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

Gonarthrosis and total knee replacement

Bachelor thesis

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ABSTRACT

TITLE: Gonarthrosis and total knee replacement

The aim 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 Ůstav in Albertov, Prague between the 2th and 13th of February 2009. All references to literature can be found in the list of references at the end.

Ingvild B. Bergvad

Ingvild B. Bergvad

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1. INTRODUCTION

Gonarthrosis is also known as degenerative arthritis of the knee joint. It mainly causes degeneration of cartilage. When the cartilage of the joint is severely degenerated as a consequence of arthrosis, a common surgery is total knee replacement. In TKR, the articulating surfaces of the joint are replaced by a prosthesis of metal and plastic. This surgery needs to be followed by adequate therapy and rehabilitation to provide the patient with a knee that functions normally.

In this thesis, all the above mentioned problems are discussed. The thesis is divided into a theoretical part and a special part. The theoretical part gives the reader the background to understand how gonarthrosis affects the joint, and an introduction to how the TKR is performed. In the special part, a patient shortly after TKR is examined and followed during two weeks and altogether ten sessions of therapy.

2. THEORETICAL PART

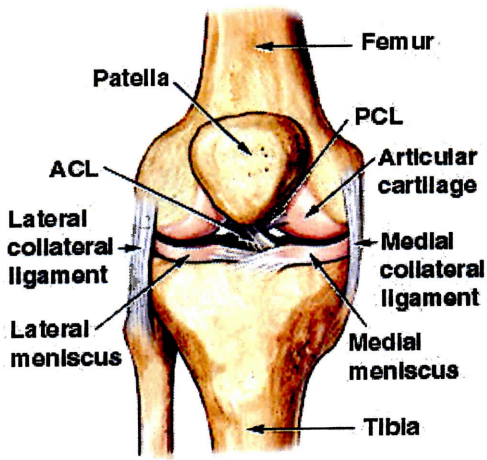
2.1. ANATOMY OF THE KNEE JOINT

2.1.1. INTRODUCTION

The knee joint is the largest and most complex joint in the body.

It is classified as a synovial joint, which means that the articulating bones are separated by a joint cavity which contains a small amount of fluid. This arrangement permits freedom of movement. All joints of the limbs are of synovial type. [11]

Figure 1. The knee joint. [26]



2.1.2. GENERAL FEATURES OF SYNOVIAL JOINTS

Synovial joint have five distinguishing features;

1. Articular cartilage;

   Hyaline cartilage covers the articulating bone surfaces. It appears as cushions, and absorbs compression. It is avascular and receives its nutrition from the synovial fluid. [5][11]

2. Joint cavity;

   The joint cavity, also known as the synovial cavity, is the space between the articulating bones. [3]

It is really just a potential space that contains a small amount of synovial fluid, and also folds of synovial membrane. [3][11]

3. Articular capsule;

   The joint cavity is enclosed by a two-layered articular capsule. The outer layer of the capsule is a fibrous membrane that is continuous with the periostea of the articulating bones. This fibrous capsule is lax and pliable, permitting considerable movement. [3]

   The inner lining of the capsule is the synovial membrane, which is composed of loose connective tissues. It extends from the margins of the articular cartilages and besides lining the fibrous capsule internally, it covers all internal joint surfaces that are not hyaline cartilage. [3][5]

4. Synovial fluid;

   Synovial fluid is secreted from the synovial membrane and it fills all free spaces within the joint cavity.

   It provides a slippery weight-bearing film that reduces friction between the cartilages. The synovial fluid is forced from the cartilages when a joint is compressed and seeps back into the articular cartilages when the pressure on the joint is relieved. [11]

5. Reinforcing ligaments;

   Synovial joints are reinforced and strengthened by a number of ligaments. Most often, these are capsular, or intrinsic ligaments, which means that they are thickened parts of the fibrous capsule. In other cases, they are found outside the capsule (extracapsular ligaments) or deep to it (intracapsular ligaments). [11]

2.1.3. 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]

2.1.4. 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]

Collateral ligaments:

The two collateral ligaments, called the medial collateral ligament (MCL) and the lateral collateral ligament (LCL), are thickenings within the articular capsule that extend from the sides of the femur. They are also referred to as the tibial and fibular collateral ligaments, after their distal attachments. Both are strong ligaments that are slack during flexion and taut during extension and act as guidance for these movements of the knee joint, preventing lateral motion. [3][4]

The MCL is a flattened, triangular ligament which fuses with the joint capsule and the medial meniscus to connect the medial epicondyle of the femur to the medial tibia. The attachment is just below the pes anserinus, thereby positioning the ligament to resist medially directed shear (valgus) and rotational forces acting on the knee. [3][16]

The round LCL does not fuse with neither the capsule nor the lateral meniscus. It originates from the lateral epicondyle of femur and is attached to the head of fibula, resisting laterally directed shear (varus) and contributing to lateral stability of the knee. [3][16]

Patellar ligaments:

The patellar ligament is a continuation of the quadriceps tendon, which extends from the patella to the tibial tuberosity. The lateral patellar retinaculum is formed by fibers of the vastus lateralis muscle and some fibers from the rectus femoris muscle. Some fibers of the iliotibial tract also radiate into it. Literally, it joins the tibial tuberosity of the tibia. The medial patellar retinaculum is formed mostly by fibers from the vastus medialis muscle, which runs distally, medial to the patellar ligament and is attached to the tibia in front of the medial collateral ligament. Transverse fibers, which arise from the medial epicondyle radiate into the medial patellar retinaculum. [16]

Cruciate ligaments:

In the center of the knee joint, between the condyles of the femur and tibia, are two ligaments: the anterior and posterior cruciate ligaments. They are strong cords that cross eachother like an X. [3]

The ACL and PCL limit forward and backward sliding of the femur on the tibial plateaus during knee flexion and extension and also prevent knee hyperextension (Figure 2). They serve in particular to maintain contact during rotary movements. They are intracapsular but extra-articular ligaments. [16]

The ACL runs from the anterior intercondylar area of the tibia to the inner surface of the lateral condyle of the femur, in an anterior, posterior direction. It is taut when the knee is fully extended and slack when the knee is flexed. It prevents backward dislocation of tibia, and excessive extensor or rotational movements, especially hyperextension. [3][4][16]

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]

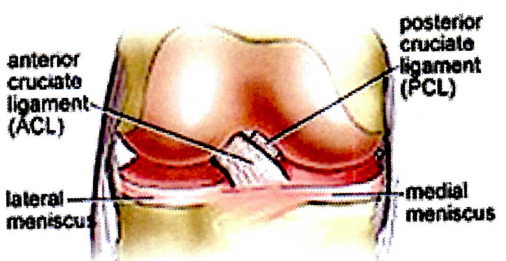
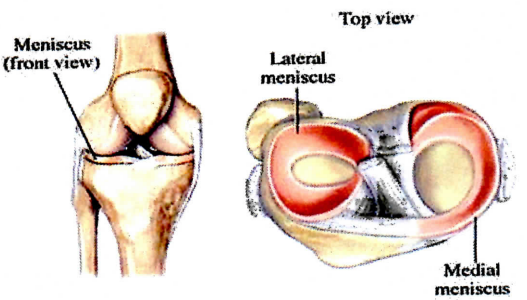


Figure 3. Menisci [20]



2.1.5. 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 menisci are thickest at their peripheral border where fibers from the joint capsule attach them to the tibia. Medially, both menisci taper down to paper thinness, with the inner edges unattached to the bone. [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. INTRODUCTION

The knee is the intermediate joint of the lower limb. It is mainly a joint with one degree of freedom, which allows the distance between the trunk and the ground to be varied. The knee works essentially by axial compression under the action of gravity.

It also has a second degree of freedom: rotation of the long axis of the leg, which occurs only when the knee is flexed.

From the mechanical point of view the knee has two important problems to solve:

1. to have great stability in complete extension, when the knee is under stress resulting from the body weight and the length of the levers (femur and tibia).
2. to have great mobility when the joint is flexion. This mobility is essential for running and the optimal orientation of foot relative to the irregularities of the ground.

The knee solves these problems by highly ingenious mechanical devices but the poor degree of interlocking of the surfaces, which is essential for good mobility, leaves it accessible to sprains and dislocations. [8][17]

2.2.2. 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 [3][6][8]

Muscle	Action
Quadriceps femoris	
Rectus femoris	Extension
Vastus lateralis	Extension
Vastus intermedius	Extension
Vastus medialis	Extension
Hamstring muscle	
Biceps femoris	Flexion and external rotation
Semitendinosus	Flexion and internal rotation
Semimembranosus	Flexion and internal rotation
Other muscles	
Gracilis	Flexion and internal rotation
Sartorius	Flexion and internal rotation
Popliteus	Flexion, internal rotation; unlocks knee joint
Gastrocnemius	Flexion
Plantaris	Flexion
Tensor fascia latae	External rotation

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 classified as primary (idiopathic) or secondary to metabolic conditions, anatomical abnormalities, trauma, or inflammatory arthritis. The stresses of weight-bearing mainly involve the medial compartment of the knee, and it is in this area that primary osteoarthritis usually first occurs. Being overweight, the degenerative changes accompanying old age, and overwork are common factors. Secondary osteoarthritis may follow ligament and meniscus injuries, recurrent dislocations of the patella, osteochondritis dissecans, joint infections and other previous pathology. It is

seen in association with knock-knee and bow-leg deformities, which throw additional mechanical stresses on the joint. [12][13]

Arthritis is commonly used as by patients, when they really have been diagnosed with arthrosis, see table 2 and figure 4 for differences between rheumatoid arthritis and arthrosis.

Table 2. The differences between RA and arthrosis [24] [25]

RHEUMATOID ARTHRITIS	ARTHROSIS
More severe	Generally less severe
Affects more women than men	Commonly found in both men and women
Can affect people at any age, but most commonly between 20-60 years	Usually affects people over 40 years
Autoimmune	Caused by wear and tear of the joints
RA can also affect inner organs	Affects only joints
Affects the synovium of the joints	Affects the joint cartilage
Inflammatory processes (synovial membrane)	No inflammatory processes in the joint
Affects by symmetrical pattern	Usually affects by asymmetrical pattern
Affects smaller joints such as in the hand	Typically affects large weight bearing joints such as hips and knees

Figure 4. Illustrated difference between osteoarthritis (arthrosis) and RA [26]

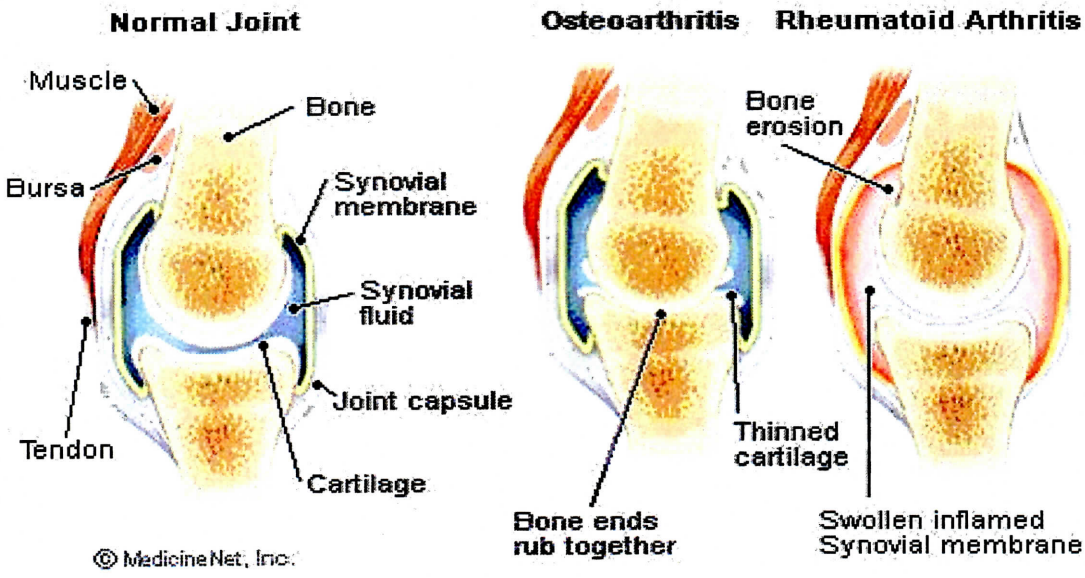


Table 3. General classification of arthrosis [13]

Process	Degeneration and progressive loss of cartilage within the joints, damage to underlying bone, and formation of new bone at the margins of the cartilage
Common locations	Knees, hips, hands (DIP, sometimes PIP), cervical and lumbar spine. Also joints previously injured or diseased
Pattern of spread	Additive, however, only one joint may be involved
Onset	Usually incidious
Progression and duration	Slowly progressive, with temporary exacerbations after periods of overuse
Swelling	Small effusions in the joint may be present
Redness, warmth and tenderness	Possibly tender, seldom warm and rarely red
Stiffness	Frequent, but brief, usually 5-10 min in the morning or after inactivity
Limitation of motion	Often develops
Generalized symptoms	Usually absent

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]

Table 4. Gonarthrosis diagnostification criteria [13]

Clinical and labratory	Clinical, laboratory and radiographic
Knee pain AND;	Knee pain, AND;
Crepitus, and morning stiffness > 30 minutes, and age > 38 years, OR;	Osteophytes, OR;
Crepitus, and morning stiffness > 30 minutes, and bony enlargement, OR;	OA synovial fluid, and morning stiffness >30 minutes, and crepitus
No crepitus, and bony enlargement	

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

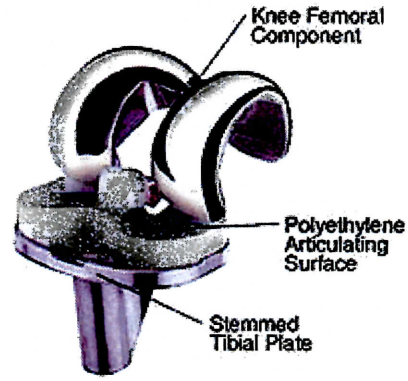
The primary indication of a total knee replacement surgery (also known as total knee arthroplasty) is to relieve pain caused by osteoarthritis. Secondary goals are to restore function and correct deformity. Candidates should have degenerative changes on radiographs and failed other methods of nonoperative and occasionally other types of operative care. Nonoperative modalities include anti-inflammatory medications, assistive devices, weight loss, and intra-articular steroid injections. In select cases, surgical options prior to total knee arthroplasty include arthroscopy and osteotomies. [2][21]

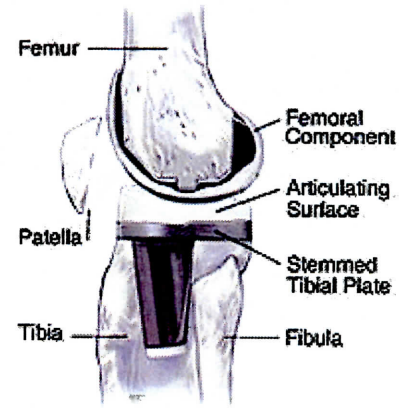
2.4.2. WHAT IS TKR?

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 5). 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 5. Components of TKR [22]





2.4.3. HOW IS THE SURGERY PERFORMED?

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:

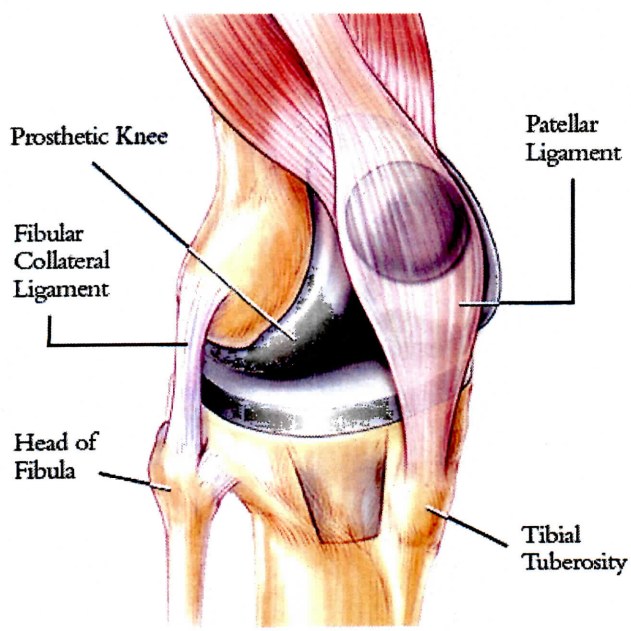
   The metal tray that will hold the polyethylene spacer is attached to the top of the tibia. The metal tray is cemented into place. The plastic spacer is then attached to the metal tray of the tibial component. If this component wears out while the rest of the artificial knee is sound, it can be replaced.

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. (figure 6)
9. Closing the incision. [21][30]

Figure 6. The prosthetic knee [29]



2.4.4. TYPES OF IMPLANTS

There are different types of implants with different specifications available on the market today. Type of implant is selected based on the patient's anatomy, degree of looseness of the knee joint, the ROM and the patients planned sports activities. The implant that will be discussed in this thesis is the same as of the patient that was studied in the special part. [21]

MEDIN Modular – MM

This implant is determined for primary knee joint replacement that is fixed by cement. It is particularly used for osteoarthritis, also knee joint destructions arising from inflammatory rheumatic illnesses and other systemic illnesses. The implant can also be a solution for some knee injuries and posttraumatic states. [21]

The femoral component MM is designed as an asymmetrical one – left and right. It is determined for application with bone cement. Alternatively, femoral component can be supplemented with distal or dorsal inserts as a solution of local bone defects. [21]

Tibial component MM is designed as a modular one - right and left, it is determined for knee joint replacement with application of bone cement. Tibial component consists of anchoring part with stem and tibial insert. Asymmetrical anchoring part of tibial component respects different shapes of medial and lateral condyles of tibia. Middle excisions provide space for eventual preservation of PCL. Stabilization is ensured by a couple of antirotary ribs, short stem and two openenings for supplementary utilization of bone screws fixating eventual bone allograft or screws fixating optional tibial augmentation. Anchoring part of the plate and the modules are made of titanium. [21]

Figure 7. Medin Modular MM [21]

2.5. POST-OPERATIVE CARE IMMEDIATELY AFTER TKR

Pain management

Patients subjective feeling of pain after the surgery is extremely variable. Each patient needs to be managed individually. In general, pain management can be summarized as follows:

- 1-2 days post-operatively: patients will have significant pain, and most need intravenous or intramuscular narcotic analgesia. Most patients can distinguish between postoperative pain and their preoperative osteoarthritic pain.
- 3 days post-operatively: the pain is usually controlled by oral analgetics
- 2-3 weeks post-operatively: some patients continue to require analgesics, where as others can manage without. [15]

It can take up to 6 months or a year before the patient feels that the knee is fully recovered. [15]

Weight-bearing on operated leg directly after TKR:

There are different protocols, and it is important to discuss this with the operating orthopedic doctor. When cement is used to fix both the femoral and tibial components, the patients are routinely allowed to bear weight as tolerated. If fixation requires bony ingrowth to the prothesis, partially weight-bearing is usually utilized.

In the following special part of the thesis, physiotherapy care of patient after TKR is described as an example of rehabilitation plan. [15]

3. SPECIAL PART

3.1. METHODOLOGY

3.1.1. SPECIFICATION OF STUDY

Clinical study of patient after total knee replacement.

The patient is a man born in 1937 with the diagnosis gonarthrosis and state after total knee replacement.

3.1.2. TIME AND PLACE

Revmatologický Ůstav 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
- ROM examination
- Antropomotoric measurements
- Orientational strength testing
- Manual Muscle testing by Kendall [9]

3.1.4. THERAPEUTIC METHODS

- Thromboembolic preventive exercises
- Exercises in ROM
- Isometric strengthening exercises
- Isotonic strengthening exercises
- Stretching exercises
- Methods for decreasing of hematoma
- PIR technique by Lewit [10]
- Soft tissue techniques

3.1.5. DIAGNOSTIC TOOLS

- Goniometer (of metal)
- Measuring tape

3.1.6. THERAPEUTIC TOOLS

- Motomed
- Overball
- Biolamp
- Soft-tennis balls

3.2. ANAMNESIS

3.2.1. PERSONAL INFORMATION

The patient is J.V., male, born in 1937.

3.2.2. DIAGNOSIS

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

3.2.3. MAIN COMPLAINT

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

3.2.4. HISTORY OF PRESENT PROBLEM

- the problems with the knee started around two years ago. The problems have been increasing with time.
- the character of the knee problems were stiffness, pain when used and oedema.
- before that he had problems with stiffness and oedema in elbows and small joints of hands from time to time.
- he was diagnosed with serum-positive rheumatologic arthritis of II degree in 1992 and has been treated for it ever since.

- the disease first manifested itself as pain in the right leg, around the ankle and oedema. With time, knees and small joints of foot and hand was affected with stiffness and oedema.
- from 1999 he has been going regularly to rheumatologic department for follow-up.
- he was operated for replacement of left knee joint 23.jan. 09. Surgery was without complications.

3.2.5. FAMILY ANAMNESIS

- mother died at 75 years old, after brain stroke
- father died at 56 years old, because of complications after a hip fracture
- brothers and sister alive and healthy
- no rheumatological diseases in the family
- no psoriasis in the family

3.2.6. SURGICAL ANAMNESIS

- 1993; operation for nodules on ankle, right side
- 1998; operation for hernia in inguinal, right side

3.2.7. WORK ANAMNESIS

- retired
- used to work in the mines

3.2.8. MEDICAL ANAMNESIS

- serum-positive rheumatoid arthritis, II. degree
- hypertension of I. degree, treated pharmacologically
- diabetes mellitus, compensated by diet

3.2.9. PHARMACOLOGICAL ANAMNESIS

Long-term use medicaments:

- Urandil
- Delagil
- Repanidal

Currently used medicaments:

- Medrol
- Apo-Ome
- Salazopyrin
- Indap
- Diroton
- Lokren
- Tramal
- Diclofenac Duo

3.2.10. SOCIAL ANAMNESIS

- lives with his wife in a 1st floor flat, with only short stair-case
- no children

3.2.11. SPORTS ACTIVITY ANAMNESIS

- currently no regular sports activity
- played active volleyball when he was younger

3.2.12. ALLERGIES

- none

3.2.13. ABUSES

- no smoking
- no alcohol drinking

3.3. STATEMENT FROM PATIENT'S MEDICAL DOCUMENTATION

- pain before operation on a scale from 1-10: 5
- operation was without complications
- type of implanted prothesis: Medin Modular

3.4. ORTHOPEDIC DOCTORS INDICATION OF REHABILITATION

- walking with crutches, without full weight on the operated leg
- exercising in the ROM of the joint
- thromboembolic prevention until 6 weeks after operation

3.5. PRESENT STATE AT INITIAL KINESIOLOGIC EXAMINATION

2.2.2009

- height: 173 cm
- weight: 69 kg
- BMI: 23
- blood pressure 150/80
- pulse 64/min

The patient is 10 days after operation. Surgery was without complications.

Stitches are still in.

He is walking with underarm crutches.

He has no pain presented when lying or sitting in bed, or performing ADL.

3.6. INITIAL KINESIOLOGIC EXAMINATION

Date: 2.2.2009

3.6.1. ASPECTION

Left side:

- small pressure wound on heel
- hematoma on medial side of knee and calf
- edema of knee, calf and ankle

Right side:

- slight edema of ankle

CONCLUSION:

Beginning pressure wound of left heel.

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

Hematoma of left knee and calf, medial parts.

3.6.2. POSTURAL EXAMINATION

- patient can not put weight on the operated leg, so the postural examination is evaluated with underarm crutches.

Anterior:

- significant varosity of right knee
- upper body and most of body weight is shifted to the right side

Posterior:

- right ankle has less significant varosity

Lateral:

- hyperextension of right knee
- semiflexion of left knee
- plantar flexion of left foot
- he leans forward on the chrutches which gives him a kyphotic back posture

CONCLUSION:

Patients posture with crutches is not satisfactory. Crutches are too short and needs to be adjusted. With time, when patient is allowed to put full weight on the leg, he will be educated in correct standing posture.

The left knee also had varosity, but this was corrected with the knee prosthesis.

3.6.3. MUSCLE PALPATION

Table 5. Muscle palpation, initial

	Right side	Left side
Tensor fascia latae	Hypertonus in distal part, less significant	Hypertonus and painful
Quadriceps*	Hypertonus and TrP's of medial and especially middle part	Hypertonus and TrP's of medial and middle parts
Hamstrings*	Hypertonus close to proximal origin	Medial hypertonus, TrP's close to proximal origin
Triceps surae*	General hypotony	General hypotony, less significant hypertonus and TrP's close to proximal origin

(*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:
All palpated muscles of the left side has a generally higher tonus and more TrP's than on the right side.

3.6.4. GAIT EXAMINATION

- he is using underarm crutches and without weight on the operated leg
- walking on flat surface is stabile but slow
- walking up and down stairs is insecure, slow, and the patient gets tired fast
- walking up stairs he has a very rounded back
- short steps
- patient walks with a three phasis type: first crutches, then operated leg and last healthy leg
- he is leaned forward on the cruthces and they might be a little bit too short for him
- he should also wear better shoes, now he is using sandals

CONCLUSION:
Crutches are too short and the patient does not have good shoes. He is recommended to wear other shoes while walking.
Stability is without pathologies when walking on flat surface, while more insecure when walking in stairs.

3.6.5. TRANSFER AND ADL EXAMINATION

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

CONCLUSION:

Patient is independent.

3.6.6. ROM EXAMINATION BY GONIOMETER

Hip joint:

Table 6. ROM examination by goniometer, initial, hip joint

	Right side		Left side	
	Active	Passive	Active	Passive
Flexion	90°	110°	85°	90°
Extension	5°	10°	5°	10°
Abduction	30°	40°	30°	40°
Adduction	30°	30°	25°	25°
External rotation	15°	15°	10°	15°
Internal rotation	5°	10°	5°	10°

Knee joint:

Table 7. ROM examination by goniometer, initial, knee joint

	Right side		Left side	
	Active	Passive	Active	Passive
Flexion	120°	130°	55°	60°
Extension	0°	0°	0°	0°

Ankle joint:

Table 8. ROM examination by goniometer, initial, ankle joint

	Right side		Left side	
	Active	Passive	Active	Passive
Plantar flexion	40°	45°	40°	45°
Dorsal flexion	20°	20°	10°	15°
Inversion	35°	40°	30°	35°
Eversion	20°	20°	20°	20°

CONCLUSION:

Hip movements are decreased by 2/3 on the right side, and by 1/3 on the left side. Flexion on the left side is restricted because of the operated knee. Active movements are more decreased.

Knee movements are satisfactory on the right side, the left side is decreased. Extension of left knee is full, flexion is stopped by pain and scar.

Ankle movements are mostly normal on right side. On the left side there are some decreased movements in dorsal flexion and eversion which might be reflex changed due to the long time problems with the knee.

3.6.7. ANTROPOMOTORIC MEASUREMENTS

Length:

Table 9. Length measurements, initial

	Right side in cm	Left side in cm
Anatomical length	89	89
Functional length	92	92
Length of thigh	46	47
Length of calf	40	39

Circumferences:

Table 10. Circumferences measurements, initial

	Right side in cm	Left side in cm
Thigh, 15 cm above patella	43	46
Thigh, 10 cm above patella	41	43
Knee joint	39	43
Calf	31	32
Ankle	27	29

CONCLUSION:

The length measurements shows that legs have the same length.

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

3.6.8. STRENGTH

Orientational testing, upper extremities:

Table 11. Orientational testing of upper extremities, initial

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

Manual muscle testing of lower extremities, according to Kendall:

Table 12. Manual muscle testing of lower extremities, initial

	Right side	Left side
Quadriceps femoris	4	3, decreased by pain
Hamstring group	4-	2, not full ROM because of decreased knee flexion after operation
Abductors	3	3
Adductor group	4-	4-
Triceps surae	5	5

CONCLUSION:

Functional strength testing of upper extremities is used to assess the patients ability to walk with crutches. Adduction of right side has decreased strength. Extension of both sides has decreased strength.

Left lower extremity has more decreased strength than the right one. Measuring of strength of m. quadriceps femoris and m. triceps surae are stopped by patients subjective feeling of pain.

CONCLUSION OF INITIAL KINESIOLOGIC EXAMINATION:

Left leg has a small pressure wound on the heel, hematoma and edema around the knee joint and medial side of calf. The patient is independent and can perform all ADL by himself. Walking is stabile on a flat surface, but not satisfactory when walking stairs. The muscles of the left lower extremity has generally higher tonus and more TrP's than on the right leg. ROM of left lower extremity are decreased essentially in flexion of 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. Orientational strength testing of upper extremities show decreased strength in some movements, especially extension on both sides and adduction of right side. Manual muscle testing of lower extremities shows generally decreased strength of the left lower extremity. Some of the measurements are stopped by the patients subjective feeling of pain when trying to flex or extend the knee joint.

3.7. SHORT-TERM AND LONG-TERM REHABILITATION PLAN

Goals of short-term plan:

- prevent thromboembolism
- prevent premature loading on operated leg
- increase ROM of the knee
- increase strength of muscles important for stability of the knee, correct loading, and walking with crutches
- decrease tension and TrP's of muscles
- decrease hematoma
- improve scar trophy and mobility
- increase sensomotor input
- increase stability and balance
- decrease pain

Short-term plan:

- exercises for increasing of venous return of blood
- education of walking with crutches without load on operated leg
- Motomed machine

- passive exercises in ROM
- strengthening exercises against gravity
- strengthening exercises with overball
- isometric strengthening exercises
- PIR technique by Lewit
- stretching exercises
- Biolamp
- soft tissue techniques
- sensomotoric stimulation and training
- stabilisation and balance training
- medications

Goals of long-term plan:
- increase general strength and condition of patient
- increase stability
- activation of deep stabilisation system
- educate the patient in how to live with his new knee

Long-term plan:
- continuous exercises, educate the patient in exercises he 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: 3
Patient is 10 days after operation.
Goal of today's therapy unit:
- anamnesis and initial kinesiological examination
- thromboembolic prevention

- increase ROM of knee, flexion
- strengthening of upper extremities
- strengthening of lower extremities
- decreasing of hematoma

Procedure:

- anamnesis (with the help of my supervisor) and initial kinesiologic examination.
- thromboembolic preventive exercises
    - alternately up and down movements with forefeet
    - circles with forefeet
    - breathing exercises with activation of abdominals
    - circles with upper extremities in flexion and extension
    - alternate flexion of knees, moderate tempo
- active and passive flexion and extension of knee, according to subjective feeling of patient
    - in supine position
    - in sitting position
- strengthening exercises for upper extremities to help walking with crutches
    - in supine position:
    - Overball under upper arm with elbow flexed, push down into extension
    - Overball between lateral part of trunk and upper arm with flexed elbow, push into adduction
    - in sitting position:
    - Overball between palms, flexed elbows, push into adduction, different heights of arms
- strengthening exercises for lower extremities
    - isometric and isotonic exercises
    - in supine position:
    - Overball between flexed knees and push into adduction
    - Overball under heel and knee and push down
    - flexed knees and push into abduction, with resistance of physiotherapist
    - resisted flexion of hip with flexed knee with alternate resisted extension of hip and knee
    - bridging exercise
    - in prone position:

- hip extension with flexed knee
- in sitting position, with knee outside bed:
- resisted flexion and extension of knee

- Biolamp 10 min, slow dynamic application over whole area of hematoma
- Motomed; flexion 60°, extension 0°, 30 min

Results:

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

All exercises are understood and accepted by the patient. He does not complain of any pain, only in the end flexion of his left knee.

This therapy session was long for him, and he got tired fast.

Self-therapy:

None

3.8.2. SESSION TWO

Date: 3.2.09

Pain today on a scale from 1-10: 3

Patient did not sleep good last night and is tired.

He is sore from yesterdays training, especially in the gluteal muscles.

Goal of today's therapy unit:

- thromboembolic prevention
- increase ROM of knee, flexion
- strengthening of upper extremities
- strengthening of lower extremities
- decrease of tension and TrP's
- decreasing of hematoma
- walking education

Procedure:

- thromboembolic preventive exercises
- active and passive flexion and extension of knee, according to subjective feeling of patient
- strengthening exercises for upper extremities
- strengthening exercises for lower extremities

- PIR technique (according Lewit) to decrease tension and TrP's
    - m. quadriceps femoris, right and left side
    - m. triceps surae: right and left side
- Biolamp 10 min
- walking education
    - correction of height of crutches
    - patient is encouraged to wear better shoes for walking
    - correct walking: 1. crutches 2. operated leg 3. healthy leg
- Motomed; flexion 65°, 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. Passive flexion of the knee is performed to patients threshold of pain, and with consideration to the fact that the stitches are still in. Walking education is important to show the patient repeatedly times, since he forgets the order of the legs and crutches.

Self-therapy:

None

3.8.3. SESSION THREE

Date: 4.2.09

Pain today on a scale from 1-10: 4

Stitches are taken out today, in the morning. It is necessary to wait for 2-3 days before starting with soft tissue techniques and more intense flexion of the knee.

Patient complains of lumbar back pain and feeling of tiredness in that part of his back.

Goal of today's therapy unit:

- thromboembolic prevention
- increase ROM of knee, flexion
- strengthening of upper extremities, to help walking with crutches
- strengthening of lower extremities
- decrease of tension and TrP's
- increase sensomotor input from feet
- show patients some exercises for relief of lumbar back

- decrease of hematoma
- walking education in stairs

Procedure:

- thromboembolic preventive exercises
- active and passive flexion and extension of knee, according to subjective feeling of patient
- strengthening exercises for upper extremities
- strengthening exercises for lower extremities
- PIR technique (according Lewit) to decrease tension and TrP's
    - m. quadriceps femoris
    - m. triceps surae
- sensomotoric stimulation of feet
    - with special ball and roll on the plant of feet
- education in exercises for relief of lumbar back
    - supine position:
    - alternately stretch opposite arm and leg
    - with flexed knees, posterior and anterior tilting of pelvis, alternately
- Biolamp 10 min
- walking education 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 70°, 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. Passive flexion of the knee is performed to patients threshold of pain, and with consideration to the fact that the stitches are still in.

The patient is a little bit unsecure when walking in the stairs, especially up stairs. He is therefore recommended not to take the stairs when he is alone.

Self-therapy:

The exercise for relief of low back pain whenever the patient feels it is necessary

3.8.4. SESSION FOUR

Date: 5.2.09

Pain today on a scale from 1-10: 3

Patient is happy today, he slept good and is generally very satisfied with his progress.

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 and TrP's
- release of lumbar fascia and muscles
- increase sensory input from feet
- decrease hematoma

Procedure:

- breathing exercises
- thromboembolic exercises
- passive F and E 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 75°, 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:

Biolamp, 10 min in the afternoon.

3.8.5. SESSION FIVE

Date: 6.2.09

Pain today on a scale from 1-10: 3

Patient still complains of lower back pain.

He wants to be re-educated in how to walk in stairs because he has forgotten how it should be done.

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 and TrP's in lower extremities
- release of lumbar fascia and muscles
- increase sensory input from feet
- decrease hematoma
- re-education of walking in stairs

Procedure:

- thromboembolic exercises
- breathing exercises
- passive flexion and extension of knee
- exercises for strengthening upper extremities
- exercises for strengthening lower extremities
- PIR for lower extremities
- PIR and soft tissue tech with balls for lumbar spine/fascia because patient complains of low back-pain
- sensomotoric stimulation of feet
- Motomed, 80° flexion, 0° extension, 30 min
- Biolamp 10 min
- re-education of walking in stairs

Results:

When strengthening abduction, the patient complains of back pain and is not able to complete the exercise.

It is necessary to show the patient correct walking repeatedly times to make sure he knows how it should be and to learn the correct stereotype for walking with crutches.

Self-therapy:

Exercises for relief of lumbar spine whenever he feels it is necessary.

3.8.6. SESSION SIX

Date: 9.2.09

Pain today on a scale from 1-10: 3

Today we will start working on the scar, and we can do more intense flexion of the knee since the stitches are out.

Goal of today's therapy unit:

- thromboembolic prevention
- activation of abdominal muscles
- improve mobility and trophy of the scar
- educate the patient in how to take care of the scar
- increase ROM of knee, flexion
- increase strength of upper extremities
- increase strength of lower extremities
- release of tension and TrP's in lower extremities
- decrease hematoma

Procedure:

- soft tissue techniques for the scar
    - with gloves and cream
    - pressure massage, S-shape, C-shape
- education of patient on how to put cream and massage the scar
- thromboembolic preventive exercises
- breathing exercises
- strengthening exercises for upper extremities
- strengthening exercises for lower extremities
- PIR of lower extremities

- Biolamp, 10 min
- Motomed, 85° flexion, 0° extension, 30 min.

Results:

The scar is painful only when pressed hard by pressure massage. It looks good, but is a little bit dry. The patient shows good understanding for how to take care of the scar himself.

All other exercises are well tolerated

Self-therapy:

Put cream and massage the scar two times every day except from the therapy session.

3.8.7. SESSION SEVEN

Date: 10.2.09

Pain today on a scale from 1-10: 4

The knee is warm today and oedema is larger on posterior side of knee.

It is therefore agreed with the patient to shorten the therapy session today. Mainly by performing less active exercises.

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
- decrease hematoma

Procedure:

- soft tissue techniques for the scar
- breathing exercises
- thromboembolic preventive exercises
- strengthening exercises for upper extremities
- passive flexion and extension of knee
- sensomotoric stimulation of feet
- Biolamp, 10 min
- Motomed, 90° flexion, 0° extension, 30 min.

Results:

Everything is well tolerated by the patient. He is afraid that warmth of the knee is the sign of an inflammation.

Self-therapy:

Patient is instructed to put something cold on the knee for 5-10 minutes several times during the rest of the day.

Put cream and massage the scar two times every day except from the therapy session.

3.8.8. SESSION EIGHT

Date: 11.2.09

Pain today on a scale from 1-10: 2

The knee is no longer warm like yesterday, and the oedema has decreased.

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
- decrease of hypertonus and TrP's
- increase sensomotor input from feet
- increase stability
- decrease hematoma

Procedure:

- breathing exercises
- thromboembolic prevention exercises
- 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
- exercises for increasing stability of the patient

- in supine position, flexed knees, imagine 3 points of foot and press down on them, rhythmic stabilisation
- in sitting position, rhythmic stabilisation

- Biolamp, 10 min
- Motomed, 90° flexion, 0° extension, 30 min.

Results:

All exercises are well tolerated. It seems like the patient has improved his strength. Scar is no longer painful, even when pressed quite hard.

Self-therapy:

3.8.9. SESSION NINE

Date: 12.2.09

Pain today on a scale from 1-10: 2

The scar has become even drier, but the patient claims he puts cream. He will get a cream which contains more fat.

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
- decrease of hypertonus and TrP's
- increase sensomotor input from feet
- increase stability
- decrease hematoma

Procedure:

- breathing exercises
- thromboembolic prevention exercises
- 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
- exercises for increasing stability of the patient
- Motomed, 95° flexion, 0° extension, 30 min

Results:

Self-therapy:

Biolamp 10 min the same afternoon.

Patient is showed and instructed to massage the scar himself and apply more fat cream to keep the scar moist.

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, and the patient expresses his satisfaction and gratitude of the two weeks of therapy.

Goal of today's therapy unit:

- final kinesiological examination
- 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
- decrease of hypertonus and TrP's
- increase sensomotor input from feet
- increase stability
- decrease hematoma

Procedure:

- breathing exercises
- thromboembolic prevention exercises
- 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
- exercises for increasing stability of the patient
- 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:

- **pressure wound on heel is almost completely healed**
- **hematoma is still present, but has a more yellow color**
- **edema of knee, calf and ankle has decreased**

Right side:

- slight edema of ankle

CONCLUSION:

Hematoma is slowly decreasing, as well as edema.

3.9.2. POSTURAL EXAMINATION

- patient can not put weight on the operated leg, so the postural examination is evaluated with underarm crutches.

Anterior:

- varosity of right leg
- upper body and most of body weight is shifted to the right side

Posterior:

- right ankle has a little bit varosity

Lateral:

- hyperextension of right knee
- semiflexion of left knee
- plantar flexion of left foot
- **kyphotic posture is decreased by correcting the height of crutches**

CONCLUSION:

Posture with crutches is better because the crutches are better adjusted and the patient is more aware of keeping an upright posture.

3.9.3. MUSCLE PALPATION

Table 11. Muscle palpation, final

	Right side	Left side
Tensor fascia latae	Slight tension in distal part	**Still tensed in distal parts, but less painful**
Quadriceps*	**TrP's are gone, tension is still present**	**TrP's are gone, hypertoned parts still present**
Hamstrings*	Tension close to proximal origin	Medial tension, TrP's close to proximal origin
Triceps surae*	General hypotony	**General hypotony, slight tension still present, TrP's are gone**

(*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 PIR technique has shown positive results, especially in the reduction of number of TrP's in m. quadriceps, both sides, and m. triceps surae, left side.

3.9.4. GAIT EXAMINATION

- he is using underarm crutches and without weight on the operated leg.
- walking on flat surface is stabile but slow.
- **longer steps**
- first crutches, then operated leg and then healthy leg.
- **posture is corrected and he is more upright**
- **he has gotten better shoes for walking**
- **walking in stairs is more stabile and the patient can now do it alone**

CONCLUSION:

Patient takes longer steps, has a better posture while walking, and is more stabile. He remembers now the correct order of crutches and legs.

3.9.5. TRANSFER AND ADL EXAMINATION

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

3.9.6. ROM EXAMINATION

Hip joint:

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

	Right side		Left side	
	Active	Passive	Active	Passive
Flexion	**100°**	**120°**	**90°**	**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 14. ROM examination by goniometer, final, knee joint

	Right side		Left side	
	Active	Passive	Active	Passive
Flexion	120°	130°	**100°**	**110°**
Extension	0°	0°	0°	0°

Ankle joint:

Table 15. ROM examination by goniometer, final, ankle joint

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

CONCLUSION:

Hip flexion is increased, as well as active hip extension.

Flexion of left knee has increased significantly, from 60° to 110° passive, and is the most important perimeter for the success of the therapy.

Dorsal flexion of left ankle joint has increased, this might be due to the decrease of edema around the ankle.

3.9.7. ANTROPOMOTORIC MEASUREMENTS

Length:

Table 16. Length measurements, final

	Right side in cm	Left side in cm
Anatomical length	89	89
Functional length	92	92
Length of thigh	46	47
Length of calf	40	39

Circumferences:

Table 17. Circumferences measurements, final

	Right side in cm	Left side in cm
Thigh, 15 cm above patella	43	**45**
Thigh, 10 cm above patella	41	**42**
Knee joint	39	**41**
Calf	31	32
Ankle	27	**28**

CONCLUSION:

Circumferences around thigh, knee joint and ankle on the left side has decreased. This shows that the edema is decreasing.

3.9.8. STRENGTH TESTING

Orientational testing, upper extremities:

Table 18. Orientational strength testing of upper extremities, final

	Right side	Left side
Flexion	Decreased strength	Decreased strength
Extension	Ok	Ok

Abduction	Ok	Ok
Adduction	**Ok**	Ok
Internal rotation	Decreased strength	Decreased strength
External rotation	Decreased strength	Decreased strength

Manual muscle testing of lower extremities, according to Kendall

Table 19. Manual muscle testing of lower extremities, final

	Right side	Left side
Quadriceps femoris	4	**4**
Hamstring group	4-	2, not full ROM because of decreased knee flexion after operation
Abductors	**3+**	**3+**
Adductor group	4-	4-
Triceps surae	5	5

CONCLUSION:

Functional strength testing of upper extremities shows mostly the same results as in the initial kinesiological examination. Adduction of right arm has increased. Manual muscle testing of lower extremities shows that m. quadriceps femoris and abductors on the left side have gained strength.

3.10. THERAPY EFFECT EVALUATION

According to the feedback from the patient, the subjective feeling of pain was reduced, he felt improvement in his condition, and his motivation increased a lot during his stay at the hospital. The patient returned home from the hospital one week after the study was completed, hence it is fair to conclude that the therapy was as successful as it could be, and that the prognosis for him looks fairly good.

Table 20. Summary of results before and after therapy

TYPE OF EXAMINATION	BEFORE THERAPY, 2.2.09	AFTER THERAPY, 13.2.09
ASPECTION	Pressure wound on left heel	Almost completely healed
	Hematoma of left knee, calf and ankle	More yellow color
	Edema of left knee and medial side of calf	Decreased
POSTURAL EXAMINATION	Increased thoracic kyphosis	Kyphotic posture is decreased
MUSCLE PALPATION	Left TFL; Hypertonus and painful	Still tensed in distal parts, but less painful
	Right quadriceps femoris; Hypertonus and TrP's of medial and middle part	TrP's no longer present
	Left quadriceps femoris; Hypertonus and TrP's of medial and middle parts	TrP's no longer present
	Left triceps surae; General hypotony, TrP's close to proximal origin	TrP's no longer present
ROM EXAMINATION	Right hip; Active F 90° Passive F 110° Active E 5°	 Active F 100° Passive F 120° Active E 10°
	Left hip; Active F 85° Passive F 90° Active E 5°	 Active F 90° Passive F 110° Active E 10°
	Left knee; Active F 55° Passive F 60°	 Active F 100° Passive F 110°
	Left ankle; Active DF 10° Passive DF 15°	Left ankle; Active DF 20° Passive DF 20°
CIRCUMFERENCES	Left side; 15 cm above patella 46 cm	 15 cm above patella 45 cm

	10 cm above patella 43 cm Knee joint 43 cm Ankle joint 29 cm	10 cm above patella 42 cm Knee joint 41 cm Ankle joint 28 cm
ORIENTATIONAL TESTING UPPER EXTREMITIES	Right side; Adduction decreased strength	Adduction OK
MANUAL MUSCLE TESTING, LOWER EXTREMITIES	Left side; Quadriceps femoris 3 Abductors 3	Qadriceps femoris 4 Abductors 3+

4. CONCLUSION

This thesis has provided information about the diagnosis gonarthrosis and TKR. The suggested rehabilitation plan that the patient followed for two weeks showed good results. However, it is important to state that this is only an example of a rehabilitation plan, and if the patient would not have been in such a good condition regarding his age and short time after the operation, the rehabilitation might have been different.

During the two weeks of clinical study of the patient, I have gained a lot of new information on how to not only work out and execute a rehabilitation plan, but also how to relate to a live person and not only theory. The whole study has been interesting and I have been inspired to conduct similar studies in the future. I have also gained valuable experience in the daily work and a physiotherapist and it has shown me the differences between the occupation in Czech Republic and my home country, Norway.

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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

TrP – Triggerpoint

9. SUPPLEMENTS

Maximal knee flexion before therapy, 2.2.09

Maximal knee flexion after therapy, 13.2.09

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Application for Ethics Board Review

Of the research project, undergraduate research, involving human subjects

Project title: Arthrosis and Total Knee Replacement

Nature of the research project: basic research / undergraduate research

Author (chief investigator): Ingvild Buset Bergvad

Supervisor (in case of student research): Mgr. Klara Faladová

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

Date: 03.02.09

Author's signature:

Ingvild B

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: 0253/2009
Date: 5.2.2009

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

Univerzita Karlova v Praze
Fakulta tělesné výchovy a sportu
-2-

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 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.

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Datum:..20.02.09.....

Osoba, která provedla poučení:...INGVILD BERGVAD.....

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Podpis osoby, která provedla poučení:...Ingvild B. Bergvad

Vlastnoruční podpis pacienta /tky:.....