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Bachelor Thesis

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“Rehabilitation after Patellar Tendon Reconstruction of the Anterior Cruciate Ligament”

Charles University
Faculty of Sports and Physical Education
Degree Program in Physiotherapy

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Abstract

"Rehabilitation after Patellar Tendon Reconstruction of the Anterior Cruciate Ligament"

"Rehabilitační přístup po rekonstrukci předního zkříženého vazu štěpem z patelárního ligamenta" (Title, Czech Language)

Post operative donor-site recovery and therapeutic recipient approach difficulties following ACL surgery may result in extensive impairment for the patient. In the following thesis I will explain the importance between selections of graft, surgical technique and rehabilitation program which can affect the occurrence of undesirable pain conditions. The subject of this cases study is a 32 year old patient with ACL patellar grafting reconstruction following a rehabilitation protocol from the orthopedic surgeon.

This thesis has been divided into two sections. Initial part describes general knee anatomy and biomechanics, variety of graft, surgical technique and rehabilitation programs. Subsequently followed by the case study which consist of Anamnesis, Initial examination/evaluation, day-to-day therapy, re-examination/evaluation (before processing into Phase II of rehabilitation protocol), and Final examination/evaluation with a Discharge summary.

Key words: anterior cruciate ligament, anterior cruciate ligament reconstruction, biomechanics, kinematics, anterior cruciate ligament graft, anterior cruciate ligament rehabilitation

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Location of Case Study: Centrum lecby pohyboveho aparatu,
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Czech Republic

Declaration

This thesis is a presentation of my original research work. Wherever contributions of others are involved, every effort is made to indicate this clearly, with due reference to the literature, and acknowledgement of collaborative research and discussions.

The work was done under the guidance of Professor Miroslava Jalovcova Mgr. and under the supervision of Pavel Fuksa Mgr., Head of the Department of Physical Therapy at the Centrum Lecby Pohyboveho Aparatu, Praha Czech Republic

Jeremy Neil Melli

In my capacity as supervisor of the candidate's thesis, I certify that the above statements are true to the best of my knowledge.

Miroslava Jalovcova Mgr.
Date:

Acknowledgments

First and foremost I offer my sincerest gratitude to my supervisor, Miroslava Jalovcova Mgr., who has supported me throughout my thesis with her patience and knowledge whilst allowing me the room to work in my own way. I attribute the level of my Bachelor degree to her encouragement and effort and without her this thesis, too, would not have been completed or written. One simply could not wish for a better or friendlier supervisor.

I am deeply grateful to my supervisor, Pavel Fuksa Mgr., Head of the Department of Physical Therapy, Institute of Centrum Lecby Pohyboveho Aparatu, Praha Czech Republic, for his detailed and constructive comments, and for his important support throughout this work.

I owe my loving thanks to my mom Rosana Melli, my dad Alejandro Melli and all other family members. They have lost a lot due to my studies abroad. Without their encouragement and understanding it would have been impossible for me to finish my studies here. My special gratitude is due to my friends for their loving support. My loving thanks are due to Jana Zelova and her family. They let me own a happy family in the Czech Republic.

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1. Anatomy, The Knee

1.1 General Anatomy of the Knee

1.1.1 Introduction

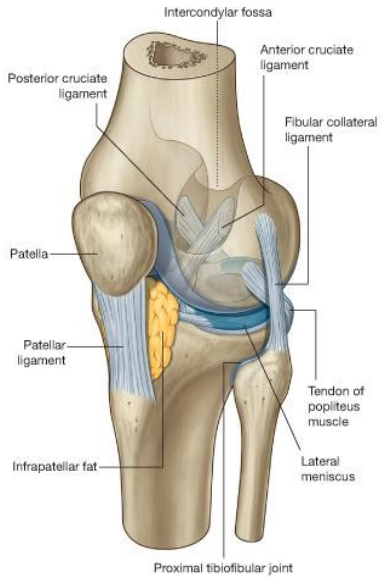
The knee joint is the largest synovial joint in the body, including three articulations within its joint capsule. It consists of two condylar articulation known as, medial and lateral tibiofemoral joint with a gliding joints identified as, patellofemoral joint. The knee bones are composed of the femur, tibia, and fibula which meet to form a hinge joint. Protecting the joint, the patella can be found anteriorly to the articulation, followed by a cushioned articulating cartilage that covers the ends of the tibia and femur, as well as the underside of the patella. The meniscuses are pads of cartilage that further cushion the joint, acting as shock absorbers between the bones. The major ligaments associated with the knee joint are the patella ligament, the tibial and fibular collateral ligaments, and the anterior and posterior cruciate ligaments. (17)

1.1.2 Tibiofemoral Joint

The tibiofemoral joint is a modified hinge joint allowing some lateral and rotational motion to occur. Lateral epicondyle is larger than medial, because of this, there is a screwing home mechanism (locking mechanism) which acts to medially rotate the tibia with respect to the femur, enabling the flexion to occur.

1.1.3 Ligaments

Many ligaments cross the knee, significantly enhancing its stability. The location of each ligament determines the direction in which it is capable of resting the dislocation of the knee. (16)



Collateral Ligaments

The collateral ligaments prevent lateral motion of the knee, similar to the collateral ligaments of the elbow. These ligaments are referred to as tibial and fibular collateral ligaments, which are also know as lateral collateral and medial collateral ligaments.

Fibers of the medial collateral ligament merge the joint capsule and medial meniscus connecting the medial epicondyle of the femur to the medial tibia, allowing it to resist medial shear and rotational forces. (17)

Fig. 1 Ligaments of the Knee(16)

The Lateral collateral ligament connects the lateral epicondyle of the femur just above the groove for the popliteus tendon to the head of the fibula separated from the fibrous membrane by a bursa, contributing to lateral stability of the knee.

Patella Ligament

The patellar ligament is the inferior patella continuation of the quadriceps femoris tendon attachment onto the superior aspect of the patella (fig. 1). It attaches to the inferior margins and apex of the patella to the tibial tubersity. Its superficial fibers are continuous over the front of the patella with those of the tendon of the quadriceps femoris.

Cruciate Ligaments

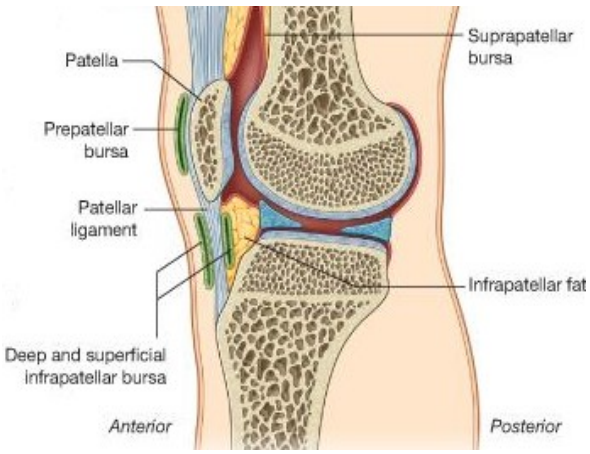
The cruciate ligaments limit the forward and backward motion of the femur onto the tibial plateaus during knee flexion and extension, additionally, limiting hyperextension. Both cruciate ligaments are in the intercondylar region of the knee and interconnected to the femur and tibia. (Fig 1)

The anterior cruciate ligament stretches from the facet of the anterior part of the intercondylar area of the tibia and ascends posteriorly, to attach to a facet at the back of the lateral wall of the intercondylar fossa of the femur

The shorter and stronger posterior cruciate ligament runs from the posterior aspect of the tibial intercondylar fossa and ascends anteriorly, to attach to the medial wall of the intercondylar fossa of the femur.

1.1.4 Joint Capsule and Bursae

The thin articular capsule at the knee is large and lax, encompassing both the tibiofemoral and patellofemoral joint. The synovial membrane attaches to the margins of the articular surfaces and to the superior and inferior outer margins of the meniscus. The cruciate ligaments are outside the articular cavity but enclosed within the fibrous membrane is the knee joint.



During knee movement a number of bursae reduce friction around the capsule. The suprapatella bursa is the largest bursa in the body and is position between the femur and quadriceps femoris tendon. The apex of this bursa is attached to the small articularis genus muscle, which pulls the bursa away from the joint during extension of the knee. Subpopliteal bursa is located between the lateral condyle of the femur and the popliteal muscle; the semimembranosus bursa is situated between the medial head of the gastrocnemius and semimembranosus tendons. (16)

Fig. 2 Joint Capsule and Bursae of the Knee Joint. Lateral view(17)

Three other key bursae are associated with the knee but are not enclosed in the joint capsule. The prepatellar bursa is situated between the skin and the anterior surface of the patella, permitting free movement of the skin over the patella during flexion and extension. The superficial infrapatellar bursa provides padding between the skin and the patellar tendon, and the deep infrapatellar bursa diminishes friction between the tibial tubersity and the patellar ligament. (17)

1.1.5 Menisci

These half moon shapes cartilages take their name after semilunar fibrocartilage discs which are firmly attached to the superior plateaus of the tibia by the coronary ligaments and joint capsule (fig. 3) and are united by the transverse ligament. The menisci are the thickest at their peripheral borders where fibers from the joint capsule solidly anchor them to the tibia. (3) The medial meniscus is also attached to the medial collateral ligament, whereas the lateral meniscus is unattached to the capsule; therefore it is more mobile than the medial meniscus. Centrally both menisci narrow down to paper thinness, with the inner edges separated from the tibia plateau. (17)

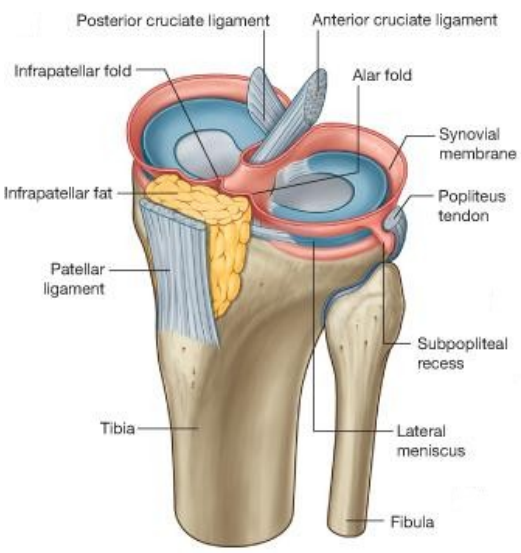


Fig. 3 Synovial Membrane of the Knee Joint(2)

The menisci improve congruency between the tibiofemoral joint during movement where the surfaces of the femoral condyles articulate with the tibial plateau; change from small curved surfaces in flexion to large flat surfaces in extension. (16)

1.2 Biomechanical and Kinesiological function of the Knee joint

1.2.1 Movement / Motions of the Knee Joint

Flexion and Extension

Flexion and extension are the primary movements permitted at the tibiofemoral joint although for the flexion movement to be initiated, the knee must be first "Unlocked."

The articulation surface of the medial condyle of the femur is longer of that than the lateral condyle rendering it almost unfeasible for any motion throughout full extension. The popliteus muscle has the job of locksmith, which acts to medially rotate the tibia enabling flexion to occur. During flexion, the femur slides forward on the tibia to prevent rolling of the tibia plateaus; opposite motion occur during extension when femur must slide backwards on to the tibia. Semimembranosus, semitendenosus and biceps femoris muscles are the primary flexors acting on the knee. Muscles which additionally assist with flexion are the popliteus, gracilis, sartorius, and gastrocnemius.

The extensors of the knee are known as the quadriceps muscles which consist of, rectus femoris, vastus lateralis, vastus medialis, and vastus intermedius. While the rectus femoris is the only muscle of this group which also crosses the hip joint, assisting it with hip flexion. All four muscles come to the attachment of the quadriceps tendon onto the patella, which distally is continued by the patellar ligament inserting into the tibia.

Patellofemoral Joint Motion

During flexion and extension at the tibiofemoral joint, the patella glides inferiorly and superiorly against the distal end of femur in a primarily vertical direction, with an excursion of approximately 7cm. During normal tracking, the patella may also slightly shift and rotate in either medial or lateral directions. (17)

Vastus medialis oblique is an active and dynamic stabilizer of the patella. In healthy, pain free individuals, the fibers of VMO are active throughout the entire range of movement. In patients with patellofemoral knee pain (Chondromalacia Patella) the fibers contract in phases, inconsistently and fatigue easily.

The specific role of VMO is to stabilize the patella within the patella groove and to control of the 'tracking' of the patella when the knee is bent and straighten. Misfiring and weaknesses in the VMO cause, mal-tracking of the patella and subsequent damage to surrounding structures and aching pain. Long-term injuries such as patellofemoral knee pain are a result of VMO malfunction; however some acute injuries cause the inhibition of

VMO (e.g. Anterior Cruciate Ligament rupture & Meniscal tears). A frequent finding of weaken VMO is a positive Q-angle [1]examination.

Axial Rotation of the Knee

The possibility of tibial rotation related to the femur, can only ensue when the knee is in flexion and not bearing weight; rotational capabilities increase at approximately 90° of flexion. Medial rotation is developed from tension with the semimembranosus, semitendinosus, and popliteus muscles, with assistances of gracilis and sartorius. Lateral flexion of tibia is solely provided by biceps femoris. A few degrees of passive abduction and adduction are permitted.

1.2.2 Range of Motion

Movement	Degrees				
Hip		**Knee**		**Foot**	
Flexion	125°	Flexion	130°	Dorsiflexion	20°
Extension	0°	Extension	0°	Plantar Flexion	45°
Hyperextension	10°			Inversion	30°
Abduction	45°			Eversion	25°
Adduction	20°				
Medial Rotation	45°				
Lateral Rotation	45°				

Table 1 Range of Motion(23)

[1]Q-Angle: The quadriceps femoris muscle is used to reflect the quadriceps femoris muscle's force on the patella. Is the angle formed by a line drawn from the ASIS to central patella and a second line drawn from central patella to tibial tubercle(19)

1.2.3 Muscles Crossing the Knee

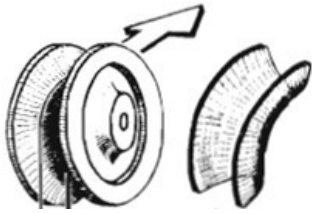
Muscle	Proximal Attachment	Distal Attachment	Primary action(s)
Rectus Femoris	Anterior inferior iliac spine	Patella	Extension
Vastus Lateralis	Greater trochanter and lateral linea aspera	Patella	Extension
Vastus Intermedius	Anterior femur	Patella	Extension
Vastus Medialis	Medial linea aspera	Patella	Extension
Semi-tendinosus	Medial ischial tuberosity	Proximal, medial tibia	Flexion and medial rotation
Semi-membranosus	Lateral ischial tubersity	Proximal, medial tibia	Flexion and medial rotation
Biceps femoris (short head)	Lateral linea aspera	Posterior lateral condyle of tibia, head of fibula	Flexion and medial rotation
Sartorius	Anterior superior iliac spine	Upper medial tibia	Assists with flexion and lateral rotation of thigh
Gracilis	Anterior, inferior symphysis pubis	Medial, proximal tibia	Adduction of thigh, flexion lower leg
Popliteus	Lateral condyle of femur	Medial, posterior tibia	Medial rotation and flexion of lower leg
Gastrocnemius	Posterior medial & lateral condyles of the femur	Tuberosity of the calcaneus by the Achilles tendon	Flexion
Plantaris	Distal, posterior femur	Tuberosity of calcaneus by Achilles tendon	Flexion

Table 2 Muscles Crossing the Knee(17)

1.2.4 Loads on Knee

Forces at the Patellofemoral Joint

Compressive force at the patellofemoral joint has been found to be one-half times body weight during normal walking gait, increasing up to over three times body weight during stair climbing (5).



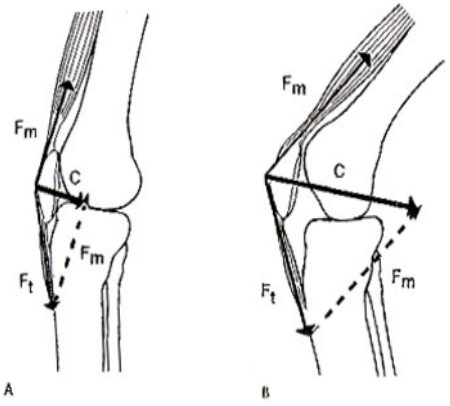


Fig. 5 (Left) Cable on a Pulley (5)
Fig. 4 (Right) Compression at the patellofemoral joint is the vector sum of tension in the quadriceps and the patellar tendon.(5)

The extensor apparatus of the knee slides on the lower end of the femur like a "*cable on a pulley"* (5) (Fig. 5). The patellar surface of the femur and the intercondylar notch effectively forms a deep vertical gutter, in the depth of which slides the patella. Thus, the force of the quadriceps, directed obliquely superiorly and slightly laterally, is turned into a strictly vertical force. Patellofemoral compression increases with knee flexion during weight bearing due to two reasons (Fig. 2); A) The increase in knee flexion amplifies the compressive component of force acting at the joint, B) During flexion, a larger amount of quadriceps tension is required to prevent the knee from buckling against gravity

Forces at the Tibiofemoral Joint

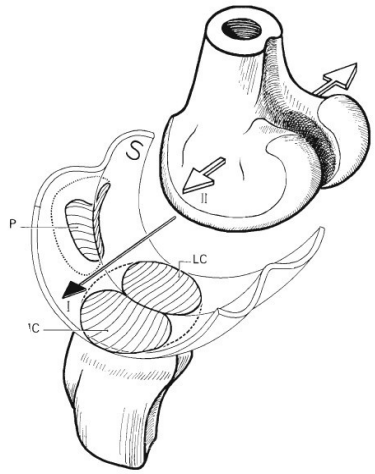


Fig. 6 Shearing force of the Tibiofemoral Joint (5)

The potential for torque development at the knee joint is large due to the position of the knee between the body's two longest bony levers; additionally, the knee joint is a major weight-bearing joint. The tibiofemoral joint is constantly loaded in both compression and shear force.

The tibia surfaces are comprised of two curved and concave parallel grooves which are separated by a rounded prominence running anteroposteriorly. The lateral and medial condyles lie in the grooves on the surfaces of the femur, and are separated by a rounded anteroposterior prominence which lodges the two intercondylar tubercles. Therefore, we can state, that the tibial condyles correspond to the femoral condyles while the intercondylar tibial tubercles come to lie within the femoral intercondylar notch. (20) (Fig.4)

1.3 Anterior Cruciate Ligament

The anterior cruciate ligament supplies fundamental ligament stabilization that resists anterior translation as well as resisting varus and valgus forces. In addition, the anterior cruciate ligament functions as mechanoreceptor, relaying information from knee strain to the central nervous system

1.3.1 Introduction to Anterior Cruciate Ligament

Detailed Anatomy of the Cruciate Ligaments

The knee joint develops as a cleft between mesenchymal rudiments of the femur and the tibia. This occurs around the eighth week of fetal development. The cruciate ligaments appear as condensations of vascular synovial mesenchyme at the same time.

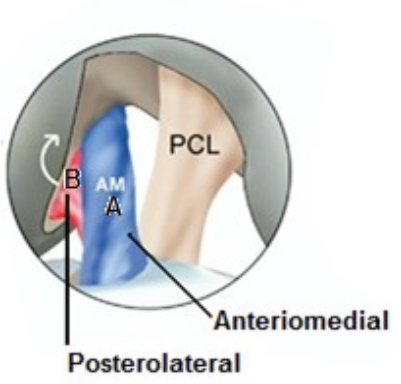


Fig. 7 Anterior View of Knee, 90° Flexion. Anteromedial and Posterolateral bundles(6)

By 14 weeks gestation, the anterior cruciate and posterior cruciate ligaments have divided; both have a functional blood supply, which is mainly derived from the middle geniculate artery. The inferomedial and lateral genicular arteries also provide blood supply throughout the fat pad.

The anterior cruciate is attached to the anterior intercondylar fossa of the tibia, along the edge of the medial condyle, and between the insertion of the anterior horn of the medial meniscus anteriorly and that of the lateral meniscus posteriorly. The ligament has a more anterior attachment to the tibia and a more lateral attachment to the femur.(5) The ACL consists of three bundles(fig.7): (A) the anteriomedial band is the longest and most superficial which makes it more subjective to injury (B) the posterolateral band rest deep and unaltered in partial tears of ligament and the intermediate band.

The cruciate ligaments are so intimately related to the capsule that they can be considered as "*actual thickenings of the capsule.*"(5) In actual fact, the capsular attachment pass through the attachment of the cruciate ligaments and the thickenings of the capsule, formed by the cruciate ligaments.

Mechanical Role of Cruciate Ligaments

The passive role of the cruciate ligaments assumes the correct sliding motion that the femoral condyles give onto the tibial plateau. During the knees initial flexion, the anterior cruciate ligaments allow the femoral condyle to slide anteriorly, whereas reaching full flexion it finally rolls in a posterior direction. The posterior cruciate ligament acts in opposite direction allowing the femoral condyle to slide posteriorly during knee extension.

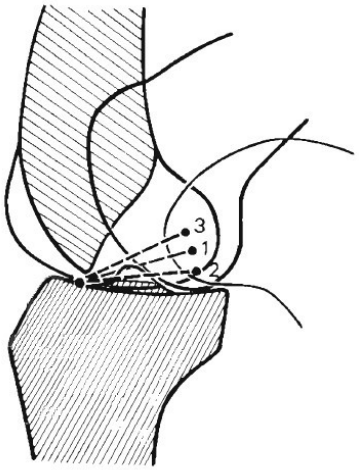


Fig. 8 Anterior Cruciate Ligament Mechanical Function(5)

The ACL, like the PCL, do not have same length fibers nor do they have same direction, therefore during movement of the knee they are not all stretch at the same time. The ACL (Fig. 8) (17) starts by lying horizontally (16) on the tibia plateau during flexion, to approximately 45°-50° and elevates to its highest point during the (3) end range motion of flexion. As described in "Detailed Anatomy of the Cruciate Ligaments" the anterior cruciate ligament is composed of 2 primary bands, the anteromedial and posterolateral and one intermediate secondary band. During flexion the anterior band is taught, while the posterior is loose; during extension, the posterolateral band is tight, while the anterior band is loose.

When the tibia provided medial rotation on the femur the cruciate ligaments cross thus coiling and stretching around each other. As a result, the tibiofemoral articulations are brought into closer proximity, successfully preventing medial rotation. The central pivot point no longer coincides with the natural center of the joint but with the medial aspect of the medial tibial spine; hence *medial rotation stretches the anterior cruciate ligament* (its fibers are attached to the anterior horn of the medial meniscus*) and relaxes the posterior cruciate.*(5)

Once presented with lateral rotation of the tibia, and viewed from anteriorly frontal plane, ligaments tend to become parallel. When view from a horizontal plane the ligaments cross each other at a greater angle than with medial rotation of the tibia, although their axial borders lose contact. Thus *stretching the posterior cruciate and relaxing the anterior cruciate ligament.*(5)

1.3.2 Etiology of the Knee due to Mechanical Forces

The average tensile strength for the anterior cruciate ligament is 2160 N. This is slightly less than the strength of the posterior cruciate ligament and approximately half as strong as the medial collateral ligament. The anterior cruciate ligament is the primary restraint to limit anterior translation of the tibia. The greatest restraint is in full extension.

Noncontact Injuries

- **Planting and cutting**: The foot is positioned firmly on the ground followed by the leg (and body for that matter) turning one direction or the other.
- **Straight-knee landing**: Results when the foot strikes the ground with the knee straight..
- **One-step-stop landing** (with the knee hyper-extended): Results when the leg abruptly stops while in an over-straightened position.
- **Pivoting and sudden deceleration:** Results from a combination of rapid slowing down and a plant and twist of the foot placing extreme rotation at the knee.

Contact and High-Energy traumatic injuries

- **Non-sport related injuries**: Result from similar contact and non-contact stresses on the ligament. Examples vary from being struck on the outer side of the knee to landing on the knee forcing it into an over-straightened position with the knee turned inward.
- **Motor vehicle accidents:** The knee is forced under the dashboard may also cause rupture of the ACL.
- **Repeated trauma**: Wear and tear can be a knee problem at any age causing small tears in the ligament, which over time become complete tears.

1.4 Methods of Diagnosis

1.4.1 Clinical Symptoms

The anterior cruciate ligament provides additional support, preventing over bending and over straightening of the knee, and limiting sliding movement between the bones. When the ligaments are subjected to forces above their threshold, either by internal or external knee articulating forces, plasticity may occur followed by tear, accompanied by ligament hemarthrosis[2]. (2)

Individuals may encounter the following symptoms subsequently after anterior cruciate ligament tear:

- An audible pop at the moment if injury.
- Knee will tend to slip out of joint, feeling unstable.
- Swelling and pain hinders movement.
- Knee may feel as it gives way or is unstable.

1.4.2 Etiology

Proper history taking is always the first step to diagnosing an anterior cruciate ligament injury. Once presented with proper knowledge of the mechanism of injury, a differential diagnosis should be considered since anterior cruciate ligament is commonly accompanied by damage to the medial meniscus and medial collateral ligament, in some severe cases lateral meniscus tear may be present.

1.4.3 Clinical Tests for the Anterior Cruciate Ligament

The Lachman Test (2)

A positive Lachman test is certain proof of anterior cruciate ligament insufficiency.

Procedure: The patient is supine with the knee flexed 15°-30°. The examiner holds the femur with one hand while pulling the tibia anteriorly with the other. The quadriceps and knee flexors must be completely relaxed.

Assessment: The anterior cruciate ligament is damaged when the mobility of the tibia with respect to the femur can be

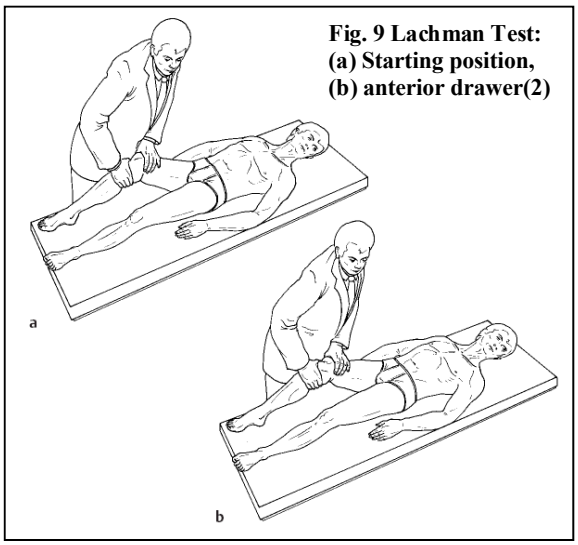


Fig. 9 Lachman Test: (a) Starting position, (b) anterior drawer(2)

[2] Hemarthros: The extravasation of blood into a joint. Also called hemarthrosis (7)

demonstrated. The end-point of motion must be soft and gradual without a hard stop; ant hard stops suggest a certain stability of the anterior cruciate ligament. A hard endpoint within 3 mm suggest complete stability of the anterior cruciate, whereas one after 5 mm or more suggests relative stability of the ACL, such as may be present following an earlier sprain.

Cruciate ligament injury should be ssupected where the endpoint is soft or absent. In th epresence of a drawer exceeding 5 mm, comparison with contralateral knee is helpful in excluding congenital laxity of articular ligaments.

The Pivot Shit Test (2)

Procedure: The patient is supine. The examiner grasps and immobilizes the lateral femoral condyle with one hand and palpates the proximal tibia or fibula with the thumb. With the other hand, the examiner holds the patient's lower leg in internal rotation and abduction (valgus stress). From this starting position the knee is then moved from extension into flexion.

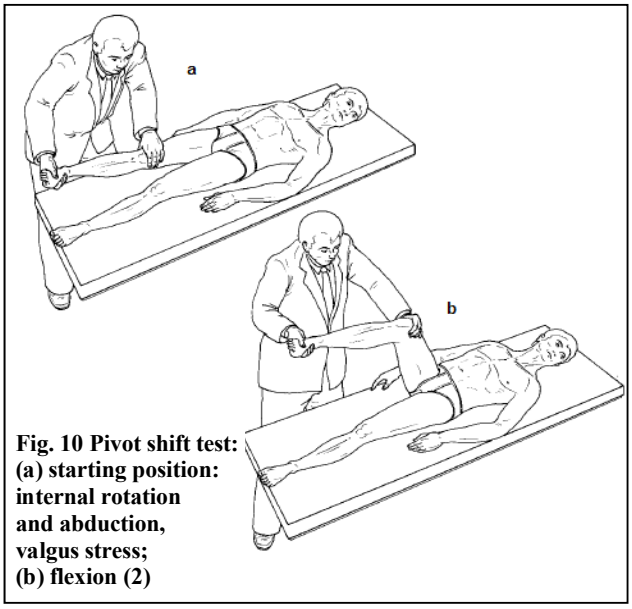


Fig. 10 Pivot shift test: (a) starting position: internal rotation and abduction, valgus stress; (b) flexion (2)

Assessment: In the presence of a torn anterior cruciate ligament, the valgus stress will cause the tibia to subluxate anteriorly while the knee is still in extension. The blockade of the knee in anterior subluxation depends on the degree of valgus stress applied; occasionally the sign can be elicited more easily when the examiner immobilizes the patient's leg between his or her own forearm and waist while applying slight axial compression. The knee is then flexed while the same internal rotation and abduction of the lower leg is maintained; this then causes the subluxated tibial head to reduce posteriorly at 20°– 40° of flexion. The iliotibial tract, which with increasing flexion glides from a position anterior to the lateral epicondyle in extension to a position posterior to the axis of flexion, draws the tibial head posteriorly again. The degree of reduction and flexion depends on the severity of the anterior subluxation. Reduction occurs earlier when there is only slight anterior translation. The patient usually confirms the diagnosis by reporting that the typical sensation of the knee giving way felt in sports activities can be reproduced in this test.

According to Jakob, a genuine pivot shift phenomenon can partially disappear, despite anterior cruciate ligament insufficiency, under the following conditions:

1. When a complete tear of the medial collateral ligament is present, the valgus opening prevents force concentration in the lateral compartment. Subluxation cannot occur under these circumstances.
2. When the iliotibial tract is traumatically divided, only the subluxation will be observed, not the abrupt reduction.
3. A bucket handle tear of the medial or lateral meniscus can prevent anterior translation or reduction of the tibia.
4. Increasing osteoarthritis in the lateral compartment with osteophytes can create a concave contour along the once convex lateral tibial plateau.

Anterior Drawer Test (2)

Procedure: The patient is supine with the hip flexed 45° and the knee flexed 90°. The examiner sits on the edge of the examining table and uses his or her buttocks to immobilize the patient's foot in the desired rotational position. The examiner then grasps the tibial head with both hands and pulls it anteriorly with the patient's knee flexors relaxed. The test is performed in a neutral position, with the foot in 15° of external rotation to assess anterior and medial instability, and with the foot in 30° of internal rotation to assess anterior and lateral instability.

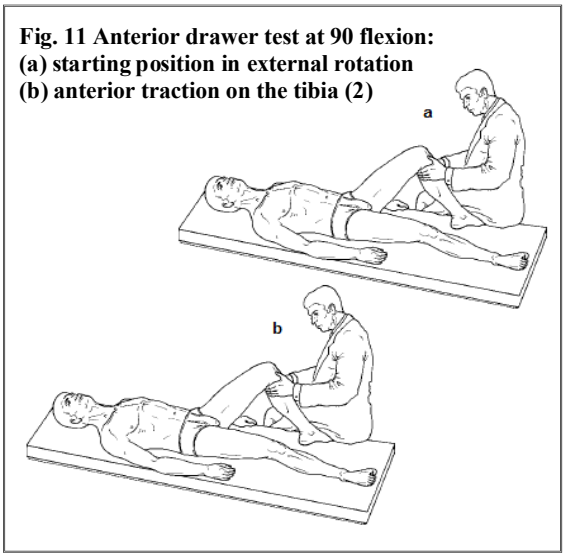


Fig. 11 Anterior drawer test at 90 flexion: (a) starting position in external rotation (b) anterior traction on the tibia (2)

Assessment: A visible and palpable anterior drawer (that is, anterior displacement of the tibia with a soft endpoint) is present in chronic insufficiency of the anterior cruciate ligament.

The anterior drawer test in 90° of flexion is often negative in acute injuries because pain often prevents the patient from achieving this degree of flexion and causes reflexive muscle contraction. Additionally, these are usually combined injuries involving complete or partial ligament tears so that the stress of the drawer test stretches the partially torn medial and lateral structures. The resulting pain produces false negative test results, giving the appearance of a stable joint.

In acute injuries in particular, the test should preferably be performed with the knee in slight flexion (Lachman test). The situation is the sensation of instability. In these cases, the test can usually be performed painlessly in 90° of flexion and still provide useful diagnostic information.

1.4.4 Imaging Studies

Acute knee injuries studies should include plain radiographs with anteroposterior, lateral, and oblique views. Radiographic findings of an avulsion fracture of the lateral tibial margin [3]or an avulsion fracture of the tibial spine suggest an ACL injury.

MRI should be performed to evaluate the ACL and to further evaluate any associated injuries. MRI is able to detect about 98% of ACL tears but is less frequently able to distinguish complete tears from partial tears

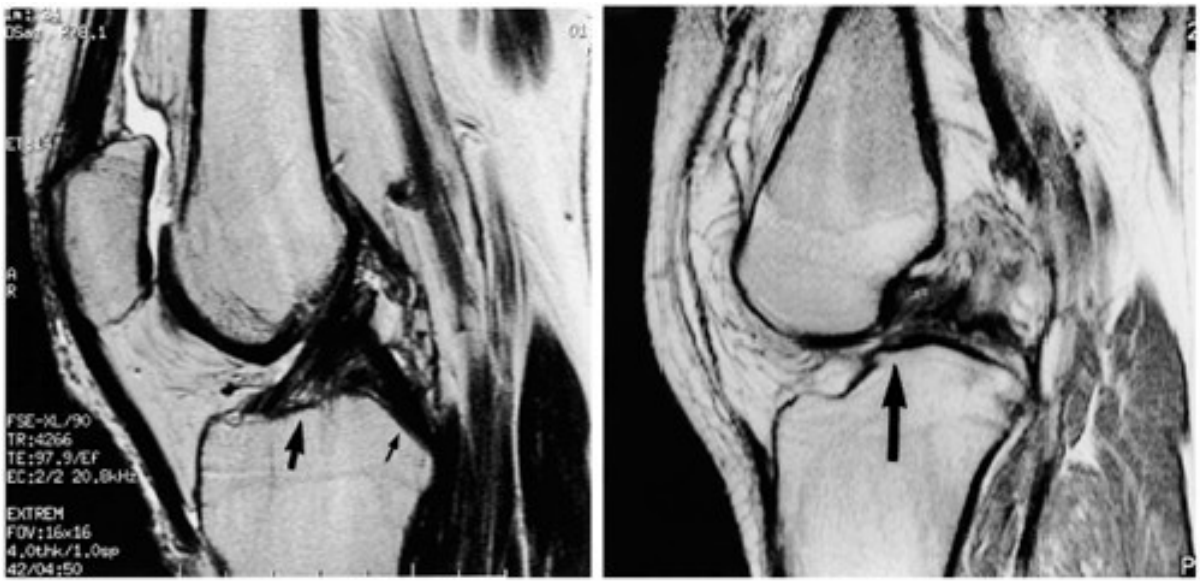


Fig. 12 Left: MRI of normal knee with intact anterior cruciate and posterior cruciate ligament Right: MRI of knee with anterior cruciate ligament tear.(13)

[3] Segond fracture: Small vertical avulsion injury of the lateral aspect of the proximal tibia just distal to the plateau.(12)

1.5 Treatment approach

Treatment options must be customized to a patient's preoperative level of activity. The following activity levels are based on the International Knee Documentation Committee:

- **Level I:** Includes jumping, pivoting, and hard cutting.
- **Level II:** Heavy manual work or side-to-side sports.
- **Level III:** Encompasses light manual work and non-cutting sports (eg, running, cycling).
- **Level IV**: Sedentary activity without sports.

Nonsurgical approach should be considered for patients who preoperative levels are III or IV.

1.5.1 Non Invasive

For patients who are willing to avoid high-demand activities and range in the levels III or IV, a non invasive approach may be appropriate. The goal is to eliminate recurrent knee instability although change in lifestyle with a withdrawal from some sports or other activities may be necessary. For clinical personal, the following evaluation guideline should be considered for a proper proficient diagnosis of absent efficiencies of the anterior cruciate ligament functions.

Guideline **(11)**

Precautions for Treatment:

- Activities that result in continued locking of the knee should be avoided.
  Open Chain exercises that may cause excessive anterior translation of the tibia on the femur should be avoided.
- Continued / worsening of pain with progressed physical therapy treatment

Examination
Medical History:
Review medical history questionnaire and medical history reported.
History of Present Illness: Interview patient at the time of examination to review patient's history and any relevant information that would pertain. Determine any past injuries that have taken place. An ACL deficient knee is almost always the result of trauma; however, this trauma may or may not be the result of an external force. A clear description of how the injury occurred is essential. Patient will usually report hearing or feeling a "pop" at time

of injury and swelling will occur within the first 2 hours of the 1 Incident will usually be followed by problems with ambulation, locking, buckling, pain, weakness and continued swelling.

Social History: Review patient's home, work, recreational and social situation. Typically patients opting for the non-surgical option are often older, and potentially less active (athletic) people. Long-term instability in the knee commonly leads to further damage to the joint including meniscal tears, articular degeneration and increasing instability. Make sure the International Knee Documentation Committee activity level scale is used.

Medications: Patient may be on NSAIDS, and/or may be have been prescribed some pain medication by their physician.

Examination (Physical / Cognitive / applicable tests and measures / other)

Pain: As measured on the VAS[4], activities that increase symptoms, decrease symptoms, location of symptoms.

Visual inspection: Attention to the presence of swelling, joint deformity, and overall patient functional use of the knee.

Lower extremity posture: Q-Angle, Hip Anteversion or Retroversion , Knee Varus, Valgus or Recurvatum, Patella Baja, Alta or Squinting, Tibial Torsion, Foot Pronation or Supination.

Edema/Atropy: Typical circumference measurements of the knee joint are taken at the mid patella (joint line), 15 cm above the superior border of the patella, and either at the tibial tubercle or 5 cm below the inferior border of the patella.

Palpation: Palpate entire knee complex. Focus on presence and extent of musculature atrophy and swelling.

ROM: Active and Passive Knee Flexion and Extension; Hip and Ankle ROM also taken.

Muscle performance: Early post-injury motor control will be assessed through standard manual muscle testing. Also make note of vastus medialis oblique muscle activity.

Ligament/Menisci testing: Valgus Stress, Varus Stress, Posterior Draw (Sag Sign), Anterior Draw, Lachman, and Pivot Shift, Apley's Compression, McMurray's 2

Patella mobility: Medial, lateral, superior, and inferior

Muscle length: Hamstrings, quadriceps, iliopsoas, iliotibial band, gastrocnemius, soleus

Gait: Patient maybe need the assistance of either crutches or cane in order to eliminate an antalgic gait pattern. The lack of terminal knee extension may also be impacting one's gait.

Balance: Gross assessment to determine patient's safety to ensure Independence with transfers, gait, and stairs. Further in depth assessment to be conducted if impairments noted in screening. Typical balance measures include single leg stance, step-up, step-down tolerance, and response to center of gravity displacement.

[4] VAS: A visual analogue scale is a psychometric response scale which can be used in questionnaires.

Functional Assessment

Use of a knee specific functional capacity questionnaire is recommended to establish early post-injury status and to track progress.

Possible tools:

- Lysholm Knee Score
- Lower Extremity Functional Score
- LIFEware Knee Assessment form

Goals:

1. Independent with home exercises, including understanding of open chain vs. closed chain quad strengthening at discharge.
2. Increase strength throughout LE musculature to 5/5 in 8-12 weeks.
3. Full A/PROM Knee in 3-4 weeks
4. Ambulation without device or deviation in 3-4 weeks.
5. Full ADL's in 6 weeks.
6. Return to Sports activity with brace in 12 weeks.

Treatment Planning / Interventions

Edema Control: Cryotherapy.

Strengthening: Entire lower extremity should be strengthened. Special attention should be paid to quadriceps, hamstrings for the ability to help stabilize knee in lieu of an intact ACL and Hip abductors to maintain proper alignment of lower extremity.

Closed Chain exercises are used for quadriceps strengthening.

Open Chain exercises that may cause excessive anterior translation of the tibia on the femur should be avoided.

Joint ROM/ Muscle Stretching

Proprioception Training: increase strength, balance, agility, coordination.

Endurance Training

Electrical Stimulation: strengthen the VMO to prevent development of patellofemoral dysfunction.

ROM: Active and Passive of knee

Stretching: Quadriceps, hamstring and ITB Balance

Gait training: Progress from possible assistive device to walking, ascending and descending stairs and finally jogging or running.

Bracing: Using of directional knee brace, especially during physical activities.

Frequency & Duration Outpatient Care: 2-3x/week for 2-3 months

Patient / family education

1. Instruction in HEP (home exercise program) of ROM, Strength and flexibility training
2. Instruction in pain control and ways to minimize inflammation
3. Instruction in activity level modification / joint protection
4. Donning and Doffing of Brace (if applicable for the patient) Orthotics- Bracing

ACL braces are designed to reduce knee instability following an injury to the ACL. In general, people with ACL injuries report an improved sense of stability when wearing an ACL brace. ACL braces are usually recommended for twisting, pivoting, cutting or jumping activities. In addition to providing increased stability to the knee, ACL braces may also decrease the risk of injuring other parts of the knee. Functional bracing may offer support and may also provide resistance to tibial translation at low loads. Bracing may diminish normal reaction times, and buckling episodes often continue. ACL braces have a light-weight frame and hinges at the knee joint. Straps help secure the brace to the knee. This type of construction allows the knee to bend and straighten while providing rotational support to the knee.

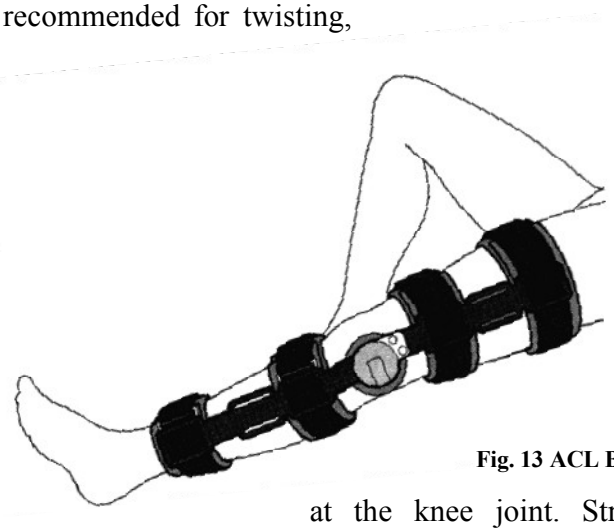


Fig. 13 ACL Brace (8)

1.5.2 Invasive (Surgical)

Patients who wish to enter functional Levels I, II, according to International Knee Documentation Committee, are a must for anterior cruciate ligament reconstructions. There are three different major surgical techniques employed in the anterior cruciate ligament reconstruction which will be described in greater detail. The following paragraphs will describe the surgical approach.

The surgery is performed in a stepwise fashion as follows: (a) evaluation under anesthesia, (b) graft harvesting and preparation, (c) notch preparation, (d) positioning and preparing the osseous tunnels, (e) graft implantation and fixation, (f) closure and postoperative assessment of stability, and (g) postoperative management and rehabilitation.(9)

Prophylactic antibiotics typically 1 g of a first-generation cephalosporin (Cefazolin) is given 30 to 60 minutes prior to surgery. The patient is placed in the supine position with both legs resting straight on the operating table. A tourniquet is placed on the proximal thigh but is seldomly inflated during the procedure. A lateral thigh post clamped to the table allows a valgus stress to be applied to the knee, enhancing visualization and access to the

medial meniscus. After adequate anesthesia, we perform a ligament examination and document the preoperative arthrometric evaluation of both knees with the KT1000™[5].

ACL surgery begins with an arthroscopic examination of the inside of your knee. This surgical technique uses three very small incisions that are about 3.2 cm in length to create "portals" into the knee. A fiber-optic light source illuminates the inside of the knee and a video camera feeds an image to a monitor so that the surgeon can see inside the knee. A sterile saline solution is continuously pumped through the knee via a cannula so that the operative field is always clear.

After the surgeon inspects the knee for damage to the cartilage or the menisci, the remnants of the torn ACL are removed with a high-speed shaver. This tool is a very specialized device that is used to remove torn ligaments or torn pieces of cartilage from the knee. The surface of the intercondylar notch where the ACL normally attaches to the femur is then prepared with a high-speed burr so that the proper location for the tunnel for femoral fixation can be seen clearly.(1)

Tunnels are then drilled through the bone in the femur and the tibia so that the graft can be placed in the center of the knee in the same position as the original ACL. A separate incision that is about 5.1 to 7.6 cm long also has to be made in order to harvest the graft from either the patellar tendon or the hamstring tendons. After the graft has been harvested, it is then prepared by placing several very strong surgical sutures through the graft that are used to fix it in place. When an allograft is used, it is not opened until it is certain that the procedure will continue with to ACL reconstruction. Some surgeons will also braid the graft before passing it through the tunnels.

After the graft is passed through the tunnels, it is then tensioned and fixed in place. A variety of fixation techniques have been developed to anchor the graft to the bone. Different techniques are used for different types of grafts, and today, fixation failures, though possible, are very rare.(1)

Once the graft has been fixed in place and any additional damage has been addressed, the incisions are closed and a sterile dressing is used to cover the knee. This dressing will usually stay on for several days while the wound begins to heal.

[5] KT1000™ : A self-contained anterior/posterior tibiofemoral displacement measuring instrument.(20)

1.5.3 Differences between Grafts

The grafts that are commonly used today are, the central part of the patellar tendon, some of the hamstring tendons, or an "allograft" from a cadaver.

Patella Autograft

The patellar tendon averages between 25 to 30 mm in width. When a patellar tendon graft is taken, the central 1/3 of the patellar tendon is removed (about 9 or 10 mm) along with a block of bone at the sites of attachment on the kneecap and tibia

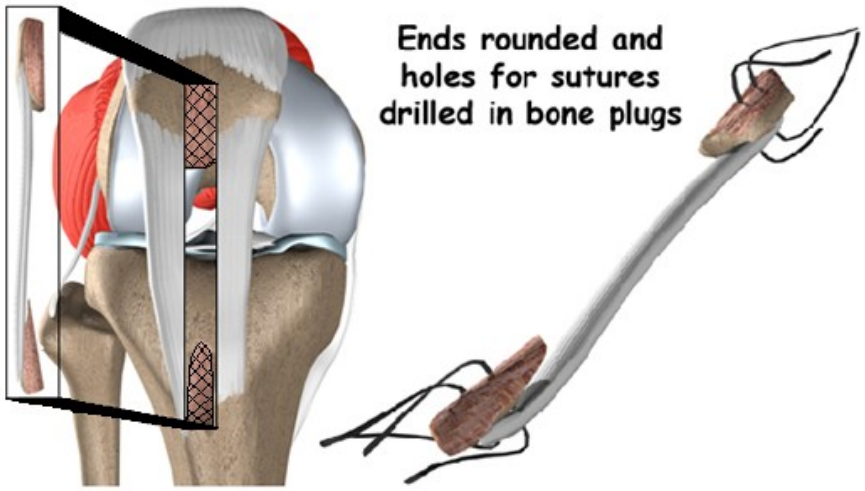


Fig. 14 Left Middle Third of Patella Ligament Cut and Removed Graft; Right: Patella Graft after Removal (11)

Advantages: Many surgeons favor the patellar tendon graft because it closely resembles what desires reconstruction. The length of the patellar tendon is similar as the ACL, and the bone ends of the graft can be placed in to the bone where the ACL attaches. This allows for "bone to bone" healing, something many surgeons believe this to be stronger than any other healing method.

Disadvantages: When the patellar tendon graft is in use, a segment of bone is removed from the kneecap and about 1/3 of the tendon is removed. There is a risk of patellar fracture or patellar tendon rupture following this surgery. Also, the most frequent problem following this surgery is pain on the front of the knee ("anterior knee pain"). In fact, patients sometimes say they have pain when kneeling, even years after the surgery. (1) The finding of histogical abnormalities in the patella tendon up to six years after the primary harvest strongly suggest that rehasversting the central third of the patella tendon cannot be recommended therefore if patella graft does not work adequately, reharvesting of the same graft would not be recommended.(18)

Hamstring Autograft

The hamstring muscles are the group of muscles on the back of your thigh. When the hamstring tendons are used in ACL surgery, two of the tendons of these muscles are removed, and "bundled" together to create a new ACL. Over the years, methods of fixing these grafts into place have improved.

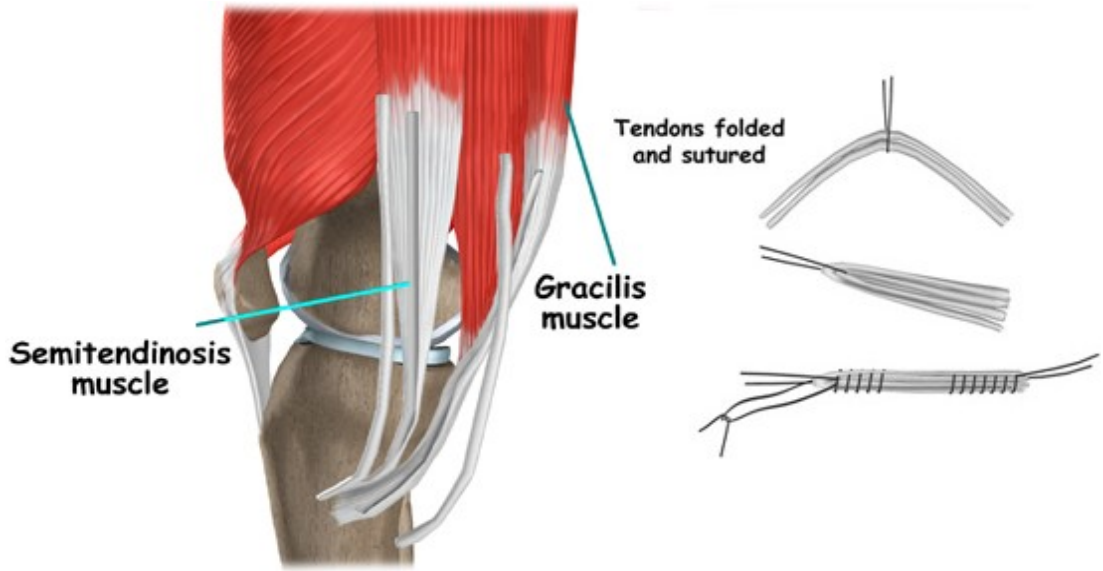


Fig. 15 Left: Hamstring Graft Site; Right: Three or Four Strips Graft (11)

Advantages: Unlike the persistent donor-site morbidity such as tenderness, anterior knee pain, disturbance in anterior knee sensitivity, and the inability to kneel and knee walk presented with patellar tendon grafting (18), the hamstring tendon does not present with these problems. The incisions are smaller, and the pain, both in the immediate post-operative period, and down the road, is thought to be less.

Disadvantages: The primary problem with these grafts is the fixation of the graft in the bone tunnels. When the patellar tendon is used, the bone ends heal to the bone tunnels ("bone to bone" healing). With the hamstring grafts, a longer period of time is necessary for the graft to become rigid. Therefore, people with hamstring grafts are often protected for a longer period of time while the graft heals into place.

Cadaver Allograft

Fig. 16 Allograft Patellar Graft (10)

Allograft is most commonly used in lower demand patients, or patients who are undergoing revision ACL surgery (when an ACL reconstruction fails). Biomechanical studies show that allograft is not as strong as a patient's own tissue. For many patients,

however, the strength of the reconstructed ACL using an allograft is adequate for their demands. Therefore this may be an excellent alternative for patients not planning to participate in high-demand sports (e.g. soccer, basketball, etc.).

Advantages: Performing the surgery using allograft allows for decreased operative time, no need to remove other tissue to use for the graft, smaller incisions, and less post-operative pain. Furthermore, if the graft were to fail, revision surgery could be performed using either the patellar tendon or hamstring grafts.

Disadvantages: Historically, these grafts were of poor quality and carried a significant risk of disease transmission. More recently, techniques of allograft preparation have improved dramatically, and these problems have greatly improved. However, the process of graft preparation (freeze-drying), kills the living cells, and decreases the strength of the tissue. There is also the concern of disease transmission. While sterilization and graft preparation minimizes this risk, it does not eliminate it entirely. The risk of complication from other factors unrelated to allograft tissue is much higher than the risk of disease transmission, but it is still there.

Summary

Many surgeons have a preferred technique for different reasons. The strength of patellar tendon and hamstring grafts is essentially equal. There is no right answer as to which is best, at least not one that has been proven in orthopedic studies. The strength of allograft tissue is less than the other grafts, but the strength of both the patellar tendon and hamstring tendon grafts exceed the strength of a normal ACL. The bottom line is 85% to 95% of patients will have clinically stable knees following ACL reconstructive surgery.

1.6 Therapeutic approach

Each surgeon will generally have attached a protocol for a therapeutic guideline but the intent of a protocol is to provide the clinician with a "guideline" for the post-operative rehabilitation course of a patient that has undergone the surgery. It is by no means intended to be a substitute for the clinical decision making regarding the progression of a patient's post-operative course based on their physical exam / findings, individual progress, and / or the presence of post-operative complications.

Different countries have shown a number of discrepancies to their post operative guidelines. These dissimilarities in guidelines can be due to a great number of differences, for instance, insurance coverage, surgical techniques, modernized investigated studies, etc. I will compare a rehabilitation guideline from a distinguished clinic in the Czech Republic to that of a USA Surgical Orthopedics Clinic

Therapeutic Approach Comparison

<table>
<tr><th colspan="3">Mid West Orthopedics, Chicago. USA</th><th></th><th colspan="3">CLPA, Praha 6.Czech Republic</th></tr>
<tr><th>Weight Bearing / ROM</th><th>Brace</th><th>Therapeutic Exercises</th><th>Week</th><th>Weight Bearing / ROM</th><th>Brace</th><th>Therapeutic Exercises</th></tr>
<tr><td colspan="3">Phase I</td><td>0</td><td colspan="3" rowspan="2">Rest</td></tr>
<tr><td rowspan="3">WB: As tolerated with crutches*
ROM: As tolerated</td><td>Locked in full extension for ambulation and sleeping</td><td rowspan="3">Heel slide
Quad/hamstring sets
Patellar mobilizations
gastrocnemius/soleus stretches***
SLR with brace in full extension until quad strength prevents extension lag</td><td>1st</td></tr>
<tr><td>Unlocked for ambulation, remove for sleeping***</td><td>2nd</td><td colspan="3">Phase I (Beginners) 30min.</td></tr>
<tr><td></td><td></td><td>3rd</td><td>WB: Full load, fully removed crutches at all times
ROM: Increase ROM</td><td>None</td><td>Exercises of quadriceps, Glutei muscles w/ ball and thera-band
Knee flexors exercise
Sensomotoric training (on the ball, Posturomed)
Gait training
Stretching of muscles
Scar therapy</td></tr>
</table>

Phase II			**4th**	**Phase II (Advance) 55min.**		
WB: Gradually discontinue crutch use ROM: Maintain full extension and progressive flexion	Discontinue use when patient has full extension and no extension lag	Progress to weight bearing gastrocnemius /soleus stretch Begin toe raises Closed chain extension Balance exercises Hamstring curls Stationary bike	**5th**	WB: FULL	**None**	Sensomotoric training (Posturomed, balancesandals, pavement) Leg curling machine (Small weight) Leg muscles exercises Back muscles exercises Rotoped (w. little pressure) Stepper Gait training on pavement Mobilization (on stretching table) Exercise of non operated leg as well
Phase III			**6th**			
WB: Full, without use of crutches and with a normalized gait pattern ROM: Gain full and pain-free	**None**	Advance closed chain strengthening Progress proprioception activities Begin Stairmaster/Nortic Trac	**7th**			
			8th	**Phase III (Super Advance) 55min.**		
		Running Straight	**12th**	WB: Full	**None**	Dynamic exercises Sensomotoric training (w/Ball, Posturomed, Balance sandals, Pavement) & combinations Machine exercises w/ bigger loads Scapula and back muscles exercises Rotoped (w/. bigger load) Stepper Running steps, kicking, pavement with soft shoes Stretching of muscles in whole leg No Jumping
Phase IV			**16th**			
WB: Full ROM: Full and pain-free	**None**	Progress flexibility/ strengthening Progression of function: forward/backward running, cutting, grapevine, etc. Initiate plyometric programs and sport specific drills	**23rd**			
Phase V			**24th**			
WB: Full ROM: Full and pain-free	**None**	Gradual return to sports participation Maintenance program for strength and endurance	**+**			

* Modified with concomitantly performed meniscus repair/transplantation or articular cartilage procedure

**Brace may be removed for sleeping after first post-operative visit (day 7-10)

***This exercise is to be completed in a non-weight bearing position

Table 3 Therapeutic Approach, Comparison. Left: Mid West Orthopedics, Chicago USA; Right: CLPA, Praha 6 Czech Republic

2. Case Study

2.1 Methodology

Background and Purpose

Specific parameters are difficult to identify since many orthopedic surgeons utilize very specific protocols. For the initial anamnesis and examinations, APTA guidelines were used which were retrieved from PTA EXAM book (9). Initial post-operative management of a patient following ACL BPTB reconstruction includes, protecting the integrity of the graft, controlling edema, and improving range of motion. Specific intervention activities include pain modulation, patellar mobility, active range of motion exercises, gait activities, and quadriceps exercises. As patients further advances into their rehabilitation program, treatment begins to focus on specific strengthening activities, emphasizing closed-chain exercises and selective functional activities. The rehabilitation guidelines which were used for this patient rehabilitation were issued by the orthopedic clinic at CLPA (Table 3 Therapeutic Approach, Comparison. Left: Mid West Orthopedics, Chicago USA; Right: CLPA, Praha 6 Czech Republic).The purpose of this case study is to enclose a deeper perception of therapeutic approaches and analyze the accessible therapeutic structure from this following clinic. The Ethics Committee of the Faculty of Physical Education and Sports at Charles University approved this thesis.

Subject

A 32-year-old man sustained a grade III ACL injury after bending awkwardly his leg during a football match. He is two weeks post operated of BPTB ACL graft and presents mild effusion in the involved knee. He is a recreational football player but would like to return to his prior status. He is currently attending physical therapy at CLPA, clinic in Prague, Czech Republic. Patient signed a inform consent allowing all medical records to be accessible for this report.

Methods and Measures

The case study was prospective and observational with repeated measures. The subject performed a serious of rehabilitation exercises which were divided into Phases (I, II, III) with according to weeks and patients progress. An initial examination and measurement were performed before entering Phase I. Following the end of Phase I, he was reexamine and measured before entering this subsequent phase. However he chose to discontinue therapy after finishing Phase II and a final examination was performed to conclude patient’s prognosis.

2.2 Anamnesis

2.2.1 General Demographics

Patients name: P. M. **Today's Date:** 25.1.2010 **Date of Surgery:** 11.01.2010

Diagnosis: S83.5 Sprain and strain involving (anterior) cruciate ligament of the knee

Age: 32 **DOB:** 23.6.1978 **Gender:** Male

Marital Status: Engaged **Education(Years/Degree):** Secondary School

Height: 178 cm **Weight:** 82 **BMI:** 25.9

Alcohol Use (Type/Amount): Beer / Socially **Tobacco Use (Amount/Years Used):**None

Employer: Kooperativa Insurance **Occupation:** Sales Manager

2.2.2 Current symptoms/Chief complaint

Chief Complaint

1) Difficulty with ambulation w/o using B/L crutches 2) Difficulty ascending / descending stairs 3) Difficulty transferring in / out of car 4) Unable to participate in sports

Functional level

OPTIMAL[6]**=** **Difficulty:** 54% (5 items unmarked) **Confidence:** 40% (1 item unmarked)

(21=no deficit)

KOOS[7]**=**	**Pain**	**Symptoms**	**ADL's**	**Sports/Recreational**	**QOL**
	44%	64%	32%	85%	50%

Patient indicated that he would like to perform the following exercises w/o difficulties:
1) Squatting 2) Kneeling 3) Running

[6] OPTIMAL: Outpatient Physical Therapy Improvement in Movement Assessment Log is an instrument that measures difficulty and self-confidence in performing 21 movements that a patient/client needs to accomplish in order to do various functional activities

[7] KOOS: (Knee injuries and Osteoarthritis Outcome Score) is developed as an instrument to assess the patients opinion about their knee and associated problems.

2.2.3 Mechanism of present injury

March 2009 patient was engaged in a recreational football match at which time present injury occurred. He was playing in a defensive position when he attempted to retrieve an inbound play by sliding towards the opponent with the football. Patient describes his right leg was straight and left knee was bent under thigh during his slide. Patient mimicked sliding position during examination; right hip was in FLEX, ER and slight ABD with extended knee while left hip was providing EX, IR and ABD.

2.3.4 Past Injuries/Hospitalization/Surgeries

Table 4 Past Injuries/Hospitalization/Surgeries

Date	Reason	Doctor	Complication
2005	Right lateral ankle strained	None	Strained 5 total times in 2005
2005	Left lateral ankle strain	None	Strained 2 total times during 2005's football season
9.2009	Right ACL tear/ medial meniscus tear	None	Patient tore his ACL during football match
11.01.2010	ACL reconstruction and menial meniscus repair	MUDr. Novak Petr	None

2.2.5 Medications

Name of Medication	Date Prescribed	How Often
Bextra	11.1.2010	3 x /day for up to7 days

Table 5 Medications

2.2.6 Living environment

Patient currently lives on a second floor flat which does not have access to an elevator. He shares the flat with his fiancé and does not require any assistance managing ambulation in /out of his flat. Patient notes no difficulty with house hold errands, such doing laundry and cleaning dishes. He subjectively describes no obscurity with sitting on the couch but has to modify operated leg position into a straight leg, sometimes placing on the table. P.M. does not have any difficulties ambulating around normal landscape not unless he is presented with uneven terrain.

2.2.7 Personal Care

Unlike sitting on the coach, patient explains an increased level of difficulties which is presented with toileting; he must modify positioning to a sideways sitting position. Some small difficulties are present with getting in / out of the bathtub but do not require personal assistance. After bathing, patient required help with redressing the leg bandage.

Patient encounters problems with putting shoes on the operated leg but can manage all other personal hygiene and dressing task solo.

2.2.8 Social support system

Patient returned to work on 25.1.2010. He does not use public transportation so his fiancé drives him to / from work; describes some difficulty with entering / exiting the car. Patient notes that he is not able to drive yet but will shortly be competent to do so.

2.3 Examinations

2.3.1 Anthropometric characteristic

Knee effusion (inflammation)

Patient currently is with expected inflammation around the operated knee. It is mostly noticeable around the lateral side as well as increased temperature. No excessive distal / proximal extremity inflammation is present; it is localized to only the operated area.

Table 6 Extremity Circumferential Measurements

Girth	15cm↑ Sup Pat.	10cm↑Sup Pat.	Mid Patella	Largest region on calf
Right	46 cm	47 cm	42 cm	37 ½ cm
Left	51 cm	50 cm	41 ½ cm	39 cm

Table 7 Length Measurements

Measurement/ Extremity	Functional Length	Anatomical Length
Right	101.5 cm	87 cm
Left	101.5 cm	87.5 cm

2.3.2 Arousal, attention, and cognition

Table 8 Arousal, attention, and cognition

Mental Status	Alert	
Learning Ability	Complex command can be given to patient w/o difficulties to execute (Multiple steps command	
Memory	Short-term: Good	Long-term: Good

2.3.3 Assistive and adaptive devices

Analysis of components and safety of a device:
Patient currently discontinued the uses of crutches according to doctor's prescription. HE does not have any additional safety devices installed due to difficulty but he notes using the railing to ascend / descend steps and door handle to enter the car.

Potential utilization of crutches:
Patient may be a candidate to return onto crutches due to his antalgic gait pattern but it is not unsure.

2.3.4 Muscle performance

Table 9 Manual Muscle Testing

Muscle	Grade	Muscle	Grade	Muscle	Grade
Supine		**Side Lying**		**Prone**	
Illiopsoas	4-/5	Gluteus Medius	4-/5	Gluteus Maximus	3/5
Sartorius	4/5	Gluteus Minimus	4-/5	Gastrocnemius	5/5
Tensor fasciae latae	3+/5	Hip Adductors	3+/5	Soleus	5/5
Tibialis Posterior	4/5	**Sitting**		Hamstring	4+/5
Tibialis Anterior	4+/5	Quadriceps	4+/5	Quadratus Lumborum	5/5
Toe Extensors	4-/5	Med. Rotators of Hip	3/5		
Toe Flexors	4+/5	Lat Rotators of Hip	3/5		

Muscle contraction characteristics

VMO is not the primary active muscle. Patient has problem with activation of VMO and patellar tracking. Patellar squinting is present during flexion. All other knee flexors, except the VMO are simultaneously activated

.

2.3.5 Gait (According to Rancho Los Amigos Terminology)

		Right (Operated) Lower Extremity	Left Lower Extremity		
Stance Phase	**Initial contact**	Posterior/lateral heel makes first contact	Normal take of toes but body looks unbalanced	**Initial swing**	**Swing Phase**
	Loading response	Antalgic gait is present during loading. Patient decreased length to avoid weight bearing.	Guarding of right LE does not allow patient to have a smooth swing phase	**Midswing**	
	Midstance	Vaulting of the opposite leg is observed, followed by a quick cadence.	Quick heel touch, right leg unloads all weight immediately to left leg	**Terminal Swing**	
	Terminal stance	Due to foot guarding a quick ataxic step with right foot is visible	Patient unloads the guarding leg onto the opposite leg causing a slight jerk.	**Initial contact**	**Stance Phase**
	Pre-swing	Base support increases with left foot mimicking a ataxic gait	Normal loading but right leg lags equal cadence	**Loading response**	
Swing Phase	**Initial swing**	Vaulting on the right leg can be observed	Foot base is loading correctly	**Midstance**	
	Midswing	Patient's maximal knee flexion is 5° during phase.	Heel rises with slow and coordinated movement although right leg has a slow stride	**Terminal stance**	
	Terminal Swing	Length step is longer than stance phase. Toe-out degrees is above exscinding medial rotations degrees	Over loading onto the toe's, prevent normal loading onto right heel	**Pre-swing**	

Table 10 Gait (According to Rancho Los Amigos Terminology)

2.3.6 Integumentary integrity

Table 11 Assessment of sensation (pain, temperature, tactile of right extremity)

Area of Skin	Pain	Temperature	Tactile Sensation
Anterior thigh (L2)	No pain	Normal Temperature	Good
Middle third of anterior thigh (L3)	Some pain on Quadriceps and distal patellar tendon attachment	Proximal normal; Above normal distally	Proximal good; Distal has decrease of tactile touch (3/10)
Patella and medial malleolus (L4)	Pain on and around patellar donor site scar	Increased temperature on and around stitches but does not persist distally	Loss of tactile sensitivity on and around stitches but does not persist distally
Fibular head and dorsum of foot (L5)	Pain around head of fibula; No pain distally from fibula	No increased temperature	Loss of sensation on proximal fibular head
Lateral and plantar aspect of foot (S1)	No pain	No increased temperature	Normal
Medial aspect of posterior thigh (S2)	Pain around knee joint	No increased temperature	Normal
Perianal area (S3-S5)	No pain	No increased temperature	Normal

2.3.7 Joint integrity and mobility

Table 12 Test for the Musculoskeletal System

Lachman test	Negative
Reverse Lachman test	Negative
Anterior draw test	Negative
Palpation of structures	Found noticeable donor graft tibial site hole

Table 13 Lower Extremity Joints

Joint	Resting Position	Grade
Tibiofemoral	25° Flexion	IV
Patellafemoral	25° Flexion	II
Proximal Tibiofibular	0° Plantar flexion	II
Distal Tibiofibular	0° Plantar flexion	IV
Talocrural	10° Plantar flexion	IV
Subtalar	Midway between extremes	IV
Midtarsal	Midway between extremes	IV

2.3.8 Orthotic, protective, and supportive devices

He used orthotic brace for the first two weeks in company with French style crutches. Doctor indicated to discontinue use of crutches and brace before entering the initial rehabilitation therapy phase.

2.3.9 Pain Perception

Subjective Pain Scale: Past Week; 8/10 worst; 2/10 least; 6/10 current (0=no pain, 10= severe pain)

Objective Discovery: Patient is tender to palpation around the scar and demonstrates increase pain sensitivity close to the superior lateral border of patella; indication of edema may conclude some noticeable tissue irritation

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2.3.10 Range of motion

Table 14 Lower Extremity Range of Motion

HIP	AROM		PROM	
Movement/Extremity	**Right**	**Left**	**Right**	**Left**
Flexion	120°	130°	125°	135°
Extension	5°	5°	10°	10°
Abduction	35°	30°	40°	35°
Adduction	20°	10°	30°	10°
Medial rotation	40°	40°	40°	45°
Lateral rotation	35°	30°	45°	35°
KNEE				
Flexion	85°	135°	90°	145°
Extension	-5°	0°	-5°	5°
ANKLE				
Dorsiflexion	10°	10°		20°
Plantar Flexion	50°	45°	50°	50°
Inversion	5°	5°	5°	5°
Eversion	5°	2°	5°	5°

2.3.11 Sensory integrity

Proprioception: Patient perceives all proprioception adequately
Kinesthesia: Normal

2.4 Evaluation

The patient demonstrates objective deficit in strength and range of motion most notably a mild extensor lag but overall good quadriceps contraction. He demonstrates functional deficits related to all phases of gait and transfers secondary to surgery. The necessity of TTWB and crutches use. The patient was instructed in his initial Home Exercise Program w/o difficulty.

Prognosis

Patient prospect currently appears to be good, although it is essential the patient follows the HEP to note; inflammation prevention and increasing range of motion are vital to a positive prognosis.

2.5 Plan of Care

Table 15 Plan of Care: Short-term & Long-term

Activities	Short-terms /Goals	Time to complete	Long-Term/ Goals	Time to complete
Standing	Stand 15min. to perform ADL's w/o symptoms	3 wks	None	
Walking	Ambulate 10 min. in community w/o pain	3 wks	Ambulate 60 min. in community w/o pain	6 wks
Transferring	Transferring sit to stand	2 wks	Perform all transfers w/o pain	4 wks
Stairs	Ascend/descend stairs w/ assistance device	1 wk	Ascend/descend stairs step over step	6 wks
AROM	Left knee ROM 0°-90°	3 wks	Knee ROM to functional Level	6 wks
Strength	Left knee EXT= 4/5 Knee FLX= 5/5 w/o pain	3 wks	LE strength 5/5 w/ good stability	6 wks
Home exercise Program	Independence with initial flexibility	1 wk	Independence with dynamic stability	7 wks

2.6 Visit / Encounter

Phase I

Today's Date: 25.1.2010

Number of Visit: 01 **Date of Surgery:** 11.1.2010

Frequency/Duration of Visit: 3 x week / 30 min. **Phase:** I

Subjective Report: Patient describes knee discomfort during normal ambulation

Pain Scale: Reports pain around formerly sutures area where stitches were removed 3 days ago and currently contains edema

Assessment: Pain; loss of motion; edema / swelling; decreased tolerance for standing, decreased dynamic stability, gait disturbance, decreased ADL; decreased function based on reports

Treatment Plan: Exercises of quadriceps, Glutei muscles w/ ball and thera-band; Knee flexors exercise; Sensomotoric training (on the ball, Posturomed); Gait training; Stretching of muscles; Scar therapy; Magneto-Therapy (25 minutes)

Today's Procedures:
-Scar therapy accompanied w/ lymphatic massage.
-SAQ's w/ ball under knee.
-Heel slide w/ ball under foot.
-Proprioreceptive mat; walking w/ proper Gait.
-Exercises on Posturomed: a) standing with legs semi flexed, shoulder width apart, swing forward and backwards, side to side and attempts to come to a complete controlled stop; b) feet shoulder width apart, patient will provide heel raise and toe's raise with slow and controlled movement; c) starting from floor take one step forward onto the Posturomed and hold a forward lounge, followed threw by completed the step, placing both feet together.
-Wobble boards: Placing a set of 6 wobble boards inline, patient will walk from one board to the next one maintaining proper posture and equilibrium.
-Floor mat:
Exercises
(Prone) Leg curl w/ 1kg ankle weight
(Side lying) Abduction w/ 1kg ankle weight w/ opposite leg semi flexed.
Stretches
(Prone) Hip/knee extensors stretch w/ strap on ankle
(Supine) Hamstring stretch w/strap for medial hamstring and lateral hamstrings
-Magneto-Therapy

Results (Deficits only): Soft tissue restrictions all along the scar. During SAQ's he cannot provide full extension and describes "stretching" feeling behind his knee (palpated to distal hamstring attachment). He lacks of proper Proprioceptive balance and coordination throughout this exercises. Noticeable faulty Gait can be seen with accompanied anlatgic pattern. His range of motion is very limited but this is to be expected after a post operated status.

(Continued)

HEP Patient was instructed to continue stretching to achieve full extension in addition to icing w/elevation. He was instructed to provide self soft tissue scar therapy to accelerate the process of tissue release.

Rehabilitation Prognosis: Unknown however he has the motivation and desire to return back to normal functional level.

Today's Date: 27.1.2010

Number of Visit: 02 **Date of Surgery:** 11.1.2010

Frequency/Duration of Visit: 3 x week / 30 min. **Phase:** I

Subjective Report: He reports feeling irritation which lead to further inflammation due to previous therapeutic session

Pain Scale: Increase pain around the scar and posterior aspect of the knee

Assessment: Pain; loss of motion; increased edema / swelling; decreased tolerance for standing, decreased dynamic stability, gait disturbance, decreased ADL; decreased function based on reports

Treatment Plan: Exercises of quadriceps, Glutei muscles w/ ball and thera-band; Knee flexors exercise; Sensomotoric training (on the ball, Posturomed); Gait training; Stretching of muscles; Scar therapy; Magneto-Therapy (25 minutes)

Today's Procedures:
-Scar therapy: accompanied w/ lymphatic massage.
-SAQ's w/ ball under knee.
-Calf raise
-Gait training: Proper walking, walking on toes and on heels.
-Exercises on Posturomed: a) standing with legs semi flexed, shoulder width apart, swing forward and backwards, side to side and attempts to come to a complete controlled stop; b) feet shoulder width apart, patient will provide heel raise and toe's raise with slow and controlled movement; c) starting from floor take one step forward onto the Posturomed and hold a forward lounge, followed threw by completed the step, placing both feet together.
-Wobble boards: Placing a set of 6 wobble boards inline, patient will walk from one board to the next one maintaining proper posture and equilibrium. Patient was additionally instructed not to look down and to perceive with his loading foot the following wobble board.
-On floor mat:
Exercises
(Prone) Leg curl w/ ½ kg ankle weight
(Side lying) Abduction w/ ½ kg ankle weight w/ opposite leg semi flexed.
Stretches
(Prone) Hip/knee extensors stretch w/ strap on ankle
(Supine) Hamstring stretch w/strap for medial hamstring and lateral hamstrings
-Magneto-Therapy

Results (Deficits only): Lymphatic's massage reduced edema caused by previous session. Antalgic guarding does not allow proper gait training. Suprapatella pain arouse during hip / knee extensors stretch in prone position furthermore he is preventing full knee extension due to the pain in the posterior aspect of the knee.

Rehabilitation Prognosis: Unknown. Irritation and inflammation are very common during the initial stages of knee rehabilitation; however it is essential to balance these predicaments accordingly to prevent excessive irritation and / or inflammation.

Today's Date: 29.1.2010

Number of Visit: 03 **Date of Surgery:** 11.1.2010

Frequency/Duration of Visit: 3 x week / 30 min. **Phase:** I

Subjective Report:	Feels positive however complains of suprapatella / popliteal aspects pain which originated since manifestation of inflammation, although he has acknowledge not following the HEP as corresponded, he only complied w/ soft tissue techniques for his scar
Pain Scale:	Past Week; 8/10Worst; 3/10Least; 4/10Current (0=no pain, 10= severe pain)

Assessment: Pain; loss of motion; increased edema / swelling; decreased tolerance for standing, decreased dynamic stability, gait disturbance, decreased ADL; decreased function based on reports

Treatment Plan:	Exercises of quadriceps, Glutei muscles w/ ball and thera-band; Knee flexors exercise; Sensomotoric training (on the ball, Posturomed); Gait training; Stretching of muscles; Scar therapy; Magneto-Therapy (25 minutes)
Today's Procedures:	-Scar therapy: accompanied w/ lymphatic massage. -SAQ's w/ ball under knee. -Gait training: Proper walking, walking on toes and on heels. -Exercises on Posturomed: a) standing with legs semi flexed, shoulder width apart, swing forward and backwards, side to side and attempts to come to a complete controlled stop; b) feet shoulder width apart, patient will provide heel raise and toe's raise with slow and controlled movement; c) starting from floor take one step forward onto the Posturomed and hold a forward lounge, followed threw by completed the step, placing both feet together d) one leg slightly flexed on Posturomed w/ other flexed above 45°, patient will hold this position and try to balance on one leg -Wobble boards: Placing a set of 6 wobble boards inline, patient will walk from one board to the next one maintaining proper posture and equilibrium. Patient was additionally instructed not to look down and to perceive with his loading foot the following wobble board. -On floor mat: Exercises (Prone) Leg curl w/ 1 kg ankle weight (Side lying) Abduction w/ 1 kg ankle weight w/ opposite leg semi flexed. (Supine) Straight leg raise w/ 1 kg ankle weight Stretches (Prone) Hip/knee extensors stretch w/ strap on ankle (Supine) Hamstring stretch w/strap for medial hamstring and lateral hamstrings -Magneto-Therapy
Results (Deficits only):	Increased soft tissue mobility due to appropriate executed HEP. Improved knee flexion and will be upgraded to LAQ's. Antalgic gait pattern continues which may cause disturbance in gait, indication to return back to ambulation w/crutches should be considered. Descending from the Posturomed illustrates his difficulty with the operated weight bearing knee bending.

Rehabilitation Prognosis: Good. Tissue mobility and increased ROM are good indicators for a proper prognosis; however pain is a major contraction but is anticipated around the donor site areas.

Today's Date: 1.2.2010

Number of Visit: 04 **Date of Surgery:** 11.1.2010

Frequency/Duration of Visit: 3 x week / 30 min. **Phase:** I

Subjective Report: Used ice through the weekend, diminishing feeling of pain and decreasing edema although describes lingering pain

Pain Scale: Pain remains around the superior aspect of patella

Assessment: Decreased pain; decreased edema / swelling; decreased tolerance for standing, decreased dynamic stability, gait disturbance, decreased ADL; increasing function based on reports

Treatment Plan: Exercises of quadriceps, Glutei muscles w/ ball and thera-band; Knee flexors exercise; Sensomotoric training (on the ball, Posturomed); Gait training; Stretching of muscles; Scar therapy; Magneto-Therapy (25 minutes)

Today's Procedures:
-Scar therapy: accompanied w/ lymphatic massage.
-Advanced to LAQ's
-Heel slides w/ ball under foot
-Exercises on Posturomed: a) feet shoulder width apart, patient will provide heel raise and toe's raise with slow and controlled movement; b) starting from floor take one step forward onto the Posturomed and hold a forward lounge, followed threw by completed the step, placing both feet together c) one leg slightly flexed on Posturomed w/ other flexed above 45°, patient will hold this position and try to balance on one leg
-Wobble boards: Placing a set of 6 wobble boards inline, patient will walk from one board to the next one maintaining proper posture and equilibrium. Patient was additionally instructed not to look down and to perceive with his loading foot the following wobble board.
-On floor mat:
Exercises
(Prone) Leg curl w/ 1 kg ankle weight
(Side lying) Abduction w/ 1 kg ankle weight w/ opposite leg semi flexed.
(Supine) Straight leg raise w/ 1 kg ankle weight
Stretches
(Prone) Hip/knee extensors stretch w/ strap on ankle
(Supine) Hamstring stretch w/strap for medial hamstring and lateral hamstrings
-Magneto-Therapy

Results (Deficits only): Greater improvement to soft tissue mobility yet distal tissues appears to be more rigid and will take longer for suitable mobility. His balance progressed and complex exercises will be added next session. During side lying Abd exercise, he present w/ posterior knee pain which prevent full flexion and a faulty pattern of Abd. He is instructed on the correct way to process but is not able to due to persistent posterior knee pain.

Rehabilitation Prognosis: Good. Patient has demonstrated diminutive increase in all therapeutic approaches and w/ continues therapy he will return to normal functional level

Today's Date: 3.2.2010

Number of Visit: 05 **Date of Surgery:** 11.1.2010

Frequency/Duration of Visit: 3 x week / 30 min. **Phase:** I

Subjective Report: Superior knee inflammation continues however a small edema on the distal attachments of vastus lateralis originates pain

Pain Scale: Past Week; 6/10Worst; 2/10Least; 3/10Current (0=no pain, 10= severe pain)

Assessment: Decreased pain; decreased edema / swelling; increased tolerance for standing, increased dynamic stability, gait disturbance, increased ADL; increasing function based on reports

Treatment Plan: Exercises of quadriceps, Glutei muscles w/ ball and thera-band; Knee flexors exercise; Sensomotoric training (on the ball, Posturomed); Gait training; Stretching of muscles; Scar therapy; Magneto-Therapy (25 minutes)

Today's Procedures:

-Scar therapy: accompanied w/ lymphatic massage.
-LAQ's w/ yellow thera-band (eccentric / concentric exercise)
-Heel slides w/ ball under foot
-Exercises on Posturomed: a) feet shoulder width apart, patient will provide heel raise and toe's raise with slow and controlled movement; b) starting from floor take one step forward onto the Posturomed and hold a forward lounge, followed threw by completed the step, placing both feet together c) one leg slightly flexed on Posturomed w/ other flexed above 45°, patient will hold this position and try to balance on one leg d) side stepping onto Posturomed followed by straightening of the loaded knee and back to down.
-Wobble boards: Placing a set of 6 wobble boards inline, patient will walk from one board to the next one maintaining proper posture and equilibrium. Patient was additionally instructed not to look down and to perceive with his loading foot the following wobble board.
-Propriorecpetive rope: Walking on a thick rope (S shaped) on the floor
-On floor mat:
Exercises
(Prone) Leg curl w/ 1 ½ kg ankle weight
(Side lying) Abduction w/ 1 ½ kg ankle weight w/ opposite leg semi flexed.
(Supine) Straight leg raise w/ 1 ½ kg ankle weight
Stretches
(Prone) Hip/knee extensors stretch w/ strap on ankle
(Supine) Hamstring stretch w/strap for medial hamstring and lateral hamstrings
-Magneto-Therapy

Results (Deficits only): After lymphatic massage, Vastus lateralis edema diminished. Balancing on rope shows to be difficult and even thought this is a new exercise, it was anticipated a superior outcome, he will not be advance to side-to-side stepping on the rope. During hamstring leg curls with the increased weight, he complained about patellofemoral pain.

Rehabilitation Prognosis: Good. Patient is about to enter the subsequent Phase and has demonstrated adequate level in which is expected at this stage of therapy

2.7 Reexamination (Entering Phase II) Date: ***5.2.2010***

2.7.1 Current Symptoms/ Chief Complaint

Chief Complaint

1) Problems during ambulation 2) pain on superior medial aspect above patella 3) difficulty ascending / descending stairs 4) difficulty with transferring in / out of car 5) unable to participate in sports.

Functional level

OPTIMAL= (21=no deficit) Difficulty: 60% (0 items unmarked) Confidence: 53% (0 item unmarked)

KOOS=	Pain	Symptoms	ADL's	Sports/Recreational	QOL
	11%	29%	31%	10%	31%

Personal Care

Patient describes no difficulty w/ ADL. He notes no difficulty with toiling and dressing unlike in the initial examination. Patient no longer has trouble getting in / out of the bathtub and does not require changing of bandage anymore.

Social support system

Patient returned back to work on the 25.1.2010, two weeks after surgery. He still describes some trouble to transfer in / out of car but does not require anyone to drive him; he can now manage driving by himself.

2.7.2 Anthropometric characteristics

Knee effusion (inflammation)

Patient current lack of complying with HEP properly may have been the proper cause of continues inflammation. Patient's inflammation remains with visible edema around the lateral superior aspect above the patella. Some increase in temperature is noted however it is not accompanied by redness.

Table 16 Extremity Circumferential Measurements (2nd)

Girth	15cm↑ Sup Pat.	10cm↑Sup Pat.	Mid Patella	Largest region on calf
Right	49 cm	46 cm	41 ½ cm	38 cm
Left	53 cm	50 cm	41 ½ cm	39 cm

Table 17 Length Measurements (2nd)

Measurement/ Extremity	Functional Length	Anatomical Length
Right	102 cm	87 cm
Left	101.5 cm	87.5 cm

2.7.3 Range of motion

Table 18 Lower Extremity Range of Motion (2nd)

HIP	AROM		PROM	
Movement/Extremity	**Right**	**Left**	**Right**	**Left**
Flexion	120°	120°	125°	130°
Extension	5°	5°	10°	10°
Abduction	35°	35°	40°	40°
Adduction	10°	10°	20°	15°
Medial rotation	40°	40°	40°	50°
Lateral rotation	35°	35°	45°	35°
KNEE				
Flexion	110°	135°	110°	145°
Extension	0°	0°	0°	5°
ANKLE				
Dorsiflexion	10°	10°		20°
Plantar Flexion	50°	50°	50°	55°
Inversion	5°	5°	5°	5°
Eversion	5°	4°	5°	5°

2.7.5 Integumentary integrity

Table 19 Assessment of sensation (pain, temperature, tactile of right extremity) (2nd)

Area of Skin	Pain	Temperature	Tactile Sensation
Anterior thigh (L2)	No pain	Normal Temp.	Good
Middle third of anterior thigh (L3)	Some pain on distal lateral quadriceps and proximal patellar ligament attachment	No increased temp.	Normal
Patella and medial malleolus (L4)	Pain on and around patellar donor site scar	No increased temp.	Normal
Fibular head and dorsum of foot (L5)	No pain	No increased temp.	Normal
Lateral and plantar aspect of foot (S1)	No pain	No increased temp.	Normal
Medial aspect of posterior thigh (S2)	No pain	No increased temp.	Normal
Perianal area	No pain	No increased temp.	Normal

2.7.6 Assistive and adaptive devices

Patient discontinues use of crutches 2 weeks post-operative. There was in debate to reissue crutches to patient due to his antalgic gait pattern although he is showing signs of improvement.

2.7.7 Gait (According to Rancho Los Amigos Terminology)

		Right (Operated) Lower Extremity	Left Lower Extremity		
Stance Phase	**Initial contact**	Posterior/lateral heel makes first contact	Normal take of toes	**Initial swing**	**Swing Phase**
	Loading response	Antalgic gait has decreased during loading. Normal stride.	Continue guarding of right LE does not allowing patient to have a smooth swing phase.	**Midswing**	
	Midstance	Slight vaulting is still present of the opposite leg.	Patient heel low slowly after training but if not remained quick loaded continues	**Terminal Swing**	
	Terminal stance	Due to foot guarding a quick ataxic step with right foot is visible	Patient continues unloading the guarding leg onto the opposite leg causing a slight jerk.	**Initial contact**	**Stance Phase**
	Pre-swing	Ataxic gait is no longer present	Normal loading with equal cadence	**Loading response**	
Swing Phase	**Initial swing**	Some vaulting is still be observed	Foot base is loading correctly	**Midstance**	
	Midswing	Patients knee flexion is normal during walking	Heel rises with slow and coordinated movement	**Terminal stance**	
	Terminal Swing	Step length is equal to opposite leg.	Over loading onto the toe's, prevent normal loading onto right heel	**Pre-swing**	

Table 20 Gait (According to Rancho Los Amigos Terminology) (2nd)

2.7.8 Muscle performance

Table 21 Manual Muscle Testing (2nd)

Muscle	Grade	Muscle	Grade	Muscle	Grade
Supine		**Side Lying**		**Prone**	
Illiopsoas	4/5	Gluteus Medius	4/5	Gluteus Maximus	4-/5
Sartorius	4/5	Gluteus Minimus	4/5	Gastrocnemius	5/5
Tensor fasciae latae	4/5	Hip Adductors	4-/5	Soleus	5/5
Tibialis Posterior	4+/5	**Sitting**		Hamstring	4/5*
Tibialis Anterior	4+/5	Quadriceps	4+/5	Quadratus Lumborum	5/5
Toe Extensors	4/5	Med. Rotators of Hip	3+/5		
Toe Flexors	4+/5	Lat Rotators of Hip	3+/5		

2.7.9 Joint integrity and mobility

Table 22 Test for the Musculoskeletal System (2nd)

Lachman test	Negative
Reverse Lachman test	Negative
Anterior draw test	Negative
Palpation of structures	Found noticeable donor graft tibial site hole

Table 23 Lower Extremity Joints (2nd)

Joint	Resting Position	Grade
Tibiofemoral	25° Flexion	IV
Patellafemoral	25° Flexion	III
Proximal Tibiofibular	0° Plantar flexion	III
Distal Tibiofibular	0° Plantar flexion	IV
Talocrural	10° Plantar flexion	IV
Subtalar	Midway between extremes	IV
Midtarsal	Midway between extremes	IV

2.8 Reevaluation

Patient current improper completion of HEP may have been the main cause of continues inflammation. However patient compliance with attending 3 times a week physical therapy as demonstrated an increased in function and strength. Patient continues desire to return back to a normal functional level will assist him into his recovery.

Range of motion increase substantially foremost we can conclude this is only the ending of the initial phase of recovery and there is a lot more areas to improve. The chart below can demonstrate how the patient's muscle strength has increased from the initial examination from 2 weeks ago till today.

2.9 Visit / Encounter

Phase *2*

Today's Date: 5.2.2010

Number of Visit: 06 **Date of Surgery:** 11.1.2010

Frequency/Duration of Visit: 3 x week / 55 min. **Phase:** II

Subjective Report: Complains of superior knee inflammation although pain which accompanied the edema has diminished

Pain Scale: Pain around the posterior aspect o the knee during specific movements

Assessment: Decreased pain; decreased edema / swelling; increased tolerance for standing, increased dynamic stability, gait disturbance, increased ADL; increasing function based on reports

Treatment Plan: Sensomotoric training (Posturomed, balance sandals); Leg curling machine (Small weight); Leg muscles exercises; Core muscles exercises; Stationary Bike (w/ little pressure); Stepper; Gait training on pavement; Mobilization (on stretching table); Hydrotherapy (15min.); Magneto-Therapy (25min.)

Today's Procedures:

-Stationary bike for 5 min.
-Stepper for 5 min.
-Treadmill for 6 min: Slow walk forward and then side stepping (4 min straight / 1 min. ea. side to side)
-Leg curl machine
Quadriceps curls: 3 sets x 10 rep
Right leg 1st 5kg, 2nd 10kg, 3rd 15kg
Left leg 1st 20kg, 2nd 20kg, 3rd, 20kg
Hamstring curls: 3 sets x 10
Right (only) 1st 7.5kg, 2nd 10kg, 3rd 10kg
-Exercises on Posturomed: a) feet shoulder width apart, patient will provide heel raise and toe's raise with slow and controlled movement; b) starting from floor take one step forward onto the Posturomed and hold a forward lounge, followed threw by completed the step, placing both feet together c) one leg slightly flexed on Posturomed w/ other flexed above 45°, patient will hold this position and try to balance on one leg d) side stepping onto Posturomed followed by straightening of the loaded knee and back to down.
-Wobble boards: Placing a set of 6 wobble boards inline, patient will walk from one board to the next one maintaining proper posture and equilibrium. Patient was additionally instructed not to look down and to perceive with his loading foot the following wobble board.
-Propriorecpetive rope: Walking on a thick rope in the floor.
-On floor mat
Stretches
(Prone) Hip/knee flexors stretch w/ strap on ankle
(Supine) Hamstring stretch w/strap for medial hamstring and lateral hamstrings
-Patella / Fibula head mobilization in all directions
-Magneto-Therapy
-Hydrotherapy in big whirlpool

(Continued)

Results (Deficits only): During the stepper machine, improper loading onto the operated knee can be observed, conversely diminished when using upper body support. Likewise improper gait pattern can be observed while walking on treadmill, even though patient does not respond to verbal stimuli, gait pattern stability increases with upper body support. Patellofemoral pain is present during both LAQ's exercises, w/ thera-band and machine

Rehabilitation Prognosis: Good. Patient's prognosis is very good. All dynamic and static movements are progressing in all aspects.

Today's Date: 8.2.2010

Number of Visit: 07 **Date of Surgery:** 11.1.2010

Frequency/Duration of Visit: 3 x week / 55 min. **Phase:** II

Subjective Report: Patient was unable to attend the physical therapy session today

Pain Scale:

Assessment: Decreased pain; decreased edema / swelling; increased tolerance for standing, increased dynamic stability, gait disturbance, increased ADL; increasing function based on reports

Treatment Plan: Sensomotoric training (Posturomed, balance sandals); Leg curling machine (Small weight); Leg muscles exercises; Core muscles exercises; Stationary Bike (w/ little pressure); Stepper; Gait training on pavement; Mobilization (on stretching table); Hydrotherapy (15min.); Magneto-Therapy (25min.)

Today's Procedures: None

Results (Deficits only): None

Rehabilitation Prognosis: Unknown

Today's Date: 10.2.2010

Number of Visit: 08 **Date of Surgery:** 11.1.2010

Frequency/Duration of Visit: 3 x week / 55 min. **Phase:** II

Subjective Report: Superior knee inflammation persist w/ lateral knee pain

Pain Scale: Pain persist w/ previous therapeutic seassion

Assessment: Decreased pain; decreased edema / swelling; increased tolerance for standing, increased dynamic stability, gait disturbance, increased ADL; increasing function based on reports

Treatment Plan: Sensomotoric training (Posturomed, balance sandals); Leg curling machine (Small weight); Leg muscles exercises; Stationary Bike (w/ little pressure); Gait training on pavement; Mobilization (on stretching table); Hydrotherapy (15min.); Magneto-Therapy (25min.)

Today's Procedures:

-Stationary bike for 5 min.
-Stepper for 5 min.
-Treadmill for 6 min: Slow walk forward and then side stepping (4 min straight / 1 min. ea. side to side)
-Leg curl machine
Quadriceps curls: 3 sets x 10
Right leg 1st 5kg, 2nd 10kg, 3rd 15kg
Left leg 1st 20kg, 2nd 20kg, 3rd, 20kg
Hamstring curls: 3 sets x 10
Right (only) 1st 7.5kg, 2nd 10kg, 3rd 10kg
-Exercises on Posturomed (patient was challenged to a increase level with adding a green thera-band mat under the loading leg): a) starting from floor take one step forward onto the Posturomed and hold a forward lounge, followed threw by completed the step, placing both feet together b) one leg slightly flexed on Posturomed w/ other flexed above 45°, patient will hold this position and try to balance on one leg c) side stepping onto Posturomed followed by straightening of the loaded knee and back to down.
-Wobble boards: Placing a set of 6 wobble boards inline, patient will walk from one board to the next one maintaining proper posture and equilibrium. Patient was advance to catching / passing a light ball with therapist during walking on wobble boards.
-Propriorecpetive rope: Walking on a thick rope in the floor. Patient was additionally instructed to walk sideways.
-On floor mat
Stretches
(Prone) Hip/knee flexors stretch w/ strap on ankle
(Supine) Hamstring stretch w/strap for medial hamstring and lateral hamstrings
-Patella / Fibula head mobilization in all directions
-Magneto-Therapy
-Hydrotherapy in big whirlpool

(Continued)

Results (Deficits only): Major dilemma w/ improper gait pattern w/ full load given that a fault pattern can emerge from this antalgic gait. Patellofemoral pain holds off completion into full ROM during quadriceps contraction under load. Inferior patella donor site pain is present during cranial direction mobilization.

Rehabilitation Prognosis: Good. Although patient encounter several problem which may appear to diminish the therapeutic approach, it is only normal to stumble onto patella associated pains / complications when dealing w/ BPTB grafting

Today's Date: 12.2.2010

Number of Visit: 09 **Date of Surgery:** 11.1.2010

Frequency/Duration of Visit: 3 x week / 55 min. **Phase:** II

Subjective Report: Complains about persistent superior knee pain and inflammation

Pain Scale: Past Week; 5/10Worst; 1/10Least; 2/10Current (0=no pain, 10= severe pain) He notes being more attentive to his HEP seeing as the chronic inflammation and pain prevents him to improve functional desires appropriately

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Assessment: Decreased pain; decreased edema / swelling; increased tolerance for standing, increased dynamic stability, gait disturbance, increased ADL; increasing function based on reports

Treatment Plan: Sensomotoric training (Posturomed, balance sandals); Leg curling machine (Small weight); Leg muscles exercises; Core muscles exercises; Stationary Bike (w/ little pressure); Stepper; Gait training on pavement; Mobilization (on stretching table); Hydrotherapy (15min.); Magneto-Therapy (25min.)

Today's Procedures:

-Stationary bike for 5 min.
-Stepper for 5 min.
-Treadmill for 6 min: Slow walk forward and then side stepping (4 min straight / 1 min. ea. side to side)
-Leg curl machine
Quadriceps curls: 3 sets x 10
Right leg 1st 5kg, 2nd 10kg, 3rd 15kg
Left leg 1st 20kg, 2nd 20kg, 3rd, 20kg
Hamstring curls: 3 sets x 10
Right (only) 1st 7.5kg, 2nd 10kg, 3rd 10kg
-Exercises on Posturomed (patient was challenged to a increase level with adding a green thera-band mat under the loading leg): a) starting from floor take one step forward onto the Posturomed and hold a forward lounge, followed threw by completed the step, placing both feet together b) one leg slightly flexed on Posturomed w/ other flexed above 45°, patient will hold this position and try to balance on one leg c) side stepping onto Posturomed followed by straightening of the loaded knee and back to down.
-Wobble boards: Placing a set of 6 wobble boards inline, patient will walk from one board to the next one maintaining proper posture and equilibrium. Patient was advance to catching / passing a light ball with therapist during walking on wobble boards.
-Propriorecpetive rope: Walking on a thick rope in the floor. Patient was additionally instructed to walk sideways.
-On floor mat
Stretches
(Prone) Hip/knee flexors stretch w/ strap on ankle
(Supine) Hamstring stretch w/strap for medial hamstring and lateral hamstrings
-Patella / Fibula head mobilization in all directions
-Magneto-Therapy
-Hydrotherapy in big whirlpool

(Continued)

Results (Deficits only): During treadmill walking his demonstrated decrease guarding on operated leg however it is a major dilemma since a faulty pattern can emerge. Patellofemoral pain prevents him from completing full extension while performing exercise on leg machine. The previously introduced rope walking exercises was challenging for his balance and was advance to side stepping which proves to be quite difficult

Rehabilitation Prognosis: Good. Patient prognosis is very good, his balance, coordination, endurance and functional movements have all increased adequately and with continue therapy he will return to normal ADL and recreational activities.

Today's Date: 15.2.2010

Number of Visit: 10 **Date of Surgery:** 11.1.2010

Frequency/Duration of Visit: 3 x week / 55 min. **Phase:** II

Subjective Report: Explains decrease in pain and inflammation after a weekend of resting, elevating and icing

Pain Scale: Noticeable decrease in inflammation around the superior aspect of the patella although it is painful to palpation

Assessment: Decreased pain; decreased edema / swelling; increased tolerance for standing, increased dynamic stability, gait disturbance, increased ADL; increasing function based on reports

Treatment Plan: Sensomotoric training (Posturomed, balance sandals); Leg curling machine (Small weight); Leg muscles exercises; Core muscles exercises; Stationary Bike (w/ little pressure); Stepper; Gait training on pavement; Mobilization (on stretching table); Hydrotherapy (15min.); Magneto-Therapy (25min.)

Today's Procedures:

-Stationary bike for 5 min.

-Stepper for 5 min.

-Treadmill for 6 min: Slow walk forward and then side stepping (4 min straight / 1 min. ea. side to side)

-Leg curl machine

Quadriceps curls: 3 sets x 10

Right leg 1st 5kg, 2nd 10kg, 3rd 15kg

Left leg 1st 20kg, 2nd 20kg, 3rd, 20kg

Hamstring curls: 3 sets x 10

Right (only) 1st 7.5kg, 2nd 10kg, 3rd 10kg

-Exercises on Posturomed (patient was challenged to a increase level with adding a green thera-band mat under the loading leg): a) starting from floor take one step forward onto the Posturomed and hold a forward lounge, followed threw by completed the step, placing both feet together b) one leg slightly flexed on Posturomed w/ other flexed above 45°, patient will hold this position and try to balance on one leg c) side stepping onto Posturomed followed by straightening of the loaded knee and back to down.

-Wobble boards: Placing a set of 6 wobble boards inline, patient will walk from one board to the next one maintaining proper posture and equilibrium. Patient was advance to catching / passing a light ball with therapist during walking on wobble boards.

-Propriorecpetive rope: Walking on a thick rope in the floor as well as sidestepping.

-Ball exercises:

Sitting on the ball a) bounce up and down b) bounce to from one leg to other c) bounce into a semi-squat, hold and come back down

Straight body, back on ball and w/ 90° flexed knees a) reach backwards with hands b) drop / raise buttocks c) walk backwards allowing back to follow the contour of the ball and stretching abdominals d) lift on leg up and then switch to opposite

Kneeling w/chest on ball a) incline to one side with whole body, they to the opposite side b) roll forward onto the ball into a push-up position, bring legs to chest and then turn back

(Continued)
Laying flat on the floor w/ball under legs a) roll ball under / away from body b) raise buttock from ground using legs on the ball w/ hand in 90° abduction c) raise buttocks w/ hand by side
-On floor mat
Stretches
(Prone) Hip/knee flexors stretch w/ strap on ankle
(Supine) Hamstring stretch w/strap for medial hamstring and lateral hamstrings
-Patella / Fibula head mobilization in all directions
-Magneto-Therapy
-Hydrotherapy in big whirlpool

Results (Deficits only): Proper loading onto operated leg w/o upper body support can been seen during the Stepper exercise. Patellofemoral pain continues to irritate during leg machine extensions. Demonstrates great difficulty w/ balance on wobble boards. Exercises on ball seem to bring discomfort in inferior aspect of the patella which reflexes his stability. Additionally he complains about kneeling pain onto the operated knee during ball exercises.

Rehabilitation Prognosis: Good. Patella donor site pain is expected after surgery and may remain present up to his whole life.

Today's Date: 17.2.2010

Number of Visit: 11 **Date of Surgery:** 11.1.2010

Frequency/Duration of Visit: 3 x week / 55 min. **Phase:** II

Subjective Report: Describes feeling very good and for the first time had no discomfort following last session

Pain Scale: Past Week; 4/10Worst; 0/10Least; 2/10Current (0=no pain, 10= severe pain)

Assessment: Decreased pain; decreased edema / swelling; increased tolerance for standing, increased dynamic stability, gait disturbance, increased ADL; increasing function based on reports

Treatment Plan: Sensomotoric training (Posturomed, balance sandals); Leg curling machine (Small weight); Leg muscles exercises; Core muscles exercises; Stationary Bike (w/ little pressure); Stepper; Gait training on pavement; Mobilization (on stretching table); Hydrotherapy (15min.); Magneto-Therapy (25min.)

Today's Procedures:

-Stationary bike for 5 min.

-Stepper for 5 min.

-Treadmill for 6 min: Slow walk forward and then side stepping (4 min straight / 1 min. ea. side to side)

-Leg curl machine

Quadriceps curls: 3 sets x 10

Right leg 1st 7.5kg, 2nd 15kg, 3rd 20kg

Left leg 1st 20kg, 2nd 20kg, 3rd, 25kg

Hamstring curls: 3 sets x 10

Right (only) 1st 10kg, 2nd 15kg, 3rd 20kg

-Exercises on Posturomed (patient was challenged to a increase level with adding a green thera-band mat under the loading leg): a) starting from floor take one step forward onto the Posturomed and hold a forward lounge, followed threw by completed the step, placing both feet together b) one leg slightly flexed on Posturomed w/ other flexed above 45°, patient will hold this position and try to balance on one leg c) side stepping onto Posturomed followed by straightening of the loaded knee and back to down.

-Wobble boards: Placing a set of 6 wobble boards inline, patient will walk from one board to the next one maintaining proper posture and equilibrium. Patient was advance to catching / passing a light ball with therapist during walking on wobble boards.

-Propriorecpetive rope: Walking on a thick rope in the floor as well as sidestepping.

-Ball exercises:

Sitting on the ball a) bounce up and down b) bounce to from one leg to other c) bounce into a semi-squat, hold and come back down

Straight body, back on ball and w/ 90° flexed knees a) reach backwards with hands b) drop / raise buttocks c) walk backwards allowing back to follow the contour of the ball and stretching abdominals d) lift on leg up and then switch to opposite

Kneeling w/chest on ball a) incline to one side with whole body, they to the opposite side b) roll forward onto the ball into a push-up position, bring legs to chest and then turn back

Laying flat on the floor w/ball under legs a) roll ball under / away from body b) raise buttock from ground using legs on the ball w/ hand in 90° abduction c) raise buttocks w/ hand by side

(Continued)

-On floor mat
Stretches
(Prone) Hip/knee flexors stretch w/ strap on ankle
(Supine) Hamstring stretch w/strap for medial hamstring and lateral hamstrings
-Patella / Fibula head mobilization in all directions
-Magneto-Therapy
-Hydrotherapy in big whirlpool

Results (Deficits only): Continues w/ full loading on Stepper w/o symptoms however guarding mechanism is present when loading onto operated leg which dissipates when transferring load to upper body. Progress was noted during extension on leg machine although patellofemoral pain was present. Same prior problem persist during ball exercise. Patella mobilization encounter inferior patella pain during cranial direction mobilization

Rehabilitation Prognosis: Good.

Today's Date: 24.2.2010

Number of Visit: 12 **Date of Surgery:** 11.1.2010

Frequency/Duration of Visit: 3 x week / 30 min. **Phase:** II

Subjective Report: Notes having a pain free weekend and feels ready to progress in today's therapeutic session

Pain Scale: Past Week; 3/10Worst; 0/10Least; 1/10Current (0=no pain, 10= severe pain)

Assessment: Decreased pain; decreased edema / swelling; increased tolerance for standing, increased dynamic stability, gait disturbance, increased ADL; increasing function based on reports

Treatment Plan: Sensomotoric training (Posturomed, balance sandals); Leg curling machine (Small weight); Leg muscles exercises; Core muscles exercises; Stationary Bike (w/ little pressure); Stepper; Gait training on pavement; Mobilization (on stretching table); Hydrotherapy (15min.); Magneto-Therapy (25min.)

Today's Procedures:

-Stationary bike for 5 min.
-Stepper for 5 min.
-Treadmill for 6 min: Slow walk forward and then side stepping (4 min straight / 1 min. ea. side to side)
-Leg curl machine
Quadriceps curls: 3 sets x 10
Right leg 1st 5kg, 2nd 10kg, 3rd 15kg
Left leg 1st 20kg, 2nd 25kg, 3rd, 25kg
Hamstring curls: 3 sets x 10
Right (only) 1st 7.5kg, 2nd 15kg, 3rd 20kg
-Exercises on Posturomed (patient was challenged to a increase level with adding a green thera-band mat under the loading leg): a) starting from floor take one step forward onto the Posturomed and hold a forward lounge, followed threw by completed the step, placing both feet together b) one leg slightly flexed on Posturomed w/ other flexed above 45°, patient will hold this position and try to balance on one leg c) side stepping onto Posturomed followed by straightening of the loaded knee and back to down.
-Wobble boards: Placing a set of 6 wobble boards inline, patient will walk from one board to the next one maintaining proper posture and equilibrium. Patient was advance to catching / passing a light ball with therapist during walking on wobble boards.
-Propriorecpetive sandals walking in group therapy
-On floor mat
Stretches
(Prone) Hip/knee flexors stretch w/ strap on ankle
(Supine) Hamstring stretch w/strap for medial hamstring and lateral hamstrings
-Patella / Fibula head mobilization in all directions
-Magneto-Therapy
-Hydrotherapy in big whirlpool

(Continued)

Results (Deficits only): Pain aroused during Stepper exercise and he was instructed to use upper body for correction of improper Gait, he describes loading approximately 80% onto LE. Patellofemoral pain persists during extension leg machine. Inferior patella pain increased during forward lounging with proprioreceptive sandals

Rehabilitation Prognosis: Good. Patient progresses into Phase III in the upcoming session and has adequately development all functions.

Today's Date: 1.3.2010

Number of Visit: 13 **Date of Surgery:** 11.1.2010

Frequency/Duration of Visit: 3 x week / 55 min. **Phase:** II

Subjective Report: Describes pain preceding prior therapy session although pain dissipated throughout the weekend

Pain Scale: Past Week; 3/10Worst; 0/10Least; 0/10Current (0=no pain, 10= severe pain)

Assessment: Decreased pain; decreased edema / swelling; increased tolerance for standing, increased dynamic stability, gait disturbance, increased ADL; increasing function based on reports

Treatment Plan: Sensomotoric training (Posturomed, balance sandals); Leg curling machine (Small weight); Leg muscles exercises; Core muscles exercises; Stationary Bike (w/ little pressure); Stepper; Gait training on pavement; Mobilization (on stretching table); Hydrotherapy (15min.); Magneto-Therapy (25min.)

Today's Procedures:

-Stationary bike for 5 min.

-Stepper for 5 min.

-Treadmill for 6 min: Slow walk forward and then side stepping (4 min straight / 1 min. ea. side to side)

-Leg curl machine

Quadriceps curls: 3 sets x 10

Right leg 1st 10kg, 2nd 15kg, 3rd 20kg

Left leg 1st 20kg, 2nd 20kg, 3rd, 25kg

Hamstring curls: 3 sets x 10

Right (only) 1st 15kg, 2nd 15kg, 3rd 20kg

-Exercises on Posturomed (patient was challenged to a increase level with adding a green thera-band mat under the loading leg): a) starting from floor take one step forward onto the Posturomed and hold a forward lounge, followed threw by completed the step, placing both feet together b) one leg slightly flexed on Posturomed w/ other flexed above 45°, patient will hold this position and try to balance on one leg c) side stepping onto Posturomed followed by straightening of the loaded knee and back to down.

-Wobble boards: Placing a set of 6 wobble boards inline, patient will walk from one board to the next one maintaining proper posture and equilibrium. Patient was advance to catching / passing a light ball with therapist during walking on wobble boards.

-Propriorecpetive rope: Walking on a thick rope in the floor as well as sidestepping.

-Ball exercises:

Sitting on the ball a) bounce up and down b) bounce to from one leg to other c) bounce into a semi-squat, hold and come back down

Straight body, back on ball and w/ 90° flexed knees a) reach backwards with hands b) drop / raise buttocks c) walk backwards allowing back to follow the contour of the ball and stretching abdominals d) lift on leg up and then switch to opposite

Kneeling w/chest on ball a) incline to one side with whole body, they to the opposite side b) roll forward onto the ball into a push-up position, bring legs to chest and then turn back

Laying flat on the floor w/ball under legs a) roll ball under / away from body b) raise buttock from ground using legs on the ball w/ hand in 90° abduction c) raise buttocks w/ hand by side

(Continued)

-On floor mat
Stretches
(Prone) Hip/knee flexors stretch w/ strap on ankle
(Supine) Hamstring stretch w/strap for medial hamstring and lateral hamstrings
-Patella / Fibula head mobilization in all directions
-Magneto-Therapy
-Hydrotherapy in big whirlpool

Results (Deficits only): Gait disturbance continues w/ Stepper exercise and he was reinstructed to use upper body support; he describes loading approximately 85% onto LE. Patellofemoral pain decreased during extension on leg machine. Patella donor site pain still presents during kneeling while exercises on ball. Inferior patella pain diminished however is still current w/ cranial patella mobilization

Rehabilitation Prognosis: Good, although patient chose to discontinue into Phase III of rehabilitation. Prognosis looks good if patient continues proper rehabilitation even if a HEP is the force of therapy

2.10 Reexamination (Final Examination) Date: ***18.3.2010***

2.10.1 Anthropometric characteristics

Knee effusion (inflammation)

Patient encountered a chronic inflammation throughout therapy which was manageable w/ proper home care and resting. The inflammation never impeded patient to participate in therapy. He currently has no inflammation around his right knee or accompanied pain. Temperature of the scar and around the scar is normal and is not painful to palpation.

Table 24 Extremity Circumferential Measurements (3rd)

Girth	15cm↑ Sup Pat.	10cm↑Sup Pat.	Mid Patella	Largest region on calf
Right	51 cm	49 cm	41 ½ cm	39 cm
Left	55 cm	51 cm	41 ½ cm	39 cm

Table 25 Length Measurements (3rd)

Measurement/ Extremity	Functional Length	Anatomical Length
Right	103 cm	87 cm
Left	101.5 cm	87.5 cm

2.10.2 Assistive and adaptive devices

None, patient discontinued use of crutches second week after surgery. Patient no longer uses railing or any handle to ascend / descend stairs or enter / exit the car.

2.10.3 Gait (According to Rancho Los Amigos Terminology)

		Right (Operated) Lower Extremity	Left Lower Extremity		
Stance Phase	**Initial contact**	Posterior/lateral heel makes first contact	Normal take of toes	**Initial swing**	**Swing Phase**
	Loading response	Normal stride with some guarding of the loading extremity	Slight guarding of right LE still does not allowing patient to have a smooth swing phase.	**Midswing**	
	Midstance	Vaulting of opposite leg has diminished although it is still present.	Heel loads slowly after specifying patient but if not, quick loaded continues	**Terminal Swing**	
	Terminal stance	Normal terminal stance	Normal initial contact	**Initial contact**	**Stance Phase**
	Pre-swing	Normal Gait; antlagic Gait is not longer present during this phase	Normal loading with equal cadence	**Loading response**	
Swing Phase	**Initial swing**	Normal initial swing	Foot base is loading correctly	**Midstance**	
	Midswing	Patients knee flexion is normal during walking	Heel rises with slow and coordinated movement	**Terminal stance**	
	Terminal Swing	Step length is equal to opposite leg.	Slightly elongated stance on toe's although big improvement	**Pre-swing**	

Table 26 Gait (According to Rancho Los Amigos Terminology) (3rd)

2.10.4 Integumentary integrity

Table 27 Assessment of sensation (pain, temperature, tactile of right extremity) (3rd)

Area of Skin	Pain	Temperature	Tactile Sensation
Anterior thigh (L2)	No pain	Normal Temperature	Good
Middle third of anterior thigh (L3)	No pain	No increased temperature	Normal
Patella and medial malleolus (L4)	Some pain to palpation on inferior border of patella on donor site	No increased temperature	Normal
Fibular head and dorsum of foot (L5)	No pain	No increased temperature	Normal
Lateral and plantar aspect of foot (S1)	No pain	No increased temperature	Normal
Medial aspect of posterior thigh (S2)	No pain	No increased temperature	Normal
Perianal area (S3-S5)	No pain	No increased temperature	Normal

2.10.5 Joint integrity and mobility

Table 28Test for the Musculoskeletal System (3rd)

Lachman test	Negative
Reverse Lachman test	Negative
Anterior draw test	Negative
Palpation of structures	Found noticeable donor graft tibial site hole

Table 29 Lower Extremity Joints (3rd)

Joint	Resting Position	Grade
Tibiofemoral	20° Flexion	IV
Patellofemoral	25° Flexion	IV
Proximal Tibiofibular	0° Plantar flexion	IV
Distal Tibiofibular	0° Plantar flexion	IV
Talocrural	10° Plantar flexion	IV
Subtalar	Midway between extremes	IV
Midtarsal	Midway between extremes	IV

2.10.6 Muscle performance

Table 30 Manual Muscle Testing (3rd)

Muscle	Grade	Muscle	Grade	Muscle	Grade
Supine		**Side Lying**		**Prone**	
Illiopsoas	4/5	Gluteus Medius	4-/5	Gluteus Maximus	4+/5
Sartorius	4/5	Gluteus Minimus	4+/5	Gastrocnemius	5/5
Tensor fasciae latae	4/5	Hip Adductors	4/5	Soleus	5/5
Tibialis Posterior	4/5	**Sitting**		Hamstring	5-/5
Tibialis Anterior	4+/5	Quadriceps	5/5	Quadratus Lumborum	5/5
Toe Extensors	4/5	Med. Rotators of Hip	4/5		
Toe Flexors	4+/5	Lat Rotators of Hip	4/5		

Muscle contraction characteristics

VMO has been trained to be primary activate muscle. Patient still encounter problem holding activation of VMO throughout entire range of motion. Patellar squinting is still present during flexion and extension. All other muscle have gain full function and home lock is utilized correctly.

2.10.7 Pain Perception

Subjective Pain Scale: Past Week; 4/10 worst; 0/10 least; 0/10 current (0=no pain, 10= severe pain)

Objective Discovery: Patient is tender to palpation around donor site on patella and can especially feel increase pain during kneeling onto the operated knee. No other tenderness around the scar and/or patella.

2.10.8 Range of motion

Table 31 Lower Extremity Range of Motion (3rd)

HIP	AROM		PROM	
Movement/Extremity	**Right**	**Left**	**Right**	**Left**
Flexion	125°	130°	135°	135°
Extension	5°	5°	10°	10°
Abduction	45°	30°	40°	35°
Adduction	20°	10°	30°	10°
Medial rotation	40°	40°	50°	40°
Lateral rotation	20°	30°	25°	35°
KNEE				
Flexion	130°	140°	140°	145°
Extension	0°	0°	0°	5°
ANKLE				
Dorsiflexion	10°	10°		20°
Plantar Flexion	50°	45°	50°	50°
Inversion	5°	5°	5°	5°
Eversion	5°	2°	5°	5°

2.11 Reevaluation

Patient has shown a great increase in all functional aspects of rehabilitation. Although he chose to discontinue rehabilitation at the clinic, he will sustain a HEP with additional exercises with according to his prognosis.

Proper rehabilitation priorities are focused on increasing range of motion, muscle strength, ensure suitable mobility of joints, and correct muscle firing pattern. Patients aspiration to return back to normal function allowed him to augment the therapeutic session into sufficient functional knee handling, however he will not be able to return to Level I activities till the end of a appropriate 6 months rehabilitation and a reexamination of his knee.

Further most we can compare the subjective OPTIMAL assessment log questionnaire filled out at the initial examination to the subsequent one filled at the final examination.

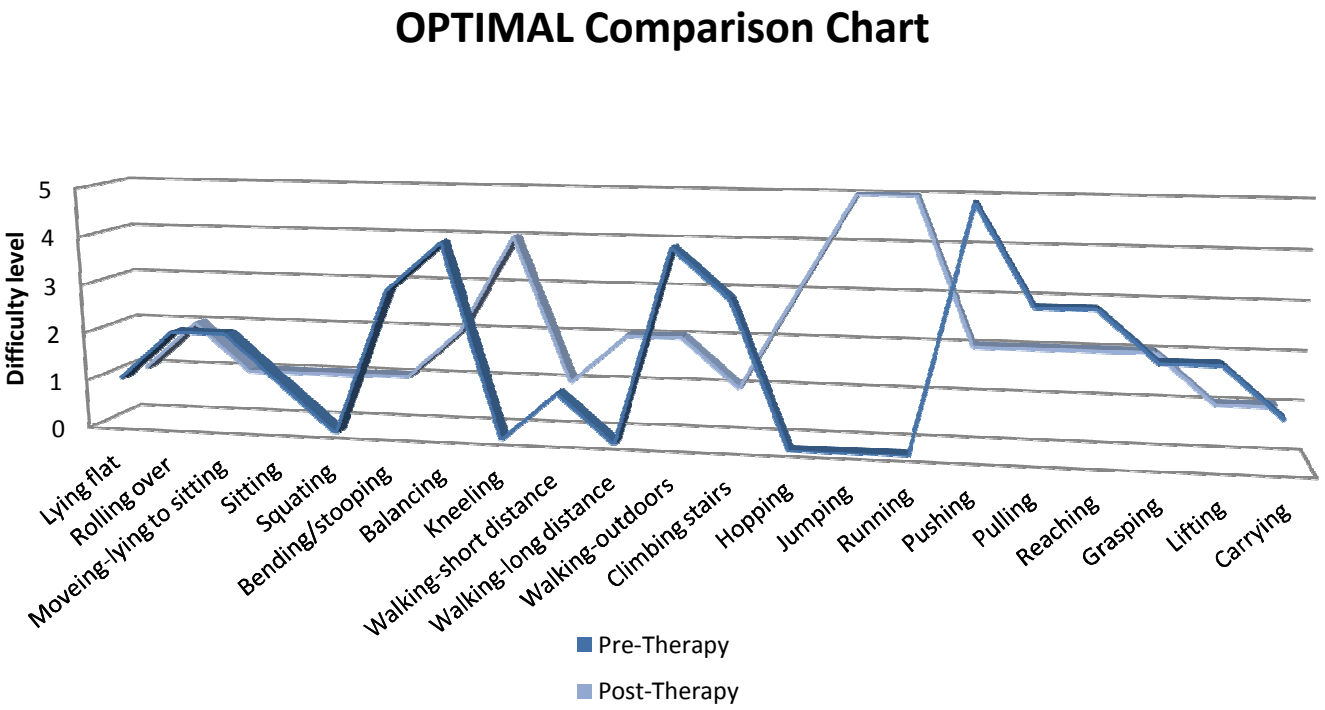

Chart 1 OPTIMAL Comparison Chart; 1=less difficult, 5=most default, 0=unable to perform

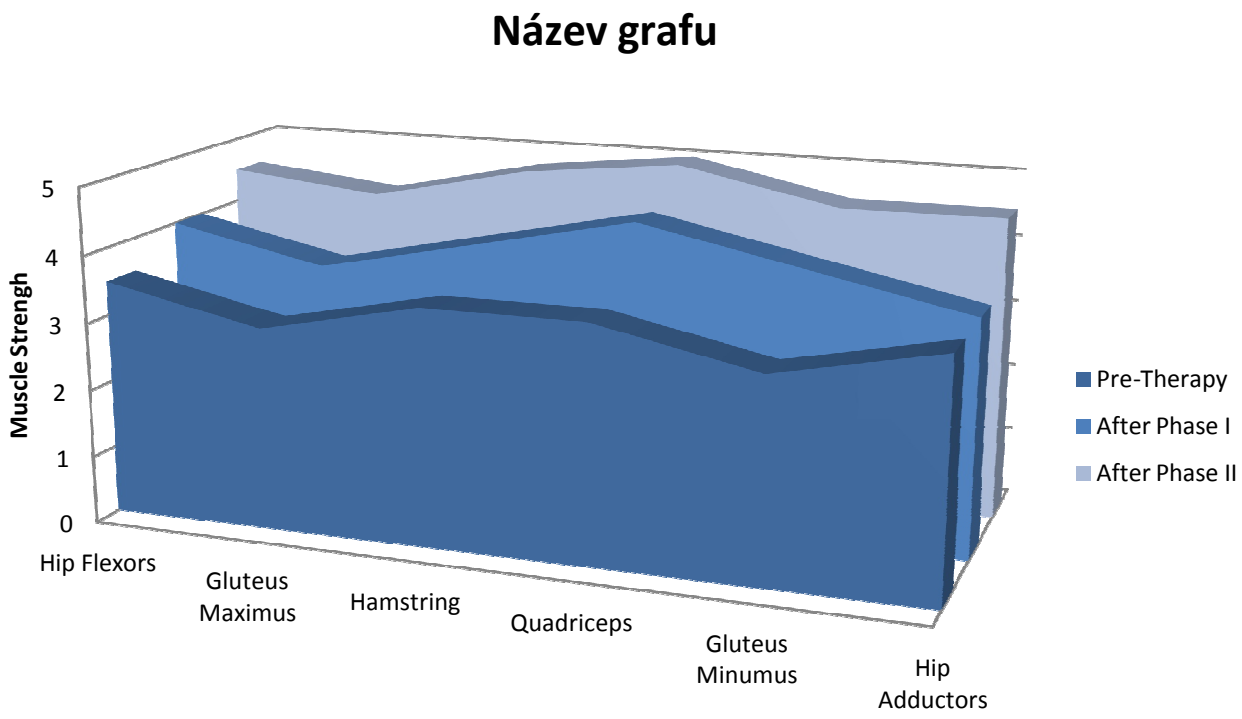

Chart 2 Improvement Muscles Chart; 0/5 = No palpable muscle contraction, 3/5 = Completes ROM against gravity, 4/5 = Completes ROM against gravity with moderate resistance, 5/5 = Completes ROM against maximal resistance

Throughout therapy, he has encountered a few problems w/ inflammation and chronic knee pain. We can see how the therapeutic units have improved his ROM and strength even though all functional movements have increased; chronic knee pain in donor site is anticipated and may persist for his entire life. The following chart demonstrates the improvements in muscle strength, from the day which the patient started therapy till the end of Phase II.

3. Discharge Summary

DISCHARGE DIAGNOSES:
-Patellafemoral syndrome
-Superior knee pain
-Edema around superior lateral aspect of patella

History of Present: The patient had ACL BPTB surgical reconstruction and participated in 2 months of physical therapy. Patient has shown a great increase in all functional aspects of rehabilitation. Although he chose to discontinue rehabilitation at the clinic, he will sustain a HEP with additional exercises with according to his prognosis

Rehabilitation Course: See above for rehabilitation procedures

Condition at Discharge: Finished with Phase II and chose to continue w/ a HEP

Functional Status: See above for functional status.

Disposition: Patient can drive and ambulate w/o assistance

Discharge Medication: None, patient does encounter some minor inflammation after normal post-therapeutic irritation however medication is not needed and he will treat this w/ ice.

Follow-up: The patient will follow up w/ orthopedic specialist in the 6 months period

Discharge Equipment: He require no additional equipment

List of Abbreviations

A

AAROM- active assistive range of motion

ABD- abduction

ACJ- acromioclavicular joint

ACL- anterior cruciate ligament

Add- adduction

ADL- activities of daily living

AROM- active range of motion

B

B/L- bilateral

BPTB-bone patella tendon bone

C

CPM- continuous passive motion

D

DF- dorsiflexion

E

ER- external rotation

Ex- exercise

Ev- eversion

F

FLEX- flexion

FWB- full weight bearing

H

HEP- home exercise program

I

Inv- inversion

IR- internal rotation

ITB- iliotibial band

L

LAQ- long arc quad

LCL- lateral collateral ligament

LE- lower extremity

LTG- long term goals

M

MCL- medial collateral ligament

MFR- myofascial release

MMT- manual muscle test

Mobs- mobilization

N

NWB- non weight bearing

O

OKC- open kinetic chain

P

PCL- posterior cruciate ligament

PF- plantar flexion

PFS- patellofemoral syndrome

Pro- pronation

PROM- passive range of motion

PT- physical therapist

PWB- partial weight bearing

R

Rot- rotation

S

SAQ- short arc quad

SB- side bending

SBA- stand by assist

SLR- straight leg raise

STM- soft tissue mobilization

Sup- supination

T

TTWB- toe touch weight bearing

U

UE- upper extremity

US- ultra sound

W

w/ - with

WFL- within functional limit

WNL- within normal limits

w/o - without

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