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1. INTRODUCTION

This thesis draws on my practical experience gained during a clinical work placement in my final year of physiotherapy studies. My work placement took place at Medicentrum Praha from the 9th of January 2023 to the 3rd of February 2023.

The goal of this Bachelor Thesis work is to give an overview of a case study of a patient after an artificial ACL reconstruction, and to give information about the knee joint, and ACL and its reconstruction.

The patient with an artificial ACL reconstruction in the case study was a 53 years old woman who does sports and likes to stay active. She has injured her ACL ligament twice while doing sports. I chose my patient since she spoke English and I am interested in knee injuries.

The theoretical part of my thesis focuses on kinesiology, and biomechanics of the knee joint. It also contains information about the anterior cruciate ligament, clinical sign of ACL tear, testing for ACL tear, surgery and graft types.

The practical part which is written based on a case study of a patient after ACL reconstruction. It contains anamnesis, initial kinesiological examination, short-term physiotherapeutic goals, long-term physiotherapeutic goals, and final kinesiological examination. It also has a chapter about evaluation the therapy effect which gives information about the progress made during the therapy process.

2. GENERAL PART

2.1 Biomechanics of the knee joint

The knee joint is made up from two joints, the tibiofemoral joint and patellofemoral joint. The main functions of the knee joint complex are to allow locomotion with minimum energy requirements from the muscles and stability, accommodating for different terrains, and to transmit, absorb and redistribute forces caused during the activities of daily living. The knee joint acts as a pivot between the two longest bones, femur and tibia whilst the quadriceps muscles act across it. The tibiofibular joint has a range of motion of 160 degrees of flexion, with coupled rotations in the other two planes. The patellofemoral joint has a complex three dimensional range of motion across tibiofemoral joint flexion in order to allow for minimal quadriceps contraction to extend the knee (Masouros et al., 2010).

The tibiofemoral joint has six degrees of freedom with three rotations and three translations with respect to a series of perpendicular anatomical axes. The avarage ranges for the tibiofemoral joint are following (Masouros et al., 2010):

- Flexion/extension- 15 to 140 degrees
- Vargus/valus rotations- 6 to 8 degrees
- Internal/external rotations- 25-30 degrees
- Antero-posterior translation- 10-15 mm
- Medio-lateral translation- 2-4 mm
- Superior/inferior translation- 2-5 mm

The patellofemoral joint is a joint in which the forces are a function of both quadrices tension and flexion angle. The main function of patella is to facilitate the knee extension by increasing the efficiency of the quadriceps muscle. This effect is achieved through the fulcrum function, exerted by the patella, which shifts the muscle line of action anteriorly. This effect produces an increase in the lever arm of the quadriceps muscle moment relative to the centre of rotation of the knee. Also the patella optimizes

the distribution of patello-femoral compressive forces by increasing the contact area during flexion. Another function of patella is to act as a guide for the extensor mechanism by centralizing the various traction forces of the different quadriceps heads and transmitting these forces to the patellar tendon (Innocenti, 2022) .

2.1.1 Roll back phenomenon

The roll back phenomenon can be described as the femur moving bodily posteriorly on the tibia as the knee flexes. This phenomenon is beneficial for maximising the flexion range by delaying contact between the posterior tibia and femur. Moreover, it would enlarge the lever-arm of the extensor mechanism increasing mechanical advantage in extending the flexed knee (Ae & Logan, 2004).

2.1.2 Screw home mechanism

Screw home mechanism is a mechanism that is a mechanism that plays role in terminal extension of the knee. The knee joint is a hinge joint which primary movements are into flexion and extension. However, the radius and length of the articular surface of the femur and tibia are different at the knee joint. Because of that a complex movement which includes sliding occurs at a certain interval, in addition to rolling between the two bones. This complex movement with sliding allows the knee joint to move smoothly. At terminal extension the knee joint is slightly hyperextended and stabilized with the tightening of the cruciate and collateral ligaments (*Screw Home Mechanism of the Knee Joint*, n.d.). During the screw home mechanism as the length of the medial femoral condyle is longer than the length of the lateral condyle, the tibia rotates externally about 15 degrees on the femur during the last 20 degrees of extension (Kim et al., 2015).

2.2 Kinesiology of the knee joint

The knee joint is one of the largest joints in the human body, it is a complex modified hinge joint which greatest range of movement is into flexion and extension in sagittal plane. The varus and valgus rotations take place in the frontal plane and the

medial rotation at the end of the knee flexion and the lateral rotation at the terminal extension of the knee both take place in the transverse plane. The knee joint consists of two main joints, tibiofemoral and patellofemoral joints which are the articulations between the femur, tibia, fibula and patella. Medial and lateral condyle of femur articulate with the tibia to form tibiofemoral joint while anterior and distal part of the femur articulate with the patella to form patellofemoral joint (*Knee*, n.d.). The two main joints let the knee to move in three different planes which offer a six degrees of freedom range of motion which include flexion and extension in sagittal plane, internal and external rotation in transverse plane and varus and valgus stress in frontal plane (Abulhasan & Grey, 2017).

The knee joint is one of the largest articulated joints of lower extremity of human endoskeleton which makes it almost frictionless and highly efficient for shock absorption. Knee joint holds femur and tibia in place through system of cartilage, tendons, and ligaments. Lower part of femur and upper part of tibia are connected with multiple ligaments at knee joint. These three bones make up the synovial joint with ellipsoidal shape allowing roll and glide movement capability. Patella has sliding movement capability on femoral groove as it is connected to tibia through patellar tendon at bottom side and with quadriceps muscles through quadriceps tendon at upper side. Articular cartilage at the surface of opposing bones provides principal interface of articulation. Most of the mechanical shocks are generated at knee joint and are absorbed by meniscus (Akhtaruzzaman et al., 2020).

Forces, moments, and stresses at knee joint depend on external and internal loading factors which include muscle forces, segmental position, velocity, acting load, and moment arms. To predict the forces and moments, it is necessary to determine the required body segment parameters (Akhtaruzzaman et al., 2020).

To establish and maintain the joint stability proprioception and accompanying neuromuscular feedback is needed. Neuromuscular control and joint stabilisation are mainly mediated by the central nervous system. Injury to capsuloligamentous structures results in articular deafferentation contributing to alterations in kinaesthesia and joint position sense. Reduction in proprioceptive activity may contribute to further degenerative changes in the joint, as the spinal reflexive pathway may be impaired.

Following ACL reconstruction surgery there is a reduction in proprioceptive activity of the knee joint which makes restoration of joint position sensibility and neuromuscular control one of the main goals of the post surgery rehabilitation programme (Lephart et al., 1998).

2.2.1 Lower extremity malalignment and ACL injuries

Malalignment of the lower extremity can possibly one of the factors that can increase the risk of ACL tear. Increased anterior pelvic tilt can increase the risk of ACL injury in men and women, it causes hamstring to be in an elongated position and therefore it may slow hamstrings neuromuscular response time and their capacity to serve as dynamic agonist to the ACL. Anterior pelvic tilt can also cause shortening of the hip flexior muscles. The other factor that may play role in ACL tear is excessive pronation, increased pronation is associated with greater internaal rotation in the transverse plane at the knee. Due to increased rotation there may be additional strain on ACL during deceleration activities and an increased risk of rupture (Hertel, 2004).

2.3 Anterior Cruciate Ligament injury

2.3.1 Etiology of ACL injury

The anterior cruciate ligament is considered the main passive restraint to anterior translation of the tibia on the femur, and it provides rotational stability to the knee in both the frontal and transverse planes. Anterior cruciate ligament injuries are one of the most common knee injuries. There are three main mechanisms for the ACL injury to happen: direct contact, indirect contact and non-contact (Raines et al., 2017).

The first mechanism is called direct contact and it happens when a person or object strikes the knee directly and therefore causes an injury to an ACL. The second mechanism is called indirect contact and it occurs when a person or object strikes a part of the body other than the knee itself, causing excessive forces to be transferred through the knee resulting in ACL failure. An example for that would be s direct blow the thigh, translating the femur posterior in respect to the tibia. The third mechanism is called non-

contact injuries and those happen when a deceleration or change in direction force are applied to the knee but often encompass an ill-timed neuromuscular firing of structures around the knee, causing translation of the tibia on the femur, which results in ACL injury. The non-contact mechanism is considered as the most common form of an ACL injury (Raines et al., 2017).

2.3.2 Clinical signs of ACL injury

Depending on the person and the ACL injury different people can have different signs and symptoms of an ACL injury. The most common signs and symptoms include:

- Instability feeling in the knee
- Reduced range of motion, the range of motion is mostly limited into extension
- Swelling around the knee right after the injury
- Acute pain
- "Popping" or cracking sensation in the knee at the time when injury happened (*ACL Injury - Symptoms and Causes - Mayo Clinic*, 2022)

2.3.3 Diagnosis of ACL injury

To diagnose an ACL injury there are several ways which are used. To diagnose it clinically magnet resonance imaging, knee arthroscopy, and ultrasonography are most commonly used. In rare cases also computed tomography is used to detect an intact ACL. To diagnose the ACL injury with orthopaedic assessment Lachman test, anterior drawer test and pivot shift test are used (Evans, 2022).

2.3.3.1 Magnet Resonance Imaging

Magnet resonance imaging (MRI) is a direct visualization method which is used to record the position and motion of the knee with precision. It is most commonly used because it is a non-invasive method. Cruciate ligaments of the knee are evaluated on oblique sagittal MRIs with T2- weighted sequences (Scarvell et al., 2005).

In acute phases of the complete ACL tear it is the easiest to diagnose it with MRI. MRI of an acute complete ACL tear shows abnormal increased T1 and T2 signal due to oedema and hemorrhage and thickening, wavy, or retracted appearance of the ACL ligament and angulation towards the horizontal plane. In case of an acute partial ACL tear the ACL fascicles look intact but the ligament itself is thickened with a T2-hyperintense signal (Kam et al., 2010).

In chronic stage it is harder to diagnose partial or complete ACL tear using an MRI due to oedema and thickening of the ACL fibers which may have already disappeared. On the MRI that is done for a chronic ACL tear the ACL may be absent or may be replaced by a fluid signal in the lateral intercondylar notch. The ligamnet may also appear thin with some residual fibers being present, and may demonstrate an abnormal posterior slope (Kam et al., 2010).

Secondary signs of the ACL tear during the MRI include an anterior tibial translation greater than 5mm which helps to distinguish complete tear from partial tear. The second secondary sign is an acute hemarthrosis an buckling of the posterior cruciate ligament (Kam et al., 2010).

2.3.3.2 Arthroscopy

Arthroscopy is used to diagnose and treat ACL rupture with a high level of accuracy. It is relatively expensive and invasive method for ACL rupture diagnosing (Li et al., 2017). During arthroscopy a narrow tube attached to the camera is inserted through a small incision. Arthroscopy lets a surgeon see a direct visualization of all intra-articular structures and through that provides a high level accuracy for treating and diagnosing an ACL rupture (*Arthroscopy - Mayo Clinic*, 2022).

2.3.3.3 Lachman test

Lachman test is one of the orthopaedic assessments that is used to diagnose ACL rupture. In Lachman test patient lies supine on the table with injured knee 15-30 degrees bent and slightly externally rotated and hamstrings relaxed (Makhmalbaf, 2013). Therapist places one of the hands on the distal anterior femur and places the other hand

in a way that the thumb would be on the tibial tuberosity and all the other fingers would be behind the tibia. To test for possible ACL tear the therapist pulls the tibia anteriorly. The test is positive in case of anterior translation of the tibia with a soft and mushy end-feel. In case of a positive test the tibia has to move forward for at least 2 mm (*Lachman Test*, n.d.).

2.3.3.4 Anterior drawer test

For the anterior drawer test the patient lies supine with their affected knee 90 degrees bent. The therapist sits on the toes of the affected leg of the patient to help to stabilize the leg. The examiner places both hand behind the tibia, below the tibial plateau so that both of the thumbs would be on the tibial tuberosity. To examine the therapist pulls the tibia anteriorly. The test is considered positive when there is anterior translation more than 6mm (*Anterior Drawer Test of the Knee*, n.d.).

2.3.3.5 Pivot shift test

As the previous two test the pivot shift test is also used to test the integrity of the ACL ligament and rotary instability of the knee (Suero et al., 2013). In this test patient lies in supine with both legs relaxed. The therapist raises up the affected leg with knee extended into 30 degrees of hip flexion and abduction. With one hand the therapist hold the calcaneus from the outside while turning the leg internally. The other hand is on the fibula on the lateral side on the knee to able to give a slight valgus force. To perform the test therapist moves the leg onto flexion and then into full extension. The test is positive when the tibia jogs backwards at around 30 to 40 degrees of knee flexion (*Pivot Shift*, n.d.).

2.3.4 Treatment of the Anterior Cruciate Ligament

There are many different ways to treat an anterior cruciate ligament tear. The surgical approaches differ depending on the anatomy, injury pattern, and demands of different people. Depending on the patient's needs the type of grafts and the type of surgery differs (*Anterior Cruciate Ligament (ACL) Reconstruction*, n.d.).

- Conservative management- this is a treatment option without surgery. It is used for people who are less interested in sporting activities or who refuse to undergo a surgery. In conservative management patients should avoid contact sports and they use physiotherapy and exercising on their own to achieve their goal and strengthen the muscles of the lower extremity surrounding the knee joint and by this decreasing pain and improving range of motion of the knee joint (Delince & Ghafil, 2012).

- Arthroscopy- it is a less invasive method which only involves a small incision through which a narrow tube that has a camera attached to it is used to treat a torn ligament (*Anterior Cruciate Ligament (ACL) Reconstruction*, n.d.).

- Open surgery- this approach has a bigger incision compared to the arthroscopy (*Anterior Cruciate Ligament (ACL) Reconstruction*, n.d.)

- Intra- articular procedure- this approach includes a small arthrotomy incision which preserves the vastus medialis obliqus muscle to the patella. It is performed either with an endoscopic technique or a double incision arthroscopic technique (*Anterior Cruciate Ligament (ACL) Reconstruction*, n.d.)

- Extra-articular reconstruction- it is used for anterior tibial subluxation to eliminate any pivot shift and to isolate and to make better the intra-articular reconstruction. It's disadvantage is that it does not recreate the normal anatomy and function of the anterior cruciate ligament (*Anterior Cruciate Ligament (ACL) Reconstruction*, n.d.).

- Single bundle reconstruction- in single-bundle reconstruction only one of the bundles is restored. It used in case of tibial insertion sites less than 14mm in length, and when there is presence of concomitant ligamentous injuries, severe arthritic changes or bone bruising (Raines et al., 2017).

- Double-bundle reconstruction- it is a surgery during which both of the bundles are restored. It is used in patients with a large tibial insertion site, large intercondylar notch, in the absence of concomitant ligament injuries, and in absence of advanced arthritic changes, severe bone bruising and closed physes. Double-bundle reconstruction more closely reproduces the native knee anatomy and kinematics of the knee (Chambat et al., 2013).

- Tunnel drilling- during the tibial tunnel placement the graft is placed so that the graft would not be impinged by the roof of the intercondylar notch and it should reside within the middle third of the former ACL insertion site. Femoral tunnel placement is done following the tibial tunnel placement and it is completed so as to make a normal ACL like graft placement (Fink et al., 2018).

2.3.5 Graft types

There are various types of grafts that can be used for the reconstruction of the anterior cruciate ligament. The type of graft used depends on the patient's age, skeletal maturity, activity level, and pre-exsisting anterior knee pain (Cerulli, 2013). The types of grafts used are- autografts, allografts and synthetic grafts (*Anterior Cruciate Ligament (ACL) Reconstruction*, n.d.):

- Autograft- autografts are usually used in patients under 25 years of age, who are active or do sports on a professional level (*Anterior Cruciate Ligament (ACL) Reconstruction*, n.d.).

- Allograft- it is used for older and less active people since it has equivalent outcomes with autograft in older people (Raines et al., 2017).

- Synthetic graft- it is not used as a first option since it has a high risk of failure. It is used for secondary reconstruction as an alternative graft for special cases (Satora et al., 2017).

Regarding the autografts the main types of grafts used are the hamstring autograft (HS), quadriceps tendon autograft (QT), and bone-patellar tendon-bone (BPTB) autograft. The BPTB autograft is a strong stiff graft with secure fixation, it has a potential for bone-to-bone ingrowth, and it has a low failure rate. The HS autograft has the same advantages as BPTB autograft but it has increased laxity and higher failure rates. The QT autograft has a good strength and reliable long term outcomes which is the reason that more surgeons have started to use it for ACL reconstruction (Raines et al., 2017).

2.3.6 Physiotherapy after ACL surgery

After the ACL reconstruction physiotherapy plays a crucial role in full recovery. In order to insure optimal recovery the physiotherapist needs to work together with a doctor to make sure the condition of the ligament. The physiotherapy consists of exercising, patient education, cryotherapy, hydrotherapy, gait training, scar care, using different modalities such as ultrasound and TENS (Van Grinsven et al., 2010).

For the first two weeks after the surgery it is important to protect the graft which is the reason for the patient to wear a brace to keep the knee from going over the range of motion told by the doctor, reduce swelling and pain and the patient is using crutches for walking and is not allowed to put full body weight on the affected leg (Della Villa et al., 2015).

Goals and therapy two weeks after the surgery:

- Cryotherapy to reduce swelling
- Scar care for the soft tissues surrounding the scar
- Restoring the patellar mobility using joint play
- Increasing range of motion into flexion and extension as told by the doctor
- Gait pattern training- ensuring the correct gait pattern while walking with crutches
- Muscle strengthening- strengthening of the muscles surrounding the knee joint with active and passive exercises (*ACL Injuries – Symptoms & Treatments | Massachusetts General Hospital*, n.d.)

From the third to fifth week it is needed to focus even more on improving the range of motion and regaining the muscles strength. In addition it is needed to start working on the balance and proprioception (*ACL Injuries – Symptoms & Treatments | Massachusetts General Hospital*, n.d.).

Goals and therapy 3-5 weeks post-surgery:

- Scar care for the soft tissues surrounding the scar
- Improving range of motion into flexion and extension using active and passive movements (maximal flexion is usually 60 degrees)
- Gait pattern- correction of the gait pattern to ensure an optimal gait pattern
- Strengthening of muscles surrounding the knee using active exercises
- Reduce swelling and pain using an icepack
- Restoring the patellar mobility using joint play
- Balance and proprioception training (*ACL Injuries – Symptoms & Treatments | Massachusetts General Hospital*, n.d.)

From the sixth to eight week the physiotherapy focuses on gaining full range of motion of the knee joint into flexion and extension, strengthening the muscles of the lower extremities and improving balance and proprioception (*ACL Injuries – Symptoms & Treatments | Massachusetts General Hospital*, n.d.).

Goals and therapy 6-8 weeks after surgery:

- Strengthening of the lower extremity muscles using active exercises
- Gaining full range of motion into flexion and extension
- Scar care for the soft tissues surrounding the scar
- Gait training- maintaining and correction of the gait pattern, walking without crutches
- Balance and proprioception training to avoid instability (*ACL Injuries – Symptoms & Treatments | Massachusetts General Hospital*, n.d.)

From the ninth to twelfth week the therapy is focused on either gaining or maintaining of the maximal range of motion, muscle strengthening and balance and proprioceptive training (*ACL Injuries – Symptoms & Treatments | Massachusetts General Hospital*, n.d.).

Goals and therapy 9-12 weeks after surgery:

- Scar care for the soft tissues surrounding the scar
- Strengthening of the lower extremity muscles
- Maintaining/gaining full range of motion of the knee joint into flexion and extension
- Gait training- gait pattern without crutches
- Balance and proprioceptive training to improve stability and prevent falls (*ACL Injuries – Symptoms & Treatments | Massachusetts General Hospital*, n.d.)

After the twelfth week of rehabilitation the therapy is still focused on gaining the muscle strength in the lower extremity muscles, maintaining full range of motion of the knee joint into flexion and extension, improving balance and proprioception, improving gait pattern and is slowly starting to progress towards exercises that are specific to the sports the patient would like to return to doing after full recovery. Returning back to doing sports usually happens 9 to 12 months after the surgery (Filbay & Grindem, 2019).

3. SPECIAL PART

3.1 Methodology

The aim of this Bachelor Thesis work is to present a case study of a patient after an artificial ACL surgery, and also it gives background information about the knee joint and its kinesiology and biomechanics, as well as information about the ACL ligament and its tear, and about its treatment possibilities after a tear.

The clinical work placement based on which the case study was written took place at Medicentrum Praha from the 9th of January 2023 to the 3rd of February 2023. My supervisor during the whole clinical work placement was Mgr. Vojtech Oplt.

The therapy schedule was chosen during the first therapy session where the patient chose suitable dates and times for her. The patient came to therapy as an outpatient. The first therapy session was for the initial kinesiological examination followed by active exercises for the knee joint and the last therapy session consisted of final kinesiological examination and exercises for the lower extremities. From therapy aids rubber bands, different unstable surfaces for improving balance, and an overball were used. I had 8 therapy session in total with the patient including the initial and final kinesiological examination from which each session was between 30 minutes to an hour long. During those 8 therapy sessions my supervisor was Mgr. Vojtech Oplt.

Before the first therapy session the patient was informed that she will be part of my Bachelor Thesis case study and she agreed with it. On the 19th of January the patient signed informed consent which was then sent to the Ethics Committee and the Ethics Committee of the Faculty of Physical Education and Sports of Charles University approved it.

3.2 Anamnesis

- Examined person: A.D.
- Year of birth, age: 53, 1970
- Diagnosis, other diagnosis+codes: After an artificial anterior cruciate ligament reconstruction, 3rd degree gonarthrosis of the left knee

Status praesens

Objective:

- Height: 160 cm
- Weight: 61 kg
- BMI, somatotype: 23.8, ectomorph
- Cognition: normal
- Communication: normal, patient is able to communicate without any difficulties
- Assistive devices: crutches, orthosis for the left knee
- Dominant limb: right
- Glasses: eyeglasses for reading
- Skin: scar on the left knee

Subjective:

Chief complaint/problem:

The patient is after anterior cruciate ligament reconstruction with synthetic graft on the left knee. The surgery took place on the 14th of December in 2022. Patient had her first anterior cruciate ligament reconstruction with autograft where soft tissue from the hamstring was taken in 2019. The first ACL tear happened while playing basketball. After the first surgery the problems with the left knee started again and the patient

started to feel pain on the medial side of the knee and it was found from the MRI that the ACL ligament was torn again but the reason for that is unknown. For the first two weeks after the surgery that took place on the 14th of December the patient had to hold her knee in a straight position and from the third to sixth week 30 degrees of flexion of the left knee joint was allowed and from the sixth week on after the surgery flexion over the 60 degrees allowed. The patient feels the flexion of the left knee joint to be the most difficult movement for her. She does not feel significant pain in the knee joint, she only feels the knee a bit painful in the mornings and when the knee is touched and on a scale from 1 to 10 she graded the pain to be between 1 and 2. 12 years ago she also had a surgery on the left knee for the medial meniscus, the injury happened while playing basketball.

Personal medical anamnesis

Patient had a surgery after medial meniscus injury 12 years ago. The present problem (reconstruction of the ACL ligament) has occurred before in 2019 when the ACL ligament was torn while playing basketball. She has varicose veins as a chronic venous disorder. She broke her wrist in the childhood but is not exactly sure which bone was broken in the wrist. Her motor development is normal without any abnormalities.

Family anamnesis

The health problem occurring on her mother's side of the family is varicose veins. There has been no sudden death and both of her parents are alive. She has a husband and 2 kids.

Injury anamnesis

In the childhood the patient broke her right wrist but she is unsure about which part of the wrist was broken. 12 years ago she had a medial meniscus tear of the left knee which she had to have a surgery done for. In 2019 she had an ACL tear of the left

knee which she had a surgery for and she had her second ACL tear in 2022 which she also had a surgery done for.

Past medical and surgical history:

Surgery for broken wrist in childhood. Surgery for medial meniscus of the left knee in 2011. In 2019 surgery of the left ACL ligament with an autograft. In 2022 surgery of the left ACL ligament with synthetic graft. 3rd degree gonarthrosis of the left knee.

Medications, pharmacological anamnesis

Patient is not taking any medications.

Allergic anamnesis

She is allergic to peanuts

Gynaecological anamnesis

Patient has no gynaecological problems

Abuses

She does not smoke. She drinks alcohol few times a month on social events.

Diet:

She does not follow any diet, she eats everything

Functional anamnesis/history

Her mobility is good except the movement of her left knee joint which is restricted due to anterior cruciate ligament reconstruction surgery in December 2022. After surgery she needs help with carrying items due to using crutches but otherwise she is able to get on by herself. She does not need help for self care. She works as a physical education teacher at elementary school. She can sleep normally.

Social anamnesis

She lives in an apartment with stairs with her husband and 2 kids. She needs help with carrying items because she is using crutches. She has no psychological problems.

Occupational anamnesis, vocation

She works as a physical education teacher at elementary school and she has been working as a PE teacher for most of her life. Her most common movements while working are sitting and standing.

Sport, regular physical activities (past and present)

She plays basketball twice a week and she also does cross-country skiing in winter and goes running when there is no snow two times a week.

Hobbies:

Her hobbies include basketball, cross-country skiing and playing basketball which she usually does two times a week.

Past rehabilitation

She has had rehabilitation in the past after the left medial meniscus surgery and after ACL ligament reconstruction in 2019. There were no complications or problems

during the physiotherapy treatments. The main goals for both physiotherapy treatments were to improve range of motion and to strengthen the muscles of the lower limb.

Contraindications

Contraindication: flexion of the left knee joint over 60 degrees

Indication of rehabilitation:

- Improving range of motion in the left knee joint
- Decreasing pain
- Strengthening of the lower extremity muscles

3.3 Initial kinesiological examination

3.3.1 Postural examination

Posterior view:

- The base of support- moderate base of support
- Shape and contours of the heels- symmetrical, right and left heel are both in rounded shape
- Shape and position of the ankle joints- ankle joints are in a neutral position and symmetrical
- Shape and thickness of the Achilles tendon- both achilles tendons are slightly falling inwards
- Contour of the calf muscles- medial contour of the calf muscles is more prominent than the lateral contour of the calf muscles. Contour of the right calf muscles is more prominent

- Shape and position of the knee joints- knee joints are slightly in a valgus position
- Popliteal line- symmetrical
- Contour of the thigh muscles- right thigh muscle appears to be bigger than the left one. Lateral part of the left thigh muscle seems to be more prominent than the medial part.
- Subgluteal line- subgluteal lines are symmetrical and on the same level
- Gluteal muscles- symmetrical
- Symmetry of thoracobrachial triangles- symmetrical
- Position of pelvis- anterior tilt of the pelvis
- Paravertebral muscles- symmetrical
- Curvature of the spine in the frontal plane- the spine is in a neutral position lordotic curve of the cervical and lumbar spine and kyphotic curve of the thoracic spine
- Position of the scapula – medial border of the scapulas is more prominent
- Position of the shoulder girdle- left shoulder is lower than the right shoulder
- Position of the upper limb- upper limbs are symmetrical in length
- Position and contour of the nuchal muscles- neutral position
- Position of the head: head slightly in a forward position

Anterior view:

- The base of support- moderate base of support
- The position of the feet, examination of the arches – there are neutral arches under the feet

- The position and shape of the toes- normal angle of toes, no hallux valgus of big toes
- Weight distribution: body weight is more on the right foot
- Shape and position of the knee joints- left and right knee are in a slight valgus position
- Configuration of m. tibialis anterior- symmetrical
- Contour of the calf muscles- calf muscles of the right leg are more prominent than the calf muscles of the left leg
- Shape of the thigh muscles- right thigh muscle appears to be bigger than the left one. On both legs, lateral contours are more prominent than medial contours.
- Position of the pelvis- anterior tilt of pelvis
- Symmetry of the muscle tone of abdominal muscles- abdominal muscles on the right and left side are symmetrical
- Position of the navel- the navel is in a neutral position
- Symmetry of thoracobrachial triangles - symmetrical
- Position of the collarbones and supraclavicular holes- symmetrical
- Position of the shoulder girdle- left shoulder is slightly higher than the right shoulder
- Position of the upper limbs- upper limbs are symmetrical in the length.
- Position of the head- face is symmetrical and head is in a slight forward position

Lateral view- right and left side:

- Weight distribution- weight distribution is more on the right foot

- Shape and position of the ankle joints- ankle joints are symmetrical and in a neutral position
- Shape and contour of the shin- shins are symmetrical
- Position of the knee joints- knees are in a slight valgus position
- Contour of the thigh muscles- anterior contours of the right and left thigh muscles are more prominent than the posterior contours
- Position of the pelvis– anterior tilt of the pelvis
- Position and curvature of the L, L/Th and Th spine- lumbar spine has a lordotic curve and thoracic spine has a kyphotic curve
- Shape of the abdominal muscles- abdominal muscles are symmetrical
- Position of the shoulder girdle- shoulders are in a protracted position
- Position and curvature of the Th/C and C spine- cervical spine is in a neutral position
- Position of the head- head is slightly in a forward position

3.3.2 Anthropometric measurements

MEASUREMENT	RIGHT	LEFT
Anatomical length of leg	82 cm	82 cm
Functional length of leg	83 cm	83 cm
Length of thigh	45 cm	46 cm
Length of middle leg	37 cm	37 cm
Length of the foot	23 cm	23 cm
Circumference of the thigh- 10cm above the knee cap	43 cm	42 cm
Circumference of the thigh- 15cm above the knee cap	46 cm	44 cm

Circumference of the knee cap	33 cm	38 cm
Circumference of tuberositas tibiae	32 cm	33 cm
Circumference of the calf	34 cm	33 cm
Circumference of the ankle joint	23 cm	23 cm
Circumference of the heel	28 cm	28 cm
Circumference of the foot	20 cm	20 cm

Table1: Initial kinesiological examination- anthropometric measurements (cm)

3.3.3 Goniometry

HIP JOINT

Hip joint- active range of motion

HIP JOINT	RIGHT	LEFT
Extension- flexion	S: 135-0-25	S: 135-0-25
Abduction- adduction	F: 45-0-30	F: 45-0-30
External rotation- internal rotation	R: 55-0-40	R: 55-0-40

Table 2: Initial kinesiological examination- goniometry of active range of motion of the hip joint

Hip joint- passive range of motion

HIP JOINT	RIGHT	LEFT
Extension- flexion	S: 135-0-30	S: 135-0-30
Abduction- adduction	F: 50-0-30	F: 50-0-30
External rotation- internal rotation	R: 55-0-45	R: 55-0-40

Table 3: Initial kinesiological examination- goniometry of passive range of motion of the hip joint

KNEE JOINT

Knee joint- active range of motion

KNEE JOINT	RIGHT	LEFT
Extension- flexion	S: 5-0-160	S: 0-0-60

Table 4: Initial kinesiological examination- goniometry of active range of motion of the knee joint

Knee joint- passive range of motion

KNEE JOINT	RIGHT	LEFT
Extension- flexion	S: 10-0-160	S: 0-0-60

Table 5: Initial kinesiological examination- goniometry of passive range of motion of the knee joint

ANKLE JOINT

Ankle joint- active range of motion

ANKLE JOINT	RIGHT	LEFT
Dorsal flexion- palmar felxion	S: 20-0-45	S: 20-0-45
Eversion- inversion	R: 15-0-40	R: 15-0-40

Table 6: Initial kinesiological examination- goniometry of active range of motion of the ankle joint

Ankle joint- passive range of motion

ANKLE JOINT	RIGHT	LEFT
Dorsal flexion- palmar felxion	S: 25-0-50	S: 25-0-50
Eversion- inversion	R: 20-0-45	R: 20-0-45

Table 7: Initial kinesiological examination- goniometry of passive range of motion of the ankle joint

3.3.4 Vele test

Right- grade 0

Left- grade 0

3.3.5 Romberg test

Romberg I- negative

Romberg II- negative

Romberg III- negative

3.3.6 Two-scale test

Right leg- 33 kg

Left leg-28 kg

3.3.7 Muscle length test

Hip flexors (according to Janda)

Right: 0

Left: 0

Hip adductor muscles (according to Janda)

Right: 0

Left: 0

Hamstrings (according to Janda)

Right: no shortness

Left: no shortness

Ankle plantar flexors (according to Janda)

Right: 0

Left: 0

3.3.8 Muscle strength test (according to Kendall)

MUSCLE	RIGHT	LEFT
Gluteus maximus	4	4
Gluteus medius	4	4
Gluteus minimus	4	4
Quadriceps femoris	5	4
Hip adductors	4	4
Lateral rotators of the hip	5	5
Medial rotators of the hip	5	5
Medial hamstrings	4	4
Lateral hamstrings	4	4
Psoas major	5	4

TFL	4	4
Triceps surae	5	5

Table 8: Initial kinesiological examination- lower extremity muscle strength test according to Kendall

3.3.9 Gait analysis

- Width of the base of support- wide base of support
- Position of the feet- right foot is in a neutral position, left foot is not bearing full body weight
- Walking rhythm- she is limping her left leg
- Walking speed- slow
- Stride length- short steps
- Movement of the foot- her heel touches the ground first, secondly her whole foot touches the ground, and the last part of foot touching the ground is the big toe, while stepping forward her COG is moving forward
- Axial position of the lower limb- left knee stays in slight flexion and is swollen due to an ACL reconstruction
- Movement and position of the knee and hip- left knee stays in slight flexion due to an ACL reconstruction and also right knee is not fully extended while walking.
- Position and movements of the pelvis- there ise a lateral tilt of the pelvis but not more than 4cm
- Movement of centre of gravity- centre of gravity is moving only slightly from side to side and up and down
- Position and movements of the trunk- trunk is slightly rotating
- Activity of abdominal muscles- no visible activity of the abdominal muscles

- Position of spine- the spinal column curves from one side to other in waves. Hyperlordosis of the lumbar sine.
- Activity of back muscles- the most movement of the back muscles can be seen in the area of the thoracic spine
- Position of shoulders- right shoulder is slightly higher and shoulders are protracted
- Position and movements of the head- head is in a neutral position and no movement of the head can be seen
- Movements of the upper extremity- upper extremities move symmetrically moving crutches forward
- Stability of walking- she is stable when using crutches while walking

Gait pattern (according to Janda)- peroneal gait pattern

Abnormal gait– antalgic gait

3.3.10 Palpation of pelvis

Her spina illiaca anterior superior is lower on the left and spina illiaca posterior superior is also lower on the left side than on the right side. Also her left illiac crest is lower than the right illiac crest. There is an anterior tilt of the pelvis.

3.3.11 Palpation of muscles

MUSCLE	RIGHT	LEFT
Triceps surae	Hypertone	Hypertone
Vastus lateralis	Normal tone	Normal tone
Vastus medialis	Hypotone	Hypotone
Rectus femoris	Normal tone	Normal tone

Semimebranosus	Normal tone	Normal tone
Semitendinosus	Hypotone	Hypotone
Biceps femoris	Normal tone	Normal tone
Gluteus maximus	Normal tone	Normal tone
TFL	Hypertone	Hypertone
Adductors	Hypertone	Hypertone
Tibialis anterior	Hypertone	Hypertone

Table 9: Initial kinesiological examination- palpation of the lower extremity muscles

3.3.12 Fascia examination

	Right leg	**Left leg**
Upper leg	Anterior side: there are no restrictions felt into lateral and medial direction Posterior side: there are no restrictions felt into lateral and medial direction	Anterior side: there is a slight barrier to the lateral side, no restriction to the medial side Posterior thigh: there are no restrictions felt into medial and lateral direction
Lower leg	Anterior side: no restrictions felt into lateral and medial side Posterior side: no restrictions felt into lateral and medial side	Anterior side: slight barrier is felt into lateral and medial direction at the level of head of tibia Posterior side: slight barrier is felt into lateral and medial side in the middle of the calf

Table 10: Initial kinesiological examination- lower extremity fascia examination

3.3.13 Hypermobility

Knee joint- extension according to Sachse

Right: Grade B

Left: not possible to push the knee into extension due to pain

3.3.14 Joint play examination according to Lewit

Screening- both left and right patella are in a slight valgus position

Lateral gapping

Medial side

Right: not restricted

Left: not restricted

Lateral side

Right: not restricted

Left: not restricted

Patella

Cranial-caudal

Right: not restricted

Left: restricted

Latero-lateral

Right: not restricted

Left: not restricted

Head of fibula

Right: restricted in dorsal direction

Left: restricted in dorsal direction

3.3. 15 Painful points around the knee

Patellar tendon of the left knee is painful while palpated.

3.3.16 Breathing pattern

Breath in supine position is regular with equal pauses between each breath, thoracic breathing patten where most of the breathing movements can me seen in the thoracic area.

All breathing movements are symmetrical during the breathing wave

Breathing wave: abdomen, lower thorax and upper thorax

Frequency/regularity/ratio of inspiration: 1:2

3.3.17 Neurological examination

Patellar tendon reflex

Right: physiological

Left: physiological

Achilles tendon reflex

Right: physiological

Left: physiological

Sensation on the left and right leg is the same and as well around the scar the sensation is the same as on the other parts of the leg.

3.3.18 Soft tissue evaluation/scar evaluation

She has a scar under her left patella. Soft tissues around the scar are not restricted.

3.3.19 Conclusion of examination

Patient's left shoulder is lower than her right shoulder, she is putting more body weight on her right leg, her left knee is a little bit swollen and the contours of the muscles of the left lower extremity are smaller than the contours of the right lower extremity. The smaller contours of the muscles of the left lower extremity and putting more body weight on the right leg is due to anterior cruciate ligament reconstruction surgery which makes it painful for the patient to put more body weight on her left leg. The circumference of the left thigh from 15cm above the knee cap is 2 cm smaller because of the muscle atrophy and immobility of the left leg after surgery. The circumference of the left knee cap is 5 cm bigger due to swelling of the left knee joint after ACL reconstruction. The flexion of the left knee joint is limited to 60 degrees after the surgery. The two scale test shows more weight bearing on the right leg which menas that there is a 5kg difference between the right and left leg. She is using crutches for walking and she walks with a two-point gait pattern. She has an orthosis around her left knee. She is walking using short steps. Her triceps surae, tensor fasciae latae, adductor and tibialis anterior muscles are in hypertone and her vastus meidalis and semitendinosus muscles are in hypotone. Based on the fascia examination there is a slight barrier into lateral and medial direction on the upper part of the anterior side of the left leg and on the left lower leg there is a slight barrier felt into lateral and medial direction at the level of head of tibia, and on the posterior side of the lower left leg there is also a slight barrier elt into lateral and medial direction in the middle of the calf. Her right knee is hypermobile graded with grade B. Her both knees are in a valgus position. Her head of fibula on the left and right side is restricted into the dorsal direction and her left patella is restricted in cranial-caudal direction. Her left patellar tendon is painful while palpated due to performed surgery.

The patient's condition 4 weeks and a few days after the surgery is considered normal since she is told by the doctor to use crutches and also has a limit for knee flexion which is 60 degrees. Also the swelling around the knee joint which makes the circumference of the left knee cap bigger than the right knee cap is considered normal in this stage after ACL reconstruction.

3.4 Short-term and long-term physiotherapy plan

3.4.1 Short-term physiotherapy plan

- To improve range of motion of the left knee joint
- Getting rid of the left patella restriction in cranial-caudal direction
- To strengthen the lower extremity muscles
- To remove the restriction in the head of fibula in the dorsal direction
- To take care of the soft tissues around the scar to keep them not restricted
- Walking without crutches
- To decrease pain and inflammation in the left knee
- Fascia release on the left leg on the anterior side of the upper and lower leg and on the posterior side of the lower leg

3.4.2 Long-term physiotherapy plan

- To gain full range of motion of the left knee joint
- Getting back to cross-country skiing, running and playing basketball
- Improving the strength of the lower extremity muscles do have the symmetrical contours and same grade of strength on the right and left side
- Improving balance and proprioception
- Equal weight bearing of the right and left leg

3.5 Therapy progress

1st Session

Date: 17.01.2023

Status praesens objective: Patient's left knee is swollen and range of motion is limited. Patient has orthosis on her left knee and she is using crutches for walking.

Status praesens subjective: Patient is feeling good and is not complaining about pain.

Goal of today's therapeutic unit: Initial kinesiological examination and therapy according to the results of initial kinesiological examination.

Proposed therapy: Individual physiotherapy. Anamnesis, postural examination, anthropometric measurements, evaluation of active and passive range of motion, muscle length tests, muscle strength tests, gait analysis, palpation of pelvis, palpation of lower extremity muscles, hypermobility tests, joint play examination, evaluation of the breathing pattern, neurological examination and soft tissue evaluation. Strengthening of the lower extremity muscles.

Procedure (description of today's therapeutic unit): Asking the patient questions to take anamnesis, postural examination from the anterior, posterior and lateral view, evaluation of the active and passive range of motion using a goniometer, muscle length tests according to Janda, muscle strength tests according to Kendall, analysing the gait pattern, palpation of pelvis, palpation of lower extremity muscles to determine the tone of the muscles, joint play examination of the patella and head of fibula, evaluation of the breathing pattern, neurological examination for deep tendon reflexes and sensation and soft tissue evaluation around the scar on the left knee. Active exercises to strengthen the lower extremity muscles. Active flexion of the left knee, active flexion of the left and right knee against resistance. Extension of the right and left knee with an overball under the knee. Hip raises with legs on the big gymball. In sitting active extension of the knee with an elastic band around the ankle with both legs.

Results (of today's therapeutic unit)- objective: Based on the initial kinesiological examination tests were made and goals were set for the upcoming treatment.

Results (of today's therapeutic unit)- subjective: Patient does not feel any additional pain after examination and exercising and she is looking forward to the upcoming therapy.

Self-therapy: Patient was not instructed with self-therapy.

2nd Session

Date: 20.01.2023

Status praesens objective: Patient's left knee is swollen and range of motion is limited. Patient has orthosis on her left knee and she is using crutches for walking.

Status praesens subjective: Patient is feeling good and is not complaining about pain or unusual discomfort.

Goal of today's therapeutic unit: Improving the range of motion of the left knee into flexion and extension. Improving the strength of the lower extremity muscles on the right and left side. Maintaining and improving the movement of the soft tissues around the scar. Getting rid of the joint play restriction in the left patella in the cranial-caudal direction and in the left and right head of fibula. Fascia release on the left upper and lower leg.

Proposed therapy: Individual physiotherapy. Active exercises to improve the range of motion of the left knee into flexion and extension using body weight, overball and gymball. Joint play examination for the left patella and for the head of fibula on the both sides. Scar massage. Fascia release.

Procedure (description of today's therapeutic unit): Scar massage for the scar after ACL reconstruction. Scar massage around the scar in C- shape and in S-shape and spirals on the sides of the scar towards the scar. Fascia release in the medial and lateral direction on the anterior side of the left upper and lower leg and on the posterior side of the left lower leg. Patella mobilization in cranial-caudal direction and mobilization of

the head of fibula on the left and right side in ventral-dorsal direction. Active exercises to strengthen the lower extremity muscles. Active flexion of the left knee, active flexion of the left and right knee against resistance. Extension of the right and left knee with an overball under the knee. Hip raises with legs on the big gymball. In prone lifting up one leg at a time with knee bent on the right and left side. In prone lifting the legs up from the table by lifting up the toes (by doing plantar flexion). In supine both knees bent squeezing legs togerther while holding an overball between the knees. In sitting active extension of the knee with an elastic band around the ankle with both legs.

Results (of today's therapeutic unit)- objective: There was no blockage of the head of fibula on the right and left side in the ventral-dorsal direction and also the blockage in the left patella in cranial-caudal direction was moved. There was a fascia release on the anterior side of the left upper leg and on the posterior side of the left lower leg.

Results (of today's therapeutic unit)- subjective: Patient said that by the end of the therapy flexion of the left knee felt more comfortable for her.

Self-therapy: Patient was not instructed with self-therapy.

3rd Session

Date: 23.01.2023

Status praesens objective: Patient's left knee is swollen and range of motion is limited. Patient has orthosis on her left knee and she is using crutches for walking.

Status praesens subjective: Patient complained about slight pain in the left knee which she could feel in the morning after waking up for a short period of time. She graded the pain 2 on a scale from 1 to 10.

Goal of today's therapeutic unit: Improving the range of motion of the left knee into flexion and extension. Improving the strength of the lower extremity muscles on the right and left side. Maintaining and improving the movement of the soft tissues around the scar. Fascia release on the left upper and lower leg.

Proposed therapy: Individual physiotherapy. Active exercises to improve the range of motion of the left knee into flexion and extension using body weight, overball and gymball. Joint play examination for the left patella and for the head of fibula on the both sides. Scar massage. Fascia release.

Procedure (description of today's therapeutic unit): Scar massage for the scar after ACL reconstruction. Scar massage around the scar in C- shape and in S-shape and spirals on the sides of the scar towards the scar. Fascia release in the medial and lateral direction on the anterior side of the left upper and lower leg and on the posterior side of the left lower leg. Active exercises to strengthen the lower extremity muscles. Active flexion of the left knee, active flexion of the left and right knee against resistance. Extension of the right and left knee with an overball under the knee. Hip raises with legs on the big gymball. In prone lifting up one leg at a time with knee bent on the right and left side. In prone lifting the legs up from the table by lifting up the toes (by doing plantar flexion). In supine both knees bent squeezing legs together while holding an overball between the knees. In sitting active extension of the knee with and without an elastic band around the ankle with both legs. In sitting extension of the knee with small pulses right before reaching the maximal range of motion. In standing extension of the hip with the left leg with a rubber band around the left leg.

Results (of today's therapeutic unit)- objective: Patient's flexion of the knee looked more fluent and confident by the end of the therapy session. There was a fascia release on the anterior side of the left upper and lower leg and on the posterior side of the left lower leg.

Results (of today's therapeutic unit)- subjective: Patient said that she felt her lower extremity muscles (especially hamstrings) being a little tired but she does not feel any pain around the left knee.

Self-therapy: Patient was instructed how to take care of the soft tissues around the scar by using C-shape and S-shape movements. She was also instructed to use an icepack for 10-15 minutes at the time on the left knee to decrease swelling.

4th Session

Date: 25.01.2023

Status praesens objective: Patient's left knee is still a little bit swollen and range of motion is limited. Patient is not wearing orthosis around her left knee any more. She is still using crutches to move around.

Status praesens subjective: Patient stopped using orthosis after the doctor let her to do so. She has no pain but she says that with an orthosis she is more careful about her left knee while walking.

Goal of today's therapeutic unit: Improving the range of motion of the left knee into flexion and extension. Improving the strength of the lower extremity muscles on the right and left side. Maintaining and improving the movement of the soft tissues around the scar. Relaxation of the hypertone adductor muscles on the left and right side.

Proposed therapy: Individual physiotherapy. Active exercises to improve the range of motion of the left knee into flexion and extension using body weight, overball and gymball. Joint play examination for the left patella and for the head of fibula on the both sides. Scar massage. PIR for the hypertone adductor muscles.

Procedure (description of today's therapeutic unit): Scar massage for the scar after ACL reconstruction. Scar massage around the scar in C- shape and in S-shape and spirals on the sides of the scar towards the scar. Active exercises to strengthen the lower extremity muscles. Active flexion of the left knee, active flexion of the left and right knee against resistance. Extension of the right and left knee with an overball under the knee. Hip raises with legs on the big gymball. In prone lifting up one leg at a time with knee bent on the right and left side. In prone lifting the legs up from the table by lifting up the toes (by doing plantar flexion). In supine both knees bent squeezing legs togerther while holding an overball between the knees. In sitting active extension of the knee with an elastic band around the ankle with both legs. In sitting extension of the knee with small pulses right before reaching the maximal range of motion. In standing extension of the hip with the left leg with a rubber band around the left leg. PIR with stretch for the adductor muscles whisch was repeated 3 times on both sides.

Results (of today's therapeutic unit)- objective: The active flexion of the knee reached 100 degrees without pain and after PIR the range of motion of the adductor muscles was bigger compared to what it was before PIR.

Results (of today's therapeutic unit)- subjective: Patient's lower extremity muscles felt tired after exercising and she was satisfied with the way how the flexion of the left knee joint has improved.

Self-therapy:

Patient was instructed with following exercises:

- Active flexion of the left knee joint in supine holding heel on the overball. Repeat 3x15 times
- Active extension of the knee joint in supine pushing the knee into table. Repeat 3x10 times
- In supine holding knees on a gymball and raising up the pelvis. Repeat 3x10 times

5th Session

Date: 27.01.2023

Status praesens objective: Patient's knee is a little bit swollen. She is not wearing orthosis any more and she entered the room without using crutches.

Status praesens subjective: Patient said that she is trying not to use crutches while walking shorter distances and she can only feel pain at the end of the motion when she is trying to flex her left knee into maximal flexion.

Goal of today's therapeutic unit: Improving the range of motion of the left knee into flexion and extension. Improving the strength of the lower extremity muscles on the right and left side. Maintaining and improving the movement of the soft tissues around the scar. Scar massage to maintain and improve the condition of the soft tissues

around the scar. Balance training to improve the gait pattern and help to put body weight equally on the right and left leg.

Proposed therapy: Individual physiotherapy. Active exercises to improve the range of motion of the left knee into flexion and extension using body weight, overball and gymball. Scar massage. Balance training using a soft mat and her own body weight.

Procedure (description of today's therapeutic unit): Scar massage for the scar after ACL reconstruction. Scar massage around the scar in C- shape and in S-shape and spirals on the sides of the scar towards the scar. Active exercises to strengthen the lower extremity muscles. Active flexion of the left knee, active flexion of the left and right knee against resistance. Extension of the right and left knee with an overball under the knee. Hip raises with legs on the big gymball. In prone lifting up one leg at a time with knee bent on the right and left side. In prone lifting the legs up from the table by lifting up the toes (by doing plantar flexion). In supine both knees bent squeezing legs togerther while holding an overball between the knees. In sitting active extension of the knee with an elastic band around the ankle with both legs. In standing holding on to a handle and trying to move body weight from right leg to the left leg. Barefoot stepping on a soft mat with both legs and then stepping back down. Standing on the right leg on a stable surface and standing on the right leg on a soft mat.

Results (of today's therapeutic unit)- objective: Patient's active flexion of the left knee joint is improved to 110 degrees of flexion with a slight pain that she can feel at the end of the movement.

Results (of today's therapeutic unit)- subjective: Patient said that she can feel her flexion of the knee to be more fluent and balance exercises gave her more confidence for walking without crutches.

Self-therapy:

Patient was instructed with following exercises:

- Active flexion of the left knee joint in supine holding heel on an overball. Repeat 3x15 times

- Active extension of the knee joint in supine pushing the knee into table. Repeat 3x10 times
- In supine holding knees on a gymball and raising up the pelvis. Repeat 3x10 times

6th Session

Date: 30.01.2023

Status praesens objective: Patient's knee is not swollen any more and she is not using crutches.

Status praesens subjective: Patient said that she almost does not feel pain at all any more while flexing the knee and walking without crutches has got more comfortable for her.

Goal of today's therapeutic unit: Improving the range of motion of the left knee into flexion and extension. Improving the strength of the lower extremity muscles on the right and left side. Maintaining and improving the movement of the soft tissues around the scar. Balance training to improve the gait pattern.

Proposed therapy: Individual physiotherapy. Active exercises to improve the range of motion of the left knee into flexion and extension using body weight, overball and gymball. Joint play examination for the left patella and for the head of fibula on the both sides. Scar massage.

Procedure (description of today's therapeutic unit): Scar massage for the scar after ACL reconstruction. Scar massage around the scar in C- shape and in S-shape and spirals on the sides of the scar towards the scar. Active exercises to strengthen the lower extremity muscles. Active flexion of the left knee, active flexion of the left and right knee against resistance. Extension of the right and left knee with an overball under the knee. Hip raises with legs on the big gymball. In prone lifting up one leg at a time with knee bent on the right and left side. In prone lifting the legs up from the table by lifting up the toes (by doing plantar flexion). In supine both knees bent squeezing legs togerther while holding an overball between the knees. In sitting active extension of the

knee with an elastic band around the ankle with both legs. Balance exercises which include standing on one leg, on right and left leg. Stepping on a soft mat with both legs and stepping back down. Standing on a one leg on a soft mat.

Results (of today's therapeutic unit)- objective: Patient is able to put body weight on the operated leg without being scared about it and her flexion of the left knee has improved to 115 degrees.

Results (of today's therapeutic unit)- subjective: She is not feeling pain any more at the end of the flexion of the knee.

Self-therapy:

Patient was instructed with following exercises:

- In sitting theraband around the ankle extension of the knee joint. Repeat 3-10 times
- In standing with theraband around the ankle flexion of the knee joint while holding the chair with both hands. Repeat 3x10 times
- In prone with theraband around the ankle flexion of the knee. Repeat 3x10 times
- In prone with knee bent 90 degrees lifting up a leg. Repeat 3x10 times

7th Session

Date: 31.01.2023

Status praesens objective: Patient is walking without orthosis and crutches and her gait pattern has improved by the way that she is able to put more body weight on the operated leg.

Status praesens subjective: Patient's left knee is not hurting and she finds walking easier and more comfortable for herself with every day.

Goal of today's therapeutic unit: Improving the range of motion of the left knee into flexion and extension. Improving the strength of the lower extremity muscles

on the right and left side. Maintaining and improving the movement of the soft tissues around the scar. Balance training to improve balance and gait pattern.

Proposed therapy: Individual physiotherapy. Active exercises to improve the range of motion of the left knee into flexion and extension using body weight, overball and gymball. Joint play examination for the left patella and for the head of fibula on the both sides. Scar massage. Balance training using body weight and unstable surfaces.

Procedure (description of today's therapeutic unit): Scar massage for the scar after ACL reconstruction. Scar massage around the scar in C- shape and in S-shape and spirals on the sides of the scar towards the scar. Active exercises to strengthen the lower extremity muscles. Active flexion of the left knee, active flexion of the left and right knee against resistance. Extension of the right and left knee with an overball under the knee. Hip raises with legs on the big gymball. In prone lifting up one leg at a time with knee bent on the right and left side. In prone lifting the legs up from the table by lifting up the toes (by doing plantar flexion). In supine both knees bent squeezing legs together while holding an overball between the knees. In sitting active extension of the knee with an elastic band around the ankle with both legs. Balance exercises which include standing on one leg, on right and left leg. Stepping on a soft mat with both legs and stepping back down. Standing on a one leg on a soft mat. Standing on a one leg and trying to reach firther away into 4 different directions with the other leg.

Results (of today's therapeutic unit)- objective: Patient is able to stand on one leg for a longer period of time. The active flexion of the left knee is 115 degrees.

Results (of today's therapeutic unit)- subjective: Patient does not feel any pain and she is happy with the improvements that she has made.

Self-therapy:

Patient was instructed with following exercises:

- In sitting theraband around the ankle extension of the knee joint. Repeat 3-10 times
- In standing with theraband around the ankle flexion of the knee joint while holding the chair with both hands. Repeat 3x10 times

- In prone with theraband around the ankle flexion of the knee. Repeat 3x10 times
- In prone with knee bent 90 degrees lifting up a leg. Repeat 3x10 times

8th Session

Date: 03.02.2023

Status praesens objective: Patient is walking without crutches and orthosis and she is using longer steps for walking.

Status praesens subjective: Patient's knee does not hurt and she able to walk longer distances.

Goal of today's therapeutic unit: Final kinesiological examination and to improve balance. Fascia release on the left upper and lower leg.

Proposed therapy: Individual physiotherapy. Postural examination, anthropometric measurements, evaluation of active and passive range of motion, muscle length tests, muscle strength tests, gait analysis, palpation of pelvis, palpation of lower extremity muscles, hypermobility tests, joint play examination, evaluation of the breathing pattern, neurological examination and soft tissue evaluation. Fascia release. Balance training using body weight and unstable surfaces.

Procedure (description of today's therapeutic unit): Scar massage for the scar after ACL reconstruction. Scar massage around the scar in C- shape and in S-shape and spirals on the sides of the scar towards the scar. Fascia release in the medial and lateral direction on the anterior side of the left upper and lower leg and on the posterior side of the left lower leg. Balance exercises which include standing on one leg, on right and left leg. Stepping on a soft mat with both legs and stepping back down. Standing on a one leg on a soft mat. Standing on a one leg and trying to reach firther away into 4 different directions with the other leg. Postural examination from the anterior, posterior and lateral view, evaluation of the active and passive range of motion using a goniometer, muscle length tests according to Janda, muscle strength tests according to Kendall, analysing the gait pattern, palpation of pelvis, palpation of lower extremity muscles to

determine the tone of the muscles, joint play examination of the patella and head of fibula, evaluation of the breathing pattern, neurological examination for deep tendon reflexes and sensation and soft tissue evaluation around the scar on the left knee.

Results (of today's therapeutic unit)- objective: The active flexion of the knee joint has increased from 115 degrees to 130 degrees and there is no swelling of the left knee joint. There was a fascia release on the anterior side of the left upper and lower leg and on the posterior side of the left lower leg.

Results (of today's therapeutic unit)- subjective: Patient feels that her stability has improved.

Self-therapy:

Patient was instructed with following exercises:

- In sitting theraband around the ankle extension of the knee joint. Repeat 3-10 times
- In standing with theraband around the ankle flexion of the knee joint while holding the chair with both hands. Repeat 3x10 times
- In prone with theraband around the ankle flexion of the knee. Repeat 3x10 times
- In prone with knee bent 90 degrees lifting up a leg. Repeat 3x10 times

3.6 Final kinesiological examination

3.6.1 Postural examination

Posterior view

- The base of support- moderate base of support
- Shape and contours of the heels- symmetrical, right and left heel are both in rounded shape
- Shape and position of the ankle joints- ankle joints are in a neutral position and symmetrical
- Shape and thickness of the Achilles tendon- both achilles tendons are falling slightly inwards
- Contour of the calf muscles- medial contour of the calf muscles is more prominent than the lateral contour of the calf muscles. Contour of the right calf muscles is more prominent
- Shape and position of the knee joints- knee joints are slightly in a valgus position
- Popliteal line- symmetrical
- Contour of the thigh muscles- right thigh muscle appears to be bigger than the left one. Lateral part of the left thigh muscle seems to be more prominent than the medial part.
- Subgluteal line- subgluteal lines are symmetrical and on the same level
- Gluteal muscles- symmetrical
- Symmetry of thoracobrachial triangles- symmetrical
- Position of pelvis- anterior tilt of the pelvis
- Paravertebral muscles- symmetrical

- Curvature of the spine in the frontal plane- the spine is in a neutral position lordotic curve of the cervical and lumbar spine and kyphotic curve of the thoracic spine
- Position of the scapula – medial border of the scapulas is more prominent
- Position of the shoulder girdle- left shoulder is lower than the right shoulder
- Position of the upper limb- upper limbs are symmetrical in length
- Position and contour of the nuchal muscles- neutral position
- Position of the head: head slightly in a forward position

Anterior view

- The base of support- moderate base of support
- The position of the feet, examination of the arches – there are neutral arches under the feet
- The position and shape of the toes- normal angle of toes, no hallux valgus of big toes
- Weight distribution: body weight is slightly more on the right foot
- Shape and position of the knee joints- left and right knee are in a slight valgus position
- Configuration of m. tibialis anterior- symmetrical
- Contour of the calf muscles- calf muscles of the right leg are more prominent than the calf muscles of the left leg
- Shape of the thigh muscles- right thigh muscle appears to be bigger than the left one. On both legs, lateral contours are more prominent than medial contours.
- Position of the pelvis- anterior tilt of pelvis

- Symmetry of the muscle tone of abdominal muscles- abdominal muscles on the right and left side are symmetrical
- Position of the navel- the navel is in a neutral position
- Symmetry of thoracobrachial triangles - symmetrical
- Position of the collarbones and superclavicular holes- symmetrical
- Position of the shoulder girdle- left shoulder is slightly higher than the right shoulder
- Position of the upper limbs- upper limbs are symmetrical in the length.
- Position of the head- face is symmetrical and head is in a slight forward position

Lateral view- right and left side

- Weight distribution- weight distribution is slightly more on the right foot
- Shape and position of the ankle joints- ankle joints are symmetrical and in a neutral position
- Shape and contour of the shin- shins are symmetrical
- Position of the knee joints- knees are in a slight valgus position
- Contour of the thigh muscles- anterior contours of the right and left thigh muscles are more prominent than the posterior contours
- Position of the pelvis– anterior tilt of the pelvis
- Position and curvature of the L, L/Th and Th spine- lumbar spine has a lordotic curve and thoracic spine has a kyphotic curve
- Shape of the abdominal muscles- abdominal muscles are symmetrical
- Position of the shoulder girdle- shoulders are in a protracted position

- Position and curvature of the Th/C and C spine- cervical spine is in a neutral position
- Position of the head- head is slightly in a forward position

3.6.2 Anthropometric measurements

MEASUREMENT	RIGHT	LEFT
Anatomical length of leg	82 cm	82 cm
Functional length of leg	83 cm	83 cm
Length of thigh	45 cm	46 cm
Length of middle leg	37 cm	37 cm
Length of the foot	23 cm	23 cm
Circumference of the thigh- 10cm above the knee cap	43 cm	42 cm
Circumference of the thigh- 15cm above the knee cap	46 cm	45 cm
Circumference of the knee cap	33 cm	35 cm
Circumference of tuberositas tibiae	32 cm	32 cm
Circumference of the calf	34 cm	33 cm
Circumference of the ankle joint	23 cm	23 cm
Circumference of the heel	28 cm	28 cm
Circumference of the foot	20 cm	20 cm

Table 11: Final kinesiological examination- anthropometric measurements (cm)

3.6.3 Goniometry

HIP JOINT

Hip joint- active range of motion

HIP JOINT	RIGHT	LEFT
Extension- flexion	S: 135-0-25	S: 135-0-25
Abduction- adduction	F: 45-0-30	F: 45-0-30
External rotation- internal rotation	R: 55-0-40	R: 55-0-40

Table 12: Final kinesiological examination- goniometry of active range of motion of the hip joint

Hip joint- passive range of motion

HIP JOINT	RIGHT	LEFT
Extension- flexion	S: 135-0-30	S: 135-0-30
Abduction- adduction	F: 50-0-30	F: 50-0-30
External rotation- internal rotation	R: 55-0-45	R: 55-0-40

Table 13: Final kinesiological examination- goniometry of passive range of motion of the hip joint

KNEE JOINT

Knee joint- active range of motion

KNEE JOINT	RIGHT	LEFT
Extension- flexion	S: 5-0-160	S: 0-0-130

Table 14: Final kinesiological examination- goniometry of active range of motion of the knee joint

Knee joint- passive range of motion

KNEE JOINT	RIGHT	LEFT
Extension- flexion	S: 10-0-160	S: 0-0-135

Table 15: Final kinesiological examination- goniometry of passive range of motion of the knee joint

ANKLE JOINT

Ankle joint- active range of motion

ANKLE JOINT	RIGHT	LEFT
Dorsal flexion- palmar felxion	S: 20-0-45	S: 20-0-45
Eversion- inversion	R: 15-0-40	R: 15-0-40

Table 16: Final kinesiological examination- goniometry of active range of motion of the ankle joint

Ankle joint- passive range of motion

ANKLE JOINT	RIGHT	LEFT
Dorsal flexion- palmar felxion	S: 25-0-50	S: 25-0-50
Eversion- inversion	R: 20-0-45	R: 20-0-45

Table 17: Final kinesiological examination- goniometry of passive range of motion of the ankle joint

3.6.4 Vele test

Right- grade 0

Left- grade 0

3.6.5 Romberg test

Romberg I- negative

Romberg II- negative

Romberg III- negative

3.6.6 Two-scale test

Right leg- 31.5 kg

Left leg- 29.5 kg

3.6.7 Muscle length test

Hip flexors (according to Janda)

Right: 0

Left: 0

Hip adductor muscles according to Janda

Right: 0

Left: 0

Hamstrings according to Janda

Right: no shortness

Left: no shortness

Ankle plantar flexors according to Janda

Right: 0

Left: 0

3.6.8 Muscle strength test (according to Kendall)

MUSCLE	RIGHT	LEFT
Gluteus maximus	5	5
Gluteus medius	5	5
Gluteus minimus	5	5
Quadriceps femoris	5	5
Hip adductors	5	5
Lateral rotators of the hip	5	5
Medial rotators of the hip	5	5
Medial hamstrings	5	5
Lateral hamstrings	5	5
Psoas major	5	4
TFL	4	4
Triceps surae	5	5

Table 18: Final kinesiological examination- lower extremity muscle strength test

3.6.9 Gait analysis

- Width of the base of support- moderate base of support
- Position of the feet- right and left foot are in a neutral position
- Walking rhythm- periodic
- Walking speed- moderate
- Stride length- longer steps

- Movement of the foot- her heel touches the ground first, secondly her whole foot touches the ground, and the last part of foot touching the ground is the big toe, while stepping forward her COG is moving forward
- Axial position of the lower limb- left knee stays in slight flexion
- Movement and position of the knee and hip- left knee stays in slight flexion due to an ACL reconstruction and also right knee is not fully extended while walking.
- Position and movements of the pelvis- there ise a lateral tilt of the pelvis but not more than 4cm
- Movement of centre of gravity- centre of gravity is moving only slightly from side to side and up and down
- Position and movements of the trunk- trunk is slightly rotating
- Activity of abdominal muscles- no visible activity of the abdominal muscles
- Position of spine- the spinal column curves from one side to other in waves. Hyperlordosis of the lumbar sine.
- Activity of back muscles- the most movement of the back muscles can be seen in the area of the thoracic spine
- Position of shoulder- right shoulder is slightly higher and shoulders are protracted
- Position and movements of the head- head is in a neutral position and no movement of the head can be seen
- Movements of the upper extremity- upper extremities move symmetrically moving crutches forward
- Stability of walking- she is stable while walking

Gait pattern (according to Janda)- peroneal gait pattern

3.6.10 Palpation of pelvis

Her spina illiaca anterior superior is lower on the left and spina illiaca posterior superior is also lower on the left side than on the right side. Also her left illiac crest is lower than the right illiac crest. There is an anterior tilt of the pelvis.

3.6.11 Palpation of muscles

MUSCLE	RIGHT	LEFT
Triceps surae	Hypertone	Hypertone
Vastus lateralis	Normal tone	Normal tone
Vastus medialis	Normal tone	Normal tone
Rectus femoris	Normal tone	Normal tone
Semimebranosus	Normal tone	Normal tone
Semitendinosus	Norma tone	Normal tone
Biceps femoris	Normal tone	Normal tone
Gluteus maximus	Normal tone	Normal tone
TFL	Hypertone	Hypertone
Adductors	Hypertone	Hypertone
Tibialis anterior	Hypertone	Hypertone

Table 19: Final kinesiological examination- lower extremity palpation of muscles

3.6.12 Fascia examination

	Right leg	Left leg
Upper leg	Anterior side: there are no restrictions felt into lateral and medial direction Posterior side: there are no restrictions felt into lateral and medial direction	Anterior side: there are no restrictions felt into lateral and medial direction Posterior thigh: there are no restrictions felt into medial and lateral direction
Lower leg	Anterior side: no restrictions felt into lateral and medial side Posterior side: no restrictions felt into lateral and medial side	Anterior there are no restrictions felt into lateral and medial direction Posterior side: there are no restrictions felt into lateral and medial direction

Table 20: Final kinesiological examination- lower extremity fascia examination

3.6.13 Hypermobility

Knee joint- extension according to Sachse

Right: Grade B

Left: Grade B

3.6.14 Joint play examination

Screening- both left and right patella are in a slight valgus position

Lateral gapping

Medial side

Right: not restricted

Left: not restricted

Lateral side

Right: not restricted

Left: not restricted

Patella

Cranial-caudal

Right: not restricted

Left: restricted

Latero-lateral

Right: not restricted

Left: not restricted

Head of fibula

Right: not restricted

Left: not restricted

3.6.15 Pain points on the knee

Patellar tendon on the left knee is painful while palpated.

3.6.16 Breathing pattern

Breath is regular with equal pauses between each breath, thoracic breathing patten where most of the breathing movements can me seen in the thoracic area.

- All breathing movements are symmetrical during the breathing wave
- Breathing wave: abdomen, lower thorax and upper thorax
- Frequency/regularity/ratio of inspiration: 1:2

3.6.17 Neurological examination

Patellar tendon reflex

Right: physiological

Left: physiological

Achilles tendon reflex

Right: physiological

Left: physiological

Sensation on the left and right leg is the same and as well around the scar the sensation is the same as on the other parts of the leg.

3.6.18 Soft tissue evaluation/scar evaluation

She has a scar under her left patella. Soft tissues around the scar are not restricted.

3.6.19 Conclusion of examination

Patient's left shoulder is lower than her right shoulder, she is putting slightly more body weight on her right leg, her left knee is little bit swollen and the contours of the muscles of the left lower extremity are smaller than the contours of the right lower extremity. The smaller contours of the muscles of the left lower extremity and putting more body weight on the right leg is due to anterior cruciate ligament reconstruction

surgery. The circumference of the left thigh from 15cm above the knee cap is 1 cm smaller and the circumference of the left thigh from 10cm above the knee cap is also 1cm smaller, and the circumference of the left calf is 1cm smaller than the right calf because of the muscle atrophy and immobility of the left leg after surgery. The circumference of the left knee cap is 2cm bigger due to slight swelling of the left knee joint after ACL reconstruction. Active flexion of the left knee joint is 130 degrees and passive range of motion of the left knee joint into flexion is 135 degrees. The left knee joint moves 0 degrees into extension during passive range of motion and 0 degrees into extension during active range of motion. There is 2 kg difference between the weight bearing of the right and left leg where the right leg is bearing more weight. Her triceps surae, tensor fasciae latae, adductor and tibialis anterior muscles are in hypertone. Her right knee is hypermobile graded with grade B according to Sachse. Her both knees are in a valgus position. Her strength of the TFL muscle is graded with grade 4 on right and left side and her psoas major is graded with grade 4 on the left side. Based on the joint play examination the left patella is still slightly restricted in the cranial-caudal direction but less compared to the initial kinesiological examination. Her left patellar tendon is painful while palpated due to performed surgery. When it comes to the gait analysis then patient is not using crutches any more for walking and she is using longer steps. She is also not using orthosis any more and she has no limitation set by the doctor for the range of motion of the knee joint.

3.7 Evaluation of the effect of therapy

The patient made significant improvements during the three week therapy. For example her gait pattern, range of motion, and lower extremity strength improved. The results were seen objectively and also subjectively by the patient. Here is a table with objective improvements during the therapy period.

	Initial kinesiological examination- 17.01.2023	**Final kinesiological examination- 03.02.2023**
Gait pattern	• More body weigh ton the right leg • Limping • Slow walking speed • Antalgic gait pattern • Walking with crutches and orthosis	• Almost equal weight bearing on the right and left leg • Normal walking speed • Physiological gait pattern Walking without crutches and orthosis
Anthropometric measurements (left leg)	• Circumference of the knee cap- 15cm above the knee cap: 44cm • Circumference of the knee cap: 38cm	• Circumference of the knee cap- 15cm above the knee cap: 45cm • Circumference of the knee cap: 35cm
AROM of the left knee joint (left leg)	S: 0-0-60	S: 0-0-130
PROM of the left knee joint (left leg)	S: 0-0-60	S: 0-0-135
Two-scale test	Right leg- 33kg Left leg- 28kg	Right leg- 31.5kg Left leg- 29.5kg
Muscle strength	• Gluteus maximus- 4	• Gluteus maximus- 5

test (left leg)	• Gluteus medius- 4 • Gluteus minimus- 4 • Quadriceps femoris- 4 • Hip adductors- 4 • Medial hamstring- 4 • Lateral hamstrings- 4	• Gluteus medius- 5 • Gluteus minimus- 5 • Quadriceps femoris- 5 • Hip adductors- 5 • Medial hamstring- 5 • Lateral hamstrings- 5
Muscle palpation (left leg)	• Vastus medialis- hypotone • Semitendinosus- hypotone	• Vastus medialis- normal tone • Semitendinosus- normal tone
Fascia examination (left leg)	• Anterior side of the upper leg: slight barrier to the lateral direction • Anterior side of the lower leg: slight barrier to the lateral and medial direction at the level of the head of tibia • Posterior side of the lower leg: slight barrier into lateral and medial direction in the middle of the calf	• Anterior side of the upper leg: no barrier felt into lateral and medial direction • Anterior side of the lower leg: no barrier felt into lateral and medial direction • Posterior side of the lower leg: no barrier felt into lateral and medial direction
Joint play (left leg)	• Patella- restricted in cranial-caudal direction • Head of fibula- restricted in dorsal direction	• Patella- no restriction • Head of fibula- no restriction

Table 21: Evaluation of the effect of therapy- comparison of initial and final kinesiological examination results

During the rehabilitation there were significant improvements seen in gait pattern, anthropometric measurements, active and passive range of motion, two-scale test, muscle strength test, muscle palpation results, fascia examination results and in joint play following ACL reconstruction surgery. The biggest improvements were seen after patient was allowed to flex her knee over 60 degrees being able to walk without crutches and orthosis and being able to do more exercises to improve strength, balance and proprioception. The patient stayed positive and motivated during the whole course of the rehabilitation programme being goal oriented and really wanting to get back to doing sports.

4. DISCUSSION

The patient after an artificial ACL reconstruction had an eight therapy sessions as an outpatient. The patient was a month and a few days after an ACL reconstruction surgery. The therapy process consisted of initial kinesiological examination, day to day therapies and a final kinesiological examination. The main techniques used were active exercises and manual therapy.

At the beginning of the therapy the patient was limping, using crutches, wearing orthosis, and had more body weight on her right leg. Her flexion of the left knee was limited to 60 degrees and her left knee was swollen. Her gluteus muscles were graded with grade 4 and there was a restriction of patella into cranial-caudal direction. The head of fibula was restricted in dorsal direction.

During the day to day therapies active exercises to strengthen the lower extremity muscles were used, especially isometric contraction of muscles surrounding the knee joint in the beginning of the therapy. In addition to that scar massage, stability exercises, PIR with stretch, fascia release, joint play treatment were performed.

All the therapeutic methods used during the 6-8 weeks after the surgery brought very good results in terms of increased range of motion of the knee joint, better gait pattern, less pain and decreased swelling around the knee joint, strengthened lower extremity muscles and better stability. Due to increased range of motion and strengthened lower extremity muscles, less pain and swelling and better stability the patient's gait pattern was improved and she was able to walk with longer steps, putting almost equal amount of weight on both legs and she was not using crutches or orthosis and her step length was also longer compared to the beginning of the therapy. In a study (Winiarski & Czamara, 2012) it was also found that between 6 and 8 weeks after the ACL surgery the patient gained significant improvements in gait velocity, step frequency, and step length compared to the first few weeks after the surgery. They also found out the following physiotherapy treatments significant improvements were noted in the range of motion of the affected knee.

The patient's therapy progress was very good, all the set short-term physiotherapy goals were achieved. In the future I would also like to use an anti-gravity treadmill after an ACL surgery to improve the gait pattern, walk up and down the hill and to be able to train running. As stated in a study by Vincent et al. (2022) using an antigravity treadmill for people who have a background in running can help to reduce the adverse effects of deconditioning during recovery. In addition to examining the joint play of the knee I would also examine the joint play of the foot, and I would use PNF technique for strengthening of the lower extremity muscles.

5. CONCLUSION

The patient came to physiotherapy at Medicentrum Praha as an outpatient after an artificial ACL reconstruction. I worked with the patient for 8 therapy sessions. During the therapy process some of the main goals were for example to improve range of motion, balance, and strength of the affected knee joint. Significant improvements were seen based on the final kinesiological examination.

Objectively the patients range of motion of the affected knee increased, muscle strength of the lower extremities was improved, gait pattern was corrected, the knee was less swollen and her balance was improved. The patient stayed motivated during the whole therapy period.

Subjectively the patient felt that she is more confident in all the movements that she needs to do during the day compared to the beginning of the treatment and she almost feels no pain in the knee. She was happy to be able to use her affected knee almost normally again and also felt more confident in stability exercises. She promised to keep working on her affected knee by doing exercises that were given to her so that she could go back to doing sports.

During the therapy process I learned more about working with a patient by myself, and how to plan therapy sessions in order to achieve all the goals set for each therapy session. In the future when treating a person that really wants to get back to doing sports I would also like to use a gym to keep them even more motivated and to help them see that it is possible to get back to doing sports.

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