CASE STUDY OF PHYSIOTHERAPY TREATMENT OF A PATIENT FOLLOWING TOTAL KNEE REPLACEMENT

JOHANNE MARIE JØRLO

Supervisor of the bachelor thesis: Mgr. Kateřina Holubová
Advisor of clinical work: Mgr. Hana Zemlerová
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DEDICATION

It is with great gratitude that I dedicate my bachelor work to the people who always believed in me, always were there and always will be. My family, my parents Eva Louise and Helge, my sister Iben Sophie and my brothers Andreas and Haakon, my friends Bettule Hamed, Pauline Johanne Kajl and Vanessa K. Ivanov. I love you and owe you everything!
DECLARATION

I declare that I carried out this bachelor thesis independently with the supervision and guidance of Mgr. Kateřina Holubová and Mgr. Hana Zemlerova, and only with the cited sources, literature, lecture content from seminars at the faculty of Physical Education and Sport, Prague and other professional sources. No invasive methods were used during the practical approach and that the patient was fully aware of the procedures at all times.

I understand that my work relates to the rights and obligations under the Act No. 121/2000 Coll., the Copyright Act, as amended, in particular the fact that the Charles University in Prague has the right to conclude a license agreement on the use of this work as a school work pursuant to Section 60 paragraph 1 of he Copyright Act.

Prague, Czech Republic 21.08.14  Johanne Marie Jørlo
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ABSTRACT

Title: Case study of physiotherapy treatment of a patient following total knee replacement

Abstract: The aim of the thesis is to present the physiotherapy given to a patient with stiffness after an atypical total knee replacement procedure. The work consists of a general part and a special part. The general part aims to explain this particular case of total knee replacement from a theoretical point of view. The goal of the special part is to present physiotherapy as treatment, it’s conduction and results.

Method: One female patient (b. 1958) with chronic stiffness following total knee replacement was selected and gave consent to take part in the case study. A copy of the form of consent can be found in the appendix at the end of this thesis. Clinical examination, therapy and progress evaluation took place at Rehabilitation Clinic Malvazinky from 21.01.14 to 31.01.14 under the supervision of Mgr. Hana Zemlerová. Utilities used in examination and treatment included treatment table, measuring tape, neurologic hammer, goniometer, overball, big balls, bosu balls, spiked balls, supportive pillows, stationary bicycle and mats. Therapeutic methods and principles used was PIR, soft tissue techniques, joint manipulation and posture correction.

The general part was based on theory learned through the bachelor studies of physiotherapy at FTVS, Charles University in Prague. Other theory was gained from the cited books, academic articles (database: EBSCOhost and ScienceDirect) or from trusted webpages retrieved from 23.01.14 to 25.08.14.

Result: The most important result after the therapy was increased range of active flexion with 15 degrees and passive flexion with 5 degrees. Both passive and active movements to extension increased with 5 degrees.

Conclusion: After the week of intensive rehabilitation, the patient had small improvements on a few factors. However, the therapy was unsuccessful in reaching the patient’s goal of increased function of the knee.

Keywords: Rehabilitation, Total knee replacement, post operation complications, chronic stiffness, chondrosarcoma, healing, PIR, soft tissue techniques
ABSTRAKT

Název: Kazuistika fyzioterapeutické léčby pacientky po totální náhradě kolenního kloubu.

Abstrakt: Účelem této práce je představit fyzioterapeutický postup použitý u pacientky trpící ztuhlostí po atypické totální náhradě kolenního kloubu. Práce se skládá ze dvou částí: obecné a speciální. Smyslem obecné části je vysvětlit tento konkrétní případ totální náhrady kolene z konkrétního hlediska. Účelem speciální části je pak uvést podrobnosti fyzioterapie jako léčby, její vedení a výsledky.


Obecná část vychází z teorie ovládnuté na základě bakalářského studia fyzioterapie na Fakultě tělesné výchovy a sportu Karlovy univerzity v Praze. Další teoretické poznatky byly získány z niže uvedených knih, akademických článků (databáze: EBSCOhost and ScienceDirect) popř. z důvěryhodných webových stránek stažených v době od 23. ledna do 25. srpna 2014.

Výsledek: Nejdůležitějším léčebným výsledkem byl rozsah aktivní flexe rozšířený o 15 stupňů a pasivní flexe rozšířený o 5 stupňů. Jak pasivní tak aktivní pohyb do extenze se zlepšil o 5 stupňů.

Závěr: Po týdnu intenzivní rehabilitace zaznamenala pacientka malé zlepšení v několika ohledech. Nicméně, léčba byla neúspěšná, pokud jde o dosažení pacientčina vlastního cíle, totiž zlepšení kolenní funkce.

Klíčová slova: rehabilitace, totální náhrada kolenního kloubu, pooperační komplikace, chronická ztuhlost, chondrosarkom, PIR, manipulace měkkých tkání
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Finally, however first in my heart, my parents who offered me moral, legal and financial support when needed throughout my studies. I would not have accomplished this without you. Thank you!

To the reader: I hope this thesis will interest, inspire and hopefully cast a new light on this topic from an aspiring physiotherapist’s point of view!

Johanne Marie Jørlo, Prague 2014
1 INTRODUCTION

With this work I will examine and present the case of a chronic stiff total knee arthroplasty after limb salvation surgery. Knee salvation surgeries, with insertion of arthroplasty, are increasingly being used in cases of bone cancer resections with great success and quality of life for the patient, in difference to the optional approach of amputation.

Knee implants are individually customized to its’ users requirements, and aims to treat many different pathological conditions, even though they are mostly associated with treating arthritic joints (Jones, 2003; Rowe, 2005; Valtonen, 2009). The goal of the replacement is to preserve or improve knee joint function, remove pain, restore range of motion and ensure stability. Lifespan of a newly implanted knee joint is estimated to be over 10 years (Jones, 2003), but excessive strain and overloading may cause earlier need of a new replacement (Gandhi, 2008). In the last years, innovation of new and modern implants has increased tremendously, and there is now possible to get joints that last longer, increase functional abilities and flexion range of motion (Gandhi, 2008).

Complications expected after total knee replacement surgeries depend on the extent of tissue resection (Benedetti, 2000; Carty, 2009) as well as what type of prosthesis is being used (Carty, 2009; Gandhi, 2008) in combination with preoperative, operative and postoperative factors (Kim, 2004; Scuderi, 2005; Yercan, 2006). In cases where the cancer has penetrated the muscle fibres of the quadriceps, removal of one of these muscles will weaken the knee function and also alter movement stereotypes (Benedetti, 2000). Compensation mechanism of the under and overlying structures around the knee are common, and may cause secondary problems with pain and overloading (Gandhi, 2008). Chronic knee stiffness following total knee replacement is a rare, and estimated to be among 1,3% of patients after primary knee arthroplasties (Kim, 2004), but disabling complication with many potential causes. Correct diagnosis of the underlying cause is essential in order to offer the most effective treatment.

Treatment to chronic stiffness includes intensive physiotherapy, bracing, manipulation under anaesthesia and invasive approaches (Millett, 2003; Panni, 2009; Seyler, 2007). Goal of treatment is to return the patient to pain-free movement with sufficient knee range of motion to ensure functional satisfaction.
2 CLINICAL PICTURE

This case study deals with a female (b. 1958) office worker, who had a surgical chondrosarcoma resection of the right distal femur and a limb salvation surgery with instalment of a massive knee endoprosthesis 17.01.13.

12 months after her surgery, she presents with chronic knee stiffness (45 degrees active arch of knee motion, 15 degrees flexion contracture and 60 degrees flexion of the knee) and functional impairments that affect her quality of life.

She is prescribed an intensive rehabilitation program as inpatient at Rehabilitation Clinic Malvazinky in Prague, Czech Republic. The program includes physiotherapy among many other therapies and exercise methods offered by the clinic. The aim of the stay is to increase range of motion to an optimal level and improve her function.
3 GENERAL PART

The general part of this thesis consists of a brief description of the structural and functional components, the total knee replacement procedure with outcome, healing and complication statistics, chondrosarcoma and its effect on healing, in addition to stiffness as a complication. The main focus of this part will be on the treatment management of chronic knee stiffness after total knee replacement.

3.1 ANATOMY OF THE KNEE

The knee is known to be the largest and most complicated joint in the body. It is a biaxial condylar synovial/hinge joint of the lower extremity that connects the two long bones: the Femur and the Tibia. The articulation takes place between the femoral condyles and the articular surface of the Tibia, also known as the Tibial Plateau. The articulation also includes a saddle joint between the sesamoid bone Patella and the patellar surface of the Femur.

![Bony structure of the tibio-femoral joint](image)

Figure 1: The bony structure of the tibio-femoral joint (Hall, 2012)

DEEP STRUCTURES

A thin fibrous capsule containing synovial fluid, stabilized by the surrounding muscles and ligaments, encloses the knee joint. Within this capsule there are the cushioning menisci and the ligaments; anterior and posterior cruciate ligaments, including the transverse ligament.
Outside the capsule we find several shock-absorbing bursae, the medial and lateral collateral ligaments, the patellar ligament connecting the Quadriceps Femoris to the tuberosity of the tibia, the arcuate and oblique popliteal ligaments (Hansen, 2011).

**MUSCLES OF THE KNEE**

Crossing muscles of the hip and knee joint includes Sartorius, Rectus Femoris, Tensor Fasciae Latae, Biceps Femoris (long head), Semitendinosus, Semimembranosus and Gracilis. These muscles are responsible for flexion and extension, adduction and abduction of the hip joint as well as stabilization, flexion and extension of the knee. Muscles acting on the knee joint alone are Vastus medialis, Vastus intermedius, Vastus lateralis, Biceps Femoris (short head) and Popliteus.

Gastrocnemius crosses both the knee and the ankle joint. Surrounding the muscles of the thigh is fascia, connective tissue that separates the muscles into compartments.
Figure 3: Cross section of the thigh (Eycleshymer and Schoemaker, 1970)

**BLOOD SUPPLY**

The femoral artery sends blood flow to the deep muscles of the thigh, before passing through the adductor hiatus and becoming the popliteal artery. Genicular arteries from the popliteal artery, provide the supply to the knee joint. Similar to the venous system of the upper extremity, the venous system of the lower extremity has valves that help in returning the blood back to the heart against the force of gravity.

**SUPERFICIAL TISSUES AND SENSORY NERVES**

Surrounding the muscles and the blood vessels are superficial fascia, nerves and superficial blood vessel branches, which again is covered by lymphatic, subcutaneous and cutaneous tissue. The superficial, cutaneous, nerves of the thigh and leg are branches of the femoral, Obturator and sciatic nerves. The lumbar plexus gives rise to the superficial nerves of the lateral part of the extremity. Around the calf is the Sural nerve, which is formed by a union of the superficial Tibial and common Fibular nerves (Hansen, 2011).
3.2 BIOMECHANICS OF THE KNEE

The knee is a joint with high requirements to sustainability against forces and flexibility. It has both stabilizing, as well as mobilizing functions. The joint has 6 degrees of freedom, whereof 3 translations: anteroposterior, laterolateral and craniocaudal, and 3 rotations: flexion-extension, internal-external rotation and varus-valgus angulation. The four principal ligaments (ACL, PCL, MCL and LCL), including the static stabilizers and the dynamic muscle stabilizers act in synchronization to define the knee motion.

RANGE OF MOTION

The range of rotation motion of the knee normally extends to 0 degrees. Hyperextension is defined as extension movement above 10 degrees, and is not uncommon. Flexion of the knee is normally to about 140 degrees. Internal and external rotation, on normally 30 and 45 degrees, can be obtained while the knee is flexed at 30 degrees of flexion. Varus-valgus angulation is minimal, yet present. Due to viscoelastic properties of connective tissue around the knee joint, the range of motion can be increased or decreased with stretching. Exceeding the maximal ROM of the knee joint can, consequently, both cause plastic or elastic deformation, depending on the degree of stretch (Hall, 2012; Seyler, 2007).

THE PATELLOFEMORAL JOINT

The patello-femoral joint has several important functions to the knee joint. The most important is the increased angle of pull of the quadriceps tendon on the tibia, which assists in improving the extension force with up to 50% (Hall, 2012). It also acts to protect the anterior aspect of the knee, redistribute compressive forces and stress to the joint and the quadriceps muscle.

THE MECHANISMS OF STANDING AND MOVING

Knee movement is composed by static and dynamic components, which includes several important, and structurally fascinating, mechanisms. In order to be able to stand we benefit by the so-called “screw-home” mechanism of knee extension, a structural detail of the anatomy that saves us much energy. When the knee is flexed
above 20 degrees, the mechanism is deactivated, and we are able to walk and adjust to different surfaces by using the internal-external rotational movement.

The Quadriceps muscle is responsible for movement of the knee to extension. At the end of the extension motion, around 20 degrees of knee flexion, movement persists on the tibia’s medial condyle because the size of the articular surface is longer. Movement above this point causes slight external tibial rotation, which is referred to as the stabilizing “screw-home” mechanism. This same mechanism prevents us from instability while standing and ruptures of the ligaments.

In knee flexion motion, the ligaments provides stability, while the muscles (Hamstrings) provides motion. At the start of the knee motion into flexion, the femur rotates laterally and releases the tension of the collateral ligaments, which then permits flexion. During the motion, the menisci are pulled back to the knee. In the end of the motion, the posterior collateral ligament is tightened to prevent the femur from sliding forward on the tibia.

Figure 4: Knee motion and muscle activation (Plexus Performance and Rehabilitation, 2014)

When walking all these mechanisms are put into action. We divide the gait into two phases: stance and swing phase. These phases can be further divided into small distinct sequences. The ligaments creates stability and halts the end of the range of motion, while the muscles stabilizes as well as moves the extremity forward with the use of both agonist and antagonist alternately for this purpose. We require 67 degrees of knee flexion to be able to complete a normal swing phase.

Ascending and descending stairs is normally done with a step over step (SOS) ambulation. In patients and the geriatric population, we can also see movements such as step by step, side-motion and with increased use of handrail. These are often due to
instability, stiffness, muscle weakness, balance troubles or fear. SOS ambulation requires the flexion range of motion of 83.5 degrees in ascent, while 83.3 degrees in descent. Step by step motion requires 78.8 degrees in ascent and 73.7 in descent (Reid, 2007).

3.3 KINESIOLOGY OF THE KNEE

The knee joint has a vital function in keeping the body upright and stable in standing (postural), but also allows us to jump, walk and run on a wide variety of terrain. The joint permits movement both in the sagittal plane with flexion and extension, in addition to slight rotational movements in the transverse plane while the knee is flexed. When the knee is extended however, the knee locks in position (due to the shape of the medial femoral condyle) and provides stability for standing.

VOLUNTARY MOTOR CONTROL

Voluntary motor control of the knee is steered by the central nervous system, cerebral cortex. Communication from the periphery to the brain comes from receptors. The receptors are located in the joint capsule and in the muscle spindles, and send signals to the reticular formation and cerebellum about position of the joint and speed of movement. Enhanced with the vestibular centre and ocular vision, as well as the superficial receptors of the skin, these structures allow precision estimation of the limb position in relation to the external environment.

REFLEXES

The patellar reflex is a proprioceptive stretch reflex with a monosynaptic reflex arc in the spinal column level L2-L4, which helps maintain posture and balance without conscious thought. When activated the quadriceps muscle is activated, and the leg extends rapidly. The absence or decreased reflex response is commonly referred to as Westphal’s sign, and indicates receptor damage, peripheral nerve disease or interruption of sensory/motor impulse transmission from the femoral nerve.
STABILITY

The stability of a joint is defined as its ability to resist the displacement of one bone end with regard of the other, while preventing injury to the structures surrounding the joint (Hall, 2012). There are many factors that influence joint stability: The shape of the bone surfaces, the organisation of the ligaments and muscles, as well as other connective tissues around the joint and central control.

The structures comprising the articulation all have a purpose in its complex function: Ligaments surrounding the knee act mainly as a static stability, while the Quadriceps and Hamstrings muscle groups contract and produce a dynamic stability.

Quadriceps muscle, innervated by the femoral nerve, is essential in movement and in the maintenance of patello-femoral stability. In cases of injury the quadriceps are particularly prone to atrophy which may cause a series of functional problems to the individual. To prevent this problem, functional weight bearing activities such as stairs walking or squats are useful in regaining muscle strength (Hall, 2012).

The Hamstrings, which are the antagonists to the Quadriceps at the knee has a tendency to strain. When activated, they cause flexion of the knee joint. The muscles originate from the ischial tuberosity and attach to the antero- and posteromedial, and the lateral part of tibia.

FLEXIBILITY

Flexibility deals with how much range of motion that is allowed in each movement plane of a joint. We differentiate between static and dynamic flexibility, where static is passive movement acted on by an external factor/clinician, and dynamic is active movement driven by the patient’s own motor control. Tightness and laxity of a joint is thereby examined by static flexibility testing, which rules out any potential muscle weakness. Dynamic flexibility, on the other hand, is very important in assessing the patient’s functional abilities of daily living.

We have two types of joint flexibility: general and specific. Normally each joint has a unique and specific amount of flexibility, however there are cases of general joint laxity, where there is an increase of overall flexibility in all joints.

Physiological factors limiting joint flexibility include the shape of the bone surfaces, muscles or subcutaneous tissue volume, which can stop movement at the end of the range of motion. Other factors might be pathological, such as central nervous system damage leading to muscle spasticity, which then can cause
contracture. However, the most common factors of decreased range of motion are lack of extensibility of collagenous tissues and tight ligaments and muscles (Hall, 2012).

Ageing and flexibility has been thought to be in an inverse relationship, although it’s now thought to be predominantly caused by increased inactivity. Lack of regular stretching of the collagenous tissues will, regardless of age, cause shortness and reduction of range of motion. Equally, when the tissues are stretched, they will elongate.

One factor increasing joint flexibility has been thought to be heat. Collagenous tissue has, in laboratory studies, shown to increase flexibility slightly with temperature elevation, however this is not well supported in other studies examining the difference between static stretching on the ankle joint with and without heat applied (Hall, 2012). Thus more studies are required to examine this hypothesis.

Muscle strength, which more commonly is known to increase active stability of the knee, is also closely linked with flexibility. Increased strength allows increased ROM, even though muscle volume may halt the end range (Hall, 2012).

Asymmetric, excessive or extreme lack of flexibility has been linked with increased risk of injury. Lack of flexibility can be harmful to collagenous tissues and muscles crossing the joint, and can lead to ruptures if the joint is stretched. In male athletes, muscle sprains to the hamstrings are common and often caused by tight muscles limiting full ROM. Lax joints usually lack stability and are at increased risk of displacement injuries and ligament ruptures.

The amount of desirable joint flexibility depends on the preferred activities of the individual, his or her occupation, religion and age. Basic knee flexion range of motion required for daily tasks are considered to be 110 to 115 degrees in Europe and North America (Li, 2007). 93 degrees are required for rising up from a chair and 106 degrees are required for shoelace tying (Gandhi, 2008).

In the geriatric population the requirements of flexibility are usually much lower than of a young. Knee flexibility is required in certain religions to take part of essential events, such as praying (Gandhi, 2008). Others might have a desire for gardening, which is an activity requiring almost the same amount of ROM.

Finding the right implant, and giving the optimal treatment should therefore be individual according the persons preferences and requirements.
3.4 CHONDROSARCOMA

Chondrosarcoma, a rare cartilage type of cancer, is the second most common form of malignant bone tumour. It usually develops in the medullary cavity or the periphery and is more common in middle-aged males. Its cause is not known, but is associated with some ailments such as Ollier’s disease and Maffucci syndrome.

This type of cancer grows slowly, is often painless and can be found around points of muscle attachment to the bone around the knee, shoulder, hip and pelvis. It rarely affects the distal part of bones. The abnormal cells grow within or on the bone, usually proximal on bones such as femur, tibia, pelvis and humerus.

It is usually differentiated into three degrees of severity; low, intermediate and high. Low forms, “Conventional” and “Clear cell” type, of chondrosarcoma are stable and benign, while intermediate, Myxoid, are more prone to spreading, and high forms, such as the “Mesenchymal” and “Dedifferentiated” type, are malignant, unstable and aggressive.

DIAGNOSIS

Due to its character, it is often not discovered until it has grown to a fairly great size or caused unexplainable fractures. Radiographic (X-ray, CT, MRI, PET scan) findings are typically uneven dots and strands of calcification (Porth, 2005). The sarcomas are graded, and it is primarily the 2nd and 3rd grade that metastasize (Terek, 2007).

TREATMENT

Chondrosarcoma is shown unresponsive to radiation and chemotherapy (Porth, 2005; Terek, 2007). Early diagnosis is critical to avoid it from transforming into mesenchymal chondrosarcoma, a highly malignant type of cancer. The standard treatment is extensive surgical removal of both tumour and a large portion of surrounding tissues. If it affects limbs or joints, the procedure is often limb salvation surgery with installation of a massive implant (Porth, 2005). There also exists Intralesional Curettage surgery for low-grade chondrosarcomas, which spares more of the surrounding tissues to avoid later functional complications.
**PROGNOSIS**

The prognosis for chondrosarcoma depends on what grade of cancer it is and the chosen method of treatment. In low-grade types the prognosis is excellent after surgical removal, and the risk of recurrence is low. In higher grades of chondrosarcoma the prognosis depends on the extent of spreading.

![Radiographic imaging of chondrosarcoma](image1)

**Figure 5:** Radiographic imaging of chondrosarcoma, a resected gross variety (WebPathology, LLC, 2014)

![Photomicrograph of malignant chondrocytes](image2)

**Figure 6:** A photomicrograph of malignant chondrocytes (Rubin, 2012)

**PSYCHOLOGICAL ASPECTS**

Cancer is a quite common disease with the potential to overwhelm and cause great stress for the affected according Gurevich and colleagues. The shock of receiving such a diagnosis can cause highly stressful thoughts, depression as well as starting various coping mechanisms for the affected. The patients’ age, personality and history, the severity of the cancer and its’ prognosis all affect the level of psychological changes. These changes can affect the course of the rehabilitation, motivation and adherence to the rehabilitation program and communication with the medical team, as well as other interpersonal relationships.
Elisabeth Kübler-Ross described, in her book “On Death and Dying” from 1969, 5 different stages of major loss and grief that originally was concerning the psychological coping mechanism when faced with death, but which she later changed to coping with any loss or traumatic event, including receiving the news of cancer and functional loss.

1. Denial
2. Anger
3. Bargaining
4. Depression
5. Acceptance

In difference to many other dangers, cancer is a threat from within the body of the affected. It is an internal hazard that can lead to insecurity and fear of own body. It has the potential of causing psychological conditions, such as post-traumatic stress disorder, depression, avoidance, sleep disorders, helplessness, hypersensitivity, eating disorders and anxiety, among others (Gurevich, 2002).

Having cancer can additionally be accompanied with many secondary complications including loss of a social role fulfilment, employability, loss of a function or movement capabilities, and so on. These losses, which can create further psychological stress for the person, are sometimes more evident when the acute shock of receiving the diagnosis has been fully grasped.

Understanding the patient as a whole, challenged by both physical and psychological changes, is important in order to obtain an optimal outcome of the rehabilitation. Ensuring good communication between the patient and the medical team is therefore vital.
3.5 TOTAL KNEE REPLACEMENT (TKR)

Total knee replacement is a procedure done surgically with removal of damaged tissue, followed by installation of a customized implant. The indication is usually painful arthritis of the knee (Jones, 2003; Rowe, 2005; Valtonen, 2009). In these cases, the implant is small; unicompartmental or bicompartmental, just enough to replace the damaged articulating surfaces of both femur and tibia (Figure 7, Figure 8). The implant can also be constrained, non-constrained or intermediated. Constrained implants have only one degree of freedom, while the ideal non-constrained prosthesis has 5 degrees of freedom with intact ligament system. The intermediated prosthesis, which includes two subtypes, has anterior posterior stability.

Figure 7, left: Unicompartmental implant (Hospital for Special Surgery, 2013)

Figure 8, right: Bicompartmental implant (Hospital for Special Surgery, 2013)

Figure 9: Types of massive knee endoprostheses (Okita, 2013)
When the indication is limb salvage, such as in the case of chondrosarcoma removal of proximal tibia or distal femur, the implant is larger and more complex (Figure 9)

**PREOPERATIVE PHASE**

The patient is firstly explained by the surgeon what to expect as outcome of the procedure, and then given preoperative advices from a physiotherapist concerning exercises. Medical evaluation, laboratory studies and a careful examination with imaging studies are done to properly find the best approach and prepare the implant to fit the persons’ individual measures.

**INTRAOPERATIVE PHASE**

The anaesthesiologist introduces general or regional anaesthesia and the appropriate surgical approach is chosen. Most commonly is the medial parapatellar. The lateral approach is less commonly used, but reports less problems with stretching due to the location of the scar (Niki, 2011). The surgeon begins the surgery, bone and damaged tissue are removed, and the implant is introduced. After the implant has been properly placed, a test of passive range of motion is done to ensure the implant is in place and correctly fitted. The surgery finishes with stitching up the patient and transporting him or her to the recovery unit.

**POSTOPERATIVE PHASE**

After the surgery is completed successfully, the client takes part in a postoperative rehabilitation plan, before going home or being transferred to a rehabilitation clinic.

This plan includes bedside exercises, exercises to activate the ROM and knee extension, gait training and progression of ambulation, as well as stretching of quadriceps and hamstrings. A successful surgery without complications usually indicates a quick hospitalization and a standard protocol of rehabilitation. Surgeries with complications must be treated according the specific problem.

**POSTOPERATIVE REHABILITATION**

Good postoperative management is essential to ensure the best possible function of the knee. The goal of the rehabilitation is to get the patient up and out of
bed, prevent deep vein thrombosis, train ambulation with use of crutches, achieve 90 degrees of flexion of the knee, educate the patient and offer an exercise program with focus on strengthening.

Miller et al. examined, in 2008, the different therapeutic exercise approaches to rehabilitation, and presented the results they found in a table (Table 1). They suggest that some of the rehabilitation measures prove to be superior to others, such as neuromuscular electrical stimulation (NMES), which could potentially to enhance speed and quadriceps strength after recovery.

| A COMPARISON OF THERAPEUTIC EXERCISE REHABILITATION APPROACHES FOLLOWING TKA |
|--------------------------------------|----------------|----------------|----------------|
| Start of therapy                | Frequency                      | Number of visits (duration) | NMES* |
| Avramidis\(^3\)                | 1 d postoperative              | 16 (8 d)                   | Yes (6 wk) |
| Mizner and Stevens\(^2\)\(^{20}\) | 2 times/1d                    | 3 times/wk                 | No |
| Moffe\(^2\)                     | 8 wk postoperative            | 12 (8 wk)                  | No |
| 18 (6 wk)                        | 1-2 times/wk                  | 18 (6 wk)                  | Yes* |
| 10-15 min                       | 5:20 min                      | 10-15 min                  | No |
| Core exercises                   |                               |                            |      |
| Quadriceps sets                | X                              | X                        | X     |
| Hamstring sets                  | X                              | X                        | X     |
| Straight-leg raise              | X                              | X                        | X     |
| Hip abduction                   | X                              | X                        | X     |
| Standing terminal extension     | X                              | X                        | X     |
| Step-ups-downs                 | X                              | X                        | X     |
| AROMAAROM                       | X                              | X                        | X     |
| Seated knee extension           | X                              | X                        |      |
| Wall squats/Standing squats     | X                              | X                        |      |
| Standing hamstring curl         | X                              | X                        |      |
| Lunges                          | X                              | X                        |      |
| Walking                         | X                              | X                        |      |
| Non-weight-bearing ROM          | X                              | X                        |      |
| Ankle pumps                     | X                              | X                        |      |
| Sit-to-stand                    | X                              | X                        |      |
| Walking backward, marching, side step | X                      | X                        |      |

Abbreviations: AROM, active assistive range of motion; AROM, active range of motion; NMES, neuromuscular electrical stimulation; ROM, range of motion; TKA, total knee arthroplasty.

* NMES parameters: 2500-Hz triangular-wave alternating current (AC), 12-s on-time, 80-s off-time, 2- to 3-s ramp-up time, knee flexed to 60°, 10 isometric contractions, dose set to maximally tolerated by the patient, large (7.6 × 12.7 cm) self-adhesive electrodes placed on motor points of the quadriceps femoris muscle.

Table 1: Comparison of therapeutic rehabilitation approaches following TKA (Meier, 2008)
Outpatient rehabilitation usually commences immediately after the patient has returned to his or her home. The patient is, at this point, more responsible for own therapy and execution of the recommended exercises. Motivation is important to keep the patient engaged with the program. Recommending the patient appropriate activities can be an excellent way of motivating the patient to keep being active and use his or her new knee joint in a safe manner. Activities, which are recommended and unadvised, can be seen in table 2.

![Table 1: Recommended and unadvised activities following TKA (Meier, 2008)](image-url)
HEALING AFTER SURGERY

Follow-ups with surgeon and physiotherapist are frequently done within the first year. Here the goal is to assess the healing process, and to make sure that the joint is functioning, as it should. Any restriction or problems must be ruled out as early as possible to make sure the soft tissues heal properly.

The goal of healing is to repair a tissue fault. The process can be divided into 4 distinct phases: Hemostasis phase, the inflammatory phase, the granulation phase and the remodeling phase. When the skin is punctured and causes hemorrhaging, the first response is to clot the area to reduce blood loss (Hemostasis). The inflammatory phase occurs immediately after and lasts up to 6 days. At the end of the inflammatory stage begins a fibroblastic phase that can last up to 4 weeks. Within this period the wound starts a contracture process, which lasts throughout the rest of the healing phase. Scar maturation follows thereafter and can last for several years. Insufficient healing can cause hypertrophic or atrophic scarring. (Mercandetti, 2013)

OUTCOME

Outcome of a total knee replacement is usually excellent in cases where the patient has suffered from chronic pain and disability, as in arthritis. 90% of the patients report reduction of pain, 70-80% reports improved function and have a gradual improvement up to 2 years after the operation (Jones, 2003). The recovery phase with the highest increase in function is from 3 to 6 months.

Several factors take part in influencing the outcome, even though some are debated (Carty, 2009; Gandhi, 2008): Preoperative state, existence of comorbidities or circulatory diseases, age, sex, implant design, surgical technique, healing, postoperative pain management and quality of postoperative rehabilitation, including the patient’s own psyche and motivation (Hanratty, 2009; Jerosch, 2006; Jones, 2003; Li, 2007; Mockford, 2008).

Normal flexion range of motion is around 140 degrees. The average range of motion after TKR is in between 100 and 110 degrees of flexion (Mockford, 2008; Panni, 2009), which is enough for being able to perform most activities of daily living independently. Gait after TKR is slightly slower with less ROM, less knee flexion during swing phase and with greater knee flexion during stance compared to non-operated individuals (McClelland, 2009).
Intraoperative complications are small, but include anaphylaxis, bleeding, thromboembolism and trauma to soft tissues, nerves and vessels (AAOS, 2007).

After surgery 15 to 30% of patients report little or no improvement of function or reduction of pain (Jones, 2003). Complications include loosening, infection, dislocation and patient-related factors (AAOS, 2007). Stiffness (Yercan, 2006), arthrofibrosis (Jerosch, 2006; Parvizi, 2006), knee extension and flexion power weakness, and hypotrophy are also reported as adverse consequences of TKR, which can influence the speed of gait in stairs ascending and descending (Meier, 2008; Valtonen, 2009). However, technical long-term failures are reported less than 10% over a span of 10 years in follow up studies (Jones, 2003).

**LIMB SALVATION SURGERY**

When a total knee replacement is used as a limb salvation procedure, the extent of bone and tissue loss is much larger than what of a standard total knee replacement, and thus the outcome is different (Benedetti, 2000). Up to 86% of the patients report, according to Carty et al., to have mild disabilities after such surgeries.

The etiology of such disabilities can be structural organization of the tissues within the limb, which is altered by the resections. Immediately after surgery, an extensive healing process begins. The healing might introduce less elastic fibres to the areas that previously encompassed essential elastic tissues. These aspects of healing can alter normal function of the limb and, in the same way, influence locomotion. Another disabling cause can be partial quadriceps muscle removal, which decreases hip-flexion, and knee-extension strength, as well as knee-extension range of motion (Carty, 2009).

This restructuring might cause stiffness that leads to functional limitations and disability. In these cases, rehabilitation is required to be more advanced and longer lasting than the standard, to avoid leaving the patient with significant impairments.

Muscle strength of the knee extensors and flexibility of the knee flexion should be of most therapeutic importance (Carty, 2009).
3.6 STIFFNESS AFTER TKR

The definition of knee stiffness after TKR is well debated but still not clearly decided. Yercan and colleagues defined stiffness after total knee replacement as >10 degrees extension deficit and <95 degrees flexion in the first 6 weeks after the surgery, while Kim et al. has defined stiffness as >15 degrees extension deficit and <75 degrees flexion. Mohammed et al. reports of yet another suggested definition of a knee motion arc of <70 degrees. These variable definitions also make epidemiology difficult and inconsistent. Kim and her colleagues report stiffness to only affect 1.3% out of 1000 individuals 32 months postoperatively, while Issa et al. report stiffness to affect up to 25% of patients. Even though variations in definition and extent, post operative stiffness is a problematic complication that can limit the quality of life of the affected (Rowe, 2005).

The aetiology can be due to preoperative, intraoperative or postoperative factors, either structural or functional, or a combination of the two. Preoperative factors include ROM before surgery, previous history of surgery to the knee, diabetes, lung disease or smoking. According Panni et al., the most frequent cause is surgical errors. Intraoperative factors comprise soft tissue balancing mismatch, component malposition or incorrect component sizing. Some postoperative factors can be depression, patient personality, inactivity, arthrofibrosis, heterotopic ossifications, lack of rehabilitation or lack of pain management (Jerosch, 2006; Panni, 2009; Scuderi, 2005; Yercan, 2006). It can also be caused by other factors than the knee itself. Both hip and spine disorders might influence it’s function.

The standard initial non-invasive procedure is intensive physical therapy with focus on stretching and strengthening. If the physiotherapy should fail, manipulation under anaesthesis (MUA) is the subsequent recommended treatment option (Mohammed, 2009). In addition there are pharmacotherapy, social and psychological support and invasive treatment methods such as arthrolysis (open/arthroscopy), quadriceps snip, open surgical release and finally, revision arthroplasty (Jerosch, 2006). I will explain the two non-invasive treatment options; physiotherapy and manipulation under anaesthesia.
3.7 PHYSIOTHERAPEUTIC MANAGEMENT OF STIFFNESS AFTER TKR

Physiotherapy treatment for stiffness after total knee replacement (TKR) is poorly studied (Mohammed, 2009), and documents of standardized treatment programs for this complication was not found during research through accessible academic databases. A cause might be due to the rarity of this complication. However, there were much data on rehabilitation in the acute and early postoperative care after the most common types of TKR, and some sources offering a view on treatment of movement restrictions.

The most important after any major joint reconstruction is to expect stiffness, prevent it, and educate the patient (Jerosch, 2006). Therapy should already be offered before the surgery, and include stretching and strengthening exercises for the lower limbs. Follow-ups after a total knee replacement should clearly document the knee function, and detect any potential complications following the surgery. In cases where stiffness is described, early response and treatment might improve the outcome and should be initiated immediately. However, the degree of long-term improvement and importance of these preoperative exercises for the final outcome are discussed and not fully supported according Schuh et al., 2009.

The treatment of stiffness should always be individual and according the underlying cause in order to achieve the best outcome. In many cases however, the underlying etiology is not found, even after wide-ranging examinations of clinical examinations, radiographic imaging and labs (Jerosch, 2006).

A physiotherapeutic examination should include anamnensis, assessment of posture and gait, basic movement patterns, range of motion, neurologic tests such as sensory and reflex tests, muscles strength and length, as well as soft tissue diagnostics (including scar assessment), joint play examination and functional assessment of movements of daily living. Radiographic imaging and medical data should be obtained, and direct contact with the medical team should be initiated.

According Shuh et al., “Postoperative milestones includes include ambulating with assistive device, independent transfers, achievement of ROM, initiation of strengthening, and understanding and performance of an appropriate home exercise program.” The patient, the family, caregiver must be educated and included in the
planning to ensure full devotion and continuance of the rehabilitation program, as the hospital stay often is quite short.

### 3.7.1 TREATMENT FOR POSTOPERATIVE STIFFNESS

The approach to postoperative stiffness should be aggressive, as well as long lasting, and the goal should be to reduce pain and swelling, maximize quadriceps muscle strength, increase range of motion and independence of functional mobility (Meier, 2008). The physiotherapeutic program can be executed intensively with the patient as inpatient at a rehabilitation facility, or regularly with the patient as outpatient.

Mockford et al examined the outcome of outpatient physiotherapy on treatment for knee stiffness in 2008. They found, by comparing two groups of a total 150 patients, that this type of rehabilitation implementation did not improve the range of motion after primary total knee replacement. However, this study failed to present the outpatient program and the respective therapy chosen, thus there is required more research to further examine this finding.

Progression of intensity and length of training should be done slowly and individually, to avoid overloading the soft tissues and cause unfavourable compensation. Walking should start on flat ground before inclining to hills and stairs. Resistance training has been recommended for major muscle groups, and should be performed 2 to 3 times per week. Aerobic training should be repeated 3 times per week for 30 to 40 minutes, according Meier et al.

Current physiotherapy methods with aim of increasing range of motion are mainly different methods of strengthening the soft tissues and stretching the surrounding muscles: active and passive, post isometric relaxation (PIR), proprioceptive neuromuscular facilitation (PNF) and static stretching. These stretches can be done manually or with the help of devices such as joint active system (JAS) or custom knee devices (Seyler, 2007).
Other therapeutic methods include mechanotherapy, thermotherapy, hydrotherapy, phototherapy, electrotherapy, kineisotherapy (exercises), sensory motor stimulation, and elements from manual therapy, patient education and spa treatments.

3.7.2 SOFT TISSUE TECHNIQUES

“Soft tissue techniques” is a group of physical manoeuvres using stretching, shifting and manipulation to improve the quality and mobility of superficial and deeper tissues. It includes myofascial release, trigger point technique, scar therapy and different massages. It usually starts by examining the tissue quality, the different layers, their mobility, and comparing sides/extremities, before prescribing a proper technique.

Scar tissue is formed to repair damage. The reorganization of the fibres causes harder fibrous connections than what originally was present, as the new tissues are less mobile and flexible than the original foundation. Without proper stimulation and treatment, the structures can create adverse outcomes of immobility, pain and unfortunate compensation mechanisms. Addressing the scars after extensive operations are therefore important in improving the outcome of the procedures. Soft tissue techniques can help release pathological fibrous tissue connections and trigger points, which might arise after operations and limit mobility (Kostopoulos, 2001).

According Lewit with his book Manipulative Therapy in Rehabilitation of the Locomotor System, the most significant function improved by soft tissue manipulation is the mobility of the fasciae, because of its link with shortened muscles.
Changes of fascia are most often seen in chronic stages. Stretching and shifting of the fascia is usually applied. R. Ward has developed many of these techniques for targeting fascia. The patient can be taught to do such soft tissue manipulations on his or her own, and they can be included in the self-therapy program.

3.7.3 MUSCLES STRETCHING

As previously mentioned, the most common factors of decreased range of motion are lack of elasticity of collagenous tissues, tight ligaments and muscles (Hall, 2012). Muscles stretching, or increasing muscles length, is done with the aim of increasing the plastic range of motion and flexibility of the muscle. It is based on concepts like reciprocal inhibition, where the antagonist muscle relaxes as the agonist contracts. Located in the muscle and tendon are receptors, muscle spindles and Golgi tendon organs, which are detecting speed and degree of muscle length. Quick changes have the potential of triggering the myotatic reflex. This reflex is a protection of potential damage and resists the change in the muscle by contracting the elongated muscle fibres. A slower stretch, of 30 to 60 seconds, doesn’t trigger this reflex.

According Nelson and Kokkonen with their book “Stretching Anatomy”, the body responds differently to short-term/acute stretching and chronic stretching done several times every week. Acute stretches is believed to cause a noticeable change in the joint range of motion, while regular heavy stretching of minimum 10 minutes three to four days a week is reported to develop increased power, strength and strength endurance, in addition to improved flexibility and mobility.

We can divide muscle stretching into active and passive stretching. Active stretching is a technique where the patient uses her own muscle power to move the joint into maximal ROM. Passive stretching is stretching done to the limb by the patient herself, a machine (CPM) or another person. According Schuh et al., stretching done passively is thought to be more effective than the active type of stretching.

Muscle stretching is done to elongate the muscle length, which might be a contributor to a reduced joint range of motion. However reduced muscle length is not always the primary cause of such a movement restriction. Finding the primary cause is therefore essential in choosing the appropriate treatment method. Muscle stretching would therefore work if the primary cause were short muscle length. In other cases muscle stretching could be considered complimentary.
Some practitioners have created stretching concepts that are thought to be more effective than the standard form of muscles stretching. Most common and used are the Post Isometric Relaxation (PIR) and Proprioceptive Neuromuscular Facilitation (PNF). These techniques are based on theory from the physiological aspect of muscles activation and relaxation, elasticity and other soft tissue properties.

Mitchell et al. introduced Post Isometric Relaxation, which later was modified by Karel Lewit. It is a technique that is based on the concept of muscular facilitation and inhibition with the aim of increasing range of motion and relaxing hypertonic muscles. It was originally intended for muscles, but later adapted to joint mobilization as well (Lewit, 2010). Its’ effect of muscle relaxation and analgesia is reported to be immediate, however non-lasting.

Dr. Herman Kabat and Maggie Knott developed PNF in the 1940s as a technique using natural movement patterns, reflexes to stretch/traction and joint compressions to coordinate, activate or stretch specific muscles. It’s based on the theory that stimulation of afferent pathways could be used to re-educate movement, and that proprioception is important in motor programming and motor system regulation. The goal of the technique is to promote functional movement and improving muscle coordination. Today PNF is used both for muscle strengthening, relaxation and for stretching with aim of improving ROM. In a comparative study by Sady et al., PNF was noted superior to both static and ballistic stretching on improving ROM in a group of college males.

3.7.4 THERAPEUTIC EXERCISE FOR MUSCLES STRENGTHENING

With the aim of treating postoperative stiffness of the knee, the therapist usually works up a muscles strengthening regime consisting of knee extension and flexion movements targeting the larger muscles of the lower extremities. After a total knee replacement the strength of the quadriceps muscle is thought to be an essential indicator of the functional outcome, and is thus of importance in the workup of an exercise program. The level of intensity of such a strengthening program is prescribed according the individual level, and there are many examples of good strengthening programs in the literature.

Bicycling, terra band, elliptical trainer and swimming pool are considered good options for resistance training in patients recovering from a total knee replacement. In addition to these techniques, functional and remedial physical
exercises, such as gait technique training, ascending and descending stairs and slow walking with emphasis on heel strike and push off at toe off is often used (Meier, 2008).

3.7.5 MANIPULATIVE THERAPY

Manipulative therapy is a method focusing on increasing the mobility of the articulations between bones, referred to as “joint play”. A proper examination of joints should determine whether the mobility is normal, absent, decreased or excessive in all movement directions. The indication is decreased joint play and stiffness (Lewit, 2010). After detection of decreased joint play and determining its underlying cause, therapy can be initiated and the restrictions can be released.

According Panni et al., manipulative therapy can be initiated from the 2nd to 3rd week after a TKR surgery to stretch the fibrous bands. Millet and colleagues insisted on focusing joint play on the patella, because of its influence on knee joint mobility in all directions. Complementary to these remarks, monitoring and restoring joint play of fibula and the small joints of the foot should be included in any postoperative TKA rehabilitation program, according Satrapova from her lecture “Physiotherapeutic Approaches in Orthopaedics and Traumatology” from 2013.

3.7.6 SENSORY MOTOR STIMULATION

Sensory motor functions include proprioception, maintaining balance and sense of joint position. Proprioception is both a conscious and an unconscious information feedback system that regulates the limb position and movement in relation to the environment.

Sensory motor stimulation (SMS) is a concept aimed at stimulating the proprioceptive system and the regulation mechanisms that are important in order to maintain static as well as dynamic stability. It can be conducted in many ways by introducing an unstable segment to the patient, such as a wobble board, which triggers stabilizing function of both the target limb and the body.

There are differences between the sense of proprioception between young and old postoperative TKA patients, where increased age and occurrence of osteoarthritis suggests decreased proprioceptive abilities. There are also studies supporting the link between increased frequency of falls and decreased proprioception and balance (Cameron, 2007).
Due to these statements, SMS can be included in rehabilitation programs where balance is decreased. According Janda et al., SMS can be applied to decrease compensation mechanisms and can also be indicated as a part of any exercise program because of its benefits.

3.7.7 DYNAMIC NEUROMUSCULAR STABILIZATION EXERCISES

The Czech neurologist Pavel Kolar developed DNS, a technique based on developmental kinesiology and Vaclav Vojta’s work, which is combining manual medicine and reflex locomotion. The goal of the technique is to activate the deeply embedded “normal” movement patterns in patients (Kobesova, 2014). Kolar used developmental positioning exercises to reboot the body’s stabilization pattern in sedentary patients and reduce overuse syndromes in athletes. It was also used to speed recovery from injuries, restore function and enhance performance.

![Figure 11: Developmental positioning](http://www.rehabps.com/REHABILITATION/Home.html, Accessed 09.12.14)

In individuals recovering from surgery with chronic motor impairments, compensation mechanisms are often seen as highly present (Gandhi, 2008). A change is often seen embedded in the gait, the posture and the breathing pattern of such
patients. These alterations can later cause adverse musculoskeletal problems, and demand further rehabilitation. DNS could therefore constitute a part of the supplementary rehabilitation program after chronic movement impairments, as a treatment or prevention of secondary issues.

3.7.8 THERMOTHERAPY AND HYDROTHERAPY

Thermotherapy and hydrotherapy by means of hot packs and warm baths can be used before the stretching sessions to influence blood circulation, increase relaxation and analgesia. Stretching sessions, gait training and strengthening in a lukewarm pool can also be found pleasant.

According Cameron and his colleagues, with their article published in 2009, hydrotherapy is considered superior to standard postoperative TKR rehabilitation when the aim is to improve knee extension.

Cold packs, in addition to limb elevation, can be used with the aim of reducing local inflammation and swelling that might occur after intensive stretching and strengthening sessions.

3.7.9 PATIENT EDUCATION

The patient education, motivation and communication with the medical team are essential for the best outcome. The aim of this education is to reduce frustration and encourage compliance to the rehabilitation program. Full instruction and inclusion is important in developing both a good home exercise regime as well as creating valuable classes at the health care centre. The patient should easily understand these programs, and the home exercises must only include gadgets/apparatuses that are accessible or affordable to him/her.

3.7.10 EFFECT OF PHYSIOTHERAPY IMPLEMENTATION ON CHRONIC POSTOPERATIVE STIFFNESS

Muscle impairments following total knee replacements can last for several years. Improving muscles strength might halt these adverse outcomes and improve long-term functional outcomes. In cases where the stiffness is detected at an early stage, up to 3 months after operation, intensive physiotherapy might increase the range of motion to an acceptable level according Mohammed et al. with their article published in 2009. However, the effect of any therapy reduces inversely with the time
since the operation, due to the soft tissue reconstruction and stiffening (Panni, 2009; Scuderi, 2005).
3.8 FURTHER NON-INVASIVE MANAGEMENT OF STIFFNESS AFTER TOTAL KNEE REPLACEMENT

The first choice of treatment when physiotherapy fail to improve the patient’s function is manipulation under anaesthesia, due to its minimal complications (Ghani, 2012) and non-invasive approach. The aim of MUA is to break intra-articular connections. The procedure consists of progressive loading to the leg until a palpable and audible break of soft tissue bonds is heard (Mohammed, 2009).

At the early healing stage, within 6 weeks and 3 months after surgery, manipulations have the best outcome (Panni, 2009). The results are significant gains of range of motion and function (Issa, 2013) with up to 38,4 degrees knee flexion-extension arc gained according Ghani et al. with their review article. The late healing stage is defined as from 3 to 6 months and thereafter. Manipulations have also proven to benefit at this stage when there is lack of motion (Mohammed, 2009).

Complications to this procedure include hemarthrosis, patellar ligament avulsion, patellar tendon tearing, heterotopic bone formation, wound separation, pulmonary embolism and fracture (Jerosch, 2006; Ghani, 2012; Mohammed, 2009). If correct rehabilitation is performed for at least 6 to 12 weeks, but still is without optimal results, invasive approaches can be considered.
4 SPECIAL PART

The special part of this thesis consists of methodology, anamnesis, differential diagnosis, initial and final kinesiologic examination, therapeutic plan and reports, in addition to an evaluation of the therapeutic effect.

4.1 METHODOLOGY

The clinical practice was conducted in the outpatient department of Rehabilitační Klinika Malvazinky in Prague, Czech Republic, from Monday the 20.01.14 to Friday the 31.01.14 under the supervision and guidance by Mgr. Hana Zemlerová and Mgr. Zuzana Bestová.

Malvazinky is ran by the company Mediterra s.r.o., which put it into operation in March 2003. The rehabilitation centre consists of both an inpatient and an outpatient department, and offers a wide selection of treatments and services. Of rehabilitation facilities available there are a fitness gym and group exercise hall, ultrasound and laser equipment, a swimming hall and therapeutic rooms equipped with balls, spike balls, wobble boards, pillows, lotions, etc. The centre has clients with a great diversity of diagnoses, but the main focus is on post operative- and post injury rehabilitation. In addition the clinic offers therapy with aim of preventing chronic, painful and degenerative diseases of the locomotion system.

My client was an inpatient at Malvazinky from 07.01.14 to 31.01.14. She received daily physiotherapeutic rehabilitation sessions at the outpatient department in addition to a selection of other therapies and services of the clinic. The patient had on average 9 sessions per day, except during weekends, of different therapies which included swimming group classes, vacuum compressive therapy, ultrasound and laser, classical and reflex massage, stationary bicycle, continuous passive motion (CPM) machine, physiotherapy and educational classes.

The patients main physiotherapeutic program at the outpatient department was conducted by Mgr. Zuzana Bestová, who offered the patient a 45 minute daily program composed of soft tissue techniques, DNS, PIR, joint centralization techniques with overball, sensory motoric stimulation, gait- and weight bearing correction, etc. The focus was on increasing the patient’s knee range of motion, as well as fixing other limiting issues related to her general function.
I completed the anamnesis assessment and initial kinesiologic examination the 21.01.14. I then created a therapeutic plan, followed up with 6 therapeutic sessions, before ending with a final kinesiologic examination the 30.01.14.

The assessment and therapy were conducted according the techniques learned during the bachelor degree of physiotherapy at FTVS, Charles University in Prague. During my practice at Malvazinky, the supervising physiotherapist Mgr. Hana Zemlerová taught me a new technique, which she later applied to my patient.

The therapy technique was inspired by Kolar. It was aimed to facilitate deep postural muscles, the joint capsule proprioceptors, and relax the larger, often overloaded and dominant, muscle groups. Firstly the patient was placed in an optimal position for inhibiting/relaxing the overloaded muscles. By applying rhythmic and gentle pressure to the unstable/weak segment, the weak muscle was facilitated. The result following this therapeutic technique was immediate. The most obvious results, which I observed, were improved upper trunk posture with decreased upper thoracic kyphosis and cervical lordosis. I also observed better movement stereotype in shoulder abduction and improved general trunk position to extension. The reason why I chose to use this technique is because I wanted to improve joint control and optimize muscle balance, as I found it theoretically and practically applicable.

The patient was informed about the practice in advance and signed an informed consent like the one that is shown (without signature) at the end of this thesis.

The general part is based on theory learned through the bachelor studies of physiotherapy at FTVS, Charles University in Prague. A search for relevant material started the 23rd of January 2014. I conducted several searches through the databases EBSCOhost, PubMed and ScienceDirect, by the use of keywords such as “Chondrosarcoma”, “Total knee replacement”, “Post operative complications”, “Stiffness”, “Treatment”, “Physiotherapy”, “Surgical approach”, and similar. I found few articles that directly corresponded, although many that was related to my topic. I conducted a critical research through google.com, where I found helpful illustrations and some trusted references. Additionally, I found much information in relevant medical, professional literature.

**Ethics Committee** of the Faculty of Physical Education and Sport – Charles University, Prague Approval number: 131/2014
4.2 ANAMNESIS

<table>
<thead>
<tr>
<th>Examined person</th>
<th>Gender</th>
<th>Year of birth</th>
<th>Handedness</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.S</td>
<td>F</td>
<td>1958</td>
<td>Left</td>
</tr>
</tbody>
</table>

Main diagnosis
Chondrosarcoma on right knee (ICD-10-CM: C41.9)

Procedure
Surgical removal of chondrosarcoma, partial excision of right lower femur and total knee replacement using a lateral approach 17.01.2013 (ICD-10-PCS 0QBB0ZZ, ICD-10-PCS 0SRC).

Date: Tuesday 21.01.14
Time: 09:00
Anamnesis no.: 1

Main Complaint
“Since the operation, which was 1 year ago, I haven’t been able to bend and use my knee normally” (Patients own words).
She describes the impairment as disabling her from many daily life- and favoured activities, such as walking stairs and horse riding. The patient is considering surgical correction of the prosthesis if therapy is unsuccessful.

Status Praesens
Inpatient. 1 year after surgery. The 14th day of her rehabilitation stay at Rehabilitation Clinic Malvazinky. The patient feels good, is in a positive state and has no complaint of pain or bad sensation. She is clear in cognition, memory and speech.

History of present problem
Date of accident and surgery: 17.01.2013. She was horseback riding, fell and fractured her right knee. After an x-ray examination there was found Chondrosarcoma in the right knee joint. The chosen management was surgical removal and instalment
of a total knee endoprosthesis, which also was done immediately. Dr. Kofránek, the surgeon, decided to use a lateral parapatellar approach. The patella was left intact.

Following surgery, the patient experienced an excessive lack of knee ROM. She underwent standard post-operation rehabilitation, but the range of motion of the knee did not improve as much as expected. The knee ROM continued limiting her quality of life, and mobility, in daily living.

After a consult with Dr. Kofránek, she was referred to an additional rehabilitation stay at Rehabilitation Clinic Malvazinky, with the aim of increasing her knee ROM and function.

**Functional demand**

She describes herself as highly active, and exercises on average 3 hours daily in addition to a daily brisk walk with Nordic walking sticks. She prefers high-energy activities to slow activities. Her motivation is the determination to recover. She prefers horse riding and had her first attempt riding again around December 2013. It went well, and she wants to continue, even though not to the same extent as before the surgery. Knee bending is required in her preferred sports activities and is therefore limiting her at a high level.

The patient is a quite active woman with a high functional demand. In her daily life she experiences high difficulty and instability with walking stairs, moving, bending and with other knee flexion activities.

The knee stiffness is worse every morning before activity, but the function seems to slightly improve (ROM) over the course of the day with activity. She describes that it’s limiting her in the level 8 out of 10 in her daily living. Pain doesn’t act as the limiting factor, and is not described as present at all in relation to the knee. No supportive devices are used at this point after recovery, but when walking outside she uses Nordic walking sticks to increase stability and security.

**Family anamnesis**

Her mother died of old age at age 79, while her father died of stroke at the age of 49. She has one sister, who is healthy. No associated familial conditions.

**Allergies**

No known allergies
**Medications**

No medications used at status praesens

**Diet**

Vegetarian

**Social history**

Single, has no children and lives with her sister in an apartment. Her sister helps her if needed.

**Occupational history**

She is an office worker with 5 days work per week. It is a sedentary type of work where she can work either from her office or home, whilst sitting in front of and typing on a computer. She is not disabled from her work because of the impairment.

**Home**

She lives in an apartment in the first floor, and therefore prefers using the optional 11 stairs instead of the optional elevator. She uses a car for transportation and Nordic walking sticks for support when walking. Taking on pants, socks and shoes takes longer time than normal and is problematic because of the limited knee ROM. The knee doesn’t affect her sleeping position or her sleep quality.

**Abuses**

Non smoker and non drinker

**Medical/Surgical History**

As a child she underwent standard immunisation procedure and was quite healthy. She has no previous surgical or medical history except in relation to the total knee replacement. She has in addition bilateral carpal tunnel syndrome.

**Previous rehabilitation**

After the surgery she stayed at Bulovka hospital, and received post operation rehabilitation, before she was transferred to Malvazinky as an outpatient.
According documentation, the patient improved knee flexion up to 90 degrees and had a more mobile patella as a result of the stay at Malvazinky. Pain, which usually occurred after long time walking, also decreased during her stay. Still there was shown little/no functional improvement beyond this.

Referral

Indication for rehospitalisation after consultation with surgeon. She will stay as an inpatient at Malvazinky with a complex rehabilitation program from 07.01.14 till 01.02.14. After this she will have weekly visits as an outpatient.

Excerpts from health file

Resting heart rate is 72 beats per minute. Her temperature is normal. No other medical reports are accessible. Contraindications: Lymphatic stimulation due to the history of cancer.
4.3 DIFFERENTIAL DIAGNOSIS

Functional

F1 Depression, inactivity and immobilization of knee after surgery
F2 Insufficient rehabilitation, stretching
F3 Lack of pain medication (antalgic gait)
F4 Weak quadriceps muscles provoking compensation of other muscles around knee, hip extensors and adductors are used in a higher degree to stabilize knee, allowing them to becoming dominant and the leg to be stiff
F5 Instability of hip due to compensation after immobilization, protective hypertone with trigger points of prime-moving muscles

Structural

S1 Atypical endoprosthesis, surgical approach
S2 Surgical complication
S3 Arthrofibrosis, fibrous tissues formation after surgery in and around knee joint
S4 Weak healing
S5 Heterotopic ossifications hardening soft tissues surrounding the joint
S6 Lack of elastic fibres after the tumour/operation
S7 Incorrect lymph circulation (build up of fluids causing movement restrictions)
S8 Peripheral nerve damage from surgery limiting activation of flexors of hip/knee.
4.4 INITIAL KINESIOLOGIC EXAMINATION

Date: Tuesday 21.01.14
Examination no.: 1
Time: 10:00

<table>
<thead>
<tr>
<th>Height</th>
<th>Weight</th>
<th>BMI</th>
<th>Somatotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,66 m</td>
<td>75 kg</td>
<td>27,2</td>
<td>Mixed</td>
</tr>
</tbody>
</table>

4.4.1 General aspection

The patient has oedema around right knee, scar on lateral part of knee and patella. There is visible atrophy of muscles and changes of the structure of subcutaneous tissue around the anterolateral, affected, thigh. Some stitches are visible in the scar tissue, not removed after surgery. Her skin colour and body temperature is normal, she has a normal body type and she shows no indication of any pathological underlying conditions.

4.4.2 Posture (Acc. Kendall)

The most important findings were asymmetry between right and left leg, where right was bigger than left (showing sign of oedema). She has a mild form of knock-knees and flat transversal arches of both feet. Left foot was more externally rotated while the right leg was in a neutral position. She has a slight trunk shift towards the left side and rotation towards right side.

From posterior view there is a difference between the shoulders, and the left shoulder is placed higher than the right.

From lateral view the right knee and ankle were more flexed/dorsi-flexed than the left. The patient is not able to fully extend right knee in standing. The head and the left shoulder was protracted and outside of the midline alignment. The spine has a quite marked S shape with sign of hyper-lordosis with centre point at TH-L junction.

**Sitting posture:** When sitting she has a stable and flat trunk position, but her head is protracted. When working from home she usually is seated in her bed with her computer in front of her. The posture is slightly collapsed and she has hyper protraction of her head while doing so.
4.4.3 Breathing
Abdominal/Thoracic

4.4.4 Gait and functional movement

When observing her casual gait as she walks into the room, I can see that she is independent, with low risk of falling, yet presents a slightly unbalanced gait with compensation of her trunk. She has a slightly asymmetrical stride length and 10 cm width in between her feet. The foot roll is not physiological in that sense that she is not rolling through the 3 weight distribution points on her right foot. She shortens the stance phase of the right foot in comparison with the left. The knee movement is also asymmetrical, where the right knee is not being extended and flexed sufficiently for a correct dynamic flow of the movement. The movement rather occurs from the hip joint and low spine and is compensated by stiffening of the upper trunk. She also presents decreased and asymmetrical arm swing where left is moving more than right.

When turning, the patient has problem with balance and she tips over a little bit when stepping on the right leg. There is increased risk of falling. To compensate her turning speed is slower than normal, and her muscles contract to prevent falling.

When walking on heels she shows sign of instability in the thoracic region of her spine with excessive movement. Backward walking is asymmetrical in means of stride length, where right leg strides shorter. Testing tiptoe walking showed a marked sign of asymmetry where right leg strides significantly shorter than left. The problem is with hip and knee flexion, where there is reduced movement and control. The patient also feels pain from her right leg while walking this way.

Squatting in standing showed that supporting from the left leg was unstable than from the right leg. The unbalanced movement looks to come from reduced hip and ankle stability, rather than the knee. The range of motion of the knee to flexion is estimated by eye measure to be approximately 60 degrees.

When assessing stairs climbing, the patient showed problems with descending. The problem occurred due to lack of right knee ROM and problems with weak quadriceps muscle when stepping down with left (healthy) extremity, while leaning weight on right (affected) knee. Ascending stairs was also problematic due to the same reason when stepping up with right knee. The reduced hip stability also was shown more markedly. The patient lifts her hip to compensate for lack of knee flexibility. She uses stairs with higher inclination to enter her own apartment.
4.4.5 Basic movement pattern

Basic movement patterns tested were hip abduction and extension. The patient had a quite good hip abduction pattern, but her extension pattern of the left leg showed uncoordinated muscle activation of the back muscles where the contralateral side was highly activated while the ipsi-lateral side only had a small activation.

4.4.6 Pelvis examination

When examining pelvis position when the patient is standing, the patient has higher crest, PSIS and ASIS on right side, which indicates a pelvic lateral tilt. When standing on the lateral edge of her feet, the tilt is still present, indicating that it is not due to any foot arch asymmetry.

4.4.7 Hypermobility (acc. Janda)

No sign of local or general hypermobility when testing knee extension on the healthy side, trunk flexion and extended elbows.

4.4.8 Anthropometry (performed in lying position)

<table>
<thead>
<tr>
<th>LOWER EXTREMITIES</th>
<th>L</th>
<th>R</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>L. Whole Anatomical</td>
<td>84 cm</td>
<td>84 cm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>87 cm</td>
<td>88 cm</td>
<td>Asymmetry</td>
</tr>
<tr>
<td>L. Thigh</td>
<td>45 cm</td>
<td>45 cm</td>
<td></td>
</tr>
<tr>
<td>L. Leg</td>
<td>38 cm</td>
<td>37 cm</td>
<td>Atrophy?</td>
</tr>
<tr>
<td>C.f. Thigh (Quadriceps)</td>
<td>48 cm</td>
<td>50 cm</td>
<td>Sign of oedema</td>
</tr>
<tr>
<td>C.f. Thigh (Vastus Medialis)</td>
<td>45 cm</td>
<td>48 cm</td>
<td>Sign of oedema</td>
</tr>
<tr>
<td>C.f. Knee joint</td>
<td>42 cm</td>
<td>48 cm</td>
<td>Sign of oedema</td>
</tr>
<tr>
<td>C.f. Calf</td>
<td>37 ½ cm</td>
<td>38 cm</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Initial kinesiologic examination: anthropometric values

Conclusion of findings from anthropometric examination includes sign of oedema with increased circumference around the knee joint. She also has a functional difference on her leg length, where right lower extremity is longer than the left.
### 4.4.9 Range of motion (Tested with Goniometer type: Medizintechnik KaWe.)

<table>
<thead>
<tr>
<th>HIP JOINT</th>
<th>NORMAL</th>
<th>LEFT</th>
<th>RIGHT</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>S: E, F (Active)</td>
<td>10° - 0° - 125°</td>
<td>10° - 0° - 80°</td>
<td>10° - 0° - 70°</td>
<td>Decreased ROM</td>
</tr>
<tr>
<td>S: E, F (Passive)</td>
<td>10° - 0° - 125°</td>
<td>10° - 0° - 90°</td>
<td>10° - 0° - 80°</td>
<td>Decreased ROM</td>
</tr>
<tr>
<td>F: Abd, Add (Active)</td>
<td>45° - 0° - 10°</td>
<td>40° - 0° - 10°</td>
<td>40° - 0° - 10°</td>
<td></td>
</tr>
<tr>
<td>F: Abd, Add (Passive)</td>
<td>45° - 0° - 10°</td>
<td>50° - 0° - 10°</td>
<td>50° - 0° - 10°</td>
<td></td>
</tr>
<tr>
<td>R: ER, IR (Active)</td>
<td>45° - 0° - 30°</td>
<td>30° - 0° - 30°</td>
<td>30° - 0° - 20°</td>
<td>Slight asymmetry</td>
</tr>
<tr>
<td>R: ER, IR (Passive)</td>
<td>45° - 0° - 30°</td>
<td>40° - 0° - 30°</td>
<td>35° - 0° - 25°</td>
<td></td>
</tr>
</tbody>
</table>

| KNEE JOINT | |
|-------------|--------|------|-------|-------|
| S: E, F (Active) | 0° - 0° - 140° | 0° - 0° - 150° | 15° – 15° – 60° A | Decreased ROM |
| S: E, F (Passive) | 0° - 0° - 140° | 0° - 0° - 150° | 10° – 10° – 80° P | Hard barrier, pain to F |
| R: ER, IR (Active) | 50° - 0° - 40° | 40° - 0° - 30° | 10° – 0° – 10° A | Decreased ROM |
| R: ER, IR (Passive) | 50° - 0° - 40° | 40° - 0° - 30° | 15° – 0° – 10° P | Hard barrier, pain |

| ANKLE JOINT | |
|-------------|--------|------|-------|-------|
| S: D.F, P.F (Active) | 20° - 0° - 50° | 20° - 0° - 50° | 20° - 0° - 50° | |

| SUBTALAR JOINT | |
|----------------|--------|------|-------|
| R: Supination, Pronation | 80° – 0° – 80° | Norm | Norm |

Table 4: Initial kinesiologic examination: goniometric values

Conclusion of findings in range of motion includes a significant decrease in ROM of right knee joint. The patient experiences pain in passive movement at the end of the ROM of the knee joint. Movement to flexion is worst. She describes the pain as a stretching type of pain, with a subjective intensity level 6/10.
4.4.10 Palpation

In comparison with the healthy leg, the right leg presents decreased elasticity of the skin and sub-skin around the scar as well as tight and restricted fascia in all directions. There is a mild dent left, which lasts for a few seconds, after using my thumb to press on the lateral part of the thigh. This indicates oedema.

The scar is located on the lateral aspect of the knee, suggesting an atypical surgical approach to total knee replacement. It has a normal pigmentation and vascularity with a yielding, slightly firm pliability and flat, depressed height (4/13 on The Vancouver Scar Scale). The scar is quite thick with marked contours and looks to form a groove at the side of the knee, which might be caused by the depth of the scar, lack of elastic fibres and the oedema. The patella is not removed after the surgery, and is possible to feel when palpating.

Generally, the patient had hypertone of the hip flexors of the right lower extremity. Most hypertone was found along Rectus Femoris with many trigger-points present. In vastus Lateralis and Medialis have no trigger-points, but are still quite hypertonic. In comparison, the left side presents a quite physiological/optimal muscle tonus.
### 4.4.11 Muscle strength testing (0 – 5 Grading According Kendall)

<table>
<thead>
<tr>
<th>TRUNK</th>
<th>L</th>
<th>R</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadratus Lumborum</td>
<td>5</td>
<td>5-</td>
<td></td>
</tr>
<tr>
<td><strong>PELVIS + THIGH</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iliopsoas</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Gluteus Maximus</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Quadriceps</td>
<td>5</td>
<td>3+</td>
<td></td>
</tr>
<tr>
<td>Adductors</td>
<td>5</td>
<td>4+</td>
<td>Asymmetrical</td>
</tr>
<tr>
<td>Sartorius</td>
<td>5</td>
<td>4+</td>
<td></td>
</tr>
<tr>
<td>Hamstrings</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Gluteus Medius</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Gluteus Minimus</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Tensor Fasciae Latae</td>
<td>5</td>
<td>4+</td>
<td>Asymmetrical</td>
</tr>
<tr>
<td><strong>CALF + FEET</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tibialis Anterior</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Gastrocnemius</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Soleus</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Toe Flexors</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Toe Extensors</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

**Table 5: Initial kinesiologic examination: muscles strength values**

Conclusion of findings from muscles strength testing: Generally weaker on right lower extremity in comparison with left: Most noticeably Rectus Femoris muscle.
## 4.4.12 Muscles length testing (0 – 2 Grading According Janda)

<table>
<thead>
<tr>
<th>TRUNK</th>
<th>L</th>
<th>R</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadratus Lumborum</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>PELVIS + THIGH</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iliopsoas</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Gluteus Maximus</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Quadriceps</td>
<td>0</td>
<td>2</td>
<td>Marked shortness, hard end feeling, pain</td>
</tr>
<tr>
<td>Adductors</td>
<td>1</td>
<td>1</td>
<td>Mild shortness, symmetrical</td>
</tr>
<tr>
<td>Hamstrings</td>
<td>1</td>
<td>2</td>
<td>Mild shortness of LS, Marked on RS</td>
</tr>
<tr>
<td>Gluteus Medius</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Gluteus Minimus</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Piriformis</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Tensor Fasciae Latae</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>Calf + Feet</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tibialis Anterior</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Gastrocnemius</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Soleus</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Toe Flexors</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Toe Extensors</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Table 6: Initial kinesiologic examination: muscles length values

Conclusion of muscles length testing: Marked shortness found on right lower extremity of quadriceps and hamstrings. Mild shortness was found on both extremities in adductors and left side hamstrings.
4.4.13 Joint play (According Lewit)

<table>
<thead>
<tr>
<th>LOWER EXTREMITIES</th>
<th>L</th>
<th>R</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phalangeal joints</td>
<td>Norm</td>
<td>Norm</td>
<td></td>
</tr>
<tr>
<td>Metatarsal joint</td>
<td>Norm</td>
<td>Norm</td>
<td></td>
</tr>
<tr>
<td>Tarsal joint</td>
<td>Norm</td>
<td>Norm</td>
<td></td>
</tr>
<tr>
<td>Ankle joint</td>
<td>Norm</td>
<td>Norm</td>
<td></td>
</tr>
<tr>
<td>Head of fibula</td>
<td>Norm</td>
<td>Norm</td>
<td></td>
</tr>
<tr>
<td>Knee joint</td>
<td>Norm</td>
<td>Norm</td>
<td></td>
</tr>
<tr>
<td>Patella</td>
<td>Norm</td>
<td>Restricted</td>
<td>The patella is markedly restricted in all directions on right lower extremity, especially in craniocaudal direction.</td>
</tr>
<tr>
<td>SI joint</td>
<td>Norm</td>
<td>Norm</td>
<td></td>
</tr>
</tbody>
</table>

Table 7: Initial kinesiologic examination: joint play values

By assessing joint play of lower extremity in all directions according Lewit, the patella was found with hard movement restrictions.

4.4.14 Special tests

Since the operation 1 year ago, 17.01.13, the patient has been allowed full weight bearing on the affected extremity for several months. By assessing two-scale test, the patient had less than 2 kg difference between the feet and the test is therefore considered negative. Rhomberg’s, and Trendelenburg’s test were also without pathological findings.

4.4.15 Neurological Examination

No abnormal findings when testing the joint positions for proprioceptive signaling, and dermatome aethesia of nerve segment L1 – S2 for sharp/blunt registration. Babinski reflex was also negative/without pathological findings.

After having completed a standard testing of reflexes however, the Patellar reflex of the right lower extremity was significantly decreased and only parts of the muscle fibres of the quadriceps muscles were firing. Reflexive movement of the leg was absent, and activation was only seen and felt by palpation. Biceps, Triceps, Achilles tendon and Plantar reflexes showed physiological and symmetrical response.
4.5 FINDINGS AND DISCUSSION

<table>
<thead>
<tr>
<th>Decreased active and passive ROM of right knee joint in flexion and extension. Active maximum flexion of knee joint is $60^0$, while passive maximum is $80^0$. This finding might be caused by immobility (and therefore lack of tissue flexibility) after surgery, insufficient stretching, or muscle imbalance caused by movement compensation patterns. It might also be caused by lack of elastic fibres around the joint, problems with the type of prosthesis or surgical approach, or problematic healing.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrophy of right anterolateral thigh</td>
</tr>
<tr>
<td>Atrophy might be due to immobility after surgery and can therefore support this functional hypothesis. It can also be due to nerve damage of the femoral nerve (L2-L4).</td>
</tr>
<tr>
<td>Hyper-tone and trigger-points of right side quadriceps muscle</td>
</tr>
<tr>
<td>Might be caused by overloading the muscles, which can be due to the sudden increase in exercise level and a sign of previous immobility. It can also be caused by femoral nerve damage or muscle imbalance.</td>
</tr>
<tr>
<td>Asymmetrical strength of quadriceps muscle, weaker on right side</td>
</tr>
<tr>
<td>Might be caused by nerve damage to the femoral nerve as a complication of surgery, bad movement stereotype or immobility.</td>
</tr>
<tr>
<td>Gait: Wide gait base and balance problems with turning</td>
</tr>
<tr>
<td>Might be caused by the combination of weakness around the hip and ankle joint and lack of flexibility of the knee. The cause is mostly functional.</td>
</tr>
<tr>
<td>Oedema around right knee joint</td>
</tr>
<tr>
<td>The patient says this oedema is acute for this time as she acquired it after a brisk walk. Still she says that it is returning after such things as a walk. This might be a sign that the structure of her lymphatic system is not working correctly and can be caused as a complication after surgery: by removal of lymphatic tissue with the tumour.</td>
</tr>
</tbody>
</table>
Decreased patellar reflex (L2-L4). Only part of the muscle was visibly activated, knee joint without movement.

This decreased patellar reflex might be caused by local oedema (functional) or a structural damage to a part of the femoral nerve (L2-L4) which either occurred due to the tumour or as a complication following the surgery. When the oedema disappears, the reflex should be assessed again.

Decreased elasticity of patella and fascia around the scar

Might be caused by abnormal healing with lack of elastic fibres/collagen. There might also be displaced minerals from the tumour. A functional cause might be immobility.

Restricted length of Rectus Femoris on the right side

This can be caused by the local oedema and also support the theory about nerve damage as a surgical complication. Rectus Femoris might also be shortened due to immobility, or it can be a reaction to too much too soon, overloading, which is causing protective contraction of the muscle.

Problematic tiptoe walking with decreased function of knee and hip flexion of the right side

This supports the theory of functional immobility, overloading, incorrect/bad movement stereotype or structural nerve damage as a complication following surgery.
4.6 THERAPY PLAN

Directly after having examined the patient, I see clear goals emerging as to where the problem areas are and where a solitary physiotherapist should focus. But since this patient has a complex program at the facility, working with several other therapists as well as training on her own, the plan must be formed on this basis as collaboration of all of these factors. I believe her stay at the facility is to examine if the problem can be solved by non-invasive procedures, or if she will need surgical diagnostics and correction.

Her main complaint is the lack of normal knee ROM. Her main objective problems, seen out of the kinesiologic assessment, is also the lack of knee ROM, circulation problems/changes, problems with quadriceps muscle activation and abnormal reflexes suggesting structural nerve changes or possibly damage from the surgery. Secondary problems, which I believe is caused by these main origins, are oedema (which again can alter the nerve signalling), muscle compensation mechanisms, overloading, trigger-points, functional limitations, etc.

The prime therapy goals should be to approach the origin of the problem: to increase the knee ROM, reduce pain and oedema and stimulate the neural activation of the quadriceps muscle. Following, the secondary problems should be approached, even though many of these will resolve themselves once their causes are correctly treated.

Her stay at Rehabilitation Clinic Malvazinky is quite intensive, as she has a full schedule of therapies from morning till evening, including ultrasound, laser, swimming classes, Pilates, physiotherapy, stretching, Yoga, massages, etc. In the extra time she is using the group exercise rooms and goes for brisk walks with the Nordic walking sticks. At the Faculty of Physical Education and Sports in Prague, Czech Republic, our professor Doc. MUDr. František Věle, CSc., have taught my class about the balance between too much and too little stimulation and in relation to time. Too much and too rapid stimulation and exercise of weak segments might cause damage, overloading and compensation mechanisms. The oedema, the trigger points and the tight fascia might be signs that the patient is at risk of overloading.

To meet these conditions, and to work as a part of the rehabilitation team at Malvazinky, I believe that the best use of my time with the patient will be to use a gentle approach and focus more on the functional part. I will focus on correcting ADL.
techniques, improving movement stereotype, increasing correct small muscle activation around the joints and increase proprioception and awareness about her posture and movement.

4.7 THERAPEUTIC GOALS

The general goal of therapy is to improve the function of the patient’s knee and prevent further compensation mechanisms and dysfunction that may arise after a faulty movement stereotype and immobilization.

SHORT TERM GOALS
1. Decrease oedema
2. Increase ROM in knee joint
3. Facilitate activation of the quadriceps muscle
4. Optimize soft tissue quality, increase elasticity
5. Increase functional mobility
6. Decrease compensation patterns

LONG TERM GOALS
- Increase joint stability
- Increase muscle strength
- Improve gait, improve turning
- Facilitate proper breathing
- Increase muscle coordination
- Examine exercise techniques, correcting if necessary
- Give training schedule
4.8 THERAPY PROPOSAL

SHORT TERM PLAN

1. Scar stimulation
2. Soft tissue techniques
3. Patellar mobilization
4. Patient education – reducing swelling
5. Post isometric relaxation (PIR) for Quadriceps and Hamstrings
6. Strengthening Quadriceps
7. Patient education – stretching
8. Massage for hypertonic muscles

LONG TERM PLAN

1. Assess favoured activities technique, correcting faulty movement stereotypes
2. Conditioning exercises in gym
3. PNF for quadriceps and hamstrings
4. Sensory motoric stimulation (SMS)
5. Gait re-education
6. Functional exercises for increasing Quadriceps strength
7. Patient education - finding an optimal activity
4.9 THERAPEUTIC PROGRESS
(From Wednesday 22.01.14 to Wednesday 29.01.14)

DATE: Wednesday 22.01.14 THERAPY SESSION NO.: 1
TIME: 13:00 – 13:30

Status Praesens (15th day of rehabilitation)

Subjective: The patient says she feels well and doesn’t express any form of discomfort or pain at the beginning of the session.

Objective: There is oedema around her right knee, a marked difference between left and right lower extremity. She walks into the room with a mild asymmetrical and stiff gait where the hip is used much more than normal in driving the body forward.

Goal of today’s therapy unit

- Activating soft tissues and scar for increased tissue re-modulation. Oedema reduction.
- Increase patellar movement and lengthen the soft tissues around the quadriceps tendon
- Relax hypertonic muscles and release trigger points
- Increase correct muscle activation; reduce compensation mechanisms by stimulating proprioception with correct joint positions.

Proposed therapy

- Soft tissue techniques with scar therapy and femoral fascia stretching (according Lewit)
- Patellar mobilization
- Passive movement of affected extremity
- PIR of knee into flexion.
- Active movements of affected extremity
- Sensory motoric stimulation
- Balance/proprioceptive exercise for activating optimal muscle coordination.

(Figure 10)
Implementation

The therapy session started with the patient lying in supine line position. The patient received scar therapy and soft tissue stretching for skin and fascia around the knee and the scar. She was then given patellar mobilization in all directions according Lewit.

The session continued with passive movements of the affected lower extremity while the patient lied in supine line position, followed by PIR of the knee into flexion. A small overball was then placed under the patient’s heel to actively engage the muscles providing flexion and extension of the knee.

The therapy unit ended with the patient learning “small foot” activation with 3-point stance in sitting position, before activating proprioception in closed chain for the ankle, knee and hip (Figure 10).

Result

Subjective: The patient doesn’t feel any improvement of knee ROM after the therapy.

Objective: There is no improvement of the ROM, as she has reached less than the maximum result at a previous point in therapy: less than 90 degrees flexion, by eye measure. The elasticity of the fibres at the end of the knee flexion movement feels hard. The quadriceps, are more optimal with less, yet still, hyper-tone after the therapy. Her gait while walking out of the room is quite the same as when she entered the room.
Evaluation of therapy

The patient informed me that she receives ultrasound for the oedema, as she also has a contraindication to lymphatic stimulation, I will focus more on hip stability and increasing of ROM than on the circulation/oedema.

The technique I used for instructing wobble board did not work in practice as well as I would have thought, and I therefore will moderate the technique into a better approach for next therapy. The reason it didn’t work was because the wobble board was not sufficiently unstable for the patient to get any gain from it.

The patient has problem with balance and the joint, which is most unstable, seems to be the hip. I will, as cause of this, focus my future therapy on stabilizing the hip.

Advice for self-therapy

- Decrease oedema: Elevating the legs over a pillow at the end of the day
- Increase knee flexion ROM: She hooks a towel around her ankle, lies in prone position and gently pulls the leg towards her with the towel in her hands. PIR can be used in this position and is taught to the patient.
Status Praesens (16th day of rehabilitation)

Subjective: The patient feels good and she says her knee swelling is reduced slightly since yesterday.

Objective: The right knee looks slightly more symmetrical in comparison with the left today, due to less oedema. But there is still a marked difference between the two.

Goal of today’s therapy unit
- Improve soft tissue quality and movement of patella
- Increase knee joint mobility
- Improve deep muscle coordination and increase hip joint stability

Proposed therapy
- Soft tissue techniques around the right knee (acc. Lewit)
- PIR for knee flexion
- Passive motion of knee in flexion and extension (acc. Kendall)
- Activation of deep, weak stabilizing muscles of hip and knee with a method taught by Mgr. Hana Zemlerová, inspired by techniques developed by Pavel Kolar.
- Activation of hip and knee flexors and extensors, targeting the weak fibres
- Activation of core muscles, targeting the weak fibres

Implementation
The patient was instructed to lie on the therapy table in supine line position. The session started with soft tissue techniques, as done in first session, with scar therapy, patellar mobilization and fascia stretching. The session continued with post isometric relaxation for the patient’s short knee flexors and extensors according Lewit, followed by passive extension and flexion movements.

The patient was then instructed to hold the position of 90 degrees flexion in hip and slightly flexed knee in supine line. Rhythmic light pressure was then applied to the lateral side of the knee, while the patient was instructed to hold the position and...
push against the resistance. This was procedure was performed by the supervising physiotherapist, Mgr. Hana Zemlerová, with the aim of activating deep and weak muscles with stabilizing function to the joints.

After this technique, I instructed the patient in doing active and passive flexion and extension of the knee with heel on an overball, focusing on the end range of motion. I then placed a big ball under the legs of the patient, who were lying in supine line position, and instructed her to keep the position.

Mgr. Hana Zemlerová then showed me the same technique of rhythmically pushing laterolateral with the aim of activating the core muscles of the patient.

Results

**Subjective:** The patient informs me that she feels more stable after the session

**Objective:** She improves her posture immediately after the therapy and is more straight with a reduced lumbar lordosis and less protraction of the head. Breathing type looks also to have improved and be more abdominal than thoracic.

Evaluation of therapy

The session went well in terms of facilitating proper muscle balance and improving posture. No marked change or increase in knee ROM or knee function after the PIR.

Advice for self-therapy

The patient informs me that she is going to buy a stationary bicycle for her home, and is therefore advised to try cycling on the stationary bicycle at the facility. I will assess and correct the technique. She is also told to continue doing long passive stretches of the knee in the evenings and at the end of the swimming pool classes.
DATE: Friday 24.01.14
TIME: 11:30

THERAPY SESSION NO.: 3

Status Praesens (17th day of rehabilitation)

Subjective: She feels well today, no pain.

Objective: Her gait is quite the same as the days before. No obvious changes to her function. The posture is not as good as immediately after the therapy session the day before.

Goal of today’s therapy unit
- Relaxing soft tissues
- Improve deep muscle synergy and increase hip joint stability
- Increase knee joint mobility

Proposed therapy
- Soft tissue techniques according Lewit
- Mobilization of patella according Lewit
- Activation of deep, weak stabilizing muscles of hip and knee with a method taught by Mgr. Hana Zemlerová, inspired by techniques developed by Pavel Kolar.
- Activation of hip and knee flexors and extensors, targeting the weak fibres
- DNS exercises in developmental position of a 3 months old baby for hyperlordosis of the neck and inhibition of upper trapezius.
- DNS exercises in developmental position of a 3 months old baby for inhibition of Iliopsoas.
- DNS exercises in developmental position of a 5 months old baby turning in side-lying position.

Implementation

The patient is told to lie on the therapy table in supine line position. I start by giving scar therapy and soft tissue therapy as the previous days. I then mobilize the affected patella in all directions and compare it with the healthy side.

After this, with the supervision by Mgr. Hana Zemlerová, I try the activation of the weak supportive muscle fibres around the hip and knee as instructed the day
before with an overball placed under the patient’s heel. I then follow up with the technique with the big ball under the legs aimed at targeting weak core muscles.

Mgr. Hana Zemlerová then instructs the patient to lie in prone position and shows a technique for spinal traction and straightening inspired by DNS and Vojta therapy. The patient is instructed to push against the therapist’s fingers with her spine to straighten excessive curvature of the neck. This is done with the patient lying in a position of the 3 months old baby. The therapist then applies a light rhythmic force against the patient’s weak segment of the spine while the patient is told to resist the force and keep the position. Another DNS exercise is done to inhibit the overactive Iliopsoas, with the patient in prone position. Here the patient is instructed to push the lumbar spine towards the therapist’s hand and then flatten the lordosis. The patient is then told to hold the position. The therapist then instructs the patient to slowly lift her heels off the therapy table, while maintaining the flattened position of the spine. This is repeated 3 times.

At the end of the session Mgr. Hana Zemlerová gives the patient another exercise from DNS, of reflex turning. The patient is instructed to lie on her left side, while her affected leg rests on a pillow. Her spine is placed in a good and straight position and her shoulder and hip joint are placed correctly. The patient’s left elbow is 90 degrees flexed and pronated, while her hand is open. The right shoulder is slightly abducted and the patient is told to push her left knee towards the treatment table. The therapist pushes down on the patient’s right knee and the patient is told to lift her right leg and hand while trying to turn over. This procedure is repeated 3 times.

Results

Better posture and gait after therapy. She looks more stable and upright in the spine. No improvement of the range of motion in the knee joint, patellar movement or improvement of knee function.

Evaluation of therapy

With more focus on reducing compensation patterns the therapy was slightly successful in improving gait and posture. However there is no improvement of the underlying cause, which should be the main focus of therapy. I could focus more on stretching the knee joint in the future, but since the patient already receives vigorous
stretching several times daily I’m not sure how much it would help improving the ROM or if it would cause overstrain and harm.

There should be a meeting with all therapists working with this patient to better make up a plan that reduces the risk of overburdening the soft tissues. I’m aware that it has been such a meeting already, which I was not allowed to attend, since I’m a student. But I will ask for a detailed schedule of all therapies the patient has received.

Advice for self-therapy

- Stretching, walking and bending the knee in the warm pool during the weekend.
- Self-mobilization of patella is taught and should be done several times daily during the weekend.
DATE: Monday 27.01.14
TIME: 11:30

18th day of rehabilitation

Cancelled

The patient had full schedule today, and didn’t have time for today’s therapy.
I received an overview over the therapies given to the patient.
Status Praesens (19th day of rehabilitation)

Subjective: She explains that she feels good and had a slight improvement of the knee ROM with less pain at the end of the motion. Still she explains that the improvement is much too little to improve her function.

Objective: She has a haematoma on her right knee after stretching and soft tissue techniques with the physiotherapist Mgr. Zuzana Bestová earlier this week. Her gait and function is the same as it has been without obvious changes.

Goal of today’s therapy unit

- Improve soft tissues and increase ROM of knee joint
- Optimize gait stereotype
- Stimulate and activate the quadriceps muscle
- Assess functional restrictions and approach the related problems
- Examine and correct technique of stair climbing

Proposed therapy

Session 1:
- Stairs descending assessment and correction
- Slow gait inspired by remedial physical education and sensory motor stimulation
- Slow tiptoe walking inspired by remedial physical education and sensory motor stimulation

Session 2:
- Bicycle technique assessment and correction
- Education of a home stretch technique for the quadriceps

Implementation

There was no available therapy bench today, and we had to adapt the session accordingly and divide it into two shorter sessions.

In the first session I assessed the patient’s gait during ascending and descending stairs. After having assessed the stairs ambulation technique, I explained to the patient how she could improve it and what to focus on when walking in stairs.
I then gave her an exercise that was inspired from a class of remedial physical education at FTVS with sensory motoric stimulation using slow gait. I instructed the patient to walk in a straight line of 10 metres and focus on quality of steps and awareness of the motion in each joint. I corrected faulty movements occurring in her knee and hip joint. After 3 cycles of slow gait, I instructed the patient to walk slowly on tiptoes. This was very demanding to the patient and after the 3 repetitions, I told her to do this in the water at the beginning of each pool classes.

In the second session we went to the gym room and I assessed and corrected her bicycle technique. It was very clear that she had faulty cycling stereotype with excessive hip movements to compensate for lack of knee range of motion. So she was told to elevate the seat of the bicycle or use an elliptical machine instead. I then told her about a home stretch technique and self applied PIR for the quadriceps that she could use when lying prone and using a band around her ankle.

Results

Subjective: She feels well after the session and says that she feels her stairs gait has improved slightly since last time.

Objective: Her gait in stairs has improved since I first assessed it. The movement is more flowing and she doesn’t seem to use the same amount of energy. Still there are problems with the flow and the speed of the movement, which are directly caused by the lack of right knee ROM and weak quadriceps muscle.

The bicycle used for testing is a recumbent stationary type of bicycle. Her bicycle technique is very poor and can be considered rather damaging because of excessive compensation of her hip; the left lower extremity, the trunk and arms. The problem is also directly caused by the lack of knee ROM, which limits her from performing one full swing with the pedal. The hip is pushed backwards and forwards to compensate, while the arms overwork to hold the body stable. The patient herself wishes to buy an ordinary type of stationary bicycle. She has problems with using such a bicycle to a greater extent than the recumbent bicycle now tested.

Evaluation of therapy

Since it was not possible to find a bench today, the session had to be changed. The patient had a more active role and I could assess and correct ADL movements more easily. I made a session based on that she is soon returning to her own home and
I therefore wanted to prevent future compensation mechanisms caused by incorrect techniques. I could have focused more on stretching the knee joint, but I’m aware that she has already had this stretching several times today and that it has not given any marked results so far in therapy.

**Advice of self-therapy**

- Slow tiptoe walking and turning in swimming pool, PIR for quadriceps in the evenings.
- Avoid excessive use of bicycle until right knee ROM has improved.
DATE: Wednesday 29.01.14  
TIME: 11:30

Therapy Session No.: 6

Status Praesens (20th day of rehabilitation)

**Subjective:** The patient feels well, but says that she has some pain around her quadriceps tendon after yesterday’s brisk walk. The pain is described subjectively as 7 out of 10 and is present when she bends the knee while trying to sit down.

**Objective:** The oedema is less present today than what it was last week. She has some minor haematoma around her patella and quadriceps tendon after the mobilisation and stretching from the therapy with Mgr. Zuzana Bestová.

Goal of today’s therapy unit

- Improve soft tissues
- Increase ROM of knee joint
- Increase balance
- Increase stability of gait and activate the quadriceps muscle

Proposed therapy

- Soft tissue techniques and scar therapy according Lewit
- Mobilization of patella according Lewit
- PIR for the quadriceps muscle, the hamstrings and the adductors according Lewit
- Passive, followed by active flexion extension movement of hip and knee on overball.
- Sensory motor stimulation exercises
- Slow tiptoe gait inspired by lectures from the class of remedial physical education.

Implementation

The session started as the sessions before, with the patient supine. I performed soft tissue techniques and scar therapy for the affected extremity, then followed by mobilization of patella in all directions. After the mobilization I focused on PIR for the quadriceps, both of the hamstrings and the adductors with the patient in supine position.
The patient was then given passive flexion and extension of the hip and knee. An overball was introduced under her heel and she was instructed to do maximal active flexion and extension.

Last exercises done during the session were aimed at stimulating proprioceptors and increase balance issues that has been observed when the patient is turning. The patient was asked to find balance on two spiked wobble-cushions, then performing slow dynamic knee flexion and extension movements while keeping an upright trunk posture. We ended the session with slow gait cycle with tiptoe walking. The patient was instructed to focus on quality and balance while walking this way.

Results

Subjective: She says that she is happy to hear that there is a small increase of ROM of her knee joint, but she still doesn’t receive any functional benefit from this since it only concerns a few degrees improvement. There is pain at the end motion of the joint. She explains that she doesn’t like slow paced therapy such as slow walking and would rather perform higher intensity training.

Objective: Her ROM has increased today with a few degrees. Her knee flexion ROM, measured by Goniometer type: Medizintechnik KaWe shows 90 degrees.

Evaluation of therapy

It was very positive and motivating with a slight improvement today! The patient doesn’t seem to enjoy slow paced activities as much as high intensity ones. I explain to her the purpose of the techniques and their benefit of activating weaker and less dominant muscles.

Advice of self-therapy

- She is told to continue stretching and walk on tiptoes in the pool
Status Praesens (21st day of rehabilitation)

The patient says that she feels no improvement of therapy on her function and tells me she is considering surgical correction as solution to her problem.

Goal of today’s therapy unit

Final kinesiologic examination

Proposed plan

Final kinesiologic examination

Implementation

The final kinesiologic examination was conducted in the same way as the initial kinesiologic examination.

Results and evaluation of therapies

An objective evaluation agrees that she has not improved to an optimal level of function to this point. Her curve of improvement of the main problem has also been quite flat even though she has received intensive rehabilitation. She still has problems with using stairs, walking steep hills, and using her knee normally. There is also an increased risk of injury to the rigid knee with riding horses and do high dynamic sports, which are preferred activities.
DATE: Friday 31.01.14          THERAPY SESSION NO.: 8
TIME: 9:30

Status Praesens (22\textsuperscript{nd} day of rehabilitation)

The patient feels well. She returns to her home today and is excited about this.

Goal of today’s therapy unit

- Last part of final kinesiologic examination
- Consultation with evaluation of therapy and future plans

Proposed plan

Final kinesiologic examination and consultation

Implementation

Some last examinations had to be done and the patient was then consulted about the findings and my suggestions to what she could do next. The patient says that the improvements, which were obtained through the therapy sessions, have been positive and motivating, but still not good enough as an improvement in ADL function. She therefore wishes a consultation with the surgeon who offered correction, as she is convinced this will be the optimal treatment for her.

Advice for future and self-therapy

I recommend her to find favoured slow activities, continue her outpatient program at Malvazinky, stretch and do PIR as a daily routine. In addition I agree with her to consult her surgeon for a re-evaluation and a consultation about her options at this point.
4.10 FINAL KINESIOLOGIC EXAMINATION

30.01.14

<table>
<thead>
<tr>
<th>Height</th>
<th>Weight</th>
<th>BMI</th>
<th>Somatotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,66 m</td>
<td>70 kg</td>
<td>25,4</td>
<td>Mixed</td>
</tr>
</tbody>
</table>

3.10.1 General aspect

The patient’s skin colour and body temperature is normal; she still has a mild oedema around right knee, and soft tissues looks quite the same as they did in initial assessment. The right front thigh still looks to cover some atrophic/damaged muscles.

The scar looks quite the same as in first assessment, forming a minor groove on the lateral part of the knee.

3.10.2 Posture (Acc. Kendall)

Starting from frontal view of the patient in standing, the lower extremities, her left foot is placed in external rotation, suggesting this is the preferred stance leg. Right is placed neutrally. Transversal arches are flat. The left calf looks to be bigger than the right. There is still, yet smaller, oedema around her right knee, and the right knee and thigh looks slightly bigger than the left. The trunk looks to be placed in neutral position without rotation and the head looks to be positioned more in midline from frontal view than in the first assessment.

From posterior view the sub-gluteal line is lower on the left side and there is marked difference between the shoulders, and the left shoulder is placed higher.

By observing the patient from lateral view, the right knee and ankle are more flexed/dorsi-flexed than on the left side, but the hip ante-flexion has decreased. The right knee is not fully extended, but it is more extended than what was observed in the first examination. The head is protracted and placed slightly outside of the midline.

**Sitting posture:** The patient sits stable with an upright trunk and upper body, but with a slightly protracted head.

3.10.3 Breathing

Abdominal/thoracic
3.10.4 Gait and functional movement

When walking normally there are still problems with a lack of flow of the movement in the swing phase. There is difference on the stride length where the left extremity has slightly greater distance coverage than the right. She also has a wide gait base with approximately 7 cm between her feet. When turning she has no/little problems with balance and is not at risk of falling. The movement stereotype turning could be better.

Walking backwards shows greater asymmetry between the stride lengths and it is even more evident that the left leg covers more ground than the right. The hip joint doesn’t reach extension before the next gait cycle commences. Walking on heels shows no findings. Tiptoe walking is much better today than last time tested and there is more stability and a greater stride length. There is still shorter stride length on right side and problems with thrusting the extremity forward to swing phase.

When squatting she is able to present a slightly greater ROM of knee flexion than she did before. By eye measure I estimate the knee flexion to be around 70 degrees.

Stairs climbing is better than in first assessment. The patients gait is more fluent. Still it is not optimal, and there is much compensation of the trunk and the hip in order to complete movements of ascending and descending.

4.10.5 Basic movement pattern

Basic movement patterns tested were hip abduction and extension. In hip extension the left has a worse movement stereotype than right. There is decreased homo-lateral paravertebral muscle activation. On right side it is almost physiological. In hip abduction the left leg shows a slight tensor mechanism. On right side there is more optimal activation.

4.10.6 Pelvis examination

When examining pelvis position when the patient is standing, the patient has slightly higher crest, posterior and anterior superior iliac spine on right side, which indicates a mild lateral tilt to right side.

4.10.7 Hypermobility (Acc. Janda)

No sign of local or general hypermobility.
### 4.10.8 Anthropometry (performed in lying position)

<table>
<thead>
<tr>
<th>LOWER EXTREMITIES</th>
<th>L</th>
<th>R</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>L. Whole Anatomical</td>
<td>81 ½</td>
<td>82 ½</td>
<td>Acceptable/normal difference</td>
</tr>
<tr>
<td></td>
<td>86</td>
<td>85</td>
<td>Acceptable/normal difference</td>
</tr>
<tr>
<td>L. Thigh</td>
<td>47</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>L. Leg</td>
<td>37 ½</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>C.f. Thigh (Quadriceps)</td>
<td>48 ½</td>
<td>51</td>
<td>Asymmetry</td>
</tr>
<tr>
<td>C.f. Thigh (Vastus Medialis)</td>
<td>43 ½</td>
<td>47</td>
<td>Asymmetry</td>
</tr>
<tr>
<td>C.f. Knee joint</td>
<td>40</td>
<td>47</td>
<td>Asymmetry</td>
</tr>
<tr>
<td>C.f. Calf</td>
<td>39</td>
<td>39 ½</td>
<td></td>
</tr>
</tbody>
</table>

*Table 8: Final kinesiologic examination: anthropometric values*

Conclusion of findings from anthropometry: Greatest asymmetry was found on circumference of thigh and around knee joint.
### 4.10.9 Range of motion (Tested with Goniometer type: Medizintechnik KaWe.)

<table>
<thead>
<tr>
<th>HIP JOINT</th>
<th>NORMAL</th>
<th>LEFT</th>
<th>RIGHT</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>S: E, F (Active)</td>
<td>10⁰ - 0⁰ - 125⁰</td>
<td>10⁰ - 0⁰ - 80⁰</td>
<td>10⁰ - 0⁰ - 70⁰</td>
<td>Decreased ROM</td>
</tr>
<tr>
<td>S: E, F (Passive)</td>
<td>10⁰ - 0⁰ - 125⁰</td>
<td>10⁰ - 0⁰ - 90⁰</td>
<td>10⁰ - 0⁰ - 80⁰</td>
<td>Decreased ROM</td>
</tr>
<tr>
<td>F: Abd, Add (Active)</td>
<td>45⁰ - 0⁰ - 10⁰</td>
<td>40⁰ - 0⁰ - 15⁰</td>
<td>40⁰ - 0⁰ - 10⁰</td>
<td></td>
</tr>
<tr>
<td>F: Abd, Add (Passive)</td>
<td>45⁰ - 0⁰ - 10⁰</td>
<td>45⁰ - 0⁰ - 15⁰</td>
<td>45⁰ - 0⁰ - 10⁰</td>
<td></td>
</tr>
<tr>
<td>R: ER, IR (Active)</td>
<td>45⁰ - 0⁰ - 30⁰</td>
<td>45⁰ - 0⁰ - 20⁰</td>
<td>30⁰ - 0 - 30⁰</td>
<td></td>
</tr>
<tr>
<td>R: ER, IR (Passive)</td>
<td>45⁰ - 0⁰ - 30⁰</td>
<td>45⁰ - 0⁰ - 30⁰</td>
<td>35⁰ - 0 - 30⁰</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>KNEE JOINT</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>S: E, F (active)</td>
<td>0⁰ - 0⁰ - 140⁰</td>
<td>0⁰ - 0⁰ - 150⁰</td>
<td>10⁰ – 10⁰ - 75⁰</td>
<td>Decreased ROM on right side, both active and passive</td>
</tr>
<tr>
<td>S: E, F (passive)</td>
<td>0⁰ - 0⁰ - 140⁰</td>
<td>0⁰ - 0⁰ - 150⁰</td>
<td>5⁰ – 5⁰ - 85⁰</td>
<td></td>
</tr>
<tr>
<td>R: ER, IR (active)</td>
<td>50⁰ - 0⁰ - 40⁰</td>
<td>40⁰ - 0⁰ - 30⁰</td>
<td>15⁰ – 0⁰ - 15⁰</td>
<td>Decreased ROM on right side, both active and passive</td>
</tr>
<tr>
<td>R: ER, IR (passive)</td>
<td>50⁰ - 0⁰ - 40⁰</td>
<td>40⁰ - 0⁰ - 30⁰</td>
<td>10⁰ - 0⁰ - 10⁰</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ANKLE JOINT</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>S: D.F, P.F (Active)</td>
<td>20⁰ - 0⁰ - 50⁰</td>
<td>20⁰ - 0⁰ - 50⁰</td>
<td>20⁰ - 0⁰ - 50⁰</td>
<td></td>
</tr>
<tr>
<td>S: D.F, P.F (Passive)</td>
<td>20⁰ - 0⁰ - 50⁰</td>
<td>20⁰ - 0⁰ - 50⁰</td>
<td>20⁰ - 0⁰ - 50⁰</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUBTALAR JOINT</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>R: Supination, Pronation</td>
<td>80⁰ – 0⁰ – 80⁰</td>
<td>Norm</td>
<td>Norm</td>
<td></td>
</tr>
</tbody>
</table>

Table 9: Final kinesiologic examination: goniometric values

Conclusion of findings in range of motion: Decreased knee ROM on right side of both flexion and extension, external and internal rotation. Maximal restriction is found in knee flexion: active maximum is 114⁰, while passive maximum is 85⁰.

### 4.10.10 Palpation

In comparison with the healthy leg, the right front thigh still has hyper-tone and trigger points along the Rectus Femoris muscle. The skin around the knee has normal temperature, but is slightly colder around the lateral side, above and around the scar. The sub-skin has the same thickness as it had in the initial kinesiologic exam, but the oedema has reduced. There is at this moment no dent left when pressing at the lateral part of the knee.
The scar is, by palpation, quite the same as in the initial kinesiologic examination. The scar forms a deep groove within the skin tissue. The skin is less elastic around the scar in all directions. The deeper soft tissues and fascia around the scar is more movable than they were the first time I palpated. This might be because of reduced oedema.

4.10.11 Muscles strength testing (0 – 5 Grading According Kendall)

<table>
<thead>
<tr>
<th>TRUNK</th>
<th>L</th>
<th>R</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadratus Lumborum</td>
<td>5</td>
<td>5-</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PELVIS + THIGH</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Iliopsoas</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Gluteus Maximus</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Quadriceps</td>
<td>5</td>
<td>4-</td>
<td>Weaker than norm</td>
</tr>
<tr>
<td>Adductors</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Sartorius</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Hamstrings</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Gluteus Medius</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Gluteus Minimus</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Tensor Fasciae Latae</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CALF + FEET</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tibialis Anterior</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Gastrocnemius</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Soleus</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Toe Flexors</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Toe Extensors</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Table 10: Final kinesiologic examination: muscle strength values

Conclusion of findings from muscles strength testing: Weak Quadriceps group and slight asymmetry between left and right Quadratus Lumborum, where the right side was weaker than the left side. The other muscles of the lower extremity are at this point more symmetrical in strength.
### 4.10.12 Muscles length testing (0 – 2 Grading According Janda)

<table>
<thead>
<tr>
<th>TRUNK</th>
<th>L</th>
<th>R</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadratus Lumborum</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>PELVIS + THIGH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iliopsoas</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Gluteus Maximus</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Quadriceps</td>
<td>0</td>
<td>2</td>
<td>Marked shortness, hard end feeling, pain!</td>
</tr>
<tr>
<td>Adductors</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Hamstrings</td>
<td>1</td>
<td>1</td>
<td>Mild shortness of LS, Marked on RS</td>
</tr>
<tr>
<td>Gluteus Medius</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Gluteus Minimus</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Piriformis</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Tensor Fasciae Latae</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>CALF + FEET</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tibialis Anterior</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Gastrocnemius</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Soleus</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Toe Flexors</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Toe Extensors</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Table 11: Final kinesiologic examination: muscle length values

Conclusion of muscles length testing: Marked shortness found on right lower extremity of Quadriceps muscle. Mild shortness was found on both extremities in the Hamstrings muscle.
4.10.13 Joint play (According Lewit)

<table>
<thead>
<tr>
<th>LOWER EXTREMITIES</th>
<th>L</th>
<th>R</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phalangeal joints</td>
<td>Norm</td>
<td>Norm</td>
<td></td>
</tr>
<tr>
<td>Metatarsal joint</td>
<td>Norm</td>
<td>Norm</td>
<td></td>
</tr>
<tr>
<td>Tarsal joint</td>
<td>Norm</td>
<td>Norm</td>
<td></td>
</tr>
<tr>
<td>Ankle joint</td>
<td>Norm</td>
<td>Norm</td>
<td></td>
</tr>
<tr>
<td>Head of fibula</td>
<td>Norm</td>
<td>Norm</td>
<td></td>
</tr>
<tr>
<td>Knee joint</td>
<td>Norm</td>
<td>Norm</td>
<td></td>
</tr>
<tr>
<td>Patella</td>
<td>Norm</td>
<td>Reduced</td>
<td>Movable, but with hard barrier at the end of the motion in all directions</td>
</tr>
<tr>
<td>SI joint</td>
<td>Norm</td>
<td>Norm</td>
<td></td>
</tr>
</tbody>
</table>

Table 12: Final kinesiologic examination: joint play values

Conclusion of joint play according Lewit: Asymmetry between the left and right patellar mobility, where right is less movable. However it has improved since last time and is much more movable than it has been.

4.10.14 Special tests

Two-scale test was negative with only 2 kg weight difference between left and right side. Right is used as the preferred stance leg with most weight distributed.

4.10.15 Neurological Examination

Reflex assessment showed finding with reduced/absent patellar (L2-L4) reflex on right side. The result is the same as last time with only a few of the fibers activated and seen by aspection, but without the expected movement response of the knee joint. Left side is normal, and there are no other abnormal findings from neurological examination.
4.11 CONCLUSION FROM FINAL KINESIOLOGIC EXAMINATION

Decreased active and passive ROM of right knee joint in flexion and extension. Active maximum flexion of knee joint is 75°, while passive maximum is 85°

Decreased or absent patellar reflex (L2-L4). Only part of the muscle was visibly activated, knee joint without movement

Right Quadriceps muscle (Innervated by Femoral nerve, L2-L4) found with hypertone and trigger points, atrophy, decreased muscle strength and restricted length

7 cm difference in circumference between left and right knee joint, mild oedema around right knee

Mild restriction of right patella and fascia around the scar

Worse movement stereotype with compensation mechanisms on left lower extremity in hip extension and abduction

Lateral tilt of pelvis, right side is higher than left
5 EVALUATION OF THE THERAPEUTIC EFFECT

Since the rehabilitation process has been in cooperation with many knowledgeable medical professionals, using several methods, I cannot take any credit for eventual improvements alone. The patient received group and individual therapy on a daily basis at Rehabilitation Clinic Malvazinky. Her programme included physiotherapy, ultrasound, laser, massage, swimming, Pilates, Yoga, as well as many other rehabilitation methods. In addition to this, the patient had a great dedication to the programme.

5.1 OBJECTIVE PROGRESS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>Initial kinesiologic exam</th>
<th>Final kinesiologic exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>21.01.14</td>
<td>30.01.14</td>
</tr>
</tbody>
</table>

BASIC ANTHROPOMETRIC MEASURES (acc. scale, BMI calculator)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Initial Value</th>
<th>Final Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>75 kg</td>
<td>70 kg</td>
</tr>
<tr>
<td>BMI</td>
<td>27.2</td>
<td>25.4</td>
</tr>
</tbody>
</table>

Table 13: Evaluation: basic anthropometric values comparison

GENERAL ASPECTION (acc. eye estimation)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Initial Value</th>
<th>Final Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right knee oedema</td>
<td>Marked</td>
<td>Mild</td>
</tr>
</tbody>
</table>

Table 14: Evaluation: general aspection comparison

POSTURE (acc. eye estimation)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Initial Value</th>
<th>Final Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knee position</td>
<td>Marked flexion in standing</td>
<td>Mild flexion in standing</td>
</tr>
<tr>
<td>Hip position</td>
<td>Marked flexion in standing</td>
<td>Mild flexion in standing</td>
</tr>
<tr>
<td>Trunk position</td>
<td>Shift to right side</td>
<td>Neutral</td>
</tr>
<tr>
<td>Shoulder position</td>
<td>Left shoulder higher (mild)</td>
<td>Left shoulder higher (marked)</td>
</tr>
</tbody>
</table>

Table 15: Evaluation: posture comparison
GAIT AND FUNCTIONAL MOVEMENT (acc. eye estimation)

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gait base</td>
<td>Approximately 10 cm</td>
<td>Approximately 7 cm</td>
<td>Slight collapse when leaning on left extremity</td>
<td>Less problems with balance, yet still wide gait base while turning</td>
<td>Problematic with swing phase and balance! Short stride length</td>
<td>Less problems with swing phase, less problems with balance and longer stride length</td>
<td>60 degrees knee flexion</td>
<td>70 degrees knee flexion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gait phase: Turning</td>
<td>Balance problems when turning,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special gait: tiptoe</td>
<td>Balance problems when turning,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special test: squat</td>
<td>60 degrees knee flexion</td>
<td>70 degrees knee flexion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 16: Evaluation: gait and functional movement comparison

BASIC MOVEMENT PATTERN

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip abduction</td>
<td>Good hip abduction</td>
<td>Tensor mechanism, left side</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 17: Evaluation: basic movement pattern comparison

ANTHROPOMETRY (acc. tape measure)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole</td>
<td>84 cm</td>
<td>84 cm</td>
<td>81 ½ cm</td>
<td>82 ½ cm</td>
<td>48 cm</td>
<td>50 cm</td>
<td>48 ½ cm</td>
<td>51 cm</td>
<td>42 cm</td>
<td>48 cm</td>
<td>40 cm</td>
<td>47 cm</td>
</tr>
<tr>
<td>Functional</td>
<td>87 cm</td>
<td>88 cm</td>
<td>86 cm</td>
<td>85 cm</td>
<td>45 cm</td>
<td>47 cm</td>
<td>47 cm</td>
<td>51 cm</td>
<td>37 ½ cm</td>
<td>38 cm</td>
<td>39 cm</td>
<td>39 ½ cm</td>
</tr>
<tr>
<td>Thigh</td>
<td>45 cm</td>
<td>45 cm</td>
<td>47 cm</td>
<td>47 cm</td>
<td>38 cm</td>
<td>37 cm</td>
<td>37 ½ cm</td>
<td>38 cm</td>
<td>37 cm</td>
<td>38 cm</td>
<td>39 cm</td>
<td>39 ½ cm</td>
</tr>
<tr>
<td>Leg</td>
<td>38 cm</td>
<td>37 cm</td>
<td>37 ½ cm</td>
<td>38 cm</td>
<td>48 cm</td>
<td>48 cm</td>
<td>43 ½ cm</td>
<td>47 cm</td>
<td>37 cm</td>
<td>39 cm</td>
<td>39 cm</td>
<td>39 ½ cm</td>
</tr>
</tbody>
</table>

Table 18: Evaluation: anthropometric values comparison

Note: First measure might have been less accurate than last, therefore the big changes in lower extremity anatomical and functional length.
### RANGE OF MOTION (acc. goniometer Medizintechnik KaWe)

<table>
<thead>
<tr>
<th></th>
<th>L</th>
<th>R</th>
<th>L</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HIP JOINT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S: E, F (Active)</td>
<td>10° - 0° - 80°</td>
<td>10° - 0° - 70°</td>
<td>10° - 0° - 80°</td>
<td>10° - 0° - 70°</td>
</tr>
<tr>
<td>S: E, F (Passive)</td>
<td>10° - 0° - 90°</td>
<td>10° - 0° - 80°</td>
<td>10° - 0° - 90°</td>
<td>10° - 0° - 80°</td>
</tr>
<tr>
<td>F: Abd, Add (Active)</td>
<td>40° - 0° - 10°</td>
<td>40° - 0° - 10°</td>
<td>40° - 0° - 15°</td>
<td>40° - 0° - 10°</td>
</tr>
<tr>
<td>F: Abd, Add (Passive)</td>
<td>50° - 0° - 10°</td>
<td>50° - 0° - 10°</td>
<td>45° - 0° - 15°</td>
<td>45° - 0° - 10°</td>
</tr>
<tr>
<td>R: ER, IR (Active)</td>
<td>30° - 0° - 30°</td>
<td>30° - 0° - 20°</td>
<td>45° - 0° - 20°</td>
<td>30° - 0 - 30°</td>
</tr>
<tr>
<td>R: ER, IR (Passive)</td>
<td>40° - 0° - 30°</td>
<td>35° - 0° - 25°</td>
<td>45° - 0° - 30°</td>
<td>35° - 0° - 30°</td>
</tr>
<tr>
<td><strong>KNEE JOINT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S: E, F (Active)</td>
<td>0° - 0° - 150°</td>
<td>15° - 15° - 60°</td>
<td>0° - 0° - 150°</td>
<td>10° - 10° - 75°</td>
</tr>
<tr>
<td>S: E, F (Passive)</td>
<td>0° - 0° - 150°</td>
<td>10° - 10° - 80°</td>
<td>0° - 0° - 150°</td>
<td>5° - 5° - 85°</td>
</tr>
<tr>
<td>R: ER, IR (Active)</td>
<td>40° - 0° - 30°</td>
<td>10° - 0° - 10°</td>
<td>40° - 0° - 30°</td>
<td>15° - 0° - 10°</td>
</tr>
<tr>
<td>R: ER, IR (Passive)</td>
<td>40° - 0° - 30°</td>
<td>15° - 0° - 10°</td>
<td>40° - 0° - 30°</td>
<td>10° - 0° - 10°</td>
</tr>
</tbody>
</table>

Table 19: Evaluation: goniometric values comparison

### PALPATION

<table>
<thead>
<tr>
<th></th>
<th>Normal temperature, decreased elasticity around right knee</th>
<th>Normal temperature/colder around scar, quite same as first exam</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Skin</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sub-skin</strong></td>
<td>Thick, restricted, oedema</td>
<td>Thick, less restricted, less oedema</td>
</tr>
<tr>
<td><strong>Scar</strong></td>
<td>Deep, thick, reduced elasticity</td>
<td>No obvious change since first exam</td>
</tr>
<tr>
<td><strong>Fascia (around right knee)</strong></td>
<td>Restricted</td>
<td>Less restricted</td>
</tr>
<tr>
<td><strong>Muscles</strong></td>
<td>Hyper-tone, trigger-points (R.S) of Rectus Femoris</td>
<td>Hyper-tone, trigger-points (R.S) of Rectus Femoris</td>
</tr>
<tr>
<td><strong>Oedema</strong></td>
<td>Mild dent left after pressing, gone after a few seconds</td>
<td>No dent left after pressing</td>
</tr>
</tbody>
</table>

Table 20: Evaluation: palpation comparison
MUSCLES STRENGTH TESTING (acc. Kendall)

<table>
<thead>
<tr>
<th>MUSCLE</th>
<th>L</th>
<th>R</th>
<th>L</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadriceps</td>
<td>5</td>
<td>3+</td>
<td>5</td>
<td>4-</td>
</tr>
<tr>
<td>Adductors</td>
<td>5</td>
<td>4+</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Sartorius</td>
<td>5</td>
<td>4+</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Tensor Fasciae Latae</td>
<td>5</td>
<td>4+</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 21: Evaluation: muscle strength values comparison

MUSCLES LENGTH TESTING (acc. Janda)

<table>
<thead>
<tr>
<th>MUSCLE</th>
<th>L</th>
<th>R</th>
<th>L</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadriceps</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Adductors</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hamstrings</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 22: Evaluation: muscle length values comparison

JOINT PLAY (acc. Lewit)

<table>
<thead>
<tr>
<th>JOINT</th>
<th>L</th>
<th>R</th>
<th>L</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patella</td>
<td>Norm</td>
<td>Marked restriction, all directions</td>
<td>Norm</td>
<td>Mild restriction, all directions</td>
</tr>
</tbody>
</table>

Table 23: Evaluation: joint play comparison

SPECIAL TESTS

<table>
<thead>
<tr>
<th>TEST</th>
<th>Less than 2 kg difference</th>
<th>2 kg difference, leaning more on right side</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two scale test</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 24: Evaluation: special tests comparison

NEUROLOGICAL EXAMINATION (assessed with neurological hammer)

<table>
<thead>
<tr>
<th>REFLEX</th>
<th>Decreased on right side, only visible movement of muscle fibres, no knee jerk</th>
<th>Decreased on right side, same response as initial assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patellar reflex</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 25: Evaluation: neurological comparison
5.1.1 OUTCOME OF OBJECTIVE PROGRESS

Roughly summarized, the therapy has been successful on improving most parameters, even though the improvements have been minimal.

Most importantly, her knee flexion range of motion has improved from 60 to 75 degrees when actively moving the limb, and from 80 to 85 degrees when passively moving the limb. Directly after having performed PIR, the patient was also able to reach 90 degrees of passive knee flexion, but this is unreachable when assessing normally, without this therapy. The patient has also increased her knee extension in standing slightly.

Big changes in the anthropometric examination, of the lower extremity anatomical length, indicate that there might have been inaccurate measuring methods. Looking away from this possible error, I measured positive results of decreased circumference of knee and lower part of the thigh with 1 cm. Most significantly, the patient decreased her weight by 5 kg, which is quite remarkable in such a short time.

The patient has increased her muscle strength in the lower extremities after the rehabilitation stay. She has greater strength in Quadriceps, Adductors, Sartorius and Tensor Fasciae Latae. Still there is minor weakness of her right side Quadriceps, which has been generally weaker than any of the other muscles of the lower extremity.

The patient seems also to be slightly more stable after therapy, and doesn’t have as much problems with turning in gait and walking on tiptoes.

Even though the oedema has decreased slightly, and the patellar tendon is easier to stimulate, there is no improvement of the patellar reflex, which might indicate that there is a structural damage to the innervation of the femoral nerve. The Rectus Femoris muscle is still hypertonic with many trigger-points, and has shown no progress after therapy, by the means of tissue quality.

Negative changes, which I observe with this evaluation, are a worsened basic movement stereotype of the hip abduction of the left extremity and increased asymmetry between the shoulders.
## 5.2 SUBJECTIVE PROGRESS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>Initial kinesiologic exam</th>
<th>Final kinesiologic exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td>Present to a mild degree when stretching knee to maximal flexion</td>
<td>Present to a higher degree than before when stretching at the end of the newly obtained knee ROM. Sharp type of pain. Not limiting her function.</td>
</tr>
<tr>
<td>Oedema</td>
<td>Troubles her, but is not causing any pain</td>
<td>Still present after vigorous training/walking, bothers her to a low degree</td>
</tr>
<tr>
<td>Stiffness of knee</td>
<td>Problematic to bend, put on shoes and socks. Restricted from using the knee normally, walking stairs</td>
<td>Still problematic, no change in function. Patient uses stairs to a bigger degree, feels more stable. But is still not satisfied with the result. Troubles her and causes limitations to her quality of life</td>
</tr>
<tr>
<td>Overall function</td>
<td>Limitations to many preferred activities, mildly decreased quality of life</td>
<td>No change in overall function. She is motivated by the positive result of therapy, but it’s not good enough</td>
</tr>
</tbody>
</table>

Table 26: Evaluation: subjective progress comparison

### 5.2.1 OUTCOME OF SUBJECTIVE PROGRESS

When evaluating the subjective changes, it is evident that the therapy has not been successful in reaching the patients goal of an improved function. Even though there are measurable and positive changes to the individual structures, it is not sufficient enough to make an improvement on the general function of the patient.
5.3 EVALUATION OF PATIENT PARTICIPATION

The patient showed full dedication to the rehabilitation programme at Malvazinky, and was much more active than the average patient. Her schedule was full with different therapies on weekdays, and every evening, including in the weekends, she exercised on her own.

6 SUMMARY AND PROGNOSIS

Theoretical factors, the subjective and objective changes, as well as the patient’s own effort in the therapeutic process, it is clear that the rehabilitation stay has not been successful in improving the patients function to an extent degree, or reaching her goal of being able to use and bend the knee normally.

There might have been great expectations to the speed of recovery, where the patient wanted to reach maximal results on the least amount of time possible. After having examined the patient’s knee and soft tissues and having observed their improvements, I would assume that further increased ROM of the knee could be reached non-invasively through intensive physiotherapy with respect of a longer timeframe.

The patient underwent an atypical surgery, 1 year ago, with removal of a tumour as well as the instalment of a total endoprosthesis in the same surgery. The functional impairment has been present ever since without any marked improvement. She has undergone standard post operation rehabilitation, with a case history of having reached only a 90-degree flexion range of motion at the maximum.

Because of these facts, I would agree with the patient, that a new consultation with the surgeon could be right at this point. In my opinion the prognosis depends on what the patient chooses to do next, and what the surgeon suggests. According my theoretical research, manipulation under anaesthesia might be a good option.


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*APA referencing*
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ABBREVIATIONS

ABD – Abduction
ADD – Adduction
ADL – Activities of daily living
CPM – Continuous passive motion
DNS – Dynamic Neuromuscular Stabilization
BMI – Body mass index
E – Extension
ER – External rotation
F – Flexion (movement)
F – Frontal plane
FTVS – Fakulta Telesne Vychovy a Sportu
IR – Internal rotation
JAS – Joint Active Systems
LE – Lower extremity
MIS – Minimal invasive surgery
MUA – Manipulation under Anaesthesia
NMES – Neuromuscular electrical stimulation
PIR – Post isometric relaxation
PNF – Proprioceptive neuromuscular facilitation
ROM – Range of motion
S – Sagittal (plane)
SMS – Sensory Motor Stimulation
TKA – Total knee arthroplasty
TKR – Total knee replacement
T – Transverse (plane)
Pictures of patient, taken 22.01.14, before therapy implication (anterior, left, right and posterior view)
Pictures of patient, taken 30.01.14, after therapy implication (anterior, left, right and posterior view)
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X-ray showing the right knee, anterior view taken 26.02.13
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Application for Ethics Board Review

of the undergraduate research, involving human subjects

Project title: Case study of patient after total knee replacement

Nature of the research project: Undergraduate research

Author (chief investigator): Johanne Marie Jerlo

Supervisor (in case of student research): Mgr. Kateřina Holubová

Case study of the physiotherapeutic rehabilitation process of a patient with diagnosis ICD-10-CM Z96.659 will be processed with the supervision and guidance of a skilled physiotherapist at Rehabilitační Klinika Malvazinky. No invasive methods will be used and personal data will not be published.

Informed consent (attached)

Date: 08.03.2014

Author’s signature:

Faculty of Physical Education and Sport, Charles University in Prague
ETHICS BOARD REVIEW

Ethics Board members: Doc. MUDr. Staša Bartůnková, CSc.
Prof. Ing. Václav Bunc, CSc.
Prof. PhDr. Pavel Slepčka, DrSc.
Doc. MUDr. Jan Heller, CSc.

The Ethics Board at the Faculty of Physical Education and Sport, Charles University, approved the research project.
Approval number: 1341/2014
Date: 19.3.2014

The Ethics Board at the Faculty of Physical Education and Sport, Charles University, reviewed the submitted research project and found no contradictions with valid principles, regulations and international guidelines for biomedical research involving human subjects.

The chief investigator of the project met the necessary requirements for receiving the Ethics Board approval.

UNIVERZITA KARLOVA v Praze
Facultas humaniorum studiorum
Josefova 31, 162 52, Praha 6

Official school stamp

Signature, REB Chairman
INFORMOVANÝ SOUHLAS

V souladu se Zákonem o péči o zdraví lidu (§ 23 odst. 2 zákona č.20/1966 Sb.) a Úmluvou o lidských právech a biomedicíně č. 96/2001, Vás žádám o souhlas k vyšetření a následné terapii. Dále Vás žádám o souhlas k nahlížení do Vaší zdravotnické dokumentace osobou získávající způsobilost k výkonu zdravotnického povolání v rámci praktické výuky a s uveřejněním výsledků terapie v rámci bakalářské práce na FTVS UK. Osobní data v této studii nebudou uvedena.

Dnešního dne jsem byla odborným pracovníkem poučena o plánovaném vyšetření a následné terapii. Prohlašuji a svým dale uvedeným vlastnoručním podpisem potvrzuji, že odborný pracovník, který mi poskytl poučení, mi osobně vysvětlil vše, co je obsahem tohoto písemného informovaného souhlasu, a měla jsem možnost klást mu otázky, na které mi řádně odpověděl.

Prohlašuji, že jsem výše uvedenému poučení plně porozuměla a souhlasím s provedením vyšetření a následnou terapií. Souhlasím s nahlížením níže jmenované osoby do mé dokumentace a s uveřejněním průběhu a výsledků terapie v rámci studie.

Datum:.................................

Osoba, která provedla poučení:..............................................

Podpis osoby, která provedla poučení:.................................

Vlastnoruční podpis pacienta/tyk:.................................