bicycle in correct position and technique.

Session 2

The patient was attending group exercise in the gym for 30 min session. The people in this group were with knee or hip surgeries and the goal was strengthening and general condition exercises of upper and lower extremities.

3.6.4 Day 4th Date: 15/1/2019

Session 1st(am)

Therapy duration: 30 min

Subjective feeling

The patient during the night he felt something like pain or itching in the area of the scar.

Objective feeling

The patient is in a good mood, the knee is swollen, the flexion is 120° and the knee is straight in relaxed position. Joint play is still restricted in the operated leg but the soft tissue mobility around the visible area close to the scar has improved.

Goals of today's therapy

- Joint play treatment
- Maintain ROM in the knee joint of flexion and extension
- Decrease edema
- Strengthening exercises for quadriceps, hip flexors, gluteal muscles
- Conditioning exercises for adductors, abductors of the hip joint and hamstrings
- Stretch-relaxation of shorted muscles- two joint hip flexors, hamstrings
- Correct walking pattern with crutches
- Walking on stairs with crutches

Therapy applied

- Soft ball massage from distal to proximal direction and moderate pressure around the operated knee and quadriceps to reduce edema and increase blood circulation in the area.
- Joint play mobilization of talocrural in dorsal direction, talocalcaneonavicular in lateral and medial directions, Lisfranc in ventral direction, Chopart in ventral direction with technique according to Lewit.
- Strengthening and conditioning exercises
 - Isometric contraction for strengthening of quadriceps femoris with over ball under the knee in supine position, I asked the patient to press the ball down to the bed and contract quadriceps by extending the leg and keep it for 5 sec. 12 repetitions
 - Isotonic contraction for strengthening of hip flexors in supine position. I asked the patient to raise the extended leg over the mattress about 20 cm keep it for 5 sec and relax. 12 repetitions

- Isotonic contraction for strengthening of hip extensors with emphasis on strengthening gluteal muscles and hamstrings. Supine position of the patient with legs flexed and support on the mattress, by pressure on the feet raise of the hip and pelvis over the bed for 5 sec and then relax. 10 repetitions
- Isotonic contraction for strengthening of gluteus medius, minimus in side lying position. I asked the patient from this position to abduct the straight and slight in medial rotation upper leg and then return in starting position. 12 repetitions
- Isotonic contraction for conditioning of hamstrings and to maintain ROM of the knee into flexion and extension in prone position. Over ball between the heels and I asked the patient by keeping the ball to flex both legs as much as he can. 12 repetitions
- PIR for hamstrings and quadriceps by technique according to Lewit performed 3 times for each muscle.
- Instruction for correction of walking with crutches. I asked the patient while walking not to be scared and try to flex the knee, also to try to do plantar flexion of the ankle joint and put pressure at the toes in order to move forward.
- Walking on stairs with crutches. The patient already knew how to walk on stairs, but I observed him in order to be sure that he is doing it correct.

Result of the therapeutic unit

- Objective: the joint play has restored after the therapy, the knee is in physiological flexion and extension. Walking after the instructions has improved but the speed has decreased for now.
- Subjective: the patient didn't feel any pain during the exercises and the breath was physiological. After the therapy he was really happy with the progress he made.

Self-therapy

Ice, active flexion and extension of the knee on the bed, sustained pressure of the knee towards the bed into extension by contracting quadriceps for 10 sec and then relax.

Session 2

The patient was attending group exercise in the gym for 30 min session. The people in this group were with knee or hip surgeries and the goal was strengthening and general condition exercises of upper and lower extremities.

Session 3

The patient is doing two times per day 15 min stationary bicycle because the flexion of his knee has been to physiological level.

3.6.5 Day 5th Date: 16/1/2019

Session 1st(am)

Therapy duration: 30 min

Subjective feeling

The patient didn't have any problem or pain during the day and night.

Objective feeling

The patient is in a good mood, the knee is swollen, the flexion is 120° and the knee is straight in relaxed position. Joint play has been restored in the operated leg and yesterday afternoon they removed the stitches, but the scar is not visible because of plaster.

Goals of today's therapy

- Maintain ROM in the knee joint of flexion and extension
- Decrease edema
- Strengthening exercises for quadriceps, hip flexors, gluteal muscles
- Conditioning exercises for adductors, abductors of the hip joint and hamstrings
- Stretch-relaxation of shorted muscles- two joint hip flexors, hamstrings

Therapy applied

- Soft ball massage from distal to proximal direction and moderate pressure around the operated knee and quadriceps to reduce edema and increase blood circulation in the area.
- Strengthening and conditioning exercises
 - Isometric contraction for strengthening of quadriceps femoris with over ball under the knee in supine position, I asked the patient to press the ball down to the bed and contract quadriceps by extending the leg and keep it for 5 sec. 12 repetitions
 - Isotonic contraction for strengthening of quadriceps with over ball between the flexed knees. I asked the patient from this position to extend one by one leg by keeping the ball between the knees. 10 repetitions in each leg.
 - Isotonic contraction for strengthening of hip flexors in supine position. I asked the patient to raise the extended leg over the mattress about 20 cm keep it for 5 sec and relax. 12 repetitions
 - Isometric contraction for conditioning of hip adductors with over ball between the flexed knees in supine position, adduction of the legs by squeezing the ball between the knees, keep it for 5 sec and then relax. 12 repetitions
 - Isotonic contraction for conditioning of hip abductors with Thera band around the bended knees in supine position, abduction of the legs with Thera band resistance, keep it for 5 sec and then relax. 12 repetitions
 - Isotonic contraction for strengthening of hip extensors with emphasis on strengthening gluteal muscles and hamstrings. Supine position of the patient with legs flexed and support on the mattress with over ball between the knees, by pressure on the feet raise of the hip and pelvis over the bed for 5 sec and then relax. 10 repetitions
 - Isotonic contraction for strengthening of gluteus medius, minimus in side lying position. I asked the patient from this position to abduct the straight and slight in medial rotation upper leg and then return in starting position. 12 repetitions

- Isotonic contraction for conditioning of hamstrings in prone position. Over ball between the heels and I asked the patient by keeping the ball to flex both legs as much as he can. 12 repetitions
- Isotonic contraction for strengthening of gluteal muscles in standing position. From this position I asked the patient to squat slowly by support on the wall with the hands. 10 repetitions
- PIR for hamstrings and quadriceps by technique according to Lewit performed 3 times for each muscle.

Result of the therapeutic unit

- Objective: the contraction of the muscles is physiological, and the knee has normal ROM. The area around the knee is still swollen and after the therapy is warmer.
- Subjective: the patient didn't feel any pain during the exercises, but he got tired.

Self-therapy

Ice, active flexion and extension of the knee on the bed, sustained pressure of the knee towards the bed into extension by contracting quadriceps for 10 sec and then relax.

Session 2

The patient was attending group exercise in the gym for 30 min session. The people in this group were with knee or hip surgeries and the goal was strengthening and general condition exercises of upper and lower extremities.

Session 3

The patient is doing two times per day 15 min stationary bicycle because the flexion of his knee has been to physiological level.

3.6.6 Day 6th Date: 17/1/2019

Session 1st(am)

Therapy duration: 30 min

Subjective feeling

The patient didn't have any problem or pain during the day and night.

Objective feeling

The patient is in a good mood, the knee is swollen, the flexion is 120° and the knee is straight in relaxed position. The scar is 18 cm with restriction in mobility in medial and lateral directions at the upper and lower endings. At the upper end there is dry blood, so the wound is not healed completely yet.

Goals of today's therapy

- Maintain ROM in the knee joint of flexion and extension
- Scar treatment
- Decrease edema
- Strengthening exercises for quadriceps with focus on vastus medialis, hip flexors, gluteal muscles
- Stretch-relaxation of shorted muscles- two joint hip flexors, hamstrings
- Balance training
- Sensomotoric training

Therapy applied

- Scar massage in the beginning with constant vertical pressure on the scar. Then pressure from medial and lateral directions towards the scar, 'S' wave in both ends and, in the end, I was trying to fold the skin at the area of the scar, but I avoided the upper end because it had dry blood.

- Soft ball massage from distal to proximal direction and moderate pressure around the operated knee and quadriceps to reduce edema and increase blood circulation in the area.
- Strengthening and conditioning exercises
 - Isotonic contraction for strengthening of quadriceps with over ball between the flexed knees. I asked the patient from this position to extend one by one leg by keeping the ball between the knees. 10 repetitions in each leg.
 - PNF 1F with repeated contraction strengthening technique to give emphasis on vastus medialis.
 - Isotonic contraction for strengthening of hip extensors with emphasis on strengthening gluteal muscles and hamstrings. Supine position of the patient with legs flexed and support on the mattress with over ball between the knees, by pressure on the feet raise of the hip and pelvis over the bed for 5 sec and then relax. 10 repetitions
 - Isotonic contraction for strengthening of gluteus medius, minimus in side lying position. I asked the patient from this position to abduct the straight and slight in medial rotation upper leg and then return in starting position. 12 repetitions
 - Isotonic contraction for strengthening of gluteal muscles in standing position. From this position I asked the patient to squat slowly by support on the wall with the hands. 10 repetitions
- PIR for hamstrings and quadriceps by technique according to Lewit performed 3 times for each muscle.
- In sitting position preparation phase of ‘small foot’ I asked the patient to move forward and backwards his feet by flexing and extending the toes for strengthening of deep flexors of toes. 2 times in each leg for 20 sec
- In sitting position ‘small foot’ training in the beginning passively then active-assistive and then active.
- For balance and sensomototoc training I asked the patient to walk slowly with the crutches on a soft mattress and try to keep correct posture and walking technique.

Result of the therapeutic unit

- Objective: the contraction of the muscles is physiological, and the knee has normal ROM. The patient was able to form the 'small foot' after the training. His balance is very good, and the muscles are cooperating in order to keep the balance on the operated leg.
- Subjective: the patient didn't feel any pain during the exercises.

Self-therapy

Ice, active flexion and extension of the knee on the bed, sustained pressure of the knee towards the bed into extension by contracting quadriceps for 10 sec and then relax, Scar massage.

Session 2

The patient was attending group exercise in the gym for 30 min session. The people in this group were with knee or hip surgeries and the goal was strengthening and general condition exercises of upper and lower extremities.

Session 3

The patient is doing two times per day 15 min stationary bicycle because the flexion of his knee has been to physiological level.

3.6.7 Day 7th Date: 18/1/2019

Session 1st(am)

Therapy duration: 30 min

Subjective feeling

The patient didn't have any problem or pain during the day and night.

Objective feeling

The patient is in a good mood, the knee is swollen, the flexion is 120° and the knee is straight in relaxed position. The scar is 18 cm with restriction in mobility in medial and lateral directions at the upper and lower endings. At the upper end there is dry blood, so the wound is not healed completely yet.

Goals of today's therapy

- Maintain ROM in the knee joint of flexion and extension
- Scar treatment
- Decrease edema
- Strengthening exercises for quadriceps with focus on vastus medialis, hip flexors, gluteal muscles
- Stretch-relaxation of shorted muscles- two joint hip flexors, hamstrings
- Balance training
- Sensomotoric training

Therapy applied

- Scar massage in the beginning with constant vertical pressure on the scar. Then pressure from medial and lateral directions towards the scar, 'S' wave in both ends and, in the end, I was trying to fold the skin at the area of the scar, but I avoided the upper end because it had dry blood.
- Soft ball massage from distal to proximal direction and moderate pressure around the operated knee and quadriceps to reduce edema and increase blood circulation in the area.
- Strengthening and conditioning exercises
 - Isotonic contraction for strengthening of quadriceps with over ball between the flexed knees. I asked the patient from this position to extend one by one leg by keeping the ball between the knees. 10 repetitions in each leg.
 - PNF 1F with repeated contraction strengthening technique to give emphasis on vastus medialis.

- Isotonic contraction for strengthening of hip extensors with emphasis on strengthening gluteal muscles and hamstrings. Supine position of the patient with legs flexed and support on the mattress with over ball between the knees, by pressure on the feet raise of the hip and pelvis over the bed for 5 sec and then relax. 10 repetitions
- Isotonic contraction for strengthening of gluteus medius, minimus in side lying position. I asked the patient from this position to abduct the straight and slight in medial rotation upper leg and then return in starting position. 12 repetitions
- Isotonic contraction for strengthening of gluteal muscles in standing position. From this position I asked the patient to squat slowly by support on the wall with the hands. 10 repetitions
- PIR for hamstrings and quadriceps by technique according to Lewit performed 3 times for each muscle.
- In sitting position preparation phase of ‘small foot’ I asked the patient to move forward and backwards his feet by flexing and extending the toes for strengthening of deep flexors of toes. 2 times in each leg for 20 sec
- In sitting position ‘small foot’ training in the beginning passively then active-assistive and then active.
- For balance and sensomototoc training I asked the patient to walk slowly with the crutches on a soft mattress and try to keep correct posture and walking technique.

Result of the therapeutic unit

- Objective: the contraction of the muscles is physiological, and the knee has normal ROM. The patient was able to form the ‘small foot’. His balance is good, and the muscles are cooperating in order to keep the balance on the operated leg.
- Subjective: the patient didn’t feel any pain during the exercises.

Self-therapy

Ice, active flexion and extension of the knee on the bed, sustained pressure of the knee towards the bed into extension by contracting quadriceps for 10 sec and then relax.

Session 2

The patient was attending group exercise in the gym for 30 min session. The people in this group were with knee or hip surgeries and the goal was strengthening and general condition exercises of upper and lower extremities.

Session 3

The patient is doing two times per day 15 min stationary bicycle because the flexion of his knee has been to physiological level.

3.7 Final kinesiological examination

3.7.1 Postural examination

Anterior view

- There is wide base of support
- The feet are in neutral position but still visible that there is more weight on right leg
- The arches of the feet are physiological
- There is physiological position of the toes
- The weight distribution is more on the right foot
- There is same contour of the calf muscles
- The left knee is not in flexion but still is more swollen
- The contour of quadriceps in the left leg is higher than the right and more visible close to patella
- The pelvis looks to be tilted to the right side
- The abdominals are symmetrical
- The left shoulder is higher than the right and both are slight protracted
- Physiologic position of the head

Posterior view

- The base of support is quite wide
- The shape and contour of the heels are symmetrical

- The calf muscles are symmetrical
- The left knee is in physiological position but more swollen than the other
- The thigh muscles are symmetrical
- The right gluteal muscles are slightly more prominent
- The pelvis looks tilted to the right
- The left scapula is higher than the right
- Physiological position of head

Right lateral view

- The distribution of the weight is more on the right leg
- The right knee is in physiological position
- Physiological tilt of the pelvis
- Physiological curve of lumbar spine
- More kyphotic curve in thoracic spine with peak at the level of Th5
- Right shoulder is protracted
- Physiological position of head

Left lateral view

- The distribution of the weight is less on the left leg
- The knee is in physiological position and is swollen
- Physiologic tilt of pelvis
- Physiologic curve of lumbar spine
- Kyphotic curve of thoracic spine with peak at the level of Th5
- Left shoulder is protracted
- Physiologic position of head

Conclusion of postural examination: the weight distribution is not physiological with more weight on the right leg. The left leg is not flexed while standing but is swollen. The pelvis seems tilted to the right side and the right shoulder is lower than the left. The weight of the body seems to be to the right side and in general he is tilted towards the right side.

3.7.2 Palpation of pelvis

- Anterior superior iliac spine on the left side is higher
- Posterior superior iliac spine on the left side is higher
- Iliac crest on the left side is higher
- Physiological tilt

Conclusion of palpation of pelvis: the pelvis presents obliquity towards the right side with no anteversion or retroversion.

3.7.3 Breathing stereotype

The patient has is using more the abdominal part of the body for breathing but the sternal part is also moving at the end of the breath.

3.7.4 Specific testing of posture

Two scales standing: right: 45 kg left: 35 kg correct standing at the limit of 15% of body weight

Romberg test (I, II, III): negative

Vele test: grade 1

3.7.5 Modification of standing

Standing on tiptoes: able

Standing on heels: able

3.7.6 Gait examination

The patient is walking with two forearm crutches with 'two point' type of gait. There is better flexion of the left knee during walking and now the patient is using plantar flexion of the ankle in order to propel the body forward. He is comfortable by walking with the crutches and during walking he looks straight with no looking down. The walking

rhythm is periodic with physiological stride length and speed of walking. The upper extremities are moving together with the operated leg.

3.7.7 Anthropometric measurements

- Leg length: anatomical right: 86 cm left: 86 cm
- Umbilicus right: 96 cm left: 96 cm
- Functional right: 90 cm left: 90 cm
- Length of the thigh: right: 45 cm left: 45 cm
- Length of the leg: right: 44 cm left: 44 cm
- Circumference of the thigh:
- 15 cm above the knee cap: right: 41 cm left: 42 cm
- 10 cm above the knee cap: right: 39 cm left: 41 cm
- Circumference of the knee: right: 37 cm left: 40 cm
- Circumference of the calf: right: 31 cm left: 31 cm
- Circumference of the ankle: right: 24 cm left: 24cm

Conclusion of anthropometric measurements: the left leg is still swollen mostly around the knee and around quadriceps but has improved from the first day.

3.7.8 Measurement of ROM

Hip joint		Active	Passive
Right	S	10-0-110	15-0-120
	F	30-0-25	40-0-30
	R	30-0-20	35-0-30
Left	S	10-0-110	15-0-115
	F	30-0-25	40-0-30
	R	30-0-15	35-0-25

Knee joint			
Right	S	0-0-125	0-0-130
Left	S	0-0-120	0-0-125
Ankle joint			
Right	S	15-0-40	20-0-50
	R	20-0-40	30-0-45
Left	S	15-0-40	20-0-50
	R	15-0-30	20-0-35

Table 7 Final Measurement of ROM

Conclusion of ROM: the mobility on the operated leg improved a lot and now is the same as the in the healthy lower extremity.

3.7.9 Muscle length examination

Muscles	Right extremity	Left extremity
Gastrocnemius (acc. Janda)	G-0	G-0
Soleus (acc. Janda)	G-0	G-0
Hip flexors (acc. Kendall)		
One joint muscles	Normal	Normal
Two joint muscles	Slight shortness	Slight shortness
Adductors (acc. Janda)	G-0	G-0
Hamstring (acc. Janda)	G-2	G-2

Table 8 Final Muscle length examination

Conclusion of length examination: the patient has slight shortness of two joint hip flexors on the operated leg and grade 2 shortness of hamstrings.

3.7.10 Manual muscle strength test (acc to Kendall)

	Right lower extremity	Left lower extremity
Gluteus maximus	4+	4
Psoas major	5	5
Tensor fascia latae	4+	4+
Sartorius	4+	4+
Quadriceps femoris	5	4+
Hip flexors as group	5	5
Iliopsoas	5	5
Hip adductors	5	5
Gluteus minimus	4+	4
Gluteus medius	4+	4
Lateral rotators	5	5
Medial rotators	5	5
Medial hamstring	5	5
Lateral hamstring	5	5
Ankle plantar flexors	5	5
Soleus	5	5

Peroneus longus, brevis	5	5
Tibialis posterior	5	5
Tibialis anterior	5	5

Table 9 Final Manual muscle strength test (acc to Kendall)

Conclusion of muscle strength test: the patient's strength improved but he needs to continue strengthening exercises especially for gluteal muscles in both sides.

3.7.11 Muscle tone palpation

	Right lower extremity	Left lower extremity
Rectus femoris	Normal tone	Normal tone
Vastus medialis, lateralis	Normal tone	Normal tone
Adductors	Normal tone	Normal tone
Tensor fascia latae	Hyper tone	Hyper tone
Semitendinosus Semimembranosus	Hyper tone	Hyper tone
Biceps femoris	Hyper tone	Hyper tone
Gluteus medius	Normal tone	Normal tone
Gluteus minimus	Normal tone	Normal tone
Gluteus maximus	Normal tone	Normal tone
Gastrocnemius	Normal tone	Normal tone
Soleus	Normal tone	Normal tone
Tibialis anterior	Normal tone	Normal tone

Erector spinae	Hyper tone	Hyper tone
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Table 10 Final Muscle tone palpation

Conclusion of muscle tone palpation: quadriceps on the operated leg are in normal tone. Hamstrings, erector spinae and tensor are hypertone in both sides.

3.7.12 Examination of soft tissues (acc to Lewit)

Skin and subskin: there is no restriction in any direction around the knee joint and around the scar. The area is swollen and warm.

Fascia: no restriction on both legs around longitudinal axis.

Scar: the scar is 18 cm with restriction in mobility in medial and lateral directions at the upper and lower endings. At the upper end there is dry blood, so the wound is not healed completely yet.

The operated area has higher temperature than the healthy extremity.

3.7.13 Movement stereotype

- Hip extension: right: pathological. There is activation first of paravertebral muscles.
Left: pathological. Activation of paravertebral in the beginning of the movement.
- Hip abduction: right: physiological. Left: pathological. Tensor mechanism, the leg is raised with slight flexion of the hip joint probably because of hyper tone of tensor fascia latae.

3.7.14 Neurological examination

- **Lower limbs:**
- **Deep reflexes:**
- Patellar reflex: right: normal left: N/A
- Achilles tendon reflex: right: normal left: normal
- Mediolplantar reflex: right: normal left: normal
- **Lassegue's maneuver:** right: negative left: negative

- **Sensation (Dermatomes: L3, L4, L5, S1):**
- Tactile: right: normal left: normal
- Algic: right: normal left: normal
- Thermic: right: normal left: normal
- Position sense: flexion of the MTP big toe right: normal left: normal
extension of the MTP big toe right: normal left: normal
- Movement sense: flexion of the MTP big toe right: normal left: normal
extension of the MTP big toe right: normal left: normal
- Stereognosis on plantar side: right: normal left: normal
- Graphesthesia on plantar side: right: normal left: normal

3.7.15 Joint play examination (acc Lewit)

Examined joint	Right leg	Left leg
Tibiofibular	No restriction in any direction	No restriction in any direction
Talocrural	No restriction in any direction	No restriction in any direction
Patella	No restriction in any direction	No restriction in any direction
Subtalar	No restriction in any direction	No restriction in any direction
Talocalcaneonavicular	No restriction in any direction	No restriction in any direction
Transverse tarsal (Chopart)	No restriction in any direction	No restriction in any direction
Tarsometatarsal (Lisfranc)	No restriction in any direction	No restriction in any direction

	direction	direction
Metatarsophalangeal	No restriction in any direction	No restriction in any direction
Proximal interphalangeal	No restriction in any direction	No restriction in any direction
Distal interphalangeal	No restriction in any direction	No restriction in any direction

Table 11 Final Joint play examination (acc Lewit)

Conclusion of joint play examination: the joint play was restored and there was good mobility in the joints.

3.8 Evaluation of the effect of the therapy

Initial examination		Final examination
48 cm	Circumference of thigh 15 cm above patella	42 cm
45 cm	Circumference of thigh 10 cm above patella	41 cm
41.5	Circumference of the knee	40 cm
R: 55 kg L: 25 kg	Two scales standing	R: 45 kg L: 35 kg
0-5-100	Active ROM of knee joint	0-0-120
0-5-115	Passive ROM of knee joint	0-0-125
3+	Gluteus maximus strength test	4
4-	Quadriceps strength test	4+

4-	Hip flexors as a group strength test	5
4-	Iliopsoas strength test	5
3+	Gluteus minimus, medius strength test	4
Hypo tone	Rectus femoris tone palpation	Normal tone
Hypo tone	Vastus medialis, lateralis tone palpation	Normal tone
There is only restriction at the lateral side of the knee joint close to the scar towards medial direction.	Skin and sub skin examination	There is no restriction in any direction around the knee joint and around the scar.
Joint play examination		
Restriction in dorsal direction	Talocrural joint	No restriction in any direction
Restriction in lateral and medial direction	Talocalcaneonavicular joint	No restriction in any direction
Restriction in ventral direction	Transverse tarsal joint (Chopart)	No restriction in any direction
Restriction in ventral direction	Tarsometatarsal joint (Lisfranc)	No restriction in any direction
There is <u>no</u> flexion of the left knee during walking and the left leg is in slight external rotation. On the	Gait examination	There is <u>better</u> flexion of the left knee during walking and now the patient <u>performs</u> plantar

left ankle also, there is <u>no</u> plantar flexion.		flexion of the ankle in order to propel the body forward.
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Table 12 Evaluation of the effect of the therapy

As we can see the knee is not so swollen but still needs improvement and the patient should continue the application of ice, standing on two scales improved within the limits of 15% of body weight and the strengthening exercises improved the function of the impaired muscles and the tone as well. All the joints with impaired joint play are now back to physiological mobility with the exercises and the manual therapy that was applied to the patient. The gait through the explanation of the correct pattern and some repetition and reminding every day made the patient able to walk with crutches in a correct pattern. The patient should continue the exercises that I gave him in order to keep the overall condition of the operated leg and return to his ADL activities. He should work more on weight distribution, but this will come when he will stop using crutches for walking and this probably will correct the pelvis obliquity towards the right side. I could use magnetotherapy in order to decrease edema or electrotherapy for edema or stimulation of quadriceps especially in the first therapies, but these machines were not accessible by me. Kinesiotaping to decrease edema was not able to be applied because the patient had stitches except the last two therapies but still, he had plaster above the fresh scar.

The most effective method was the strengthening exercises and general conditioning exercises of the patient that helped his operated leg gain the normal mobility. The patient was positive with everything that I was doing or saying to him without any fear or complain.

4 Conclusion

The patient was friendly, smiling and cooperative even though I was not speaking Czech and he was not speaking English so all the time my supervisor was translating everything that I was saying. He was already familiar with this kind of surgery as he did the same on the other leg some years ago, so he knew how to walk with crutches normally and on stairs.

The goal of the therapies was accomplished, and we were trying to achieve all the goals of the therapeutic units despite the fact that we did only 7 days sessions. I am thankful for my patient that was following everything that I was saying and my supervisor that was translating for me.

The work on the hospital for thesis gave me enough experience on how to work with patients with different disorders and with different language speaking patient. During the practice I was able to apply all the techniques and knowledge that I gained from my studies in UK FTVS in Prague.

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6 Supplement

6.1 List of Pictures

Picture 1 Components of Knee Articulation [2]	7
Picture 2 Menisci and Ligaments [4].....	8
Picture 3 Bursae and Ligaments of Knee [2].....	9
Picture 4 Knee Motion into Extension [6].....	13
Picture 5 Normal Mechanical Axis of The Lower Limb [7]	14
Picture 6 Mechanical Axes and Misalignments [7]	15
Picture 7 Healthy knee and knee with OA [25]	16
Picture 8 Degeneration of Matrix [11].....	17
Picture 9 Kellgren & Lawrence grading system [28]	18
Picture 10 X-ray of Total Knee Replacement [24]	21

6.2 List of Tables

Table 1 Muscles That Act on The Knee [1].....	12
Table 2 Measurement of ROM	32
Table 3 Muscle Length Examination.....	33
Table 4 Manual muscle strength test (acc to Kendall).....	34
Table 5 Muscle tone palpation.....	35
Table 6 Joint play examination (acc Lewit).....	37
Table 7 Final Measurement of ROM.....	62
Table 8 Final Muscle length examination.....	62
Table 9 Final Manual muscle strength test (acc to Kendall)	64
Table 10 Final Muscle tone palpation.....	65
Table 11 Final Joint play examination (acc Lewit)	67
Table 12 Evaluation of the effect of the therapy	69

6.3 List of Abbreviations

OA- osteoarthritis

MRI-magnetic resonance imaging

US- ultrasound

ROM- range of motion

ACL- anterior cruciate ligament

PCL- posterior cruciate ligament

ADL- activity daily living

BMI- body mass index

CT- computer tomography

STT- soft tissue techniques

PIR- post isometric relaxation

PNF- proprioceptive neuromuscular facilitation

TKR- total knee replacement

MCL- medial collateral ligament

LCL- lateral collateral ligament

6.4 Informed consent

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:

6.5 Approval by the Ethics Committee

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

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 after total knee replacement surgery.

Project form: Bachelor Thesis

Period of realization of the project: January 2019

Applicant: Petrocheilos Stavros, UK FTVS Physiotherapy department

Main researcher: Petrocheilos Stavros, UK FTVS Physiotherapy department

Workplace: Rehabilitační Nemocnice Beroun

Supervisor: PhDr. Tereza Nováková, Ph.D.

Project description: Case study of a patient after total knee replacement. The aim of the case study is to first exam the patient's initial state using questionnaires, specific physiotherapy examinations and observations. After two working weeks of physiotherapeutic techniques the patient will undergo a final examination using questionnaires, specific physiotherapy examinations and observations to observe changes from the initial state and evaluate the effectiveness of the physiotherapeutic procedures used. The knowledge for the methods used to collect data acquired during the three year Bachelor degree Physiotherapy program at UK FTVS.

Characteristics of participants in the research: 1 male patient 71 years old. The patient is staying at Rehabilitační Nemocnice Beroun during the 2 working weeks that the research is occurring.


Ensuring safety within the research: Risks to the patient will be minimised. There will be a varying team of qualified physiotherapists and doctors on the same floor during all procedures during the research. The patient is notified about using a scale of pain from 1-10 (10 maximum) and not to continue with a procedure if the pain goes over 5. No invasive methods will be used during the research. The physical presence of responsible supervision Mgr. Ján 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 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, 12/1/2019

Applicant's signature: 

Approval of UK FTVS Ethics Committee

The Committee: Chair: doc. PhDr. Irena Parry Martínková, Ph.D.

Members: prof. PhDr. Pavel Slepíčka, DrSc.
doc. MUDr. Jan Heller, CSc.
PhDr. Pavel Hráský, Ph.D.
Mgr. Eva Prokešová, Ph.D.
MUDr. Simona Majorová

The research project was approved by UK FTVS Ethics Committee under the registration number: 013/2019

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.