CHARLES UNIVERSITY IN PRAGUE

Faculty of physical education and sport

Department of Physiotherapy

CASE STUDY OF PATIENT WITH POSTOPERATIVE OF PATELLA TENSION

Bachelor's Thesis

Prague 2013

Author: Osama Saleh Al sheikh

Supervisor: Mgr. Lenka Satrapová

ABSTRACT

Title: Postoperative of Patella Tension Cerclge of Left Knee

Objective: The aim of this Bachelor Thesis research is based on understanding the functional features of the knee joint, the mechanism of patella fracture and focusing on the main principles and procedures of the therapy before reconstruction.

Methods: The study lasted for a period of two weeks. The rehabilitation plan which was executed during the two weeks for five sessions went accordingly. Range of motion exercises, PIR as well as sesnsomotoric and proprioreceptive stimulation exercises were performed on each day, including mobilization of restricted joints and strengthening and stretching exercises for weak and short muscles respectively.

Results: After the five therapeutic sessions, I took a final kinesiological examination in order to compare the results with the initial examination and the results showed an increase in the range of motion of the knee in both extension and flexion.

KEY WORDS: Postoperative of patella tension cerclage of left knee, Range of Motion, Quadriceps, Hamstrings, sensomotoric training, Post Isometric Relaxation

DECLARATION

I declare that this Bachelor's Thesis is based on my own individual work during my two weeks of clinical practice at C.L.P.A (Centrum léčby pohybového aparátu) that was done between the 5th of February 2013 and the 19th of February 2013. The information used in the writing of this Bachelor Thesis was sourced from the literature provided at the end of the project.

.....

Osama Saleh Alsheikh

DEDICATION

This Bachelor's Thesis is dedicated to my family, most especially my parents ,my wife and my son have been a source of strength, encouragement and support throughout my years of study and through my toughest times in Czech Republic.

To the lecturers of Charles University, Faculty of Sport and Physical Education, my completion of my studies would not have been possible without the help from each one of you.

Lastly to all my dear friends, the list is endless, your support and friendship made this a much easier journey and to you all, I say thank you.

ACKNOWLDGEMENTS

I would like to thank my supervisor Mgr. Lenka Satrapova for the advice and help she gave during the preparation of my Bachelor Thesis. I would also like to thank the patient I worked with for his cooperation and patience during the two weeks of my practice that I worked with him. Lastly, I thank my supervisor Dr. Edwin Mahr who assisted me during my clinical work placement at C.L.P.A (Centrum léčby pohybového aparátu)

Table of Contents

1. INTRODUCTION

This Bachelor's Thesis research is based on the patella tension cerclge of the knee joint. It will involve an overview of the knee joint, the biomechanical principles of the knee joint and the patella in particular, mechanisms of patella fracture, the clinical examination of the knee joint, symptoms of injuries of the patella fracture, surgical and conservative ways of treatment. Physiotherapy and rehabilitation after patellar fracture. All these will be discussed in the theoretical part of the thesis

The practical part which is the case study will include the therapeutic unit applied on the patient and the progress of the therapy. This will include the following:

i. Anamnesis
ii. Present state of the patient
iii. Previous rehabilitation
iv. Initial kinesiological examination
v. Conclusion of the initial examination
vi. Therapy proposal
vii. Short and long term rehabilitation plan
viii. Day to day therapy applied (for five days) and the subjective and objective results for each day
ix. Final kinesiological examination
x. Conclusion of the kinesiological examination and progress of the therapy applied

The main aim of the thesis is for the reader to get an overview on the subject of patella tension cerclage from a theoretical and practical point of view.

1.1 Anatomy of the knee and patella

1.1.1. 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)

1.1.2. 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. (1)

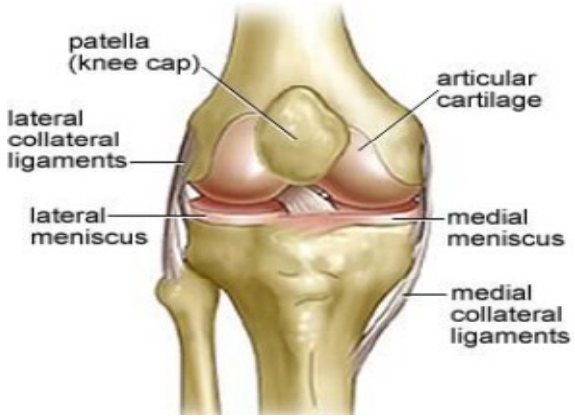


Figure 1: The knee joint.(3)

1.1.3. 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.(3,4)

1.1.4. 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 11

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

1.1.5. 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. (3,4)

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 intermediacy can be found deep to the rectus femoris, and is the mid sized version of the other two vastus muscles.(3,4)

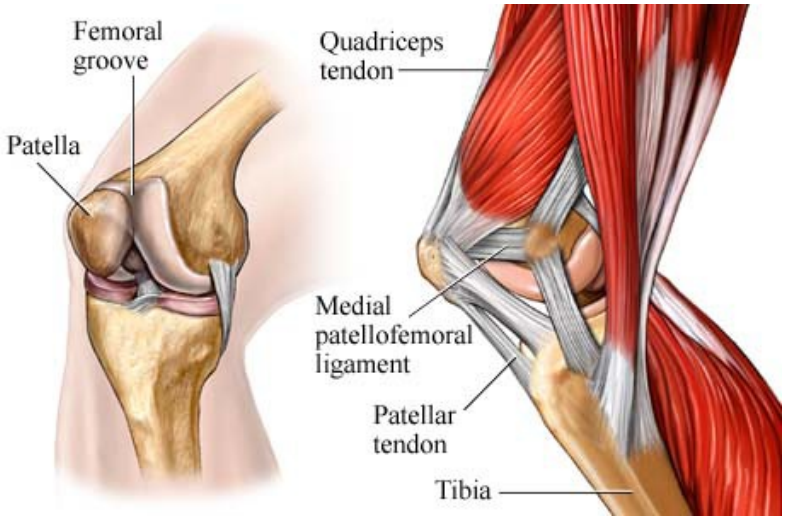


Figure 2: Muscles, ligaments, and tendons of the knee: Medial view.(1)

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 the semitendonosus muscle.(2)

Figure 3: Muscles, ligaments, and tendons of the knee: Lateral view.(1)

1.1.6 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°.(2)

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 losing 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°. (4)

1.1.7 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 intermediaries 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 condoles, which prevent lateral dislocation during flexion. The retinacular fibers 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 hypo plastic. 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.(1,4)

2. BIOMECHANICS OF KNEE JOINT

2.1 Patellofemoral Biomechanics

2.1.1 Patella Function

The primary function of the patella is to act as a fulcrum, effectively increasing the lever arm of the quadriceps. The patella is appropriately suited to act as a pivot surface for the quadriceps tendon. This fulcrum action requires a surface adapted to bearing high compressive loads with minimal friction forces. The hyaline cartilage of the patella, the thickest in the body, provides this environment. The viscoelastic properties of cartilage allow it to deform to distribute the contact load over a large area. The patella also acts as a site of convergence for the four quadriceps muscles figure 11. Through particular congruency with the patellofemoral groove, it produces stability of these four muscles under load. Finally, the patella also protects the underlying femoral condyles from trauma. (5)

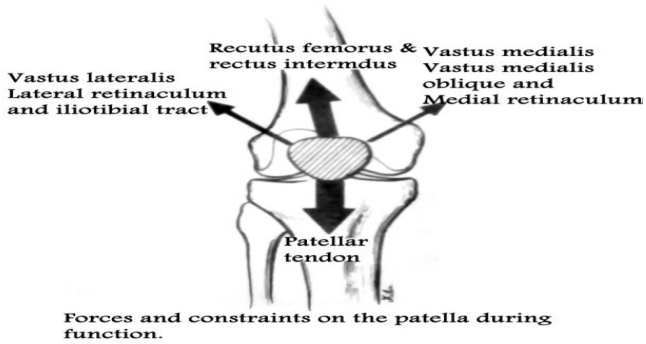
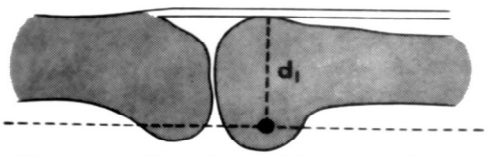


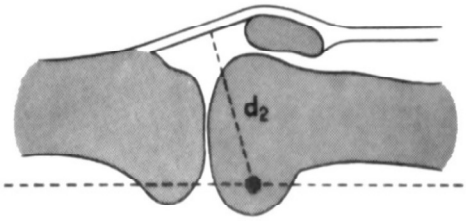
Figure 4: Forces and constraints on the patella during function.(18)

2.1.2 Patellar Contribution to Quadriceps Extension Torque

The patella is an important component of extensor function, significantly contributing to knee extension torque – Knee extension torque or moment is the product of the quadriceps force multiplied by the length of the moment arm through which it acts. The moment arm, the distance between the joint center of rotation and the quadriceps mechanism, is increased if the quadriceps mechanism is moved interiorly and decreased if it is moved posterior. The patella more effectively increases the moment arm of the quadriceps as the knee is extended. The maximum effect is at a knee flexion angle of approximately 20° (Figure 12. D1. and .D2).The patella becomes less prominent with flexion as it sinks posterior into the intercondylar notch. Sub-sequently the patella only contribute about one- sixth of the moment arm between 60° and 120° degrees flexion. (5)



Without a patella the knee at full extension has a small moment arm (d1).

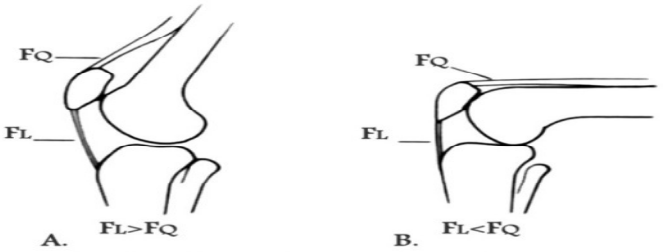


The patella lengthens the extension moment arm (d2) of the knee at full extension.

Figure 5:The patella extension moment arm.(8)

2.1.3 Transmission of the Quadriceps Force to the Patellar Tendon

A complex relationship exists between the force in the quadriceps tendon and the force in the patellar tendon .The relative force in each tendon varies with knee flexion angle, At small angles the patellar tendon force is larger, whereas at large flexion angles, the quadriceps tendon force is larger; The relative changes in the ratio of forces in each tendon are due to variations in the moment arm of each tendon with knee flexion angle Figure 13.



Shifting location of patellofemoral contact area at different flextion angles determines the force ratio. A. At 30° knee flexion,the contact area is located distally. The quadriceps (F_Q) acts as a mechanical advantage and generates a greater ligamentum force (F_L). B. At 90° of knee flexion the opposite situation occurs.

Figure 6: Different flexion angles and force ratio.

At a knee flexion angle of 30°, Huberti, et al, (Huberti Hh, W Hayes et al., 1984) found that the force in the patellar tendon exceeds the force in the quadriceps by 30% , while at 50° flexion, the two forces are equal; As knee flexion is continued beyond 90°, the force in the patellar tendon is 30% less than the force in the quadriceps tendon . While also the patella act as balance beam Figure 14. (5)

2.1.4 Dynamic of the Patellofemoral Joint (PFJ)

The term dynamics refers to the forces on an object; here, we analyze the:

• forces on the patellofemoral joint

• contact area of the patellofemoral joint

• the contact pressure that results from these forces

• To obtain the relationship between force and pressur. (7)

2.1.5 Patellofemoral Compression Force

The resultant patellofemoral force depends on two factors:

• knee flexion angle

• the force in the quadriceps and patellar tendons

• Increasing knee flexion angle decreases the angle between the quadriceps tendon and patellar tendon, thus increasing the amount of the force in the quadriceps and patellar tendons that acts on the patellofemoral articular surface. (7)

Theoretically, then, increasing knee flexion increases the resultant patellofemoral force Figure 15.In the actual case, this increase in force with flexion is limited at flexion angles more than 70° to 80° by contact between the quadriceps tendon and the distal femur , The resultant patellofemoral force is significantly reduced due to load sharing from the tend femoral contact point. (7)

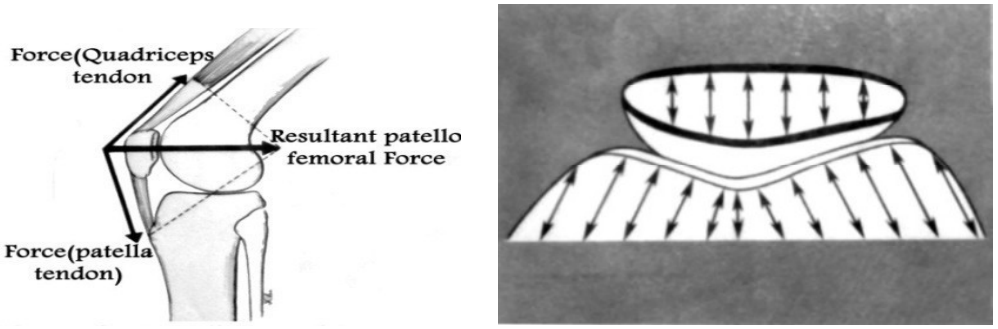


Figure 7: the resultant patellofemoral force compresses the patella against the femur; This compressive force is the consequence of the quadriceps tendon force and patella tendon force. B. Osseous structure of PFJ in cross section demonstration the contact forces carried by the Patellofemoral joint. (7,8)

Although the range of reported values is between 60° and 130° degrees, others authors suggest that this angle is between 70° and 80° degrees for most activities. (9)
The torque generated by the quadriceps muscle during walking, climbing stairs, and other normal activities is the product of the weight of the subject multiplied by the distance between the center of mass of the upper body and the center of the knee joint ; Therefore, hip flexion, which brings the center of mass of the upper body closer to the center of rotation of the knee, reduces the torque generated by the quadriceps muscle; Patients with knee joint pathology or pain compensate by modifying their body position .These patients will use more hip flexion and less knee extension, reducing the resultant patellofemoral force Figure 16. (8)

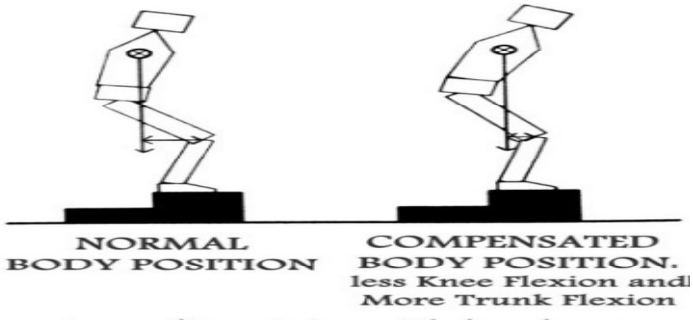


Figure 8: moment arm and the knee torque; Ascending stairs with less knee flexion and more trunk flexion reduces the torque on the knee; this compensated body position moves the center of mass of the trunk closer to the knee , thereby reducing the knee moment arm and the knee moment arm and the knee torque. (8)

2.1.6 Patellofemoral Contact Area

The patella begins to contact the femur with quadriceps muscle recruitment wit hout knee flexion. This contact begins on the inferior patella at full extension and moves superiorly with increasing knee flexion. During knee flexion from full knee extension, the distal part of the patella comes in contact with the lateral femoral condyle at 10° to 20° of knee flexion, and the patella then follows an S-shaped curve through the trochlea; The part of the patellar surface articulating with the femur moves proximally during flexion of the knee, At 90° the contact area has reached the superior patellar; Throughout this range from 0° to 90° the contact area extends transversely across the

patella, All areas of the lateral facet and medial facet proper contact the femur in this flexion range , Beyond 90° the contact area diminishes slightly, as only the lateral and medial edges of the patellar facets are in contact with the femur Figure 9 . (8)

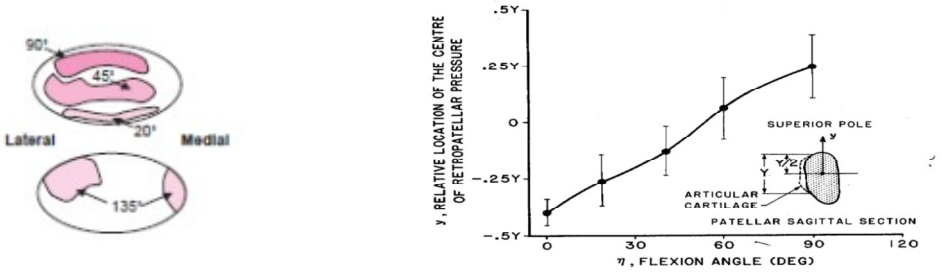


Figure 9: Contact Area. A. areas of articular contact on the patella with increasing knee flexion .B. The center of pressure moves superiorly from the inferior articular surface with knee flexion. (8)

2.1.7 Patellofemoral Contact Pressure

2.1.7.1 Flexion

Patellofemoral contact pressure is defined as the normal perpendicular (angle or corner) force per unit contact area. When considering contact pressure, two different mechanical situations must be analyzed: physiologic flexion, extension against resistance, Physiologic flexion may be defined as flexing or extending the knee with the weight of the upper body being supported by the knee joint *(close chain).* Activities of daily living involving physiologic flexion include walking, rising from a chair, and squatting. In physiologic flexion, knee torque and therefore, quadriceps force, increase with increasing knee flexion angle. The resultant patellofemoral force also increases with flexion angle to a maximum at 70° to 90° flexion 35. (6)

The increase in patellofemoral force would markedly increase the contact pressure if not for the accompanying increase in contact area with flexion to 90° Figure 18.

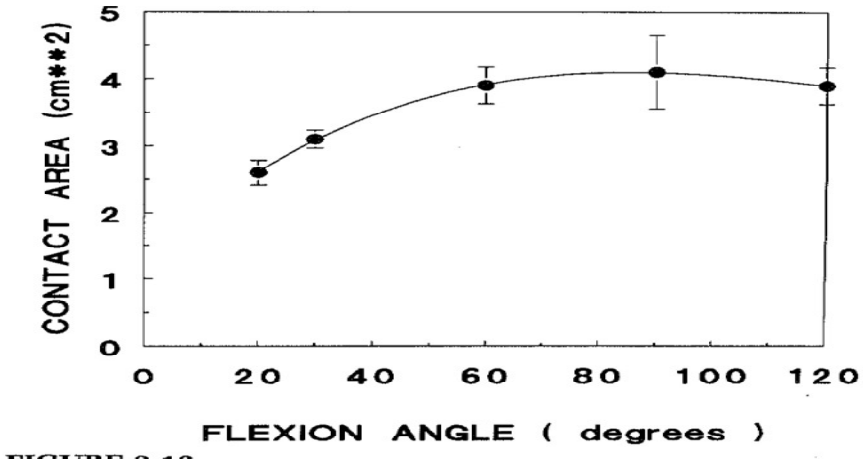


Figure 10: Patellofemoral contact pressure with flexion on normal knees(18)

The increase in contact area protects the patellofemoral joint by limiting the increase in the contact pressure with increasing patellofemoral force. The resultant patellofemoral force does, however, increase disproportionately to the contact area, causing the contact pressure to increase modestly with flexion Figure 19. The patella is further protected by the particular cartilage thickness. The thickness of the particular cartilage varies with the functional needs of the patella, patella that articulates at 30° knee flexion At 30° the patellofemoral contact pressure is low thickness of cartilage is small while at 60° knee flexion At 60° the contact pressure is almost double the pressure at 30°; hence the cartilage is much thicker in this area (see Figure 19). (6)

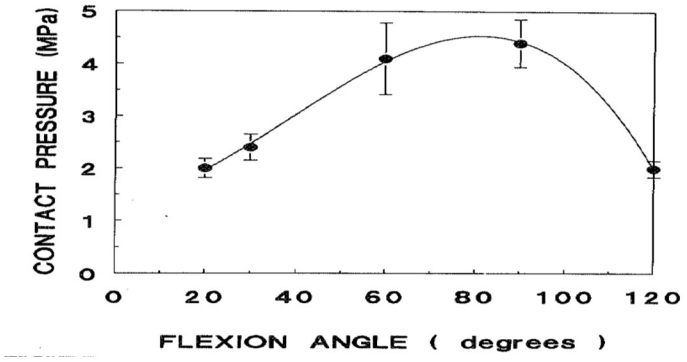


Figure 11: Patellofemoral contact pressure with flexion on normal knees (18)

The contact pressure is distributed over both the medial and lateral facets. In the flexion range from 0° through 90° the entire articular surface of the patella comes into

contact with the femur. The resultant patellofemoral force and the contact area are greater on the lateral facet than the medial facet throughout this flexion range. The ratio of both these parameters from 0° through 90° is approximately equal. This results in an equality in the contact pressure on the medial and lateral facets, even though the lateral facet is subjected to greater force than the medial facet. (6)

2.1.7.2 Extension

A different contact pressure profile is obtained during extension against resistance. Extension against resistance, extending *(or flexing)* the lower leg against gravity, occurs in the sitting position when a weighted lower leg is raised *(or lowered)* against gravity *(open chain)*. This motion is typical of quadriceps strengthening exercises. In this situation, the torque generated at the knee increases with extension because the weight is moved farther from the center of rotation of the knee. This increase in torque with extension is supplied by increasing the quadriceps force, and hence, increasing the resultant patellofemoral force. Unlike physiologic flexion *(closed chain)* where the resultant patellofemoral force increases with flexion, in extension against resistance the resultant patellofemoral force increases with extension. This situation concentrates the maximum patellofemoral force over the smaller contact area present at low flexion angles. The high force on a small area leads to large contact pressures on the patella. (6)

2.2 Biomechanical Function Of The Patella

The patella and patellar tendon, together with the quadriceps and the quadriceps tendon, produce the extensive mechanism of the knee joint. The patella increases the lever arm of the m.quadriceps femoris during E of the knee joint. From a mechanical perspective, the patella allows for an increase of about 30% in strength of E (kicking) of the knee joint. It also provides a better distribution of the compressive forces on the femur by increasing the surface contact between the patellar tendon and the femur, as well as protecting the patellar tendon from excessive friction. The movement of the patella within the femoral trochlea depends on the traction of the m.quadriceps femoris, patellar tendon, the depth of the femoral condyle and the shape of the patella. (5)

The biomechanical function of the patella is shown easily by studying the diagrams below of the forces with and without the patella to be present.

The Q force of the m.quadriceps femoris, acts on the patella (Figure 7). It can be analyzed into two components, the Q1 force which acts along the coronal axes of the knee joint (E - F), and which tends to push the patella on the femur. A second force Q2 acts along the line of the patellar ligament. This force, Q2 acts on the tibial tuberoses and it can also be analyzed into two other components, the Q3 force which acts on the coronal axes of the knee joint (E - F) and its main function is to keep the lower leg and the thigh together. The second one is the tangential Q4 force which is the active agent for the E of the knee joint and moves forward the lower leg under the femur. (11)
Suppose that the patella is removed, for example after a patellectomy (Figure 8). The Q force which we consider equal to the other Q force from the figure 7, is exerted tangentially on the patella surface of the femoral bone and directly to the tibia tuberosity. It can therefore be analyzed into two components, the Q5 force holding the lower leg pressed onto the femur, and the Q6 force which is responsible for the E of the knee joint. We note that the tangential Q6 force is significantly reduced and the centripetal Q5 force is relatively increased. (5)

If we compare now the active forces in these two cases (Figure 9), it is clear that Q4 force is 50% higher than the Q6. As a result, the patella by elevating the quadriceps tendon increases the potential of it. It is also clear that, in the absence of the patella, the Q5 force, which is the contact force, it increases. Nevertheless this positive effect is offset due to limitation of the range of F, shortening of the quadriceps tendon and from the increased susceptibility to injury (5)

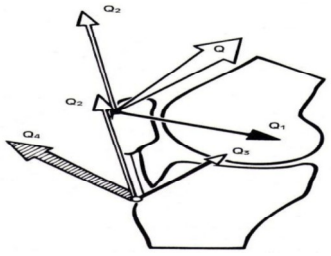


Figure 12 - Forces which are acting on the knee joint while patella is present, according Kapandji (19)

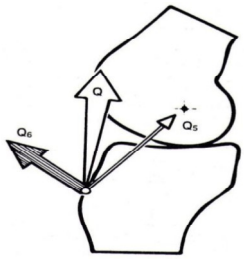


Figure 13 - Forces which are acting on the knee joint while patella is not present, according Kapandji (19).

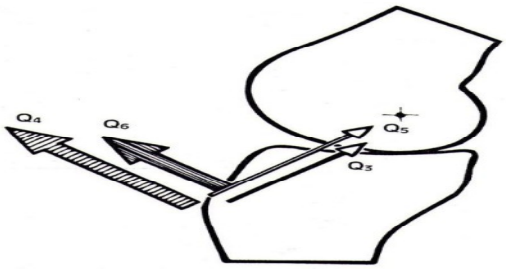


Figure 14 - A compare of the active forces from the previous two cases, according Kapandji (19).

2.2.1 Kinematics

Kinematics refers to motion of an object *without* reference to the forces acting on the object; In this section we will quantify the motion of the normal patella with respect to the femur.

2.2.1.1 Q Angle

The Q angle is the angle between the quadriceps tendon and patellar tendon at full extension Figure 20.a normal knee valgus would generate a small Q angle. The major contribution to the Q angle is created by the terminal external rotation of the tibia, the “screw-home” effect. This laterally rotates the tibial tubercle, the attachment of the patellar tendon, greatly accentuating the Q angle At full extension, the Q angle produces a valgus force on the patellar this situation, the patella is free from the restraints of trochlea and this valgus force must be resisted by the medial retinaculum and vastus medialis). (9,18)

Q angle is measured as the angle formed by the intersection of the line drawn from the anterior superior iliac spine (ASIS) to the midpoint of the patella and a proximal extension of the line drawn from the tibial tubercle to the midpoint of the patella Figure 20. (9,18)

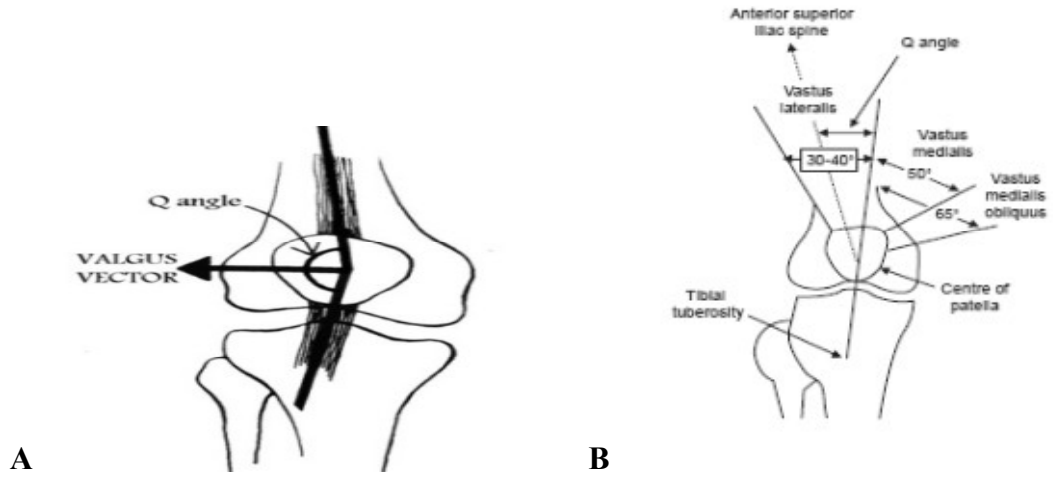


Figure 15 A. The Angle between the quadriceps tendon and the patella tendon forms the Q angle; the Q angle produces a valgus force (18). B.The measurement of the Q Angle, and illustration the angles of pull by the different parts of the quadriceps muscle.(19)

2.2.1.2 Patellofemoral Motion

1. At full extension with the quadriceps contracted, the patella lies in the supratrochlear fat pad.
2. From Full extension through about 20° flexion the patella is not yet firmly entrenched *(fixed)* in the patellofemoral groove of the femur. In this early stage of flexion, the stability of the patella is maintained by the tension of the quadriceps. *(The lack of firm stability in early flexion is reflected by the relatively high frequency of tracking problems in this range.)*
3. After 20° flexion, the stability of the patella is maintained by congruity with the trochlea. This congruity accounts for the consistent tracking patterns encountered after 20° to 30° flexion
4.Because of the angle of the quadriceps mechanism (Q angle), the patella enters the patellofemoral groove from the lateral side as flexion is initiated. The patella continues to move medially (Stein La, An Endicott et al., 1993) to about 30° flexion as the tibia derotates, releasing the valgus force produced by the Q angle. At the same time as, the patella assumes a prominent position on the trochlea. In this prominent position, the quadriceps lever arm is greatest. At this stage, patellar tracking is ensured by congruity

with the femur. After 40° of flexion, the patella begins to return to a centered position as it sinks posteriorly into the trochlea. It reaches a central 38 position at roughly 80° and remains centered throughout the remainder of flexion. (9)

The patella normally shows a slight tilt with flexion. The patella, initially level, slowly tilts medially until it reaches about 4° medial tilt at 40° flexion. At this point, it reverses and begins to tilt laterally, reaching a neutral tilt at a knee flexion angle of 70°**.** The patella continues to tilt laterally, attaining 4° lateral tilt at a knee flexion angle of 100°. Further flexion returns the patella to a neutral position at 120° to 140°. The patella also rotates Figure 21 about its center with knee flexion. Defining neutral rotation as the patella position at full extension, the patella steadily internally rotates to reach a maximum of 12° internal rotation with full flexion. (9)

2.2.1.3 Patellar Kinematics

As the knee starts to bend, the pulling force of the tendons (patellar and quadriceps) are exercised at an angle, creating compression forces between patella and femur. The compression leads to reaction forces that are affected by the angle which is formed form the knee F and the size of the active and passive pulling force of the m.quadriceps femoris.(9,5)

While walking the reaction force reaches half of the body weight at the time that the knee is flexed in 15° and the foot touches the ground. This force may reach 350% of the body weight in case of an increased activity when the knee is flexed up to 60°. During intensive exercise and in 135° of knee F, the reaction force reaches 800% of the body weight. (18)

A large patellofemoral reaction occurs while the knee joint is flexed in 90°. The reaction force at this point is up to 250% of the body weight and it is greater than the power which is performed from the m.quadriceps femoris.(9)

As a conclusion, the larger the range of knee F, the more is the input force of the m.quadriceps femoris and so greater will be the reaction force which is acting on the

patella. On the contrary the smaller the range of knee F, the less is the force of the m.quadriceps femoris and therefore the reaction of the patella will be smaller.(13,21)

The physiological balance contractions of the vasti muscles produce a force which has a cranial direction along the longitudinal axis of the femur. If there is an imbalance between these muscles, for example if the m.vastus lateralis override to an atrophic m.vastus medialis, the patella moves to a lateral direction. This is one of the mechanisms responsible for patellar dislocation that always happens to the lateral direction.(9)

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.(11,12)

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 combination, 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 combinations, increased fracture fragment displacement, and less damage to articular cartilage.(12)

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.(6)

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. (12)

Frequency

Patella fractures account for approximately 1% of all skeletal injuries. (26)

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 hyper flexion 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. (29,28)

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 condoles. 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.(28)

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. (14)

A displaced transverse fracture can have combinations if a blow to the knee occurs after the tensile force. For instance, a hyper flexion moment to the knee resulting in a transverse fracture pattern can be followed by a fall onto the knee, which causes combinations.(14)

2.3.4. Indications and Contraindications of patella operative: .(35)

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. (13)

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. (15)

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.(15,13)

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. (13,15)

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.

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.(14)

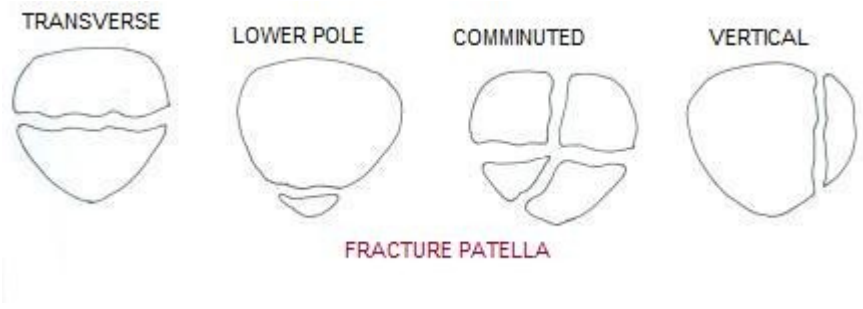


Figure 16: Fractures of patella.(18)

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

19 20 Displaced fractures in which the bone fragments are separated

- Undisplaced fractures in which the bone fragments are not separated.(28)

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. (21)

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.(21)

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. 21 This can occur in up to 20% of fractures treated with internal fixation. It often is due to inadequate fixation, unrecognized combinations, 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.(14)

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. (16)

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. (15)

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 combinations, 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. (21)

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. Displaced fractures of the patella are treated surgically to stabilize the patella.(22)

2.4 Physiotherapy and rehabilitation after patellar fracture

2.4.1. Rehabilitation

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 a certain period of time. The physician will indicate when the immobilizer can be removed for exercise. (22)

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 (30). 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 (21). 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.(23)

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,
- restoring range of motion (ROM) to prevent later permanent limitation of flexion or extension.
- restoring proprioception or internal spatial awareness in the patella and knee, to prevent damaging it again
- 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, \ freeing adhesions so that they do not organize into thicker scar tissue, which might restrict joint mobility,

- rebuilding muscle strength to restore function and also to stabilize the joint and protect it from further injury,
- restoring gait patterns to prevent strain in the back, the hip or the other leg,
- maintaining muscle responsiveness and limiting inhibition in the early phases and actual wasting in the later stages,
- building endurance to strengthen bones and muscles to have as fast recovery as it is possible.0
- building nutritional awareness to optimize weight and correct dietary0 imbalances. .(30,33)0

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.(22)

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. (22)

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 deep vein thermoses- 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-inflammatory,
- 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.(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 minimizing 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. (22)

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.(21)

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.(23)

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. (34)

Intermediate phase:

- Start active mobilization, but avoid reflex quadriceps inhibition,
- actively increase range of motion and strength,
- restore proprioception. (23)

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.(21)

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 quadrates labarum. When this is easily done for ten repetitions, add a TheraBand and increase as strength improves, or move to a sideling 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. (21)

Long term RHB:

The key principles are to:

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

3. SPECIAL PART (CASE)

3.1. Methods

The clinical work placement took place in the Centrum lecby pohyboveho oparatu Hospital (CLPA, Sokolovská 304 Praha 9 Vysočany) from 5.2.2013 up to **19.2.2013**. My clinical practice was supervised byPhD. Edwin Mahr of the department of physical rehabilitation. In that time I was able to see my patient 5 times during the outpatient hours plus.

During the performance of the therapeutic units our main concern for the patient was the improvement of his range of motion, muscles power, balance and stability. For that reason mainly manual therapy was applied but as well I used specially designed equipment for the improvement of the proprioception, the co-ordination and the muscular strength of the patient. During the performance of the examinations (initial kinesiology and final kinesiology examination) the equipment that I used involved:

- Goniometer, for the evaluation of the available range of motion of the associated body segments (lower extremities
- Measurement tape (for the performance of the anthropometry measurements
- Neurological Hammer (for the evaluation of the deep tendon reflexes as a part of the Neurological Examination)

My patient was a postoperative of patella tension cerclage of left knee. after sport accident (hockey).

3.2. Anamnesis

3.2.1. History

On 24.12.12 around 00:30 o'clock, patient fall on ice during a hockey match with a direct hit to his left knee. After the accident the patient was transferred to the hospital with sharp pain. After X- Ray diagnoses patient has comminuted fracture patella on left knee.

In same day patient did the operation in his patella (patella tension cerclage), without contraindications for surgery.

Patient discharge in 30.12.2012

After the operation he was applying on his left knee ice packs 3Xday for 10 mints. Isometric exercise for quadriceps muscles 3X day 100 times.

3.2.2. Present state

Height: 178 cm

Weight: 76 kg

BMI: 22.7

Pain level: 7/10

Blood pressure: 135 mmHg (systolic) / 82 mmHg (diastolic)

Heart rate: 68 bpm

On 8.1.2013 patient came to CLPA for first session of therapy after 2 weeks from surgery. He was in good condition with two elbow crutches and immobilizer on left knee.

3.2.3. Personal anamnesis:

- All common childhood diseases.
- Epileptic.

3.2.4. Operation anamnesis:

- Non.

3.2.5. Family anamnesis:

- Father: healthy.
- Mother: healthy.
- Brother: healthy.

3.2.6. Social Anamnesis

- He is single.
- Lives with his family, so he can have some help with his daily living activities if needed.
- In his daily life and activities he faced some difficulties because of the injury.
- Patient lives in a flat on the 2rd floor. It has an elevator.

3.2.7. Occupation anamnesis

The patient work in a sports equipment shop, so the injury does affect his work.

3.2.8. Hobbies-ADL:

- Football
- Ice hockey
- Floorball

3.2.9. Allergic anamnesis:

- Non

3.2.10. Medication:

- DEPAKINE CHRONO – 1 X day for partial epilepsy.

3.2.11. Abuses:

- Smoking (10-15) cigarette.
- Alcohol social.

3.2.12. Previous rehabilitation:

- Non.

3.2.13. Statement from the patient's medical documentation:

- No medical documentation available

3.2.14. Indication of rehabilitation

Recommendations of the doctor:

-Then check via him, in the next 14 days.

- Use the functional knee immobilizer.
- Apply ice on the left knee joint.
- Regular analgesics if pain.
- Soft tissue for left knee.
- Mobilization of left knee.
- Hydrotherapy.
- Sensomotoric training.
- Bicycle exercise.
- Walking with crutches (forearm) without big load on the injured leg.

3.3. Initial kinesiologic examination:

The initial kinesiological examination took place on Wednesday 6rd of February 2013. For all the examinations that I performed patient took off his knee brace. I performed the following examinations to the patient:

1. Postural examination [by Kendall]
2. Examination of the pelvis [by Kendall]
3. Gait examination [by Kendall]
4. Soft tissue examination [by Lewitt]
5. Muscle tone examination [by Kendall]
6. Range of motion examination [by Kendall]
7. Anthropometric measurements [by Kendall]
8. Muscle strength test [by Kendall]
9. Muscle length test [by Kendall]
10. Joint play examination [by Lewitt]
11. Neurological examination [by Lewitt]
12. Evaluation of stability on left knee joint:

3.3.1. Postural examination [by Kendall]

For the postural examination patient is standing on the floor, without the use of the crutches. I examined patient form posterior, lateral and anterior views but it was not possible to use the plumb line.

V- Posterior view

- Asymmetric of the heels shape and position.
- Asymmetric of the Achille's tendons.slightly bigger on left side.
- Asymmetric of the calfs. hypotonic on left side.
- Left popliteal line is higher than the right one.
- Left subgluteal line is slightly higher than the Right.
- Right lower angle of scapula is lower than the left one.
- The distance between the medial border of scapula and spine is higher than the Left.

- Scapula alata(winging) on the Right scapula.
- The trunk is leaning a little bit to right.
- The head is leaning to the Lift.

VI-Lateral view

- Right foot more forward.
- Left knee in slight flexion.
- Trunk slightly rotated to the left side.
- The abdominal wall is in a small prominence.
- Lumbar spine slightly lordosis.
- Thoracolumbar spine is flat.
- Thoracic spine is slightly kiphosis.
- Elbow joints are semi flexed both upper extremities.
- Thoracocervical spine kiphosis.
- Cervical spine slightly kiphosis.
- The shoulders are anterior protraction.
- Head foreword.

VII-Anterior view

- Arch of foot Symmetry not flat.
- Right patella is (higher than the Left one)
- There is scar and swelling in left patella.
- Left quadriceps is hypotrophy.
- Right anterior superior iliac spine is higher than the Left one.
- Umbilicus is shifted to the Right.
- Sternum is on the midline.
- Left nipple is higher than the Right one.
- Left clavicle is slightly higher.
- Right shoulder is slightly higher than left one.
- Head shifted to the Left.

3.3.2. Examination of the pelvis [by Kendall]

The examination of the pelvis was done with the patient in standing position.

V-Posterior view:

o Left PSIS is lower than the Right one.

o Iliac crest, right higher than the Left one.

VI-Lateral view:

o PSIS and ASIS are in same level in both sides.

VII-Anterior view:

o Left ASIS is lower than the right one.

[

3.3.3. Gait examination [by Kendall]

Patient is using crutches (forearm) for walking, the doctor recommended the patient to walk with crutches (forearm) without big load on the injured leg. We performed the gait examination for walking with the crutches. During the whole examination of gait patient didn't fell neither dizzy or any kind of pain.

Walking with crutches

- Patient is using the 3point type of walking with crutches and he does it correctly (first the crutches, then the injured leg and in the end the healthy leg).
- He is walking with confidence and his velocity can be characterized as fast.
- Both of his shoulder while he is walking are in elevation and slightly protracted.
- Asymmetric steps of length, Symmetric swinging motion of arms.
- Patient walk with straight back. Limping more and leaning to the right side.
- More loading on the lateral side of right feet.
- Left knee semi-flexion in stance and swing phase.
- Not enough dorsal flexion of left feet.

3.3.4.Soft tissue examination [by Lewitt]

I examined the connective tissues – skin, sub skin and fascia – of the area around the left knee joint and the left thigh and all the layers were restricted in all – caudal, cranial, lateral and medial – directions.

The scar on patella of left knee joint completely healing not active and in good condition. There is no increase of temperature around scar. Scar calm length is 14 cm.

3.3.5. Muscle tone examination [by Kendall]

Muscles	Left	Right
Rectus femoris	Slight hypotone	Hypotone
Vastus medialis, vastus intermediaries, vastus lateralis	Eutone	Hypotone
Hip Adductors	Eutone	Hypertone
Hip abductors	Eutone	Eutone
Hamstrings	Eutone	Hypertone
Tensor fasciae latae	Eutone	Eutone
Gluteal muscles	Eutone	Hypotone.
Gastrocnemius	Eutone	Hypotone
Tibialis anterior	Eutone	Hyperton

Table no.1 – Initial examination: Muscle tone examination

3.3.6.Anthropometric measurements

V- Height

In standing: 142 cm In sitting: 98 cm

VI- Lengths of lower extremities

Body part	Left cm	Right cm
Anatomical length (form trochanter major to lateral malleolus)	93	95
Functional length (from anterior superior iliac spine to medial malleolus)	98	98
Functional length (from umbilicus to medial malleolus)	110	109
Thigh (from trochanter major to knee joint)	50	51
Middle leg (from knee joint to lateral malleolus)	44	44
Foot (from heel to longest toe)	26.5	26.5

Table no.2 – Initial examination: Lengths of lower extremities (cm).

VII- Circumferences of lower extremities

The measurements were done with a measuring tape and the patient in supine position on the therapeutic table.

Body part	**Left** cm	**Right** cm
Thigh (15 cm above the knee cap)	41	46
Thigh (10 cm above knee)	36	40
Knee joint (around the knee joint)	41	38
Calf (place of highest volume)	33	35
Ankle joint (around medial and lateral malleolus)	26	25
Foot (around metatarshal heads)	23,5	24

Table no.3 – Initial examination: Circumferences of lower extremities (cm).

3.3.7. Range of motion examination [by Kendall]

The examination of ROM was performed according to the principles of Kendall and the results of my examination are written according to the SFTR method. For measuring of ROM I used a goniometer and for measuring of the passive movements I had the help of my supervisor.

V- Hip joint

Left hip joint	**Active range of motion**	**Passive range of motion**
S	15- 0 -110	20-0-130
F	30- 0 -25	35- 0 -35

Right hip joint	**Active range of motion**	**Passive range of motion**
S	40- 0 -140	50- 0 -145
F	40- 0 – 30	45- 0 – 45

VI- Knee joint

Left knee joint	**Active range of motion**	**Passive range of motion**

S	0- 0 – 60	10- 0 – 70

Rigth knee joint	Active range of motion	Passive range of motion
S	10- 0 – 140	15- 0 -160

V11- Ankle joint

Left ankle joint	Active range of motion	Passive range of motion
S	15- 0 -50	25- 0 -55
Rs	10- 0 – 20	15- 0 - 20

Right ankle joint	Active range of motion	Passive range of motion
S	20- 0 – 55	30 - 0 - 60
Rs	15- 0 – 25	25- 0 - 30

3.3.8. Muscle strength test [by Kendall]

I performed all the muscle strength tests according to Kendall. The grading is of the results is also according to Kendall, where:

No contraction 0

Contraction felt with no visible movement 1

Movement through complete ROM for the tested muscle 2

Gradual release from test position 3-

Holds test position (no added pressure) 3

Holds test position against slight pressure 3+

Holds test position against slight to moderate pressure 4-

Holds test position against moderate pressure 4

Holds test position against moderate to strong pressure 4+

Holds test position against strong pressure 5

Examined muscle	Right	Left
Quadriceps femoris	5	3
Gluteus maximus	5	4+

Gluteus media	+4	4
Gluteus minimus	5	4
Tibialis anterior	5	4
Gastrocnemious	5	4+
Hamstrings	5	4+
Adductors	4	3
Iliopsoas	+4	4
Tensor fascia latae	5	+4
Sartorius	5	4
Soleus	5	+4
Tibialis posterior	5	5
Peroneus longus	5	+4
Peroneus brevis	+4	+4

Table no.4 – Initial examination: Muscle strength test, grading according to Kendall.

3.3.9. Muscle length test [by Kendall]

The muscle length tests were performed according to Kendall and the results are written according to Janda, where:

0 No shortness

1 Moderate shortness

2 Marked shortness

Examined muscle	**Right**	**Left**
Hamstrings	0	1
Tensor fasciae latae	0	1

Iliopsoas	0	1
Gastrocnemius	0	1
Soleus	0	1
Rectus femoris	0	0
Tensor fasciae latae	0	1
Adductor	0	1

Table no.5 – Initial examination: Muscle length test, grading according to Janda.

3.3.10. Joint play examination [by Lewitt]

All the examinations were performed according to Lewitt.

Patella:

- The left patella is restricted in all directions (cranial, caudal and lateral and medial direction)
- The right patella is free in all – cranial, caudal, lateral and medial – directions.

Tibiofibular joint:

- The left is restricted in both ventral and dorsal directions.
- The right one is not restricted in any direction.

Distal 2^{nd} – 5^{th} interphalangeal joints:

- All joints are restricted in dorsal and ventral directions in both feet.

Proximal 2^{nd} – 5^{th} interphalangeal joints:

- All joints are restricted in dorsal and ventral directions in both feet.

Interphalangeal joint of big toe:

- There is no restriction in any direction in both feet.

Metatarsophalangeal joint of big toe:

- The left feet is restricted in dorsal and ventral directions.
- There is no restriction in any direction in right feet.

Metatarsal heads:

- All restricted (one head against the next one movement), in both feet.

Lisfranc joint:

- The left feet is restricted in dorsal and ventral directions.
- There is no restriction in any direction in right feet.

Chopart joint:

- Restricted in dorsal and ventral directions in both feet.

Talocrural joint:

- Not restricted in dorsal direction in both feet.

3.3.11. Neurological examination [by Lewitt]

V- Superficial sensation

- Dermatome L_3: patient is feeling the same in both lower extremities.
- Dermatome L_4: patient is feeling the same in both lower extremities.
- Dermatome L_5: patient is feeling the same in both lower extremities.
- Dermatome S_1: patient is feeling the same in both lower extremities.
- Dermatome S_2: patient is feeling the same in both lower extremities.

***VI-Deep sensations test*:**

- Vibration: negative in both lower extremities.

- Joint position sense: negative in both lower extremities.

- Two-point discrimination: negative in both lower extremities.

- Graphesthesia: negative in both lower extremities.

VII- Deep tendon reflexes:

For the examinations of the deep tendon reflexes I used a neurological hammer. Evaluation grades:

- 0 absent
- 1 bypoactive or present only with reinforcement
- 2 normal response
- 3 brisk with or without evidence of spread to the neighboring roots
- 4 unsustained clonus
- 5 sustained clonus

Reflexes	Right	Left
Knee jerk reflex	2	2
Achilles tendon reflex	2	2
Plantar reflex	2	2

Table no.6 – Initial examination: Examination of deep tendon reflexes.

3.3.12. Evaluation of knee stability on left knee joint:

- Drawer sings (one plan anterior and posterior stability test):

Negative.

- Reverse lachman test (one plan posterior stability test):

Negative.

- Lachman test (one plan anterior stability test):

Negative.

3.4. Conclusion of initial kinesiological examination

The left knee is a bit swollen (3 cm bigger circumference than the right one).

- Patient has a faulty posture with small base of support, the whole right side in more tone than the left one and his left knee joint fixed in a small flexion.
- Slight lateral tilt of the pelvis to the left.
- When the patient is walking with crutches I can say that he has a good walking pattern..
- All the connective tissues – skin, sub skin and fascia – of the area around the left knee, scar tissue and the left thigh are restricted in all (cranial, caudal, lateral and medial) directions. The scar was in good condition, not active and the clam is 14 cm.
- Muscle tone imbalance in the left leg. Hamstrings are hypertonic and the quadriceps, gluteal and calf muscles are hypotonic.
- Patient has muscles weakness on left side (Gluteus maximums. Quadriceps. Hip adductors)
- The ROM of flexion of left knee joint is decreased in both active and passive movements. The ROM of extension of left knee joint is full range.
- Short hamstrings, hip Adductors, gastrocnemius, triceps surae, Tensor fasciae latae and Iliopsoas in left leg.

- The left patella is restricted in cranial, caudal, medial and lateral directions; the right one is free in all (cranial, caudal, lateral and medial) directions. The left tibiofibular joint is restricted in both dorsal and ventral directions.
- Restriction also found in the interphalangeal, metatarsophalangeal (2nd – 5th), chopart joints and in metatarsal heads in both feet. Patient also has decreased arch of both feet.
- In left feet there is restriction in the Metatarsophalangeal joint of big toe and Lisfranc joint in dorsal and ventral directions. In right feet is free no restricted. Metatarsal heads are restricted (one head against the next one movement) in both feet.

3.5. Short-term rehabilitation plan:

- Relive pain
- Elimination of the remaining swelling on the lower part of the left knee, by applying some slight and local pressure in caudo-cranial direction.
- Release the restricted connective tissues – skin, sub skin and fascia – of the area of the left knee joint, the scar and the left thigh, by means of soft tissue techniques.
- Release the restriction of left patella and tibiofibular joint, by means of Joint play technique by Lewitt.
- PIR by Lewit to release the tension in muscles
- Elongation of the short muscles hamstrings, Adductors, gastrocnemius, triceps surae, Tensor fasciae lata and Iliopsoas in left leg with stretching exercises.
- Improve the ROM of the left knee joint in both flexion.
- Gradually strengthening of the weak muscles of the left lower extremity (quadriceps, gluteus maxims, and hip adductors).
- Improve the stability and balance of the left knee joint, by means of sensomotoric training exercises.
- Instruct patient about self-therapy.

3.6. Long-term rehabilitation plan:

- Maintain and even improve more where is possible all the results from the Short-term rehabilitation plan.
- Maintain muscle strength.
- Improve movement of patient through exercises.
- Correction of patient's gait. Than running and jumping.

- Patient return to his hobbies and sport.
- Improve the performance of patient's daily living activities as much as possible.

3.7. Day To Day Therapy

Instruments used in rehabilitation process:

During the whole rehabilitation process I used the following tools and devices: soft ball, over-ball, posturomed and exercise ball.

3.7.1. 1st therapeutic session: 8.2.2013

V- Goals of today's therapy unit:

- Elimination of the remaining swelling in the left knee joint.
- Release the restricted connective tissues – skin, sub skin and fascia – of the area of the left knee joint, the scar tissue and the left thigh.
- Release the restriction of left patella and tibiofibular joint and other small joints.
- Relaxation of the hypertonic muscles in left lower extremity.
- Improve the ROM of the left knee joint in flexion
- Elongation of the short muscles hamstrings. Hip adductors, Iliopsoas, Tensor fasciae latae gastrocnemius and triceps surae in left side.
- Strengthening of left quadriceps, hip adductors and gluteal muscles.
- Instruct patient for self-therapy: stretching of hamstrings and Adductor. Strengthening of

VI- Procedures:

1. Soft tissue techniques for the restricted connective tissue.
2. Joint play method, according to Lewitt.
3. PIR method, according to Lewitt.
4. Exercises to increase ROM.
5. Stretching exercises.
6. Strengthening exercises.
7- Self-therapy.

Execution:

. Soft tissue techniques:

I performed soft tissue techniques for the swelling, the area around the left knee joint and the left thigh in all – cranial, caudal, lateral and medial – directions and for all

the layers of the connective tissue (skin, sub skin and fascia). For the thigh I also used a soft ball.

For scar i performed pressure by both thumps perpendicular on the scar, S-shape and squeezing.

Joint play method:

All the following techniques of the joint play method were performed according to Lewitt.

Mobilization of the left patella (cranial, caudal, lateral and medial – directions and circumduction movement).

Mobilization of the right tibiofibular joint in both ventral and dorsal directions.

Mobilization Distal 2^{nd} – 5^{th} interphalangeal joints in dorsal and ventral directions in both feet.

Mobilization Proximal 2^{nd} – 5^{th} interphalangeal joints in dorsal and ventral directions in both side.

Mobilization Metatarsophalangeal joint of big toe on left feet in dorsal and ventral directions.

Mobilization Metatarsal heads in both feet.

Mobilization Lisfranc joint on left feet in dorsal and ventral directions.

PIR method:

PIR method, according to Lewitt, performed for all the following muscles:

- Hamstring, in left sides.
-Tensor fasciae latae in left side
- Adductors in left side.
- Gastrocnemius in left side.
- Iliopsoas in left side.
- Tibialis anterior in left side.

. Increase range of motion:

Passive range of motion exercises patient in supine position with left knee extend. I lift the left knee form middle – posterior side of thigh and other hand under the heel. Passively i provide flexion for patient left knee gradually to limit the patient can bear the pain

Increase ROM to extension and flexion a Patient is on supine position on the bed with his left leg straight. His right leg is flexed in hip and knee joints and his foot is stepping on an over-ball, which is on the bed. From this position, patient straightens his left lower extremity by rolling the over-ball (the leg should not fall from the over-ball). Then he is rolling back the ball as far as he can flex his knee and repeats 10 times.

. Stretching exercises:

I performed passive stretching for:

- Hamstring, in left side. Supine position.
- Gastrocnemius in left side. Supine position.
- Adductors in left side. In side laying position.
-Tensor fasciae latae. In left said laying position.

. Strengthening exercises:

V- Quadriceps:

Patient is on supine position with an over-ball under his left knee joint and he presses his knee downwards against the over-ball. Repeat 20 times.

Patient is on supine position on the bed and he raises his left lower extremity, with straight knee and dorsal flexion of ankle, and then slowly back to the initial position. Repeat 20 times.

From the same position, patient slightly lifts his left leg off the bed, with straight knee and dorsal flexion of ankle, moves it to the abduction. Then he goes back to the starting position and relaxes. This is for strengthening of quadriceps with hip abductors and adductors and patient does 20 repetitions.

VI- Gluteus maximums:

Patient is on prone position. Then slowly lift his left leg of the bed with straight knee. Patient does 10 repetitions.

VII-Adductor muscles:

Straight Leg Raise patient Lay on the left hip of the bad leg and take the leg straight up patient does 20 repetitions.

Self-therapy:

Patient is on supine position with a towel under his left knee joint and he presses his knee downwards against the towel Repeat 20 times.

Straight Leg Raise patient Lay on the left hip of the bad leg and take the leg straight up patient does 20 repetitions.

Stretching of hamstring muscles for left lower extremities. Patient is in supine position on a bed with right leg flexed on the knee and hip joints. With his hands patient grabs the left leg from the popliteal fossa and raises his leg to the flexion of hip joint with straight knee. Patient stays there and stretches the muscle for a few seconds and then goes back. He should do 3-4 repetitions 3 times per day.

Objective results:

The left patella is still restricted in cranial, caudal and lateral directions, but it has better mobility after therapy.

There is increases of range of motion of left knee (active range of motion in sagittal plane: 0 – 0 – 65, passive range of motion in sagittal plane: 0 – 0 - 75)

Subjective information: Patient said that during the exercises he was feeling pain (6-10).

3.7.2. 2end therapeutic session: 11.2.2013

V- Goals of today's therapy unit:

- Elimination of the remaining swelling in the left knee joint.
- Release the restricted connective tissues – skin, sub skin and fascia – of the area of the left knee joint, the scar tissue and the left thigh.
- Release the restriction of left patella and tibiofibular joint and other small joints.
- Relaxation of the hypertonic muscles in left lower extremity.
- Improve the ROM of the left knee joint in flexion
- Elongation of the short muscles hamstring. Adductors, Iliopsoas, Tensor fasciae latae gastrocnemius and triceps surae in left side.
-Improve of left knee stability and balance by Sensomotoric exercise.
- Strengthening of left quadriceps, hip adductors and gluteal muscles.
- Instruct patient for self-therapy: stretching of hamstrings and Adductor. Strengthening of quadriceps and adductor muscles

VI- Procedures:

1. Therapy for the swelling.
2. Soft tissue techniques for the restricted connective tissue.
3. Joint play method, according to Lewitt.
4. PIR method, according to Lewitt.
5. Exercises to increase ROM.
6. Stretching exercises.
7. Strengthening exercises.
8. Sensomotoric training.

Execution:

Soft tissue techniques:

I performed soft tissue techniques for the swelling, the area around the left knee joint and the left thigh in all – cranial, caudal, lateral and medial – directions and for all the layers of the connective tissue (skin, sub skin and fascia). For the thigh I also used a soft ball.

For scar i performed pressure by both thumps perpendicular on the scar, S-shape and squeezing.

Joint play method:

All the following techniques of the joint play method were performed according to Lewitt. Mobilization of the left patella (cranial, caudal, lateral and medial – directions and circumduction movement).

Mobilization of the right tibiofibular joint in both ventral and dorsal directions.

Mobilization Distal 2^{nd} – 5^{th} interphalangeal joints in dorsal and ventral directions in both feet.

Mobilization Proximal 2^{nd} – 5^{th} interphalangeal joints in dorsal and ventral directions in both side.

Mobilization Metatarsophalangeal joint of big toe on left feet in dorsal and ventral directions.

Mobilization Metatarsal heads in both feet.

Mobilization Lisfranc joint on left feet in dorsal and ventral directions.

PIR method:

[

PIR method, according to Lewitt, performed for all the following muscles:

- Hamstring, in left side.

-Tensor fasciae latae in left side

- Adductors in left side.

- Gastrocnemius in left side.

- Iliopsoas in left side.

- Tibialis anterior in left side.

Increase range of motion

Passive range of motion exercises patient in supine position with left knee extend. I lift the left knee form middle – posterior side of thigh and other hand under the heel. Passively i provide flexion for patient left knee gradually to limit the patient can bear the pain

Increase ROM to extension and flexion a Patient is on supine position on the bed with his left leg straight. His left leg is flexed in hip and knee joints and his foot is stepping on an over-ball, which is on the bed. From this position, patient straightens his left lower extremity by rolling the over-ball (the leg should not fall from the over-ball). Then he is rolling back the ball as far as he can flex his knee and repeats 10 times.

Increase ROM with gravity assessment of knee flexion. Patient is on supine position on mat closed the wall with his both leg semi flexed on the wall, patient applied flexion of left knee as much as possible keep it on this position for 5 second, then right feet help the left leg to return start position. This exercise for 5 mints

Increase ROM with gravity assessment of knee flexion. Patient is on supine position on mat closed of the wall with his both leg semi flexed on the wall,. But the right leg is applied more pressure, by pushing the left leg to increase the flexion. Than wait for 5 second then returns to starting position this exercise for 5 mints

. Stretching exercises

I performed passive stretching for:

- Hamstring, in left side. Supine position.

- Gastrocnemius in left side. Supine position.

- Adductors in left side. In said laying position.

-Tensor fasciae latae. In left said laying position.

Strengthening exercises

V- Quadriceps

Patient is on supine position with an over-ball under his left knee joint and he presses his knee downwards against the over-ball. Repeat 20 times.

Patient is on supine position on the bed and he raises his left lower extremity, with straight knee and dorsal flexion of ankle, and then slowly back to the initial position. Repeat 20 times.

From the same position, patient slightly lifts his left leg off the bed, with straight knee and dorsal flexion of ankle, moves it to the abduction. Then he goes back to the starting position and relaxes. This is for strengthening of quadriceps with hip abductors and adductors and patient does 20 repetitions.

VI- Gluteus maximums

Patient is on prone position. Then slowly lifting his left leg of the bed with straight knee. Patient does 10 repetitions.

VII- Adductor muscles:

Straight Leg Raise patient Lay on the left hip of the bad leg and take the leg straight up patient does 20 repetitions.

Sensomotoric training.

V- Small foot exercise:

Patient is sitting on the bed with both soles in full contact with the ground. he is instructed to keep in touch with the ground only the 3 points of the foot.

Patient is sitting on bed with both soles in full contact with the ground. Active models the small foot by narrowing the forefoot on one leg and pulling it toward the heel with increasing flexion of knee as much as possible. Than pulling the heel backward with increasing extension of knee as much as possible.

Objective results:

The soft tissue of the left knee joint appeared a slight better mobility in cranial and caudal direction.

The left patella is still restricted in cranial, caudal and lateral directions, but it has better movement after therapy.

There is increases of range of motion of left knee (active range of motion in sagittal plane: 0 – 0 – 75, passive range of motion in sagittal plane: 0 – 0 – 80).

Subjective information:

- Patient said that pain dresses than first session (4- 10).
- He can see the improvement since we started the rehabilitation plan.

3.7.3. 3rd therapeutic session13.2.2013

V- Goals of today's therapy unit:

- Elimination of the remaining swelling in the left knee joint.
- Release the restricted connective tissues – skin, sub skin and fascia – of the area of the left knee joint, the scar tissue and the left thigh.
- Release the restriction of left patella and tibiofibular joint and other small joints.
- Relaxation of the hypertonic muscles in left lower extremity.
- Improve the ROM of the left knee joint in flexion
- Elongation of the short muscles hamstring. Adductors, Iliopsoas, Tensor fasciae latae gastrocnemius and triceps surae in left side.
- Improve of left knee stability and balance by Sensomotoric exercise.
- Strengthening of left quadriceps, hip adductors and gluteal muscles.
- Instruct patient for self-therapy: stretching of hamstrings and Adductor. Strengthening of quadriceps and adductor muscles.

VI- Procedures:

1. Soft tissue techniques for the restricted connective tissue.
2. Joint play method, according to Lewitt.
3. PIR method, according to Lewitt.
4. Exercises to increase ROM.
5. Stretching exercises.
6. Strengthening exercises.
7. Sensomotoric training.
8. self-therapy.

Execution:

Soft tissue techniques:

I performed soft tissue techniques for the swelling, the area around the left knee joint and the left thigh in all – cranial, caudal, lateral and medial – directions and for all the layers of the connective tissue (skin, sub skin and fascia). For the thigh I also used a soft ball.

For scar i performed pressure by both thumps perpendicular on the scar, S-shape and squeezing.

Joint play method:

All the following techniques of the joint play method were performed according to Lewitt Mobilization of the left:

- Patella:

(Cranial, caudal, lateral and medial – directions and circumduction movement).

- Tibiofibular joint:

Mobilization of the tibiofibular joint in both ventral and dorsal directions.

PIR method:

PIR method, according to Lewitt, performed for all the following muscles:

- Hamstring, in left side.
-Tensor fasciae latae in left side
- Adductors in left side.
- Gastrocnemius in left side.
- Iliopsoas in left side.
- Tibialis anterior in left side.

Increase range of motion:

Passive range of motion exercises patient in supine position with left knee extend. I lift the left knee form middle – posterior side of thigh and other hand under the heel. Passively i provide flexion for patient left knee gradually to limit the patient can bear the pain

Increase ROM to extension and flexion a Patient is on supine position on the bed with his left leg straight. His left leg is flexed in hip and knee joints and his foot is stepping on an over-ball, which is on the bed. From this position, patient straightens his left lower extremity by rolling the over-ball (the leg should not fall from the over-ball). Then he is rolling back the ball as far as he can flex his knee and repeats 10 times.

Increase ROM with gravity assessment of knee flexion. Therapeutic table so closed to the wall. Patient is on supine position on therapeutic table with his legs semi

flexed on the wall, patient applied flexion of left knee as much as possible keep it on this position for 5 second then right feet help the left leg to return start position .this exercise for 5 mints

Increase ROM of knee flexion a patient is in same position. But the right leg is applied more pressure, by pushing the left leg to increase the flexion. Than wait for 5 second then returns to starting position this exercise for 5 mints.

Increase ROM of knee flexion on mat. Patient on prone position, feet on top of the exercise ball, legs straight. Patient rolling the exercise ball towards by bending his knees and allow it to slowly return back this exercise for 5 mints.

Increase ROM of knee flexion. Patient on prone position on mat. Put the robe around the ankle joint, than ask the patient to pull the robe as much as he can by both hand to provide flexion of knee. After that return back this exercise for 5 mints.

Stretching exercises:

I performed passive stretching for:

- Hamstring, in left side. Supine position.
- Gastrocnemius in left side. Supine position.
- Adductors in left side. In said laying position.
-Tensor fasciae latae. In left said laying position.

Strengthening exercises:

V- Quadriceps:

Patient is on supine position with an over-ball under his left knee joint and he presses his knee downwards against the over-ball. Repeat 20 times.

Patient is on supine position on the bed and he raises his left lower extremity, with straight knee and dorsal flexion of ankle, and then slowly back to the initial position. Repeat 20 times.

From the same position, patient slightly lifts his left leg off the bed, with straight knee and dorsal flexion of ankle, moves it to the abduction. Then he goes back to the starting position and relaxes. This is for strengthening of quadriceps with hip abductors and adducors and patient does 20 repetitions.

VI- Gluteus maximums:

Patient is on prone position. Then slowly lift his left leg of the bed with straight knee. Patient does 10 repetitions.

Patient on supine Position with both knees bent as much as he can and his feet on the floor. The patient actions are clenching his buttocks and lift your bottom off the floor as high as you can without arching his back. Hold for 3-5 seconds and slowly lower, patient dose10 repetitions.

VII- Adductor muscles:

Straight Leg Raise patient Lay on the left hip of the bad leg and take the leg straight up patient does 20 repetitions.

Self- therapy:

Patient is on supine position with a towel under his left knee joint and he presses his knee downwards against the towel repeat 20 times.

Straight Leg Raise patient Lay on the left hip of the bad leg and take the leg straight up patient does 20 repetitions.

Patient on supine Position with both knees bent as much as he can and his feet on the floor. The patient actions are clenching his buttocks and lift his bottom off the floor as high as he can without arching his back. Hold for 3-5 seconds and slowly lower, patient dose10 repetitions.

Stretching of hamstring muscles for left lower extremities. Patient is in supine position on a bed with right leg flexed on the knee and hip joints. With his hands patient grabs the left leg from the popliteal fossa and raises his leg to the flexion of hip joint with straight knee. Patient stays there and stretches the muscle for a few seconds and then goes back. He should do 3-4 repetitions 3 times per day.

Patient should also work with the 3 points of the foot, so she can easily when she is in sitting position to train the small foot exercise.

Objective results:

- The soft tissue of the left knee joint appeared a slight better mobility in cranial and caudal direction.
- The left patella has better movement more in caudal and cranial direction after therapy.

- There is slight batter movement of tibiofibular joint in dorsal more than ventral direction.
- The joint play free in all direction of left feet in (Distal 2nd – 5th interphalangeal- Proximal 2nd – 5th interphalangeal- Metatarsophalangeal joint of big toe- Lisfranc joint), And in Metatarsal heads in both feet.
-There is increases of range of motion of left knee (passive range of motion in sagittal plane: 0 – 0 – 85).
I stopped continue the exercisers (Sensomotoric training) because my patient filet dizzy.

Subjective information:

My patient was feeling ok during the exercise. Before to start the Sensomotoric exercises he felt dizzy. So I stopped the exercise and i ask him to do the self-therapy at home.

3.7.4. 4th therapeutic session15.2.2013

V-Goals of today's therapy unit:

- Elimination of the remaining swelling in the left knee joint.
- Release the restricted connective tissues – skin, sub skin and fascia – of the area of the left knee joint, the scar tissue and the left thigh.
- Release the restriction of left patella and tibiofibular joint and other small joints.
- Relaxation of the hypertonic muscles in left lower extremity.
- Improve the ROM of the left knee joint in flexion.
- Improve of left knee stability and balance by Sensomotoric exercise.
- Elongation of the short muscles hamstring. Hip adductors, Iliopsoas, Tensor fasciae latae gastrocnemius and triceps surae in left side.
- Strengthening of left quadriceps, hip adductors and gluteal muscles.
- Instruct patient for self-therapy: stretching of hamstrings and Adductor. Strengthening of quadriceps and adductor muscles.

VI- Procedures:

1. Therapy for the swelling.
2. Soft tissue techniques for the restricted connective tissue.
3. Joint play method, according to Lewitt.

4. PIR method, according to Lewitt.

5. Exercises to increase ROM.

6. Strengthening exercises.

7. Sensomotoric training.

8- Self-stretching exercises.

9. Self-therapy.

Execution:

Soft tissue techniques:

I performed soft tissue techniques for the swelling, the area around the left knee joint and the left thigh in all – cranial, caudal, lateral and medial – directions and for all the layers of the connective tissue (skin, sub skin and fascia). For the thigh I also used a soft ball.

For scar i performed pressure by both thumps perpendicular on the scar, S-shape and squeezing.

Joint play method

All the following techniques of the joint play method were performed according to Lewitt Mobilization of the left:

- ***Patella:***

(cranial, caudal, lateral and medial – directions and circumduction movement).

- Tibiofibular joint:

Mobilization of the tibiofibular joint in both ventral and dorsal directions.

PIR method:

PIR method, according to Lewitt, performed for all the following muscles:

- Hamstring, in left side.

-Tensor fasciae latae in left side

- Adductors in left side.

- Gastrocnemius in left side.

- Iliopsoas in left side.

- Tibialis anterior in left side.

Increase range of motion

Passive range of motion exercises patient in supine position with left knee extend. I lift the left knee form middle – posterior side of thigh and other hand under the

heel. Passively i provide flexion for patient left knee gradually to limit the patient can bear the pain.

Increase ROM to extension and flexion a Patient is on supine position on the bed with his left leg straight. His left leg is flexed in hip and knee joints and his foot is stepping on an over-ball, which is on the bed. From this position, patient straightens his left lower extremity by rolling the over-ball (the leg should not fall from the over-ball). Then he is rolling back the ball as far as he can flex his knee and repeats 10 times.

Increase ROM with gravity assessment of knee flexion. Therapeutic table so closed to the wall. Patient is on supine position on therapeutic table with his legs semi flexed on the wall, patient applied flexion of left knee as much as possible keep it on this position for 5 second then right feet help the left leg to return start position this exercise for 5 mints.

Increase ROM of knee flexion a patient is in same position. But the right leg is applied more pressure, by pushing the left leg to increase the flexion. Than wait for 5 second then returns to starting position this exercise for 5 mints.

Increase ROM of knee flexion on mat. Patient on prone position, feet on top of the exercise ball, legs straight. Patient rolling the exercise ball towards by bending his knees and allow it to slowly return back this exercise for 5 mints.

Increase ROM of knee flexion. Patient on prone position on mat. Put the robe around the ankle joint, than ask the patient to pull the robe as much as he can by both hand to provide flexion of knee. After that return back this exercise for 5 mints.

Strengthening exercises

V- Quadriceps:

Patient is on supine position with an over-ball under his left knee joint and he presses his knee downwards against the over-ball. Repeat 20 times.

Patient is on supine position on the bed and he raises his left lower extremity, with straight knee and dorsal flexion of ankle, and then slowly back to the initial position. Repeat 20 times.

From the same position, patient slightly lifts his left leg off the bed, with straight knee and dorsal flexion of ankle, moves it to the abduction. Then he goes back to the starting position and relaxes. This is for strengthening of quadriceps with hip abductors and adductors and patient does 20 repetitions.

To strengthen quads, increase knee mobility. Patient sitting on a firm chair with his knee bent and his foot on the floor. The action is patient Lift his foot up and straighten his knee as much as possible. Hold for 3-5 seconds and slowly lower does 20 repetitions.

Patient sitting on a firm chair with his knee bent and his foot on the floor. The action is patient March his legs up and hold for 3-5 seconds than down one at a time slowly. Lift his knee and foot up for and then back down does 20 repetitions.

VI- Gluteus maximums:

Patient is on prone position. Then slowly lift his left leg of the bed with straight knee patient 20 repetitions.

Patient on supine Position with both knees bent as much as he can and his feet on the floor. The patient actions are clenching his buttocks and lift his bottom off the floor as high as he can without arching his back. Hold for 3-5 seconds and slowly lower, patient dose10 repetitions.

VII- Adductor muscles:

Straight Leg Raise patient Lay on the left hip of the bad leg and take the leg straight up, patient does 20 repetitions.

Patient on side lying one leg extended on ball that press the ball down word and relax.

Patient on spine position with both knee flexion as much as the patient he can than i put the over-ball between legs and I ask the patient to squeeze on over-ball patient does 20 repetitions.

VIII- Bicycle exercise:

- With low resistance for 10 mints.

Sensomotoric training.

V- Small foot exercise:

Patient is sitting on the bed with both soles in full contact with the ground. He is instructed to keep in touch with the ground only the 3 points of the foot.

Patient is sitting on bed with both soles in full contact with the ground. Active models the small foot by narrowing the forefoot on one leg and pulling it toward the heel with increasing flexion of knee as much as possible. Than pulling the heel backward with increasing extension of knee as much as possible.

VI- Exercises with posturomed

Patient is in standing position on posturmed. Then I ask the patient to lift one leg foreword and instructed the patient to keep the other leg in touch with the ground only the 3 points of the foot with straight back. When he lift the left leg patient should support his body by holding the upper part of posturmed to avoid the full weight bearing.

Patient is in same position on postuemed. Then I ask the patient to lift one leg backward and instructed the patient to keep the other leg in touch with the ground only the 3 points of the foot with straight back. When he lift the left leg patient should support his body by holding the upper part of posturmed to avoid the full weight bearing.

Patient on standing position front of postumed, right leg on floor and the left leg on postuemed parallel to each other. I informed the patient to put Partial load on the left foot and more load on the right. Patient should keep the both legs in touch only the 3 points of foots, with straight back.

Self-stretching exercises

V- Straight Leg Hamstring:

On supine position with left leg straight and rope wrapped around foot. Patient lift right left as far as possible, then give gentle assistance with rope until stretch is felt, holding 2 seconds and relaxing, Repeat.

Patient should keep opposite leg on ground by pushing heel as far away from head as possible.

VI- Adductor muscles:

On supine with rope wrapped around foot. Wrap rope around inside of low leg. Actively patient lift the left leg to side as far as possible and then give gentle assistance with rope until stretch is felt. Exhale and hold for 2 seconds, relax, and repeat.

Patient should keep opposite leg on ground by pushing heel as far away from head as possible. Pull rope with same -side hand as leg being stretched. Keep toes pointed to sky. Keep back in line and shoulders on ground.

V11- Abductor muscles:

On supine with rope wrapped around foot, wrap rope around inside of low leg. Actively patient lift leg to side as far as possible and then give gentle assistance with rope until stretch is felt, exhale and hold 2 seconds, relax and repeat.

Patient Keep opposite leg on ground by pushing heel as far away from head as possible, pull rope with same side hand as leg being stretched. Keep toes pointed to sky. Keep back in line and shoulders on ground.

Self-therapy:

Patient is on supine position with a towel under his left knee joint and he presses his knee downwards against the towel Repeat 20 times.

Straight Leg Raise patient Lay on the left hip of the bad leg and take the leg straight up patient does 20 repetitions.

Patient on supine Position with both knees bent as much as he can and his feet on the floor. The patient actions are clenching his buttocks and lift his bottom off the floor as high as he can without arching his back. Hold for 3-5 seconds and slowly lower, patient dose10 repetitions.

Patient should also work with the 3 points of the foot, so she can easily when she is in sitting position to train the small foot exercise.

Gravity-induced PIR method, according to Lewitt for:

Hamstrings muscles, on left side

Rectus femoris, on left side.

Patient should do 3 repetitions for each muscle 3 times per day.

Strengthening of quadriceps, 3 times per day. For the following exercises patient is on supine position:

VI- With dorsal flexion of the ankle and straight knee, patient raises his left leg, by flexing the hip joint, goes back to the initial position and repeats 10 times.

VI- Patient raises again his left leg with the same way but with an external rotation of the whole left leg, 10 repetitions.

VIII- Then patient performs another 10 repetitions with an internal rotation of his left leg.

Objective results:

- The soft tissue of the left knee joint appeared a slight better mobility in cranial and caudal direction.

- The left patella has better movement in all direction but more in caudal and cranial more than lateral direction after therapy.
- There is slight batter movement of tibiofibular joint in dorsal more than ventral direction.
- The small joint has batter movement in all direction.
-There is increases of range of motion of left knee (active range of motion in sagittal plane: 0 – 0 – 85. passive range of motion in sagittal plane: 0 – 0 – 95).
- During the exercises of the sensomotoric training patient was confident.
- There is decrease of swelling 1 cm

Subjective information:

Patient said that yesterday he did for 10 – 15 minutes, in the lowest resistance, on the stationary bicycle. He felt pain but he can control the pain.

3.7.5. 5th therapeutic session18.2.2013

V- Goals of today's therapy unit

- Elimination of the remaining swelling in the left knee joint.
- Release the restricted connective tissues – skin, sub skin and fascia – of the area of the left knee joint, the scar tissue and the left thigh.
- Release the restriction of left patella and tibiofibular joint and other small joints.
- Relaxation of the hypertonic muscles in left lower extremity.
- Improve the ROM of the left knee joint in flexion.
- Improve of left knee stability and balance by Sensomotoric exercise.
- Elongation of the short muscles hamstring. Adductors, Iliopsoas, Tensor fasciae latae gastrocnemius and triceps surae in left side.
- Strengthening of left quadriceps, hip adductors and gluteal muscles.

VI- Procedures:

1. Therapy for the swelling.
2. Soft tissue techniques for the restricted connective tissue.
3. Joint play method, according to Lewitt.
4. PIR method, according to Lewitt.
5. Exercises to increase ROM.
6. Strengthening exercises.
7. Sensomotoric training

Execution:

Soft tissue techniques:

I performed soft tissue techniques for the swelling, the area around the left knee joint and the left thigh in all – cranial, caudal but more in lateral and medial – directions and for all the layers of the connective tissue (sub skin and fascia). For the thigh I also used a soft ball.

For scar I performed pressure by thump perpendicular on the scar, S- shape and squeezing..

Joint play method:

All the following techniques of the joint play method were performed according to Lewitt Mobilization of the left:

- ***Patella:***

(Cranial, caudal, lateral and medial – directions and circumduction movement).

- Tibiofibular joint:

Mobilization of the tibiofibular joint in both ventral and dorsal directions.

. ***PIR method:***

PIR method, according to Lewitt, performed for all the following muscles:

- Hamstring, in left side.
-Tensor fasciae latae in left side
- Adductors in left side.
- Gastrocnemius in left side.
- Iliopsoas in left side.
- Tibialis anterior in left side.

Increase range of motion:

Passive range of motion exercises patient in supine position with left knee extend. I lift the left knee form middle – posterior side of thigh and other hand under the heel. Passively i provide flexion for patient left knee gradually to limit the patient can bear the pain.

Increase ROM to extension and flexion a Patient is on supine position on the bed with his left leg straight. His left leg is flexed in hip and knee joints and his foot is stepping on an over-ball, which is on the bed. From this position, patient straightens her

left lower extremity by rolling the over-ball (the leg should not fall from the over-ball). Then he is rolling back the ball as far as he can flex his knee and repeats 10 times.

- Increase ROM with gravity assessment of knee flexion. Therapeutic table so closed to the wall. Patient is on supine position on therapeutic table with his legs semi flexed on the wall, patient applied flexion of left knee as much as possible keep it on this position for 5 second then right feet help the left leg to return start position .this exercise for 5 mints.

Increase ROM of knee flexion a patient is in same position. But the right leg is applied more pressure, by pushing the left leg to increase the flexion. Than wait for 5 second then returns to starting position this exercise for 5 mints.

Strengthening exercises:

V- Quadriceps:

Patient is on supine position with an over-ball under his left knee joint and he presses his knee downwards against the over-ball. Repeat 20 times.

Patient is on supine position on the bed and he raises his left lower extremity, with straight knee and dorsal flexion of ankle, and then slowly back to the initial position. Repeat 20 times.

From the same position, patient slightly lifts his left leg off the bed, with straight knee and dorsal flexion of ankle, moves it to the abduction. Then he goes back to the starting position and relaxes. This is for strengthening of quadriceps with hip abductors and adductors and patient does 20 repetitions.

To strengthen quads, increase knee mobility. Patient sitting on a firm chair with his knee bent and his foot on the floor. The action is patient Lift his foot up and straighten his knee as much as possible. Hold for 3-5 seconds and slowly lower does 20 repetitions.

Patient sitting on a firm chair with his knee bent and his foot on the floor. The action is patient March his legs up and hold for 3-5 seconds than down one at a time slowly. Lift his knee and foot up for and then back down does 20 repetitions.

VI- Gluteus maximums:

Patient is on prone position. Then slowly lift his left leg of the bed with straight knee, patient 20 repetitions.

Patient on supine Position with both knees bent as much as he can and his feet on the floor. The patient actions are clenching his buttocks and lift his bottom off the floor as high as he can without arching his back. Hold for 3-5 seconds and slowly lower, patient dose 10 repetitions.

VII- Adductor muscles:

Straight Leg Raise patient Lay on the left hip of the bad leg and take the leg straight up, patient does 20 repetitions.

Patient on side lying one leg extended on ball that press the ball down word and relax.

Patient on spine position with both knee flexion as much as the patient he can than i put the over-ball between legs and i ask the patient to squeeze on over-ball patient does 20 repetitions.

VIII- Bicycle exercise:

- Withe low resistance for 10 mints.

Sensomotoric training.

V- Small foot exercise:

Patient is sitting on the bed with both soles in full contact with the ground. he is instructed to keep in touch with the ground only the 3 points of the foot.

Patient is sitting on bed with both soles in full contact with the ground. Active models the small foot by narrowing the forefoot on one leg and pulling it toward the heel with increasing flexion of knee as much as possible. Than pulling the heel backward with increasing extension of knee as much as possible.

VI- Exercises with posturomed

Patient is in standing position on posturmed. Then I ask the patient to lift one leg foreword and instructed the patient to keep the other leg in touch with the ground only the 3 points of the foot with straight back. When he lift the left leg patient should support his body by holding the upper part of posturmed to avoid the full weight bearing.

Patient is in same position on postuemed. Then I ask the patient to lift one leg backward and instructed the patient to keep the other leg in touch with the ground only the 3 points of the foot with straight back. When he lift the left leg patient should

support his body by holding the upper part of posturmed to avoid the full weight Bearing.

Patient on standing position front of postumed, right leg on floor and the left leg on postuemed parallel to each other. I informed the patient to put Partial load on the left foot and more load on the right. Patient should keep the both legs in touch only the 3 points of foots, with straight back.

Self-stretching exercises

V- Straight Leg Hamstring:

On supine position with left leg straight and rope wrapped around foot. Patient lift right left as far as possible, then give gentle assistance with rope until stretch is felt, holding 2 seconds and relaxing, Repeat.

Patient should keep opposite leg on ground by pushing heel as far away from head as possible.

VI- Adductor muscles:

On supine with rope wrapped around foot. Wrap rope around inside of low leg. Actively patient lift the left leg to side as far as possible and then give gentle assistance with rope until stretch is felt. Exhale and hold for 2 seconds, relax, and repeat.

Patient should keep opposite leg on ground by pushing heel as far away from head as possible. Pull rope with same -side hand as leg being stretched. Keep toes pointed to sky. Keep back in line and shoulders on ground.

V11- Abductor muscles:

On supine with rope wrapped around foot, wrap rope around inside of low leg. Actively patient lift leg to side as far as possible and then give gentle assistance with rope until stretch is felt, exhale and hold 2 seconds, relax and repeat.

Patient Keep opposite leg on ground by pushing heel as far away from head as possible, pull rope with same side hand as leg being stretched. Keep toes pointed to sky. Keep back in line and shoulders on ground.

Objective results:

- The soft tissue of the left knee joint appeared a slight better mobility in all direction but more in caudal and cranial direction.

- The left patella has better movement in all direction but more in caudal and cranial more than lateral direction after therapy.
- There is slight batter movement of tibiofibular joint in dorsal more than ventral direction.
- The small joint has batter movement in all direction.
-There is increases of range of motion of left knee (active range of motion in sagittal plane: 5 – 0 – 95. passive range of motion in sagittal plane: 10 – 0 – 110).
- There are decrees of swilling.
- There is improvement of length in short muscles hamstring. adductors, iliopsoas, tensor fasciae latae gastrocnemius and triceps surae in left side.

Subjective information:

Patient said that he feel better after 5 sessions of therapy because he saw the improvement of muscles, Range of motion and the stability.

3.8. Final kinesiologic examination:

The final kinesiological examination took place on **18.2.2013**. For all the examinations that I performed patient took off his knee brace. I performed the following examinations to the patient:

1. Postural examination [by Kendall].
2. Examination of the pelvis [by Kendall].
3. Gait examination [by Kendall].
4. Soft tissue examination [by Lewitt].
5. Muscle tone examination [by Kendall].
6. Range of motion examination [by Kendall].
7. Anthropometric measurements [by Kendall].
8. Muscle strength test [by Kendall].
9 . Muscle length test [by Kendall].
10. Joint play examination [by Lewitt].
11. Neurological examination [by Lewitt].

3.8.1. Postural examination [by Kendall]

For the postural examination patient is standing on the floor, without the use of the crutches. I examined patient form posterior, lateral and anterior views but it was not possible to use the plumb line.

V- Posterior view

- Asymmetric of the heels shape and position.
- Asymmetric of the Achille's tendons.slightly bigger on left side but not as much as **before.**
- Asymmetric of the calfs. hypotonic on left side.
- Lift popliteal line is higher than the right one but not as much as before.
- Lift subgluteal line is slightly higher than the Right.
- Right lower angle of scapula is lower than the left one.
- The distance between the medial border of scapula and spine is higher than the Lift **but not as much as before.**
- Scapula alata(winging) on the Right scapula.
- The trunk is leaning a little bit to right.
- The head is leaning to the left but not as much as before.

VI- Lateral view

- Right foot more forward
- **Left knee in slight flexion but not as much as before.**
- Trunk slightly rotated to the left side.
- The abdominal wall is in a small prominence.
- Lumbar spine slightly lordosis.
- Thoracolumbar spine is flat.
- Thoracic spine is slightly kiphosis.
- Elbow joints are semi flexed both upper extremities.
- Thoracocervical spine kiphosis.
- Cervical spine slightly kiphosis.
- The shoulders are anterior protraction.
- Head foreword.

VII- Anterior view

- Arch of foot Symmetry.
- Right patella is (higher than the Lift one) but not as much as before.
- Right anterior superior iliac spine is higher than the Lift one.
- Umbilicus is shifted to the Right but not as much as before.
- Sternum is on the midline.
- Lift nipple is higher than the Right one but not as much as before.
- Lift clavicle is slightly higher.
- Right shoulder is slightly higher than left one but not as much as before.
- Head shifted to the Lift.

3.8.2. Examination of the pelvis [by Kendall]

The examination of the pelvis was done with the patient in standing position.

V- Posterior view:

o Left PSIS is lower than the Right one **with minimal difference.**

o Iliac crest, right higher than the Lift one **with very little difference.**

VI- Lateral view:

o PSIS and ASIS are in same level in both sides.

VII- Anterior view:

o Left ASIS is lower than the right one **with minimal difference.**

3.8.3. Gait examination [by Kendall]:

Patient is using crutches (forearm) for walking, the doctor recommended the patient to walk with crutches (forearm) without big load on the injured leg. We performed the gait examination for walking with the crutches. During the whole examination of gait patient didn't fell neither dizzy or any kind of pain.

[

Walking with crutches:

Patient is using the 3point type of walking with crutches and he does it correctly (first the crutches, then the injured leg and in the end the healthy leg).

He is walking with confidence and his velocity can be characterized as fast.

Both of his shoulder while he is walking are in elevation and slightly protracted.

- Asymmetric steps of length.
- Ssymmetric swinging motion of arms.

- Patient walk with straight back.
- Limping more and leaning to the right side but not much like before.
- More loading on the lateral side of right feet.
- Left knee semi-flexion in stance and swing phase but less than before.
- Not enough dorsal flexion of left feet but better than before.

3.8.4. Soft tissue examination [by Lewitt]

I examined the connective tissues – skin, sub skin and fascia – of the area around the left knee joint and the left thigh and all the layers were restricted in all – caudal, cranial, lateral and medial – directions. The soft tissue of the left knee joint appeared a slight better mobility in all direction but more in caudal and cranial direction.

The scar on patella of left knee joint completely healing not active and in good condition. There is no increase of temperature around scar. Scar calm length is 14 cm.

3.8.5. Muscle tone examination [by Kendall]

Muscles	**Right**	**Left**
Rectus femoris	Slight hypotone	Hypotonic(better than in initial examination)
Vastus medialis, vastus intermediaries, vastus lateralis	Eutone	Hypotone(better than in initial examination)
Hip Adductors	Eutone	Slight Hypertone
Hip abductors	Eutone	Eutone
Hamstrings	Eutone	Slight Hypertone
Tensor fasciae latae	Eutone	Eutone
Gluteal muscles	Eutone	Hypotone. (better than in initial examination)
Gastrocnemius	Eutone	Hypotone(better than in initial examination)
Tibialis anterior	Eutone	Hypertone

Table no.7 – Final examination: Muscle tone examination.

3.8.6. Anthropometric measurements

V- Height

In standing: 142 cm In sitting: 98 cm

VI- Lengths of lower extremities

Body part	**Left** cm	**Right** cm
Anatomical length (form trochanter major to lateral malleolus)	**94**	95
Functional length (from anterior superior iliac spine to medial malleolus)	98	98
Functional length (from umbilicus to medial malleolus)	110	109
Thigh (from trochanter major to knee joint)	50	51
Middle leg (from knee joint to lateral malleolus)	44	44
Foot (from heel to longest toe)	26.5	26.5

Table no.8 – Final examination: Lengths of lower extremities (cm).

VII- Circumferences of lower extremities

The measurements were done with a measuring tape and the patient in supine position on the therapeutic table.

Body part	**Left** cm	**Right** cm
Thigh (15 cm above the knee cap)	**43**	46
Thigh (10 cm above knee)	**37**	40
Knee joint (around the knee joint)	**39.5**	38
Calf (place of highest volume)	**34**	35
Ankle joint (around medial and lateral malleolus)	26	25
Foot (around metatarshal heads)	**24**	24

Table no.9 – Final examination: Circumferences of lower extremities (cm).

3.8.7. Range of motion examination [by Kendall]:

The examination of ROM was performed according to the principles of Kendall and the results of my examination are written according to the SFTR method. For measuring of ROM I used a goniometer and for measuring of the passive movements I had the help of my supervisor.

V- Hip joint

Left hip joint	**Active range of motion**	**Passive range of motion**
S	**20- 0 -125**	20-0-130
F	30- 0 -25	35- 0 -35

Right hip joint	**Active range of motion**	**Passive range of motion**
S	40 - 0 -140	50- 0 -145
F	**45- 0 – 45**	45- 0 – 45

VI- Knee joint

Left knee joint	**Active range of motion**	**Passive range of motion**
S	**5- 0 - 100**	**10- 0 – 115**

Right knee joint	**Active range of motion**	**Passive range of motion**
S	10- 0 - 140	15- 0 -160

VII- Ankle joint

Left ankle joint	**Active range of motion**	**Passive range of motion**
S	**20- 0 -50**	25- 0 -55
Rs	**10- 0 - 25**	**20- 0 - 30**

Right ankle joint	Active range of motion	Passive range of motion
S	20- 0 - 55	30 - 0 - 60
Rs	15- 0 - 25	25- 0 - 30

3.8.8. Muscle strength test [by Kendall]

I performed all the muscle strength tests according to Kendall. The grading is of the results is also according to Kendall, where:

No contraction 0

Contraction felt with no visible movement 1

Movement through complete ROM for the tested muscle 2

Gradual release from test position 3-

Holds test position (no added pressure) 3

Holds test position against slight pressure 3+

Holds test position against slight to moderate pressure 4-

Holds test position against moderate pressure 4

Holds test position against moderate to strong pressure 4+

Holds test position against strong pressure 5

Examined muscle	Right	Left
Quadriceps femoris	5	**3+**
Gluteus maximus	5	**3+**
Gluteus mediu	+4	**4+**
Gluteus minimus	5	4
Tibialis anterior	5	4
Gastrocnemious	5	4+
Hamstrings	5	4+
Adductors	4	**3+**
Iliopsoas	+4	**4+**

Tensor fascia latae	5	+4
Sartorius	5	4
Soleus	5	+4
Tibialis posterior	5	5
Peroneus longus	5	+4
Peroneus brevis	+4	+4

Table no.10 – Final examination: Muscle strength test, grading according to Kendall.

3.8.9.Muscle length test [by Kendall]

The muscle length tests were performed according to Kendall and the results are written according to Janda, where:

0 no shortness

1moderate shortness

2 marked shortness

Examined muscle	**Right**	**Left**
Hamstrings	0	1 ***(better than in initial examination)***
Tensor fasciae latae	0	**0**
Iliopsoas	0	**0**
Gastrocnemius	0	**0**
Soleus	0	**0**
Rectus femoris	0	0
Tensor fasciae latae	0	**0**

Adductor	0	1 ***(better than in initial examination)***

Table no 11– Final examination: Muscle length test, grading according to Janda.

3.8.10. Joint play examination [by Lewitt]

All the examinations were performed according to Lewitt.

***Patella*:**

- The left patella is **slight restricted in lateral – medial direction. More mobility cranial and caudal direction.**
- The right patella is free in all – cranial, caudal, lateral and medial – directions.

Tibiofibular joint:

- The left is **slight restricted in ventral , more mobility in dorsal directions.**
- The right one is not restricted in any direction.

Distal 2nd – 5th interphalangeal joints:

- All joints are **no't** restricted in dorsal and ventral directions in both feet.

Proximal 2nd – 5th interphalangeal joints:

- All joints are **no't** restricted in dorsal and ventral directions in both feet.

Interphalangeal joint of big toe:

- There is **no** restriction in any direction in both feet.

Metatarsophalangeal joint of big toe:

- There is **no** restriction in any direction in both feet.

Metatarsal heads:

- There is **no** restriction in any direction in both feet.

Lizfranc joint:

- There is **no** restriction on ventral directions and dorsal direction **in both feet**.

Chopart joint:

- There is **no** restriction in any direction in both feet.

Talocrural joint:

- N**ot** restricted in dorsal direction in both feet.

3.8.11. Neurological examination [by Lewitt]

V- Superficial sensation Neurological examination:

- Dermatome L_3: patient is feeling the same in both lower extremities.
- Dermatome L_4: patient is feeling the same in both lower extremities.
- Dermatome L_5: patient is feeling the same in both lower extremities.
- Dermatome S_1: patient is feeling the same in both lower extremities.
- Dermatome S_2: patient is feeling the same in both lower extremities.

***VI-Deep sensations test*:**

- Vibration: negative in both lower extremities.

- Joint position sense: negative in both lower extremities.

- Two-point discrimination: negative in both lower extremities.

- Graphesthesia: negative in both lower extremities.

VI- Deep tendon reflexes [by Lewitt]:

For the examinations of the deep tendon reflexes I used a neurological hammer. Evaluation grades:

- 0 absent
- 1 hypoactive or present only with reinforcement
- 2 normal response
- 3 brisk with or without evidence of spread to the neighboring roots
- 4 unsustained clonus
- 5 sustained clonus

Reflexes	**Right**	**Left**
Knee jerk reflex	2	2
Achilles tendon reflex	2	2
Plantar reflex	2	2

Table no.12 – Final examination: Examination of deep tendon reflexes.

3.9. Conclusion of final kinesiological examination

- Patient has a faulty posture with small base of support, the whole right side in more tone than the left one and his left knee joint fixed in a small flexion. But not as much as in initial examination, so it change also the posturer of shoulder,

Umbilicus, Lift nipple. Examination of the pelvis there is improvement of posturer slightly.

- The left knee is a bit swollen (1,5 cm bigger circumference than the right one). In initial examination was 3cm.
- Patient using the crutches.. He is limping more and leaning to the right when he is walking, without extension of the left knee joint.
- Patient is using the 3point type of walking with crutches and he does it correctly (first the crutches, then the injured leg and in the end the healthy leg).
- He is walking with confidence and his velocity can be characterized as fast. Patient walk with straight back. Limping more and leaning to the right side. More loading on the lateral side of right feet. Left knee semi-flexion in stance and swing phase. Not enough dorsal flexion of left feet.
- Muscle tone imbalance between right and left legs. Tibialis anterior, hip adductors and Hamstrings are slight hypertonic and the gluteal, Quadriceps and gastrocnemius muscles are slight hypotonic.
- The soft tissue of scar in left knee joint appeared a slight better mobility in all direction but more in caudal and cranial direction.
- Muscles Short Tensor Iliopsoas and hip adductors (left leg).
- The left patella is slightly restricted in cranial, caudal but more in lateral directions
- Tibiofibular joint in left side is slight restricted in ventral, more mobility in dorsal directions.\
- The improvement that I recommend it due to the different between the initial examinations and final**.**

4. Evaluation of the results of the therapy / prognosis

The end of the therapeutic sessions found Mr. M.K. very satisfied. The One 24.12.12 patient had an operation in his patella (patella tension cerclage), without contraindications for surgery.

On 8.2.2013 patient came to CLPA for first session of therapy after 2 weeks from surgery. He was in good condition with two elbow crutches and immobilizer on left knee. He was in pain (Pain level: 7/10) and there was major swelling of the left knee (knee Circumferences 3 cm different than right one). His main concern was the restricted motion of his knee and the dysfunction effect on his ADL.

During the initial examination that was performed on 8th of February 2013, the patient has a faulty posture with small base of support, the whole right side in more tone than the left one and his left knee joint fixed in a small flexion. Patient is using the 3point type of walking with crutches and he does it correctly with confidence and his velocity can be characterized as fast. He was also wearing immobilizer on left knee. All the connective tissues – skin, sub skin and fascia – of the area around the left knee, scar tissue and the left thigh are restricted in all (cranial, caudal, lateral and medial) directions. The scar was in good condition, not active and the clam is 14 cm. The ROM of flexion of left knee joint is decreased in both active and passive movements. The ROM of extension of left knee joint is full range. Muscle tone imbalance in the left leg. Hamstrings are hypertonic and the quadriceps, gluteal and calf muscles are hypotonic. Muscle weakness was found on quadriceps, hip adductors and gluteus maximums. Shortness on hamstrings, hip Adductors, gastrocnemius, triceps surae, Tensor fasciae latae and Iliopsoas in left leg. The patella and trbiofibular joint are restricted on all direction on left side.

The therapy I applied was in left knee concentrated to regain the normal ROM. Restore muscle weakness and release the restricted connective tissues. Improve the stability and balance. The first therapeutic unit took place on 8th of February 2013 and the last one on 18th of February 2013 and we have completed 5 sessions. During this short therapy time we managed an improvement in all levels. Elimination of the pain and swelling was successful and the ROM is improve (Active range of motion 5- 0 – 100, Passive range of motion 10- 0 – 115), when I start the bicycle exercise there were big improvement of range of motion. The Patient improved the faulty posture. He has

small base of support, the whole right side in more tone than the left one and his left knee joint fixed in a small flexion but not as much as in initial examination, so it change also the posturer of shoulder, Umbilicus, Lift nipple. Examination of the pelvis there is improvement of posturer slightly. The patient now is still walking with the crutches and still he is limping on right side but not much like before with semi-flexion of left knee but not much like before. The muscles tone imbalance between right and left legs is improving (Tibialis anterior, Hip adductors and Hamstrings are slight hypertonic and the gluteal, Quadriceps and gastrocnemius muscles are slight hypotonic). Although he feels confident enough when walking and does not need his knee brace anymore. Also the muscle differences (in strength, length and tone) were balanced and the instability of his right knee joint has clearly improved.

I consider my therapy effective and the rehabilitation process successful. The patient didn't have any problem in the execution or any complaint on any of the components (exercises, tasks, self-therapy) of his rehabilitation program. The prognosis of the patient is good. My estimation is that if he continues with his exercises (but on strengthening exercise I will ask him to start with weight first step with 0.5 kg) till when I receive the new indication if the physician agree with normal load of left leg my therapy plan will be the same to increase the range of motion and self-stretching and joint play and soft tissues. On Sensomotoric training it will be without support the upper part when the patient lifting the right leg and I will start to use the other training of Sensomotoric (will add gait exercises to improve and correct the walking of patient, then running and jumping.

He will be able to maintain this general good condition and he will achieve further improvement in the dynamic stability and balance of his left knee joint. The prognosis of the patient is that he will be fine by continuing his self-therapy exercises.

5. CONCLUSION

I have 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 left knee into flexion), and as such, I am satisfied with the results.

I feel really happy after these two weeks of practice in the CLPA hospital. 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 5 sessions in the patient's situation filled me as a physiotherapist and as a person that can help others through the profession.

The patient was very cooperative right from the start and did not have any problems with the whole rehabilitation process. He 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 CLPA hospital, PhD. Edwin Mahr 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.

References

1. Dandy Dj. (1990). Anatomy of the Medial Suprapatellar Plica and Medial Synovial Shelf. *Arthroscopy, 6*, 79.
2. Dye Sf. (1993). Patellofemoral Anatomy. In Jm Fox & W Del Pizzo (Eds.), *The Patellofemoral Joint* (pp. 1-11). New York: McGraw-Hill, Inc.
   Pain. *Am J Sports Med, 30*(3), 447-456.
3. Kendall, P.F. et al. (2005). *Muscles Testing and Function with Posture and Pain.* 5th edition. Published by Lippincott Williams & Wilkins.
4. Abernethy P, G Wilson, & P Logan. (1995). Strength and Power Assessment *Sports Med, 19*, 401-417
5. Freddie H, Fu, J Michael, Seel, & A Richard, Berger. (1993). Patellofemoral Biomechanics. In M James, Fox & D Wilson, Pizzo (Eds.), *The Patellofemoral Joint* (pp. 49-61). New York: McGraw-Hill, Inc.
6. Amis Aa, & F Farahmand. (1996). Biomechanics of the Knee Extensor Mechanism. *Knee, 3*, 73-81.
7. Ahmed Am, Dl Burke, & A Hyder. (1987). Force Analysis of the Patellar Mechanism. *j orthop res, 5*(69).
8. Reilly Dt, & M Martens. (1972). Experimental Analysis of Quadriceps Muscle Force and Patellofemoral Joint Reaction Force for Various Activities. *Acta Orthop Scand, 43*, 126-137.
9. Augustsson J, A Esko, & R Thomee, Et Al. (1998). Weight Training of the Thigh Muscles Using Closed Vs Open Kinetic Chain Exercises: A Comparison of Performaince Enhancement. *J Orthop Sports Phys Ther, 27*(1), 3-8.
10. Dupuy De, Dh Hangen, & Je Zachazewski, Et Al. (1997). Kinematic Ct of the Patellofemoral Jo. *Am J Roentgenol 169* (1), 211-215.
11. Boden Bp, & Aw Pearsall, Et Al. (1997). Patellofemoral Instability: Evaluation and Management. . *J. Am. Acad. Orthop. Surgeons*(5), 47-57.
12. Castro Whm, J Jerosch, & Tw Grossman. (2001). *Examination and Diagnosis of Musculoskeletal Disorders. Clinical Examination - Imaging Modalities* (J Grossman, Trans.). Stuttgart. New York: Thieme.
13. Fulkerson Jp. (2002). Diagnosis and Treatment of Patients with Patellofemoral Pain. *Am J Sports Med, 30*(3), 447-456
14. Dye Sf. (2005). The Pathophysiology of Patellofemoral Pain: A Tissue Homeostasis Perspective. *Clin Orthop Relat Res, 436*(436), 100-110.
15. Jalovcova M. (2008). Basic Therapeutic Methods I: Anthropometric Measurements, Lecture notes, Charles University in Prague
16. Jalovcova, M. (2008). Basic Therapeutic Methods I: Evaluation of Motion of Joint, Lecture notes, Charles University in Prague

17. Lewit, K. (1999). *Manipulative Therapy in Rehabilitation of the Locomotor System.* 3rd ed. Published Butterworth Heinemann Ltd., Oxford.

18. Freddie H, Fu, J Michael, Seel, & A Richard, Berger. (1993). Patellofemoral Biomechanics. In M James, Fox & D Wilson, Pizzo (Eds.), The Patellofemoral Joint (pp. 49-61). New York: McGraw-Hill, Inc.
,
19. Carlson M, & J Wilkerson. (2007). Are Differences in Leg Length Predictive of Lateral Patello-Femoral Pain? *Physiother Res Int, 12*(1), 29-38.
20. Maunder T. (1996). Conservative Treatment of Patellofemoral Joint Problems. *knee, 3*, 104.
21. Mcconnell J. (2007). Rehabilitation and Nonoperative Treatment of Patellar Instability. *Sports Medicine & Arthroscopy Review, 15*(2), 95-104.
22. Zappala Fg, Cb Taffel, & Gb Salsich. (1992). Rehabilitation of the Patellofemoral Joint Disorders. *Orthop Clin North Am, 23*, 555-566.
23. Beckman M, R Craig, & Rc Lehman. (1989). Rehabilitation of Patellofemoral Dysfunction in the Athlete. *Clin Sports Med, 8*(4), 841-860

LISTOF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

.ABD: abduction
.ADD: adduction
.B.M.I: body mass index
.B:P: blood pressuer
.CPM: continual passive motion.
.DF: dorsiflexion
.DIP: distal interphalangeal.
.E: extension.
.ER: external rotation.
.F: flexion.
.IR: internal rotation.
.PF: plantarflexion.
.PIP: proximal interphalangeal.
.PIR: post-isometric relaxation.