CHARLES UNIVERSITY IN PRAGUE

Faculty of Physical Education and Sport

BACHELOR THESIS

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CHARLES UNIVERSITY IN PRAGUE

Faculty of Physical Education and Sport

Casuistic of patient with Gonarthrosis and Total knee replacement

Bachelor thesis

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ABSTRACT

TITLE: Casuistic of patient with Gonarthrosis and total knee replacement

Gonartrosa a totální náhrada kolenního kloubu

The goal of this bachelor thesis is to do a clinical study of a patient with gonarthrosis and following total knee replacement (TKR). The study is the final work of a bachelor degree in physiotherapy. In this thesis, the knee joint is described with anatomy and function. Thereby follows a description of gonarthrosis and its effects on the knee joint. TKR is discussed in the end of the theoretical part.

In the special part, the examinations and rehabilitation of a patient with TKR is described, as well as therapy effect evaluation and prognosis for the patient. The study lasted for a period of two weeks. During the initial meeting and evaluation of the patient, a rehabilitation plan was worked out and executed during the two weeks with all together ten sessions. Therapy was executes with the help of conventional therapy such as exercising and different techniques and modalities from physical therapy. The main goal was to help the patient retrieve full function of the knee joint, which was achieved in a satisfying way, but continuous attention and therapy is necessary to fully rehabilitate the patient back to his previous life style.

KEY WORDS: knee joint anatomy, gonarthrosis, cartilage degeneration, total knee replacement, rehabilitation plan

DECLARATION

I declare that this Bachelor Thesis is based on my own individual work during my two weeks of clinical practice at the Revmatologický Ústav in Albertov, Prague between the 2th and 13th of February 2009.

Lars Lonvik

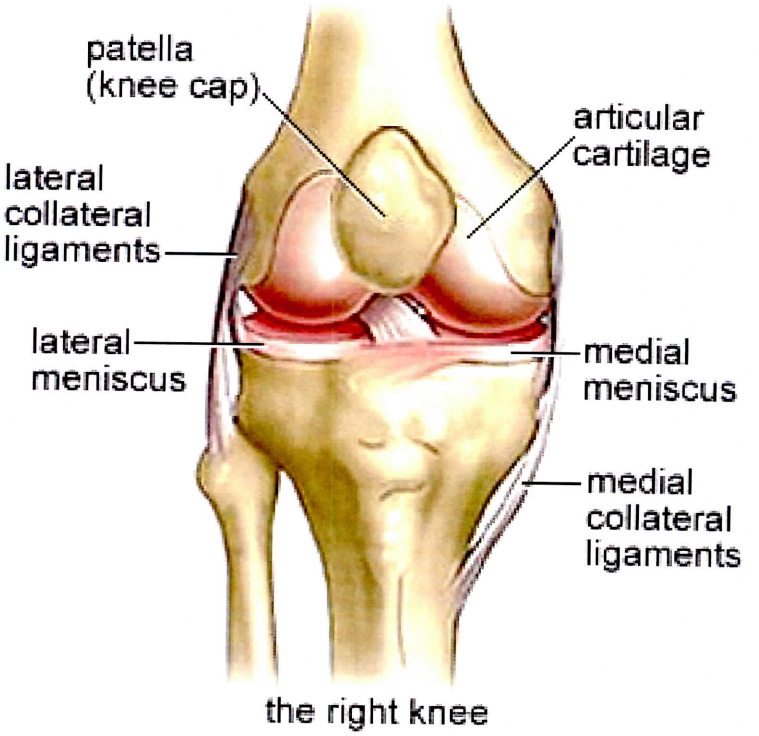
2. THEORETICAL PART

2.1. ANATOMY OF THE KNEE JOINT

2.1.1. INTRODUCTION

The knee joint is our largest and most superficial joint. It is primarily a hinge type of synovial joint, allowing flexion and extension, however, the hinge movements are combined with gliding and rolling and with rotation about a vertical axis.. This arrangement permits freedom of movement. All joints of the limbs are of synovial type. (1,11)

Figure 1. The knee joint. (26)



2.1.2. BONES

The articulating bones of the knee joint are the femur, the tibia and the patella. The knee joint is actually a composite of three synovial joints; the articulations between the medial and lateral femoral and tibial condyles, which make up the medial and lateral tibiofemoral joints, and the patellofemoral joint. [4]

2.1.3. LIGAMENTS

Many ligaments cross the knee, significantly enhancing its stability. The location of each ligament determines the direction in which it is capable of resisting the dislocation of the knee. [4]

EXTRACAPSULAR LIGAMENTS

The joint capsule is strengthened by five extracapsular or capsular ligaments: patellar, fibular collateral, tibial collateral, oblique popliteal ligament and arcuate popliteal ligament. They are sometimes called external ligaments to differentiate them from internal ligaments, such as the cruciate ligaments.

The patellar ligament, the distal part of the quadriceps tendon, is a strong, thick fibrous band passing from the apex and adjoining margins of the patella to the tibial tuberosity. The patellar ligament is the anterior ligament of the knee joint. Laterally, it recieves the medial and lateral patellar retinacula, aponeurotic expansions of the vastus medialis and lateralis and overlying deep fascia. [3]

The retinacula make up the joint capsule of the knee on each side of patella, and play an important role in maintaining alignment of the patella relative to the patellar articula surface of the femur.

The collateral ligaments are taut when the knee is fully extended, contributing to stability while standing. As flexion proceeds, they become increasingly slack, permitting and limiting rotation of the knee. The fibularcollateral ligament (FCL/lateral collateral ligament), a cord-like extracapsular ligament, is strong. It extends inferiorly from the lateral epicondyle of the femur to the lateral surface of the fibular head. The

tendon of the popliteus passes deep to the FCL, separating it from the lateral meniscus. (19)

The tendon of the biceps femoris is split into two parts by this ligament. The tibial collateral ligament(TCL/medial collateral ligament) is a strong, flat, capsular band that extends from the medial epicondyle of the femur to the medial condyle and the superior part of the medial surface of the tiba. At its midpoint, the deep fibers of the TCL are firmly attached to the medial meniscus. The TCL, weaker than the FCL, is more often damaged. As a result, the TCL and medial meniscus are commonly torn during contact sports such as football and ice hockey.

The oblique popliteal ligament is a recurrent expansion of the tendon of the semimembranosus that reinforces the joint capsule posteriorly as it spans the intracondylar foss. The ligament arises posterior to the medial tibial condyle and passes superolaterally toward the lateral femoral condyle, blending with the central part of the posterior aspect of the joint capsule.

The arcuate popliteal ligament also strengthens the joint capsule posterolaterally. It arises from the posterior aspect of the fibular head, passes superomedially over the tendon of the popliteus, and spreads over the posterior surface of the knee joint. (3)

INTRA-ARTICULAR LIGAMENTS

The intra-articular ligaments within the knee joint consist of the cruciate ligaments and menisci. The popliteal tendon is also intra-articular during part of its course. (3)

The cruciate ligaments cross within the joint capsule of the joint but outside the synovial cavity. The cruciate ligaments are located in the center of the joint and cross each other obliquely, like the letter X. During medial rotation of the tibia on the femur, the cruciate ligaments wind around each other, so the amount of medial rotation possible is limited to about 10 degrees. (3)

It is the cruciate ligaments that maintain contact with the femoral and tibial articular surfaces during flexion of the knee. (3)

CRUCIATE LIGAMENTS

The two cruciate ligaments are in the intercondylar region of the knee and interconnect the femur and tibia. They are called cruciate (latin for shaped like a cross) because they cross each other in the sagittal plane between their femoral and tibial attachments:

- The anterior cruciate ligament attaches to a facet on the anterior part of the intercondylar area of the tibia, and ascends posteriorly to attach to a facet at the back of the lateral wall of the intercondylar fossa of the femur.
- The posterior cruciate ligament attaches to the posterior aspect of the intercondylar area of the tibia and ascends anteriorly to attach to the medial wall of the intercondylar fossa of the femur.

The anterior cruciate ligament crosses lateral to the posterior cruciate ligament as they pass through the intercondylar region. [3]

The anterior cruciate ligament prevents anterior displacement of the tibia relative to the femur and the posterior cruciate ligament restricts posterior displacement. [3]

The shorter and stronger PCL runs from the posterior intercondyloid area to the lateral surface of the medial condyle of femur in a superior, anterior direction. The PCL becomes tighter during increasing flexion. It prevents forward dislocation of the femur, backward dislocation of the tibia, and hyperflexion of the knee. [3][4][16]

Several other ligaments contribute to the integrity of the knee. The oblique and arcuate popliteal ligaments cross the knee posteriorly, and the transverse ligament connects the two menisci internally. Another restricting tissue is the iliotibial tract, a broad, thickened band of the fascia latae with attachments to the lateral condyle of the femur and the lateral tubercle of the tibia, which has been hypothesized to function as an anterolateral ligament of the knee. [4]

Figure 2. ACL and PCL [27]

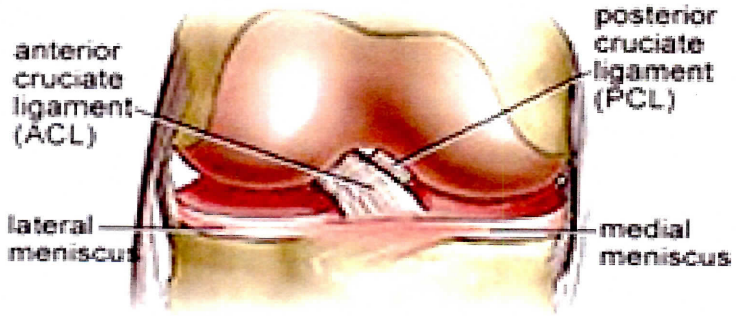
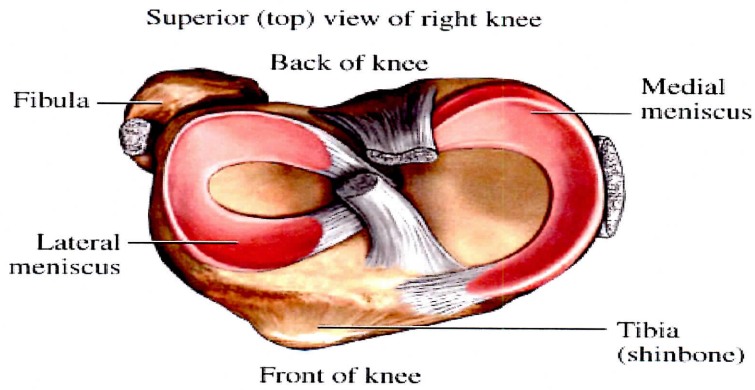


Figure 3. Menisci of the knee joint [20]



2.1.4. MENISCI

The menisci are two half-moon shaped fibro-cartilaginous discs firmly attached to the superior plateaus of the tibia by coronary ligaments and joint capsule (Figure 3). They are also joined to eachother by the transverse ligament.

The menisci deepen the articulating depressions of the tibial plateaus, adjusting the nonmatching surfaces of the tibial and femoral condyles and assist with absorption of force at the knee. The internal structure of the medial two-thirds of each meniscus is particularly well suited to resisting compression. [3][4]

The medial meniscus is semicircular in shape and is fused with the MCL. Its points of attachment are widely separated. The medial meniscus is wider posteriorly than anteriorly. Its attachment makes it far less mobile than the lateral meniscus. External rotation of the leg causes the greatest stress and on it, while internal rotation relaxes it. [16]

The lateral meniscus is almost circular, its points of attachment lie close together, and it is of uniform width. It is more mobile than the medial meniscus, as it does not fuse with the fibular collateral ligament, and therefore it is less stressed by the different movements. [16]

2.2. BIOMECHANICS AND KINESIOLOGY OF THE KNEE JOINT

2.2.1. MOVEMENTS OF THE KNEE JOINT

As mentioned above, the tibiofemoral joint has two degrees of freedom, and four movements; flexion, extension, internal and external rotations, with flexion and extension being the primary movements. [8]

Extension is defined as the movement of the posterior aspect of the leg away from the posterior surface of the thigh. During extension, injury to the knee is most likely to result in fractures of the articular surfaces and rupture of ligaments. [8]

Flexion is defined as the movement of the posterior aspect of the leg towards the posterior aspect of the thigh. During flexion, the knee is unstable and the ligaments and menisci are the most susceptible to injury. [8]

When the knee is about to be fully extended from a flexed position, a rotational movement occurs to lock the joint. This mechanism is called the "screw-home" mechanism. If this screw-home action takes place when the foot is not free, as in standing up, the femur is the bone that rotates medially in relation to the tibia until the knee is locked. If the action takes place when the foot is free, as when kicking a football, the tibia rotates laterally in relation to the femur. [8]

The screw-home mechanism occurs because the articular surface of the medial condyle is longer than that of the lateral condyle. As a result, the lateral condyle uses up its

articular surface just before full extension is realized. The completion of extension occurs as the medial condyle continues to rotate on its longer articular surface, accompanied by the screw-home action and the locking of the knee. During this final phase, the lateral condyle acts as a pivot. [3]

The unlocking of the extended knee is provided by the popliteus muscle, which rotates the tibia medially on the femur, enabling flexion to occur. As flexion proceeds, the femur must slide forward on the tibia to prevent rolling off the tibial plateaus. Likewise, the femur must slide backwards on the tibia during extension. [6]

Rotation of the leg around its long axis can only be performed with the knee flexed, and is enabled by the fact that the condyles of the femur are curved and the condyles of the tibia are flat. [3]

Internal rotation brings the toes to face medially and plays an important role in adduction of the foot. [8]

External rotation brings the toes to face laterally and also plays an important role in abduction of the foot. [8]

There is also a type of axial rotation called automatic because it is inevitably and involuntarily linked to movements of flexion and extension. It occurs especially at the end of extension or the start of flexion. When the knee is extended the foot is laterally rotated and when the knee is flexed the leg is medially rotated. [8]

2.2.3. RANGE OF MOTION

In the tibiofemoral joint, the range of motion is greatest by far in the sagittal plane. Motion in this plane from full extension to full flexion of the knee is from 0° to 140°. [8]

Motion in the transversal plane, internal and external rotation, is influenced by the position of the joint in the sagittal plane. With the knee in full extension, rotation is almost totally restricted by the locking of the joint. The range of motion increases as the knee is flexed, reaching a maximum at 90° flexion. With the knee in this position,

external rotation ranges from 0° to 45° and internal rotation from 0° to 30°. Beyond 90° knee flexion, the range of rotations decreases, mainly because the soft tissues restrict rotation. [8][14]

2.2.4. MUSCLES ACTING AT THE KNEE JOINT

Extensors of the knee:

The quadriceps femoris is the extensor muscle of the knee. It is a very powerful muscle consisting of the three vasti and the rectus femoris. It can shorten up to 8 cm when contracted, and develop force up to 42 kg weight. It is three times stronger than the flexors, as can be expected from the fact that it counteracts the effect of gravity. When the knee is locked in hyperextended position, the quadriceps is not required for maintainance of the erect posture, but as soon as flexion is initiated, the quadriceps contract so as to prevent a fall resulting from knee flexion. [6][8]

Flexors of the knee:

The flexors of the knee joint are the hamstring muscles – biceps femoris, semitendinosus, semimembranosus and the two muscles inserted to the medial aspect of the tibia – gracilis and sartorius. Gastrocnemius also weakly contributes to knee flexion. The total force produced by the flexors is equivalent to 15 kg weight, around one third of what is produced by the quadriceps. [6][8]

Rotators of the knee:

The flexors also act as rotators of the knee, and they are divided into two groups depending on their insertion. The biceps femoris and tensor fascia latae, which are inserted laterally, work as external rotators. Sartorius, semitendinosus, semimembranosus, gracilis and popliteus, which are attached medially, are internal rotators. The combined power of the medial rotators is 2 kg and is only a little greater than the power of the lateral rotators, which is 1.8 kg. [8]

Table 1. Overview of the muscles acting at the knee joint [19]

Movement	Degrees possible	Primary muscle movement	Secondary muscle movement	Factors limiting movement	Comments
Extension	-	Quadriceps femoris	Weakly: Tensor fascia latae	Anterior edge of lateral meniscus contacts shallow groove between tibial and patellar surfaces of femoral condyles; anterior cruciate ligament contacts groove in intercondylar fossa.	Ability of qudriceps to produce extension is most effective when hip joint is extended; flexion diminnishes its efficiency.
Flexion	120 degrees (hip extended); 140 degrees (hip flexed); 160 degrees passively	Hamstrings	Gracilis, sartorius, gastrocnemius, popliteus	Calf contacts thigh; length of hamstrings is also a factor – more knee flexion is possible when hip joint is flexed; cannot fully flex knee when hip is extended	Normally, role of gastrocnemius is minimal, but in presence of a supracondylar fracture, it rotates (flexes) distal fragment of femur
Medial rotation	10 degrees with knee flexed; 5 degrees with knee extended	Semitendinosus and semimembranosus when knee is flexed; popliteus when non-bearing knee is extended	Gracilis, sartorius	Collateral ligaments, loose during flexion without rotation, become taut at limits of rotation	When extended knee is bearing weight, action of popliteus laterally rotates femus; when not bearing weight; popliteus medially rotates patella
Lateral rotation	30 degrees	Biceps femoris when knee is flexed	-	Collateral ligaments become taut; anterior cruciate ligament becomes wound around posterior posterior cruciate ligament	At the end of rotation, with no oppositio, tensor latae can assist in maintaining position

2.2.5. LOADS ON THE KNEE JOINT

Because the knee joint is located between the two longest levers of the body, the femur and tibia, the potential for torque development at the joint is large. The knee is also a major weight-bearing joint. [6]

The knee joint is loaded in both compression and shear during daily activities. Weight bearing and tension development in the muscles crossing the knee contribute to these forces, with compression dominating when the knee is fully extended. [6]

Compressive forces at the knee joint are slightly greater than three times body weight during the stance phase of walking, increasing up to around four times body weight when walking up stairs. The medial tibial plateau bears most of this load during stance when the knee is extended, with the lateral tibial plateau bearing more of the much smaller loads imposed during the swing phase. Since the medial tibial plateau has a surface area around 60% larger than that of the lateral tibial plateau, the stress acting on the joint is less than if peak loads were distributed medially. The fact that the articular cartilage on the medial plateau is three times thicker than that on the lateral plateau also helps protect the joint from wear. [6]

The menisci act to distribute loads at the knee joint over a broader area, thus reducing the extent of joint stress. The menisci also assist with force absorption at the knee, bearing as much as an estimated 45% of the total load. [6]

As knee flexion occurs and the angle at the joint increases to 90%, the shear component at joint force produced by weight bearing increases. Shear at the knee, which causes a tendency for the femur to displace anteriorly on the tibial plateaus, must be resisted by the ligaments and other supportive structures crossing the knee. Since these structures can be stretched or even ruptured under such stress, activities like deep knee bends and full squats that require load bearing during extreme knee flexion are not recommended. [6][14]

2.3. GONARTHROSIS

2.3.1. GENERAL ABOUT ARTHROSIS

Arthrosis, also known as osteoarthritis, is the most common chronic form of arthritis. Arthrosis is often called "wear-and-tear arthritis". Arthrosis is the most prevalent in the aged and is probably related to the normal aging process. More women than men are affected. [11]

Arthrosis is a complex phenomenon involving physical and metabolic factors. In a joint, the cartilage covers the end of the bone and plays a role in the mobility of the joint with minimal friction. The cells are replaced at the same rhythm as they are destroyed. The joint thus preserves all its mobility capacities.

When the cells are replaced more slowly than they are destroyed, and/or the physical load, such as shocks or repeated friction, are too significant, the metabolic balance of the joint becomes deregulated. Wear of the cartilage then starts with cracks which gradually deepen until actual holes are formed (ulcerations). The bone can be completely bare in places and the bone surfaces come into direct contact with each other.

The phenomenon tends to auto-amplify (the magnitude of the problem increases automatically). It results in a painful limitation of joint mobility: the joint becomes stiffer and stiffer. The pain associated with arthrosis occurs when the joint is used and calms down when at rest. Certain inflammatory forms are nevertheless also painful at night. Arthrosis can affect all the joints in the body but is most often seen in the knees, hands, spinal column and hips. It is favoured by physical or hereditary factors, by age or by obesity.

More specifically, G*onarthrosis* is chronic wear of the cartilage in the knee joint. It can be situated in several places: between the femur and the tibia (internal or external

femorotibial arthrosis), between the femur and the patella or kneecap (femoropatellar arthrosis) or between the femur, tibia and kneecap (global arthrosis).

When the axis of the knees is not perfectly horizontal (bow legs or knock-knees), the pressure exerted by body weight is not distributed evenly at the level of the joint. Certain parts of the articular surfaces rub more than others and the cartilage wears down and deteriorates.

Excess weight is an evident risk factor for gonarthrosis, but it can also occur following a past history of trauma such as a fracture or serious sprain with torn ligaments. [12][13]

2.3.2. PATHOPHYSIOLOGY

What is commonly known about arthrosis is that it affects primarily the articular cartilage of synovial joints. But pathophysiologic changes occur also in the synovial fluid, the subchondral bone and the overlying joint capsule. [12]

Normal joints release enzymes that break down the articular cartilage. In the early degenerative process of arthrosis, increased amounts of the enzymes are released, without anyone knowing the exact reason for this, and various metalloproteinases occur. These proteinases are involved in the excessive matrix degradation that characterizes cartilage degeneration in arthrosis. [2][12]

The cartilage-forming cells (chondrocytes) replicate in an attempt to build up new cartilage, but are unable to do so, and the underlying bone becomes exposed as increasing area of the bone is deprived of cartilage. [13][23]

As the disease progresses, the exposed bone tissue thickens and forms bony spurs (ostephytes) in the periphery of the bone, that enlarge the bone ends and may restrict joint movement. The subchondral bone in the middle of the bone becomes sclerotic. [13][23]

The change seen in the synovial fluid in a joint affected by arthrosis is characterized by reduced production by the synovial cells that make up the synovial membrane. That means that the synovial fluid will have less content of the major component, hyaluronic acid, and more water content because of inflammation, especially in later stages of the disease. Since the amount of real synovial fluid will be decreased, the cartilage will receive less nutrition and the viscosity needed to absorb shock from movements will be decreased. [23]

Since cartilage itself is not innervated, the pain is presumed to arise from a combination of mechanisms, including the following:

- Osteophytic periosteal elevation
- Vascular congestion of subchondral bone, leading to increased intraosseous pressure
- Synovitis with activation of synovial membrane nociceptors
- Fatigue in muscles that cross the joint
- Overall joint contractures [2] [23]

2.3.3. CLINICAL SYMPTOMS AND HOW TO DIAGNOSE GONARTHROSIS

The clinical symptoms of gonarthrosis are pain, stiffness and swollen joint. The affected joint may make a crunching noise as they move. This sound, called crepitus, results as the roughened articular surfaces rub together. [11]

Cartilage erosion is evaluated by x-ray pictures, but it is not always so that x-ray findings and symptoms appear at the same time. There is no clear connection between the degree of gonarthrosis seen by x-ray and the pain or other symptoms. [7][13][23]

Physical examination findings early in the disease process include the following:

- Join may appear normal
- Gait may be antalgic if weight-bearing joints are involved

Later in the disease process, physical examination findings may include the following:

- Visible osteophytes

- Warm joint
- Palpable osteophytes
- Decreased ROM because of bony restrictions and/or soft tissue contractures
- Crepitus [23]

2.3.4. TREATMENT OPTIONS

PHARMACOLOGICAL OPTIONS:

Medicines for arthrosis patients are divided into 4 groups;

1. Analgetics (painkillers)

   This type of medications can alleviate the pain present with arthrosis, but doesn not decrease stiffness. They are divided in two main gropus;

   a) Paracetamol containing drugs

      Paracetamol can be used in normal dosages by most patients, also in heart or intestinal disease. If decreased liver-function is present in the patient, use of paracetamol must be carefully discussed with medical doctor. Paracetamol can be combined with other drugs used for arthrosis.

   b) Stronger analgetics (morphine-similar) drugs

      Only for use over shorter periods of time and there were other drugs have had not sufficient effect. Risk of addiction. [19]

2. Antiinflammatory drugs (antiflogistics) (NSAID's) (Voltaren, Diclofenac)

   These drugs can both alleviate pain and other inflammation related problems such as stiffness and swelling/oedema.

   Side effects: stomach ulcer. Oedemas, increased blood pressure. Should not be used with heart disease or decreased kidney function. [19]

3. Glucosamine

   Some studies have shown that glucosamine can reduce arthrotic pain, especially by/with gonarthrosis. Usually the treatment is ended after 3 months if no effect is seen. [19]

4. Cortisone, injections

   Cortisone injections can sometimes be an alternative, especially if there is a great inflammation in the joint. Administered into the joint by medical doctor. (19)

SURGICAL OPTIONS

The last 4 options depend on the location and severity of the arthrosis.

1. Total knee arthroplasty; used when severe degeneration of the joint is present.
2. Arthroscopic debridement; removal of loose bodies from the joint.
3. Cartilage transplantation; for small, isolated areas. Autologous cartilage can be grafted into the defect.
4. Osteotomies of the distal femur or proximal tibia; used when the degeneration is limited to the lateral or medial compartment of the joint.
5. Unicompartmental knee arthroplasty; can be performed for isolated lateral or medial compartment arthrosis. (15)

2.4. TOTAL KNEE REPLACEMENT

2.4.1. INTRODUCTION

The most common indication for total knee replacement is osteoarthritis, or degenerative joint disease. The end stage of osteoarthritis is wearing out of cartilage (smooth, gliding bone ends) resulting in bone-to-bone contact in diseased joints. It is progressive and becomes increasingly painful as the cartilage erodes. Younger people who get knee replacements have damaged their joints by trauma (accidents that destroy joint surfaces), infection, cancer or tumor, or inflammatory conditions as rheumatoid arthritis.(3)

The patients can normally choose between two types of anaesthesia when they go through an operation (spinal anaesthesia or epidural anaesthesia). Spinal anaesthesia is however the most commonly used for patients undergoing total knee replacement surgery. The first thing that the surgeon will do is to make a midline incision alongside of the patella to surgically expose the joint. The incision is made under tourniquet control. Once the joint is fully exposed he or she will start working on cutting the bones

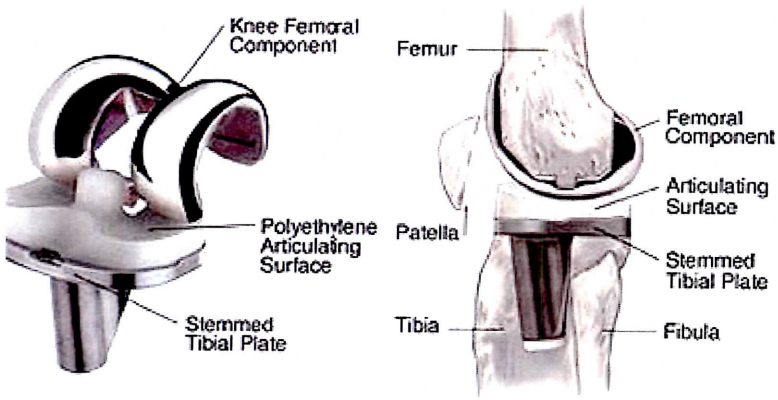
so that the prosthesis parts will fit perfectly. The surgeon will normally start working on the head of femur and then move on to cutting the tibia. [3]

2.4.2. TKR COMPONENTS

In TKR, the surfaces of the distal femur, proximal tibia and, sometimes, the patella are replaced. This is performed with a femoral component and a tibial base plate made of a metal, usually cobalt-chromium or titanium. The tibial component has a polyethylene plastic piece that is fixed to the metal base plate and articulates with the femur (figure 4). The undersurface of the patella is replaced with polyethylene.

The components are held in place with cement (cemented) or a rough coating on the surface of the component into which bone can grow (non-cemented).[15]

Figure 4. TKR Component (23)



2.4.3. THE SURGERY PROCEDURE

The procedure of TKR uses the following steps:

1. **Accessing the knee joint**:

   An incision is made on the front of the knee to allow access to the knee joint.

2. **Femoral resection**:

   After exposure of the knee joint, releasing of the soft tissues and positioning of the knee joint into flexion, a special cutting jig is placed on the end of the femur. This jig is used to make sure that the bone is cut in the proper alignment to the leg's original angles, even if the degeneration of the joint has caused valgus or varus position. The jig is used to cut several pieces of bone from the

distal femur so that the artificial knee can replace the worn surfaces with a metal surface.

3. **Tibial resection:**

   The top of the tibia is cut using another jig that ensures the alignment is satisfactory. Corrective setting into varosity or valgosity is used only in the case of extraordinary anatomic conditions – congenital defects, posttraumatic cases or revisions.

4. **Patellar resection:**

   The undersurface of the patella is removed. This step is used only in case it is necessary to change also the articular surface of patella, depending on degree of degeneration.

5. **Placing the Femoral Component**:

   The metal femoral component is placed on the femur. The metal prosthesis is cut so that it matches the taper almost exactly. With a cemented femoral component, an epoxy cement is used to attach the metal prosthesis to the bone.

6. **Placing the Tibial Components**:

   The metal tray that will hold the polyethylene spacer is attached to the top of the tibia. The metal tray is cemented into place. The plastic spacer is then attached to the metal tray of the tibial component. If this component wears out while the rest of the artificial knee is sound, it can be replaced.

7. **Placing the Patellar Component**:

   A patella button is sometimes cemented into place behind the patella depending on the degree of arthritis.

8. **The artificial knee replacement is now complete**.

9. **Closing the incision**.

3. SPECIAL PART

3.1. METHODOLOGY

3.1.1. SPECIFICATION OF STUDY

Clinical study of patient after total knee replacement.

The patient is a woman born in 1928 with the diagnosis gonarthrosis and state after total knee replacement.

3.1.2. TIME AND PLACE

Revmatologický Ústav in Albertov, Prague. Between the 2th and 13th of February 2009.

3.1.3. DIAGNOSTIC METHODS

- Aspection
- Postural examination
- Muscle palpation
- Gait examination
- Transfer and ADL examination
- Range of motion (ROM) examination
- Anthropometric measurements
- Strength testing
- Manual Muscle testing by Kendall [9]

3.1.4. THERAPEUTIC METHODS

- Conditional thromboembolic preventive exercises
- Exercises in ROM
- Isometric strengthening exercises
- Isotonic strengthening exercises
- Stretching exercises
- PIR technique by Lewit [10]
- Soft tissue techniques for scar treatment

3.1.5. DIAGNOSTIC TOOLS

- Goniometer
- Measuring tape
- Neurological hammer

3.1.6. THERAPEUTIC TOOLS

- Motomed (Motodlouha)
- Overball
- Soft balls with bumps
- Balance board

3.2. ANAMNESIS

PERSONAL INFORMATION

The patient is Z.R., female, born in 1928.

DIAGNOSIS

M17.1 Primary gonarthrosis, unilateral, left side. Status after TKR.

MAIN COMPLAINT

Decreased ROM of left knee joint, pain and swelling after total knee replacement surgery.

HISTORY OF PRESENT PROBLEM

- Operation was carried out 4.12.
- Hypertension was seen in the postoperative period.
- Rehabilitative stay in RU from 10.12. to 23.12.
- For early infection it was used antibiotics and warfarin.
- She had a period with nausea and vomiting, from 24. to 28.12.
- ATB planted, to improve the situation.
- For continued elevation of inflammatory parameters and local signs of infection she was transferred to orthopedic clinic Motol. After treatment here for 16 days she was improving, and transferred back to the RU rehabilitation.

SOCIAL ANAMNESIS

-retired

- lives alone in a flat.
- three children, does not live with her anymore.

FAMILY ANAMNESIS

- Her son has rheumatoid arthritis

ALLERGIES

- none

ABUSES

- no smoking
- occasional alcohol and coffee drinking

3.3. STATEMENT FROM PATIENT'S MEDICAL DOCUMENTATION

- Was unfortunately not available at the time.

3.4. ORTHOPEDIC DOCTORS INDICATION OF REHABILITATION

- breathing exercises.

-thromoembolic preventive exercises

- active exercises in bed.

- walking on high walker.

3.5. PRESENT STATE AT INITIAL KINESIOLOGIC EXAMINATION

2.2.2009

- height: 162 cm
- weight: 56 kg
- BMI: 21
- blood pressure 140/80
- pulse 60/min

The patient is 7 weeks after operation, but because of infection she has not had the chance to do any rehabilitation for the TKR until now.

She is walking with forearm crutches.

She has no pain when during ADL, or during the day in general, but sometimes feels pain during the night.

3.6. INITIAL KINESIOLOGIC EXAMINATION

Date: 2.2.2009

ASPECTION

Left side:

- edema of knee, calf and ankle

Right side:

- slight edema of knee

CONCLUSION:

Edema of left knee, calf and ankle and right knee. Edema of right knee is less significant.

POSTURAL EXAMINATION

- postural examination is done with forearm crutches.

Anterior:

- varosity of both knees, giving her a bow-legged appearance
- she leans forward on the crutches, needs to be educated in correct positioning.
- she leans slightly to the right side, without rotation of the spine or hip.
- she has normal tonus on the muscles of her back, and no marked deviations.

Posterior:

- right ankle has less significant varosity

Lateral:

- hyperextension of right knee
- semiflexion of left knee
- plantar flexion of left foot

CONCLUSION:

Patients posture with the crutches needs to be adjusted. With time, when the patient gains more strength and balance, she will be educated in correct standing posture.

MUSCLE PALPATION

Table 2. Muscle palpation

	Right side	Left side
Tensor fascia latae	Slight hypertonus in distal part	Hypertonus in distal part
Quadriceps*	Normal tonus	Slight hypotonus, mostly in medial part
Hamstrings*	Slight hypotonus, less than on left side	Hypotonus, especially in lateral part
Triceps surrae*	Normal tonus	General hypotonus
Gluteus maximus	Normal tonus	Hypotonus

(*m. quadriceps femoris from medial to lateral; m. vastus medialis, m. rectus femoris, m. vastus intermedius and m. vastus lateralis)

(*hamstring group from medial to lateral; m. semimembranosus, m. semitendinosus and m. biceps femoris)

(* m. triceps surae from deep to superficial; m. plantaris, m. gastrocnemius, medial and lateral heads)

CONCLUSION:

The palpated muscles of the left side has a generally lower tonus than on the right side.

GAIT EXAMINATION

- she is using forearm crutches during the gait examination.
- walking on flat surface is stabile but slow. Leaning excessively on the crutches
- walking up and down stairs is slow, but she is determined, and knows the routine in which order to place the crutches and legs
- this means a routine of 3 phases: first crutches, then operated leg and last healthy leg

CONCLUSION:

Her walking is good, but still slow. She leans too much forward on the crutches, and needs education in straightening the back more during the walking.

TRANSFER AND ADL EXAMINATION

- she can sit, walk and stand without help, but with crutches
- she is able to do all transfer activities alone
- all ADL can be performed by the patient alone

CONCLUSION:

Patient is independent.

ROM EXAMINATION BY GONIOMETER

Hip joint:

Table 3. ROM examination by goniometer, initial, hip joint

	Right side		Left side	
	Active	Passive	Active	Passive
Flexion w/flexed knee	100°	115°	90°	100°
Extension	10°	10°	10°	10°
Abduction	40°	45°	30°	35°
Adduction	10°	10°	5°	5°
External rotation	40°	40°	30°	35°
Internal rotation	25°	30°	25°	30°

Knee joint:

Table 4. ROM examination by goniometer, initial, knee joint

	Right side		Left side	
	Active	Passive	Active	Passive
Flexion	110°	120°	65°	75°
Extension	0°	0°	5° flexion	5° flexion

Ankle joint:

Table 5. ROM examination by goniometer, initial, ankle joint

	Right side		Left side	
	Active	Passive	Active	Passive
Plantar flexion	45°	45°	40°	45°
Dorsal flexion	20°	20°	15°	20°
Inversion	35°	40°	30°	35°
Eversion	20°	20°	20°	20°

CONCLUSION:

The most marked difference from the norm is the flexion of the left knee. This is because of the operation, the knee is stiff, and needs increasing in ROM.

She cannot fully extend the left knee, release of tight muscles is needed.

Hip also has some restrictions, mostly on the left side, but not as marked as on the knee.

ANTROPOMOTORIC MEASUREMENTS

Length:

Table 6. Length measurements, initial

	Right side in cm	Left side in cm
Anatomical length	81	82
Functional length	77	78
Length of thigh	43	44
Length of calf	37	38

Circumferences:

Table 7. Circumferences measurements, initial

	Right side in cm	Left side in cm
Thigh, 15 cm above patella	43	44
Thigh, 10 cm above patella	41	42
Knee joint	42	44
Calf	33	34

CONCLUSION:

The length measurements shows that the left is slightly longer on the left side.

The circumferences measurement shows general higher circumferences of left leg, this is due to oedema.

STRENGTH EXAMINATION

Orientational testing, upper extremities:

Table 8. Orientational testing of upper extremities, initial

	Right side	Left side
Flexion	Normal strength	Normal strength
Extension	Normal strength	Normal strength
Abduction	Normal strength	Normal strength
Adduction	Normal strength	Normal strength
Internal rotation	Dcreased strength	Decreased strength
External rotation	Normal strength	Normal strength

Manual muscle testing of lower extremities, according to Kendall:

Table 9. Manual muscle testing of lower extremities, initial

	Right side	Left side
Quadriceps femoris	5	3
Hamstring group	5	2
Iliopsoas	5	4
Gluteus maximus	5	3
Abductors	4	3
Adductor group	4	4
Triceps surae	5	4

CONCLUSION:

The strength on the right side is mostly normal, while the left side is weaker, as a result of the operation on that side.

CONCLUSION OF INITIAL KINESIOLOGIC EXAMINATION:

The patient is independent and can perform all ADL by herself. Her walking is stabile, needs some education still in walking in stairs. The muscles of the left lower extremity has generally lower tonus than on the right leg. ROM of left lower extremity are decreased, mostly on the left side, and especially in the knee joint. Length measurements of lower extremities show that they are similar in length. Measuring of circumferences are higher around left thigh, knee and ankle joints. Strength testing of upper extremities shows that she is strong. Manual muscle testing of lower extremities shows generally decreased strength of the left lower extremity.

3.7. SHORT-TERM AND LONG-TERM REHABILITATION PLAN

Goals of short-term plan:

- increase ROM of the knee
- increase strength of muscles important for stability of the knee, correct loading, and walking with crutches

- decrease tension of muscles
- improve scar mobility
- increase sensomotor input
- increase stability and balance
- decrease pain

Short-term plan:

- education of walking with crutches
- Motomed machine (Motodlaha)
- passive exercises in ROM
- muscle strengthening exercises, isometric and isotonic
- PIR technique by Lewit
- stretching exercises
- soft tissue techniques
- sensomotoric stimulation
- stabilisation and balance training

Goals of long-term plan:

- increase general strength and condition of patient
- continued increase of stability
- activation of deep stabilisation system
- educate the patient in how to live with her new knee

Long-term plan:

- continued exercises, educate the patient in exercises she can do at home
- exercises on unstabile surfaces
- exercises on gymball
- education of patient

3.8. DAY-TO-DAY THERAPY

3.8.1. SESSION ONE

Date: 2.2.09

Pain today on a scale from 1-10: 2

Goal of today's therapy unit:

- anamnesis and initial kinesiological examination
- conditional exercises for thromboembolic prevention
- education in walking
- increase ROM of knee, flexion
- strengthening of lower extremities
- scar treatment

Procedure:

- anamnesis and initial kinesiologic examination.
- education in walking. We started by walking from her room to the exercise room, which includes walking down 2 sets of stairs. She gets instructions on how to place the crutches; in walking on a flat surface she places crutches first, then operated leg, then healthy leg. The same order goes when walking down the stairs. She leans forward and has little flexion in her knees, and is educated to straighten her back more, and flex the knees more in her walking.
- soft tissue techniques for the operation scar on her left knee. This is done with gloves and a cream, for better movement of the skin. The scar is slightly pulled in opposite directions, both vertically and horizontally. Then the scar is pressed towards each other, in an S-shape. This is to increase blood flow to the scar, and improve mobility.
- conditional exercises
    - alternately up and down movements with forefeet and toes
    - circles with forefeet
    - breathing exercises
    - circles with upper extremities in flexion and extension
    - alternate flexion of knees
- active and passive flexion and extension of knee, according to subjective feeling of patient
    - in supine position

- strengthening exercises for lower extremities
    - isometric and isotonic exercises
    - in supine position:
    - The quadriceps are strengthened in a sitting position, with knees over the edge of the bench, and holding on to the bench. The exercise is extension of the knee against pressure from my hand, which is above her ankle, in direction of flexion. This is performed 10 repetitions, 2 times, on both legs.
    - Next exercise is for strengthening of the hamstrings, in a prone position. The exercise is flexion of the knee against slight pressure from my hand, on her ankle in the direction of extension. This is done 10 repetitions, 2 times, on each leg.
    - The gluteal muscles are next to be strengthened, in prone position. Isomentric contraction is used, telling the patient to contract the gluteal muscles, and relax. This is done 20 times, followed by a small break, then 20 more times.
    - resisted flexion of hip with flexed knee with alternate resisted extension of hip and knee
- PIR of hamstrings

-To begin with the patient is in prone position, knee in slight flexion. I tell the patient to give resistance to my hand, which gives slight pressure to the ankle in the direction of knee flexion. Then I tell her to breathe in, hold the breath for a few seconds, then breathe out and relax. This relaxation will increase her range of motion in knee flexion, into the next restriction. This is repeated 3 times.

- After this, there is walking back to her room , which includes upstairs walking. She is educated to put the non-operated leg on the stair first, then the operated, and finally the crutches.
- At her room, the final exercise for the day using the motomed (motodlouha). This is a machine where you can place one of the legs inside, adjusting fit to the leg and foot, and adjust the degrees of flexion and extension. The machine will then move the leg automatically into flexion and extension at the preferred degrees. She used this for 30 minutes, the flexion was set to 75 degrees flexion, 0 degrees extension.

Results:

Patient is active and willing to cooperate during taking anamnesis and kinesiological examination.

All exercises are understood and the patient is very cooperative. She does not complain of any pain, and shows good form.

Self-therapy:

She will do walking exercises and Motomed again in the afternoon.

3.8.2. SESSION TWO

Date: 3.2.09

Pain today on a scale from 1-10: 2

Patient slept well last night and is in a good mood.

Goal of today's therapy unit:

- thromboembolic prevention
- increase ROM of knee, flexion
- strengthening of lower extremities
- education in walking
- scar treatment

Procedure:

-soft tissue techniques for the operation scar on her left knee. This is done with gloves and a cream, for better movement of the skin. The scar is slightly pulled in opposite directions, both vertically and horizontally. Then the scar is pressed towards each other, in an S-shape. This is to increase blood flow to the scar, and improve mobility.

- conditional exercises for thromboembolic prevention
- active and passive flexion and extension of knee
- strengthening exercises for lower extremities
- PIR technique (according Lewit) to decrease tension
    - m. quadriceps femoris, right and left side
    - hamstrings: right and left side
- walking education
    - continued walking from and to her room, both on flat surface, and up and down stairs.
- Motomed; flexion 80°, extension 0°, 30 min

Results:

All exercises are well tolerated and understood by the patient. PIR technique gives slight release of muscles, especially of the m. quadriceps, left side. Walking education is

important to show the patient several times, to educate her to try to bend her knees properly, to step down on the 3 points in her feet, and have correct order of crutches and feet.

Self-therapy:

She will do walking exercises and Motomed again in the afternoon.

3.8.3. SESSION THREE

Date: 4.2.09

Pain today on a scale from 1-10: 2

The patient has just eaten, and is in a good mood.

Goal of today's therapy unit:

- thromboembolic prevention
- increase ROM of knee, flexion
- strengthening of lower extremities
- decrease of tension
- increase sensomotor input from feet
- show patients some exercises for relief of lumbar back
- scar treatment
- education in walking

Procedure:

- soft tissue techniques for the operation scar on her left knee.
- conditional exercises for thromboembolic prevention
- active and passive flexion and extension of knee
- strengthening exercises for lower extremities
- PIR technique (according Lewit) to decrease tension and TrP's
    - m. quadriceps femoris
    - hamstrings
- sensomotoric stimulation of feet
    - with a small ball with bumps
- walking education

-continued education on flat surface, and up and down stairs

- correct walking up stairs: 1. healthy leg 2. operated leg 3. crutches
- correct walking down stairs: 1. crutches 2. operated leg 3. healthy leg

- Motomed; flexion 80°, extension 0°, 30 min

Results:

Self-therapy:

She will do walking exercises and Motomed again in the afternoon.

3.8.4. SESSION FOUR

Date: 5.2.09

Pain today on a scale from 1-10: 2

The patient is in a good mood, she has slept and eaten well.

Goal of today's therapy unit:

- thromboembolic prevention
- activation of abdominal muscles
- increase ROM of knee, flexion
- increase strength of lower extremities
- release of tension
- release of lumbar fascia and muscles
- increase sensory input from feet
- scar treatment

Procedure:

- breathing exercises
- conditional exercises for thromboembolic prevention
- passive flexion and extension of knee
- strengthening exercises for upper extremities
- strengthening exercises for lower extremities
- PIR for lower extremities
    - m. triceps surae
    - hamstrings
    - m. quadriceps

- PIR and soft tissue techniques with balls for lumbar spine/fascia because patient complains of low back-pain
- sensomotoric stimulation of feet
- Motomed; flexion 85°, extension 0°, 30 min

Results:

All exercises are performed and tolerated without problems. Activation of abdominal muscles can be felt during breathing exercises.

PIR technique releases tension slightly.

The patient likes the techniques for his lumbar back pain and says that he feels release.

The patient is very motivated by the daily increase in flexion degrees when using the Motomed, and is so far very satisfied with his progression.

Self-therapy:

She will do walking exercises and Motomed again in the afternoon.

3.8.5. SESSION FIVE

Date: 6.2.09

Pain today on a scale from 1-10: 2

She is in a good mood today.

Goal of today's therapy unit:

- thromboembolic prevention
- activation of abdominal muscles
- increase ROM of knee, flexion
- increase strength of upper extremities
- increase strength of lower extremities
- release of tension in lower extremities
- increase sensory input from feet
- balance exercises to improve stability
- education of walking

Procedure:

- conditional exercises for thromboembolic prevention
- breathing exercises
- passive flexion and extension of knee
- exercises for strengthening upper extremities

- exercises for strengthening lower extremities
- PIR for lower extremities
- sensomotoric stimulation of feet
- Motomed, 90° flexion, 0° extension, 30 min
- education of walking

Results:

90° was tried with the Motomed, but she felt a little uncomfortable, so tomorrow 85° will be tried again.

Self-therapy:

She will do walking exercises and Motomed again in the afternoon.

3.8.6. SESSION SIX

Date: 9.2.09

Pain today on a scale from 1-10: 2

The patient is in a good mood, and feels rested.

Goal of today's therapy unit:

- thromboembolic prevention
- activation of abdominal muscles
- improve mobility and trophy of the scar
- increase ROM of knee, flexion
- increase strength of upper extremities
- increase strength of lower extremities
- release of tension in lower extremities
-increase sensation in feet
- balance exercises for improving stability

Procedure:

-scar treatment
- conditional exercises for thromboembolic prevention
- breathing exercises
- strengthening exercises for lower extremities
- PIR of lower extremities
-rolling a small ball with bumps on the soles of the patient, to activate sensation
-balance exercise

-patient is in supine, with bent knees, soles of the feet on the table. She is given slight pushes in lateral and medial directions to the knee, and is told to try to keep the knees in position.

- Motomed, 85° flexion, 0° extension, 30 min.

Results:

The Motomed had to be adjusted back to 85° today, as she felt 90° was too much yet. All other exercises are well tolerated.

Self-therapy:

She will do walking exercises and Motomed again in the afternoon.

3.8.7. SESSION SEVEN

Date: 10.2.09

Pain today on a scale from 1-10: 2

She feels good today, says that pain is very minimal, and mainly when laying down for longer periods of time.

Goal of today's therapy unit:

- thromboembolic prevention
- activation of abdominal muscles
- improve mobility and trophy of the scar
- increase ROM of knee, flexion
- increase strength of upper extremities
- increase sensomotor input from feet

Procedure:

-scar treatment

- breathing exercises
- conditional exercises for thromboembolic prevention
- strengthening exercises for upper extremities
- passive flexion and extension of knee
- increase sensation in feet
- balance exercise

-patient is in supine, with bent knees, soles of the feet on the table. She is given slight pushes in lateral and medial directions to the knee, and is told to try to keep the knees in position.

- Motomed, 90° flexion, 0° extension, 30 min.

Results:

Everything is well tolerated by the patient. No complains about pain, and she shows good progress.

The Motomed was back to 90° today, and was well tolerated this time.

Self-therapy:

She will do walking exercises and Motomed again in the afternoon.

3.8.8. SESSION EIGHT

Date: 11.2.09

Pain today on a scale from 1-10: 2

She is rested, and in a good mood.

Goal of today's therapy unit:

- thromboembolic prevention
- activation of abdominal muscles
- improve mobility and trophy of the scar
- increase ROM of knee, flexion
- increase strength of upper extremities
- increase strength of lower extremities
- increase sensomotor input from feet
- increase stability

Procedure:

- breathing exercises
- conditional exercises for thromboembolic prevention
- soft tissue techniques for the scar
- passive and active flexion and extension of the knee
- strengthening exercises for upper extremities
- strengthening exercises for lower extremities
- PIR for lower extremities
- sensomotoric stimulation of feet
- balance exercise

- patient is in supine, with bent knees, soles of the feet on the table. She is given slight pushes in lateral and medial directions to the knee, and is told to try to keep the knees in position.

-a balance board was placed under her left foot, while she was sitting at the bed. She was then given slight pushes to the sides of her knee, which she was supposed to resist, to get rhythmic stabilization.

- Motomed, 90° flexion, 0° extension, 30 min.

Results:

All exercises are well tolerated. It seems like the patient has improved her strength.

A new balance exercise was used today, the patient had some trouble to begin with, but she got used to it after a while, and managed it well.

Self-therapy:

She will do walking exercises and Motomed again in the afternoon.

3.8.9. SESSION NINE

Date: 12.2.09

Pain today on a scale from 1-10: 2

She slept well, and says she doesn't feel much pain today.

Goal of today's therapy unit:

- thromboembolic prevention
- activation of abdominal muscles
- improve mobility and trophy of the scar
- increase ROM of knee, flexion
- increase strength of upper extremities
- increase strength of lower extremites
- increase sensomotor input from feet
- increase stability
- scar treatment

Procedure:

- breathing exercises
- conditional exercises for thromboembolic prevention
- scar treatment

- passive and active flexion and extension of the knee
- strengthening exercises for upper extremities
- strengthening exercises for lower extremities
- PIR for lower extremities
- sensomotoric stimulation of feet
- balance exercise
    - patient is in supine, with bent knees, soles of the feet on the table. She is given slight pushes in lateral and medial directions to the knee, and is told to try to keep the knees in position.

    -a balance board was placed under her left foot, while she was sitting at the bed. She was then given slight pushes to the sides of her knee, which she was supposed to resist, to get rhythmic stabilization.
- Motomed, 95° flexion, 0° extension, 30 min

Results:

The patient managed the exercises well. She has great enthusiasm, which makes progress better both for her and for me.

Self-therapy:

None

3.8.10. SESSION TEN

Date: 13.2.09

Pain today on a scale from 1-10: 2

This is the last day of the therapy, as well as final kinesiologic examination.

Goal of today's therapy unit:

- final kinesiological examination
- thromboembolic prevention
- activation of abdominal muscles
- scar treatment
- increase ROM of knee, flexion
- increase strength of upper extremities
- increase strength of lower extremites

- increase sensomotor input from feet
- increase stability

Procedure:

- breathing exercises
- conditional exercises for thromboembolic prevention
- scar treatment
- passive and active flexion and extension of the knee
- strengthening exercises for upper extremities
- strengthening exercises for lower extremities
- PIR for lower extremities
- sensomotoric stimulation of feet
- balance exercise
    - patient is in supine, with bent knees, soles of the feet on the table. She is given slight pushes in lateral and medial directions to the knee, and is told to try to keep the knees in position.

    -a balance board was placed under her left foot, while she was sitting at the bed. She was then given slight pushes to the sides of her knee, which she was supposed to resist, to get rhythmic stabilization.

- Motomed, 100° flexion, 0° extension, 30 min

Results:

All exercises are well tolerated and performed in a good way.

Final kinesiological examination is performed without problems, the patient cooperates and the results are satisfactory.

Self-therapy:

None

3.9. FINAL KINESIOLOGIC EXAMINATION

Date: 13.2.2009

3.9.1. ASPECTION

Left side:

- edema of knee, calf and ankle has decreased

Right side:

- slightly less edema of knee

CONCLUSION:

Edema has decreased on both sides.

3.9.2. POSTURAL EXAMINATION

- postural examination is evaluated with forearm crutches.

Anterior:

- varosity of both knees, giving her a bow-legged appearance.

- she leans forward on the crutches sometimes, but is more aware of it, and corrects it herself.

-she leans slightly to the right side, without rotation of the spine or hip.

-she has normal tonus of the muscles of her back, and no marked deviations.

Posterior:

- right ankle has less significant varosity.

Lateral:

- hyperextension of right knee
- semiflexion of left knee
- plantar flexion of left foot

CONCLUSION:

Posture is better than when these sessions started, as she has now been educated, and had some time to practice it.

3.9.3. MUSCLE PALPATION

Table 10. Muscle palpation, final

	Right side	Left side
Tensor fascia latae	Slight hypertonus in distal part	**Normal tonus**
Quadriceps*	Normal tonus	**Normal tonus**
Hamstrings*	Slight hypotonus, less than on left side	Hypotonus, especially in lateral part
Triceps surae*	Normal tonus	General hypotonus

(*m. quadriceps femoris from medial to lateral; m. vastus medialis, m. rectus femoris, m. vastus intermedius and m. vastus lateralis)

(*hamstring group from medial to lateral; m. semimembranosus, m. semitendinosus and m. biceps femoris)

(* m. triceps surae from deep to superficial; m. plantaris, m. gastrocnemius, medial and lateral heads)

CONCLUSION:

The tonus on the left side has improved, especially TFL and Quadriceps.

3.9.4. GAIT EXAMINATION

- she is using forearm crutches
- walking on flat surface is stabile but slow.
- walking is more secure and stabile
- first crutches, then operated leg and then healthy leg
- better posture during the walking

-walking in stairs is very good, and she can do it by herself

CONCLUSION:

She can do all the walking by herself. The balance and order of the crutches and feet is correct, and has improved.

3.9.5. TRANSFER AND ADL EXAMINATION

- she can sit, walk and stand without help, but with crutches.
- she is able to do all transfer activities alone.
- she can do all ADL alone.

3.9.6. ROM EXAMINATION

Hip joint:

Table 11. ROM examination by goniometer, final, hip joint

	Right side		Left side	
	Active	Passive	Active	Passive
Flexion w/flexed knee	**110°**	**120°**	**95°**	**110°**
Extension	10°	10°	10°	10°
Abduction	30°	40°	30°	40°
Adduction	30°	30°	25°	25°
External rotation	15°	25°	10°	25°
Internal rotation	5°	10°	5°	10°

Knee joint:

Table 12. ROM examination by goniometer, final, knee joint

	Right side		Left side	
	Active	Passive	Active	Passive
Flexion	**120°**	**130°**	**80°**	**100°**
Extension	0°	0°	**0°**	**0°**

Ankle joint:

Table 13. ROM examination by goniometer, final, ankle joint

	Right side		Left side	
	Active	Passive	Active	Passive
Plantar flexion	45°	45°	40°	45°
Dorsal flexion	20°	20°	**20°**	20°
Inversion	35°	40°	30°	35°
Eversion	20°	20°	20°	20°

CONCLUSION:

Both hip and knee flexion is increased, the most significant progress in the therapy. Knee extension is also improved, as full extension is now possible.

3.9.7. ANTROPOMOTORIC MEASUREMENTS

Length:

Table 14. Length measurements, final

	Right side in cm	Left side in cm
Anatomical length	81	82
Functional length	77	78
Length of thigh	43	44
Length of calf	37	38

Circumferences:

Table 15. Circumferences measurements, final

	Right side in cm	Left side in cm
Thigh, 15 cm above patella	43	**43**
Thigh, 10 cm above patella	41	**41**
Knee joint	42	**41**
Calf	33	34
Ankle	43	44

CONCLUSION:

Circumferences around thigh and knee joint on the left side has decreased. This is likely from decreasing oedema.

3.9.8. STRENGTH TESTING

Orientational testing, upper extremities:

Table 16. Orientational strength testing of upper extremities, final

	Right side	Left side
Flexion	Normal strength	Normal strength
Extension	Normal strength	Normal strength
Abduction	Normal strength	Normal strength
Internal rotation	Decreased strength	Decreased strength
External rotation	Decreased strength	Decreased strength

Manual muscle testing of lower extremities, according to Kendall

Table 17. Manual muscle testing of lower extremities, final

	Right side	Left side
Quadriceps femoris	5	**4**
Hamstring group	5	**3**
Iliopsoas	5	4
Gluteus maximus	5	3
Abductors	4	3
Adductor group	4	4
Triceps surae	5	4

CONCLUSION:

Manual muscle testing of the upper extremities are the same as in the initial examination. For the lower extremities m. quadriceps femoris and hamstring on the left side have improved in strength.

3.10. THERAPY EFFECT EVALUATION

Range of motion has been bettered during the 2 weeks, especially flexion in the hip and knee joints. Her walking has improved, she is more secure and confident, remembers the orders of the feet and crutches, and to correct her posture if necessary. Muscle strength has been improved in her left thigh region. She was already strong in her right leg and upper extremities, and will surely continue to improve strength where it is needed. Her stabilty needed to be worked on as a result of the surgery, and after 2 weeks she has improved, although she still needs some time to make it better. She will still use crutches for a while, and with continued training in muscle strength and stability exercises she has good chances of regaining a good balance.

The patient returned home from the hospital the same day as the study was completed, and she had showed good progress along the way in the 2 weeks. She was deemed well enough to go home at that point, so the prognosis looks good for her.

4. CONCLUSION

During the 2 weeks I had this time with the patient, I had the chance to use different examinations and therapies, and to see the effect these can have.
The patient was very cooperative, and with her good mood she made it a great experience for me, and the prognosis looks good for her as well.
It also gave me the opportunity to see the differences and similarities between Czech Republic and Norway, in terms of how the work is done.

5. LIST OF REFERENCES

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6. LIST OF FIGURES

7. LIST OF TABLES

8. LIST OF ABBREVIATIONS

ACL – Anterior cruciate ligament

ADL – Activities of daily living

DF – Dorsal flexion

DIP – Distal interphalangeal joint

E - Extension

F - Flexion

LCL – Lateral collateral ligament

MCL – Medial collateral ligament

MM – Medin Modular

OA – Osteoarthritis

PCL – Posterior cruciate ligament

PIP – Proximal interphalangeal joint

PIR – Post-isometric relaxation

RA – Rheumatoid arthritis

ROM – Range of motion

TFL – Tensor fascia latae

TKR – Total knee replacement

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Application for Ethics Board Review

Of the research project, undergraduate research, involving human subjects

Project title: Case study of Total Knee Replacement

Nature of the research project: basic research / undergraduate research

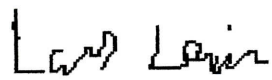
Author (chief investigator): Lars Lønvik

Supervisor (in case of student research): Mgr. Jitka Čemusová

Case study of the physiotherapy of the patient with diagnosis: Total knee replacement
will be processed with supervision of skilled physiotherapeutist in: Revmatologický ústav
No invasive method will be used. Personal datas will be not published.
Informed consent (in Czech language, **attached)**

Date: 10.02.09

Author's signature:



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

Ethics Board members: Doc. MUDr. Staša Bartůňková, CSc.
Prof. Ing. Václav Bunc, CSc.
Prof. PhDr. Pavel Slepička, 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: 0277/2009
Date: 20.2.2009

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.

Official school stamp

Signature, REB Chairman