Charles University

Faculty of Physical Education and Sport

Department of Physiotherapy

Case study of Physiotherapy Treatment of a Patient after Anterior Cruciate Ligament Reconstruction

Bachelor Thesis

Supervisor:

doc. PaedDr. Dagmar Pavlů, CSc.

Author:

Georgina Collin

Prague, 2020

Declaration

I hereby declare that this bachelor thesis was entirely written by myself based on the Clinical Work Placement which took place in Centrum Léčby Pohybového Aparátu, from the 1st of June until the 19th of June 2020. All the information taken for the purpose of writing this bachelor thesis has been listed at the end of it.

I declare that no invasive methods were used during the therapy period and that the patient was fully aware of the procedures and techniques we were following.

Georgina Naomi Collin

Prague, July 2020

Acknowledgements

I would like to thank my parents for their support; in my studies and my sport. Thank you for helping me live a big life.

My coach, Zlatan, for always telling me I am strong enough to do anything I put my mind to.

My practice supervisor in CLPA, Martina Damborova, for being incredibly kind and helpful.

My in faculty supervisor, Dr Dagmar Pavlů, for her advice and help.

All my classmates over the years, I have made friends I know I will carry with me for the rest of my life.

Abstract

Title: Case study of Physiotherapy Treatment of a Patient after Anterior Cruciate Ligament Reconstruction

Thesis Aim: This thesis is divided into two sections, the theoretical section and practical section. In the theoretical section I will explore the anatomy, kinesiology and biomechanics of the knee joint, followed by specifics about the Anterior Cruciate ligament. In the practical section I present the case study with the initial examinations, therapy progress and final examinations. Finally, I evaluated the effectiveness of my applied therapy.

Method: The rehabilitation plan involved 10 therapies over a 4 week period where I was working alongside my patient with the help and expertise of my supervisor Mgr. Martina Damborova. All treatments and examinations applied are based on the knowledge I have gained in the last 4 years at the Faculty of Sport and Physical Education, Charles University. Examinations applied include, but are not limited to, postural and gait examinations, muscle length and strength examinations, active and passive range of motion. Therapies applied include; joint mobilization, post-isometric relaxation, soft tissue techniques and a specialised physical activity program. The specialised activity program involved active movement on both stable and unstable surfaces, TheraBand use and working with gym balls. The main goals of the therapy were to improve range of motion and muscle strength of the operated leg.

Result: After 10 therapy sessions the patient could feel as well as see the improvement in her left leg. Overall range of motion and muscle strength was almost completely restored and pain was decreased. By the end of the 4 weeks the patient had greatly improved functional use of her injured leg.

Keywords: ACL lesion, ACL reconstruction, Range of motion, knee, physiotherapy, surgery.

Abstraktní

Název: Případová studie léčby fyzioterapie pacienta po rekonstrukci předního zkříženého vazu

Cíl práce: Tato práce je rozdělena do dvou částí, teoretické a praktické. V teoretické části se budu zabývat anatomií, kineziologií a biomechanikou kolenního kloubu, následovanou specifikami předního zkříženého vazu. V praktické části uvádím případovou studii s počátečním vyšetřením, průběhem terapie a závěrečným vyšetřením. Nakonec jsem vyhodnotil účinnost své aplikované terapie.

Metoda: Rehabilitační plán zahrnoval 10 terapií během 4 týdnů, kdy jsem pracoval spolu se svým pacientem s pomocí a odborností mého školitele Mgr. Martina Damborová. Všechny aplikované ošetření a zkoušky vycházejí ze znalostí, které jsem získal v posledních 4 letech na Fakultě sportovních a tělovýchovných studií Univerzity Karlovy. Použitá vyšetření zahrnují, ale nejsou na ně omezena, vyšetření posturální a chůze, vyšetření délky a síly svalu, aktivní a pasivní rozsah pohybu. Použité terapie zahrnují; mobilizace kloubů, postizometrická relaxace, techniky měkkých tkání a specializovaný program fyzické aktivity. Program specializované činnosti zahrnoval aktivní pohyb, nestabilní povrchy, jejich používání a práci s míčky v tělocvičně. Hlavním cílem terapie bylo zlepšit rozsah pohybu a svalové síly operované nohy.

Výsledek: Po 10 terapeutických sezeních se pacient cítil a viděl zlepšení její nohy. Celkový rozsah pohybu a svalové síly byl téměř úplně obnoven. Na konci 4 týdnů pacientka výrazně zlepšila funkční využití její nohy.

Klíčová slova: léze ACL, rekonstrukce ACL, rozsah pohybu, koleno, fyzioterapie, chirurgie.

Contents

1 Preface

This thesis is concerned with the rehabilitation of a patient after a left ACL reconstruction.

I, the physiotherapist, completed a four-week-long placement in Centrum Léčby Pohybového Aparátu, from the June 1 until June 27 2020.

The goal of this placement was to rehabilitate the patient to the best of my abilities drawing on the knowledge I have gained after four years of physiotherapy studies in the Faculty of Physical Education and Sport, Charles University.

This thesis is divided into two parts. The first is theoretical knowledge of the knee joint; divided into anatomy, biomechanics, kinesiology and specifics about the ACL

The second part contains the practical side. It is focussed directly on the four-week treatment procedure of the patient and the ACL rehabilitation. It comprises three parts; the initial examination, the therapy progress and the final examination.

2 Theoretical information about the Knee Joint

The knee is a synovial hinge joint, designed for movements of flexion and extension, with small movement into rotational and side-to-side motions. The knee has six degrees of freedom, three rotational and three translational. The knee is a relatively complex joint, with a large number of ligaments and menisci that maintain stability as well as large muscle groups that cross the joint. [1]

2.1 Bones of the Knee

2.1.1 Femur

The femur is the largest, strongest, and heaviest bone in the human body. The femur bone often accounts for a quarter of a person's overall height. The femur is divided into three anatomical regions; the proximal femur, the shaft and the distal femur. The proximal femur contains a neck and a head that articulates with the acetabulum of the pelvis to form the hip joint. [3]

At the tip of the head of the femur is the fovea capitis, which is important for blood supply during childhood as the arteries pass through it in order to supply the femur neck with blood. Once a person’s growth plates have fused together, the arterial blood supply comes from the circumflex arteries.

The proximal femur also contains the greater and lesser trochanters, which are boney prominences on the proximal part of the femoral shaft; they are the main attachment points of many muscles that pass down the leg. They can be seen in Figure 2-1 at the top of the femur bone, the lesser trochanter is most visible in the posterior view.

In between the two trochanters are two extending lines, seen in the left anterior view of Figure 2-1, is the intertrochanteric line and in the posterior view is the intertrochanteric crest. Approximately two-thirds of the way up the intertrochanteric crest is the quadrate tubercle which is the insertion point of the quadratus femoris.

The femoral shaft slants in the medial direction of the body, bringing the lower limb closer to the medial line of the body, improving stability.

In the right posterior view of Figure 2-1 boney landmarks seen on the shaft include the pectineal line, which is the insertion of the pectineus; the gluteal tuberosity is just lateral and it is the insertion of the gluteus maximus; these converge to form the linea aspera, a ridge that runs down the length of the shaft.

Continuing down posteriorly, the linea aspera widens to form the popliteal fossa; the femur then widens to form the medial and lateral supracondylar ridges. On the medial supracondylar ridge is the adductor tubercle, which is the insertion of the adductor magnus. Between the two femoral condyles is the intercondylar fossa which provides the attachment points for the anterior and posterior cruciate ligaments. Further down the posterior view of the femur are the medial and lateral epicondyles and below this are the medial and lateral condyles, which articulate with the tibia to form the tibiofemoral joint.

The anterior view of the femur has no notable landmarks on the shaft. The lateral and medial epicondyles and condyles are also seen from the anterior view. Between these condyles is the patella surface, also known at the trochlear groove which the patella sits in. [1,4]

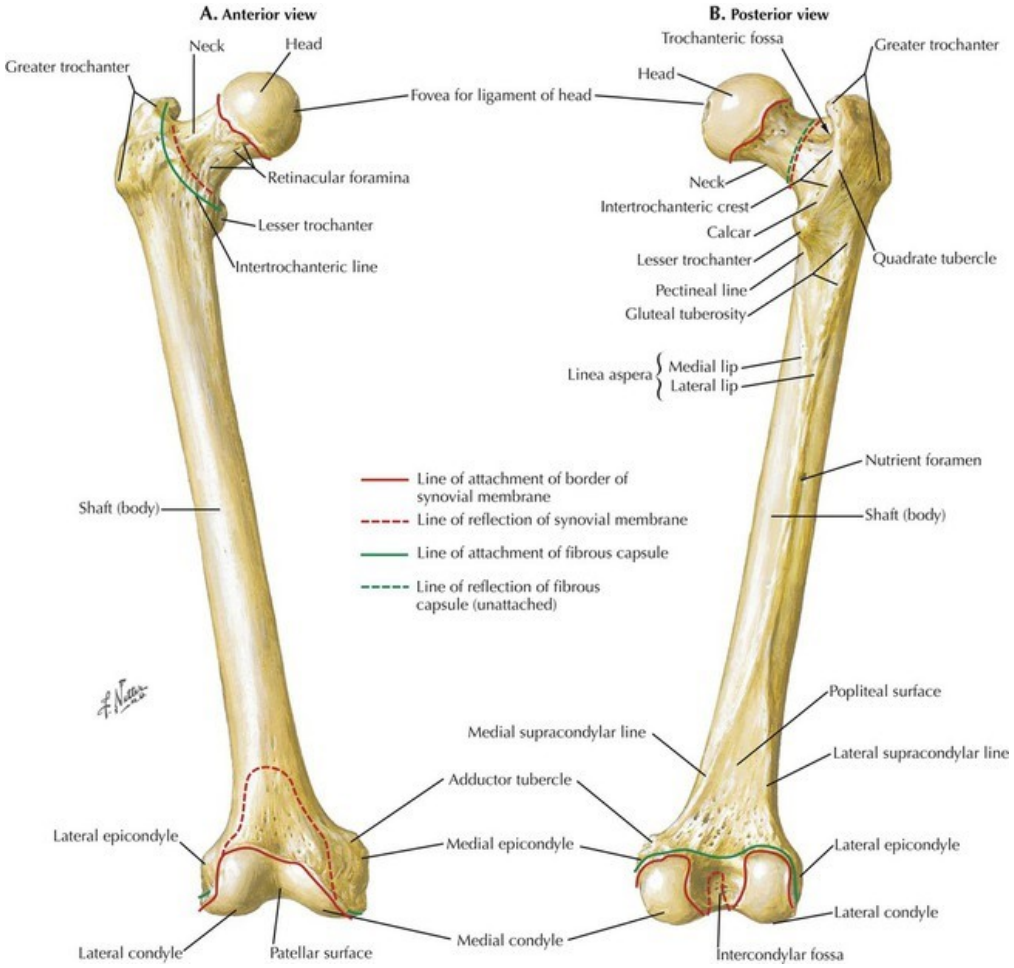

Figure 2-1: The femur according to Thompson [52]

2.1.2 Patella

The patella is classified as a sesamoid bone and is embedded in the patella tendon. The patella bone provides additional strength and leverage to the quadriceps and protects

the knee joint. As seen in Figure 2-2, on the anterior surface, the patella has a medial and lateral border, and at its most distal point, it has an apex. The apex is the attachment of the patella ligament. The top of the patella has the base, which is the attachment of the rectus femoris muscle. The medial and lateral borders allow for the attachments of the vastus medialis and lateralis respectively. As illustrated in Figure 2-2, on the posterior surface of the patella bone there are two facets, one for the medial condyle and a larger one for the lateral condyle of the femur. There is also a rough surface at apex that part of the patella ligament attaches to. [1,3]

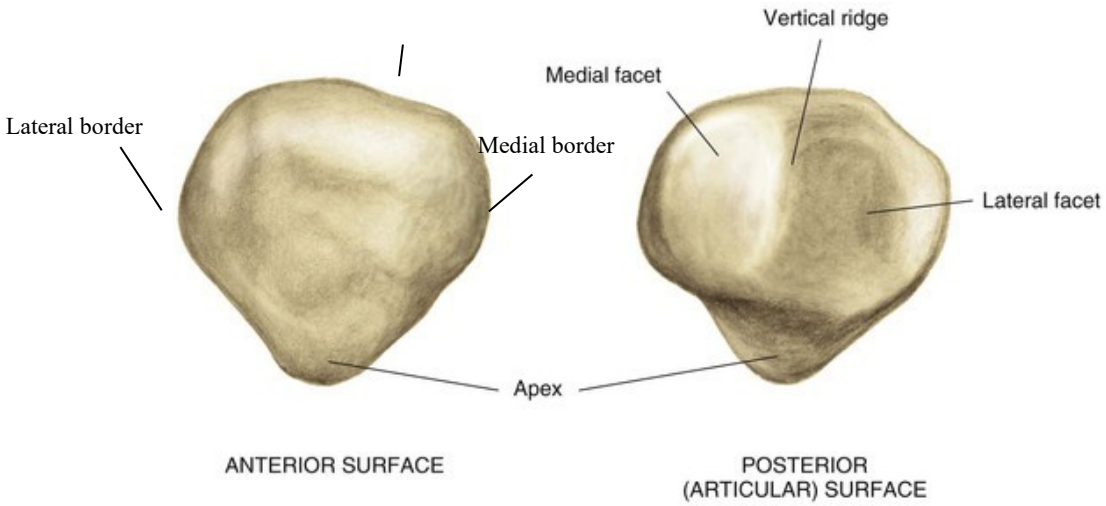

Figure 2-2: Patella [54]

2.1.3 Tibia

The tibia is the larger, stronger bone in the lower leg. It is located on the medial side of the leg.

In, Figure 2-3, the posterior view of the proximal Tibia are the medial and lateral condyles. These condyles are slightly concave with a flat surface known as the tibial plateau labelled as the superior articulating surfaces. They articulate with the femur to form the major articulation, the tibiofemoral articulation, in the knee joint. As shown in the anterior view, between the condyles are two intercondylar eminences, these are the main sites of attachment of the cruciate ligaments and menisci.

Laterally and anteriorly is the Gerdys tubercle which is the insertion of the iliotibial tract and inferiorly and lateral to this tubercle is the articular facet for the fibular head.

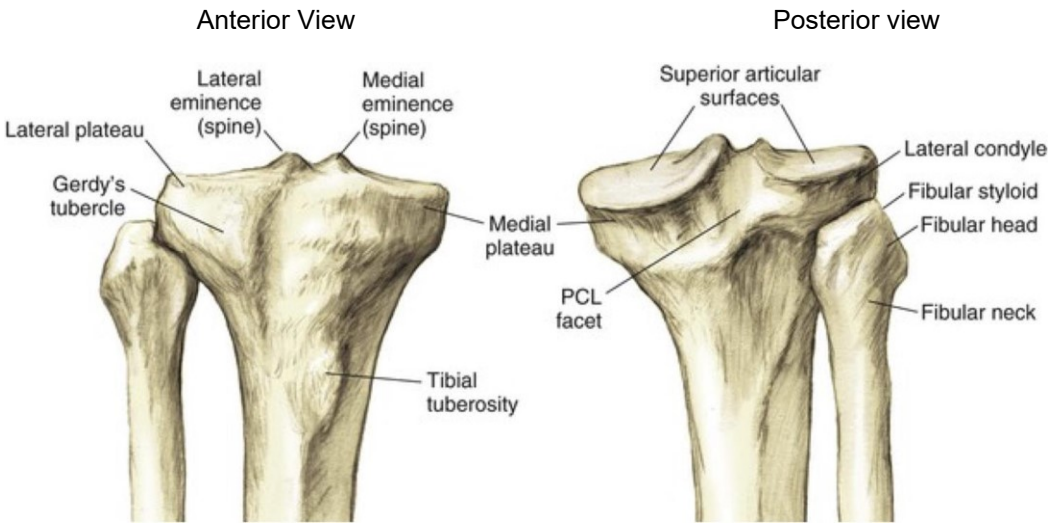

Figure 2-3: Proximal tibia [54]

In the distal anterior view, the tibial tuberosity is at the most proximal part of the shin. The tibial tuberosity is the insertion of the patella ligament (Figure 2-4).

The tibial shaft has three surfaces, and three borders, the clinically important are the anterior border, lateral border and posterior surface. The anterior border is also known as the shin bone and is palpable through the skin. The lateral border is the attachment point of the interosseus membrane that binds the fibula and tibia together. The posterior surface is marked by the soleal line, which is part of the origin of the soleus muscle.

The distal part of the tibia widens to assist with weight-bearing. The tibia has a boney prominence on the medial side called the medial malleolus, which articulates with the talus. The lateral surface of the distal tibia also provides the fibular notch, which is the point of articulation between the tibia and the fibular. [1,3]

2.1.4 Fibula

The fibula does not articulate directly with the knee joint as the lateral condyle of the tibia extends above the head of the fibula. Still, the fibula plays a critical clinical in role in the function of the knee joint. Seen in Figure 2-4 at the most proximal end is the fibula head and at the most distal end is the lateral malleolus. The tendon of the biceps femoris and the lateral collateral ligament attaches to the fibular head. [1]

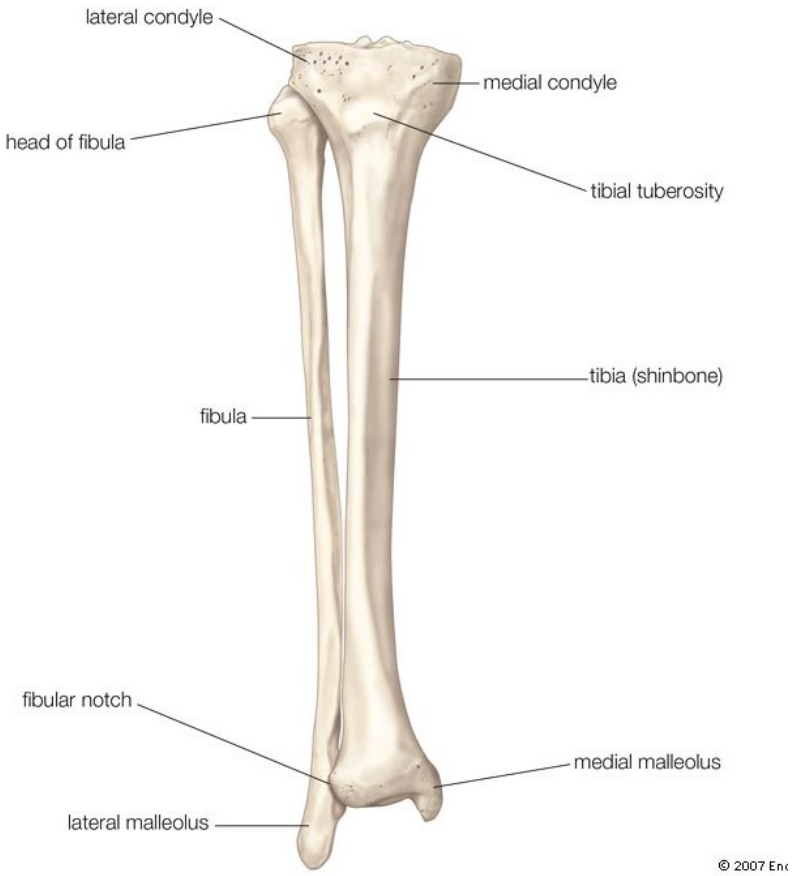

Figure 2-4: Anterior Aspect of the right Tibia and Fibula anterior view [48]

2.2 Joint Articulations

The main joint articulation in the knee joint, and the largest joint in the human body, is the tibiofemoral joint. This is an articulation between the condyles of the distal femur and the tibial plateaus on the superior surfaces of the condyles of the proximal tibia. The tibiofemoral joint is a hinge joint.

The posterior patella and the distal trochlear groove of the femur also articulate to form a saddle joint, called the patellofemoral joint.

The last joint articulation is between the head of the fibula and articular facet of the tibia. While the superior tibiofibular joint is often not considered part of the knee joint, it has clinical relevance in the treatment of the knee. [1,3,4]

2.3 Ligaments

As seen in Figure 2-5 and Figure 2-6, there are four main ligaments of the knee that are crucial for the stability of the knee joint, two extracapsular ligaments; the medial and lateral collateral ligaments, and the two intracapsular ligaments; the anterior and posterior cruciate ligaments.

The medial collateral ligament (also known as the tibial collateral ligament) is a flat ligament found on the medial aspect of the knee; it attaches proximal of the medial condyle of the femur and inserts into the medial condyle and medial shaft of the tibia. The medial collateral ligament prevents the knee from deviating medially and rotating externally.

The lateral collateral ligament (also known as the fibular collateral ligament) extends on the lateral aspect of the knee, from the lateral epicondyle of the femur and travels through the tendon of the biceps femoris to the lateral surface of the fibula head. The lateral collateral ligament prevents the knee from deviating laterally or rotating internally.

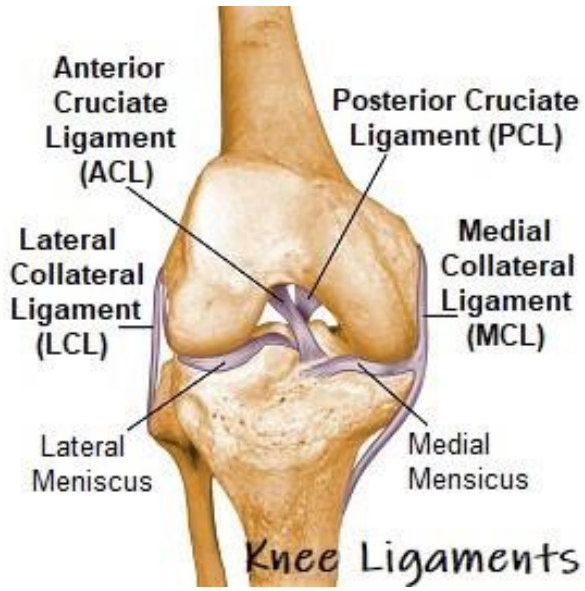

Figure 2-5: Four major stabilising ligaments of the knee [55]

The anterior cruciate ligament (ACL) runs anterior to posterior. It runs from the intercondylar anterior eminence of the tibia to the lateral condyle of the femur. The ACL resists anterior tibial translation and internal rotation across the femur.

The posterior cruciate ligament (PCL) travels posterior to anterior from the posterior intercondylar eminence on the tibia to the lateral surface of the medial condyle. The PCL resists posterior translation and external rotation of the tibia on the femur. [2,11]

As the knee is a complex structure, there many other ligaments that assist in stabilisation, as shown in Figure 2-6 and figure 2.7.

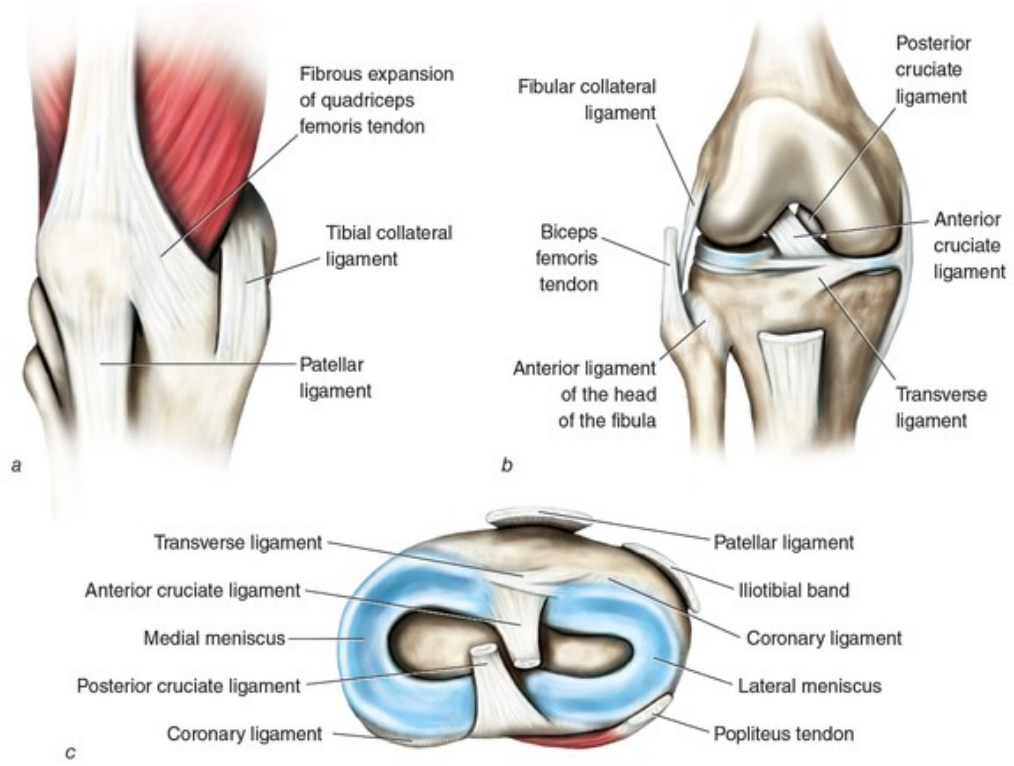

Figure 2-6: Anterior view of ligaments in the Knee according to Behnke [47]

The patellar ligament Figure 2-6 (a) extends anteriorly from the apex of the patella to the tibial tuberosity. The medial and lateral patellar retinaculum attach on either side of the patella ligament and are extensions of the vastus lateralis and medialis muscles. These ligaments work to stabilise the patella.

In Figure 2-6 (c), we can see many intracapsular ligaments that hold the menisci in place, including the; transverse ligament and coronary ligament. [1]

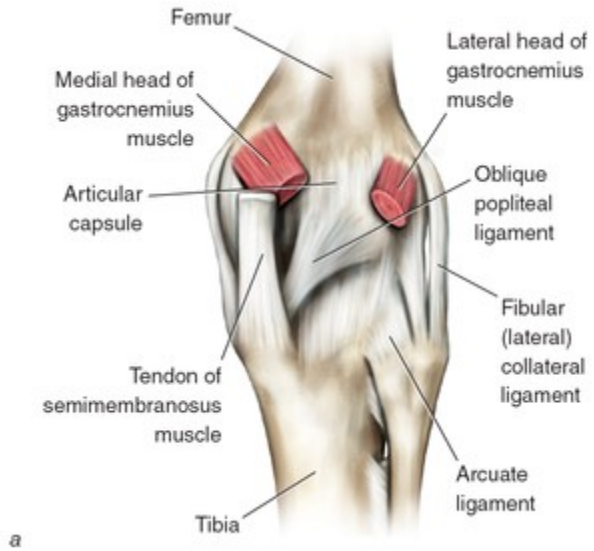

Figure 2-7: Posterior view of ligaments in the Knee according to Behnke [47]

The arcuate ligament labelled lower right Figure 2-7, arises on the posterior aspect of the fibular head and crosses the midline of the knee to attach medially to the posterior joint capsule. The arcuate popliteal ligament prevents overextension of the knee.

The oblique popliteal ligament, labelled middle right in Figure 2-7 is found posteriorly on the knee; it is an expansion of the semimembranosus tendon on the posterior medial condyle of the tibia. The oblique popliteal ligament crosses the midline of the knee and attaches to the posterior lateral condyle of the femur. [3]

2.4 Menisci

The menisci are fibrocartilaginous circular plates that function to disperse body weight and shock absorb. The menisci of the knee are concave on top and flat on the bottom, and they prevent friction of the femur against the tibia during movements. The outer portion of the menisci is vascularised, while the inner portion is avascular, giving rise to the theory that the inner portion is more adapted for compressive forces, while the outer portion resists tensional forces.

As shown previously in Figure 2-6 (c), there are two menisci found in the knee; the medial and lateral. The medial meniscus is semicircular in shape and lies between the medial tibial plateau and the medial condyle of the femur. The lateral meniscus is circular in shape and lies between the lateral tibial plateau and the lateral condyle of the femur. [1,3]

2.5 Bursas

A bursa is a synovial membrane sack filled with synovial fluid. The bursa is often located at a point between two structures such as a tendon, ligament, muscle and bone. The primary purpose of a bursa is to provide cushioning and lubrication for joints to avoid friction and damage to structures. There are 14 bursae in the knee joint; I will focus on the large bursae that cushion the crucial structures.

Anteriorly, the infrapatellar bursa sits below the patella. The suprapatellar bursa lies above the patella. The prepatellar bursa sits in front of the patella.

Posteriorly, the pes anserine bursa sits between the tibia and the tendons of the semitendinosus, Sartorius and gracilis. [1,3]

2.6 Joint capsule

The joint capsule consists of two layers, the internal (fibrous) layer and external (synovial) layer. The external layer is fibrous and consists of three layers; the extensor retinaculum, the fascial layer and the deep layer. The external layer provides stability to the joint. The internal layer comprises the synovial membrane that secretes synovial fluid, and it lubricates the joint and reduces friction. The joint capsule non-specifically passes from the femoral condyles to the tibial condyles under the patella. According to Cyriax (1982), the capsular pattern of the knee joint is first flexion then extension. [1,3,4]

2.7 Muscles

The muscles extending over the knee joint are responsible for its movement and stabilisation. For simplicity, I have divided the muscles in the thigh broadly into the anterior and posterior compartments.

In the anterior compartment, Figure 2-8, the quadriceps femoris muscle is the major muscle group, and it produces extension of the knee. The group is composed of four smaller muscles that all insert into the base of the patella and tibial tuberosity via the patellar ligament. The four smaller muscles are:

- Rectus femoris muscle originates from the anterior inferior iliac spine and ilium
- Vastus medialis muscle originates from the intertrochanteric line, medial lip of linea aspera of femur
- Vastus intermedialis muscle originates from the anterior and lateral surface of the shaft of femur
- Vastus lateralis muscle originates from the greater trochanter, lateral lip of line aspera of femur.

Sartorius muscle is the longest muscle in the body, and it originates from the anterior superior iliac spine and inserts into the pes anserinus, while it resides in the anterior compartment its insertion is posterior and it causes flexion of the knee joint and internal rotation.

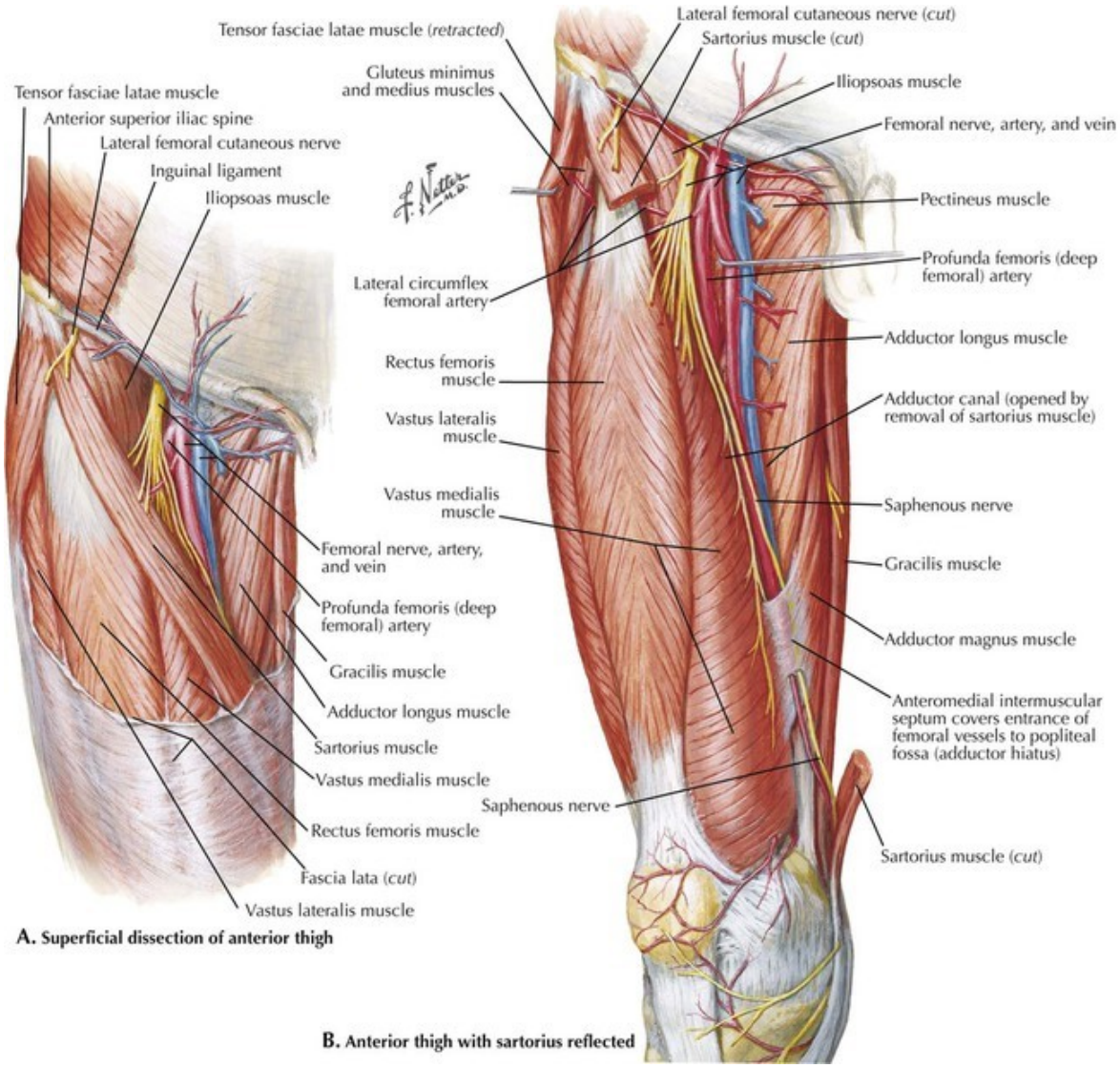

Figure 2-8: Anterior View of the Leg Muscles according to Netter [24]

The posterior compartment of the knee, Figure 2-9, is responsible for flexion. The major muscle group is often referred to as the hamstrings. It comprises the semitendinosus, semimembranosus and the biceps femoris.

The semitendinosus originates from the ischial tuberosity and inserts into the pes anserinus. The semimembranosus originates from the ischial tuberosity and inserts into the medial condyle of the tibia.

The biceps femoris has a long and short head, the long head originates from the ischial tuberosity, and the short head originates from lateral supracondylar line of femur, and it inserts into the lead of fibula.

The gracilis muscle originates from the body of anterior ramus of pubis and inserts into the superior part of medial surface of tibia. It adducts thigh and flexes and medially rotates the leg.

The popliteus originates from the lateral aspect of lateral condyle of femur and lateral meniscus and inserts into the posterior tibia and posterior soleal line.

The gastrocnemius has two heads, the lateral head originates from the lateral aspect of lateral condyle of femur and the medial head originates from the medial condyle of femur. They blend to insert into the posterior aspect of calcaneus via calcaneal tendon. The main movement of the gastrocnemius as ankle plantar flexion, but it also assists in knee flexion.

The plantaris originates from the lateral supracondylar ridge of the femur and inserts into the calcaneal tendon, deep to the gastrocnemius. The main movement of the plantaris is also ankle plantar flexion, but it assists in knee flexion.

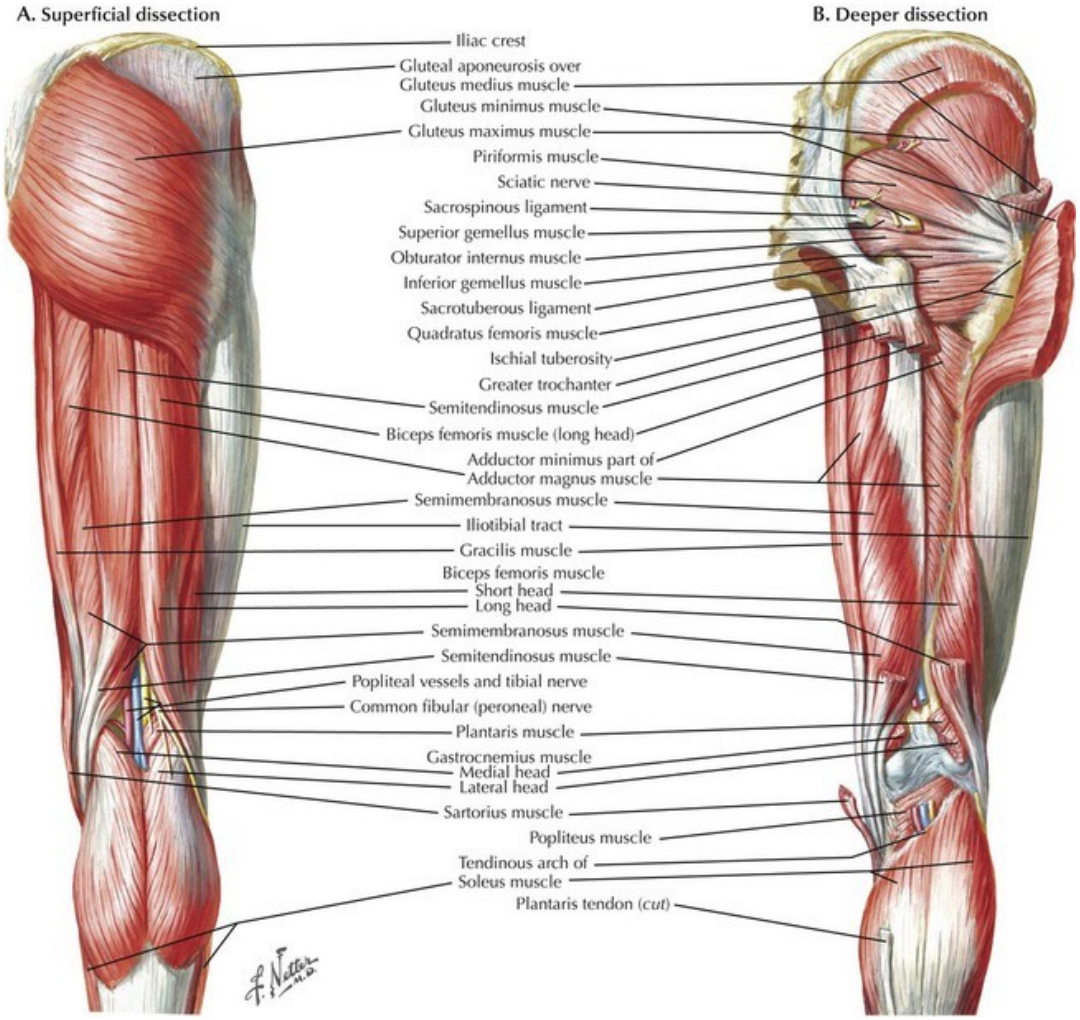

Figure 2-9: Posterior View of the Leg Muscles according to Netter [24]

An additional, clinically relevant muscle is the tensor fascia lata, which runs laterally down the thigh and is illustrated in both Figure 2-8 and Figure 2-9. The tensor fascia lata originates at several boney points in the hip joint and inserts into the femoral and tibial condyles, patella, head of the fibula and the tibial tuberosity. [1,3,4,22]

2.8 Innervations

The knee joint is innervated by the femoral nerve, saphenous nerve, tibial nerve and common fibula nerves. The lumbar plexus and the sacral plexus are the two plexuses that give way for these innervations. [1]

2.8.1 The lumbar plexus

The largest branch arising from the lumbar plexus is the femoral nerve seen in green in Figure 2-10. It arises from posterior rami nerve roots L2-L4. The femoral nerve innervates the anterior and lateral thigh muscles it extends to the medial leg and ends at the foot, it has both motor and sensory functions It innervates the muscles responsible for hip flexion and knee extension; the pectineus, iliacus, sartorius, rectus femoris, vastus lateralis, vastus medialis and vastus intermedius.

There are two sensory branches arising from the femoral nerve, that travel down the anteromedial part of the thigh, lower leg and foot.

The saphenous nerve is a sensory branch of the femoral nerve, and it supplies the prepatellar skin.

The obturator nerve arises from the anterior rami L2-L4. The posterior division innervates the muscles in the medial compartment of the thigh; obturator externus, adductor longus, adductor brevis, adductor magnus and the gracilis. A small branch accompanies the femoral artery to supply to capsule of the knee joint. It also innervates the skin of the medial thigh. [3,24]

2.8.2 The sacral plexus

The sacral plexus arises from L4-S4 and innervates much of the motor posterior compartment of the leg.

The superior gluteal nerve arises from the L4-S1 nerve roots and innervates the gluteus minimus, gluteus medius and tensor fascia lata.

The sciatic nerve is the largest nerve in the human body, and is illustrated in green in Figure 2-11. The nerve arises from the L4-S3 nerve roots and innervates the muscles in the posterior thigh; biceps femoris, semimembranosus, semitendinosus and the hamstring portion of the adductor magnus. The sciatic nerve terminates at the apex of the popliteal fossa where it bifurcates into the tibial and common fibular nerves.

- The tibial nerve innervates the muscles of the posterior lower leg; gastrocnemius, plantaris, soleus.
- The common fibula nerve innervates the muscles in the anterior compartment of the lower leg. [3,24]

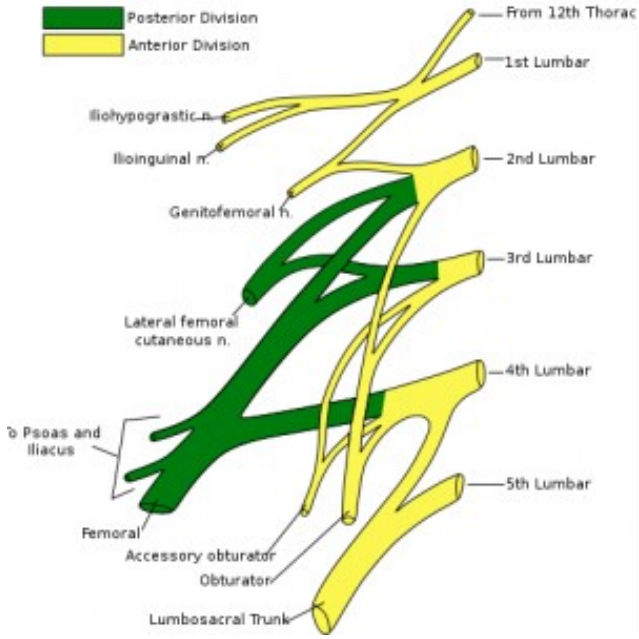

Figure 2-10: The Lumbar Plexus according to TeachMeAnatomy [5]

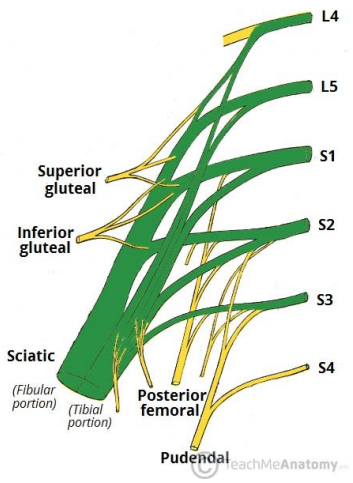

Figure 2-11: The Sacral Plexus according to TeachMeAnatomy [5]

2.9 Biomechanics of the knee joint

The knee joint functionally allows shortening and lengthening of the lower extremity through flexion and extension. In a closed kinematic chain, it supports body weight in a static erect posture. Dynamically it supports and moves the body in activities of daily living.

The knee complex consists of two joint articulations, the tibiofemoral joint and the patellofemoral joint. [32,39]

2.9.1 Biomechanics of patellofemoral joint

The patella has a sliding articulation with the femur and moves 7cm caudally in full flexion. Maximum contact between the femur and patella occurs at 45 degrees of knee flexion.

The main function of the patellofemoral joint is to increase the mechanical leverage of the quadriceps. Additionally, it provides some protection of the anterior aspect of the knee joint. Internal forces acting on the patella are;

- The lateral retinaculum, vastus lateralis and tensor fascia latae pull laterally
- The medial retinaculum and vastus medialis pull medially
- The quadriceps via quadriceps tendon pull superiorly
- The patellar ligament pulls inferiorly [34,41]

2.9.2 Biomechanics of the tibiofemoral joint

The tibiofemoral joint is a double condyloid hinge joint and is the main joint of the knee. It bears the weight of the human body and it allows the lower extremity to functionally shorten and lengthen in activities of daily living.

The tibiofemoral joint is the articulations of the lateral and medial condyles of the femur and tibia. The femur is angled distally and medially, and the femoral condyles lie medial to the femoral head, as a result, the anatomical axes of the tibia and femur are at a 170-175 angle in the frontal plane. The medial femoral condyle extends further distally than the lateral condyle, meaning that despite the angulation of the anatomical axes the distal end of the femur articulates with the tibia horizontally. [26, 39]

On the distal femur the medial condyle is larger in size with and slightly more posterior than the lateral condyle, functionally this allows for rotation. Additionally, on the proximal tibia the medial plateau is larger than the lateral plateau.

The tibiofemoral joint is a large weight bearing joint, as a result, it contains structures within the joint designed to absorb force. [29,34]

2.9.3 Menisci

From a biomechanical position, the menisci are important structures of the knee joint that are crucial for its function.

The main role of the menisci is to provide load bearing and stability to the knee. They provide load bearing by distributing weight bearing forces and shock absorbing.

The menisci provide stability by deepening the tibial plateau in the joint as well as decreasing the friction between the tibia and femur.

In large part due to the attachment point of the ACL, the medial meniscus is injured twice as often as the lateral meniscus. [39,40]

2.9.4 Movements of the knee joint

The knee is an imperfect hinge joint and therefore has major movement in the sagittal plane around the frontal axis. However, the knee joint has polycentric motion, that is, the centre of rotation changes during movement. Subsequently, knee motion occurs in all three planes simultaneously. [29]

The knee joint has 6 degrees of freedom; 3 rotations and 3 translations. The degrees of freedom can be seen below in figure 2-12.

In the sagittal plane the flexion-extension range of motion of the knee joint, extension-flexion diagram in Figure 2-12, varies person to person it can generally be said to range between -3°-0°-155°. Gait requires between 0°-70° of flexion. Range of motion of the knee joint in the sagittal plane needed to carry out activities of daily living is 0°-0°-117°. [34]

Knee internal and external rotation occurs in the transverse plane, and can be thought of as freedom of rotation, internal-external diagram in Figure 2-12. The rotational freedom of the knee joint is different at different stages of flexion. In full extension rotation is limited by the contact of the tibial and femoral lateral condyles, this mechanism

is discussed further in Section 2.9.6. The range of motion of internal and external rotation reaches its peak at between 30-40° of flexion. With the knee in this position, external tibial rotation is approximately 18°, and internal tibial rotation is about 25° (Blankevoort, 1988). [34]

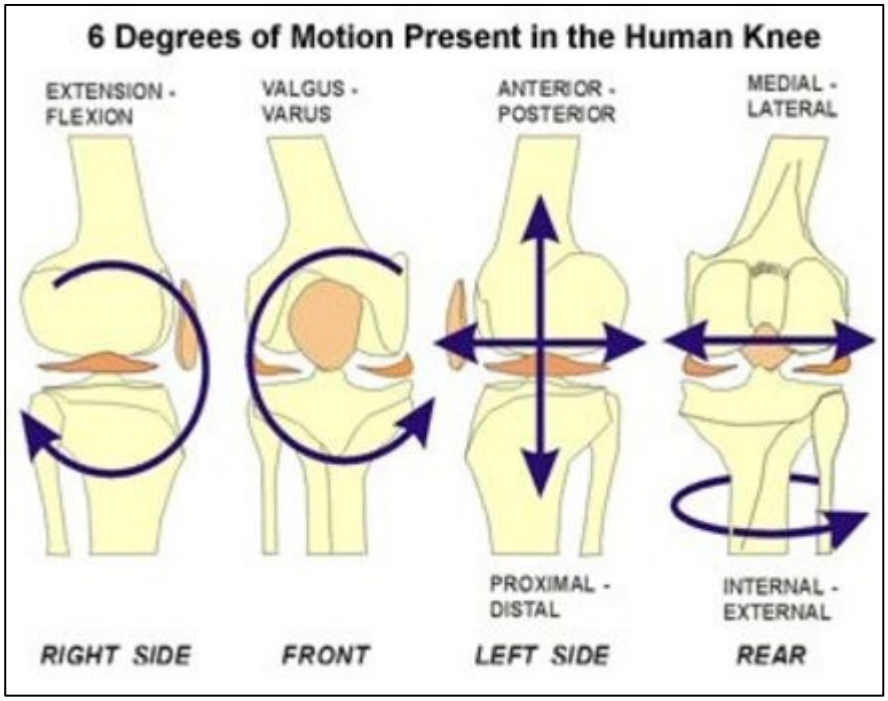

Figure 2-12: Motions of the Knee Joint according to Singh [39]

Varus and valgus movement in the frontal plane, valgus-varus diagram in Figure 2-12, is similarly affected by knee flexion. In full extension, passive abduction and adduction of the knee joint is almost 0. Similarly, in full flexion motion in the frontal plane is limited due to the soft tissues. [34]

The translational degrees of freedom are labelled as anterior-posterior, proximal-distal, and medial-lateral in Figure 2-12.

2.9.5 Lever system of the knee joint

The knee joint is a third class in both movements of flexion and extension. In the movement of extension, the fulcrum is the knee joint, the applied force is the insertion of the quadriceps on the tibial tuberosity, and the resistance is the foot.

The knee joint is situated between the two longest lever arms in the human body, the femur and tibia, the resistance of these bones in the lever system of the knee joint is very large increasing the potential for torque (a twisting force causing rotation) and subsequent injury. [39]

2.9.6 Screw home mechanism

The screw home mechanism is considered a key element of knee stability; it refers to the rotation between the tibia and femur at the end of extension. The knee locks in the last 20-30 degrees of extension and unlocks in the first 20-30 degrees of flexion. This occurs because the medial tibial condyle has a larger plateau allowing the medial portion to slide further over the femoral condyle, the femoral condyle is also more oblong in shape, facilitating this slide. Other factors influencing the locking of the knee in extension are the lateral pull of the quadriceps and the passive tension of the ACL ligament.

In standing the movement is in a closed kinetic chain and the tibia is fixated on the ground. During extension in standing there is internal rotation of the femur on the tibia. In an open kinetic chain movement, the tibia laterally rotates on the femur. [15,23,4]

2.9.7 Roll back phenomenon

The roll back phenomenon refers to the posterior rolling of the femoral condyles, seen in figure A of Figure 2-13, and anterior glide of the femur in knee flexion, seen in figure B of Figure 2-13, in a closed chain movement. In an open chain movement, the tibia glides posteriorly. The instant centre of rotation is the point at which the joint surfaces are in direct contact, as the knee flexes the instant centre of rotation moves posteriorly. The roll back of the centre of rotation allows knee flexion to occur without impingement. The roll back occurs as a result of the anatomical structures and the tibial plateau, as well as the passive tension of the PCL. [15,23]

A B

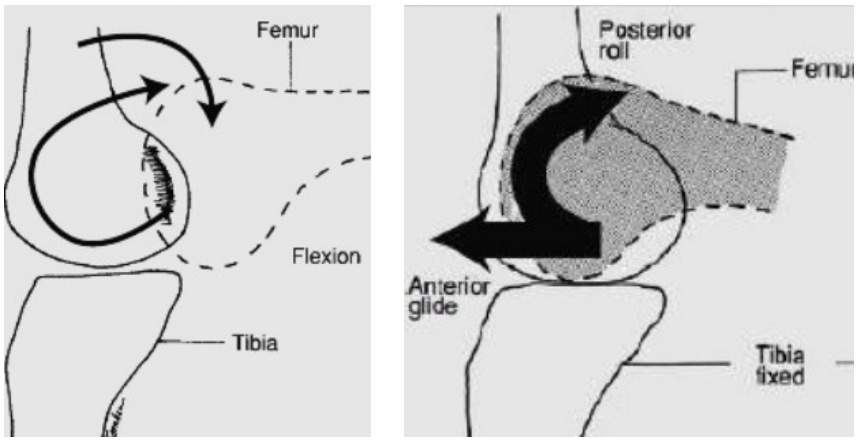

Figure 2-13: Roll back phenomenon [51]

2.9.8 Forces acting on the knee joint

Static forces on the knee joint can be simplified to three components; the ground reaction force, which is equal to body weight, the tensile force through the tendons and ligaments around the joint, and the joint reaction force on the tibial plateau.

Dynamic forces on the tibiofemoral joint are produced by body weight, muscles, other soft tissues and externally applied forces.

Common activities of daily living, such as walking, stair ascending and sit-to-stand place heavy load on the knee. The main functions of the knee in these daily movements include supporting body weight, absorbing heel strikes and assisting in the swing of the lower limb. The loads on the knee in each of these activities varies from person to person, but it is estimated to be;

- 2-3 times body weight during walking
- 2-5 times body weight during sit-stand-sit
- 4-6 BW during stair ascending [26]

The two major forces acting on the tibiofemoral joint at all times are shear and compression. Compression is most present in extension of the knee, especially during stance phase during gait. This is why single leg stance is contraindicated in the first 4 weeks after ACL surgery.

Shear force occurs when one body part is pushed in one direction and another part is pushing in the opposite direction. Closed kinetic chain movements produce much less shear force than open kinetic chain movements, which is why in ACL rehabilitation gait training and squats are exercised before machine leg extensions. [35]

2.10 Kinesiology of the knee joint

2.10.1 Alignment of the lower extremity

The anatomical axis of the femur is oblique and runs inferiorly and medially, while the anatomical axis of the tibia is vertical. As discussed previously, this results in the tibiofemoral joint being 170-175 degrees in the frontal plane in a physiological knee figure 2-13 a. This creating physiological valgus and allows better stability.

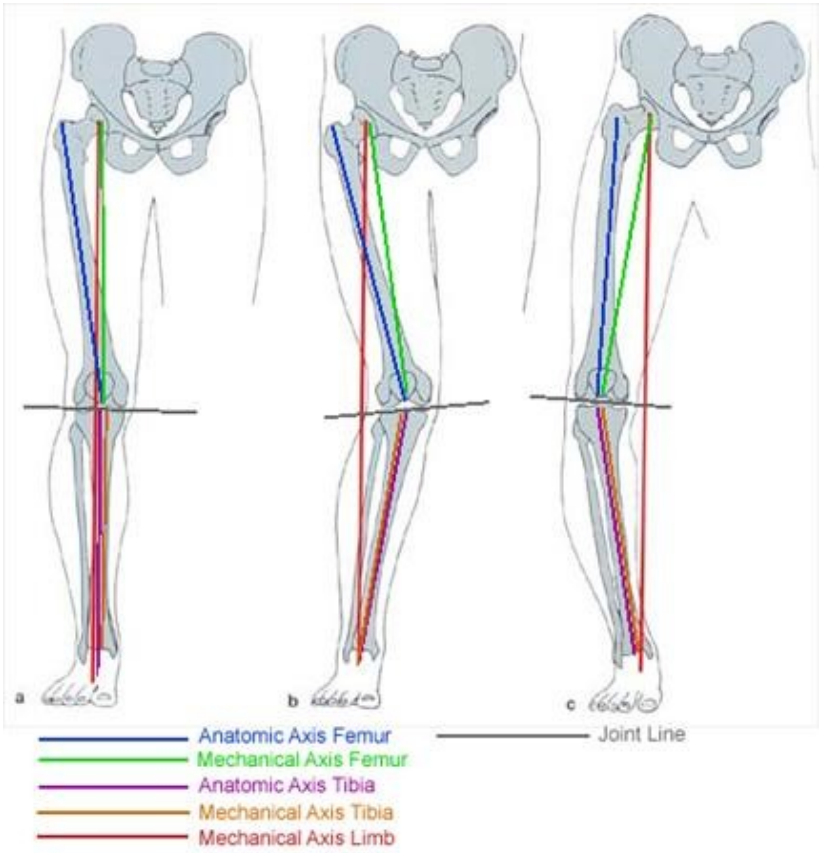

Figure 2-14: Alignment of knee joint [29]

The frontal axis has a small varus-valgus rotation, approximately 6-8 degrees in extension and the transverse axis has an internal-external rotation, 25°-30° in flexion.

The anatomical axis of the lower limb runs through the centre of the femoral shaft, as seen by the blue line in Figure 2-14.

The mechanical axis (red line) of the knee runs from the centre of the femur head to the centre of the ankle joint, passing through the knee joint in a physiological knee as can be seen in Figure 2-14a.

When the mechanical axis passes laterally to the knee joint, the knee is in a valgus position, as can be seen in Figure 2-14b.

When the mechanical axis passes medially to the knee, join the knee is in a varus position, as can be seen in Figure 2-14c. [1, 34,39]

2.10.2 Stabilising system of the knee joint

The knee is stabilised by both primary and secondary stabilisers. Primary knee stabilisation is achieved by the ligaments. While secondary stabilisation is achieved by the contractile force of the muscles crossing over the joint.

Figure 2-15 outlines the major ligaments of the knee joint and their role in primary stabilisation. The medial and lateral collateral ligaments resist varus and valgus rotation. With the cruciate ligaments resist internal and external rotation, as well as anterior and posterior translation of the tibia over the femur. The ACL is the main primary stabiliser of the knee, contributing to 85% of the overall knee stability. [38]

The secondary stabilisers of the knee joint are the muscles. The muscles of the knee joint have been discussed in more detail in Section 2.7. While the main function of the muscles is to produce movement in the knee joint, they also interact with the neuromuscular system to control knee motion and subsequently play a large role in proprioception.

The anterior compartment of the muscles act to extend the knee joint, while the posterior compartment acts to flex the knee joint.

These muscles also aid in tibial translation, the quadriceps and gastrocnemius aid in anterior translation, while the soleus and hamstrings aid in posterior translation. [41]

Additionally, the semitendinosus acts as a medial rotator, the biceps femoris and semimembranosus muscles act as lateral rotators and the popliteus muscle both laterally and medially rotates the knee joint. [38]

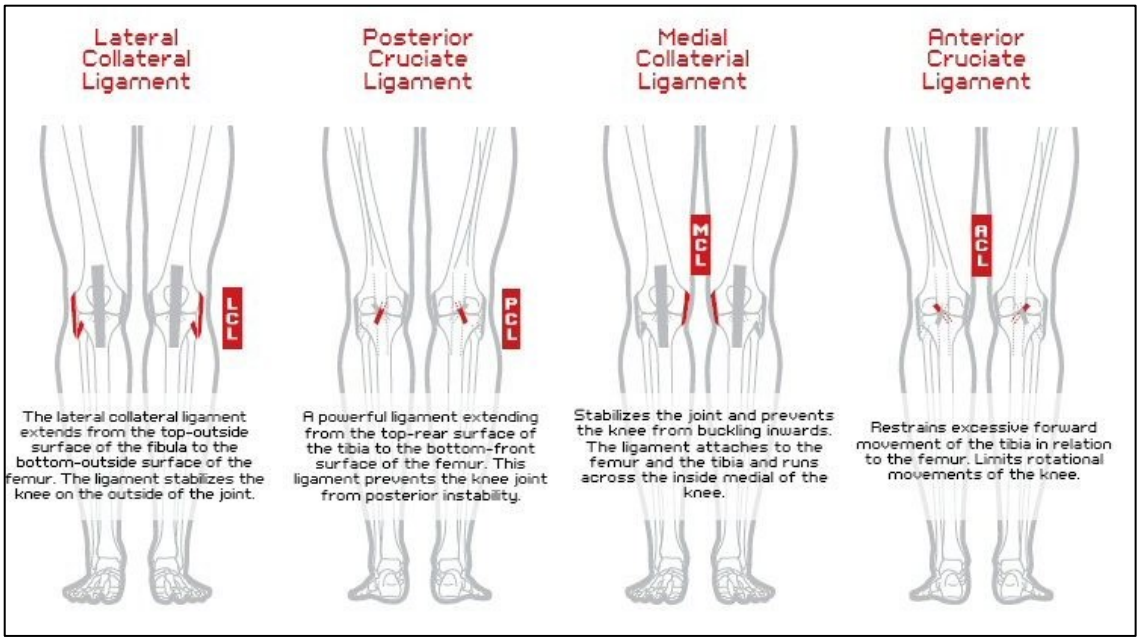

Figure 2-15: Primary stabilisers of the knee joint according to Singh [39]

2.11 Characteristcs of ACL injury

2.11.1 Biomechanics of the ACL

The anterior cruciate ligament's primary function is to prevent anterior translation and internal rotation of the tibia relative to the femur. The ACL is one of the four main primary stabilisers of the knee joint. The ACL consists of two fibre bundles, the anteromedial (AM) bundle and the posterolateral (PL) bundle. The PL bundle is located anteriorly to the AM bundle. The PL bundle is more oblique in shape, and provides more stability in rotation and extension, while the AM bundle provides passive resistance into flexion of the knee joint.

When the knee is fully extended the average length of the PL bundle of the ACL is 25 mm, when the knee joint is 90 degrees flexed the AM bundle of the ACL measures on average to 31 mm. The average diameter is 7-12mm. [27]

The ACL provides stability to the knee joint through passive restriction to movement of the tibia and femur. It also contains proprioceptors which provide information about the position of the joint, and this notifies the central nervous system about when the secondary stabilisers, the muscles, need to be stimulated [40]

2.11.2 Mechanism of ACL rupture

ACL rupture is the most common injury to the knee joint.

A common and frequent injury mechanism is non-contact combined valgus- and internal-rotation trauma. The ACL is at the greatest risk of rupture when the knee is in 10-30 degrees of flexion, and the knee is in a valgus position. This often occurs in sports such as football, downhill skiing, basketball and soccer when the players explosively change direction. ACL injuries are often associated with other ligamentous injuries.

Another mechanism of injury, although less common, is when an external force is applied either posteriorly or medially to the proximal tibia.

Domnick, Raschke and Herbort (2016) state acute ACL ruptures are common orthopaedic traumas, with an incidence of up to 84 per 100000 persons in the United States. [21]

2.11.3 Clinical presentation of ACL rupture

Clinical presentation is individual for each injury and will vary. Generally, the clinical picture will present as;

- an audible pop or crack at the time of injury.
- Immediate and extensive inflammation of the knee
- Extreme pain
- Restricted movement, particularly an inability to fully extend the knee
- The patient will report a feeling of instability in the knee joint
- The knee may give way on pivoting of twisting motions.
- Widespread mild tenderness and sensitivity around joint. [32]

2.11.4 Diagnosis of ACL rupture

The main mediums used for diagnosis of ACL lesions are; Magnetic resonance imaging (MRI), arthroscopy and manual orthopaedic assessment methods. [42]

Magnetic resonance imaging

MRI uses a powerful magnetic field to produce detailed images of the structures in the knee. MRI is often preferable to arthroscopy as it is a non-invasive diagnostic tool and consequently avoids surgical risks. However, MRI has been shown to be less reliable ineffective in diagnosing ACL tears than arthroscopy. [36]

Arthroscopy

Knee arthroscopy is a surgical procedure allowing a surgeon to have a clear view of the knee without making a large incision. The surgery involves making a small incision and inserting a small camera into the knee in order to see the inside of the joint. Arthroscopy allows direct vision of all intra-articular structures, providing a high level of accuracy for both diagnosis and treatment of ACL lesions. The reliability of ACL lesion diagnosis through arthroscopy was found to be higher than the reliability of MRI imaging. [37]

Lachman's Test

The Lachman Test is used to assess the integrity of the ACL in the sagittal plane. It is a gentler assessment method than the anterior drawer test. The test is performed by

lying the patient down in supine then flexing their knee to 20-30 degrees with a very slight external rotation the leg (Figure 2-16). The examiner places one hand medially, below the knee joint with the fingers behind the tibia and the thumb on the shin bone. The other hand above the knee on the anterolateral side of the thigh. The examiner then pulls the tibia anteriorly. Anterior translation and a soft end feel relative to the other leg indicates a ruptured ACL. [30]

Figure 2-16: Lachman's Test [53]

Anterior Draw Test

For the Anterior Draw Test, the patient is in supine with their hips flexed to 45 degrees and knees flexed to 90 degrees (Figure 2-17). The examiner sits on the toes of the examined leg and grasps the patient's leg with both hands below the tibiofemoral joint line and translates the tibia anteriorly. The test is considered positive if there is a lack of end feel or excessive anterior translation relative to the other leg. [30]

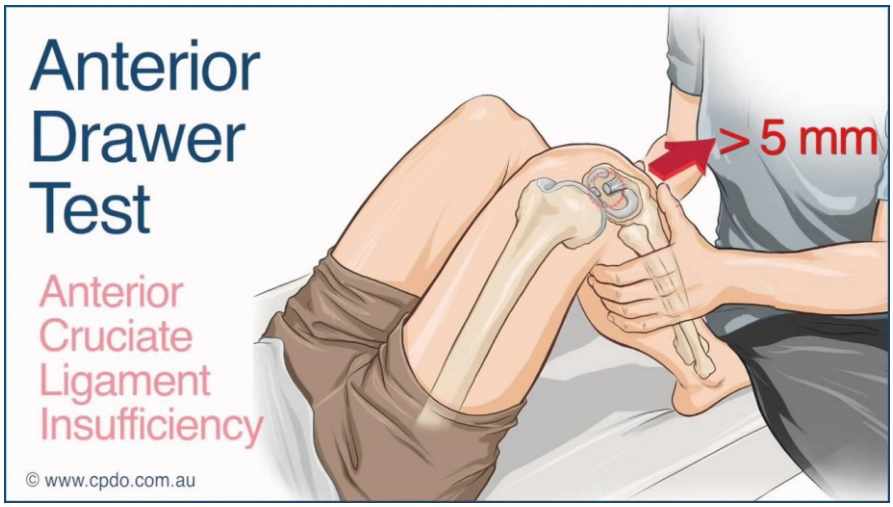

Figure 2-17: Anterior Drawer Test [53]

Pivot Shift Test

The pivot shift test is a test of anterolateral rotary stability of the knee. The patient lies supine with the legs extended, the therapist grasps the leg laterally by the heel and places the other hand on the proximal tibia just distal to the knee joint the examiner then provides a valgus stress to the knee joint while internally rotating the tibia (Figure 2-18). A positive test is indicated by subluxation of the tibia while the femur rotates internally. [30]

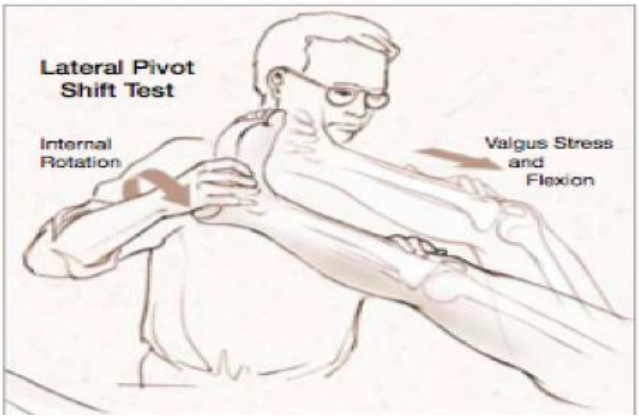

Figure 2-18: Lateral Pivot Shift Test [42]

2.11.5 Operation procedure for ACL reconstruction

ACL reconstructive surgeries vary around the world with differences in both grafts and surgical procedures. Major differences in techniques include;

- Arthroscopic versus open surgery
- Intra-articular vs extra-articular graft location; extra articular reconstructions focus on preventing tibial anterior translation, while intraarticular reconstructions focus on repairing the primary ACL lesion. Extra-articular operations were originally most popular though due to residual instability intra-articular reconstruction has become more popular these days, however it does not restore full knee kinematics. [43]
- Femoral tunnel placement- tunnel malposition is one of the most common causes of ACL reconstruction failure. Small changes to tunnel placement can significantly impact the outcome.[44]
- Number of graft strands- Higher stiffness is achieved by using more stands and therefor more stability, but there is limited long term evidence for the difference between 3,4 and 5 strand grafts. [42]

- Single vs double bundle- As the ACL ligament is a double bundle ligament physiologically, when it is reconstructed with a single bundle the knee does not regain full kinematics. For this reason, the double bundle reconstruction is preferable, however the graft harvest is more difficult and invasive, as well the healing takes longer. [42]
- Graft type- There are many different graft types, including but not limited to; autografts, synthetic materials, cadaveric allografts, and even grafts from living related donors have been tested. Autographs are the most widely used grafts in ACL reconstructions. [45]

The most common autographs are taken from either the patella ligament or the hamstrings tendon for ACL reconstruction [42]. A majority of ACL reconstructions in CLPA are patella ligament BTB grafts as it is a slightly less invasive procedure with a smaller graft being taken. In BTB patella ligament reconstructions the surgeon resects the mid portion of the patella ligament and the graft has a bone block on either end, this allows for potentially superior integration of the graft to the tibial and femoral tunnels. [46]

Multiple studies have been conducted into the differences in effectiveness between the two different grafts. Generally, there is negligible difference in the function of the repaired ACL, there is just a difference in the healing process between the two.

It has been reported that often patients with patella ligament grafts feel more anterior pain than hamstring tendon grafts however this can be expected as a result of the scar and the incision point.

When a graft is taken from the patella ligament the quadriceps muscle will often be more effected, whereas when a graft is taken from the hamstring tendon the hamstrings will be more affects. According to this, the therapy should be adjusted to focus more on the respective muscles, especially stretching, soft tissue techniques and PIR. [45]

2.11.6 Physiotherapeutic Procedures

In CLPA the rehabilitation process is divided into 4 parts [57].

The first rehabilitation stage is from the operation to week 3;

- The major goals in the first two weeks are to decrease pain and inflammation, education of use of crutches and gait, increase range of motion, quadriceps activation, maintain flexibility of hamstrings and calves.

In this stage the focus is on;

- cryotherapy,
- scar care,
- thromboembolic prevention,
- basic movement patterns,
- gait training without crutches,
- stretching of posterior leg,
- simple anti-gravity strength training exercises such as isometric quadriceps activation, heel slides with heel in contact with surface. [57, 56].

The second rehabilitation stage is from weeks 4-8;

- The major goals in this stage are restoring near to, or full, ROM in knee flexion and extension, maintaining or restoring full flexibility to all other joints, muscle strengthening, gait stereotype retraining, restoring proprioception of affected leg, improving cardiovascular fitness.

In this stage the focus is on;

- Cardiovascular fitness training begins on the stationary bike, stepper and walking on the treadmill.

  Scar care continues.
- Gradually increasing the load of strength training but strapping weights to the ankles in open chain exercises, and beginning on the weight machines in weeks5/6 for quadricep extensions and hamstring curls. Beginning the quadricep extensions at 2.5kg and not exceeding 10kg, and beginning the hamstring curls at 5kg and not exceeding 20kg.
- Sensomotoric training with balance aids
- Training of movement stereotypes
- Stabilization exercises
- Before exercise magnetotherapy, after therapy hydrotherapy whirlpool [57, 56].

The third rehabilitation stage is from week 8 onwards;

- The major goals in this stage are to have full and pain-free ROM, have functional quadriceps strength, progress strength training, cardiovascular fitness, continue proprioception.

In this stage the focus is on;

- increasing resistance in cardio of stationary bike and stepper,
- running on treadmill
- beginning jumping on trampoline,
- training of movement stereotypes,
- increasing resistance on exercise machines above 10kg and 20kg on quadriceps extension and hamstring curls respectively
- Exercising with larger load
- Preparation for sports activities
- Sensomotoric training on unstable surfaces
- Whirlpool after therapy [57, 56].

The fourth rehabilitation stage is from week 16 onwards;

- The major goals in this stage is to continue to strengthen the lower extremities, proprioception training, continue to improve cardiovascular fitness.

In this stage the focus is on;

- increasing resistance in cardio of stationary bike and stepper,
- running on treadmill
- beginning plyometric training
- Sensomotoric training on unstable surfaces
- Training muscle strength and coordination
- Preparation for sports activities
- Whirlpool after therapy [57, 56].

3 Case Study

3.1 Methodology

The practice was completed in Ústřední vojenská nemocnice (UVN) from the 1 of June 2020 to the 27 of June 2020. It was a total of four weeks, each day working for 4 hours.

My patient was assigned to me on the third day of my practice and I worked with her from the 3 of June until the 27 of June 2020 a total of 10 therapy sessions. The patient was made aware of the Ethical conduct and agreed to it by signing the informed consent from the Ethics Committee, therefore all procedures to follow were done with an absolute and clear consent from the patient.

The patient I chose was an orthopaedic patient who had undergone ACL reconstructions three weeks previously. Each session lasted 45 to 60 minutes and consisted of physical exercises and therapy such as soft tissue techniques, post isometric relaxation, mobilisation and active movement. The first therapy consisted of the initial examination of the patient: their history of the condition, their medical history, family history and their active daily living. Followed by the complete initial kinesiological examination of the patient. In the last session with the patient, the final examination was completed in line with the initial examination, which was used to measure the effectiveness of the therapy. Besides our sessions, the patient was also undergoing hydrotherapy, magnetotherapy and cryotherapy.

3.2 Anamnesis

3.2.1 Examined person

- Gender: female
- Year of birth: 1979

3.2.2 Diagnosis

The left ACL was reconstructed on the 14/05/20 using the patella ligament as a graft and the BTB technique. The surgeon also shaved the patella during the surgery.

3.2.3 Personal anamnesis

On the 23 of November 2019, she was dancing, and she fell and twisted her knee. She visited the doctor and she was informed it was just a small sprain. After the injury and

doctors visit she felt persistent pain and instability in the joint and the knee stayed inflamed with haematoma. During April 2020, she visited a new doctor who diagnosed the ACL rupture. The surgery was performed on the 14 of May 2020. Since the injury in November, she has gained 10 kg. The patient reports a visual analogue scale (VAS) of 1-4, the worst pain, 4 is felt at night.

3.2.4 Past Medical History:

When she was 5 years old, she was hit by a car and fractured her left clavicle and needed surgery, and she was in an upper extremity full brace for 6 weeks.

She has had two children via caesarean in 2012 and 2015.

She had gall bladder surgery in September 2019.

3.2.5 Excerpt from patient's health file (translated from Czech to English):

12.45pm-13.33pm, 14/05/2020

Operation: ACL reconstruction, BTB technique, shaving of patella

Text of the operational protocol:

- First, we removed the graft from the patella ligament in the standard way and it was adjusted to 10mm in diameter.
- Finding on sulcus of patella, shaving due to signs of chondropathy.
- Medial meniscus is intact, left untreated, lateral meniscus is normal, condyle cartilage is normal, complete lesions of ACL.
- Phoss levelling performed, guide wire under target, channelled 10 mm, threaded through graft, toned and anchored, screw, rinse and coagulate minor bleeding abrasions.
- Suture, cover, bandage and place in orthosis.
- Without complications.

3.2.6 Indications for rehabilitation

Whirlpool

Physiotherapeutic methods- Kinesiological assessment, soft tissue techniques, PIR, manual methods, active movement.

Magnetotherapy

3.2.7 Present status:

Subjective: the patient feels small pain when walking, she feels the largest amount of pain at night. She feels the pain in the anterior part of the knee and also deep in the knee joint. She is impatient to get back to dancing and she asked when she will be able to drive again.

Objective: She is walking without any assistive devices. She is eager to begin the rehabilitation and wants to resume her normal life as soon as she can. However, she is still tentative to actively move the knee.

- Height: 176cm
- Weight: 86kg
- BMI: 27.8, overweight
- Communication: physiological
- Cognition: physiological
- Dominant limb: left upper limb
- Assistive devices: she is walking without the crutches, and she is not using the knee brace. However, she wears the brace and uses the crutches when she is travelling to and from home to feel safer.

3.2.8 Chief complaint

Left Leg, ACL reconstruction, 14/05/2020

3.2.9 Medications

pharmacological anamnesis: none now, but she was taking anti-thrombolytic injections

3.2.10 Allergies

band aids, strapping tape

3.2.11 Abuses:

drinks alcohol 1 time per month

3.2.12 Diet:

Currently, she is eating a low carbohydrate diet because she would like to lose some weight.

3.2.13 Functional anamnesis:

Lives in a house, after the operation she slept on the ground floor of the house and three days ago she began sleeping in her bed on the first floor again.

3.2.14 Family anamnesis:

Mother had cancer; grandfather died at 33years old from cancer

3.2.15 Social anamnesis:

Two children, both parents still alive

3.2.16 Occupational anamnesis:

Financial advisor, she is also studying two days per week. She spends a lot of time sitting at a desk. She is currently on sick leave.

3.2.17 Sport, hobbies:

She was a dancer, and she still plays tennis and she practices yoga

3.2.18 Prior rehabilitation

The patient spent two days in the hospital after the surgery on the 15/04/2020 and was instructed on home exercises including thromboembolic prevention, isometric contraction on thigh muscles, sitting exercises, stabilizing exercises, closed chain exercises, walking with crutches, ascending and descending the stairs and cryotherapy.

02/06/20 is the first outpatient physiotherapy.

3.3 Initial Kinesiological Examination

3.3.1 Postural Examination:

Performed without assistive devices.

Anterior view

- The base of support- narrow, the right foot is more externally rotated than the left.
- Position and shape of the toes: both feet facing slightly outwards, toes not pressed
- Arches: both arches are flattened, both ankle joints are in valgosity
- Contour of calf muscles: right side larger than left, but both with muscle tonus but left with obvious atrophy.
- Shape and position of the knee: both knees in valgus with medial collapse of patella
- Shape of the thigh muscles: right side larger than left, left with obvious atrophy.
- Position of the pelvis: in line
- Symmetry of abdominal muscles: symmetrical, abdominal triangle larger on right side
- Position of umbilicus: centre
- Position of collarbones: left collar bone elevated
- Position of the shoulder girdle: left shoulder elevated
- Position of the head: tilted to the left side

Posterior view

- The base of support-narrow, right foot more turned outwards than left
- Shape of the heels: left heel is more swollen than right
- Shape and position of the ankle joint: right heel is turned inwards, contour and shape on right is normal, on left ankle swelling means bones prominences cannot be seen.
- Achilles tendon: appears normal shape on right, slight definition can be seen in centre of left but due to swelling it cannot be clearly seen.
- Contour of the calf muscles: right is larger than left, the medial side of both calves has less tone that the lateral, especially the left.
- Position of the knee joint: both knees are in valgosity
- Popliteal lines: symmetrical
- Contour of thigh muscles: right side is larger

- Sub-gluteal line: right sub-gluteal line extends further than left, consistent with atrophy of operated leg. However, even the right sub-gluteal line does not extend the length of the gluteal muscles.
- Gluteal muscles: right side with more muscle definition, left side dropped down lower. Both sides have poor muscle definition.
- Position of the pelvis: appears in line
- Position of the scapula: rotated anteriorly, medial borders are further apart than physiological.
- Position of the shoulder: left shoulder raised
- Position of the head: tilted slightly to left side

Right lateral view:

- Shape of ankle joint: normal
- Position of the knee joint: hyperextension
- Position of the pelvis: physiological anteversion
- Shape of the spine: lordosis in lumbar spine, slight kyphosis in thoracic. Lumbar lordosis larger than thoracic kyphosis
- Position of the shoulder: in protraction
- Position of the head: straight, no protraction

Left lateral view:

- Shape of ankle joint: physiological
- Position of the knee joint: in slight flexion (approximately 5 degrees)
- Position of the pelvis: physiological anteversion
- Shape of the spine: lumbar lordosis is larger than thoracic kyphosis
- Position of the shoulder: in protraction
- Position of the head: slight, not in protraction

Conclusion of Postural Examination

The patient externally rotates both feet and the medial arches are collapsed. The ankle and knee joints are in valgosity. She holds the left knee in slight flexion due to the

limitation after the surgery. The right knee is in hyperextension. There is atrophy and smaller size of the left thigh and lower leg.

She has global low muscle definition and a high level of subcutaneous tissue.

Both shoulders are elevated and held in protraction, but left shoulder is higher.

3.3.2 Palpation of pelvis

- Anterior superior iliac spines: right side higher
- Posterior superior iliac spines: right side higher
- Iliac crests: right side higher

Conclusion of Pelvis Palpation

The pelvis is shifted to the left side and is in slight anteversion.

3.3.3 Modification of standing:

Standing on tiptoes: patient was able to complete

Standing on heels: patient was able to complete it, but was unstable in position and couldn't hold it.

Conclusion

The patient can perform both tasks, however muscle weakness and stability prevented her from holding the position on heels.

3.3.4 Breathing stereotype:

- Standing-upper thoracic
- Sitting-lower thoracic
- Lying -lower thoracic

Conclusion of Breathing Examination

The patient elevated the rib cage during breathing in standing, minimal movement of the abdominal wall was observed. In lying rib flare was observed in inspiration.

3.3.5 Specific testing of posture:

- Two- scale standing- right leg- 45, left leg-40
- Vele test- negative, toes aren't pressed

- Romberg test- I, II, III all negative.
- Trendelenburg test- was performed on the 05/06/20 as it was contraindicated before. Her opposite hip drops when she stands on one leg when both sides were tested. Standing on left leg was worse. Test was positive.

Conclusion

Her weight distribution is very good, almost even. All other tests were physiological.

Edit; once Trendelenburg test was conducted and was found to be positive more gluteal exercises were added into the program.

3.3.6 Anthropometric measurements:

Table 3-1: Anthropometric Measurements

Measurement of		
Height in standing	176cm	
Height in sitting	92.7cm	
Arm span	174cm	
	Right Leg	Left Leg
Anatomical:	89.2cm	89.2cm
Functional	91cm	91cm
Length of thigh:	43.5cm	43.5cm
Length of calf	46.2cm	46.2cm
Foot	22cm	22.5cm
Circumference of thigh		
15cm above patella	64cm	58.5cm
10 cm above patella	57.5cm	55.5cm
Circumference of knee	45cm	47.5cm
Circumference of calf	42cm	40.5cm
Circumference of ankle	27.5cm	29.5cm
Circumference of foot	24.5cm	24.5cm

Conclusion of Anthropometric Examination

Lengths of both legs were symmetrical, however circumferences differed. The left leg was smaller around the muscle bulk of the thigh and the calf. This is consistent with atrophy of the muscles after the surgery. The circumference of the left knee was larger than the right, due to the inflammation still present after the surgery. The ankle was also swollen, and 2 cm larger in circumference.

3.3.7 Gait Examination

The patient walks without any assistive devices or brace. However, she said she is still using the crutches and brace when she is walking around outside.

Frontal View

- Width of base of support: wide
- Position of the feet: slight external rotation
- Rhythm: slow, shorter stance phase on operated leg.
- Movement of the foot: physiological
- Axial position of the lower limb: knees and ankles are in valgosity, both move even further medially during stance phase.
- Position and movement of the pelvis: pelvis bounces during locomotion, opposite side of pelvis drops during stance phase.
- Position of the spine: straight
- Movement of arms: left arm moves more than right arm
- Movement of the head: she looks down at the ground
- Stability of walking: stable

Side View

- Width of base of support: wide
- Position of the feet: slight external rotation.
- Stride length: smaller stride when the left leg is in stance.
- Movement of the foot: physiological
- Axial position of the lower limb: she leaves her left leg further behind.
- Movement and position of the knee and hip: left knee does not go into full extension.
- Position and movement of the pelvis: pelvis rotates and is bouncy during gait.

- Position of the spine: physiological
- Position of shoulders: both in protraction, left more than right
- Movement of the head: looking down at the ground.

Conclusion of Gait Examination

The patient walks with a limp and the stance phase of the left leg is not as long in duration as the right leg. She is still not confident in locomotion and relies on visual control of her feet and lower leg.

She has functional deficits in her gait, the collapse of the medial arch of the foot is pronounced and the knees fall further into valgosity in stance phase. She rotates her pelvis and drops the opposite side of the pelvis, consistent with Trendelenburg sign.

3.3.8 Modification of Gait

- Walking on narrow basis: ankle instability can be observed, and overall stability is impaired, she was not able to keep the narrow base for a prolonged time and she fell into wide stance.
- Walking on soft surfaces: ankle instability and medial collapse of ankle can be observed
- Walk with eyes closed: rhythm was slower, and patient was tentative, but she could complete it.
- Walk backwards: patient didn't actively use glutes and moved excessively with the pelvis.
- Walk on tiptoes: her heels turned inwards
- Walk on heels: she could complete the movement, but she was unstable.
- Walk in squatting: not examined as it was a contraindicated movement.

Conclusion Gait Modification Examination

The patient could complete all the modifications. Walk in squatting was not assessed as the movement is still contraindicated in the third week after surgery. Segmental and global instability was seen especially in the walking on narrow base. she was more cautious on the left leg in all movements but not pain was reported, only a feeling of pressure in the joint.

3.3.9 Measurement of ROM, Goniometry

Measured in supine

Table 3-2: Measurement of ROM, Goniometry

Motion	Right side: Active/ Passive	Left side: Active/ Passive
Ankle PF:	40°/ 45°	30°/ 35°
Ankle DF:	20°/ 25°	15°/ 20°
Ankle inversion:	30°/ 40°	35°/ 35°
Ankle eversion:	20°/ 25°	15°/ 20°
Knee flexion:	130°/ 135°	80°/ 85°
Knee extension:	+10°/ +15° in hyperextension	5°/ 0°
Hip IR:	30°/ 40°	25°/ 30°
Hip ER:	40°/ 45°	30°/ 35°
Hip ADD:	20°/ 20°	20°/ 20°
Hip ABD:	55°/ 65°	55°/65°
Hip flexion:	85°/ 90°	65°/ 80°
Hip extension:	20°/ 30°	15°/20°

Conclusion of Goniometry Examination

Due to the patient's weight, the barrier of passive flexion of the healthy knee joint was the soft subcutaneous tissue on the back of the thigh. The patient reported that she felt I could push the knee further however, the barrier was felt. Due to this can be hypothesized that passive range of motion of joints affected by the higher than normal subcutaneous tissue will be somewhat subjective.

According to the results in the healthy leg the patient has hypermobility of the hip and knee joints, this is especially seen in the 10° value of hyperextension in the knee joint of the healthy knee.

The operated knee joint has an expected lower range of motion, and the patient was not able to actively put the knee in extension. Almost all movements in the foot hip were more restricted in the operated leg.

3.3.10 Muscle length test (according to Kendall and Janda):

Table 3-3: Muscle Length Test (According to Kendall and Janda)

Muscle	Right	Left	Kendall/ Janda
Gastrocnemius	0	0	Acc. Janda
Soleus	0	1	Acc. Janda
One joint hip flexors	0	0	Acc. Kendall
Two joint hip flexors	0	1	Acc. Kendall
Hip adductors	0	0	Acc. Janda
Hamstring	0	0	Acc. Janda
Paravertebral muscles:	1		Acc. Janda
Forward bending test	Lumbar spine stayed in lordosis, movement occurred in hip joint and patient was able to touch toes.		
Piriformis	0	-	Acc. Janda

Conclusion of Muscle Length Test

The soleus and two joint hip flexors of the left leg were shortened, possibly due to the initial fixation and atrophy. Testing the length of the two joint flexors was incomplete as the patient felt pain and the knee could not be moved further into flexion.

Paravertebrals were tested in sitting according to Janda, patient had shortened paravertebrals and head was 13cm from knees.

The piriformis was not tested on the left leg as it was advised not to, due to the translatory pressure of the tibia on the femur.

3.3.11 Muscle Tone Palpation (According to Lewit)

Table 3-4: Muscle Tone Palpation (According to Lewit)

Muscle	Right	Left
Iliacus	Normal tonus	Normal tonus
Hamstring	Normal tonus	Normal tonus
Piriformis	Normal tonus	Normal tonus
Adductors	Normal tonus	Normal tonus
Gluteal muscles	Hypotone	Hypotone

Rectus femoris	Normal tonus	Hypertone
Vastus medialis	Hypotone	Hypotone
Tensor fasciae latae	Hypertone	Hypertone
Gastrocnemius	Normal tonus	Normal tonus
Soleus	Normal tonus	Hypertone

Conclusion of Muscle Tone Palpation

In the right leg; the posterior lower leg and tensor facia latae were in hypertone. The vastus medialis was in hypotone on both legs, indicating a deficit in the medial compartment of the leg. Many muscles on the operated leg were in hypertone, possibly as a result of the atrophy while in the brace with limited range motion and the consequent overuse of the muscles after they became weakened. Both gluteal muscles were in hypotone, which can be expected as they are also weakened as seen in the muscle strength examination below.

3.3.12 Muscle Strength Test of Lower Extremities (According to Kendall)

Table 3-5: Muscle Strength examination (According to Kendall)

Muscle	Right	Left
Gluteus maximus	3+	3
Iliopsoas	5	4+
Sartorius	4	3+
Tensor fasciae latae	5	5
Quadriceps femoris	5	3+
Hip flexors as a group	5	5
Hip adductors	5	4+
Gluteus minimus	4+	4
Glutes medius	4+	4
Lateral rotators of the hip	5	-
Medial rotators of the hip	4	-
Lateral hamstring	5	4+
Medial hamstring	5	4+

Popliteus	5	-
Ankle plantar flexors	4+	4
Soleus	5	4+
Peroneus longus	5	4+
Peroneus brevis	5	4+
Tibial anterior	4	4
Tibialis posterior	4+	4+

Conclusion of Muscle Strength Test

Gluteus maximus on both sides was weak.

The muscles in the operated leg were generally weaker than on the right leg. This is an expected result of the immobilisation after surgery.

Some tests were modified on the left leg due or pressure was applied just above, or as close to the knee as possible due to contraindications or limitations after surgery.

The iliopsoas was tested in sitting, because the supine test would put translatory pressure on the knee joint, however the knee could not be flexed more than 90 degrees.

The medial and lateral rotators of the hip joint were not tested on the left leg to avoid translatory pressure of the tibia on the femur.

Muscle strength of the popliteus was not tested on the left leg as the movement of the tibia on the femur is contraindicated. On the left leg the piriformis was tested and pressure was applied as close to the knee joint as possible to that the movement occurs in the pelvis and not knee joint.

Muscle strength of the lower leg was good with an expected slight decrease in strength on the operated leg.

3.3.13 Soft tissue and fascia examination (According to Lewit):

- Thigh: in right leg no restriction was found. In left leg, in lower thigh kiblers fold was hard to keep in craniocaudal direction, and patient reported a burning sensation.
- Knee: in right leg there was slight restriction in lateral side of knee. In left leg restriction was found in whole knee joint in all directions.

- Calf: no restriction in right leg, lower calf, lower than soleal line on left leg was restricted in craniocaudal direction.
- Ankle: Achilles tendon was no restricted in right leg, in left leg it felt tight in c-wave and s-wave.

3.3.14 Palpation of scar:

Scar is located along the length of the patella tendon. It is warm to touch, moves well with c-shape and s-shape in proximal scar, but distal part feels hard and isn't moveable, especially over the tibial tuberosity. The colour of the scar is dark purple, but it looks well-healed with just a few small parts of the scar still with a scab. She reports hypoesthesia around scar.

Conclusion of scar palpation:

The scar is healing well, but there are differences in the tissues along the length.

3.3.15 Joint play examination (According to Lewit):

Table 3-6: Joint play examination (According to Lewit)

Joint	Right	Left
Patella	No restriction	Restricted in all directions, especially caudally.
Head of fibula	No restriction	Restricted both posteriorly and anteriorly.
Talocrural	No restriction	No restriction
Subtalar	No restriction	Restricted
Talocalcaneonavicular	No restriction	No restriction
Lisfranc	No restriction	No restriction
Chopart	No restriction	No restriction

Conclusion

The patient had no restrictions in the healthy leg, the left leg was restricted around the knee joint

3.3.16 Movement stereotypes of lower extremity (according to Janda):

Hip extension:

Left- Lumbar paravertebral muscles were activated first along with the gluteal muscles. She completed the movement with hyperlordosis of lumbar spine and improper activation of glutes, paravertebral dominance.

Right- gluteal muscle recruitment was more fluid, however lumbar paravertebrals were still recruited in time with gluteal muscles resulting in the movement occurring in the lower back as well as hip joint.

Hip abduction:

Left- her pelvis moved further into anteversion at the beginning of the movement and the foot was turned inwards during the movement, indicated tensor fascia dominance and gluteus medius and minimus weakness.

Right- the movement was more fluid due to the higher muscle strength, but the hip stayed in flexion and the tensor fascia lata dominance could still be observed.

Conclusion

The patient has incorrect muscle recruitment order in both abduction and extension on both legs, while the movement was more fluid in the right leg due to the higher muscle tone the incorrect muscle recruitment order was the same in both.

3.3.17 Neurological examination

Superficial (tactile)

Tactile superficial sensation, tested by running my hands along the dermatomes of both legs and asking the patient about the sensation she felt.

Table 3-7: Superficial tactile sensation of the lower extremity

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

S2 segment	Normal sensation	Normal sensation

Conclusion

Patient has physiological sensation in all dermatomes; the only abnormality is in the left leg in the area around the scar tissue in which she has hyposthesia.

Deep sensation (proprioception)

Conducted with patient in supine with eyes closed.

Position sensation- the patient was instructed to move the body part on the right leg that the therapist was moving on the left leg. The patient was able to identify all movements. The sensation was then assessed on the right leg for comparison.

Start stop-patient was instructed to say when the movement starts and stops. Flexion of the toes, ankle and knee joint was tested and the patient was able to identify when the movement was beginning and ending. The sensation was then assessed on the right leg for comparison.

Deep tendon reflexes

Table 3-8: Deep tendon reflexes of the lower limb

Tendon	Right	Left
Patella	physiological	Not tested.
Achilles	physiological	physiological
Plantar	physiological	physiological

Conclusion

Deep sensation was physiological in in both legs.

3.3.18 Examination of hypermobility (according to Sachse):

Shoulder Joint ('scarf examination')- GRADE C, patients elbow passed more than halfway between midline and contralateral shoulder on both extremities.

Extension of knee- GRADE C, 15° of extension of right leg. Left leg was not tested for the purpose of hypermobility testing.

Rotation of hip joint- GRADE B, 100° tested on right leg.

Elbow extension while keeping elbows in contact- GRADE C, patient reached 140°

Lumbar spine anteflexion- GRADE C, patient could put palms on floor.

Conclusion of hypermobility examination;

The patient has grade C range of motion in 4 of the 5 tests and grade B in hip rotation. On this basis we can propose the patient has constitutional hypermobility.

3.3.19 Conclusion of kinesiological examination

The patient is a slightly overweight resulting in increased pressure on the lower extremities. The foot arches are flattened and the knees are rotated internally and in a valgus position in both legs. She naturally externally rotates her feet, possibly due to her training as a dancer over a long period. She hyperextends her right leg in standing. It can be hypothesized that the combination of these positions of the lower extremity would have put her at a higher risk of an ACL tear as it's in a lengthened position at rest.

In locomotion the patient relied on visual control, and she was not confident in movements from this we can presume that her proprioception would be lowered.

In the left leg the soleus and rectus femoris were both hypertonic and shortened. The strength of the left leg was decreased in most muscles, especially in the extensors of the knee and hip joints. The functional deficits of length and strength in the left, operated leg are likely as a result of muscle atrophy, lack of confidence and pain.

The left patella is restricted in all movements, and the fibula head is restricted. The left ankle joint had less range of motion and the subtalar joint was blocked. This was likely due to the fixation of the leg after surgery and the swelling present in the knee and whole lower leg.

Range of motion of all joints in the operated leg was decreased. All movements in the left ankle joint were between 5-10° less than the right ankle joint. The left knee joint had an active range of 5°-0°-80°, compared to the active range of motion of the right leg of +10°-0°-130°. This is expected after 3 weeks of immobilisation in the brace, another main cause of the decreased range of motion, especially in the ankle joint is the swelling. The swelling was documented in the anthropometric measurements in which the left knee was 2.5cm larger in circumference and the left ankle joint was 2cm larger in circumference compared with the right leg.

Her movement stereotypes of hip extension and abduction were incorrect in both legs. The incorrect muscle recruitment order and the dominance of certain muscles was more pronounced in the left leg due to the weakness of her glutes. In hip extension the lumbar lordosis was increased in the movement indicating the lumbar paravertebrals were dominant and the gluteus maximus was weak. In the hip abduction the leg was in flexion and the foot was turned in, indicated the tensor fascia lata dominance

A major factor in the incorrect stereotypes was the weakness of her gluteal muscles. Resulting in the recruitment of other muscles to assist in the movement.

After the goniometry examination in which the healthy knee could be extended to -15°, the muscle length tests in which the healthy leg was not shortened in any muscles and the muscle tone palpation which showed no hypertonic muscles in the healthy leg and few in the left leg it was decided to test for hypermobility. Hypermobility testing was all grade C according to Sachse and it was concluded the patient has constitutional hypermobility.

Stability was not specifically investigated but as a result of the decrease in muscle strength and the tentativeness of the patient in movements and her need for visual control of the lower extremity it can be predicted that her stability will be impaired. In the gait modification on a narrow base she was unable to complete it and fell into a wider stance.

3.4 Short term and long term combined physiotherapy plan

Short term rehabilitation plan;

Increase range of motion of left knee and ankle joints

Increase muscle strength, especially of gluteal muscles bilaterally and of operated lower extremity.

Decrease valgus position of ankle and knee joints in both legs

Release tightened fascia and subcutaneous tissue around left knee joint and left thigh

Improve stability and proprioception of both lower extremities

Improve scar mobility and promote healing

Improve gait stereotype

Decrease pain

Long term rehabilitation plan;

Restore complete muscle strength

Restore full range of motion to left knee

Decrease risk of reinjury by improving dynamic stability of both lower limbs.

Return patient to her hobbies such as dancing and tennis.

3.5 Therapy progress

3.5.1 First therapeutic unit, 02/06/2020

Patient current status:

Subjective: The patient was happy to start moving with her leg and begin regaining strength and mobility. She said she is still bringing the brace and her crutches when she leaves home in case her knee gets painful.

Objective: The patient still walks with a small limp. She was cautious to move the knee.

Goals of today's therapy;

- Increase range of motion
- Relaxation of hypertonic muscles
- Fascial release
- Muscle strengthening
- Assessment of patient's initial state

Procedure of today's therapy:

Initial kinesiological examination

Scar therapy- s-wave and c-wave

Soft tissue techniques with soft ball on left leg around knee joint and thigh muscles. Firstly rolling in cranial direction then also making c-wave and s-wave with balls for fascial release.

Muscle strengthening:

Active movement of hamstrings against gravity in prone position. Patient was instructed to bend the knee until she felt pain or blockage, then to lower the knee and repeat the exercise 10 times.

Abduction of leg against gravity in side-lying, patient was instructed to complete the exercise 10 times and 3 sets.

Adduction of legs. Patient in supine with knees and hips bent, squishy ball between knees, the patient was instructed to squeeze her knees together the exercise was repeated 10 times.

Open chain extension of knee, in sitting with squishy ball under knee, the patient was instructed to straighten her knee and raise her heel off the ground. Exercise was completed in three positions- neutral position of hip joint, slight external rotation of hip joint, slight internal rotation of hip joint. 3 sets of 10 repetitions

Knee flexion in reclined sitting position with foot on squishy ball. Patient was instructed to bend her knee and pull the foot towards her. 3 sets of 10 repetitions.

Heel raises in standing with hands on wall. 3 sets of 10 repetitions.

Patient was instructed to complete the above exercises at home. Completing 3 sets of 10 repetitions for each.

Result of today's therapeutic unit:

Subjective: The patient understood all the home exercises, she said the knee felt better in the end of the therapy, less painful and easier to move.

Objective: The patient was less cautious of the knee in the end of the therapy.

3.5.2 Second therapeutic unit, 05/06/2020

Patient current status:

Subjective: The patient is still using the crutches and brace when she's traveling from home, but she can walk without both with no problems. She said she is completely the exercises at home without problems, she feels some pain and pressure in the knee joint in walking and movements, but it was grade 3/10 subjectively.

Objective: The patient still walks with limp, and she is tentative when moving with the knee.

Goals of today's therapy:

- Decrease feeling of pain/pressure
- Increase range of motion
- Relaxation of shortened muscles
- Fascial release
- Muscle strengthening

Procedure of today's therapy:

Testing of Trendelenburg sign- positive.

Scar therapy- s-wave and c-wave

Soft tissue techniques with soft ball on left leg around knee joint and thigh muscles. Firstly rolling in cranial direction then also making c-wave and s-wave with balls for fascial release.

Mobilisation of patella, fibula head, talocrural, Lisfranc and chopart joints. Patella was restricted in all directions, especially caudally. Fibula head was restricted anteriorly so PIR was applied.

PIR of hamstrings.

PIR of hip flexors with emphasis on 2-joint hip flexors.

Gait training on normal surface:

- hip flexion, knee flexion, plantar flexion, toe extension in swing phase
- heel strike, roll along lateral arch, toe off in stance phase.
- Side walking, for gait stereotype training
- Walking backwards

<u>Muscle strengthening;</u>

Sitting on yoga ball, walking feet forwards and back while keeping seated on ball. 8 repetitions.

Sitting on yoga ball and rolling forwards to work on loaded knee flexion. The patient is instructed to sit on the ball and slowly roll forwards, keep in contact with the yoga ball then to push back into the sitting position again. After a few repetitions begin to lift slightly off ball at the end of movement. 8 repetitions

Standing on stimulation mat.

Patient was instructed for small foot and big foot. Pressure was applied on metatarsal heads 1 and 5 posteriorly and heel was fixated. Repeated 12 times.

Standing on the Posturomed- instruct the patient not to lock the knees, engage the core, pull the shoulders backwards and down. For 1-2 minutes.

Stepping over the Posturomed, unhealthy leg first, then healthy. instruct patient to keep small foot, and to keep body firm. 6 repetitions.

Side stepping over Posturomed. 4 repetitions.

Lunge onto Posturomed with unhealthy leg then healthy leg and hold position. Instruct patient not to let knee go further than toes. Move leg slightly forwards and backwards. Completed 3 times on each leg.

Walking on squishy mat, forwards then sideways then backwards. Poor control in ankle joint was observed, the medial arches were collapsing with each step. Completed 4 times.

Calf raises while holding onto bar for support. 3 sets of 10 repetitions.

Open chain extension of knee, in sitting with squishy ball under knee, the patient was instructed to straighten her knee and raise her heel off the ground. Exercise was completed in three positions- neutral position of hip joint, slight external rotation of hip joint, slight internal rotation of hip joint. 3 sets of 10 repetitions

Knee flexion in prone with 0.5kg weight for first set, 1kg for second and third sets. Three sets of 10 repetitions.

Side lying, bottom knee flexed, leg abduction first set with 0.5kg second and third sets with 1kg. Three sets of 10 repetitions.

Patient in supine with squishy ball between knees, adduct knees. Three sets of 10 repetitions.

Hamstring stretch in supine with strap around foot. In neutral, adduction, abduction.

In prone, knee flexed, strap around foot, pulling knee further into flexion. Patient reported pain and was instructed to not push further than the painful point of flexion.

Result of today's therapeutic unit:

Subjective: The patient reported feeling more ‘pressure’ around the knee joint at the end of the therapy than at the beginning. She expressed her frustration and wanting to be pain-free and able to move the knee normally.

Objective: The patient completed all the exercises without problems. Their progress was explained to them and the length of recovery was explained to her. She seemed to expect the recovery would be shorter.

3.5.3 Third therapeutic unit, 08/06/2020

Patient current status:

Subjective: The patient reported feeling a lot of pain Friday afternoon after the first session in the gym, but on Saturday and Sunday she completed the exercises with no pain.

Objective: The patient was in a good mood, she was still walking with a limp and dragging the left leg in locomotion. At beginning of therapy she could actively flex knee to 100 degrees.

Goals of today's therapy:

- Scar therapy
- Fascial release
- Increase range of motion
- Stretching of shortened muscles
- Muscle strengthening
- Improve stability of the lower extremities

Procedure of today's therapy:

Mobilisation of patella, fibula head, talocrural, Lisfranc’s, choparts joints

PIR of hip flexors especially 2-joint hip flexors.

Muscle strengthening:

Standing on stimulation mat

Small foot and big foot training. Pressure was applied on metatarsal heads 1 and 5 posteriorly and heel was fixated. Repeated 12 times.

Standing on the Posturomed- instruct the patient not to lock the knees, engage the core, pull the shoulders backwards and down. For 1-2 minutes.

Stepping over the Posturomed, unhealthy leg first, then healthy. instruct patient to keep small foot, and to keep body firm. 6 repetitions.

Side stepping over Posturomed. 4 repetitions.

Lunge onto Posturomed with unhealthy leg then healthy leg and hold position. Instruct patient not to let knee go further than toes. Move leg slightly forwards and backwards. Completed 3 times on each leg.

Walking on squishy mat, forwards then sideways then backwards.

Sitting on yoga ball, walking feet forwards and back while keeping seated on ball. 8 repetitions.

Sitting on yoga ball and rolling forwards to work on loaded knee flexion. The patient is instructed to sit on the ball and slowly roll forwards, keep in contact with the yoga ball then to push back into the sitting position again. After a few repetitions begin to lift slightly off ball at the end of movement. 8 repetitions

Calf raises while holding onto bar for support. 3 sets of 10 repetitions.

Squishy ball under knee, active extension. In neutral, turned out, turned in. two sets of 10 repetitions against gravity, third set with 0.5kg weight around ankle.

Knee flexion in prone with 1kg weight, 3 sets 10 repetitions. Patient could flex knee to 105 degrees

Side lying, bottom knee flexed, leg abduction with 1kg. 3 sets of 10 repetitions.

Patient in supine with squishy ball between knees TheraBand around outside of knees. Patient abducts and adducts knees. Three sets of 10 repetitions.

Hamstring stretch in supine with strap around foot. In neutral, adduction, abduction.

In prone, knee flexed, strap around foot, pulling knee further into flexion she could push knee to 110 degrees and didn't report any pain

Result of today's therapeutic unit:

Subjective: The patient said she felt better in this therapy than the first. She said she still feels some pressure and achy feeling in the knee after a lot of movement, but less.

Objective: The patient was less tentative with the knee, her movements were more physiological and less analgesic.

3.5.4 Fourth therapeutic unit, 10/06/2020

Patient current status:

Subjective: The patient felt no pain after the last therapy in the gym.

Objective: The patient could actively flex the knee to 100 degrees, but I think she is stopping the flexion before the end point because of fear of pain.

Goals of today's therapy:

- Scar therapy
- Fascial release
- Increase range of motion
- Stretching of shortened muscles
- Muscle strengthening
- Improve stability of the lower extremities

Procedure of today's therapy:

Scar therapy- s-wave and c-wave. Along the proximal scar the tissue is moveable, it is most stuck around the tibial tuberosity.

Soft tissue techniques, with soft ball on left leg around knee joint and thigh muscles. Kiblers fold around knee joint and thigh muscles, subcutaneous tissue was most stuck in medial knee.

Mobilisation of patella- was limited in caudal direction.

Mobilisation of fibula head- was very limited anteriorly so PIR of biceps femoris was applied then mobilisation was continued.

Mobilisation of talocrural, Lisfranc and choparts joints.

Talocrural joint was restricted so muscle length of triceps surae was tested, soleus was limited grade 1 according to Janda.

PIR of soleus and 2-joint hip flexors.

Muscle strengthening;

Standing on stimulation mat.

Small foot was completed active-assisted 4 times then actively 10 times.

Standing on the Posturomed- instruct the patient not to lock the knees, engage the core, pull the shoulders backwards and make the small foot. Practice moving the Posturomed anteriorly and posteriorly, then laterally.

Step over the Posturomed, unhealthy leg first, then healthy. Patient was instructed to try not looking at feet while walking to take away visual control and improve proprioception.

Side stepping over Posturomed.

Lunge onto Posturomed with unhealthy leg then healthy leg and hold position. Instruct patient not to let knee go further than toes. Move leg slightly forwards and backwards.

Walking on squishy mat, forwards then sideways then backwards.

Sitting on yoga ball, walking feet forwards and back while keeping seated on ball. 8 repetitions.

Sitting on yoga ball and rolling forwards to work on loaded knee flexion. The patient is instructed to sit on the ball and slowly roll forwards, lift slightly off ball at the end of movement then to push back into the sitting position again. 8 repetitions

Calf raises while holding onto bar for support. 3 sets of 10 repetitions.

Squishy ball under knee, active extension. In neutral, turned out, turned in. with 0.5kg weight.

Knee flexion in prone with 1kg weight repetitions. Patient could flex knee to 110 degrees

Side lying, bottom knee flexed, leg abduction 2kg 3 sets of 8 repetitions.

Patient in supine with squishy ball between knees TheraBand around outside of knees. Patient abducts and adducts knees. Three sets of 10 repetitions.

Hamstring stretch in supine with strap around foot. In neutral, adduction, abduction.

In prone, knee flexed, strap around foot, pulling knee further into flexion could push knee to 115 degrees and didn’t report any pain

Result of today's therapeutic unit:

Subjective: The patient feels good, she still feels like there is ‘pressure’ in the knee joint but less pain. She said she is feeling less scared with the knee movements. She really likes the joint mobilisations and soft tissue techniques, and she said she feels like she could sleep through them.

Objective: By the end of the therapy, the patient’s knee flexion had increased 5-10 degrees and when she walked out of the therapy her gait stereotype was more physiological and less analgesic.

3.5.5 Fifth therapeutic unit, 15/06/2020

Patient current status:

Subjective: The patient has begun doing cryotherapy three times per week and has been 4 times so far, she feels the knee is much better for three hours after the cryotherapy but then the pain comes back. She says when she walks up the stairs leaving the cryotherapy she feels no pain, but it’s the only time she can walk up the stairs pain free. She feels like her knee isn’t improving and its ‘stuck’ in the same point.

Objective: The patient could flex the knee to 100 degrees actively, I think her negative feelings about the injury progress are affecting her active movements at the beginning of each therapy.

Goals of today's therapy:

- Scar therapy
- Fascial release
- Increase range of motion
- Stretching of shortened muscles
- Muscle strengthening- increased intensity of strengthening exercises
- Improve stability of the lower extremities

Procedure of today's therapy:

Scar therapy- s-wave and c-wave. Along the proximal scar the tissue is moveable, it is most stuck around the tibial tuberosity.

Soft tissue techniques, with soft ball on left leg around knee joint and thigh muscles. Kiblers fold around knee joint and thigh muscles, subcutaneous tissue was most stuck in medial knee.

Mobilisation of patella- was limited in caudal direction

Mobilisation of fibula head, talocalcaneal, Lisfranc and choparts joints

PIR of hamstrings, hip flexors and soleus.

Joint play of fibula head and talocrural joint was retested after PIR and both were improved

Cardiovascular fitness:

5 minutes on Stationary bike

5 minutes on stepper with low resistance at level 1

5 minutes on treadmill

2 minutes walking forwards focusing on gait training for example; correct heel strike, extend knee during stance phase, flex knee during swing phase,

1 minute walking sideways

1 minute walking backwards

Muscle strengthening:

Walking on unstable platforms and holding on one leg. Focusing on not hyperextending stance leg.

Standing on Bosuball.

Walking on tight rope- she needed me to walk along beside her to use my hand as balance.

Squats - wall slide with gym ball behind back and oval ball between knees. Instructed to keep hip, knees and feet in line, not to let knees extend over toes, not drop lower than 90 degrees of knee flexion. Instructing the patient to focus on equally distributing her weight on both legs.

Patient in sitting with squishy ball under knee, active extension in neutral with 1kg weight around ankle. 3 sets of 10 repetitions.

Hamstrings bridges with squishy ball between knees to keep knees from going into valgosity. 3 sets of 10 repetitions.

Knee flexion in prone with 1kg weight repetitions. Patient could flex knee to 120 degrees. 3 sets of 10 repetitions.

Side lying, bottom knee flexed, leg abduction 2kg 3 sets of 10 repetitions.

Result of today's therapeutic unit:

Subjective: The patient said she feels some muscle pain in the side of her leg but a 'good pain' from the exercises.

Objective: At the end of the therapy the patient could flex the knee 10 degrees more than at the beginning and she is still improving in strength and range of motion. It seems she is using the IT band more than her glutes in leg abduction so next therapy we will test Trendelenburg sign.

3.5.6 Sixth therapeutic unit, 17/06/2020

Patient current status:

Subjective: The patient feels good, doesn't feel much pain and she said she's happy to be starting on the stationary bike, she has been using a stationary bike at cryotherapy too and she said she's enjoying exercising more.

Objective: The patient is in a better mood and more positive than the last therapy. Active flexion at the beginning of therapy was 115 degrees.

Goals of today's therapy:

- Scar therapy
- Fascial release
- Increase range of motion
- Stretching of shortened muscles
- Improve stability of the lower extremities
- Muscle strengthening

Procedure of today's therapy:

Scar therapy- s-wave and c-wave. Along the proximal scar the tissue is moveable, it is most stuck around the tibial tuberosity.

Soft tissue techniques, with soft ball on left leg around knee joint and thigh muscles. Kiblers fold around knee joint and thigh muscles, subcutaneous tissue was most stuck in medial knee.

Mobilisation of patella- was limited in caudal direction

Mobilisation of fibula head, talocalcaneal, Lisfranc and choparts joints

PIR of hamstrings, hip flexors and soleus.

Cardiovascular fitness:

5 minutes stationary bike

5 minutes on stepper with low resistance at level 1

5 minutes on treadmill

2 minutes walking forwards focusing on gait training for example; correct heel strike, extend knee during stance phase, and flex knee during swing phase

1 minute walking sideways

1 minute walking backwards

Muscle strengthening:

Walking over Posturomed. Focusing on keeping knees soft, not hyperextending, looking up to take away visual control.

Walking on unstable platforms and holding on one leg. Focusing on not hyperextending stance leg.

Tight rope- three times using my hand to help with balance, once on her own.

Standing with yellow (lightest) TheraBand around knees and touching toes to three points away to work on glute strength in stance phase. Three sets of 4 repetitions on both legs. Instruct patient to hold hips stable.

Bridge with band around knees, focus on keeping knees in line and not fall into valgosity

Wall squats- wall slide with gym ball behind back and oval ball between knees. Instructed to keep hip, knees and feet in line, not to let knees extend over toes, not drop lower than

90 degrees of knee flexion. Instructing the patient to focus on equally distributing her weight on both legs. Knee cracked but was not painful first set with oval ball between knees for first set and second and third sets without ball between knees and focusing not to let the knees fall into valgus.

In prone, knee flexed, strap around foot, pulling knee further into flexion could push knee to 120 degrees and didn't report any pain.

Result of today's therapeutic unit:

Subjective: The patient said she really felt her glutes are more tired, but she didn't feel pain in the knee. Still she said she was feeling pressure in the knee joint.

Objective: We worked a lot more on glute strength today to improve gait stereotype and hold lower extremity in a better position. By the end of the therapy her pelvis appeared to be lees bouncy during gait.

3.5.7 Seventh therapeutic unit, 19/06/2020

Patient current status:

Subjective: The patient reported that she was feeling a lot of pain today.

Objective: The patient's left knee was red, warm and swollen. The diameter of the left knee was 46.8cm and the right knee was 44.9cm. Range of motion of knee flexion was 110 degrees

Goals of today's therapy:

- Decrease pain
- Improve range of motion
- Improve stability of the lower extremities

Procedure of today's therapy;

Scar therapy- s-wave and c-wave. The scar is still healing well and but was warm touch around, it is most stuck around the tibial tuberosity.

Soft tissue techniques, with soft ball on left leg around knee joint and thigh, rolling in cranial direction to encourage lymph drainage. Kiblers fold around quadriceps, fascia felt very stiff and stuck, but fold was tolerated by patient.

Mobilisation of patella; was very limited in all directions especially caudal.

Mobilisation of head of fibula, talocrural, Lisfranc, choparts, metatarsophalangeal.

PIR of quadriceps, 2 joint hip flexors were limited.

PIR of biceps femoris, gastrocnemius and soleus.

Trigger point release of proximal tensor fascia latae and soft tissue techniques along whole fascia.

Trigger point release of hamstrings, especially around insertion of semimembranosus and semitendinosus.

Standing on stimulation mat.

Practice small foot walking on Posturomed, only forwards today as gait stereotype was analgesic and knees were turning into valgosity in stance phase sometimes. Focus on slow controlled movements and holding body firmly.

Walking forwards on soft matt, focus on small foot in stance and on slow movements.

Sitting with squishy ball under knee, active extension. In neutral against gravity with no weight.

'Clams'- patient in side lying with knees bend, hip external rotation and abduction, keeping feet together and not moving hips. To work on gluteal strength. 3 sets of 10 repetitions.

Patient went for hydrotherapy and then after she came back and lymphodrenage taping was applied to the knee. She was instructed to try to keep the tape until next therapy, but because she has a history of skin allergic reactions to tape, I instructed her to remove if there was any feeling of discomfort.

Result of today's therapeutic unit:

Subjective- She reported less pain than at the beginning of therapy.

Objective- Knee flexion was tested again, and patient reached 115 degrees. I instructed her to rest until the next therapy, I instructed her to elevate and ice the knee over the weekend.

3.5.8 Eighth therapeutic unit, 22/06/2020

Patient current status;

Subjective- patient was in a much better mood, she said she has no pain in walking and the knee feels much better than on Friday. She rested and iced the knee all weekend.

Objective- Lymphodrenage taping was removed and she reported no having any skin reaction. knees were same temperature and colour. Left knee was 45.3cm in circumference and right knee was 44.6cm. Left knee active flexion was 120 degrees. Inflammation and range of motion was really improved from last therapeutic session.

Goals of today's therapy:

- Scar therapy
- Fascial release
- Increase range of motion
- Stretching of shortened muscles
- Muscle strengthening
- Improve stability of the lower extremities

Procedure of today's therapy:

Scar therapy- s-wave and c-wave. Along the proximal scar the tissue is moveable; it is still stuck around the tibial tuberosity.

Soft tissue techniques, with soft ball on left leg around knee joint and thigh muscles. Kiblers fold around knee joint and thigh muscles, subcutaneous tissue was most stuck in medial knee.

Mobilisation of patella- was limited in caudal, cranial and lateral directions.

Mobilisation of fibula head, talocrural, Lisfranc and choparts joints

PIR of hamstrings, 2-joint hip flexors, soleus and gastrocnemius

Cardiovascular fitness:

5 minutes stationary bike

5 minutes on stepper with low resistance

5 minutes on treadmill

2 minutes walking forwards focusing on gait training for example; correct heel strike, extend knee during stance phase, flex knee during swing phase

1 minute walking sideways

1 minute walking backwards

Muscle strengthening:

Standing on stimulation mat

Practising small foot and big foot exercise. First 3 were active-assisted and after 10 were completed actively. Pressure was applied on metatarsal heads 1 and 5 posteriorly and heel was fixated.

Posturomed- standing on platform, stepping over forwards, stepping over sideways. Patient was instructed to keep knees 'soft' and not lock them in extension.

Lunging onto Bosuball, then squatting on Bosuball. Focussing on keeping toes, knees and hips inline, small foot.

Tight rope- first two with therapists' hand, second two on her own.

Sitting with squishy ball under knee, knee extensions with 2kg weight around ankle. 10 repetitions with no pain.

Knee extensions 2.5 kg on machine, limited between 60-0 degrees Quality of movement was good in 2.5kg so it was taken up to 3.5kg 10 repetitions. In 3.5 kg quality was still good so weight was put to 4.5kg and another 10 repetitions was completed.

Hamstring curls on machine with 7.5 kg. Machine was locked between 80-0 degrees. She was instructed to complete the eccentric contraction slower.

Crab walk with green TheraBand around knees 4 x 10 repetitions on each leg. in last set knees were falling into valgosity.

Clams for 1 set of 10 repetitions to keep focus on gluteal strengthening without valgus pressure on knees.

Lunge stance resisting valgus pull of TheraBand around knee. 3 x 10 repetitions.

Instruction of single leg deadlifts with no weight for home program.

Hamstring stretch in supine with strap around foot. In neutral, adduction, abduction.

In prone, knee flexed, strap around foot, pulling knee further into flexion she could push knee to 120 degrees and didn't report any pain

Result of today's therapeutic unit:

Subjective: The patient was really happy to complete the strengthening program with no pain and she felt her leg muscles were tired at the end of the therapy.

Objective: The patient completed the strengthening program really well and I was surprised with the weight she could complete on the knee extension machine. Her range of motion of the left knee was consistently 120 degrees throughout the therapy. Her patella was still limited, but this could be due to her moving the knee less and being more cautious with it since the last therapy.

3.5.9 Ninth therapeutic unit, 22/06/2020

Patient current status;

Subjective: The patient was feeling less pain in the knee, just 'pressure' and only feels pain in full flexion, no other movements.

Objective: The patient has more confidence in gait and movements of the knee.

Goals of today's therapy:

- Scar therapy
- Fascial release
- Muscle strengthening
- Mobilisation of restricted joints
- Improve stability of the lower extremities

Procedure of today's therapy:

Scar therapy- s-wave and c-wave. Along the proximal scar the tissue is moveable, it is still stuck around the tibial tuberosity.

Soft tissue techniques, with soft ball on left leg around knee joint and thigh muscles. Kiblers fold around knee joint and thigh muscles.

Mobilisation of patella- was limited in caudal direction.

Mobilisation of fibula head, talocrural, Lisfranc and chopart joints

PIR of hamstrings, 2-joint hip flexors.

Cardiovascular fitness;

5 minutes stationary bike

5 minutes on stepper with low resistance at Level 1

5 minutes on treadmill;

2 minutes walking forwards focusing on gait training for example; correct heel strike, extend knee during stance phase, flex knee during swing phase,

-1 minute walking sideways

-1 minute walking backwards.

Standing on stimulation mat

Muscle strengthening;

Practicing small foot and big foot exercise, first 3 were active-assisted and after 10 were completed actively. Pressure was applied on metatarsal heads 1 and 5 posteriorly and heel was fixated.

Posturomed- standing on platform, stepping over forwards, soft mat was placed on top of Posturomed. Stepping over sideways over Posturomed. Patient was instructed to keep knees 'soft' and not lock them in extension.

Walking across unstable surfaces, adding in upper extremity movements too by throwing soft ball between patient and myself.

Tight rope- first two with my hand, second two on her own.

Squatting on Bosuball, focusing on keeping toes, knees and hips inline. 3 sets of 10 repetitions.

Knee extensions 4 kg on machine, limited between 70-0 degrees, 10 repetitions for first set. Quality of movement was good, so it was increased to 5kg 10 repetitions. Movement quality was still good in second set so third set of 10 was completed with 6 kg.

Hamstring curls on machine with 7.5 kg. Machine was locked between 80-0 degrees. She was instructed to complete the eccentric contraction slower. Two sets of 10 repetitions with 7.5kg, then third set with 8.5kg.

Crab walk with green TheraBand around knees 6 x 10 repetitions on each leg. she was instructed to keep her knees from falling into valgosity.

Hamstring stretch in supine with strap around foot. In neutral, adduction, abduction.

In prone, knee flexed, strap around foot, pulling knee further into flexion she could push knee to 120 degrees and didn't report any pain

Result of today's therapeutic unit:

Subjective: The patient said she would like to increase the range of motion in her left knee to be the same as her right knee, but I explained that her current range of motion of -5-0-120 is functional, and more important now is improving her strength.

Objective: The patient's strength is improving well and the quality of her movements is getting better, she is able to walk on unstable surfaces and hold her body position, but she still hyperextends her knees and lets them fall into valgus when she's tired.

3.5.10 Tenth therapeutic unit, 22/06/2020

Patient current status:

Subjective: The patient was feeling good, she said she feels no pain in the knee now, just pressure when she's bending it into a large degree of flexion.

Objective: The patient was eager to begin the therapy and she was positive about how her knee was feeling.

Goals of today's therapy:

- Scar therapy
- Fascial release
- Muscle strengthening
- Improve stability of the lower extremities

Procedure of today's therapy:

Final kinesiological examination

Scar therapy- s-wave and c-wave. Along the proximal scar the tissue is moveable, it is still stuck around the tibial tuberosity.

Soft tissue techniques, with soft ball on left leg around knee joint and thigh muscles. Kiblers fold around knee joint and thigh muscles.

Mobilisation of patella- was free in all directions.

Mobilisation of fibula head, talocrural, Lisfranc and chopart joints

PIR of 2-joint hip flexors.

Cardiovascular fitness:

5 minutes stationary bike

5 minutes on stepper with low resistance at Level 1

5 minutes on treadmill;

2 minutes walking forwards focusing on gait training for example; correct heel strike, extend knee during stance phase, flex knee during swing phase,

1 minute walking sideways

1 minute walking backwards.

Standing on stimulation mat

Muscle strengthening:

Practicing small foot and big foot exercise, 12 repetitions completed actively.

Posturomed- standing on platform, stepping over forwards, soft mat and other squishy surfaces were placed on top of Posturomed. Stepping over sideways over Posturomed. Patient was instructed to keep knees 'soft' and not lock them in extension and hold body posture.

Walking across unstable surfaces, adding in upper extremity movements too by throwing soft ball between patient and myself.

Knee extensions 6 kg on machine, limited between 90-0 degrees, 10 repetitions for first set. Quality of movement was good, so it was increased to 8kg for the next two sets of 10 repetitions.

Hamstring curls on machine with 8.5 kg. Machine was locked between 80-0 degrees. Three sets of 10 repetitions.

Crab walk with green TheraBand around knees 6 x 10 repetitions on each leg. she was instructed to keep her knees from falling into valgosity.

Lunge stance resisting valgus pull of TheraBand around knee. 3 x 10 repetitions.

Hamstring stretch in supine with strap around foot. In neutral, adduction, abduction.

In prone, knee flexed, strap around foot, pulling knee further into flexion she could push knee to 125 degrees and didn’t report any pain

Result of today's therapeutic unit:

Subjective: The patient was really happy when she saw the progress of her range of motion and anthropometric measurements from the initial examination to the final examination.

Objective: The patient was really engaged with the exercises today and her balance and ankle stability were much better than in previous therapies.

3.6 Final kinesiological examination

3.6.1 Postural Examination:

Anterior view

- The base of support- normal
- Position and shape of the toes: feet facing forwards, toes not pressed
- Arches: arches are flattened especially the left, ankle joint is in valgosity
- Contour of calf muscles: symmetrical
- Shape and position of the knee: both knees in valgus with medial collapse of patella
- Shape of the thigh muscles: Lower thigh muscles are symmetrical, but top of thigh on right side still larger than left especially on medial side.
- Position of the pelvis: in line
- Symmetry of abdominal muscles: symmetrical, abdominal triangle larger on right side
- Position of umbilicus: centre
- Position of collarbones: left collar bone elevated
- Position of the shoulder girdle: left shoulder elevated
- Position of the head: tilted to the left side

Posterior view

- The base of support-normal
- Shape of the heels: symmetrical
- Shape and position of the ankle joint: symmetrical, both in valgus position
- Achilles tendon: both have tonus, right slightly more than left. They are located in the centre of ankle joint, the left is slightly more angled outwards.
- Contour of the calf muscles: symmetrical
- Position of the knee joint: both knees are in valgosity
- Popliteal lines: symmetrical
- Contour of thigh muscles: Lower thigh muscles are symmetrical, but top of thigh on right side still larger than left especially on medial side.
- Sub gluteal line: right sub gluteal line extends further than left
- Gluteal muscles: Both with low muscle tonus.

- Position of the pelvis: in line
- Position of the scapula: rotated anteriorly, medial borders are further apart than physiological.
- Position of the shoulder: left shoulder raised
- Position of the head: tilted slightly to left side

Right lateral view:

- Shape of ankle joint: physiological
- Position of the knee joint: hyperextension
- Position of the pelvis: physiological anteversion
- Shape of the spine: lordosis in lumbar spine, slight kyphosis in thoracic. Lumbar lordosis larger than thoracic kyphosis
- Position of the shoulder: in slight protraction
- Position of the head: straight, no protraction

Left lateral view:

- Shape of ankle joint: physiological
- Position of the knee joint: straight, not hyperextended
- Position of the pelvis: physiological anteversion
- Shape of the spine: lumbar lordosis is larger than thoracic kyphosis
- Position of the shoulder: very protracted
- Position of the head: not in protraction

Conclusion of Postural Examination

The medial arch on the left foot is slightly more flattened than the right and as a result the left Achilles tendon appears more angled. Muscle tonus on both legs appears symmetrical, just at the top of the right thigh the medial side appears to have more bulk.

The gluteal line of the left side was more extended than in the initial examination but still shorter than on the right side. While the gluteal lines were increased the muscles still were in low tonus and bulk.

Shoulder a-symmetry of left side elevation and protraction was unchanged from initial examination.

3.6.2 Modification of standing:

- Standing on tiptoes: patient was able to complete
- Standing on heels: patient was able to complete it, but was unstable in position.
- Trendelenburg test: positive

Conclusion:

Patient was able to perform all movements, opposite hip still dropped in Trendelenburg test, but it was a much slighter movement than in initial examination.

3.6.3 Palpation of pelvis

- Anterior superior iliac spines: right side higher
- Posterior superior iliac spines: right side higher
- Iliac crests: right side higher

Conclusion of Pelvis Palpation

The pelvis is shifted to the left side and is in slight anteversion.

3.6.4 Breathing stereotype:

- Standing-upper thoracic
- Sitting-lower thoracic
- Lying -lower thoracic

Conclusion of Breathing Examination

The patient elevated the rib cage during breathing in standing, minimal movement of the abdominal wall was observed. In lying rib flare was observed in inspiration.

3.6.5 Specific testing of posture:

- Two- scale standing- right leg- 45, left leg-40
- Vele test- negative, toes aren’t pressed
- Rhomberg test- I, II, III all negative.

Conclusion

Her weight distribution is almost symmetrical. All other tests were physiological.

3.6.6 Anthropometric measurements:

Table 3-9: Anthropometric Measurements

Measurement of		
Height in standing	176cm	
Height in sitting	92.7cm	
Arm span	174cm	
	Right Leg	**Left Leg**
Anatomical:	89.2cm	89.2cm
Functional	91cm	91cm
Length of thigh:	43.5cm	43.5cm
Length of calf	46.2cm	46.2cm
Foot	22cm	22.5cm
Circumference of thigh		
15cm above patella	62cm	61.5cm
10 cm above patella	57cm	57cm
Circumference of knee	45cm	45.5cm
Circumference of calf	42cm	42cm
Circumference of ankle	27.5cm	27.5cm
Circumference of foot	24.5cm	24.5cm

Conclusion of Anthropometric Examination

Circumference 15cm above the knee joint of the left thigh was 0.5cm smaller than the right thigh. 10cm above the knee joint the right and left thighs were the same circumference. This Indicates a great improvement in muscle bulk in the operated leg.

The circumference of the knee joint was still slightly higher, 0.5cm, than the left knee, due to inflammation.

Circumference of the lower legs were symmetrical.

3.6.7 Gait Examination

The patient walks without any assistive devices or brace.

Frontal View

- Width and base of support: normal
- Position of the feet: slight external rotation
- Rhythm: normal
- Movement of the foot: physiological
- Axial position of the lower limb: knees and ankles are in valgosity, both move even further medially during stance phase.
- Position and movement of the pelvis: pelvis bounces during locomotion, opposite side of pelvis drops during stance phase.
- Position of the spine: straight
- Movement of arms: left arm moves more than right arm
- Movement of the head: she looks down at the ground
- Stability of walking: stable

Side View

- Width and base of support: normal
- Position of the feet: slight external rotation.
- Stride length: normal in both
- Movement of the foot: physiological
- Axial position of the lower limb: she moves more with pelvis but both legs move symmetrically.
- Movement and position of the knee and hip: physiological in knee joint, the hip joint rotates rather than going into full extension.
- Position and movement of the pelvis: pelvis rotates and is bouncy during gait.
- Position of the spine: physiological
- Position of shoulders: both in protraction, left more than right
- Movement of the head: looks straight.

Conclusion of Gait Examination

Both legs move symmetrically, and stance phase is of equal during in both. They both fall into valgus in stance phase and the hip is bouncy and rotates. Because of her

hypermobility and low muscle tonus we can hypothesize that the hip rotates rather than extending because of poor muscle control rather that tightened muscle.

She looks straight ahead of her instead of at her feet.

3.6.8 Modification of Gait

- Walking on narrow basis: ankle instability can be observed but movement was completed
- Walking on soft surfaces: ankle instability and medial collapse of ankle can be observed
- Walk with eyes closed: able to complete
- Walk backwards: completed with rotation of pelvis
- Walk on tiptoes: able to complete with good stability
- Walk on heels: able to complete
- Walk in squatting: able to complete but knees dropped into valgus

Conclusion Gait Modification Examination

Her global stability was good and she was able to complete all modifications, instability in ankle joint and valgus position was still observed.

3.6.9 Measurement of ROM, Goniometry

Table 3-10: Measurement of ROM, Goniometry

Motion	Right side: Active/ Passive	Left side: Active/ Passive
Ankle PF:	40°/ 45°	40°/ 45°
Ankle DF:	20°/ 25°	20°/ 25°
Ankle inversion:	35°/ 40°	35°/ 40°
Ankle eversion:	20°/ 25°	15°/ 20°
Knee flexion:	135°/ 140°	120°/ 125°
Knee extension:	+10°/ +15° in hyperextension	0°/ -5°
Hip IR:	30°/ 40°	30°/ 40°
Hip ER:	40°/ 45°	40°/ 45°
Hip ADD:	20°/ 20°	20°/ 20°

Hip ABD:	55°/ 65°	55°/65°
Hip flexion:	85°/ 90°	85°/ 90°
Hip extension:	20°/ 30°	20°/30°

Conclusion of Goniometry Examination

Range of motion of all joints on the left leg was improved. Ankle plantar flexion and dorsiflexion were the same in the right and left legs, eversion of the left ankle was still slightly decreased.

Range of motion of left knee was still slightly lower than right knee, but taking into account her constitutional hypermobility, 0°-0°-120° active range of motion of the left knee is functional.

Movements in the hip joint were symmetrical on both the left and right legs.

3.6.10 Muscle length test (according to Kendall and Janda):

Table 3-11: Muscle Length Test (According to Kendall and Janda)

Muscle	Right	Left	Kendall/ Janda
Gastrocnemius	0	0	Acc. Janda
Soleus	0	0	Acc. Janda
One joint hip flexors	0	0	Acc. Kendall
Two joint hip flexors	0	0	Acc. Kendall
Hip adductors	0	0	Acc. Janda
Hamstring	0	0	Acc. Janda
Paravertebral muscles:		0	
Piriformis	0	0	Acc. Janda

Conclusion of Muscle length examination:

No muscles were shortened.

3.6.11 Muscle Tone Palpation (According to Lewit)

Table 3-12: Muscle Tone Palpation (According to Lewit)

Muscle	Right	Left

Iliacus	Normal tonus	Normal tonus
Hamstring	Normal tonus	Normal tonus
Piriformis	Normal tonus	Normal tonus
Adductors	Normal tonus	Normal tonus
Gluteal muscles	Normal tonus	Normal tonus
Rectus femoris	Normal tonus	Normal tonus
Vastus medialis	Hypotone	Hypotone
Tensor fasciae latae	Hypertone	Hypertone
Gastrocnemius	Normal tonus	Normal tonus
Soleus	Normal tonus	Normal tonus

Conclusion of Muscle Tone Palpation

Tonus of both legs was symmetrical, vastus medialis was in hypotone while tensor fascia lata was in hypertone.

3.6.12 Muscle Strength Test of Lower Extremities (According to Kendall)

Table 3-13: Muscle Strength examination (According to Lewit)

Muscle	Right	Left
Gluteus maximus	4+	4+
Iliopsoas	5	4+
Sartorius	4+	4+
Tensor fasciae latae	5	5
Quadriceps femoris	5	4+
Hip flexors as a group	5	4+
Hip adductors	5	4+
Gluteus minimus	4+	4+
Glutes medius	4+	4+
Lateral rotators	5	5
Medial rotators	5	5
Lateral hamstring	5	5

Medial hamstring	5	5
Popliteus	5	-
Ankle plantar flexors	5	5
Soleus	5	5
Peroneus longus	5	5
Peroneus brevis	5	5
Tibial anterior	4+	4
Tibialis posterior	5	5

Conclusion of Muscle Strength Test

The gluteal muscles were both stronger than in the initial muscle strength examination, although still not grade 5.

Left leg was still slightly weaker in the thigh muscles. The lower leg strength was symmetrical except for the tibialis anterior, which was slightly weaker.

3.6.13 Soft tissue and fascia examination (According to Lewit):

- Thigh: in right leg no restriction was found. Left leg was still with restriction but only slight.
- Knee: no restriction in either knees.
- Calf: no restriction in right leg, below soleal line on left leg was restricted.
- Ankle: Achilles tendon was not restricted c and s shape was applied and the tendon felt to have good elasticity in both legs.
- Scar: the scar is well healed and moves well, distally around the tibial tuberosity is harder to move.

3.6.14 Palpation of scar:

Scar is located along length of patella tendon. It is the same temperature as the surrounding tissues, it moves well with c-shape and s-shape in the proximal scar, but distal part is less moveable especially over the tibial tuberosity. The colour of the scar is pink and well healed. She reports hypoesthesia around scar.

Conclusion of scar palpation:

The scar is healing well, but there are differences in the tissues along the length.

3.6.15 Joint play examination (According to Lewit):

Table 3-14: Joint play examination (According to Lewit)

Joint	Right	Left
Patella	No restriction	Restricted caudally
Head of fibula	No restriction	No restriction
Talocrural	No restriction	No restriction
Subtalar	No restriction	No restriction
Talocalcaneonavicular	No restriction	No restriction
Lisfranc	No restriction	No restriction
Chopart	No restriction	No restriction

Conclusion of joint play examination

Only restriction was in caudal movement of patella.

3.6.16 Movement stereotypes of lower extremity (according to Janda):

Hip extension:

Of both right and left legs- Lumbar paravertebrals were still recruited in time with gluteal muscles resulting in the movement occurring in the lower back as well as hip joint in both the right and left legs.

Hip abduction:

Of both right and left legs- Her pelvis moved further into anteversion at the beginning of the movement and the foot was turned inwards during the movement, indicated tensor fascia dominance and gluteus medius and minimus weakness in both legs.

Conclusion

The patient has incorrect muscle recruitment order in both abduction and extension on both legs. However, the movement was equally fluid in both legs.

3.6.17 Neurological examination

Superficial (tactile) Neurological Examination

Tactile superficial sensation, tested by running my hands along the dermatomes of both legs and asking the patient about the sensation she felt.

Table 3-15: Superficial tactile sensation of the lower extremity

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

Conclusion

Patient has physiological sensation in all dermatomes, the only abnormality was in the left leg in the area around the scar tissue in which she has hyposthesia.

Deep sensation Neurological examination

Conducted with patient in supine with eyes closed.

Position sensation- the patient was instructed to move the body part on the right leg that the therapist was moving on the left leg. The patient was able to identify all movements. The sensation was then assessed on the right leg for comparison.

Start stop-patient was instructed to say when the movement starts and stops. Flexion of the toes, ankle and knee joint was tested and the patient was able to identify when the movement was beginning and ending. The sensation was then assessed on the right leg for comparison.

Deep tendon reflexes

Table 3-16: Deep tendon reflexes of the lower limb

Tendon	Right	Left
Patella	physiological	Physiological
Achilles	physiological	physiological
Plantar	physiological	physiological

Conclusion

Deep sensation was physiological in in both legs.

3.6.18 Conclusion of Final Examination

Medial arches of both feet remained in valgus, the left foot was slightly more flattened than the right and as a result the left Achilles tendon appeared more angled. Muscle tonus on both legs was symmetrical, just at the top of the right thigh the medial side appears to have more bulk. This indicated a great success in the rehabilitation program in restoring complete muscle strength in the operated leg.

The gluteal line of the left side was more extended than in the initial examination but still shorter than on the right side. While the gluteal muscles were increased, they still were in low tonus and bulk.

Shoulder a-symmetry was unchanged throughout the therapy, most probably due to the long duration of the left shoulder being held in elevation and protraction (since a car accident when she was 5 years old).

In locomotion the patient moved both legs symmetrically and stance phase was of equal duration in both legs. This was a great improvement compared to the initial examination when the left leg stance phase was shorted in duration. Both knees and ankles still fall into valgus in stance phase, however the medial arches hold their shape and collapse less than 4 weeks ago.

The hip is bouncy and rotates, because of her hypermobility and low muscle tonus we can hypothesize that the hip rotates rather than extending because of poor muscle control rather that shortened muscles.

She looks straight ahead of her instead of at her feet. Indicating her proprioception and stability has improved over the course of the therapy as she no longer feels the need for visual control.

The anthropometric measurements of the thigh muscles showed a great increase in muscle bulk the only difference being 0.5cm smaller 15 cm above the knee joint. The circumference of the right, healthy leg decreased by 2cm 15cm above the knee joint and 0.5cm 10cm above the knee joint, this was due to her diet and weight loss over the last 4 weeks. Circumference of the left knee joint was 0.5cm larger than the right, indicating some small level of inflammation present, but this was greatly improved from the 2.5cm different in the initial examination. Circumference of the lower leg and ankle joints was

symmetrical, indicating full restoration of muscle bulk in the triceps surae and no inflammation present.

Decrease in inflammation meant restoration of ROM of ankle joint. Increase in inversion of left because of no walking and loss of medial arch. Increase of inversion in right leg due to better activation of medial compartment due to sensomotoric training. She had complete bilateral symmetry of hip joint ROM.

Left patella was much more moveable with only slight restriction in caudal direction compared to right side. Fibula head and subtalar joint restrictions were resolved during the therapy, possibly as a result of the PIR of the hamstrings and soleus and the dissolution of the inflammation in the lower leg.

3.7 Evaluation of effectiveness of the therapy

I was very satisfied with my patient's progress throughout the 4 weeks of therapy. Objectively the left leg was greatly improved, as can be seen in Table 3-17 where a direct comparison of the initial and final examinations are drawn of the notable results.

Table 3-17: Results of therapy on left leg

Left leg	Initial examination 2.6.2020	Final examination 24.6.2020
15 cm above	58,5	61,5
10 cm above	55,5	57
Active Range of motion	5°-5°-80°	0°-0°-120°
Gluteus maximus strength	3	4+
Shortened hip flexors two joints	1	0

I would also like to note a subjective improvement I noticed, throughout the duration of the therapy I noticed the patients mental state played a large part in the level of pain she reported and in the progress session to session. I tried my best to support her and assure her that her progress was going well when she was doubtful. I noticed that in the fourth week of the therapy, she was more confident on the knee and engaged and happy in the therapy sessions. Additionally, the largest improvements in strength and proprioception were seen in the fourth week. From this I can hypothesize that the patients subjective feeling had a large impact on the improvement of her injury.

4 List of Literature

Bibliography

1. MOORE, Keith Leon, AGUR, Anne M. R. and DALLEY, Arthur F., 2015, Essential clinical anatomy. Philadelphia : Wolters Kluwer.
2. Publishing, S. (2014). *Knee anatomy speedy study guides*. [Place of publication not identified]: Dot EDU.
3. Kenhub. 2020. *Knee Joint*. [online] Available at: <https://www.kenhub.com/en/library/anatomy/the-knee-joint> [Accessed15 June 2020].
4. Knee. (2020). Retrieved 15 June 2020, from https://www.physio-pedia.com/Knee
5. The Knee Joint - Articulations - Movements - Injuries - TeachMeAnatomy. (2020). Retrieved 6 June 2020, from https://teachmeanatomy.info/lower-limb/joints/knee-joint/
6. KOLÁŘ, Pavel and ANDELOVA, Vanda, 2013, Clinical rehabilitation. Prague : Rehabilitation Prague School.
7. Themes, U. (2020). Lower Limbs. Retrieved 4 June 2020, from https://radiologykey.com/lower-limbs/
8. SHULTZ, Sandra J., HOUGLUM, Peggy A. and PERRIN, David H., 2016, Examination of musculoskeletal injuries. Champaign, IL : Human Kinetics.
9. KENDALL, Florence P., 2010, Muscles: testing and function with posture and pain. Baltimore, MD : Lippincott Williams & Wilkins.
10. CYRIAX, J. (1982). Textbook of orthopaedic medicine, vol. 1: diagnosis of soft tissue lesions. (ed 8). London; Balliere Tindall.
11. LEWIT, Karel, 2010, Manipulative therapy: musculoskeletal medicine. Edinburgh : Elsevier/Churchill Livingstone.
12. M. MARIESWARAN, ISHITA JAIN, BHAVUK GARG, VIJAY SHARMA and DINESH KALYANASUNDARAM, 2018, A Review on Biomechanics of Anterior Cruciate Ligament and Materials for Reconstruction[online]. 13

May 2018. [Accessed 28 June 2020]. DOI 10.1155/2018/4657824. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5971278/

13. MEYLER, Zinovy, [no date], Knee Anatomy. Arthritis [online]. [Accessed 23 May 2020]. Available from: https://www.arthritis-health.com/types/joint-anatomy/knee-anatomy

14. FNP, Kathleen Davis, 2017, The knee: Anatomy, injuries, treatment, and rehabilitation. Medical News Today [online]. 18 August 2017. [Accessed 30 June 2020]. Available from: https://www.medicalnewstoday.com/articles/299204.php

15. Common Knee Injuries - OrthoInfo - AAOS, [no date]. OrthoInfo [online], [Accessed 23 June 2020]. Available from: https://orthoinfo.aaos.org/en/diseases--conditions/common-knee-injuries/

16. Madeti, B., Chalamalasetti, S., & Bolla Pragada, S. (2015). Biomechanics of knee joint — A review. *Frontiers Of Mechanical Engineering*, *10*(2), 176-186. doi: 10.1007/s11465-014-0306-x

17. Anterior Cruciate Ligament (ACL) Injuries - OrthoInfo - AAOS, [no date]. OrthoInfo [online], [Accessed 23 June 2020]. Available from: https://orthoinfo.aaos.org/en/diseases--conditions/anterior-cruciate-ligament-acl-injuries/

18. Knee Arthroscopy: Reasons, Procedure & Benefits, [no date]. Healthline [online], [Accessed 17 June 2020]. Available from: https://www.healthline.com/health/knee-arthroscopy

19. Anterior Cruciate Ligament (ACL) Injuries, [no date]. Core EM [online], [Accessed 17 June 2020]. Available from: https://coreem.net/core/acl-injuries/

20. Lateral pivot shift test: Valgus stress on knee plus internal/external rotation of ..., [no date]. grepmed [online], [Accessed 17 June 2020]. Available from: https://www.grepmed.com/images/810/lateralpivotshift-diagnosis-sports-aliem-knee-test-exam

21. Domnick, C., Raschke, M. J., & Herbort, M. (2016). Biomechanics of the anterior cruciate ligament: Physiology, rupture and reconstruction

techniques. World journal of orthopedics, 7(2), 82–93. https://doi.org/10.5312/wjo.v7.i2.82

22. Lower Limbs. (2020). [online] Retrieved 2 July 2020, from https://radiologykey.com/lower-limbs/

23. Page, P., Frank, C. C., & Lardner, R. (2010). Chain Reactions. In Assessment and Treatment of Muscle Imbalance: The Janda Approach (pp. 30–37). Human Kinetics.

24. Hansen, J. and Netter, F. (2014). Netter's Atlas of Human Anatomy. 6th ed. Philadelphia, Penn.: Sanders Elsevier,

25. MEYLER, Zinovy, [no date], Knee Anatomy. Arthritis [online]. [Accessed 13 June 2020]. Available from: https://www.arthritis-health.com/types/joint-anatomy/knee-anatomy

26. Zhang, L., Liu, G., Han, B., Wang, Z., Yan, Y., Ma, J., & Wei, P. (2020). Knee Joint Biomechanics in Physiological Conditions and How Pathologies Can Affect It: A Systematic Review. Applied bionics and biomechanics, 2020, 7451683. https://doi.org/10.1155/2020/7451683

27. Tran, T. D., & Tran, Q. L. (2018). A cadaveric study on the anatomy of anterior cruciate ligament in Vietnamese adults. *Asia-Pacific journal of sports medicine, arthroscopy, rehabilitation and technology*, *14*, 22–25. https://doi.org/10.1016/j.asmart.2018.05.001

28. *Understanding Anterior Cruciate Ligament (ACL) Injuries* (2020). University of Wisconsin, Sports Medicine Clinic.https://www.uwhealth.org/sports-medicine/clinic/understanding-anterior-cruciate-ligament-acl-injuries/13064

29. Knee Biomechanics - Recon - Orthobullets. (2020). [online] [Accessed 12 July 2020], from http://www.orthobullets.com/recon/9065/knee-biomechanics

30. Kopkow, C., Lange, T., Hoyer, A., Lützner, J., & Schmitt, J. (2015). Physical tests for diagnosing anterior cruciate ligament rupture. *Cochrane Database Of Systematic Reviews*. doi: 10.1002/14651858.cd011925

31. Olsen OE,Myklebust G,Engebretsen L, et al.Injury mechanisms for anterior cruciate ligament injuries in team handball: a systematic video

analysis.Am J Sport Med 2004;32(4):1002-12. doi: 10.1177/0363546503261724.

32. Nagano Y, Ida H, Akai M, Fukubayashi T. Biomechanical characteristics of the knee joint in female athletes during tasks associated with anterior cruciate ligament injury. The Knee. 2009 Mar 1;16(2):153-8.

33. Page, P., Frank, C. C., & Lardner, R. (2010). Chain Reactions. In Assessment and Treatment of Muscle Imbalance: The Janda Approach (pp. 30–37). Human Kinetics.

34. Nordin, M., & Frankel, V. (1991). Basic Biomechanics of the Musculoskeletal Systm. *Journal Of Pediatric Orthopaedics*, *11*(6), 788. doi: 10.1097/01241398-199111000-00020

35. Lutz, G. E., Palmitier, R. A., An, K. N., & Chao, E. Y. (1993). Comparison of tibiofemoral joint forces during open-kinetic-chain and closed-kinetic-chain exercises. The Journal of bone and joint surgery. American volume, 75(5), 732–739. https://doi.org/10.2106/00004623-199305000-00014

36. Bari, A. (2014). Evaluation of MRI Versus Arthroscopy in Anterior Cruciate Ligament and Meniscal Injuries. JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH. doi: 10.7860/jcdr/2014/10980.5331

37. Li, K., Du, J., Huang, L., Ni, L., Liu, T., & Yang, H. (2017). The diagnostic accuracy of magnetic resonance imaging for anterior cruciate ligament injury in comparison to arthroscopy: a meta-analysis. Scientific Reports, 7(1). DOI: 10.1038/s41598-017-08133-4

38. Abulhasan, J., & Grey, M. (2017). Anatomy and Physiology of Knee Stability. Journal Of Functional Morphology And Kinesiology, 2(4), 34. doi: 10.3390/jfmk2040034

39. Singh, D. (2020). Normal Biomechanics of Knee and Movements | Bone and Spine. Retrieved 2 July 2020, from https://boneandspine.com/normal-biomechanics-of-knee

40. Understanding Anterior Cruciate Ligament (ACL) Injuries. (2020). [online]. Retrieved 08 July 2020, from https://www.uwhealth.org/sports-medicine/clinic/understanding-anterior-cruciate-ligament-acl-injuries/13064

41. Sharma. (2020). 1. biomechanics of the knee joint basics. Retrieved 12 July 2020, from https://www.slideshare.net/saurabsharma/1-biomechanics-of-the-knee-joint-basics

42. Anterior Cruciate Ligament (ACL) Rehabilitation. (2020). [online]. Retrieved 10 July 2020, from https://www.physio-pedia.com/Anterior_Cruciate_Ligament_(ACL)_Rehabilitation

43. Dodds, A., Gupte, C., Neyret, P., Williams, A., & Amis, A. (2011). Extra-articular techniques in anterior cruciate ligament reconstruction. The Journal Of Bone And Joint Surgery. British Volume, 93-B(11), 1440-1448. doi: 10.1302/0301-620x.93b11.27632

44. Burnham, J. M., Malempati, C. S., Carpiaux, A., Ireland, M. L., & Johnson, D. L. (2017). Anatomic Femoral and Tibial Tunnel Placement During Anterior Cruciate Ligament Reconstruction: Anteromedial Portal All-Inside and Outside-In Techniques. Arthroscopy techniques, 6(2), e275–e282. https://doi.org/10.1016/j.eats.2016.09.035

45. Meyers, A., Haims, A., Menn, K., & Moukaddam, H. (2010). Imaging of Anterior Cruciate Ligament Repair and Its Complications. American Journal Of Roentgenology, 194(2), 476-484. doi: 10.2214/ajr.09.3200

46. Shaerf, D. (2014). Anterior cruciate ligament reconstruction best practice: A review of graft choice. World Journal Of Orthopedics, 5(1), 23. doi: 10.5312/wjo.v5.i1.23

47. Behnke, R. (2012). Kinetic anatomy. Champaign, IL: Human Kinetics.

48. Definition, Anatomy, Function, & Facts. (2020). Retrieved 13 July 2020, from https://www.britannica.com/science/fibula-bone

49. The Sciatic Nerve - Course - Motor - Sensory - TeachMeAnatomy. (2020). Retrieved 13 July 2020, from https://teachmeanatomy.info/lower-limb/nerves/sciatic-nerve/

50. Wikimedia Commons. (2020). Retrieved 13 July 2020, from https://commons.wikimedia.org/wiki/File:Lumbar_plexus.svg

51. TKA Axial Alignment - Recon - Orthobullets. (2020). Retrieved 13 July 2020, from https://www.orthobullets.com/recon/5014/mechanical-alignment-in-tka

52. Thompson, J. C. (2010). Thigh/Hip. Netter's Concise Orthopaedic Anatomy, 249–284. doi:10.1016/b978-1-4160-5987-5.50013-9

53. Shapiro, Y. (2018). Anterior Cruciate Ligament (ACL) Injuries. Retrieved 13 July 2020, from https://coreem.net/core/acl-injuries/

54. Knee and Lower Leg. (2020). Retrieved 10 July 2020, from https://musculoskeletalkey.com/knee-and-lower-leg/

55. Guide, K., Anatomy, K., & Ligaments, K. (2020). Knee Ligaments - Cruciates & Collaterals - Knee Pain Explained. Retrieved 14 July 2020, from https://www.knee-pain-explained.com/knee-ligaments.html

56. Werstine, M. (2020). Physiotherapy following ACL reconstruction protocol. Retrieved 13 July 2020, from http://fowlerkennedy.com/wp-content/uploads/2015/11/PHYSIOTHERAPY-FOLLOWING-ACL-RECONSTRUCTION-PROTOCOL-November-2015.pdf

57. Centrum léčby pohybového aparátu. (2020). Rehabilitace po plastice LCA | Centrum léčby pohybového aparátu. Retrieved 13 July 2020, from https://www.clpa-mediterra.cz/zdravotni-pece/fyzioterapie/rehabilitace-po-plastice-lca/

5 Supplements

5.1 List of Figures

5.2 List of Tables

5.3 List of Abbreviations

ABD: abduction

ADD: adduction

ACL: Anterior Cruciate Ligament

ER: external rotation

IR: internal rotation

E: extension

F: flexion

DF: dorsiflexion

PL: plantarflexion

ROM: range of motion

5.4 Ethics Committee Agreement

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

Application for Approval by UK FTVS Ethics Committee

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

The title of a project: Case study: Rehabilitation after Anterior Cruciate Ligament reconstruction

Project form: Bachelor Thesis

Period of realization of the project: June 2020 to July 2020

Applicant: Georgina Naomi Collin, UK FTVS, Physiotherapy Department

Main researcher: Georgina Naomi Collin, UK FTVS, Physiotherapy Department

Workplace: C.L.P.A., Prague, Czech Republic

Supervisor: doc. PaedDr. Dagmar Pavlů, CSc.

Project description: The project is to conduct rehabilitation of a patient after Anterior Cruciate Ligament reconstruction. The goal of the case study is to first examine the patients current state after surgery, then beginning the physiotherapeutic treatments. The project is to implement effective therapy to improve the patients range of motion and muscle strength. After 4 weeks when the study has come to an end the patient will be examined again.
Characteristics of participants in the research: Female, 41 years old. The patient comes every second day to CLPA to follow her therapy program. Thee patient is registered in the hospital with a valid health care check.
Ensuring safety within the research:. The risk for the patient will be minimised as she will be followed and closely monitored every therapy session by a team of qualified physiotherapists. No invasive procedures will be used during the case study and the patient has been instructed to notify us of any pain. Risks of the anticipated therapy will be no higher than the usual risks of ACL reconstruction rehabilitation. Risks of therapy and methods will not be higher than the commonly anticipated risks for this type of therapy.
Ethical aspects of the research: The collected data will be anonymized within one week after the end of working with the patient. I understand that anonymization means that the text does not use any item of information or combination of items that could lead to the identification of a person. I will be careful not to enable recognition of a person in the text of the thesis, especially within the anamnesis. After the text has been anonymized, any personal data still kept elsewhere will be delete. No photographs, audio recordings or video recordings will be taken during the research.
I shall ensure to the maximum extent possible that the research data will not be misused.
Informed Consent: will be attached, used and explained to the patient.

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, 05/06/2020 Applicant's signature:

Approval of UK FTVS Ethics Committee

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

The research project was approved by UK FTVS Ethics Committee under the registration number: 172/2020
Date of approval: 8. 6. 2020

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

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

UNIVERZITA KARLOVA
Fakulta tělesné výchovy a sportu
José Martího 31, 162 52, Praha 6
– 20 –
Stamp of UK FTVS

Signature of the Chair of
UK FTVS Ethics Committee

5.5 6.5 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: .....