CHARLES UNIVERSITY
FACULTY OF PHYSICAL EDUCATION AND SPORT UK
DEPARTMENT OF PHYSIOTHERAPY

Therapeutic approach and procedures in treatment of Fracture of patella

Bachelor Thesis

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April 2009, Prague

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Declaration:

I declare that this Bachelor Thesis has been based entirely on my own individual work and on my own practice that took place in Vojenska Nemocnice in Prague from Monday the 9th of February 2009, to Friday the 20th of February 2009.

All the information used for the development of this Bachelor Thesis has been taken from the list of literature that exists in the end of this Thesis.

In Prague, 2009 Pavlos Anastasiadis

Acknowledgement:

With this chance I would like to thank the people who influenced me in my life and during my stay in Prague. First of all the most important people for the formation of my personality is my family and I would like to thank them for the wise guiding during my childhood and the important advises in every serious decision of my life. They were always standing by my side whatever my decisions were. As everybody does I did a lot of mistakes in my life, but my parents always supported me. They wanted me to take my life lesson and learn how to react and behave in every situation by learning through my mistakes. Furthermore, they gave me the appropriate education because they are both professors and good persons. When I took the decision that this profession is physiotherapy they wanted me to join one of the best universities in Europe so that I would fulfill my dreams in a perfect way.

I really appreciate everything that my parents gave me and still giving me and I want to graduate to make them happy. There are a lot of other people who helped me during my stay in Prague, but unfortunately I can not mention each one here.

Having the opportunity to study physiotherapy in this school was fantastic I would like to thank all the faculty staff for all the knowledge they gave me. I want also to thank the professors of Charles University in Prague. Their passion for physiotherapy, their great work in the classes and the knowledge that they shared with the students made me love even more this profession. I appreciate the great effort of the whole department of Physiotherapy.

I would like to thank my adviser Miss Puchmeltrova for all the help in the clinical practice I had in Vojenska Nemocnice. She is a skillful physiotherapist with plenty of knowledge. She was really helpful to me during the practice and she gave me the confidence and guidance to work independently with our patients. I want to thank also the other physiotherapists in Vojenska Nemocnice for the help and cooperation during my practice. Special thanks to my supervisor Mgr Faladova for all the help in making and writing this bachelor thesis.

Pavlos Anastasiadis

In Prague, April 2009

Contents:

List of Abbreviations.

ABD: abduction.

ADD: adduction.

B.M.I: body mass index

B.P: blood pressure

CPM: continual passive motion.

DF: dorsiflexion.

DIP: distal interphalangeal.

DVT: deep vein thrombosis

dx: dexter; right.

E: extension.

ER: external rotation.

F: flexion.

IR: internal rotation.

PF: plantarflexion.

PIP: proximal interphalangeal.

PIR: post-isometric relaxation.

sin: sinister; left.

Abstract.

Name of the Bachelor Thesis: Therapeutic approach and procedures in treatment of fracture of patella.

Author: Pavlos Anastasiadis

Aim: In this thesis I will discuss about fracture of the patella of the knee, surgery after the fracture and its rehabilitation, and I involve a detailed physiotherapeutic record of eight sessions of rehabilitation.

Clinical Findings: The patient is a 24 year and he is student. Physiotherapy was given after surgery because of fracture of the right patella of the knee. Initial Kinesiological Examination revealed hypertonus adductors of hip and shortness of rectus femoris , shortness of sartorius, slight weak of gluteus maximus and hamstrings, all bilateral findings, and a ROM of right knee from 0°-110° in the frontal plane.

Methods: The rehabilitation took place some days during morning hours and other days after the launch time. It took place from Wednesday to Friday the first week, and from Monday to Friday the second week. The first meeting with the patient was an Initial Kinesiological Examination and the very last meeting was the Final Kinesiological Examination. Various methods of strengthening targeted weak muscles was used, including implementation of TheraBands, exercise balls, light weights and stretching of short and/or hypertonic muscles by PIR according to Lewit.

Results: Strengthening exercises helped improve correct movement of the body during gait, and stretching increased the ROM in the right knee in the frontal plane from 0°-110° to 0°-130°.

Key words: Knee, Fracture of patella, mobilisation, PIR.

1. Preface.

During my childhood I used to deal with a lot of sports. In these sports plenty of injuries usually happened. Also from the age of 12 years I play volleyball in official championship in my country and I was member of the junior and army national volleyball teams for years. As a player I saw a lot of my co-players to have problems, difficulties and injuries, especially with their knees. So, I understood that I wanted to treat people with injuries, but I did not have the knowledge and the skills at that moment. After my studies here in Prague the university gave this knowledge to treat not only people with injuries but a variety of diseases, syndromes or problems.

Now, as a third and final year student of Physiotherapy at the Faculty of Physical Education and Sports, Charles University, Prague, 2009, we are obliged to undergo a two-week practice at a clinic that offers physiotherapy to its patients. On the basis of these two weeks of practice, we are to write a so-called Bachelor Thesis. My practice lasted from Monday the 9th of February 2009, to Friday the 20th of February 2009. In my thesis I will try to give you an example how I practically use all of these knowledge for an injury of patella of the knee. That is, I will show you a complete session of therapy units including evaluation, examination, inclusions that connect them to the therapeutic plan, and the execution of a therapy proposal with its effect on the patient's rehabilitation program.

During that time I had 9 meetings with one patient; one meeting with the patient every day (excluding Saturday and Sunday), including the last day of my practice, Friday the 20th of February.

My practice was held at Vojenska Nemocnice, in Prague.

2. General Part.

2.1 Anatomy of the knee and patella

2.1.1. The knee as a structure

The knee (also known as gyena) is a complex, compound, condyloid variety of a synovial joint. It actually comprises three functional compartments: the femoropatellar articulation consists of the patella, or "kneecap", and the patellar groove on the front of the femur through which it slides; and the medial and lateral femorotibial articulations linking the femur, or thigh bone, with the tibia, the main bone of the lower leg. The joint is bathed in synovial fluid which is contained inside the synovial membrane called the joint capsule. (1)

2.1.2. The knee joint capsule

The joint capsule is a thick ligamentous structure that surrounds the entire knee. Inside this capsule is a specialized membrane known as the synovial membrane which provides nourishment to all the surrounding structures. Other structures include the infrapatellar fat pad and bursa which function as cushions to exterior forces on the knee. The capsule itself is strengthened by the surrounding ligaments.

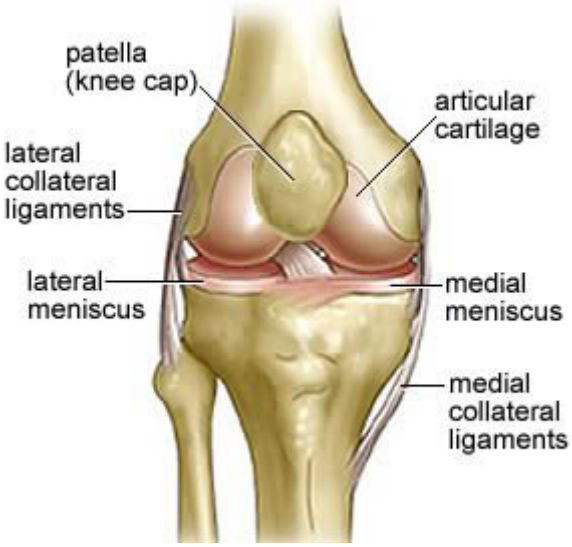

Figure 1: The knee joint(19)

2.1.3. Ligaments of the knee joint

The stability of the knee owes greatly to the presence of its ligaments. Each has a particular function in helping to maintain optimal knee stability in a variety of different positions.

1. Medial Collateral Ligament (MCL) - This band runs between the inner surfaces of the femur and the tibia. It resists forces acting from the outer surface of the knee- valgus forces.
2. Lateral Collateral Ligament (LCL) - This ligament travels from the outer surface of the femur to the head of the fibula. It resists impacts from the inner surface of the knee- varus forces.
3. Anterior Cruciate Ligament (ACL) - The ACL is one of the most important structures in the knee- not least because injury to it may require extensive surgery and rehabilitation. The cruciate ligaments are so called because they form a cross in the middle of the knee joint. The ACL, travels from the anterior (front) of the tibia to the posterior (back) of the femur and prevents the tibia moving forward. It is most commonly injured in twisting movements.
4. Posterior Cruciate Ligament (PCL) - This ligament travels from the posterior surface of the tibia to the anterior surface of the femur and in doing so wraps around the ACL.(2,3)

2.1.4. Menisci

The menisci are the shock-absorbers of the knee - wedged horizontally between the femur and the tibia. They fill in the incongruence between the rounded ends of the femur bone and the flattened ends of the tibia bone upon which the femur sits. The two menisci differ in shape and mobility.

The lateral meniscus is more O-shaped and quite highly mobile, able to slide forwards and backwards with knee movement. The popliteus tendon passes along one edge, which breaks the attachment to the capsule of the joint, and this adds to the mobility.

The medial meniscus is larger and more C-shaped, and tightly bound to the capsular structures and to the medial collateral ligament along the outer rim. It moves very little with the movement of the knee. It is this inflexibility which leads to the

medial meniscus being torn more frequently than the lateral meniscus. The lateral one can move and absorb impact, while the medial one simply rips.(3,4)

2.1.5. Muscle Groups surrounding the knee joint

Anterior muscles

The anterior muscles are the extensor muscles. Crossing over the anterior aspect of the thigh, the elongated sartorius muscles resembles a strap and is useful to both the hip joint and the knee joint. Flexion and lateral rotation of the hip can occur just as easily as flexion and medial rotation of the knee. Nick named the “tailor’s muscle” it is the longest muscle of the human body. The anterior muscles share a common insertion point along the patella and are attached via the patellar tendon.

The patellar tendon runs continuously over the patella and then branches directly into the patellar ligament. The patellar ligament attaches to the tibial tuberosity. The satorius and the quadriceps femoris work in complete unison with each other in order to perform functions. Excellent examples of their unique abilities include the actions of kicking a football and similar moves that work the knee against the thigh.

The quadriceps femoris includes 4 muscles. The rectus femoris is the only one out of the 4 muscles which can affect either the hip joint or the knee joint, despite its superficial location.

The largest muscle of the quadriceps femoris group is the vastus lateralis. As the name implies, this muscle runs laterally. For medicinal injections in infants, this muscle is a common site for injections when the buttocks or the shoulder muscles aren’t available or acceptable sites.

The medial muscle of the thigh in this group is the vastus medialis. The vastus intermedius can be found deep to the rectus femoris, and is the mid sized version of the other two vastus muscles.(4)

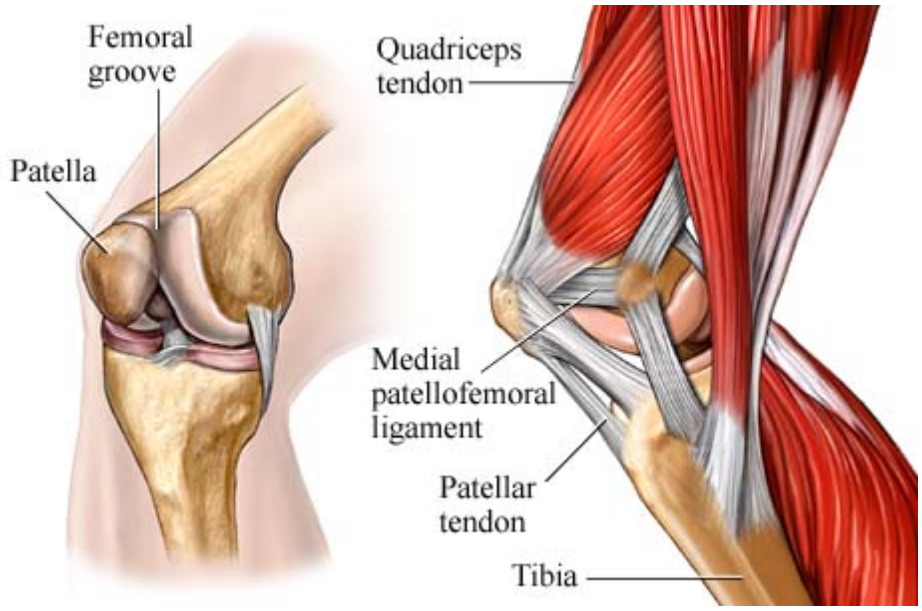

Figure 2: Muscles, ligaments, and tendons of the knee: Medial view.(20)

Posterior muscles

The posterior muscles are also referred to as the flexor muscles. The three posterior muscles of the thigh are counter acting muscles known as antagonistic muscles of the quadriceps femoris. This arrangement allows for knee flexion. The muscles of flexion are often referred to as the hamstring muscles. This common term was developed from butchering practicing of swine, as butchers relied on this same tendon to hang hocks of pork to dry.

The posterior lateral aspect of the thigh is devoted to the biceps femoris. This muscle initiates movement of either the hip or the knee and is equipped with two different heads; one superficial and long and one that is short and much deeper.
The posterior medial aspect of the thigh is devoted to the semi-tendonous fusiform muscle. This muscle is also capable of performing active functions on either the hip or the knee.

Along the posterior aspect of the thigh, there is an additional flattened semi membranosus muscle that can be found positioned deep in comparison to thesemitendonosus muscle.(4)

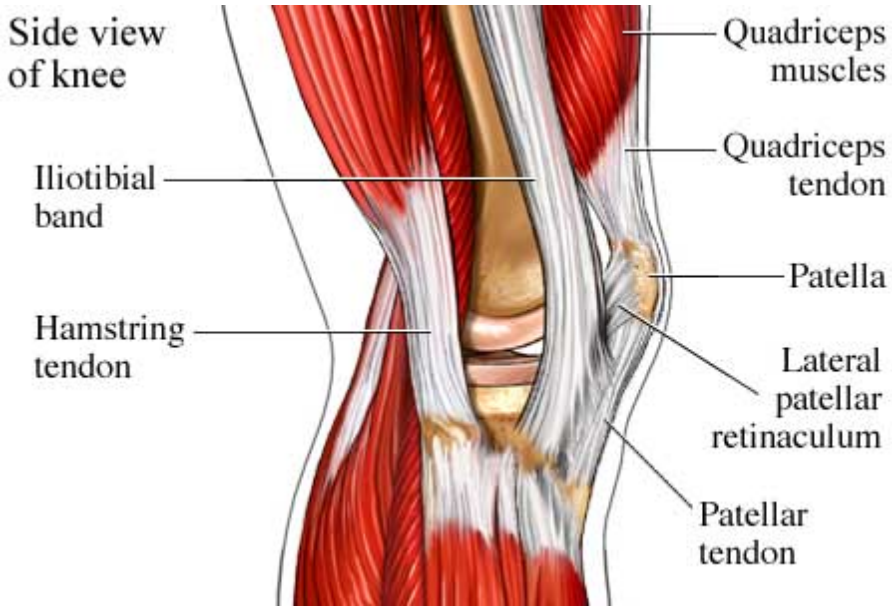

Figure 3: Muscles, ligaments, and tendons of the knee: Lateral view.(21)

2.1.6 Movements of the Knee Joint.

Flexion and extension are the primary movements of the knee joint and their range of motion is measured from a position of reference, which it is in when tibia and femur share the same longitudinal axis, when seen from a lateral view.

An extension movement occurs as the distance between the distal tibia and the proximal femur increases. From maximal flexion to the position of reference, this extension movement is termed relative extension, as the foot is still in flexion. However, there should not be any absolute extension, that is, active movement possible into extension from the position of reference. Passive absolute extension should range from 5°-10°.(3)

Flexion is the opposite movement to extension and the range of flexion depends on the position of the hip and whether it is passive or active. Active knee flexion may reach 140° if the hip is flexed and 120° if the hip is extended. This is due to the hamstrings loosing its efficiency as the hip moves into extension. The range of passive knee flexion depends upon the amount of muscle mass between the approaching bones, but may reach 160°.

Rotation may only occur on a flexed knee. If measured on a subject sitting on a bench with his lower legs hanging off the table, active medial rotation may reach 30° and active lateral rotation may reach 40°, but this depends on the degree of flexion

in the knee. Lateral and medial rotation of the knee is important contributors to adduction and abduction of the ankle.(3,4)

2.1.7 Patella as a structure

The **patella**, also known as the **knee cap** or **kneepan**, is a thick, circular-triangular bone which articulates with the femur and covers and protects the knee joint. It is the largest sesamoid bone in the human body. It is attached to the tendon of the quadriceps femoris muscle, which contracts to extend/straighten the knee. The vastus intermedialis muscle is attached to the base of patella.

The vastus lateralis and vastus medialis are attached to lateral and medial borders of patella respectively. The patella is stabilized by the insertion of vastus medialis and the prominence of the anterior femoral condyles, which prevent lateral dislocation during flexion. The retinacular fibres of the patella also stabilize it during exercise.

The primary functional role of the patella is knee extension. The patella increases the leverage that the tendon can exert on the femur by increasing the angle at which it acts.

The patella ossifies between the ages 2-6 years. In some people it may be absent congenitally or hypoplastic. In 2% of the population there is a bipartite patella, which is usually asymptomatic. Direct trauma, however, may produce symptoms that mimic those of a fracture.(5)

2.2 Biomechanics of patella

2.2.1 Patello-femoral and tibio-femoral joints

The patello-femoral joint refers to a specific part of the knee joint. Medically, the kneecap is known as the patella and the thigh bone is called the femur. The knee joint is composed, as I mentioned above, of three bones - the femur (or thigh bone), the tibia (or shin bone), and the patella (or kneecap). The parts of the knee joint are subdivided into the tibio-femoral joint which refers to the joint space between the tibia and the femur; and the patello-femoral joint which is the joint space between the patella and the femur. Both of these joints (patello-femoral and tibio-femoral) form the knee joint.

The patella is connected to the quadriceps tendon at the top of the patella. The quadriceps tendon attaches to the quadriceps muscle which attaches to the pelvis. The patellar tendon goes from the bottom of the patella to the front of the tibia known as the tibial tubercle. When the quadriceps muscle contracts (shortens), it pulls the patella which in turns pulls on the tibial tubercle, which causes the knee to straighten (go into extension). As the knee moves, the patella glides across the front of the knee joint in a shallow groove on the front of the femur which is known as the trochlear groove of the femur.(6)

2.2.2 Biomechanical abnormalities

There are several basic types of abnormalities that may occur with the patella: it may dislocate (slip out of place), sublux (partially slip out of place), fracture, develop degenerative arthritis, or develop a tracking problem. A tracking problem refers to the fact that the patella stays in place in front of the knee, but it no longer remains centered in the front part of the femur known as the trochlear groove.

When tracking problems occur, the kneecap develops an abnormal set of biomechanics that results in abnormally increased pressure on the underside of the patella (patellar articular surface). The pain that results from this has a variety of different names, and while there are some technically medical differences between the various names listed below, for the sake of simplicity, we will assume that they all refer to the same type of patellar problem. A few of the most common diagnoses associated with tracking problems are: Lateral Facet Syndrome (of Ficat), Anterior Patello-femoral Pain Syndrome, Chondromalacia, Lateral Pressure Syndrome, Malalignment Syndrome, Maltracking Syndrome, and sometimes Patello-femoral Degenerativ Arthritis.Basically, all of the above diagnoses refer to a biomechanical abnormality of the joint space between the patella and the trochlear groove of the femur. Normally, the patella sits centered in the groove.However, if it begins to move towards one side of the groove, the amount of pressure on the underside of the kneecap (patellar articular surface) changes. This results in the development of pain initially. If untreated, the end result is arthritis of the patella.(6)

The centering of the patella in the trochlear groove is related to the strength of the vastus medialis obliqus (a part of the vastus medialis muscle) and the medial patello-femoral ligaments which pulls the patella towards the opposite knee while the

vastus lateralis and lateral patello-femoral ligaments pull the knee cap towards the outside (lateral) aspect of the knee. When all of these forces are in proper alignment, the patella is centered in the trochlear groove of the femur

If an imbalance develops with weakness of the vastus medialis muscle and/or weakness of the medial patello-femoral ligaments and/or over-development of the vastus lateralis muscle and/or tightness of the lateral ligaments of the patello-femoral joint, then a force imbalance develops. When this happens, the patella begins to move laterally (towards the outside) within the trochlear groove. As the knee is flexes, the tension increases on the tight lateral structures. In turn, this causes pain with bent knee activities.

This results in abnormally increased contact between the femur and the patellar articular surface which may eventually result in arthritis. If the imbalance is overwhelming, then the patella may actually slip out of place. (6)

2.3 Patellar fracture

2.3.1. What is fracture of patella?

A fracture of the patella is an injury to the kneecap. The kneecap bone is one of three bones that make up the knee joint. The patella is lined with cartilage on its undersurface, and is important in providing strength of extension of the knee joint. A fracture of the patella should be considered when the patient presents with persistent patellar tenderness and pain or a joint effusion and a history of a direct or indirect injury.

Traumatic fractures of the patella occur with both direct and indirect mechanisms. A direct mechanism, such as a fall, focuses the mechanical forces directly on the patella and results in a higher degree of comminution, less displacement of fracture fragments, and more damage to the articular cartilage compared with an indirect mechanism. Indirect mechanisms, such as jumping (rapid flexion against a fully contracted quadriceps), increase tension and compression on the patella and result in less comminution, increased fracture fragment displacement, and less damage to articular cartilage.(6,8)

2.3.2. How does a patella fracture occur?

A patella fracture most often occurs from a fall onto the kneecap. When this occurs, the fracture can be associated with abrasions and lacerations to the skin overlying the injury. Patella fractures can also occur when the quadriceps muscle is contracting but the knee joint is straightening (a so-called 'eccentric contraction'). When the muscle pulls in this manner, the patella can fracture.(7)

Problem

Patella fractures become problematic if the extensor mechanism of the knee is nonfunctional, articular congruity is lost, or stiffness of the knee joint ensues. In order to avoid these problems, the surgeon must achieve anatomic restoration of the joint and must allow early motion.

Frequency

Patella fractures account for approximately 1% of all skeletal injuries.

2.3.3. Etiology

The subcutaneous location of the patella makes it prone to injury. Fractures occur as a result of a compressive force such as a direct blow, a sudden force as occurs with hyperflexion of the knee, or from a combination of these. A variety of fracture patterns result, depending on the mechanism of injury. The most common patterns are often described as stellate or transverse. Less common patterns include vertical, marginal, osteochondral, or sleeve fractures. Sleeve fractures are seen exclusively in the pediatric population. On radiographs, sleeve fractures are represented by a small bony avulsion fracture. However, they are actually larger than they appear on radiographs because they are surrounded by a significant portion of articular cartilage.

A direct blow to the patella most often results in a stellate fracture pattern. The compressive forces applied to the patella result in a comminuted pattern. The energy of the blow is absorbed by the fracture and may cause damage to the articular cartilage of both the patella and the femoral condyles. Free osteochondral lesions, therefore, must be excluded. Approximately 65% of these fractures do not involve the extensor retinaculum. If the extensor mechanism has not been disrupted and if intra-articular step-off is less than 2 mm, the fracture may be treated with a nonoperative modality.(8)

Another mechanism of injury to the patella is a tensile force, as is sustained with hyperflexion of the knee with an eccentric contraction of the quadriceps. Approximately 35% of these are nondisplaced fractures with an intact retinaculum. This type of fracture, with less than 2 mm of intra-articular step-off, can be treated with a nonoperative modality. A combination of these 2 mechanisms can lead to a variety of other fracture patterns.

A displaced transverse fracture can have comminution if a blow to the knee occurs after the tensile force. For instance, a hyperflexion moment to the knee resulting in a transverse fracture pattern can be followed by a fall onto the knee, which causes comminution.(8)

2.3.4. Indications and Contraindications

Indications for operative treatment include disruption of the extensor mechanism, articular incongruity with more than 2 mm of step-off, or more than 3 mm of separation between primary fracture fragments.

Relative contraindications to closed treatment of patella fractures include open fractures and intra-articular displacement with disruption of the extensor mechanism. Contraindications to operative repair of patella fractures include a preexisting lack of active extensor function, septic arthritis, and fixed flexion contractures of the knee.(8)

2.3.5. Diagnosis

A. History: The individual usually reports pain in the affected knee. Individuals may report an accident, a fall from a height, or a direct blow to the knee while playing a contact sport, or they may report a near fall or some sudden twisting motion of the knee that resulted in persistent pain and tenderness.

B. Physical exam: Painful swelling (edema) and bruising (ecchymosis) may be present around the patella. Extending or bending the knee may prove painful or impossible, depending upon the degree of bone displacement or associated injury to tendons and ligaments surrounding the knee. Nevertheless, the ability to bend or extend the knee does not rule out a patellar fracture. Following serious accidents, associated injuries may be present, which may include injuries to the hip or spine.

C. Tests: Standard x-rays with special views of the patella are usually sufficient to diagnose a patellar fracture. CT scan may be necessary for more difficult cases where x-rays are not definitive. Patella fractures themselves generally do not require MRI evaluation, but associated injuries to nearby tendons and ligaments may need to be evaluated by MRI studies. A standard x-ray of the unaffected (contralateral) knee may prove helpful by providing a comparison.

Also, aspiration of fluid from the affected knee may be performed both to relieve pain and to check for the presence of fat, which often indicates the presence of a fracture.(8)

2.3.6. Classification of patella fracture

Classification is according to the pattern of the fracture.

- Transverse in which the fracture occurs through the mid line dividing the bone into two parts upper and lower.
- Longitudinal in which there is a vertical split in the bone
- Lower or upper pole fractures
- Comminuted fractures in which there are multiple pieces
- Osteochondral fractures that involve the cartilage.(9)

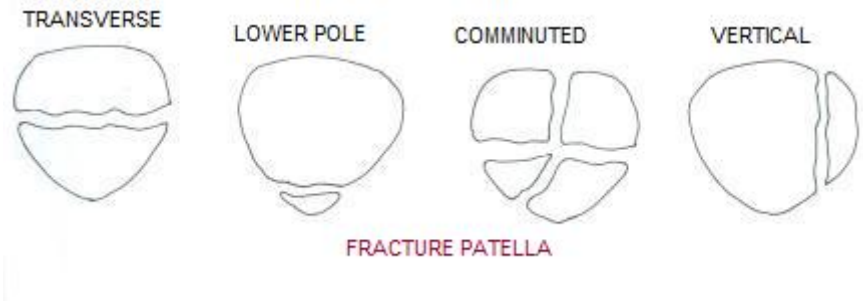

Figure 4: Fractures of patella.(22)

Classification of patella fracture is also according to the separation of the bone fragments.

- Displaced fractures in which the bone fragments are separated
- Undisplaced fractures in which the bone fragments are not separated.(9)

2.3.7. Surgery

Two types of surgery may be done to repair a fractured kneecap:

Open reduction-internal fixation (ORIF) surgery. The surgeon opens the skin and puts the broken bones back together with metal wires, pins or screws. Broken pieces of bone too small to be fixed are removed. If the kneecap is so severely fractured that it cannot be repaired, it may be partially or totally removed. After the bones have been joined, the opening is closed, a sterile dressing is put over the area and the knee is put in a cast or other device so it cannot move while it heals. Sometimes, especially in patients who are thin, the wires, pins or screws can be irritating. If so, the devices will be removed after your kneecap has fully healed.

Full or partial patellectomy. This two-hour procedure removes all or part of the kneecap. If your surgeon finds that the break is too severe to repair, he or she will remove the damaged pieces of bone. The surgery preserves the quadriceps tendon above the kneecap, the patellar tendon below and other soft tissues around the kneecap. After this surgery, you will be able to extend your knee, but the strength of the extension will be weaker.(10)

2.3.8 Complications and possible risks

A. Infections

Rates as high as 2-10% have been reported. Wound healing also may be problematic, especially with associated soft tissue lesions. This high rate is attributable to the subcutaneous location of the patella, with lack of overlying soft tissue. In order to allow healing, the knee often must be immobilized to avoid further stress to the soft tissue. Deep infections require surgical debridement and prolonged antibiotic therapy. Untreated infections can lead to septic arthritis with a poor prognosis.

B. Stiffness

This often occurs following prolonged immobilization. If the patient is amenable to early motion, initiate physical therapy once the soft tissues have stabilized. Patellar mobilizing exercises are mandatory to allow better tracking of the patella. If arthrofibrosis ensues, additional procedures, such as manipulation under anesthesia or arthroscopy, may be required.

C. Hardware prominence

This is best avoided by careful intraoperative techniques. Wire ends should be within soft tissue and not immediately subcutaneous. Up to 15% of patients with symptoms require hardware removal once the fracture is healed.

Prominent wires at the anterior surface of the patella near the prepatellar bursa can lead to prepatellar bursitis. Therefore, ensuring that K-wires and cerclage wires are shortened as much as possible is important.

D. Loss of fixation/loss of reduction

This can occur in up to 20% of fractures treated with internal fixation. It often is due to inadequate fixation, unrecognized comminution, or aggressive postoperative therapy. If only minimal displacement occurs, the fracture may be treated with immobilization until healing occurs. With loss of extensor mechanism or unacceptable incongruity, the fracture must be revised with hardware or by a partial patellectomy.(8,11,12)

2.3.9. Treatment

Treatment of patellar fractures is determined by displacement. Nondisplaced fractures are typically treated without surgery (conservative treatment) by splinting the knee in extension (straight) for 4 to 6 weeks. Since the patella does not bear weight, there is no weight bearing restriction. Crutches, canes, or a walker may be used to aid in walking. Exercise of other leg muscles is encouraged while wearing the splint.After 4 to 6 weeks when the fracture is considered healed, physical therapy to regain range of motion is begun.(11)

Displaced fractures of the patella are treated surgically to stabilize the

fragments. Metal pins, screws, wires, or plates may be used to hold pieces of bone together. In cases in which too much bone has shattered, a partial or complete removal (excision) of the patella itself (patellectomy) may be performed. Surgeons generally retain as much of the original patella as possible to aid the knee in maintaining strength.

Following surgery, the knee usually will be immobilized in a brace. Weight bearing and walking are permitted as tolerated as soon as possible after surgery. Exercises to strengthen important muscles of the leg are begun immediately and range of motion exercises are begun at 4 to 6 weeks after surgery. A healed fracture and a strong quadriceps muscle permit a return to vigorous activity in 6 months.(11)

2.4 Physiotherapy and rehabilitation after patellar fracture

2.4.1Rehabilitation

The goals of rehabilitation after a patella fracture are to reduce pain and to restore function of the involved limb. The rehabilitation protocol depends upon the type, severity, and operative or nonoperative management of the fracture. If the fracture is managed operatively, postoperative rehabilitation is guided by the treating physician.

Regardless of how the fracture is managed, the knee may be immobilized for acertain period of time (13). The physician will indicate when the immobilizer can be removed for exercise.

Early rehabilitation includes gait training with assistive devices, such as canes or crutches, as needed. Individuals are immediately instructed in exercises to prevent loss of motion and strength in adjacent joints. Ankle exercises are taught to promote circulation, and individuals are encouraged to perform these intermittently. Modalities including heat and cold can be used to control pain and edema (14). As guided by the treating physician, range of motion, strengthening, and proprioceptive exercises of the involved joint can be initiated and progressed as indicated and tolerated by the individual (13). Once the fracture is healed, exercises are continued until strength is restored in the knee joint, a normal gait is observed, and full function returns.

A home program should be taught to complement supervised rehabilitation and to be continued after the completion of physical therapy.

Occupational therapy may be recommended to maximize independence in activities of daily living. An ergonomic assessment may be indicated to assess the workplace and suggest adaptations to allow the individual to return to work.(14)

2.4.2 The General Objectives of Rehabilitation of Patella and Knee joint.

As physiotherapists, we need to have in mind all the following, very important goals to achieve the best possible recovery and rehabilitation for the patient:

- protecting the joint in the early stages from further mechanical injury via the appropriate use of braces, crutches or sticks,
- reducing internal swelling as soon as possible to allow full mobilisation,
- reducing inflammation, so that adhesions are not formed and that secondary destruction is not initiated by enzyme release from inflamed tissues,
- identifying infection if there is any, early before it has a chance to spread,
- restoring range of motion (ROM) to prevent later permanent limitation of flexion or extension,
- maintaining muscle responsiveness and limiting inhibition in the early phases and actual wasting in the later stages,
- freeing adhesions so that they do not organise into thicker scar tissue, which might restrict joint mobility,
- rebuilding muscle strength to restore function and also to stabilise the joint and protect it from further injury,
- restoring gait patterns to prevent strain in the back, the hip or the other leg,
- restoring proprioception or internal spatial awareness in the patella and knee, to prevent damaging it again.
- building endurance to strengthen bones and muscles to have as fast recovery as it is possible.
- building nutritional awareness to optimise weight and correct dietary imbalances.(15,16)

2.4.3 The Phases of Rehabilitation.

Short term RHB:

Short term rehabilitation can be divided into different phases, and the main focus is rebuilding quadriceps and hamstring strength and regaining good range of motion.

Immediate phase:

Immediately after surgery, care focuses on pain relief, protecting the patella and knee and maintaining its vital functions, such as blood flow and nerve supply.

One exercise that can be done at this stage to prevent inhibition of the quadriceps muscle, is **the Static Quad exercise**. While lying supine in bed, contract the quadriceps muscle and hold for 5 counts. Do a total of 5 contractions every hour or so.

One exercise to prevent deep vein thrombosis is **the Foot Pump exercise**. While lying supine in bed, dorsiflex the ankle and hold for 5 counts. Plantarflex the ankle and hold for 5 counts. This is one repetition. Do a total of 5 repetitions every 30 minutes.(15,16)

Early phase - in bed:

In the early phase after injury or surgery, when the patella and knee joint are painful and tense with internal bleeding or fluid, and the patient is in bed, it is very tempting for the patient to just keep it still and avoid hurting it further, but it is very important to keep the knee moving unless there is a complication. This is to:

- Prevent DVT - via CPM and foot pumps,
- maintain flexion to keep the knee mobile to prevent adhesions forming - via CPM, heel slides and facilitated heel slides,
- maintain extension - via static quads, passive extension and short arc extensions,
- limit swelling and inflammation - via icing and anti-inflammatories,
- prevent quadriceps muscle inhibition - via static quads.

When the joint is operated upon, there is usually an excess of joint fluid in the joint space. There may also be blood in the joint. At first this fluid is quite liquid and

can easily be aspirated with a needle and syringe. Later, however, the bulk of the liquid is reabsorbed and the remaining fluid becomes sticky and forms strands (adhesions) stretching across the joint cavity. These may form in the pouch above the kneecap (suprapatellar pouch) or in the space below the kneecap (the anterior interval) or in the gutters at either side of the joint space.(15,16)

A CPM (continuous passive motion) machine is an apparatus which is attached to the leg, and which takes the leg passively through the range of motion set by a physiotherapist, nurse or physician. This has the effect of minimising stiffness from internal swelling. It is of particular value after knee replacement, cruciate ligament surgery and patella fracture, but may be applied routinely post knee surgery, generally only for one or two sessions a day. The machines are generally set to allow a limited range of motion, so as to not place the swollen knee under undue stress. The speed is also variable.

The Heel Slide is a simple early exercise to maintain some range of movement. They can be done in bed even while the knee is still painful, as long as the surgeon allows it and the knee is not in an immobiliser. While lying supine, pull the heel towards the buttocks as far as it will go until pain is felt, then slowly push it down again into the resting position. Repeat 4-9 times, several times pr day.

If the hamstrings are too weak to do a heel slide unassisted, the normal leg can facilitate the exercise by helping pull the operated leg. This is **the Facilitated Heel Slide exercise**.

The Short Arc Extension exercise: While lying supine, place a pillow under the knee or the distal thigh, and actively extend the knee. Do it 10 times.(7)

Early phase - mobile:

- Maintain comfort,
- maintain passive range of motion to prevent internal adhesions and stiffness,
- prevent quadriceps atrophy,
- solve complications early.

When the patient starts to walk after a period in bed there are new things to focus on. The muscles are likely to be weaker than normal, and the inflammatory process will be inclined to produce adhesions. Rehabilitation needs to focus on

flexibility, strength and proprioception, and crutch walking should be taught.

Intermediate phase:

- Start active mobilisation, but avoid reflex quadriceps inhibition,
- actively increase range of motion and strength,
- restore proprioception.

Hamstrings stretches are really important to allow the knee muscles to balance properly, and thus prevent further injury. The hamstrings tend to weaken and contract, especially after some time on crutches. Initially this is reversible, but later on the shortening can become permanent, with loss of range of motion. A simple stretch is to sit and bend forward, reaching the toes with your fingers, or lying on your back with non-operated leg flexed at the hip and knee with sole of the foot on the ground, while holding a towel or belt in the hands, putting the operated foot in the loop, straightening the operated leg, and pull it towards your trunk while maintaining the straight leg.

The Full Arch Extension exercise can be used both to increase quadriceps strength and proprioception. While sitting on the or on a chair, keeping non-operated foot on the ground, slowly extend and flex the knee repeatedly. Do 3-5 sets and 6-12 repetitions. When able to do 5 sets of 12 reps, attach a TheraBand or a weight to both legs, and flex one knee while the other extends. Increase resistance as strength improves.(15,16)

The Straight Leg exercise will help improve proprioception, hip and knee flexor strength and balance between agonist, synergist and antagonist. While lying supine or supported on your elbow behind you, with non-operated leg flexed at hip and knee with sole firmly on the ground, the other leg on the ground fully extended, flex the operated foot at the hip, while maintaining knee extension. Perform movements slowly up and down. As strength increases, add resistance in forms of weight collars or TheraBand.

The Bridge exercise is a good exercise for both stretching hip flexors and increasing hip extensor strength. While lying supine, with both feet flexed at the hip and knee and soles of feet firmly on the ground, thrust the pelvis slowly up towards the roof, hold for 5 counts, and slowly lower to the ground again. Repeat for maximally 12 repetitions and 5 sets. Concentrate on performing movement slowly. To

also include hip adductors, place a ball or pillow between the knees while doing the exercise.

Hip Abductor exercises. Hip abductors also need strengthening. While lying supine in bed with legs straight, start by abducting both legs simultaneously. This will prevent activation of quadratus lumborum. When this is easily done for ten repetitions, add a TheraBand and increase as strength improves, or move to a sidelying position, balancing yourself with one arm under the head and the other in front of you. Then do hip abduction. TheraBands can be used in this exercise as well, to increase resistance.(7)

Long term RHB:

The key principles are to:

- Build strength & endurance,
- balance the main muscle groups,
- maintain range of motion,
- prevent further damage by optimising your weight and regaining full position sense in the knee (15, 16).

3. Special part.

3.1 Methods.

The clinical practice on which this special part of the thesis is based, was held during a two-week period from Monday the 9th of February 2009 to Friday the 20th of February 2009, at Vojenska Nemocnice in Prague, Czech Republic.

The person was an out-patient and the author of this thesis was the responsible physiotherapist for the last one and a half week of his rehabilitation program. Physiotherapy sessions were done as is indicated in the following special part.

Rehabilitation unit department at Vojenska's Nemocnice is out-patient rehabilitation clinic, offering treatment for patients who suffer from all the disorders, for which physiotherapeutic treatment provision is necessary. Also there is a fully equipped hydrotherapy and electrotherapy department.

Tools and equipment used during my practice were plumb line, goniometer, red and green TheraBand, soft balls of all the sizes using for soft tissue techniques, different sizes of physiotherapeutic exercises balls, light weights and gym bicycle.

3.2 Anamnesis.

Entrance examination date: 11/02/2009

Patient

-J.P, male

Date of birth: 20/01/1985, 24years old

Diagnosis

-S 820 Fracture of patella of right knee

Personal anamnesis

-The patient had an accident during he was playing football and that was fracture of patella bone of his right knee. After that, he went for operation at Motol hospital in Prague, on 03/12/2008. He was hospitalized for two days and then he got discharged note on 05/12/2008. During those days he had orthesis on the operated knee and he learned how to walk with crutches. Also, he visited the hospital on 12/12/2008 and the orthopaedic doctor cut off the stitches from the surgery. On 29/12/2008 he was sent to Vojenska Nemocnice for rehabilitation, that was his first rehabilitation session. Patient feels very good and he visits the department of rehabilitation in Vojenska

Nemocnice twice a week. His last rehabilitation took place on 20th of February.

Operation and medical anamnesis

03/12/2008: Operation on the right patella of the right knee

12/12/2008: Patient went to the hospital to cut off the stitches from his knee

23/12/2008: First X-ray control after the surgery.

Family anamnesis

-Mother; 46 years old; healthy.

-Father; 47 years old; healthy.

-Brother; 28 years old; healthy.

Allergies

-Bee sting.

Present medication.

-Wobenzym He has been told from doctor to take 30 pills per day. (10-10-10)

-10-10-10 means 10 tablets in the morning, 10 for lunch, 10 for evening.

Abuses

- He is smoker. He usually smokes 20 cigarettes per day.

- He drinks alcohol on occasion.

-He drinks 3-4 cups of coffee every day.

Social anamnesis

-He is student of economics in VSE in Prague.

-He lives with his family in their house. He has to climb 24 stairs to get to his bedroom.

Hobbies-Interests

-Football, swimming, music, reading books

Previous Rehabilitation

Since his first time at Vojenska hospital 29.12.08:

He had nine rehabilitation sessions, which included:

-Educational therapy

-Mobilization of the patella and peripheral joints

-Isometric exercises for quadriceps

-Exercises to increase strength of knee extensors.

-Hydrotherapy, whirlpool therapy

Present state (Status presens):

Height: 1.85cm, Weight: 72kg,

B.M.I: 21

BP: I20/80

Breathing rate per minute: 12

-The patient feels very well. He complains about his big scar on the knee and that his knee is sometimes swollen when he wakes up, usually in the morning. The patient is in 72th day after operation of fractured patella and he looks in very good condition. He walks without crutches and he can move by himself without assistance. The examination has been made by therapist in patient-self standing position.

3.3 Initial kinesiological examination.

3.3.1 Postural Evaluation.

Table 1: Posterior view

Heel form and position	Normal shape and position (both)
Achille's tendon contour	Symmetrical
Achille's tendon thickness	Symmetrical
Calf	Left one has slightly bigger size than the right
Popliteal lines	Looks lateral (both) and the left one is higher 1cm than right
Thigh contour	Left one has bigger size than the right
Subgluteal lines	Right is slight lower
Posterior superior illiac spine	Symmetrical
Ilium crests	Symmetrical

Trunk outlines	In right slightly more concave
Inferior scapula angles	Symmetrical
Scapulas	Symmetrical
Shoulder position	Elevation of the right one
Head position and chin position	Slightly protracted
Auricles	Normal level

Table 2: Anterior view

Feet distance	Normal
Flat transversal sole fornix	Normal
Flat longitudinal sole fornix	Normal
Calf tibial side	Left is bigger in size than the right one
Calf fibula side	Left is bigger in size than the right one
Patella	Right is swollen and faces more medially than the left one
Thigh contour	Left is smaller in size
Anterior superior illiac spine	Symmetrical
Umbilicus	Middle line
Nipples	Symmetrical
Clavicles	Elevation of the right one

Table 3: Lateral view

Knee joint position	Slight Semiflexed knees
Position of pelvis	Posterior tilt

Lumbar part of spine	Hyperlordosis
Thoracic part of spine	Scoliosis
Shoulder position	Elevation of the right one
Cervical part of spine	Normal curve
Head position	Slightly protracted

3.3.2 Anthropometric measurements

- Weight: 72 kg , Right: 36 kg Left: 36 kg
- Height: 182 cm (in present state)

Table 4: Anthropometric measurements of the lower extremities.

Measurement of	Left leg	Right leg
Anatomical Length	87 cm	88 cm
Functional Length	90 cm	91 cm
Circumference of thigh	46 cm	41 cm
Circumference of knee	37 cm	39 cm
Circumference of calf	36 cm	34 cm
Circumference of foot	23 cm	25 cm

3.3.3 Gait Examination.

-Patient was walking with axillary crutches immediately after the surgery as he has been told by her orthopedic surgeon. Two weeks later he was walking without the crutches and he has no problems. He walks more than two months now, without any assistant device.

- Tip-toes walking: Patient can provide it but not for long time because he feels pain on his knee.
- Walking on heels: Steps without problem
- Backwards walking: Not very stable movement of the right leg
- Hands up walking: Steps without problem

- Closed eyes walking: He uses his left side of the body more than the right

The patient in some steps he walks with extended right knee.
-Step phase: There is small circumduction of the right leg
-Stance phase: Normal
-Rhythm of walk: Rhythm is good.
-Pelvis movement: Small elevation on the right side.
-Trunk movement: Normal
-Arm synkinesis: There is no big movement of the arms.

3.3.4 Basic Movement Patterns

The examination of basic moving patterns were provided according to Vladimir Janda

- Extension in hip joint: **negative** on both sides

  Patient can perform the movement. Activation normally of hamstrings and gluteus maximus and also of the erector spinae.

- Abduction in hip joint: **negative** on both sides

  Patient can perform the movement.

3.3.5 Goniometry-Range of Motion Examination.

Active Movement			**Passive movement**		
Left	**Hip**	Right	Left	**Hip**	Right
10 ^{o}	Extension	8^{o}	10 ^{o}	Extension	10^{o}
120^{o}	Flexion	105^{o}	120^{o}	Flexion	110 ^{o}
45 ^{o}	Abduction	40 ^{o}	45 ^{o}	Abduction	45 ^{o}
10 ^{o}	Adduction	10^{o}	10 ^{o}	Adduction	10 ^{o}

45 ^{o}	External rotation	40^{o}	45^{o}	External rotation	45^{o}
45^{o}	Internal rotation	40^{o}	45^{o}	Internal rotation	45^{o}
–	**Knee**	–	–	**Knee**	–
135 ^{o}	Flexion	105 ^{o}	140 ^{o}	Flexion	110 ^{o}
0 ^{o}	Extension	0 ^{o}	0 ^{o}	Extension	0 ^{o}

Table 5: Goniometry – range of motion of the lower extremities.(17)

3.3.6 Muscle Strength Examination.

Tested muscle	Right side	Left side
Gluteus maximus	4-	4-
Hip adductors (Pectineus, adductor magnus, gracilis, adductor brevis, adductor longus)	4	4
Tensor fasciae latae	4	4
Sartorius	4	4
Iliopsoas (Psoas major, psoas minor, iliacus)	4-	4
Quadriceps femoris (Rectus femoris, vastus laterallis, v.intermedius, v.mediallis)	4-	4
Hamstrings	4-	4
Plantar flexors (Gastrocnemius, plantaris)	4-	4
Soleus	4	4

Table 6: Muscles of the Lower Limb (17).

3.3.7 Muscle Length Examination.

A. Length of Hip Flexors

Muscle	Description of Length
Iliopsoas	Not short.(bilaterally)
Rectus femoris	Short.(bilaterally)
Sartorius	Short.(bilaterally)
Tensor Fasciae Latae	Not short.(bilaterally)

Table 7: Length of Hip Flexors.(17).

B. Length of Hamstrings.

Muscle	Description of Length
Forward Bending	Not short.(bilaterally)
Straight-Leg Raising	Not short. (bilaterally)

Table 8: Length of Hamstrings.(17).

C. Length of Ankle Plantarflexors.

Muscle	Description of Length
1-joint plantarflexors (soleus and popliteus)	Not short. (bilaterally)
2-joint plantarflexors (gastrocnemius and plantaris)	Short. (bilaterally)

Table 9: Length of Plantarflexors of the Ankle.(17).

3.3.8 Palpation Examination.

Table 10: Palpation examination of the muscles

Left	Muscles	Right
Normal tonus	Hamstrings	Normal tonus
Normal tonus	Quadriceps	Normal tonus
Normal tonus	Gluteus maximus	Normal tonus
Normal tonus	Gastrocnemius	Normal tonus
Hypertonus	Hip adductors	Hypertonus

- Patient has temperature in normal level
- During palpation on the muscles of both lower extremities I observed that gluteus maximus, quadriceps and hamstring muscles of both sides, they have normal tonus, Generally the shape and size of the muscles of the patient on both sides are good, except quadriceps and hamstring muscles of the right leg, which show small atrophy in comparison of the left leg. This is normal after operation on the area of knee joint. Also, during palpation I did not palpate any trigger point on the muscles of the patient.
- There was no pain during palpation.
- Examination of scar.(see below)

Scar examination:

- The scar on the knee of the patient is suspended vertically, along the patella bone.
- It looks quite healed without any infection.
- It is in good condition.
- It has normal color and it is nice movable, although that is quite big in size.

3.3.9 Joint Play Examination.

-Left patella:

-Mobile in all directions: Cranial, caudal, medial and lateral

.-Right patella:

-Mobile in both medial and lateral direction, but less so in medial direction

-Caudal direction is the only test that produces discomfort.

-Left tibiofemoral and tibiofibular joints:

-No movement restrictions.

-Mobile in all directions

-Right tibiofemoral and tibiofibular joints:

-There is movement restriction in the joint examination but no significant pain.

-It was necessary to provide it more gently

-Left/Right talocrural joints:

-Mobile in all directions.

-Not painful in any direction

-Right Lisfranc and Chopart joints (also include cuboid and navicular bones):

-Mobile in all directions.

-Not painful in any direction

-Left Lisfranc and Chopart joints (also include cuboid and navicular bones):

-Mobile in all directions.

-Not painful in any direction.

-Left/Right metatarsophalangeal and interphalangeal joints:

-Mobile in all directions.

-Not painful in any direction

- Left head of fibula:

-Mobile in both dorsal and ventral directions

-Right head of fibula

-Mobile in dorsal and ventral directions

-A little painful in dorsal direction

3.4 Conclusion of Initial Kinesiological Examination.

During posture examination we found the following positive signs:

-Calf contour on the left side is bigger than the right one.

-Patella of right knee is swollen and faces medially.

-Thigh contour on the right side is smaller than the left.

-Right clavicle is elevated.

-Elevation of the right shoulder.

-Head and chin protracion.

-Hyperlordosis of lumbar spine.

-Scoliotic recurvation of thoracic spine.

-Posterior tilt of pelvis

-Semiflexed knees

We can see that the calf contour on the right side it is smaller in size than the left side because after operation the calf muscles shows some atrophy. The same reason has valitidy and for the smaller size of right thigh contour. The right patella area and the area around the scar is swollen after the surgery, sign which is normal.

Anthropometric Measurements:

- Circumference of the right knee and foot is bigger in cm than the left.
- Circumference of the right thigh and calf is smaller than left.

These findings are normal because of the slight atrophy of the muscles in the area of the right knee, calf and thigh.

Gait:

-During walking examination the patient does small circumduction of the right leg.

-Small elevation of the right side of pelvis.

We observe the above that the patient does not load much the right lower extremity because he is afraid of his operated knee.

Palpation

-Palpation show normal tonus in all muscles except left and right adductors.

-Hypertonus of left/right hip adductors.

-Scar is in very good condition and moveable.

Muscle shortness.

-Bilateral finding of no shortness of 1-joint hip flexors.

-Bilateral finding of no shortness of hip abductors, adductors, extensors, external nor internal rotators.

-Bilateral finding of shortness of rectus femoris, sartorius and gastrocnemius.

-Bilateral finding of weak hip extensors (gluteus maximus and hamstrings).

The shortness of these muscles is normal finding after the surgery procedure.

Muscle strength.

-The muscles of the right lower extremity around the knee (quadriceps femoris, hamstrings) are less strong than the left but just a little. Patient looks very fit and powerful enough.

Joint play

-Right patella examination was restricted in caudal direction. This is because of the scar and the swollen area around the patella.

-Right tibiofemoral and tibiofibular joints restricted movement.

-Right head of fibula examination is painful in dorsal direction.

Other findings.

-Reduced ROM of right knee into flexion and right hip into flexion, because the muscles are not so strong.

3.5 Rehabilitation plan.

3.5.1 Short-term.

-Light soft tissue techniques on the scar area to reduce swelling and to prevent from infection..

-Mobilization of right patella in all four directions (cranial, caudal, medial, lateral) but especially in caudal direction where there is a blockage.

-Mobilization of the right tibiofibular and tibiofemoral joints in ventral and dorsal directions.

-Increase ROM of the right knee by Lewit PIR of rectus femoris.

-Release tension of left and right hip adductors by Lewit PIR.

-Improve muscle strength by strengthening exercises of hip extensors and abductors and knee extensors and flexors.

-Improve muscle length of the shortened muscles.

-Activation of deep stabilization system with exercises on unstable surface.

-Improve balance of the right leg and the whole body by sensomotoric stimulation exercises

-Better normalization of walking.

-Improve activity of stabilization muscles of the knee.

-Educational therapy and general condition exercises.

3.5.2 Long-term.

-Balance the main muscle groups around the knee joint

-Improve activation of small muscles of the feet.

-Maintain range of motion

-After improving of the gait evaluation to maintain the correct walk pattern

-Instruction of patient how to provide correct the auto-therapy exercises

-Increase activities of daily living

-Remedial swimming; this is good to maintain ROM and to maintain strength, with minimal stress on weight-bearing joints.

-Helping him to increase confidence (psychological state)

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3.6 Therapy and Rehabilitation.

3.6.1 Therapeutic Unit 1; Wednesday 11.02.09.

1st session:

Initial Kinesiological Examination.

-Soft tissue techniques for the scar:

We provide general massage around the scar with usage of special cream, which named Campherol. Compressions on the scar with thumb for 15 seconds and we continue in 1cm on the surface of the scar. We use the S-shape figure by pushing medially nest to the scar boarders with both thumbs. Also we use the C-shape by "pulling" the scar on the side with all fingers.

-Mobilisation of the right patella in caudal, cranial, medial and lateral direction.

-Mobilisation the right head of fibula in dorsal and ventral direction.

-Mobilisation of tibiofemoral and tibiofibular joints of the right leg in both dorsal and ventral direction.

Strengthening exercises.

1-"*Overball under heel 1*": Patient is supine, with both lower limbs lying extended on the table. Placing an overball under one of the patient's heels, patient is asked to press the ball towards the bench and hold the foot at the same place throughout the exercise, while the examiner continuously pushes the foot from side to side, trying to bring the patient's foot out of balance. The exercise is done on both feet, and is designed to activate many muscles, from the trunk down to the toes, to make them work together. 2 sets, 10 repetitions; 2x10.

2-"*Overball under heel 2*": Supine on the bench, with lower limbs fully extended, an overball is placed under the heel, and the patient is asked to press it into the bench. This to activate more gluteus maximus. 2x10.

3-"*Overball under knee*": Supine on the bench, lower limbs extended, overball is placed under the knee, and the patient is told to press the ball into the bench. This to activate more the hamstrings. 2x10.

4-"*Overball between knees*": Patient supine, with hip and knee F, with overball between the knees. Patient is asked to extend one knee at the time. This exercise will activate hip adductors and knee extensors. 2x10.

3.6.2. Therapeutic Unit 2; Thursday 12.02.09.

2nd session:.

Subjective findings: Patient today he feels a little bit tired from the yesterday session as he said.

Objective findings: Today is the second therapeutic session and walking pattern of the patient has slightly improved.

Therapy:

Patient from today will have 15 minutes whirpool therapy and after this we will proceed with the other therapies.

-Soft tissue techniques for the scar

-Mobilisation of the right patella in caudal, cranial, medial and lateral direction.

-Mobilisation the right head of fibula in dorsal and ventral direction.

-Mobilisation of tibiofemoral and tibiofibular joints of the right leg in both dorsal and ventral direction.

-“Overball under heel 1”

-”Overball under heel 2”

-”Overball under knee”

-”Overball between knees”

-”Hip Abduction”:

In a supine position on the bench, with a red colored TheraBand tied around the knees, patient is asked to do hip abduction. 2x10.

-Lewit PIR on rectus femoris.

.Sensomotoric stimulation and improvement of proprioception:

Patient is asked to stand on unstable surface and hold this position. After that he has to balance with only one leg and later to change leg. This exercise is perfomed also with semiflexed knees. Later the therapist applies small forces on the patient around shoulder joint and pelvis to compel the patient to hold the balance position.

3.6.3 Therapeutic Unit 3; Friday 13.02.09.

3rd session:

Subjective findings: Patient feels great today and he said that he really wants to improve his condition and to be totally healthy again.

Objective findings: Gait of the patient has really improved and his muscles seem to be more

activated. Day by day they look stronger

-Whirpool therapy for 15 minutes

-Soft tissue techniques for the scar

-Mobilisation of the right patella in caudal, cranial, medial and lateral direction.

-Mobilisation the right head of fibula in dorsal and ventral direction.

-Mobilisation of tibiofemoral and tibiofibular joints of the right leg in both dorsal and ventral direction.

Strentghening exercises like previous session.

-“Overball under heel 1”

-”Overball under heel 2”

-”Overball under knee”

-”Overball between knees”

-”Hip Abduction”

-Sensomotoric stimulation and improvement of proprioception

-Patient will exercise on the gym bicycle for 10 minutes. The bicycle is set to smallest resistance level.

3.6.4 Therapeutic Unit 4; Monday 16.02.09.

Subjective findings: Patient said that he sees improvement on his knee and he feels his right leg more strong than before.

Objective findings: The right knee area looks less swollen than before and the flexion of the right knee is increased 10 degrees.

-Whirpool therapy for 15 minutes

-Soft tissue techniques for the scar

-Mobilisation of the right patella in caudal, cranial, medial and lateral direction.

-Mobilisation the right head of fibula in dorsal and ventral direction.

-Mobilisation of tibiofemoral and tibiofibular joints of the right leg in both dorsal and ventral direction.

-“Overball under heel 1”

-”Overball under heel 2”

-”Overball under knee”

-”Overball between knees”

-”Hip Abduction”

-Lewit PIR on rectus femoris.

-"*Bridges*": In supine lying, with flexion in hips and knees, with soles of feet firmly planted on the bench, patient is asked to push the pelvis towards the ceiling. 3x3, with a 3 second count in the top position.

-Sensomotoric stimulation and improvement of proprioception

-Exercise on the gym bicycle for 10 minutes with smallest resistance.

3.6.5 Therapeutic Unit 5; Tuesday 17.02.09.

5th session:

Subjective finding: Today is patient feels great and he feels his knee very strong as he said. The patient likes the therapeutic sessions.

Objective finding: Walking pattern of the patient has improved. Knee of the patient is not swollen as much as before. ROM of the flexion of the right knee is increased around 10 degrees.

-Whirpool therapy for 15 minutes

-Soft tissue techniques for the scar

-Mobilisation of the right patella in caudal, cranial, medial and lateral direction.

-Mobilisation the right head of fibula in dorsal and ventral direction.

-Mobilisation of tibiofemoral and tibiofibular joints of the right leg in both dorsal and ventral direction.

-"Overball under heel 1"

-"Overball under heel 2"

-"Overball under knee"

-"Overball between knees"

-"Hip Abduction"

-"Bridges exercises"

-Lewit PIR on rectus femoris.

-Sensomotoric stimulation and improvement of proprioception

Autotherapy:

-Patient is instructed in scar mobilisation techniques.

-Patient is instructed in gravity-induced PIR for rectus femoris according to Lewit.

Exercise on the gym bicycle for 10 minutes with smallest resistance.

3.6.6 Therapeutic Unit 6; Wednesday 18.02.09.

6th session:

Subjective finding: Today patient feels great and he likes to cooperate during our therapeutic sessions because he realizes the improvement of his condition.

Objective finding: The gait of the patient is close to normal. Joints of the patient which before were restricted they are with less restriction now. Range of motion of the flexion of the right knee increased almost 10-15 degrees.

-Whirpool therapy for 15 minutes

-Soft tissue techniques for the scar

-Mobilisation of the right patella in caudal, cranial, medial and lateral direction.

-Mobilisation the right head of fibula in dorsal and ventral direction.

-Mobilisation of tibiofemoral and tibiofibular joints of the right leg in both dorsal and ventral direction.

-"Overball under heel 1"

-"Overball under heel 2"

-"Overball under knee"

-"Overball between knees"

-"Hip Abduction"

-Lewit PIR on rectus femoris.

-Sensomotoric stimulation and improvement of proprioception

Autotherapy:

-Patient is instructed in scar mobilisation techniques.

-Patient is instructed in gravity-induced PIR for rectus femoris according to Lewit.

-Slight changes in muscle strengthening program. Exercises like before, with some additions. The therapist puts a small weight around the lower leg, above the ankle of the patient.

1-"*Hip extension*": While in prone position on the bench, patient is asked to first flex one knee to about 90, then lift the knee off the table (hip E). This is for strengthening of hamstrings and gluteus maximus. Patient does 3 sets, with 10 repetitions. 3x10 each leg

2-"*Heel to buttocks*": While in prone position, with lower limbs extended, patient is told to pull one heel towards the buttocks, then down again. 2x15 each leg. Fo strengthening of knee flexors.

3-”*Circles*”: While in supine position, patient is asked to perform circles with her heel on the table, as far up towards the buttocks as possible. 2x15.
Exercise on the gym bicycle for 10 minutes with smallest resistance.

3.6.7 Therapeutic Unit 7; Thursday 19.02.09.

7th session:

Subjective finding: The patient feels great and he feels that his knee became stronger
Objective finding: Walking pattern is very good. Range of motion of the flexion of the knee is improved.
-Whirpool therapy for 15 minutes
-Soft tissue techniques for the scar
-Mobilisation of the right patella in caudal, cranial, medial and lateral direction.
-Mobilisation the right head of fibula in dorsal and ventral direction.
-Mobilisation of tibiofemoral and tibiofibular joints of the right leg in both dorsal and ventral direction.
The same exercises like the previous session
-“Overball under heel 1”
-”Overball under heel 2”
-”Overball under knee”
-”Overball between knees”
-”Hip Abduction”
-Lewit PIR on rectus femoris.
And some new exercises:
-”*TheraBand kicking*”: In a supine position, the patient hold one end of a TheraBand in her hands, while the other end is tied around her feet. Exercise was done with both feet at the time, with one foot at the time and the other stationary, and with one foot going up, the other down. 2x20 with red color. We use this exercise for strengthening of the quadriceps muscles and tensor fascia latae.
-”*TheraBand abduction*”: In a supine position, red and green TheraBands are tied around the patient’s feet, and the patient told to do hip abduction. 2x15 with red color. By this exercise we want to improve the strength of abductors.
-”Hip extension”. 3x10.
-”Heel to buttocks”

-Sensomotoric stimulation and improvement of proprioception

-Exercise on the gym bicycle for 10 minutes with smallest resistance.

3.6.8 Therapeutic Unit 8; Friday 20.02.09.

8th session:

Subjective finding: Today is the last day of our therapeutic sessions. The patient feels very good and quite strong as he said.

Objective finding: The muscles of the right lower extremity became stronger and range of motion of the flexion of the knee is increased almost 20 degrees. The gait is very improved.

-Whirpool therapy for 15 minutes

-Soft tissue techniques for the scar

-Mobilisation of the right patella in caudal, cranial, medial and lateral direction.

-Mobilisation the right head of fibula in dorsal and ventral direction.

-Mobilisation of tibiofemoral and tibiofibular joints of the right leg in both dorsal and ventral direction.

The same exercises like the previous session:

-“Overball under heel 1”

-”Overball under heel 2”

-”Overball under knee”

-”Overball between knees”

-”Hip Abduction”

-Lewit PIR on rectus femoris.

-”TheraBand kicking

-”TheraBand abduction

-”Hip extension”. 3x10.

-”Heel to buttocks”

-Sensomotoric stimulation and improvement of proprioception

-Exercise on the gym bicycle for 10 minutes with smallest resistance.

Final kinesiological exam.

3.7 Final kinesiological examination.

3.7.1 Postural Evaluation.

Table 1: Posterior view

Heel form and position	Normal shape and position (both)
Achille's tendon contour	Symmetrical
Achille's tendon thickness	Symmetrical
Calf	Left one has bigger size than the right
Popliteal lines	Looks lateral (both) and the left one is higher 1cm than right
Thigh contour	Left one has bigger size than the right
Subgluteal lines	Right is slight lower
Posterior superior illiac spine	Symmetrical
Ilium crests	Symmetrical
Trunk outlines	In right slightly more concave
Inferior scapula angles	Symmetrical
Scapulas	Symmetrical
Shoulder position	Elevation of the right one
Head position and chin position	Slightly protracted
Auricles	Normal level

Table 2: Anterior view

Feet distance	Normal
Flat transversal sole fornix	Normal
Flat longitudinal sole fornix	Normal

Calf tibial side	Left is bigger in size than the right one
Calf fibula side	Left is bigger in size than the right one
Patella	Right is swollen and faces more medially than the left one
Thigh contour	Left is smaller in size
Anterior superior illiac spine	Symmetrical
Umbilicus	Middle line
Nipples	Symmetrical
Clavicles	Elevation of the right one
Shoulder position	Elevation of the right one
Head position	Slightly protracted

Table 3: Lateral view

Knee joint position	Slight Semiflexed knees
Position of pelvis	Posterior tilt
Lumbar part of spine	Hyperlordosis
Thoracic part of spine	Scoliosis
Shoulder position	Elevation of the right one
Cervical part of spine	Normal curve
Head position	Slightly protracted

3.7.2 Anthropometric measurements

Measurement of	Left leg	Right leg
Anatomical Length	87 cm	88 cm
Functional Length	90 cm	91 cm
Circumference of thigh	46 cm	43 cm **improved**
Circumference of knee	37 cm	38 cm **improved**
Circumference of calf	36 cm	34 cm
Circumference of foot	23 cm	24 cm **improved**

3.7.3 Gait Examination.

-Patient was walking with axillary crutches immediately after the surgery as he has been told by her orthopaedic surgeon. Two weeks later he was walking without the crutches and he has no problems. He walks almost two months now, without any assistant device.

- Tip-toes walking: Patient can provide it for longer time than before and without any pain on his knee. **Improved**
- Walking on heels: Steps without problem
- Backwards walking: More stable movement of the right leg. **Slightly Improved**
- Hands up walking: ok
- Walking with increased hip and knee flexion (monkey walking): it is very difficult for the patient to walk like this especially when he uses the right lower extremity
- Closed eyes walking: ok **Improved**

-Step phase: Normal. **Improved**

-Stance phase: Normal

-Rhythm of walk: Rhythm is good.

-Pelvis movement: Yes. Normal rotation and shift of pelvis. **Improved**

-Trunk movement: Normal

-Arm synkinesis: There is normal movement of the arms. **Improved**

3.7.4 Basic Movement Patterns

The examination of basic moving patterns were provided according to Vladimir Janda

- Extension in hip joint: **negative** on both sides

Patient can perform the movement. Activation normally of hamstrings and gluteus maximus and also of the erector spinae.

- Abduction in hip joint: **negative** on both sides

Patient can perform the movement.

3.7.5 Goniometry-Range of Motion Examination.

Active Movement			**Passive movement**		
Left	**Hip**	Right	Left	**Hip**	Right
10 ^{o}	Extension	10^{o} **Improved**	10 ^{o}	Extension	10^{o}
120^{o}	Flexion	110 ^{o} **Improved**	120^{o}	Flexion	115 ^{o} **Improved**
45 ^{o}	Abduction	40 ^{o}	45 ^{o}	Abduction	45 ^{o}
10 ^{o}	Adduction	10^{o}	10 ^{o}	Adduction	10 ^{o}

45 ^{o}	External rotation	40^{o}	45^{o}	External rotation	45^{o}
45^{o}	Internal rotation	45^{o} **Improved**	45^{o}	Internal rotation	45^{o}
–	**Knee**	–	–	**Knee**	–
135 ^{o}	Flexion	125 ^{o} **Improved**	140 ^{o}	Flexion	130 ^{o} **Improved**
0 ^{o}	Extension	0 ^{o}	0 ^{o}	Extension	0 ^{o}

Table 5: Goniometry – range of motion of the lower extremities.(17)

3.7.6 Muscle Strength Examination.

Tested muscle	Right side	Left side
Gluteus maximus	4+ **Improved**	4+ **Improved**
Hip adductors (Pectineus, adductor magnus, gracilis, adductor brevis, adductor longus)	4+ **Improved**	5- **Improved**
Sartorius	4	4
Iliopsoas (Psoas major, psoas minor, iliacus)	4+ **Improved**	4
Quadriceps femoris (Rectus femoris, vastus laterallis, v.intermedius, v.mediallis)	4+ **Improved**	5- **Improved**
Hamstrings	4+ **Improved**	4+ **Improved**
Plantar flexors (Gastrocnemius, plantaris)	4 **Improved**	4

Soleus	4+ **Improved**	5- **Improved**

Table 6: Muscles of the Lower Limb (17).

3.7.7 Muscle Length Examination.

Right	**Muscle(s)**	**Left**
No shortness	1-joint hip flexors	No shortness
Small shortness	2-joint hip flexors	Small shortness
No shortness	Ankle plantarflexors	No shortness
No shortness	Ankle dorsiflexors	No shortness
No shortness	Hip abductors	No shortness
No shortness	Hip adductors	No shortness
No shortness	Knee flexors	No shortness

Table 7: Muscle Length After Therapy (8).

3.7.8 Palpation Examination.

- Patient has temperature in normal level
- During palpation on the muscles of both lower extremities I observed that gluteus maximus, quadriceps and hamstring muscles of both sides, they have normal tonus, Generally the shape and size of the muscles of the patient on both sides are good. The quadriceps and hamstring muscles of the right leg, which showed small atrophy in comparison of the left leg, before, the seem to be in bigger size now. Also, during palpation I did not palpate any trigger point on the muscles of the patient.

- There was no pain during palpation.
- Examination of scar.(see below)

Scar examination:

- The scar on the knee of the patient is suspended vertically, along the patella bone.
- It looks healed without any infection.
- It is in very good condition.
- It has normal color and it is nice movable, although that is quite big in size.

Table 10: Palpation examination of the muscles

Left	Muscles	Right
Normal tonus	Hamstrings	Normal tonus
Normal tonus	Quadriceps	Normal tonus
Normal tonus	Gluteus maximus	Normal tonus
Normal tonus	Gastrocnemius	Normal tonus
Normal tonus **Improved**	Hip adductors	Normal tonus **Improved**

3.7.9 Joint Play Examination.

-Left patella:

-Mobile in all directions: Cranial, caudal, medial and lateral

.-Right patella:

-Mobile in both medial and lateral direction, but less so in medial direction

-Caudal direction is a bit restriction in this direction but better than before. **Slightly Improved**

-Left tibiofemoral and tibiofibular joints:

-No movement restrictions.

-Mobile in all directions

-Right tibiofemoral and tibiofibular joints:

-There is no movement restriction in the joint examination and no significant

pain. **Improved**

-Left/Right talocrural joints:

-Mobile in all directions.

-Not painful in any direction

-Right Lisfranc and Chopart joints (also include cuboid and navicular bones):

-Mobile in all directions.

-Not painful in any direction

-Left Lisfranc and Chopart joints (also include cuboid and navicular bones):

-Mobile in all directions.

-Not painful in any direction.

-Left/Right metatarsophalangeal and interphalangeal joints:

-Mobile in all directions.

-Not painful in any direction

- Left head of fibula:

-Mobile in both dorsal and ventral directions

-Right head of fibula

-Mobile in dorsal and ventral directions

-Not painful in dorsal direction **Improve**

3.8 Therapy Effect Evaluation.

Results of therapy:

Patient has improved the ROM of his right knee into flexion with 20°, from 110° with some pain, to 130° with minimal pain and normal tonus.

Gait has improved. The patient is now able to walk with a more erect posture, including the hip extensors. The patient he does not walk with extended right knee

anymore. Pelvis movement is normal. The patient he does not walk with extended right knee anymore

In joint play examination after the therapeutic mobilization of the joints, right patella moves in caudal direction with less restriction, right head of fibula moves in dorsal direction without restriction. Also tibiofibula and tibiofemoral joints are more moveable without restriction on both dorsal and ventral directions.

Also during anthropometric measurements we found that circumferences of the right foot, knee and thigh are improver and smaller in size than before. The scar is healed very much and it looks in very good condition and the area around the scar is not swollen as much as before.

In addition, the muscles around the kneecap which are involved in knee movements they became stronger in almost all the cases. Also the knee flexors, (gastrocnemius, popliteus) seem to be in normal length again.

3.9 Prognosis.

Prognosis of rehabilitation after patella fracture injury and surgery was very good for this patient. He had good improvement as discussed in the final kinesiologic examination. So far there have been no complications, neither with surgery nor with therapy. Patient shows a great interest in improvement. He is young, fit, strong and athletic type that is why his muscles and range of motion of his joints will come fast in previous condition and he will have no problem for quick recovery.

As the patient told me he will continue the rehabilitation program in a private clinic because he really wants to play again football soon. However, at the same time he continues auto-therapy exercises at home.

The next orthopedic control is in 3 months, that is, in the end of May or beginning of June. The orthopedic doctor will then decide how patient’s rehabilitation has been so far, and if he can proceed for new surgery to take off the wire from the bone of right patella.

4.Conclusion.

The third day of my two-week practice period, I was given a list of prospective patients. Up to that point, I've never had any experience with a patient after surgery because of fracture of patella, so I choose that one. I did the Initial Kinesiological Examination based on my own intuition and general knowledge in the field of rehabilitation, and started working. I produced results on the area of my rehabilitational focus (improving range of motion of the right knee into flexion), and as such, I am satisfied with the results.

I feel really happy after these two weeks of practice in the Military hospital of Prague. It was the first time I managed to use the knowledge that our university offers me in real profession conditions. Then the fact that there was an improvement after these 8 sessions in the patient’s situation filled me as a physiotherapist and as a person that can help others through the profession.

But the good improvement of the patient’s condition happened not only because of my personal work but also because of his great cooperation and the willing to work hard with his problem. She had positive reactions like a person and trusted my abilities from the first meeting. Without her great effort it would not be possible to see improvement in her situation.

Finally, my adviser in military hospital, Mgr. Martina Puchmeltrova guided and helped me during this practice with both a professional and humanistic way which was really determining for the therapy success and for fulfilling the goals of this practice.

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Figures Sources:

19) Figure 1: The knee joint
http://www.oromedhealthcare.com/aching-knees.php
20) Figure 2: Muscles, ligaments, and tendons of the knee: Medial view
https:/.../en-us/support/topic.asp?hwid=zm2283
21) Figure 3: Muscles, ligaments, and tendons of the knee: Lateral view
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22) Figure 4: Fractures of patella
http://www.joint-pain-expert.net/patella-fracture.html

6. Supplement

6.1 Ethic committee statement