

**Case Study of Physiotherapy Treatment of a Patient with the
Diagnosis of Anterior Cruciate Reconstruction**

BACHELOR DEGREE PROGRAM IN PHYSIOTHERAPY

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Acknowledgement

I would like to thank all of my teachers at the Faculty of Physical Education and Sport for the education I received in getting me to the level I am at today. I would also like to thank my supervisor, Mgr. Helena Vomáčková for setting me in the right direction on this work, as well as my instructor Mgr. Ondřej Houška for advising me during my practice at Rehabilitační nemocnice Beroun. Finally, I would like to thank my mum for helping me on to this path from the beginning.

Abstract

Title: Case Study of Physiotherapy Treatment of a Patient with the Diagnosis of Anterior Cruciate Ligament Reconstruction.

Thesis aim: The thesis is split into two parts; 1) Theoretical part. 2) Practical part (Case Study). The theoretical part will show an overview of the anatomy, kinesiology and biomechanics of the knee joint, as well as how an anterior cruciate ligament injury is commonly obtained, the reconstruction surgery procedure, and the therapy used by the therapist in the rehabilitation process. In the practical part, I shall apply this theoretical knowledge, as well as the knowledge of examinations and therapies that I have learned during my degree on to a patient with the diagnosis of anterior cruciate reconstruction, analysing the results.

Clinical findings: The patient was a 24 year old female, with a diagnosis of anterior cruciate reconstruction of the left knee, performed by an allograft 6 weeks prior. The main clinical findings were a range of motion deficit in the operated knee in both flexion and extension, as well as general weakening and atrophy of the muscles in this side.

Procedures: The procedures used were based on those taught by Charles University in Prague, Faculty of Physical Education and Sport. These included but were not limited to; post isometric relaxation, joint mobilisation, and soft tissue techniques according to Lewit, length and strength measurements according to Kendall as well as my own exercises based on my theoretical knowledge.

Result: Following 8 therapy sessions, there was an increase in range of motion in of the knee in both directions, as well as an increased gait quality and general strength improvement of the lower extremity on the operated side.

Conclusion: The physiotherapeutic procedures that were performed had a definite positive effect on the patients situation.

Keywords: anterior cruciate ligament, allograft, range of motion, weakness of operated extremity,

Abstrakt

Název: Případová studie fyzioterapeutické léčby pacienta s diagnostikou rekonstrukce předního křížového vazů.

Cíl práce: Práce je rozdělena na dvě části; 1) Teoretickou část a 2) Praktickou část (případová studie). V teoretické části bude uveden přehled anatomie, kineziologie a biomechaniky kolenního kloubu, stejně jako způsobu, jakým se obecně dosahuje zranění předního křížového vazů, rekonstrukční chirurgický zákrok předního zkříženého vazů a vyšetření a terapie terapeutů aplikované v průběhu rehabilitačního procesu. V praktické části se práce věnuje výše uvedeným teoretickým znalostem, stejně jako vyšetřením a terapiím, které si student osvojil během studia o práci s pacienty s diagnózou rekonstrukce předního křížového vazů.

Klinické nálezy: Pacientkou je 24letá žena s diagnózou rekonstrukce předního křížového vazů levého kolena, která byla provedena allotransplantací 6 týdnů před terapií. Hlavními klinickými nálezy byla řada nedostatků v rozsahu pohybu v operovaném kolenu, a to jak v ohybu, tak v prodloužení, stejně jako obecné oslabení a atrofie svalů na levé noze.

Postupy: Použité postupy vycházely z náplně vyučování Univerzity Karlovy v Praze, Fakulty tělesné výchovy a sportu. Ty zahrnovaly, ale neomezovaly se pouze; na postizometrickou relaxaci, mobilizaci kloubů a techniky měkkých tkání podle Lewita, měření délky a síly podle Kendalla, stejně jako vlastní cvičení založená na teoretických znalostech studenta.

Výsledek: Po 8 terapiích došlo ke zvýšení rozsahu pohybu kolena v obou směrech, stejně jako ke zvýšení kvality chůze a také celkovému zlepšení pevnosti levé dolní končetiny.

Závěr: Fyzioterapeutické postupy, které byly provedeny, měly jednoznačně pozitivní vliv na stav pacienta.

Klíčová slova: anterior cruciate ligament, allograft, přední křížový vaz, rozsah pohybu, slabost operovaných končetin

Declaration

I declare that this Bachelor Thesis was written by myself based on my practice at Rehabilitační nemocnice Beroun from 8.1.2018 to 19.1.2018 with the help of the sources which I will list at the end of the thesis in the list of literature.

I declare that no invasive methods were used on any person during my clinical practice and my patient was fully aware of any techniques, examination, therapies or situations at any time. My practice was under supervision of Mgr. Ondřej Houška whilst on my practice, and Mgr. Helena Vomáčková at the Department of Physiotherapy, Faculty of Physical Education and Sport at Charles University in Prague.

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1. Introduction

My thesis placement took place at Rehabilitační nemocnice Beroun from 8.1.2018 to 19.1.2018. The aim of the thesis is partly to provide the theoretical background to an allograft anterior cruciate ligament reconstruction, including the surgery itself, the mechanism for injury and the anatomy, kinesiology and biomechanics of the knee, as well as the therapy used by the therapist throughout the rehabilitation process. Another aim of the thesis is to show the practical aspect of this theory on to a patient with the diagnosis of anterior cruciate reconstruction, analysing the effectivity of the results.

I had a patient with the diagnosis of an anterior cruciate reconstruction done by allograft 6 weeks prior to this therapeutic treatment. The patient had previous rehabilitative therapy on the knee after unsuccessful manipulation under anaesthetic surgeries which negatively affected the patients viewpoint on further therapy. The goal of the therapy undertaken was to increase the range of motion in the knee joint in both extension and flexion, increase the general strength condition of the operated lower extremity, decrease the dependence on crutches of the patient and improve the patients psychological relationship with rehabilitative therapy.

2. GENERAL PART

2.1 Anatomy of the knee joint

The knee joint is a hinge joint situated between the longest bone in the body; the femur, the patella and the tibia. Due to humans bipedal nature, the knee joint supports the vast majority of the humans weight and is therefore one of the strongest and most important joints in the human body. The nature of human movement means that the lower limb can be placed in many different positions on the ground, such as when running or jumping. The anatomy and structure of the joint helps to allow this, without injury most of the time.

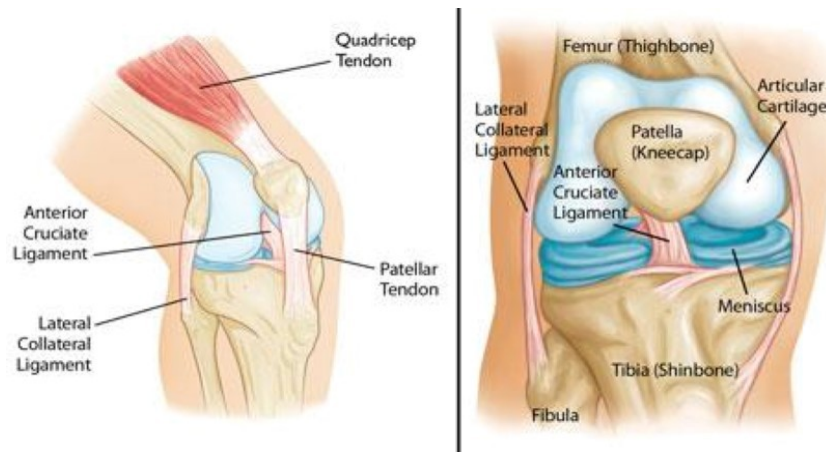


Figure 1. Gross anatomy of the knee joint

2.1.1 Bones and articular surfaces of the knee joint

The knee joint comprises of three component bones; the femur, the patella and the tibia. The femur is the longest bone in the body and it sits proximal compared to the other two bones and articulates with the pelvis at its proximal end. At the distal end of the femur are the medial and lateral condyles that articulate with the tibia. The condyles of the femur are lined with articular cartilage (Fig. 1). The tibia is classified as a long bone and is distal to the femur. At its distal end it articulates with the ankle. The proximal end of the tibia articulates with the femur at the tibial plateau which are called the tibiofemoral joints. The patella is classified as a sesamoid bone (a bone located inside of a tendon that passes over a joint) situated inside the quadriceps tendon it articulates with the femur as the patellofemoral joint (Fig. 1).

2.1.2 Menisci

The menisci are crescent shaped discs (medial and lateral) made from fibrocartilage that sit on top of the tibia between the femur. Each menisci are attached via the joint capsule and the tibia through the coronary ligaments. They have some degree of mobility especially the lateral one. The menisci are attached to each other via a transverse ligament They act as shock absorbers by increasing the surface area the weight of the body spreads over.

2.1.3 Joint Capsule

The entire knee joint is encapsulated by the joint capsule. It consists of a fibrous and synovial membrane. The capsule increase stability in the joint and also contains synovial fluid which bathes the patella, femur and tibia nourishing the tissues and helping with lubrication.

2.1.4 Ligaments of the knee joint

Collateral ligaments: This comprises of the medial and lateral collateral ligament which help prevent lateral movement of the joint, keeping the joint moving only in flexion and extension. The lateral collateral ligament attaches at the lateral condyle of the femur to the head of the fibular, whereas the medial collateral ligament attaches from the medial condyle of the femur to the medial condyle of the tibia while also having some fibers connecting it to the medial meniscus.(10) (11)

Anterior and posterior cruciate ligaments: The cruciate ligaments are named after the fact that viewed together they appear as a cross. The anterior cruciate ligament connects the intercondylar eminence of the tibia with the posteromedial surface of the lateral condyle on the femur, The function of the anterior cruciate ligament is both to prevent hyperextension in the knee and to prevent anterior translation of the tibia away from the femur. The posterior cruciate ligament attaches from the posterior eminence of the tibia to the anteromedial surface of the medial epicondyle. The function of the posterior cruciate ligament is to prevent anterior shifting of the femur away from the tibial plateau.

Other ligaments: The arcuate ligament, ligament of Wrisberg and oblique popliteal ligament are all located on the posterior side of the knee, while in the anterior aspect there is the patella ligament connecting the apex of the patella with the tibial tuberosity.

The coronary ligament combines with the capsular ligament connecting the lateral edges of the menisci with the cranial end of the tibia. AS stated previously there is a ligament connecting the medial and lateral menisci called the transverse ligament.

2.1.5 The muscles of the knee joint and their innervation (Fig. 3). (16) (17)

The muscles of the knee joint help to keep the joint stable. The categories of muscles in the knee are based on the side of the knee they operate on, either anterior or posterior

The posterior group of muscles acting on the knee:

Biceps femoris

Origin of long head: originates at the distal part of the sacrotuberous ligament and at the posterior ischial tuberosity.

Origin of short head: Lateral lip of linea aspera, the proximal 2/3 of supracondylar line, and lateral intermuscular septum.

Insertion: Lateral head of fibula, the lateral condyle of the tibia, the deep fascia of the lateral leg.

Action: The long and short heads of the biceps femoris flex and laterally rotate the knee joint. The long head also extends and assists in lateral rotation of the hip joint.

Nerve to long head: Sciatic (tibial branch), L5, S1,

Nerve to short head: Sciatic (peroneal branch), L5, S1,

Semitendinosus

Origin: The ischial tuberosity by the tendon common with the long head of biceps femoris.

Insertion: Proximal, medial surface of the tibia and deep fascia of the leg.

Action: It flexes and medially rotates the knee joint. Extension and internal rotation of the hip joint.

Nerve: Sciatic (tibial branch), L4, 5, S1, 2.

Semimembranosus

Origin: Ischial tuberosity, both proximal and lateral to the biceps femoris and the semitendinosus.

Insertion: Posteromedial aspect of the medial condyle of the tibia.

Action: Flexion and medial rotation of the knee joint. Extension and some medial rotation of the hip joint.

Nerve: Sciatic (tibial branch), L4, 5, S1, 2.

Gracilis

Origin: lower half of the symphysis pubis and medial margin of the inferior ramus of the pubis.

Insertion: Medial surface of the body of the tibia, distal to the tibial condyle, proximal to insertion of the semitendinosus, and lateral to the insertion of the Sartorius.

Action: Adducts the hip joint, flexion and medial rotation of the knee joint.

Nerve: Obturator, L2, 3, 4.

Popliteus

Origin: Anterior part of the lateral condyle of the femur and oblique popliteal ligament of the knee.

Insertion: Triangular area proximal to the soleal line on the posterior tibia and fascia

Action: In non-weight bearing the popliteus medially rotates the tibia on the femur and flexes the knee. In weight bearing, it laterally rotates the femur on the tibia and flexes the knee. It helps to reinforce the posterior ligaments of the knee joint.

Nerve: Tibial, L4, 5, S1.

Gastrocnemius

Origin of medial head: Proximal and posterior part of the medial condyle and adjacent part of the femur, also the capsule of the knee joint.

Origin of lateral head: Lateral condyle and posterior surface of the femur, the capsule of the knee joint.

Action: plantarflexion of the ankle joint and assists in the flexion of the knee joint.

Nerve: Tibial, S1, 2.

Plantaris

Origin: Distal lateral supracondylar line of the femur adjacent part of its popliteal surface and oblique popliteal ligament of knee.

Insertion: Posterior calcaneus.

Action: Plantarflexes the ankle joint and assists in flexion of the knee joint.

Nerve: Tibial, L4, 5, S1,

The anterior group of muscles acting on the knee

Sartorius

Origin: Anterosuperior iliac spine.

Insertion: Proximal medial surface of the tibia near the anterior border.

Action: Flexion, lateral rotation and abduction of the hip joint. Flexes and assists in medial rotation of the knee joint.

Nerve: Femoral, L2, 3,

Quadriceps femoris

Origin of rectus femoris:

Straight head: anteroinferior iliac spine

Reflected head: groove above rim of acetabulum

Origin of vastus lateralis:

Proximal part of intertrochanteric line, anterior and inferior border of greater trochanter, lateral lip of the gluteal tuberosity, proximal half of lateral lip of linea aspera.

Origin of vastus intermedius

Anterior and lateral surfaces of the proximal 2/3 of the body of the femur, distal half of the linea aspera,.

Origin of vastus medialis

Distal half of the intertrochanteric line, medial lip of the linea aspera, proximal part of the medial supracondylar line, tendon of the adductor longus, adductor magnus and medial intermuscular septum.

Insertion: Proximal border of the patella and through the patellar ligament to the tibial tuberosity.

Action: The quadriceps extends the knee joint, and the rectus femoris portion flexes the hip joint.

Nerve: Femoral, L2, 3, 4.

Genu articularis

This is a muscle that lies deep beneath the vastus intermedius and originates on the anterior surface of the femur proximal to the condyles. It inserts, not to the bone, but to the synovial membrane of the knee. As the knee moves to extension, the muscle contracts.

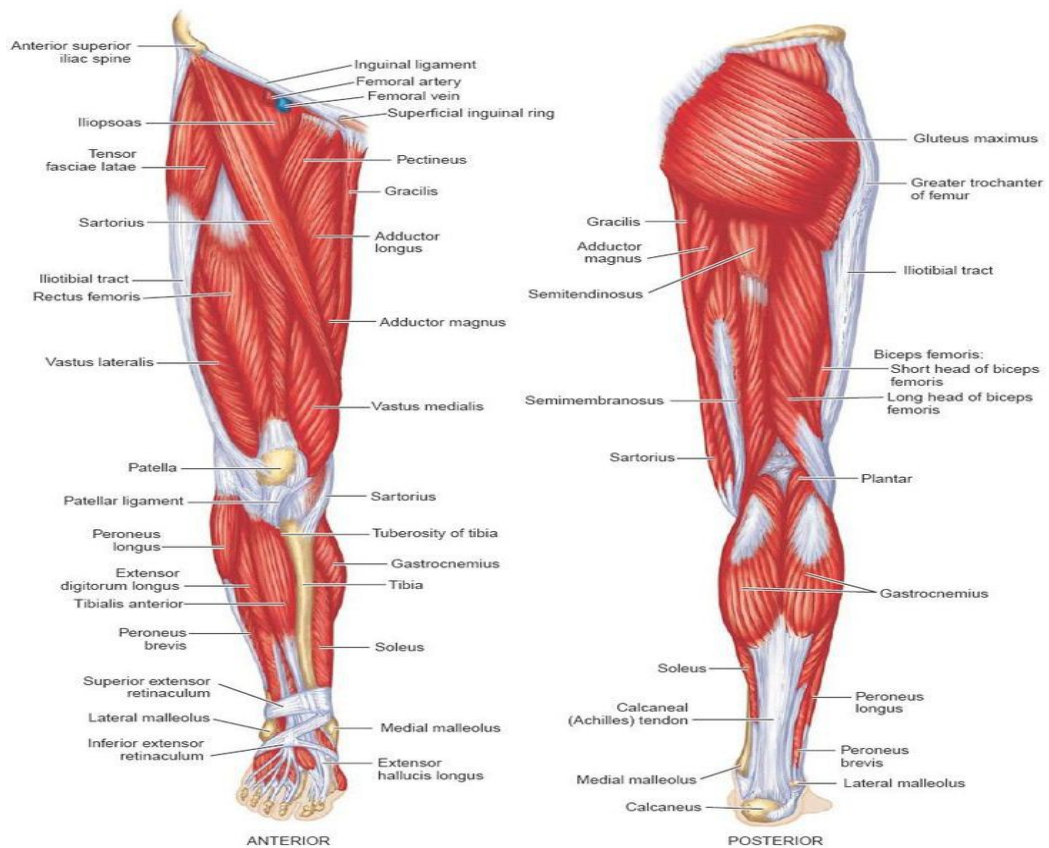


Figure 2. Muscles of the lower extremity.

2.2 Kinesiology and biomechanics of the knee joint

The knee joint operates through two planes, sagittal and horizontal. The sagittal plane allows the knee to move in flexion and extension while the horizontal plane allows torsion movements, or internal and external rotation. The predominance set by the structural anatomy of the knee joint is that of flexion and extension.(2) There is a strong kinesiological link between the knee and the hip and ankle being that most of the muscles that act over the knee also act over one of the two other joints. In the anatomical position the knee joint is at 0 degrees flexion. In this position the ligaments surrounding the joint are tight and it allows maximum stability.(1) This is called locked knee. The body's centre of gravity passes anteriorly to the knee joint which aids in keeping the knee joint in this position when standing. There is a potential for a large torque force to be generated by the knee due to the very long levers of the femur and tibia. The stability of the knee comes mainly from the soft tissue acting upon it rather than the bones themselves.(1) (5)

2.3 Movements of the knee joint

The greatest movements of the knee joint are that of flexion and extension however due to the anatomy of the joint, when the knee extends there is a certain amount of external rotation, and there is movement in the opposite direction of internal rotation when the knee flexes.(6) These rotations however are difficult to see on the patient unless the patient is standing under load.(2)

2.4 Rupture of the Anterior cruciate ligament

The rupturing of ligaments is usually due to acute trauma on the ligament. In the case of the ACL, the rupture often occurs in a non contact situation when the patient lands rotated from a jump with extended knee joint. This is due to the ACL being at its tautest when the knee is in hyperextension due to the action of it preventing anterior translation of the tibia against the femur.(3) (7) Pivoting and cutting sports often result in rupture of the ACL where the ACL comes under an intense tautness in a very short space

of time. The majority of ACL ruptures occur from non contact. ACL tears also have a high relation with tears of the menisci. The rupture of the ACL often occurs with a loud popping sound that is clearly noticeable to the sufferer, along with intense pain. ACL injuries occur predominantly in females especially adolescents. ACL injuries are one of the highest occurring knee injuries in the general and athletic population taking significant time to heal and recover from. Full ACL ruptures can be treated both conservatively and surgically. There is an increasing trend to treat ACL ruptures without surgery if the patient will not be undertaking explosive activities that feature high torsion of the knee. For athletes or those who participate in such activities, surgery is recommended as after an ACL rupture there is lasting noticeable instability in the joint. One of the surgeries for an ACL rupture is an ACL reconstruction via an allograft.

2.5 Reconstruction of the ACL by way of allograft

The reconstruction of the ACL via an allograft is surgery using a replacement ACL from a cadaver. The pros of this procedure is that there is no need to take a graft from a patient to create the replacement ACL.(4) This reduces the healing time of the patient and complications. The attaching of the replacement ACL requires only an arthroscopy do be done, reducing the level of scars present in the post surgery state. The cons of doing an allograft is that there is a potential for the graft to be weaker than one taken from the patient due to the storage procedure. The surgeon attaches the replacement ACL close to the site of the original attachments of the ACL to try and recreate the same function as close as possible.(4) (3)

2.5.1 Post operation expectations, therapy and prognosis

The restrictions in the patient after the surgery are similar to that of a typical arthroscopy. There may be swelling occurring after the surgery in the knee.(8) (9) There is likely to be a restriction in the knee joint in the direction of flexion and most likely in extension aswell. After the surgery weight bearing is based on the patients subjective feeling and most patients use crutches for the first 1 or 2 weeks before walking without them. There is likely to be weakness in the operated extremity after a time of low use. It should be noted that prehab is important in ACL with a focus on the strengthening as

there is a correlation between improved quadriceps strength before surgery and increased function of the lower limb after surgery.(4) As well as weakness in the muscles around the joint there are also likely to be muscles acting compensatory especially during ambulation on crutches which can lead to hypertonic muscles. General treatment of the patient after this surgery therefore includes; strengthening of weakened muscles, relaxing hypertonic muscles around the joint. Returning the ROM in the joint back to normal levels (usually comparable with the non operated side), correct ambulation. The prognosis of the surgery and post surgery rehabilitation is good. Most young athletic persons that have the operation return to their sports between 6 months and 1 year and there is a low incidence of reoccurring ACL rupture. The major problem faced in the post operative stage is returning the level of knee extension to normal levels.

3. SPECIAL PART (CASE STUDY)

3.1 Methodology

My clinical work placement was performed at Rehabilitační nemocnice Beroun. It began on the 8th January daily until the 19th January. The total hours worked was 80 with 8 hours being performed each day.

During my practice my clinical supervisor was Mgr. Ondřej Houška, Cert. MDT. I performed my initial examination and anamnesis on the patient on the 10th January and started therapy sessions with them on the 11th of January, through to the 16th, with the final examination taking place on the 17th January. In total I had 8 physiotherapy sessions with my patient.

I performed the therapy on my patient in a single occupancy cubicle aswell as in a large gymnasium. My examination and therapy techniques were mainly performed manually by hand, however, some instruments were used. For the examination these were a measuring tape, goniometer and neurological hammer. For the therapeutic procedures, a small inflatable therapy ball, large exercise ball, foam pad for balance training, and a green theraband.

The patient was fully aware of every procedure performed during the practice, the patient signed an informed consent and my work has been accepted by the ethics committee at the Faculty of Sports and Physical Education.

3.2 Anamnesis

Examined person

B.P, female

Year of birth: 1993

Diagnosis

Anterior cruciate ligament reconstruction of the left knee by allograft

Present State

Height: 167cm

Weight: 54kg

BMI: 19.4

Blood pressure: 120/80 mmHg

Additional devices: crutches

The patient is 6 weeks after reconstruction of the ACL. The operation was performed on the 24/11/2017 by MUDr. Smetana without any complications. The procedure was performed with general anaesthetic and an allograft was used. The patient feels a sharp pain during both flexion and extension of the operated knee. The patient is using crutches to aid locomotion but is happy to stand without them. The patient is in a nervous state about the upcoming physiotherapy due to negative past experiences.

History

The patient was playing volleyball in early 2012, when she fell on the fully extended left leg and felt a sudden pop and pain. After seeing a doctor on the evening of the injury, an MRI was performed. The results showed a rupture of the ACL and meniscal damage. The recommendation was for the patient to undergo an arthroscopy of the affected knee joint. This arthroscopy was performed in May 2012 in which the ACL was removed and the damaged meniscus sutured. The patient underwent rehabilitation following the operation but struggled to gain full range of motion, alongside continuing pain and a poor locomotion stereotype. In August 2012 and early 2013, two further arthroscopic operations were carried out in which a medial meniscectomy was performed

alongside manipulation under anaesthetic to increase ROM. These surgeries and their respective post surgery rehabilitations failed to correct the patients situation and after a long period of instability and a lack of range of motion in the knee, a further operation on 24.11.2017 was performed, in which the ACL of the affected knee was reconstructed by an allograft. The patient is 6 weeks after the operation and is still reliant on crutches due to low confidence in walking on the operated leg.

Injury anamnesis: The patient ruptured the left ACL during a volleyball game in early 2012 by landing awkwardly on the extended leg. No other previous injuries.

Surgery anamnesis: May 2012 left ACL removed and suturing of damaged meniscus by MUDr Smetana. August 2012 manipulation under anaesthetic and partial medial menisectomy by arthroscopy. 2013 manipulation under anaesthetic and arthroscopy. 24.11.2017 reconstruction of the ACL by allograft carried out by MUDr Smetana.

Social anamnesis: The patient lives in a stable household with her parents and sister in a two storey home, with stairs connecting the floors. She is in a happy, healthy long term relationship. She enjoys her life, and sleeps well with little stress. She has a friendly, communicative personality, however, she is cautious and somewhat nervous about the upcoming rehabilitation program.

Personal anamnesis: Autoimmune thyroiditis. Ovarian cysts.

Occupational anamnesis: The patient is a student in her final year of study.

Family anamnesis: The patient's family are all healthy with no related illnesses or injuries.

Gynaecological anamnesis: Ovarian cysts.

Hobbies: The patient was a keen recreational volleyball player until the injury in 2012. She also likes the science of nutrition and often likes to cook healthy food.

Allergies: None

Abuses: The patient likes to drink socially a couple of times a month and does not smoke or take any abusive substances.

Pharmacological anamnesis: None

3.2.1 Prior rehabilitation

The patient received physiotherapy after all three arthroscopic surgeries before the ACL reconstruction, with the therapies focussing on a return to the normal range of motion in the operated knee, strengthening of the surrounding muscles that affect the knee and hip joint, and correcting the gait pattern. After the 3rd operation involving manipulation under anaesthetic, intensive rehabilitation was performed involving strengthening of the flexors and extensors of the knee, strengthening of the muscles around the hip joint, stability training and intensive correction of ROM deficits in flexion and extension. The patient did not respond well to the therapy and experienced a lot of pain during the sessions even though there was some progress towards improving ROM in flexion of the operated knee. The patient is therefore now wary of future therapies and the therapist providing it. During the previous therapy, the patient was sent to see a psychologist as the pain was believed to be of psychological origin, however, the psychologist referred the patient back with the diagnosis that the pain is only mechanical. This further caused the patient to lose trust in the therapy provided.

3.2.2 Indication for rehabilitation

The doctor recommended the patient receive physiotherapy once a day. The therapy of the operated side was recommended to include:

- Instruction in scar massage
- Correct gait pattern without crutches (full loading)
- Correct breathing stereotype
- Strengthening of the extensors and flexors of the knee
- Strengthening of the gluteals and abductors and adductors of the hip.

- Sensorimotoric training
- Relaxation of hypertonic muscles
- Mobilisation of the patella, head of fibula, sacroiliac joint, as well as all of the ankle and foot
- Increase ROM in the operated knee in flexion and extension

3.3 Initial kinesiological examination

3.3.1 Postural examination

Anterior view

- The base of support is quite narrow
- The position of the feet are symmetrical with both feet parallel, facing forwards
- Both feet have a slightly collapsed medial longitudinal arch
- The weight distribution of the feet is on the medial arch
- Both knee joints are slightly valgus
- The position of the patellas are asymmetrical with the left patella appearing lower
- The contour of the calf and thigh muscles are asymmetrical with the left side appearing atrophied
- The toes are not pressed into the floor
- The left side of the pelvis is lower than the right
- Both scapulas are slightly protracted with the patient's arms somewhat internally rotated
- The position of the head is symmetrical

Posterior view

- Both the heels are valgus
- The knee joints are asymmetrical with the left being lower
- Popliteal line – Both popliteal lines are oblique and the right is slightly higher
- There is asymmetry of the gluteal muscles with visible atrophy on the left side.
- There is hyperactivity in the paravertebral muscles on both sides around the

lumbar area

Lateral view (right side)

- The position of the pelvis has a noticeable anterior tilt
- The right leg is in full extension
- The lumbar spine is hyperlordotic

Lateral view (left side)

- The position of the pelvis has a noticeable anterior tilt
- The left leg is not in full extension and is slightly bent
- The lumbar spine is hyperlordotic

Conclusion of the postural examination: The patient is not full extending the left knee which is lowering the left side of the pelvis downwards. There is atrophy on the left lower extremity compared with the right. The patients weight distribution appears to be more on the medial arch of the foot, creating a drop in the arch and causing valgosity in both knees

3.3.2 Gait examination

The patient walks with crutches comfortably using a three point gait pattern, however there is a tendency to help lift the leg from the ground with excessive contraction of the ipsilateral quadratus lumborum instead of flexion in the hip and knee. There is also not a significant heel strike in the movement. The patient does not feel yet feel comfortable walking without crutches.

3.3.3 Anthropometric measurements

	Left	Right
Anatomical length of the lower extremity	83cm	83.5cm
Functional length of the lower extremity	90cm	90.5cm
Circumference of the thigh	40cm	42cm

Circumference of the calf	33cm	34cm
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Table 1. Anthropometric measurements of the lower extremity

3.3.4 Goniometry

ACTIVE RANGE OF MOTION			
Joint	Motion	Right-Degrees	L-Degrees
Hip	Flexion	S:20-0-105	S:20-0-100
	Extension		
	Abduction	F:50-0-15	F:45-0-10
	Adduction		
	Internal rotation	R:35-0-30	R:35-0-30
	External rotation		
Knee	Flexion	S:0-0-135	S: -10-0-80
	Extension		
Ankle	Dorsal flexion	F:25-0-40	F:25-0-40
	Plantar flexion		
	Inversion	R:20-0-35	R:20-0-35
	Eversion		

Table 2. Active range of motion in the lower extremities.

PASSIVE RANGE OF MOTION			
Joint	Motion	Right-Degrees	L-Degrees
Hip	Flexion	S:30-0-110	S:25-0-105
	Extension		
	Abduction	F:50-0-25	F:45-0-20
	Adduction		
	Internal rotation	R:40-0-45	R:40-0-45
	External rotation		
Knee	Flexion	S:0-0-135	S:-10-0-80
	Extension		

Ankle	Dorsal flexion	F:25-0-45	F:25-0-45
	Plantar flexion		
	Inversion	R:20-0-35	R:20-0-35

Table 3. Passive range of motion in the lower extremities.

Conclusion of the goniometry examination: The patient has severe restriction in the left knee in both active and passive movement in flexion. The patient also has some restriction in extension of the left knee. There was no difference between active and passive movement of the knee ROM, mainly due to the patients inability to relax during while being passively moved.

3.3.5 Muscle tone examination (according to Lewit)

	Left	Right
Rectus femoris	Hypotonic	Normal tone
Vasti (medialis and lateralis)	Hypotonic	Normal tone
Adductors	Hypotonic	Normal tone
Tensor fascia latae	Hypertonic	Hypertonic
Semitendinosus and semimembranosus	Normal tone	Normal tone
Biceps femoris	Normal tone	Normal tone
Gluteus medius	Normal tone	Normal tone

Gluteus maximus	Normal tone	Normal tone
Piriformis	Normal tone	Normal tone
Quadratus lumborum	Hypertonic	Hypertonic
Erector spinae	Hypertonic	Hypertonic
Rectus abdominis	Hypotonic	Hypotonic
Gastrocnemius	Hypotonic	Normal tone
Soleus	Hypotonic	Normal tone
Tibialis anterior	Normal tone	Normal tone

Table 4. Muscle tone examination (according to Lewit).

Conclusion of the muscle tone examination: The main extensors of the knee (rectus femoris and vasti muscles) and ankle plantar flexors are hypotonic on the left side as well as the adductors. The abdominals were hypotonic on both sides of the body. The quadratus lumborum, tensor fascia latae and erector spinae muscles were hypertonic on both sides.

3.3.6 Soft tissue examination (according to lewit)

Skin and subskin – free movement in all directions around the operated knee, equal to

that of the contralateral side.

Fascia - no restriction in either direction around the longitudinal axis of the thigh or calf in either limb.

Scar – no stitches in the scars and some restriction on the medial scar in the all directions. All older scars from previous operations had no restriction in any direction. There is no swelling around the operated area.

3.3.7 Muscle length test (according to Kendall)

	LEFT	RIGHT
Hamstrings*	No shortness	No shortness
One joint hip flexors**	No shortness	No shortness
Two joint hip flexors**	N/A	N/A
One joint ankle plantar flexors	No shortness	No shortness
Two joint ankle plantar flexors*	No shortness	No shortness

Table 5. Muscle length test (according to Kendall).

*The test is slightly modified as the patient could not reach full extension, therefore the test is performed with the patient semiflexing the knee about 10° from full extension.

**The patient could not perform the test for the two joint hip flexors as the knee was too painful to be flexed to that extent. The leg was supported in order to atleast measure the length of the one joint hip flexors

3.3.8 Muscle strength test (according to Kendall)*

	Left lower extremity	Right lower extremity
Ankle plantar flexors	Grade 4	Grade 5
Biceps femoris	Grade 5	Grade 5
Gluteus maximus	Grade 4	Grade 4+
Gluteus medius	Grade 4	Grade 4+
Gluteus minimus	Grade 4	Grade 4+
Hip adductors	Grade 4+	Grade 5
Hip flexors	Grade 5	Grade 5
Iliopsoas	Grade 4	Grade 5
Lateral rotators	Grade 4	Grade 5
Medial rotators	Grade 4	Grade 5
Peroneus brevis	Grade 4+	Grade 4+
Peroneus longus	Grade 4+	Grade 4+
Quadriceps femoris	Grade 4	Grade 5
Sartorius	Grade 4	Grade 5
Semitendinosus /	Grade 4	Grade 5

Semimembranosus		
Soleus	Grade 4	Grade 5
Tensor Fasciae Latae	Grade 5	Grade 5
Tibialis anterior	Grade 5	Grade 5
Tibialis posterior	Grade 5	Grade 5

Table 6. Muscle strength test according to Kendall.

*where needed tests were modified slightly to allow for the restriction the patient has in full flexion and extension of the left knee.

Results of the strength test: there were no major weaknesses in any area but the general condition of the left lower extremity to the right was lower.

3.3.9 Examination of joint play (by Lewit)

Examined joint	Left side	Right side
Patella	Slight restriction in caudal direction, no restrictions in other directions	No restriction in any of the directions
Tibiofemoral	CONTRAINDICATED	No restriction in any of the directions
Fibula head	No restriction in any direction	No restriction in any direction
Talocrural	No restriction in any direction	No restriction in any direction
Talocalcaneal	No restriction in any direction	No restriction in any direction
Transversetarsal (chopart)	No restriction in any direction	No restriction in any direction
Tarsometatarsal (lisfrancs)	No restriction in any direction	No restriction in any direction
Metatarsophalangeal	Restriction in the 1 st digit in the latero-lateral direction	Restriction in the 1 st digit in the latero-lateral direction
Proximal interphalangeal	Restriction in the 1 st digit in the latero-lateral direction	Restriction in the 1 st digit in the latero-lateral direction
Distal interphalangeal	No restriction in any direction	No restriction in any direction

	direction	direction
Sacroiliac joint	No restriction in any direction	No restriction in any direction

Table 7. Examination of joint play (according to Lewit).

Results of the joint play examination: The only joint examined with restriction was the left patella and the metatarsophalangeal and proximal phalangeal joints in the 1st digit of either side.

3.3.10 Breathing examination

The patient breathes predominately with an upper thoracic breathing pattern with limited use of the abdominals. The patient does not breath deeply but rather shallow.

3.3.11 Neurological examination

Superficial sensation: The area around the scar did not have any difference in sensation.

Dermatome	Left	Right
L1 segment	Sensation is normal	Sensation is normal
L2 segment	Sensation is normal	Sensation is normal
L3 segment	Sensation is normal	Sensation is normal
L4 segment	Sensation is normal	Sensation is normal
L5 segment	Sensation is normal	Sensation is normal
S1 segment	Sensation is normal	Sensation is normal
S2 segment	Sensation is normal	Sensation is normal

Table 8. Dermatome sensation examination.

Deep tendon reflexes: The achilles reflex was consistent with a physiological response in both sides. The patella reflex was not attempted due to possible pain occuring around the operated area.

3.3.12 Conclusion of the examination

According to my examination I conclude that the patient is mainly suffering from a loss of knee function after the reconstruction of the left ACL. During the postural examination it can be observed that the patient is unable to fully extend the affected extremity. This flexion

of the knee makes it appear that there is asymmetry in the positioning of the pelvis, and that the left side of the pelvis is lower than the right, but this is caused only by the lack of full ROM in the left knee joint. There is some slight anterior pelvic tilt in the patient. The patients weight is over the medial arch of the foot causing a collapse of the arch and valgosity in each of the knees. There are some slight differences in the anthropometric lengths of the lower extremities with the left leg being 0.5cm longer than the right, but the patients inability to fully extend the knee must be taken into account. The circumference of the thigh and calf showed atrophy in the left operated leg which back up findings in the postural examination. The length tests performed all came back negative for shortness in any of the tested areas. The goniometry examination showed a large restriction in the ability of the operated knee in extension and flexion. The patient was too scared to fully relax during the examination of any passive range of motion which affected the results. The muscle tone examination showed some hypotonicity in the left side of the rectus femoris, vasti muscles, ankle plantar flexors and adductors. The abdominals were hypotonic on both sides of the patient. On both sides of the body there was hypertonicity in the erector spinae muscles, quadratus lumborum and tensor fascia latae. The soft tissue examinations of skin, subskin and fascia brought normal results, only the medial scar of the arthroscopy showed some restriction in the caudocranial direction. According to the strength tests performed there were no major deficiencies in strength in any particular muscles however there was a clear lack of general strength in the muscles of the left extremity compared to those of the right. Regarding the joint play examination, the only joints examined that showed restriction were the left patella in the caudal direction and the metatarsophlangeal and proximal phalangeal joints in the 1st digit of either side in the laterolateral direction. The patients breathing pattern is mainly upper thoracic and somewhat shallow. The neurological examinations performed had physiological results with no difference in either extremity. The patient is still walking with crutches 6 weeks after the operation and is uncomfortable with the thought of not using them due to fear of falling and the fear of experiencing excessive pain.

3.4 Short-term and long term physiotherapy plan.

3.4.1 Short-term physiotherapy plan

- Improve breathing stereotype to include more abdominal breathing
- Increase ROM in the knee joint in flexion and extension
- Encourage and practice walking without the use of crutches
- Practice walking up and down stairs with and without crutches
- Improve the gait pattern to help reduce the collapsed foot arches
- Improve general strength and conditioning of the lower extremity with a focus on the rectus femoris, vasti muscles, ankle plantar flexors and adductors.
- Improve patient-therapist trusting relationship that was negatively affects by the previous rehabilitations
- Release the restrictions in the left patella in the caudal direction and those in the MTP and PIP joints of the 1st digit in the laterolateral direction.
- Relax hypertonic muscles using PIR for the quadratus lumborum, tensor fascia latae and paravertebral muscles.
- Perform sensorimotoric training of the lower extremities
- Perform soft tissue therapy on the scar

3.4.2 Long-term physiotherapy plan

- Continue to regain patients confidence in the operated knee by continuing with sensorimotoric and balance training
- Continue to strengthen the lower extremities with an increased focus on plyometric training.
- Introduce exercises that compliment the patients eventual return to recreational volleyball.

3.5 Therapy Progress

Thursday 11th January (am)

Goals of today's therapy unit

- Soft tissue techniques on the scar from the operation
- Increase range of motion in the left knee joint in flexion and extension
- Improve breathing stereotype to include greater abdominal breathing
- Release the joint play restriction in the caudal direction of the left patella as well as in the MTP and PIP joints of the 1st digit in either side.

Procedure of today's therapy unit

- Scar therapy by using soft tissue techniques according to Lewit (S-wave and C-wave), on the restricted medial scar in all directions.
- Increase in the ROM of knee extension by the patient laying supine and a small therapy ball placed under the ipsilateral ankle, raising the knee from the treatment table. Only gravity was used in this method to bring the knee into further extension due to the lack of trust between patient and therapist. Talking to the patient about other topics was used to take the patients mind from focussing on the knee joint to help decrease the protective mechanism preventing increased extension. 3 sets of 1 minute repetitions were used and in between repetitions the patient took the leg back into slight semi flexion due to uncomfort in the extended position.
- Increasing the range of motion of knee flexion by the patient lying prone and passively moving the knee into flexion until the barrier is reached, and waiting at the barrier for the muscles to relax further and gently guiding the knee into further flexion. This technique was performed 5 times until there was no further improvement. PIR was not used due to uneasiness in the first session by the patient.
- The patient lays supine on the treatment table while we place our palms on the patients anterolateral abdomen and instruct the patient to try and breath into the area covered by the hands. Resistance is given against inhalation. The therapy is repeated for 10 breath cycles, after which the breathing pattern is observed and the cycle is repeated 3 times.
- Joint play techniques according to Lewit for the patella on the left side in the caudal direction as well as the MTP and PIP joints of the 1st digit in either side.

Results of today's therapy unit

Objective

- No restriction in the MTP and PIP joints of the 1st digit or in the patella of the left extremity.
- Still a restriction in the medial scar.
- Approximately 5 degrees increase in flexion of the knee (judged by eyesight)
- Improved abdominal breathing pattern while the patient is supine but it is lost when the patient returns to standing.

Subjective

- The patient felt pain during the first time the end range of flexion of the knee was met which the patient rates as a 6/10 pain level.
- The patient felt unable to relax during the therapy to increase knee extension ROM but by the end of the session felt more comfortable with the therapy and more enthusiastic for the next session.

Thursday 11th January (pm)

Goals of today's therapy unit

- Teach correct procedure to walk up and down stairs using crutches
- Improve the gait pattern used when walking to reduce weight over the medial longitudinal foot arch.
- Sensorimotoric training to increase proprioception in the foot

Procedure of the therapy unit

- The patient was taught to correctly walk upstairs using the healthy leg first, then the operated leg, followed finally by the crutches. The patient walked up 5 flights of stairs using this method. The patient was taught the correct procedure to descend stairs by first using the crutches, followed by the operated leg and finally the healthy leg. The patient also descended 5 flights of stairs.
- The patient walked along a flat corridor and was instructed to focus on the heel strike of the leading foot, followed by the rolling or uncurling of the foot along the lateral border to reduce the weight over the medial longitudinal arch.

- The patient performed sensorimotoric training of the small foot by a piece of paper being placed under the left foot and the patient was asked to scrunch the paper together using the muscles of the small foot.

Results of the today's therapy unit

Objective

- The patient learned the correct stair walking procedure with crutches
- The patient corrected the gait pattern to reduce flat foot which simultaneously reduced the valgosity shown in the knees.
- The patient was unable to successfully use the small muscles of the foot to affect the paper underneath.

Subjective

- The patient did not feel any pain when walking on the stairs but felt uneasy at the start and nervous, especially descending the staircase, however, after several minutes the patient increased in confidence. The patient's outlook on the upcoming therapy is positive.

Friday 12th January (am)

Goals of today's therapy unit

- Encourage and practice walking without the use of crutches
- Increase ROM in the knee joint in flexion and extension
- Relax hypertonic muscles using PIR for the quadratus lumborum, tensor fasciae latae and paravertebral muscles.

Procedure of today's therapy unit

- Patient attempted ambulation on the corridor without the use of the crutches but while holding onto a railing support in the corridor
- Increase the ROM of knee extension by a small ball being placed under the patient's ipsilateral ankle while in supine. We gently applied pressure downwards to the joint with both hands pressing the knee joint into greater extension. We

also talk to the patient about other topics to help take the patients mind from focussing on the knee joint decreasing perceived uncomfortability. 3 sets of 1 minute repetitions were used and in between repetitions the patient took the leg back into slight semi flexion to relieve the uncomfort of the extended position.

- Increasing the range of motion of knee flexion by the patient lying prone and passively moving the knee into flexion until the barrier is reached, and waiting at the barrier for the muscles to relax further and gently guiding the knee into further flexion. PIR techinques according to Lewit were used in this adapted flexed position for the knee extensors.
- PIR for the quadratus lumborum, tensor fascia latae and paravertebral muscles according to Lewit.

Objective results

- Patient was able to ambulate without the crutches however the patient had a poor gait pattern with overactivity of the quadratus lumborum in the left side compensating for a lack of flexion in the left knee
- Paravertebral and tensor fascia latae muscles were succesfully relaxed after PIR
- The final knee flexion passively achieved was 85 degrees (measured with a goniometer)

Subject Results

- The patient struggled with the relaxation of the knee into extension which she feels is due to a lack of sleep from the night before caused by a new patient in the room that snores.
- The patient started off with low confidence in the ability to walk without crutches however by the end of the session the patient was more confident in her ability and wanted to practice again in her room.

Friday 12th January (pm)

Goals of today's therapy unit

- Generally strengthen the lower extremity with a focus on the rectus femoris, vasti muscles, ankle plantar flexors and adductors.
- Improve the gait pattern to help reduce the collapsed foot arches
- Perform sensorimotoric training of the lower extremities
- Perform soft tissue therapy on the scar

Procedure of today's therapy unit

- Strengthening of the rectus femoris and vasti muscles by the patient lying supine on the treatment table with a small inflatable therapy ball underneath the exercised knee. The patient presses the knee down in the direction of the bed for 10 seconds and then relaxes for 5 seconds. This repetition is repeated 10 times for a single set. 4 sets were performed in this exercise.
- The patient lay supine with a green theraband looped around the plantar aspect of the foot from the cranial direction. The patient was asked to perform ankle plantar flexion against the resistance provided by the theraband.
- A green theraband was wrapped around the patients distal medial thigh from a lateral direction while the patient was in supine with the legs abducted. The patient was then instructed to adduct the legs against the resistance provided by the theraband and return to the starting position. This exercise was repeated for 10 repetitions repeated for 4 sets.
- The patient tried walking without crutches with a focus the heel strike of the leading foot, followed by the rolling or uncurling of the foot along the lateral border to reduce the weightover the medial longitudinal arch.
- The patient again performed sensorimotoric training of the small foot by a piece of paper being placed under the left foot and the patient was asked to scrunch the paper together using the muscles of the small foot.

Results of today's therapy unit.

Objective

- The patient is able to successfully locomote without the use of crutches and to transfer the weight throughout the entire foot during walking. The patient improved the heel strike during gait.

- During the sensorimotoric training of the small foot, the patient is able to slightly contract the paper together.
- The patient will not use the crutches any more in the future.

Subjective

- The exercises used with the small inflateable therapy ball were too easy for the patient along with the adduction exercise with the green theraband.
- The patient did not feel pain during any of the exercises performed in today's therapy

Autotherapy: Patient is instructed to practice walking in the way they were taught over the weekend, with a focus the heel strike of the leading foot, followed by the rolling or uncurling of the foot along the lateral border.

Monday 15th of January (am)

Goals of today's therapy unit

- Increase in the ROM in knee flexion through PIR with stretching.
- Practice walking up and down stairs with the patient without the use of crutches
- Relax hypertonic muscles using PIR for the quadratus lumborum, tensor fascia latae and paravertebral muscles.
- Perform soft tissue therapy on the scar

Procedure of today's therapy unit

- Increasing the range of motion of knee flexion by the patient lying prone and passively moving the knee into flexion until the barrier is reached, and waiting at the barrier for the muscles to relax further and gently guiding the knee into further flexion. PIR techniques according to Lewit were used in this adapted flexed position for the knee extensors.
- The patient practiced ambulation ascending stairs without crutches by first ascending one step with the healthy leg and then reaching the same step with the operated leg. The patient performed the descent by placing the healthy leg down

one step first and then matching it with the operated leg on the same step. 5 flights of stairs were completed in each direction.

- PIR was performed for the quadratus lumborum, tensor fascia latae and paravertebral muscles according to Lewit.
- Scar therapy by using soft tissue techniques according to Lewit (S-wave and C-wave), on the restricted medial scar in all directions.

Results of today's therapy unit

Objective

- Knee flexion was improved to approximately 90 degrees (judged by eyesight)
- Patient is able to ambulate up the stairs while holding on to support banister.
- The ascent is smoother than descent in the patient on stairs.
- No restriction in the medial scar
- The quadratus lumborum is still hypertonic

Subjective

- Patient is more confident in the operated leg to ambulate on stairs.

Monday 15th of January (pm)

Goals of today's therapy unit

- Improve general strength and conditioning of the lower extremity with a focus on the rectus femoris, vasti muscles, ankle plantar flexors and adductors.
- Practice walking up and down stairs with the patient without the use of crutches

Procedure of today's therapy unit

- The patient stood against a wall with the large exercise ball situated between her lower back and the wall. The patient performed squats up until the level of discomfort/pain reaching 5/10. 10 squats were performed in a set and 4 sets were performed with a 1 minute rest period.
- The patient lay side lying on the unoperated side with the operated leg directly over the operated side. The patient performed abduction against gravity for 10 repetitions per set also for 4 sets with a 1 minute rest period.

- The patient stood facing the wall and performed ankle plantarflexion to take her up on to her toes and forefoot. 10 repetitions per set also for 4 sets with a 1 minute rest period.
- The patients lay in supine with the knees semiflexed to a position that was comfortable and the patient raised the pelvis off the floor performing a glute bridge. 8 repetitions of 3 sets with a 1 minute rest period.
- The patient practiced ambulation ascending stairs without crutches by first ascending one step with the healthy leg and then reaching and exceeding that step to the one above with the operated leg. The patient performed the descent by placing the healthy leg down one step first and then exceeding it to a lower step with the operated leg. 5 flights of stairs were completed in each direction.

Result of today's therapy unit.

Objective

- The patient is able to ambulate up and down stairs using alternate steps instead of leading with the unoperated leg and catching up with the operated side.

Subjective

- The patient found the side lying abductor exercise difficult compared to the other exercises.
- The patient felt slight discomfort in the operated knee joint after performing the squat exercise which then disappeared after several minutes.

Tuesday 15th of January (am)

Goals of today's therapy unit

- Relax hypertonic muscles using PIR for the quadratus lumborum, tensor fasciae latae and paravertebral muscles.
- Increase ROM in the knee joint in flexion and extension
- Perform sensorimotoric training of the lower extremities

Procedure of today's therapy unit

- Work on increasing the range of motion in the knee in flexion by the patient lying prone and the therapist first passively moving the knee into flexion until

the protective twitch of the extensor muscles engages and then for the muscles to relax and gently guiding the knee into further flexion. PIR techniques according to Lewit were then used in this adapted flexed position for the knee extensors.

- Increased the ROM in knee extension by a small ball being placed under the patients ipsilateral ankle while in supine. We gently applied pressure downwards to the joint with both hands pressing the knee joint into greater extension. This pressure was maintain for approximately 1 minute for 3 sets
- PIR was performed for the quadratus lumborum, tensor fascia latae and paravertebral muscles according to Lewit.
- A foam balance pad was used in which the patient stood on with both feet, the patient attempted to maintain good posture especially of the feet not reverting back to the position of flat foot. The patient then attempted to stand only on the operated leg on the pad.

Results of todays therapy unit.

Objective

- Range of motion in flexion was increased to 100 degrees and extension to 0 degrees (measured by goniometer)
- The quadratus lumborum, tensor fascia latae and paravertebral muscle were all in normal tonus after the therapy
- The patient is able to balance on a foam balance pad with both legs but can not yet manage only standing on the operated leg.

Subjective

- The patient is very happy with th increase in ROM and can feel the difference in locomotion

Tuesday 15th of January (PM)

Goals of today's therapy unit

- General strengthening of the lower extremities focussed on the rectus femoris, vasti muscles, ankle plantar flexors and adductors.

Procedure of today's therapeutical unit

- The patient stood against a wall with a large exercise ball placed between her lower back and the wall. The patient performed squats up until the level of discomfort/pain reaching 5/10. 10 squats were performed per set with 4 sets performed inbetween which there was a 1 minute rest period.
- The patient lay side lying on the unoperated side with the operated leg directly over the operated side. The patient performed abduction against gravity for 10 repetitions per set also for 4 sets with a 1 minute rest period.
- The patient stood facing the wall and performed ankle plantarflexion to take her up on to the toes and forefoot. 12 repetitions per set also for 4 sets with a 1 minute rest period.
- The patients lay in supine with the knees semiflexed to a position that was comfortable and the patient raised the pelvis off the floor performing a glute bridge. 10 repetitions of 4 sets were performed with a 1 minute rest period between each set.

Results of today's therapy unit

Subjective

- The patient feels happy but tired in the worked muscles, and is eager to continue with the strengthening of the operated lower extremity.

Final kinesiological examination

3.3.1 Postural examination

Anterior view

- The base of support is somewhat narrow
- The position of the feet are symmetrical with both feet parallel, facing forwards
- Normal height of medial longitudinal arch of the foot
- The weight distribution of the feet is evenly spread throughout the whole foot
- Both knee joints normal regarding valgosity/varosity
- The position of the patellas are symmetrical
- The contour of the calf and thigh muscles are slightly assymetrical with the left side appearing atrophied compared to the right
- The toes are not pressed into the floor
- The pelvis is an equal height on both sides
- Both scapulas are slightly protracted with the patients arms somewhat internally rotated
- The position of the head is symmetrical

Posterior view

- The valgosity/varosity of both heels are normal
- The knee joints are symmetrical
- There is some assymetry of the gluteal muscles with slight atrophy on the left side.

Lateral view (right side)

- The position of the pelvis has small level of anterior tilt
- The right leg is in full extension
- The lumbar spine is mildly hyperlordotic

Lateral view (left side)

- The position of the pelvis has a small level of anterior tilt
- The left leg is in full extension
- The lumbar spine is somewhat hyperlordotic

Conclusion of the postural examination: There is some atrophy on the left lower extremity compared with that on the right. The patients has the weight evenly distributed throughout the foot. There is only a slight anterior pelvic tilt

3.3.2 Gait examination

The patient walks without crutches comfortably and uses some overuse of the left quadratus lumborum to help the operated extremity from the ground. There is adequate heel strike

3.3.3 Anthropometric measurements

	Left	Right
Anatomical length of the lower extremity	83cm	83.5cm
Functional length of the lower extremity	90cm	90cm
Circumference of the thigh	40cm	42cm
Circumference of the calf	33cm	34cm

Table 9. Final anthropometric measurements of the lower extremity

3.3.4 Goniometry

ACTIVE RANGE OF MOTION			
Joint	Motion	Right-Degrees	L-Degrees
Hip	Flexion	S:25-0-110	S:25-0-110
	Extension		
	Abduction	F:50-0-15	F:50-0-10
	Adduction		

	Internal rotation	R:35-0-30	R:35-0-30
	External rotation		
Knee	Flexion	S:0-0-135	S: 0-0-95
	Extension		
Ankle	Dorsal flexion	F:25-0-45	F:25-0-45
	Plantar flexion		
	Inversion	R:20-0-35	R:20-0-35
	Eversion		

Table 10. Final active range of motion in the lower extremities.

PASSIVE RANGE OF MOTION			
Joint	Motion	Right-Degrees	L-Degrees
Hip	Flexion	S:30-0-115	S:25-0-115
	Extension		
	Abduction	F:50-0-25	F:50-0-20
	Adduction		
	Internal rotation	R:40-0-45	R:40-0-45
	External rotation		
Knee	Flexion	S:0-0-135	S:-0-0-100
	Extension		
Ankle	Dorsal flexion	F:25-0-45	F:25-0-45
	Plantar flexion		
	Inversion	R:20-0-35	R:20-0-35

Table 11. Final passive range of motion in the lower extremities.

Conclusion of the goniometry examination: The patient has a restriction in the left knee in both active and passive movement in flexion.

3.3.5 Muscle tone examination (according to Lewit)

	Left	Right

Rectus femoris	Normal Tone	Normal tone
Vasti (medialis and lateralis)	Normal Tone	Normal tone
Adductors	Hypotonic	Normal tone
Tensor fascia latae	Normal tone	Normal tone
Semitendinosus and semimembranosus	Normal tone	Normal tone
Biceps femoris	Normal tone	Normal tone
Gluteus medius	Normal tone	Normal tone
Gluteus maximus	Normal tone	Normal tone
Piriformis	Normal tone	Normal tone
Quadratus lumborum	Normal tone	Normal tone
Erector spinae	Normal tone	Normal tone
Rectus abdominis	Hypotonic	Hypotonic

Gastrocnemius	Normal tone	Normal tone
Soleus	Normal tone	Normal tone
Tibialis anterior	Normal tone	Normal tone

Table 12. Final muscle tone examination (according to Lewit).

Conclusion of the muscle tone examination: The abdominals are hypotonic along with the left adductor group.

3.3.6 Soft tissue examination (according to lewit)

Skin and subskin – free movement in all directions around the operated knee, equal to that of the contralateral side.

Fascia - no restriction in either direction around the longitudinal axis of the thigh or calf in either limb.

Scar – no stitches in the scars and no restriction in any direction. All older scars from previous operations had no restriction in any direction. There is no swelling around the operated area.

3.3.7 Muscle length test (according to Kendall)

	LEFT	RIGHT
Hamstrings	No shortness	No shortness
One joint hip flexors**	No shortness	No shortness
Two joint hip flexors**	N/A	N/A
One joint ankle plantar flexors	No shortness	No shortness

Two joint ankle plantar flexors*	No shortness	No shortness
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Table 13. Final muscle length test (according to Kendall).

*The patient could not perform the test for the two joint hip flexors as the knee was too painful to be flexed to that extent. The leg was supported in order to atleast measure the length of the one joint hip flexors

3.3.8 Muscle strength test (according to Kendall)*

	Left lower extremity	Right lower extremity
Ankle plantar flexors	Grade 5	Grade 5
Biceps femoris	Grade 5	Grade 5
Gluteus maximus	Grade 4+	Grade 5
Gluteus medius	Grade 4+	Grade 5
Gluteus minimus	Grade 4+	Grade 4+
Hip adductors	Grade 4+	Grade 5
Hip flexors	Grade 5	Grade 5
Iliopsoas	Grade 4+	Grade 5
Lateral rotators	Grade 5	Grade 5
Medial rotators	Grade 4+	Grade 5
Peroneus brevis	Grade 4+	Grade 4+
Peroneus longus	Grade 4+	Grade 4+
Quadriceps femoris	Grade 4	Grade 5
Sartorius	Grade 4+	Grade 5
Semitendinosus / Semimembranosus	Grade 4+	Grade 5
Soleus	Grade 4+	Grade 5
Tensor Fasciae Latae	Grade 5	Grade 5
Tibialis anterior	Grade 5	Grade 5
Tibialis posterior	Grade 5	Grade 5

Table 14. Final muscle strength test according to Kendall.

*where needed tests were modified slightly to allow for the restriction the patient has in full flexion and extension of the left knee.

Results of the strength test: there were no major weaknesses in any area but the general condition of the left lower extremity compared to the right was somewhat lower.

3.3.9 Examination of joint play (by Lewit)

Examined joint	Left side	Right side
Patella	No restriction in any of the directions	No restriction in any of the directions
Tibiofemoral	CONTRAINDICATED	No restriction in any of the directions
Fibula head	No restriction in any direction	No restriction in any direction
Talocrural	No restriction in any direction	No restriction in any direction
Talocalcaneal	No restriction in any direction	No restriction in any direction
Transverse tarsal (chopart)	No restriction in any direction	No restriction in any direction
Tarsometatarsal (lisfrancs)	No restriction in any direction	No restriction in any direction
Metatarsophalangeal	No restriction in any of the directions	No restriction in any of the directions
Proximal interphalangeal	No restriction in any of the directions	No restriction in any of the directions
Distal interphalangeal	No restriction in any direction	No restriction in any direction
Sacroiliac joint	No restriction in any direction	No restriction in any direction

Table 15. Final examination of joint play (according to Lewit).

Results of the joint play examination: No restriction in any joint tested in any directions

3.3.10 Breathing examination

The patient breathes predominately with a lower thoracic breathing pattern with some use of the abdominals. The patient breathes to a normal depth.

3.3.11 Neurological examination

Superficial sensation: The area around the scar did not have any difference in sensation.

Dermatome	Left	Right
L1 segment	Sensation is normal	Sensation is normal
L2 segment	Sensation is normal	Sensation is normal
L3 segment	Sensation is normal	Sensation is normal
L4 segment	Sensation is normal	Sensation is normal
L5 segment	Sensation is normal	Sensation is normal
S1 segment	Sensation is normal	Sensation is normal
S2 segment	Sensation is normal	Sensation is normal

Table 16. Final dermatome sensation examination.

Deep tendon reflexes: The achilles reflex was consistent with a physiological response in both sides. The patella reflex was not attempted due to possible pain occurring around the operated area.

Conclusion of the examination and the final effect of the therapy

The patients postural examination showed that the differences previously seen in the obliquity of the pelvis can be put down to the fact that the patient was not stood with the left knee fully extended. There was still some anterior pelvic tilt of the pelvis, however. There is still a small circumference in the thigh and calf of the operated side which is to be expected after only 8 therapeutic sessions over 2 weeks. The patients operated left knee no has full extension in both passive and active ranges of motion. In flexion of the left knee, however, there is still a deficit in the range of motion, with 95 degrees active and 100 degrees passively. The tonus of the rectus femoris, vasti muscles and ankle plantar flexors improved however the left adductors and whole abdominals did not. The restriction of the scar was negated from the performing of soft tissue techniques. There was a general increase in the strength of the lower extremity of the left leg bringing it closer to the level of the right side. The restrictions in the patella that were established were corrected aswell as those affecting the 1st either extremity. The breathing pattern shifted caudally from that of upper thoracic breathing with little use of the abdominals, to lower thoracic breathing with greater use of the abdominals. Again all neurological examinations performed had physiological results with no difference in either extremity. One of the greatest results in the therapy is that the patient is no longer using crutches and is capable of ambulating up and down stairs without them. The psychological aspect of the therapy was important in dealing with this patient, as they had previous negative experiences with therapy. The patient finished

the therapy happy and looking forward to the next stages of the rehab assigned.

4. Conclusion

The patient was friendly and very cooperative despite being nervous from the beginning. There was a significant psychological aspect to the situation from the patient's previous negative experiences with rehabilitation which changed the style of therapy used. It was important to start slow and easy with the patient, avoiding intensive therapies. It was important to make the patient feel that they are in control of the situation to improve results.

Despite anterior cruciate reconstruction being known as a rather straight forward operation and rehabilitation, the situation was also complicated by the fact that the patient had already had three previous surgeries on the operated knee. Once the patient felt relaxed and comfortable with the therapy there was a clear increase in the effectiveness of the therapy provided.

The thesis work solidified my knowledge in that the psychological state and view of the patient can dramatically affect the results gained and the outlook of the physiotherapy treatment just as much as the mechanical and functional aspects.

In this respect the placement was interesting, enjoyable, and educating. I was able to successfully use my knowledge gained through study and Charles University in Prague.

5. BIBLIOGRAPHY

Books

- (1) Bartlett R. (1999). *Sports Biomechanics: Reducing injury and improving performance*. United States: Routledge.
- (2) Canale, J. S., & Beaty, J. H. (2012). *Campell's operative orthopedics* (12th ed). Philadelphia: Elsevier Mosby.
- (3) Dandy, J. D., & Edwards, J. D. (2003). *Essential orthopaedics and trauma* (4th ed). Edinburgh: Elsevier Science Limited.
- (4) Fontera W.R., Silver J.K., Rizzo T.D. (2008). *Essentials of Physical Medicine and Rehabilitation* (2nd ed.). Philadelphia: Saunders Elsevier.
- (5) Hamil J., Knutzen K.M. (2009). *Biomechanical Basic of Human Movement* (3rd ed.). Philadelphia: Lippincott Williams & Wilkins.
- (6) Kendall F.P. et al. (2005). *Muscles Testing and function with posture and pain* (5th ed.). Philadelphia: Lippincott Williams & Wilkins.
- (7) Kolář P. et al. (2013). *Clinical Rehabilitation*. Czech Republic: Rehabilitation Prague School.
- (8) Lewit K. (2010). *Manipulative Therapy: Musculoskeletal Medicine*. Czech Republic: Churchill Livingstone Elsevier.
- (9) Liebenson, C. (1996). *Rehabilitation of the spine a practitioner's manual*. USA: Lippincott Williams and Wilkins.
- (10) Lindsay D.T, (1996). *Functional human anatomy*. United States: Mosby – Year Book.
- (11) Netter, F. H. (2011). *Atlas of human anatomy* (5th ed). USA: Lenehan A, Saunders Elsevier.

Lectures

(12) Vomackova, H., Vlacilova, I. (2015) Measurement of Joint Motion Goniometry. Lectures notes. Prague Czech Republic: Charles University

(13) Vomackova, H., Vlacilova, I. (2013) Manual Muscle Strength Test. Lectures notes. Prague Czech Republic: Charles University

(14) Vlacilova, I. (2015) Nerve Supply of the Upper and Lower Limb. Lectures notes. Prague Czech Republic: Charles University

(15) Vomackova, H., Vlacilova, I. (2013) Gait Analysis/ Assessment. Lectures notes. Prague Czech Republic: Charles University

(16) Vomackova, H., Vlacilova, I. (2013) Anthropometric Measurements. Lectures notes. Prague Czech Republic: Charles University

(17) Vlacilova, I. (2015) Lower Extremity Palpation. Lectures notes. Prague Czech Republic: Charles University

6. Supplements

6.1 List of Figures

Figure 1: Anatomy of the knee joint

Available at: <https://orthoinfo.aaos.org/en/diseases--conditions/common-knee-injuries/>

Figure 2. Muscles of the lower extremity.

Available at <http://baldaivirtuves.info/human-anatomy-leg-muscles/human-anatomy-leg-muscles-624-best-muscles-images-on-pinterest-muscles-medicine-and-human-download/>

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6.2 List of abbreviations

ACL: Anterior cruciate ligament.....

ROM: Range of motion.....

PIR: Post isometric relaxation.....

BMI: Body mass index.....

Cm: Centimetre.....

6.3 Approval by the ethics committee

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

Application for Approval by UK FTVS Ethics Committee

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

The title of a project: CASE STUDY OF PHYSIOTHERAPEUTIC TREATMENT OF A PATIENT AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

Project form: Bachelor Thesis

Period of realization of the project: January 2018

Applicant: Michael Bramham, UK FTVS - Physiotherapy department

Main researcher: Michael Bramham, UK FTVS - Physiotherapy department

Workplace: Rehabilitační nemocnice Beroun

Supervisor: Mgr. Helena Vomáčková

Project description: Case study of a patient after anterior cruciate ligament reconstruction. The aim of the case study is to first exam the patient's initial state using questionnaires, specific physiotherapy examinations and observations. After two working weeks of physiotherapeutic techniques the patient will undergo a final examination using observations, specific physiotherapy examinations and questionnaires to observe changes from the initial state and evaluate the effectiveness of the physiotherapeutic procedures used.

Characteristics of participants in the research: 1 female patient aged 24. The patient is staying at Rehabilitační nemocnice Beroun during the full 2 working weeks that the research is occurring.

Ensuring safety within the research: Risks to the patient will be minimised. There will be a varying team of qualified physiotherapists and doctors on the same floor during all procedures during the research. The patient is notified about using a scale of pain between 1-10 (10 being maximum) and to not continue with a specific procedure if pain levels go over a level 5. No invasive methods will be used during the research. The physical presence of the responsible supervision Mgr. Helena Vomáčková.

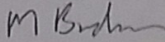
Ethical aspects of the research: All data obtained during the research will strictly be used only for the Bachelor thesis and possible further research at UK FTVS. The bachelor thesis will contain no data leading to the identification of the patient used in the research. After the anonymisation the personal data will be deleted. Any photographs containing the patient's likeness will be suitably blurred or adapted to ensure full anonymity. No photos or video will be taken during the research. I shall ensure to the maximum extent possible that the research data will not be misused.

Informed Consent: attached

It is the duty of all participants of the research team to protect life, health, dignity, integrity, the right to self-determination, privacy and protection of the personal data of all research subjects, and to undertake all possible precautions. Responsibility for the protection of all research subjects lies on the researcher(s) and not on the research subjects themselves, even if they gave their consent to participation in the research. All participants of the research team must take into consideration ethical, legal and regulative norms and standards of research involving human subjects applicable not only in the Czech Republic but also internationally.

I confirm that this project description corresponds to the plan of the project and, in case of any change, especially of the methods used in the project, I will inform the UK FTVS Ethics Committee, which may require a re-submission of the application form.

In Prague, 24.01.2018

Applicant's signature: 

Approval of UK FTVS Ethics Committee

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

Members: prof. PhDr. Pavel Slepíčka, DrSc.

doc. MUDr. Jan Heller, CSc.

PhDr. Pavel Hráský, Ph.D.

Mgr. Eva Prokešová, Ph.D.

MUDr. Simona Majorová


The research project was approved by UK FTVS Ethics Committee under the registration number: 042/2018

Date of approval: 24.1.2018

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

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

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


Signature of the Chair of
UK FTVS Ethics Committee

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:.....

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Místo, datum

Jméno a příjmení pacienta Podpis
pacienta:

Jméno a příjmení zákonného zástupce

Vztah zákonného zástupce k pacientovi
Podpis: