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Post-surgical rehabilitation of the knee menisci

(Comparison of post-surgical rehabilitation in Albania and USA/ literature review)

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Master thesis

Prague, May 2014

Abstract

Title

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Aim

The purpose of this thesis is to outline the most frequent injuries occurring in the knee menisci. To evaluate the post-surgical rehabilitation of the knee menisci in Albania and to compare it with recommended guidelines from American Academy of Orthopaedic Surgeons in USA. The main goal is to find out what could be done, to improve the post-surgical rehabilitation program followed in Albania, after a knee menisci injury.

Method

This thesis is a literature review, reviewing journals with an impact factor higher than 1, clinical trials, systematic reviews and pilot studies not older than the year 2000. All these materials were gathered from web medical databases such as (PubMed, Medline, Science Direct, Scopus, Pedro, Web of Science). Primary sources of information were scientific books in Albanian, Italian and English languages, from period of autumn 2011 to the spring of 2014. Due to lack of literature and both written studies and guidelines concerning rehabilitation in Albania, the data gathered were taken from Military Hospital of Albania-Traumatology Department, either from interviews with the doctors and physiotherapist working in this institution or by my own experience working in the Military Hospital in Tirana and in a private clinic. Rehabilitation guidelines from American Academy of Orthopaedic Surgeons (AAOS) in USA were taken as a reference, in order to compare the rehabilitation program followed in Albania for patients after the surgery of injured knee menisci. To develop the search strategy, combination of the keywords: *menisci injury, surgery of menisci, rehabilitation of menisci* and *physical therapy of menisci* were used.

Results

Many differences were found, comparing the level of rehabilitation after menisci surgery and the health care the patients take in Albania and USA. Outcomes in Albania were not satisfactory with lack of controls after the operation, not a fulfilled rehabilitation program from the side of the patients, and no used physical therapy as an important part of the

rehabilitation program. So, in Albania there is not present a high quality post-surgical rehabilitation of the knee menisci.

Key words

Menisci injury, surgery of menisci, post-surgical physical therapy rehabilitation program

Shrnutí

Název práce

Pooperační rehabilitace úrazů menisků kolenních kloubů (Porovnání po operační rehabilitace v Albanii a USA/ vyhodnocení údajů z literatury)

Cíl práce

Cílem této práce je podat přehled nejčastějším typem úrazů menisku. Zhodnocení pooperačního rehabilitačního program nasledován v Albanii a porovnat to s rehabilitačním programem nasledován po operace menisku ve Spojenech Statu podle American Academy of Orthopaedic Surgeons (AAOS). Hlavním cílem přitom je najít co by se dalo udělat aby se zlepšilo pooperační rehabilitační program nasledován v Albanii po urazu menisků.

Metoda

Táto práce představuje vyhodnocení literatury, časopisu s impakt faktorem vyšší než 1 a publikováne od roku 2000, klinické studie, systematické přehledy či pilotní studie od roku 2000, byly shromážděny z internetových lékařských databází,jako (PubMed, Medline, ScienceDirect, Scopus, Pedro, Web of Science). Hlavním zdroje, ze kterých bylo čerpano jsou vědecké (knihy v albanštíně i v anglickém jazyku) zhromaždění pravidelně od podzimu 2011 do jara 2014. Vzhledem k nedostatku literatury týkajicích se rehabilitace v Albánii, údaje byly převzaty z Vojenské Nemocnice v Tirany-Traumatologickém oddělením. A to bud' z rozhovorů s lékaři a fyzioterapeuty pracující ve Vojenské Nemocnice, nebo podle mé vlastní pracovní zkušenosti v teto nemocnice i ve soukromnou klinku. Rehabilitacní program z AAOS v USA, byl přijat jako referenční pro porovnání pooperačního rehabilitacního program následovan po úrazu menisku v Albánii a USA. Kombinace klíčových slov, byly použity pro vyhledávání informačních zdroje.

Výsledky

Porovnáním úrovni rehablitiace po operaci menisků v Albánii a USA, byly zjištěny mnoho rozdily. Výsledky v Albánii nebyly uspokojivé s nedostatkem pooperační kontroly, rehabilitační program nebyl splněn ze strany pacientů, nebyla aplikovana fizikální terapie jako součast pooperačního rehabilitačního programu. Výsledky odhalily spousta problémů v albánském zdravotního pojištěního systému. Na závěr úroveň rehabilitace v Albánii není vysoká.

Kličová slova

Úraz menisků, operace menisků, pooperační fizikální terapie.

Declaration

I hereby declare that this work is entirely my own individual work, based on the knowledge I gain from books, journals, reports, scientific studies and attending lectures and seminars during my studies in Prague and research on Albanian resources of data and health institutions, which are listed in list of literature.

Prague, May 2014 Fregen Dedja

Dedication

Roza and Besnik I dedicate this work to you, my dear parents.

I could never stop thanking you, for every single sacrifice, you have made for my education, giving me courage to fulfill all my ambitions and dreams. You have selflessly put my education above all else, and taught me the importance of hard work and determination.

Thank you for being always by my side in every way possible. Some obstacles in my life have not been easy to overcome, but you have always been there for me giving me strength and optimism. I hope I have never disappointed. You make me the luckiest girl in the world. I love you.

Acknowledgment

This thesis would not have been possible unless the support of my family, partner and dear friends.

Firstly, I would like to thank my partner for all the support and love he gives to me each and single day, being always a shoulder to cry on during hard times and always trying to make me smile and be positive. Andrea, without your love and devotion, everything would have been different in my life. I love you so much. Thank you for being part of my life.

Special thanks go for my sister. She is my hero and one of the most important guidance in my life. I can't imagine my life without you.

I would like to give my sincere thanks and appreciation to my best friends Alba and Xhejni. Alba, since the first day I meet you, I knew that our friendship would grow into something very special and important to me. You have always been my family, my shelter, my happiness, my sweet and smart doctor. It is not possible to count all our memories starting from summer 2006, but each of them made me believe that I am so lucky to have you. You have always been there for me whenever I needed you, listening to me, understanding me, giving me so much strength, always believing on me. Our special friendship makes us overcome the sense of distance that separates us and feel like we are in the same room like we used to do during all our student life. You will always be one of the best things ever happened to me!

Xhejni my soulmate, without you I would have never felt fullfilled. Our friendship shaped me the person I am today and I want to thank you with all my heart for the support, love, encouragement, laughts, adventures, advices and dreams we chase together. I could never put into words how important you are to me.

I would like to thank all my friends in Czech Republic who welcomed me and made me feel like I was home.

I would like to show my gratitude to my professors that formed me professionally giving me the tools to build my future as a physiotherapist.

Last but not least, I would like to thank my supervisor Mgr. Miroslava Jalovcova for her assistance and guidance toward my master thesis.

Table of Contents:

List of Abbreviations:

USA	United States of America
FTVS	Fakulta Tělesné Výchovy a Sportu
ROM	Range of Motion
AAOS	American Academy of Orthopaedic Surgeons
ACL	Anterior Cruciate Ligament
PCL	Posterior Cruciate Ligament
MCL	Medial Collateral Ligament
LCL	Lateral Collateral Ligament
GAG	Glycosaminoglycan
MR	Magnetic Resonance
CT	Computer Tomography
OA	Osteoarthritis
CMI	Collagen Meniscus Implantation
MAT	Meniscal Allograft Implantation
EMG-BFB	Electromyography Biofeedback
CKC	Closed Kinetic Chain
KOOS	Knee Injury and Osteoarthritis Outcome Score
ES	Electrical Stimulation

1 Introduction

Knee pain may derive from the damage of one or more structures of the soft tissue that stabilize the knee joint (including the ligaments, muscles, tendons and menisci). The increasing popularity of some recreational and adrenaline sports, increase the frequency of injuries of the knee structures, especially ligaments and menisci (Heqimi L. M., 2011).

Soft tissue injuries of the knee are some of the most common and clinically challenging cases. It is very important to establish clear diagnostic and therapeutic objectives for these injuries, in order to formulate the proper rehabilitation program (Brent, 2009). Damages of these structures might be restrictive for the patients because of the long-term recovery period including several months of rehabilitation, sometimes up to a year. (Dungl, 2005).

For most patients, the etiology or the severity of the pathologic process of an injury (acute or chronic), can be determined from a targeted history, focused physical examination and thoughtful workup including diagnostic imaging, such as plain radiography, magnetic resonance (Heqimi L. M., 2011).

The main acute goals of rehabilitation after menisci surgeries are to control the pain and inflammation associated with surgery, maintain ROM (range of motion), general conditioning restore or maintenance of isolated muscle function and optimize integrated lower extremity neuromuscular coordination. Regular physical therapy after the surgery is very important for future prognosis. Prolonged knee immobilization after surgery can result in the rapid development of muscular atrophy and delays in functional recovery (Brindle 2011). After the surgery we should be careful with the weight bearing of the lower limb. The patient gradually, can fully weight-bear the lower limb when walking or during other activities. Full weight-bearing is indicated by the orthopaed in a 3 month period. After this indicated period by an orthopedic surgeon, the patient can start to sport without limitations.

The initial goal of the rehabilitation protocol is to prevent excessive weight-bearing forces that can lead to further damages of the operated knee. This limitation is designed to control high compressive and shear forces that could disrupt the healing meniscus repair or transplant (Shaqiri, 2005). There are variations in the protocol according to the type, location and size of the meniscus tear. A supervised rehabilitation program is supplemented with home exercises performed on a daily basis. The therapist must evaluate the patient thoroughly to implement the appropriate protocol, and should examine the patient in the clinic and use therapeutic procedures and modality treatments required for successful rehabilitation. Patients are warned

that an early return to strenuous activities, including impact loading, jogging, deep knee flexion, or pivoting, carries a definite risk of a repeat meniscus tear or tear to the transplant. This is particularly true in the first 1 to 3 months, where full flexion or deep-squatting activities may disrupt the healing repair sites or transplants. (Heckman, 2006).

There are several reasons why I chose to write about post-surgical rehabilitation of menisci and why I decided to focus on post-surgical rehabilitation of the knee menisci in Albania comparing it to USA. When I came to Albania before starting my master program I volunteered in the Military Hospital of Tirana in the Traumatology Department for several months. I noticed that the highest percent of the damages were fractures of the lower extremities and in the second place were knee damages, especially menisci tears and ligamentous ruptures. Unfortunately, I witnessed a very poor rehabilitation protocol followed, after the menisci operation. So I thought to dedicate this thesis as a study material for physiotherapists, doctors and my students in Albania.

2 Objectives and research method

This thesis is a literature review, which represents a selection of published and unpublished documents on issues which contain information, data and evidence written from a particular point of view. Thereby the aim of a review is to fulfill appointed aims, express credible views on the kind of the research being proposed (Fink, 2010). Main aim of this thesis is to compare different approaches to patients after menisci surgery in Albania and USA and to find out what can be done, in order to improve post-surgical rehabilitation program of the knee menisci in Albania.

I was educated in one of the most well-known university in Europe and learned how to follow different guidelines for different diagnoses. During all my studies in Czech Republic I used to have so many practices in different hospitals and I have seen and experienced how the medical system function not only in Czech Republic, but even in other hospitals in Europe where I used to volunteer. When I came in Albania many things were different. So I decided to dedicate my thesis to post-surgical rehabilitation of menisci and to fulfill this aim comparing it with a state that has a lot of experience in the rehabilitation field. I chose USA because I noticed that in Albania many doctors and physiotherapists took this state as a reference.

Albania is my homeland and after my studies I will work there and put all my efforts to achieve a rehabilitation standard, like the one that I was educated all these years. That is why I decided to write this literal review, as a material for further studies in my homeland. My purpose is to use this thesis as a material for physiotherapists and doctors in Albania, to compare and see what they can change in our medical system in order to make things better.

Investigative questions:

1. Which are the most frequent menisci injuries addressed for surgical treatment in Albania?
2. What are the differences between post-surgical menisci rehabilitation in Albania and USA?
3. Is rehabilitation process in Albania up to date?

Aim of thesis

The purpose this thesis is to compare the rehabilitation program and different approaches to patients after menisci operation in USA based on American Academy of Orthopaedic Surgeons guidelines in USA and in Albania based on the physiotherapy department of the state Military Hospital in Tirana. All the sources of information will be gathered to either support or not the proposed hypotheses.

This thesis could be used in the future as a motivating work for further researches and improvements in Albania health care and to assure a material for physiotherapist in Albania. All data used were collected from autumn 2011 till spring 2014.

Hypothesis

1. Post-surgical rehabilitation of the knee menisci in Albania is not sufficient.

Methodology

Research criteria for data collection and analysis:

Articles:

The articles were gathered from databases PubMed, Medline, Scopus, Pedro, Cochrane library, Web of Science and Science Direct, to prosper the search strategy using the keywords *menisci injury, surgery of menisci, post-surgical physical therapy,* and *rehabilitation in Albania*. Different combinations of these keywords were used to source the articles that fulfilled the search criteria, in order to obtain more specific and expanded comprehension concerning the thesis topic.

Articles were also collected from relevant journals with the impact factor more than 1, based on the keywords mentioned above. Inclusion criteria were that the articles were written in English and Albanian. English articles were not older than 2000 and Albanian articles had conclusions that were not supported by newer articles, menisci surgery, menisci rehabilitation, menisci guidelines. Included articles were taken as a source of information. These articles were red and a quality assessment was made, in order to decide whether to include these articles in thesis or not.

During process of searching relevant articles for this thesis, following selection criteria were used:

Inclusion criteria

- Language: articles in English and Albanian
- Population: patients after menisci surgery
- Intervention: menisci surgery
- Outcome: rehabilitation after menisci surgery

Exclusion criteria:

- Based on the intervention: no updated information, information older than year 2000
- Based on the outcome: no rehabilitation therapy was done after the menisci operation

Data that were compatible with the inclusion and exclusion criteria were included in the thesis.

Clinical trials and systematic reviews found in Albanian not having actual information about rehabilitation and menisci surgery were excluded. Because the amount of Albanian articles was limited, in first instance articles in English were screened and read. This due to the fact that Albanian medical associations of physical activity and sport, before the year 2000, did lots of researches in the physical activity field, but still not treating direct the concept of rehabilitation.

Furthermore, after year 2000 a period of research in rehabilitation area has been established. Beside different literature sources, the information was gathered based on practical experience in the Military Hospital in Tirana, from interviews and email correspondence with the doctors and physical therapists working in the Military Hospital in Albania and from books in Albanian language written about the topic assumed in this thesis.

Direct contact with the doctors, physiotherapists and patients, were used to arrive in conclusion concerning rehabilitation schedule followed after menisci surgery in Albania. Rehabilitation is yet a new and unknown field in Albania, yet creating lots of difficulties in finding data and information.

Books:

Crucial source of information were monographs (books in Albanian and English language).To find different books using the listed keywords, the website

www.amazon.co.uk was used as a source of e-publications or e-books. The national library database of Albania www.bksh.al was used as a searching engine for monographies in Albanian language, concerning the topic of this thesis.

Other sources:

To construct my research part, concerning rehabilitation program followed in Albania after a menisci surgery, information sources as: materials from the physiotherapy conference held in Tirana in January 2012: presentation "Knee damages", were used. Email correspondence with head of Traumatology department in the Military Hospital in Albania Dr.Arben Runa, interviews with orthopedists, surgeons and physiotherapists working in the Military Hospital in Tirana, also my own experience during a three month internship in the Military Hospital in Tirana, were important sources in order to form a full picture of rehabilitation program followed in Albania after a knee menisci.

Due to lack of Albanian rehabilitation guidelines, American Academy of Orthopaedic Surgeons (AAOS) guidelines were analyzed and compared with Albanian rehabilitation program after a menisci surgery. The results were interpreted based on the above mentioned comparison between AAOS and Albanian rehabilitation program.

3 Overview of the knee articulation

3.1 Anatomy of the knee articulation

The knee joint is the largest synovial and one of the most complex joint in human body with a complicated anatomical and functional character. It is considered as a hinge joint with additional rotation movements. Many components of the knee articulation, such as the bones, muscles, ligaments and joint surfaces must work in synchronicity for the leg to function accurately. In order to better understand the biomechanical requirement of knee movement, we should define the anatomical structures (Vogds, 2009).

The knee articulation is formed of four bones: femur, patella, tibia and fibula. Femur is convex at its distal end, so it can easily articulate with the patella and tibial plateau. The articular parts of femur are its medial and lateral condyles. These excurse slightly posteriorly and distally, with the lateral condyle being wider in its frontal part than in its back. The medial condyle has a more constant width. Attached to the tibia are two structures called menisci. The condyles of tibia are divided by the intercondylar eminence.

Figure 1:The knee joint anatomy (AAOS, 2010)

So, between each condyle of the femur,there is the corresponding meniscus and a condyle of tibia, forming all together two condylid joints. The third articulation found in the knee is between the femur and patella (femoropatellar articulation). We can conclude that the knee articulation consists of three articulations in one (Čihák, 2001).

The articular capsule of the knee joint is lax and wide, thin in front and at the side, and contains the patella, ligaments, bursa and menisci. The capsule consists of a synovial and a fibrous membrane separated by fatty deposits anteriorly and posteriorly (Platzer, 2004).

Anteriorly, the synovial membrane is attached on the margin of the cartilage both on the femur and tibia leaving both epicondyly, where muscles and ligaments will be attached. Into the anterior part of the joint capsule is inserted patella and both menisci are located within the synovial capsule. Synovial membrane lies at the articular capsule and lines the suprapatellar bursa and also other bursa that communicate with the knee joint. Whereas on the tibia, the anterior part of the synovial membrane is located near the cartilage. Posteriorly the synovial membrane of the femoral attachment is located at the cartilaginous margin of the medial and lateral femoral condyles (Cake, 2004).

The knee involves a large number of bursa, which can be divided into bursa communicating with each other (suprapatellar bursa, semimembranosus bursa, medial and lateral subtendinousbursae of gastrocnemius) and non-communicating (infrapatellar bursa, subcutaneous prepatellar bursa, subtendinous prepatellar, subcutaneous prepaterllar bursae). In collaboration with the menisci and burse, ligaments play a crucial role in protecting the articular capsule; they also insure the knee joint stability by limiting movements. The ligaments are divided into intercapsular and extracapsular.

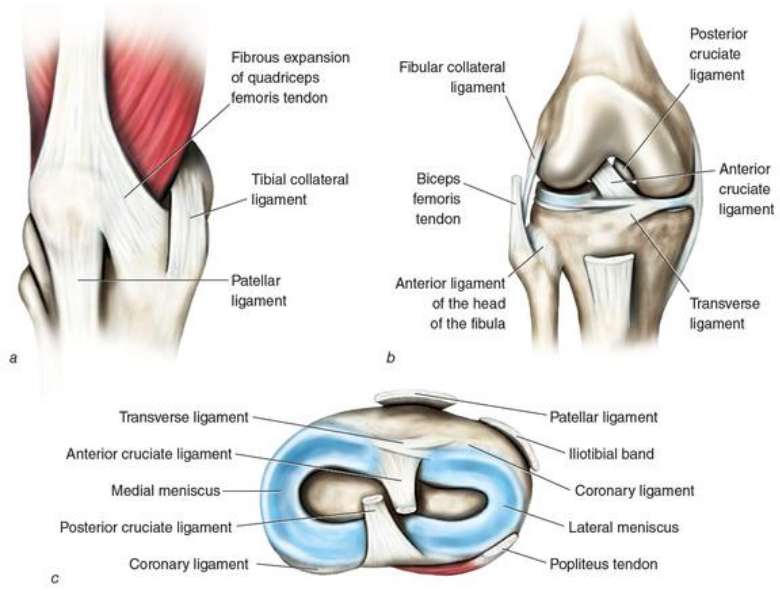


Figure 2: Knee Structure (Behnke, 2010)

Intracapsular ligaments

Intracapsular ligaments join together femur and tibia. They play a very important role in the knee stabilization function. In the intracapsular ligaments are involved, the anterior cruciate ligament (ACL), the posterior cruciate ligament (PCL), the posterior and anterior meniscofemoral ligaments and the transverse or meniscomeniscal ligament.

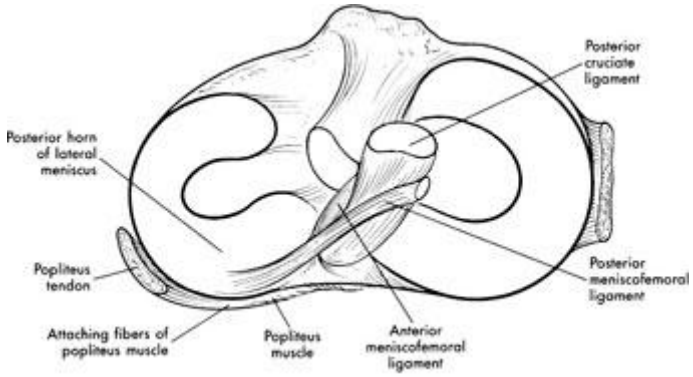


Figure 3: Superior view of tibial condyles after removal of femur (Crane, 2010)

The anterior cruciate ligament (ACL) goes from the lateral femur condyle to the anterior intercondylar area. Its role is very crucial because it prevents the tibia from being pushed far anterior relative to the femur. The anterior cruciate ligament (ACL) is often torn during movements of the knee, like bending or twisting. Another ligament which is part of the intracapsular structure of the knee is the posterior cruciate ligament (PCL). It goes from the medial condyle of femur to the posterior intercondylar area. Damages of this ligament are not so common, but can happen as a direct result of forced trauma to the ligament. The role of this ligament is prevention of posterior displacement of the tibia relative to the femur (Platzer, 2004).

The anterior and posterior meniscofemoral ligaments pass posteriorly behind the posterior cruciate ligament, stretching from posterior part of lateral meniscus to the medial condyle of femur. The transverse ligament connects the anterior convex margin of the lateral meniscus to the anterior end of the medial meniscus. Its function is prevention of the anterior horns of the menisci from moving forward when the knee is being extended, and prevents also the condylar surfaces of tibia and femur from exerting pressure on the menisci.

Extra capsular ligaments

Extra capsular ligaments are found in the anterior, posterior and lateral compartment of the knee. They play a crucial role in the stabilization and range of motion of the knee.

In the anterior part we can find the patellar ligament, which is a strong, flat ligament originating from the common tendon of the quadriceps femoris muscle, continuing on the apex of the patella distally and inserted on the tuberosity of the tibia.

On the lateral side of the knee is located the lateral collateral ligament (LCL) or fibular collateral ligament, which originates from the lateral femur epicondyle into the head of the fibula. The medial collateral ligament or medial collateral ligament (MCL) is located in the inner side of knee joint. Its origins are medial epicondyle of the femur and, MCL is inserted into the medial part of the body of the tibia, about 3 cm below the medial condyle of tibia (Bejtullahu, 2007).

The oblique-popliteal ligament is also part of extracapsular ligaments of the knee. It is located in the dorsal part of the knee articulation, going from lateral epicondyle and condyle of the femur to medial condyle of tibia. Arcuate popliteal ligament is a Y-shaped ligament originating from the posterior part of the intercondylar area of tibia and the lateral epicondyle of the femur to the head of fibula (Cake, 2004).

3.2 Structure of menisci

The menisci are two semilunar shaped cartilages positioned between the convex femurs superiorly and the relatively fat tibial plateau interiory. The menisci consist of two fibrocartilaginous disks, which fill the space between the tibial plateau and the femoral condyles. Without the help of the menisci, the convex femoral condyles cannot efficiently articulate with the flat surface of the tibia. This congruency is maximized during knee flexion. They are of an approximately 35mm in diameter and 110 mm in length. They cover one half of two thirds of the articular surface of their corresponding tibial plateau (Joseph, 2009).

The menisci improve the congruency between the femoral condyles and the tibia by extending the superior tibial surface. Both menisci are wedge shaped in the coronal plane. The lateral meniscus is more circular in shape than the medial one. The superior parts of the

menisci are concave, enabling effective articulation with their respective convex femoral condyles, whereas the interior surfaces are flat to adapt-conform to the tibial plateau.

Both menisci, even though having similar function, have differing anatomy. The medial one has an irregular radius, making it $3/5^{th}$ of a complete ring around the tibial plateau. It has a c-shaped structure larger in radius than the lateral one. Its anterior horn is attached to the tibia near the insertion of the anterior cruciate ligament (ACL), and the posterior horn is attached at the posterior intercondylar fossa between the posterior cruciate ligament (PCL) and the lateral meniscus posterior horn. Due to posterior insertion ligament of the medial meniscus to the posterior intercondylar fossa of the tibia the peripheral border is firmly attached to the medial capsule and this fact makes the medial meniscus less moveable then the lateral one (Goyal, 2013).

The lateral meniscus has a more circular shape, covering up to two thirds of the articular surface of the underlying tibial plateau. The lateral meniscus comparing to the medial one, encompasses more of the tibial plateau's total surface area than the medial meniscus because it has a constant radius. It is shaped into 4/5 of a complete ring or known also as O-shaped (Gupte, 2003).

The coronary ligament attaches the body of the lateral meniscus to the capsule, except at the posterolateral corner, close to the popliteal hiatus. There are two meniscofemoral ligaments passing from the posterior horn of the lateral meniscus to the lateral part of the medial femoral condyle. Ligament Humphrey passes anterior to the PCL and ligament Wrisberg passes posterior to the PCL. The lateral meniscus, unlike the medial one, is only loosely attached to the joint capsule and shares no attachment with the lateral collateral ligament. This make the lateral meniscus have more than twice the movement of the medial meniscus (Joseph, 2009).

The medial one, due to the fact that is attached to the medial collateral ligament, is limited in mobility. The lateral one is connected to the femur via the posterior meniscofemoral ligament (liament of Wrisberg) and anterior meniscofemoral ligament (ligament of Humphrey) ,which can tension its posterior horn anteriorly and medially with increasing knee flexion (Gupte, 2003).

The transverse ligament connects anterior aspects of both menisci. The increased stability provided by the ligamentous attachments prevents the menisci from being extruded out of the joint during compression (Brindle, 2001).

Some of main the functions of menisci are; shock absorption thanks to their viscoelastic consistence; facilitation of load transmission through the tibiofemoral joint by making possible congruency of the joint surfaces and increasing the articular contact. Menisci serve to cushion the knee joint, deepen the socket of the knee and increase joint congruity to better distribute weight-bearing forces, provide its stability, prevent joint hyperextension, facilitate joint gliding and protect the joint margins (Logan, 2009).

The medial meniscus transmits 50% of the entire load in the medial part, and the lateral meniscus 70% of the load in the lateral section. Other important function is protection of the ends of the bones from rubbing on each other and to deepen the tibial sockets into which the femur attaches. The serve have an important function in proprioception due to nerve ending in menisci and also play a role as secondary restraints to anterior translation of tibia. Menisci help also the joint lubrication and cartilage nutrition by keeping the synovial fluid film over the joint surfaces compressing the synovial fluid into the cartilages of the knee articulation (Manske, 2006).

The menisci are inserted to the tibia by the coronary ligaments and by direct insertion the posterior and anterior horns into the bone. These insertions are adapted to transmit flexible and sheer loads from the menisci to the tibia. Also the menisci are attached to the joint capsule. The medial one is attached to the deep part of the medial collateral ligament, and the lateral meniscus to the lateral capsule. The capsule attachments of the lateral meniscus are less secure than those of the medial one.

When the knee moves in flexion and extension, the menisci follow the movements of the tibia. During flexion the menisci move posteriorly due to the semimembranosus muscle and popliteus muscle. During extension the menisci are pulled anteriorly by the meniscopatellar ligaments. In rotation the menisci follow the movements of the femur. Compressive forces absorbed by menisci are approximately 50% to 60% of the knees loads. The meniscal load increases to more than 85% of the total knee joint compressive forces, when the knee is at 90grade flexion and when the force is applied at the posterior part of the joint. This fact may be related to posterior degenerative tears, as well as to the continuous activity imposed on the menisci during positional activities for example squatting. Acute tears occur often during activities, like running or other maneuvers, when the knee is near full extension (Houglum, 2005).

3.2.1 Vascular anatomy of menisci

Proper vascular supply is very important to meniscal healing. The major vascularization to the inferior and superior parts of each meniscus is provided by the lateral, medial, and middle geniculate arteries, that branch off the popliteal artery.

The middle geniculate artery is a small posterior branch that perforates the oblique popliteal ligament at the posteromedial corner of the tibiofemoral joint. A premeniscal capillary network-web arising from branches of these arteries originates within the synovial and capsular tissues of the knee along the periphery of the menisci (Brindle, 2001).

Direct blood supply do not receive all the surface of menisci, but approximately 10% to 30% of the peripheral medial meniscus border and 10% to 25% of the lateral meniscus border. Another direct way for vascularization and nourishment is secured from ligamentous vessels that travel a short distance from the anterior and posterior horns into the substance of the menisci forming terminal loops. The rest portion left of each meniscus (65% to 75%) receives nourishment only from the synovial fluid via diffusion (Masouros, 2008).

Vascular anatomy of the menisci can be divided into three zones: “red-red”, “red-white” and “white-white” zones. The “red-red” zone is very vascular and is located in the peripheral third of meniscus. This means, that if a tear is situated in this zone, due to high blood supply from both sides of the tear, the process of healing is fast and with high potential of recovery.

The “red- white” zone is situated between the peripheral and inner part of menisci, at the border of vascular supply (red zone) and the avascular zone (white zone). A tear in this zone is supplied by blood just from the peripheral region of meniscus, and not from the inner part of it, which is avascular. The “white- white” zone, as the name indicates, is located in the inner part of meniscus and is an avascular zone. If a tear happen to be in the “white –white” zone, the healing process will be not very satisfactory, because it will not be supplied by blood from the both sides of the tear. The vascular supply is a very crucial parameter to indicate the prognosis for meniscal lesions (Shaqiri, 2005).

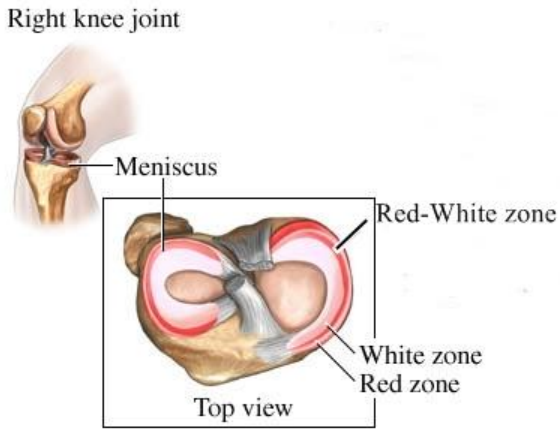


Figure 4: Three vascular zones of the menisci (Foundry, 2011)

3.2.2 Neuroanatomy of menisci

The posterior articular branch of the posterior tibial nerve and the terminal branches of the obturator and femoral nerves, innervate the knee joint. Nerve fibers enter the joint capsule, along with the vascular supply, and give to the menisci the needed substances. Mainly, the nerve fibers and also sensory receptors are mostly located in the vascular zone, especially in the posterior and anterior horns of menisci. Also Ruffini, Pacinian, and Golgi tendon mechanoreceptors found in the knee joint capsule and in the peripheral menisci lead to the result, that they give crucial contributions to proprioception. Researchers found out that some of the pain in meniscal tears may come from the meniscus itself, mostly in the tears located in the "red-red" or "red-white" zones, which are accompanied even by bleeding (Hyang, 2003).

3.2.3 Histology and structure of menisci

Mechanical properties are dictated by the microstructural characteristics of the menisci. The menisci are made of 70% water and 30% organic matter. Collagen is found in 75% of the organic matter, while 8% to 13% of the remaining dry matter consists of noncollagenous proteins. Type I collagen fibers provide the primary meniscal structural support, this domination of type I collagen is one of the major differences between the menisci and hyaline, or articular, cartilage, which is composed of predominantly type II collagen (Brindle, 2001).

The cellular meniscal components include also fibrochondrocytes placed within the extracellular matrix. Fibrochondrocytes expose the assets of chondrocytes and fibroblasts,

synthesizingand maintaining the extracellular matrix, especially the collagen. Fibrochondrocytes are mostly situated in the deeper layers of the menisci and their function is to synthesize and keep the extracellular matrix.

Fibroblasts produce crucial matrix proteins (proteoglycan and collagen) and are located on the surface of the menisci. The matrix proteins produced by fibroblasts have a very important role in facilitation load transmission in the knee joint. Reciprocal action between glycosaminoglycan and collagen act as a fiber reinforced material, providing the menisci with resistance to forces of tension, shearing and compression (Manske, 2006).

Meniscal glycosaminoglycan's trap water and assure resistance to compressive loading because they are negatively charged molecules. Noncollagenous glycoproteins, like elastin, thrombospondin and fibronectin have an important role in putting together the matrix proteins (Manske, 2006).

To assimilate compressive loads into circumferential stresses there are arranged three collagen fiber layers.

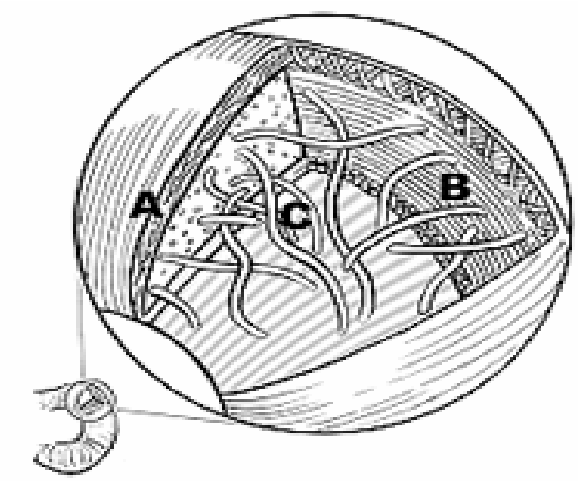


Figure 5:Pattern of meniscal collagen fibers: radial fibers (A); circumferential fibers (B); and perforating fibers (C)(Joseph J. Fazalare MD, Meniscal Repair of the Knee, 2009)

In the surface, the fibers travel radially, serving as "ties" that resist shearing or splitting. In the middle layer, the fibers are parallel or circumferentially positioned so to better resist hoop stress during weight bearing. In the deep layer there are found collagen accumulations that are regulated parallel to the periphery. Remains of the extracellular matrix are composed of proteoglycans. Chains of proteoglycan aggregates called glycosaminoglycan

(GAGs), compose just 1% of the wet weight of the meniscus but mostly contribute to its material properties, such as tissue hydration, compressive stiffness and elasticity. The size of these proteoglycan macromolecules in combination with water-retention and electrostatic repulsion properties is what gives the menisci their compressive stiffness.

Meniscal shock absorption is time dependent due to the ejection of water out of the extracellular matrix. The ejection of water from the GAG substances insures not only compressive stiffness but also joint lubrication. Mostly GAG are concentrated in the meniscal horns and in the inner half of the menisci, which correspond with the primary weight-bearing areas. Meniscal tissue displays the time-dependent viscoelastic property of "creep", deforming over time when loading occurs with greater frequency properties (Brindle, 2001). Rather, elastin, which constitutes less than 0.06% of meniscal tissue, is believed to aid in the recovery of shape after load deformation.

4 Mechanism of injury

Majewski in his study (Majewski, 2006), reported that injures to the menisci are the second most often injury occurring to the knee, with an incidence of 12% - 14%. Its prevalence is 61 cases per 100.000 persons. Most frequent lesions of the menisci are done during sport practicing, mostly football and skiing Studies confirm that all meniscal lesions occurring during different sports are in high percentage lesions of the medial meniscus 24%, lateral meniscus 8% and 20-30% are combined meniscal tears and ligament injuries. Majewski in his study observed that from all the cases having a combined meniscal tear (medial meniscus and anterior cruciate ligament-ACL), almost 85% of this cases needed arthroscopic treatment.

In acute injuries of the soft structures of the knee (menisci, ligament) mostly this symptoms appear: pain, joint swelling, often with joint filling and reduced mobility. Medial menisci injuries are often associated with anterior cruciate ligament ACL insufficiency, as a result of abnormal tibial translation. The lateral meniscus is usually connected with an acute ACL tear. Isolated injury of the medial meniscus does not affect the knee instability, but if combined with a ligament rupture, ACL more often, the knee becomes unstable. The isolated tears of menisci tend to be degenerative ones, while combined tears are more likely to be acute (Shelbourne, 2009).

So if the knee is stable even though with a meniscal injury may not be needed to a meniscal repair. But this is not true for an unstable knee, because passing the time the knee will be more unstable and the risk of degenerative changes in the knee is high. Meniscal repair when it is combined tear even with an ligament repair, have better prognosis than an isolated meniscal repair.

Choosing the optimal therapy for an injury depends on the accuracy of diagnosis, type of injury, physician experience and the cooperation of the patient. If surgical treatment should be chosen, often it is the invasive arthroscopy. This due to a general effort to maintain as many parts as possible, of the injured structures of the knee articulation, especially menisci and cartilage (meniscal suture, reinsertion of cartilage). The goal of meniscal surgery is to restore a functional meniscus, to prevent the development of degenerative osteoarthritis in the involved knee. The goal of rehabilitation is to restore patient function based on individual needs (Brindle, 2001).

4.1 Types of meniscal tears

The main mechanisms of injury in menisci are a combination of torsion (sharp twist by unstable load) and axial loading (high compressive force between tibial and femoral articular joints). Injuries of a healthy meniscus are usually produced by a compressive force coupled with transverse plane tibiofemoral rotation as the knee moves from flexion to extension during rapid cutting or pivoting (Cake, 2004).

Types of meniscal tear differ concerning the location of the tear and the mechanism of injury. Lateral meniscus has a larger articular surface, the load transmission in lateral meniscus is higher, is more mobile and collecting all this factors we came to the conclusion that, the probability to have a lesion or fracture is lower, than the medial meniscus (Masouros, 2008).

Frayed Edged

The meniscal lesion can be seen just as a small damage at the edge of the meniscus. A frayed inner meniscal border is a common consequence. Surgeons just reduce this worn-out part hoping that the damage is enclosed and so preventing enzyme release from the area which can increase further degeneration processes in the meniscus. This situation can be very problematic, because if the meniscus undergoes degenerative processes, this means that the whole structure goes through internal change. In this case the meniscus loses most of its functions and especially the shock-absorber one, making the cartilage at the ends of femur and tibia be overstressed and in this situation arthritis can be developed. Degenerative meniscal tears include many tissue-cleavage planes, delamination and calcified cyst formation, OA signs like osteophytes and damage of the articular cartilage (Strover, 2008).

Figure7: Frayed Edged (Strover, 2008)

Radial tear

Radial tear is a sharp edged fissure from the medial to the lateral border of meniscus (across its radius). It is manageable to suture by stitching the superficial part of the split, but the main problem is the inner part of the split that may not heal properly due to the poor vascular supply in that area. Radial meniscal tears also disorder the circumferential collagen fibers and are more willingly to debridement than to repair.

Figure 8:Radial Tear (Strover, 2008)

Parrot- break tear

De facto a parrot-break tear is a neglected oblique radial tear, which tries to heal spontaneously taking a shape of a parrot's break and having a risk of getting catched in the joint and causing pain or instability.

Figure 9: Parrot- break tear (Strover, 2008)

Circumferential tear

This kind of tear expands all along the length of the meniscus parallel to the circumferential fibers.

Figure 10: Circumferential tear (Strover, 2008)

Bucket-handle tear

Bucket-handle tear is in itself, a form of a longitudinal tear. As the direction of the tear is from the inter part of meniscus to the periphery, the circumferential fibers are also disrupted. This kind of tear is less willing to heal as damaged circumferential fibers may not be able to repair. Due to the change of its inner structure and the overall biomechanics of the knee, such a lesion makes the meniscus unable to perform well its functions. In some cases the 'handle' can be caught on the femur's condyles and lock the knee joint preventing full extension and causing pain. Bucket-handle tear is situated in the white-white area, so surgeons usually remove them as they don’t have good prognosis and they don’t heal.

Figure 11: Bucket- handle tear (Strover, 2008)

Horizontal cleavage tear

Horizontal cleavage tear is a horizontal division in the body of the meniscus. These tears are not so usual. Mostly they are asymptomatic but apparent on a MRI scan. Some of the causes of these tears can be: a minor injury, continuous stress in the knee articulation, degenerative processes that damage the area, often falling during sports or other daily activities. In the early faze the lesion is just as a fissure, than it breaks out on the inner part of the knee forming this type tear.

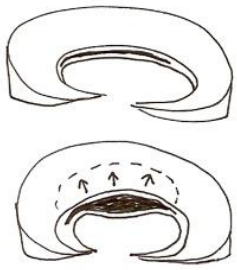


Figure 12:Horizontal cleavage tear (Strover, 2008)

Flap tear

This kind of tear is a horizontal one occurring at the surface of the meniscus. The flap tear is disposed to peel, rubbing with other structures of the knee and causing different symptoms. To trimme the flap away is easy and there is a good prognosis of healing because there is sufficient body of the meniscus to heal the lesion and provide shock absorption to the knee.

Figure 13: Flap tear (Strover, 2008)

5 Clinical examination

The data obtained during the initial physical examination in combination with other diagnostic tests are largely decisive to decide if surgery after meniscal injury is needed. A complete examination should consist of a thorough injury history, regional palpation, and special tests.

Some specific tests we use to distinguish menisci problems are: McMurray test, Payr's test, Prone knee extension, Bounce test, Appley's compression test, Childress' test, Thessaly test, Ege's test and Steinmann test.

It is very important to involve in clinical examinations diagnostic imaging, such as conventional radiography to evaluate the possibility of a fracture, osteochondral injury or even intraarticular loose body (Kola, 2012). Magnetic resonance imaging helps to visualize internal structures in details and better identification of meniscal tears.

5.1 Physical examination

The most frequent symptoms present in the patients who have injured menisci are pain, swelling, locking of the knee and instability. The pain is manifested when the knee is flexed, for example when squatting. Other potential reasons of causing knee pain might include even intraarticular and extraarticular problems, such as arthritis and tendopathy (Manske, 2006).

The instability is also associated with ligamentous injury. The physical examination of a patient should include a whole inspection of the body, palpation, specific tests to distingue the origin of the problem in the knee (whether it's because of meniscus or ligamentous injury).The McMurray test, Payr's test, Appley's compression test, Steinmann tests and Thessaly test are the most frequently used clinical tests for meniscal pathology (Canaj, 1999).

McMurray test

During the McMurray test the patient lies supine with fully flexed knee. In this position the examiner with one hand, holds the sole of the foot, and with the other palpates the tibio-fibular joint. Depending on the meniscus that is going to be tested the examiner starts the maneuver in different positions. To test the lateral meniscus the maneuver starts with external rotation of the tibia, and is performed extending the knee, going to inner rotation of the tibia and applying at the same time valgus stress. When testing the medial meniscus the tibia starts

the maneuver in inner rotation of the tibia, applying varus stress in the knee while extending the knee and externally rotation the tibia (Brown, 2004).

The examiner always palpates the side of the joint that is being tested. The test can be repeated with increasing the flexion of the knee till 90 degrees. The test is positive if the patient feels pain or a “click” sound is felt by the examiner or the patient.

Figure 14: Mc.Murray test a) initial position b) final position

Appley's compression test

We use the Appley's compression test to distingue between meniscal or ligamentous pathology. The patient is in a prone position with the 90 grades flexed knee. The examiner pressure downward on the heel compressing the menisci between tibia and femur, and from this position rotates the tibia, maintaining the initial pressure. This test is positive if the patient feels pain in the lateral or medial part of the knee.

To distinguish ligamentous pathology, the same test is applied, but instead compressing the examiner distracts the tibia from femur. If pain is located during this traction maneuver, than we can indicate ligamentous pain than meniscal injury.

Figure 15: Appley's compression test

Payr test

This test is also used to detect meniscal pathology. The patient is in a supine or sitting position. The heel crosses the dorsal part of the opposite tibia, The examiner lifts the heel towards the ceiling and the knee towards the table. Every pain in the medial part of the leg, determine medial meniscus pathology.

Steinmann test

The patient sits in the edge of the examination table with the 90 degree flexion in the knee joint. The examiner holding the food from the heel and its ventral part rotates the tibia internally and externally. If the patient reports pain in the medial part of the knee, than the medial meniscus might have pathology. If the patient reports pain the lateral part of the knee, than we should take into consideration lateral meniscus pathology.

Figure 16: Steinman test a) neutral position b) rotation of tibia externally c) rotation of tibia internally

Thessaly's Test

Thessaly is a clinical screening tool for meniscal injuries, that shows the dynamic reproduction of knee joint loading. Thessaly test is done in a knee flexion of 5° and 20°. The therapists supports the patients from the front and the patient rotates the knee and the body, externally and internally, keeping the knee in 5° flexion. The same procedure is repeated with the knee flexed at 20°.The patients having a meniscal tear, can experience a joint-tine discomfort and may have a sense of locking and pain.

Figure 17: Thessaly's Test a) neutral position of the patient with a 20°flexion of the knee b) internal rotation of the knee and the body c) neutral position of the patient with a 20°flexion of the knee d) external rotation of the knee and the body

Ege's Test

Ege's test is a weight bearing test, detecting a meniscus tear on the medial or lateral side of the knee. Depending on the meniscus we want to examine, the patient's feet are turned outwards for medial meniscus or inward for lateral meniscus.

Figure 18: Ege's Test

Duck Walk (Childress' Test)

Duck walking test or Childness' test is a weight-bearing test that consists in several repetitions of full weight bearing flexion on the knee in different positions. The patient tries to walk in these positions. If pain or snapping in posterior horn area, is present during duck walking, than we can take into consideration a meniscal pathology.

A patient can't perform duck walking, if having medial meniscus pathology (Kolář, 2009).

Figure 19: Duck Walk test

Bounce Home Test

Bounce home test helps detect meniscal injuries while making a passive flexion of knee and hip. The therapist holds the heel of the patient and requests the patient to extend the knee freely and slowly. If the femur rotation on tibia, and if extension of the knee is blocked, than we can suspect for a meniscal injury.

Figure 20: Bounce Home Test a) initial position b) final position

Steinman's Tenderness Test

This test is done in order to diagnose meniscal tears at the knee joint. The patient lies supine with a flexed knee and hip to 90 degrees. The therapist palpates the lateral and medial line of the knee joint and moves anteriorly and posteriori with flexion and extension of the knee. Tibia is rotated laterally and medially. If these movements are painful, than this sign indicates meniscal injury. The Steinman's Tenderness test is repeated in different degrees of knee flexion.

Figure 21: Steinman's Tenderness test

Joint Line Tenderness

The purpose of the test is to asses any meniscal injury. The patient is in a sitting position or laying with the knee at a 90° flexion. The therapist palpates both medial and lateral tibiofemoral joint line. If the patient feels pain in the line palpated, than the test is positive.

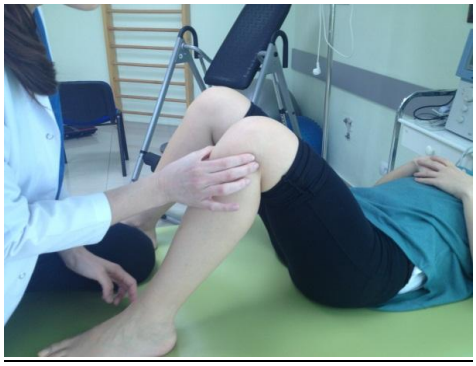


Figure 22: Joint Line Tenderness

Helfet test

The test is performed in a sitting position. The therapist should note the location and the axe of the tibial tuberosity. The patient is asked to extend the leg. The therapist should foucus on the line of movement of the tibial tuberosity. No lateral movement of tibial tuberosity or blocked movement of the leg while extending indicates meniscal injury.

Figure 22: Helfet test

Merke test

This test is done in order to find menisci pathology. The patient stands on the leg that will be examined and rotates the body left and right. If the patient feels pain along the knee joint line, than the test can be considered positive.

Figure 23: Merke Test

Bragard test

The tests helps to detect meniscal tears or articular surface irregularity, such as chondral lesion.. The patient lies on the bed. If pain is present while external rotating and extending the knee, than the test is considered positive. External tibial rotation and knee extensions moves the meniscus more anteriorly, which can be a reason of pain reproduction along the joint line.

Figure 24: Bragard test

5.2 Imaging examination

Radiographs

Radiographs can be done in a standing position with anterio-posterior view, a lateral view and a Merchant view. When having 45 degrees of flexion in a standing postero-anterior view, it better demonstrates posterior part narrowing and is suitable when the examiner suspect early joint degeneration. Standing radiographs make possible the examination of alignment, which is very important due to atraumatic meniscal tears. In this kind of tear there are found different deformities, which increase stresses especially on medial meniscus (Manske, 2006).

Magnetic Resonance Imaging (MRI)

Magnetic Resonance Imaging is largely used to visualize inner structure of menisci in details, cause it provides very good imaging of soft tissues of the body. Menisci without pathologic changing have a low signal intensity shown in the MRI and pathologic morphology and areas of high signal intensity show tears or other meniscal pathology, such

as degeneration for example. MRI also visualizes meniscal cysts and very good imaging of ligaments, articular cartilage and capsular attachments of the meniscus (Çela, 2001).

For patients to whom the MRI is contraindicated (claustrophobic, patients who have heart pacemakers), computer tomography (CT) is indicated.

5.3 Healing process

Healing is a long process that needs proper treatment and care. In a study done by Cake there were reported two patterns followed for meniscal repair. The first one was the *extrinsic* happening in the red-red area or the vascular area. The capillaries in this zone form a net, which supplies with nutrients all the mesenchymal cells, make possible proper healing. The second pattern is the *intrinsic* one. It is based on self-healing capacity of the synovial fluid and meniscal fibrocartilage. This author describes that a good fixation of the knee joint is more important than joint immobilization, because immobilization and unloading do not heal during the meniscal healing the vascular area (Cake, 2004).

Nowadays different methods are used to improve the healing process of the meniscus, such as application of an exogenous fibrin clot, placement of vascular channels to connect the tear with the vascular periphery, abrasion of the synovial border to form a fascular pannus and placement of pedicle synovial grafts over the meniscal tear. The future reserves more sophisticated methods used for this aim. It is also thought, that the use of cytokines and growth factors may affect the process of healing (Manske R. , 2006).

5.3.1 Non-operative tears

There are several tears that can be healed conservatively without any need of an operation. Indications for these cases involve absence of symptoms such as swelling and pain, small separations in the meniscal capsular zone (between the medial meniscus and the medial collateral ligament) and degenerative knee disease. It is found that radial tears do not heal properly conservatively. Better results of conservative healing are found in vertical longitudinal tears and horizontal degenerative apertures (Logerstedt, 2010).

In the cases that the meniscus is treated with a conservative intervention the most important procedures followed are the application of ice, wrapping, compression, and nonsteriodial anti-inflammatory drugs. Best results are obtained if these methods are

combined with physical therapy to improve the range of motion, stability and muscular strength (Çaushi, 2005).

It is very important the education of the patient during the process of the healing, he should gradually restart activities and should be very careful to avoid movements of the knee that can increase the risk of having a tear, such as pivoting movements, hyperflexion of the knee, especially during the first three days to first week, period that pain and swelling could still be present and the patient is not fully recovered.

Several conservative treatments were used to reduce the instability in the medial or lateral knee compartment, reduce pain and swelling, such as wedged insoles, ankle foot orthotics, knee braces, taping, kinesiotaping. Eun-Hi Choi and other authors (Choi, 2011) after examining the effects of knee brace in different activities, such as slow walking or fast walking ,came into conclusion that the knee brace during activities stabilized the knee and activated more efficiently the femoral muscles, especially m. quadriceps femoris.

Complications of the conservative care include progression of the lesion and joint degeneration, especially if there is a high loss of meniscal function (Logerstedt, 2010).

5.3.2 Surgical treatment

5.3.2.1 Meniscal surgery

The goal of meniscal surgery is to restore a functional meniscus, so to prevent the development of degenerative osteoarthritis in the involved knee (Brindle 2011). Meniscus tears that occur in the periphery may be repaired using a variety of operative procedures with high success rates. Complex multiplanar tears that extend into the central one-third avascular zone can also be successfully repaired using a meticulous vertically divergent suture technique. The outcome of these repairs justifies preservation of meniscal tissue, especially in younger athletic individuals. Meniscal transplantation is a valid treatment option for patients who have undergone meniscectomy and have related tibiofemoral joint pain, or in whom articular cartilage deterioration in the meniscectomized compartment is present (Heckman,2006).

It is necessary to monitor the patient's response after the surgery. The main complication is mostly arthrofibrosis, which can significantly worsen the outcome of therapy. After failure of nonoperative treatment or in case that some injuries are primary recommended directly for

a surgery, there are several current methods used to repair meniscal tears. These methods include the open technique, the arthroscopic outside-in, the inside-out, and the all-inside technique (Ichinohe, 2000). Many studies led to the conclusion that surgery induces more often the development of post-operative degenerative conditions if not correctly connected to a specific rehabilitation protocol (Frizziero, 2012).

If after six to twelve weeks, the conservative treatment was unsuccessful, patient are indicated to undergo surgical treatment. Indications for operation are pain, swelling, instability to achieve full extension of knee, locked knee, and tears of meniscus especially in young patients. The aim of operation of the knee is to maximally maintain and stabilize the meniscus. These procedures include partial or total meniscectomy, vascular stimulation to increase the healing process, meniscal repair and replacement. Meniscectomy can be using open or close techniques.

Contraindications include tears located in the inner one-third region (width greater than 8 mm), tears with major tissue fragmentation or degeneration, and tears with edges that cannot be reduced and approximated. Longitudinal tears less than 10 mm in length or incomplete radial tears that do not extend into the outer one-third of the meniscus are not repaired (Heckman, 2006).

Contraindications for a meniscus transplant are advanced knee joint arthritis, defined as less than 2 mm of tibiofemoral joint space on 45° weight-bearing posteroanterior radiographs and MRI evidence of flattening of the femoral condyle, concavity of the tibial plateau, and osteophytes that prevent anatomic seating of the transplant (Trees, 2011).

Knee joint instability is a contraindication unless the patient is willing to undergo ligament reconstruction either before or with the meniscus transplant. Other contraindications include knee arthrofibrosis, muscular atrophy, and prior joint infection.

5.3.2.2 Total and partial menisectomy

In the year 1885 was reported the first surgical human meniscus repair and was a very long and difficult procedure. At the time, total meniscectomy became the preferred operation and the only way of repairing meniscal damages, because this kind of operation was considered very technically challenging and tear meniscus were also considered as functionless

structures. After long term observations about the results of the total meniscectomy, were noticed early beginning of osteoarthritis, prompting the discovery of other surgical options.

Other options were taken into consideration, replacing so the total meniscectomy, such as partial meniscectomy, repairs and transplantations. It is really important for the surgeon, that before selecting a particular surgical technique, to consider the patient's health, lifestyle, age, and willingness to undergo the surgery. Another very important process in the whole operation process is the education of the patients about the pros and cons of meniscal repair or resection and they should be informed of their extent period of rehabilitation and obligations. Patients should know that the surgical success is also based on which meniscus was injured and the type of tear they have.

For patients older than 30 years, partial meniscectomy is recommended as the surgical treatment of choice, even patients older than 50 years are ideal candidates for partial meniscectomy due to the high risk they have to develop OA. To indicate a patient to undergo a surgical repair are taken into consideration some factors, such as location of the tear type of injury, and also the vascular supply. Partial meniscectomy is mostly used in flap tears, radial tears, horizontal cleavage tears and tears located in the avascular area (white- white zone) (Brindle, 2001). In this kind of surgery the torn or instable fragment of meniscus is removed. Partial meniscectomy can be done arthroscopically. Studies show that results are very good in 90% of knees without articular degeneration and in 60% to 70% of knees with degenerative joint disease.

Complications of partial meniscectomy are repetitive tearing (which are not so common), mistakenly injuries of the joint surface from using the instruments and risk of necrosis in the avascular zones, due to decreased blood supply (Bejtullahu, 2007).

In those cases where the menisci are damaged beyond repair or has been partially removed with still persistent pain, locked knee, instability and swelling, a total meniscectomy is done. Total meniscectomy is last choice decision, due to high costs, increased risk of osteoarthrisis and high risk of future total knee replacement.

Partial meniscectomy alter the biomechanics of the knee: after total meniscectomy the peak local contact pressure is pressure is 235% of normal, while in the partial meniscectomy increased by 65% (Fizziero, 2012).

There is a difference even between lateral and medial meniscectomy. The lateral meniscectomy proves a decrease of the contact area between articular structures by 40% to

50% and increase of the contact stress by 200%. While the medial menisectomy decreases contact area by 50% to 70% and contact stress increases less than half of lateral one, which is 100% (Shaqiri, 2005).

5.3.2.3 Techniques used for meniscal repair

There are different techniques for meniscal repair. We can divide them into two categories of repairs: repair with an implant and suture repair.

Suture Repair

The suture repair involves two techniques: the inside-out technique, the outside- in technique and all inside. Suture techniques use a specialized implant. This surgical technique is very much developed due to its less "invasive" technique and better prognosis of OA (osteoarthritis) risk after the meniscectomy. Suture Repair is indicated in acute states, longitudinal lesions, lesions of menisci associated with ligament injury or lesions in the vascular zone (red-red or red white zone) (Topi, 2007).

Outside-In Technique

This technique of arthroscopic meniscal repair was developed by Warren and Rodeo as a method to lower the risk of injury of the peroneal nerve during arthroscopic lateral meniscal repair (Rodeo, 2000). This technique is used for repair of most meniscal tears. To perform this technique is needed an 18-gauge spinal needle, an arthroscopic grasper, and suture material. To perform the outside-in technique without damaging the peroneal nerve, the knee should be positioned in a 90degrees of flexion for a lateral meniscal repair and 10degrees flexion for a medial meniscal repair.

The surgeon, using topographic landmarks, firstly palpates the knee trying to find the place where the tear may be located. In order to avoid damages of the vein or nerves trans illumination can be used. It is very important to protect and identify properly the saphenous nerve and vein on the medial part of menisci. The surgeon places a needle across the tear from outside. Due to a small skin incision, the needle passes across the tear of meniscus and enter in the inner part of meniscus. Next to the first needle, is passed a second one, achieving proper suture orientation. The second needle can be placed next to the first one, achieving so proper suture adjustment. To make this repair two manners are used. The first one is by

making a knot in the end of the suture. The knot is then put into the joint opposite to meniscus and keeps the tear in a reduced position. So, the sutures close by each other tie together subcutaneously over the capsule. Another way to tie the sutures together outside the anterior part of meniscus is using a standard square knot (Evans, 2013).

The permanent suture is preferred for repairs of teals that have a poor blood supply and not a good prognosis of healing, such as those in chronic tears, tears with marginal vascularity and older patients.

The advantages of outside-in technique comparing to the inside-out techniques are that sutures can be established without the need for hard cannulas for the fixation of the suture, as used mostly in the inside-out techniques. The use of these cannulas can increase the risk of minor damages in the joint surface when putting needles from the outside part of the joint, such as scratching of the joint surface. Another advantage of the outside-in technique is exact suture placement even in zones with limited access, this due to the small needles used, instead the hard cannulas in inside-out technique. Also the repair can be done with very small incisions, with less dissection than used in the inside-out technique (Manske, 2006).

Inside-Out Technique

This technique becomes popular in early 1980s by Henning. The inside-out technique uses double-armed sutures, done with flexible long needles placed arthroscopically into the meniscus and directed by particular cannulas. In order to get back the needles as they exit from the joint, lateral and medial incisions are done. It is very important the positioning of the incisions and dissection to the joint capsule to decrease the risk of any neurovascular injury (Manske, 2006). This technique is used because it provides a very good visualization for placement of the sutures, and also due to the fact that it is used to repair meniscal tears in every zone, that they might be located. The disadvantage is the incision that should be done to place the needles and a risk of neurovascular injuries.

All- Inside Technique

This kind of technique uses non-suture implants and the choice the implant going to be used, depends on the surgeon's decision. The surgeon should be very careful while making this decision because some implants tend to lead to chondral injury once they are implanted (Manske, 2006).

Suture with an implant

Collagen meniscus implantation (CMI)

Purified type I collagen is taken from Achilles tendons to make CMI. These collagens are divided, washed, refined, filtered, freeze-dried, given a proper shape, and cross linked by an organic compound called glutaraldehyde, forming a flexible C-shaped disk. The CMIforms a 3-dimensional area that is appropriate for colonization by precursor cells and vessels and makes possible creation of fully functional tissue. Histologic studies done to analyze the way that this tissue is formed, showed that the lacunae of the implant are filled with connective tissue that contains newly formed vessels and fibroblast-like cells. In his study Rodkey (William, 2008) highlighted that CMI, which is a new biomechanically competent tissue imitating meniscus, can be used to replace irreparable parts of meniscus or lost meniscal tissue in patients with a chronic meniscal injury**.**

This implant supports new tissue in growth and seems to have benefits for patients having a chronic meniscal injury. This was proven from clinical outcomes of Rodkey study in patients having a chronic meniscal injury (William, 2008).

Meniscal Allograft Implantation

Meniscal allograft implantation (MAT) is yet an experimental technique used recently to repair meniscus tears, and a rescue type of operation possible for the completely meniscus-deficient knee. The ideal candidate for an application meniscus allograft is an active, young person with pain over a meniscus- deficient zone (Manske R. , 2006).

Also MAT is indicated in patients who had an unsuccessful partial or total meniscectomy with partial pain or high disposition of OA evolution. Best results in this kind of surgery are obtained when the knee has no arthritic damages in the articular cartilage, advanced OA or deformations of the knee (knee varus or valgus). Before having this kind of

implantation is important for the surgeon to verify from the standing radiographs adequate limb alignment and also from physical examination if the knee has any instability or other deformation. Each of these findings should be highly considered before MAT.In a histologic analysis of human meniscal allograft, Rodeo and colleagues showed that human meniscal allograft transplants are repopulated with cells that are derived from the synovial membrane (Rodeo, 2000).

MAT treatment is not an easy one; it carries several difficulties from finding the proper graft, preservation of donor cells in the transplanted tissue, sterilization and verifying graft's immunogenicity (Fizziero, 2012).

6 Post- surgical rehabilitation program for menisci injuries

Receiving the proper rehabilitation program after meniscal injuries is very important. During this process it is crucial a multidisciplinary interaction between the orthopaedic surgeon, physical therapist, patient, patients' family and all the working staff, when the patient returns to his previous job and to his everyday activities. Factors like the type of meniscal tear, type of surgical intervention, patients functional needs, state of the knee articulation before the operation and motivation of the patient are crucial in deciding the rehabilitation protocol and proper timing of recovery needed after a surgery of injured menisci (Canaj, 1999).

The rehabilitation program for menisci injuries has gone through a considerable evolution over the past several years. Comparing to the past, current treatments and methods being used, make possible a more rapid return to daily activities of the patient with a more significant reduced damaging effects (Bejtullahu, 2007).

6.1 Post operation rehabilitation program for partial menisectomy

An arthroscopic partial meniscectomy is often a surgery of choice, if the meniscus is not reparable and the patients continue to experience knee locking, pain and high limitations in the knee range of motion. Concerning the American Academy of Orthopaedic Surgeons, after the knee surgery, a rigorous rehabilitation program is necessary to be followed in order to restore the knee mobility, return to everyday living activities, insuring a healthy unlimited life and returning to sports. It is very important that every program should be supervised by the surgeon doctor and physical therapist, which are responsible about choosing proper exercises that will help the patient to achieve his rehabilitation goal. All the activities performed by the patients including exercises should be recommended by the orthopaedic surgeon. Approximately the rehabilitation program starts with a two or three times per day exercise set, which lasts approximately 20 to 30 minutes each set of exercises.

Directly after the operation, the patient should be placed on crutches because of reflex inhibition of muscle activity (Heckmann, 2006). Depending on the ability of the patient to walk without assistance, within a few days after the operation as the pain and edema disappear, the weight bearing is to tolerance. The most important objectives after partial meniscectomy are the control of the swelling and pain, to achieve as soon as possible the

maximum knee range of motion and basing on the tolerance of the patient: full load walk (Brindle, 2001).

Exercises for muscles quadrates femoris reinforcement are started immediately after the operation, but they are not easily performed by the patient because of reflex inhibition of the muscles. Ankle pumps, hip exercises and hamstring stretches are usually done the first or second day after the operation. Open and closed kinetic chain exercises can be started on the first two or three days after the surgery. Step by step, other exercises are added, such as step-ups and step-downs, stationary bike, use of weights, balance exercising are also important to increase proprioception, and then activities that include dynamic balance training. Improving function, restoring knee stability, muscular strengthening, neuromuscular coordination and preventing further damages of the knee are the main goals of rehabilitation after surgery of the knee menisci.

The muscles that should be activated during a well-structured rehabilitation program are quadriceps, hamstrings, hip abductors, hip adductors and gluteus muscles (especially gluteus medius and maximus).

In the following two-four weeks after the operation of menisci low intensity activity might be recommended, such as walking, riding a stationary bicycle, simple warm up exercises, or slow tempo walking in the treadmill. It is very important after the warm-up or before the exercising to perform stretching exercises that should be repeated till the end of the program. During the exercise the patient should not feel pain, if so the patient should stop exercising and contact the doctor. During the second till fourth week the aim of rehabilitation is to achieve a full range of motion in the knee articulation.

Some stretching exercises that are recommended from the American Academy of Orthopaedic Surgeons are *heel cord stretch*- no need for equipment, 2-4sets of repetitions, six to seven days per week. The muscles that are activated during heel cord stretch are gastrocnemius and soleus. The patient should feel the stretch in the calf and into the heel. The stretch can be hold for 30 seconds to than relax for 30 seconds. While performing this exercise the patient should not arch the back.

Another stretch exercise recommended from the American Academy of Orthopaedic Surgeons (AAOS, 2010) could be *standing quadriceps stretch.* No equipment is needed while performing this exercise. In this exercise the main muscle working is quadriceps and the patients feels its stretch in the front of the thigh. It is important to have proper balance while doing standing quadriceps stretch so the patient can hold on the back of a chair or a wall for balance grasping the ankle and gently pulling the heel closer to the body. This position can be

hold for thirty seconds to one minute and should always be repeated with both legs. The back should not be arched or twisted. This exercise can be repeated 2 to 3 times and 4 to 5 days per week.

Concerning American Academy of Orthopaedic Surgeons (AAOS, 2010), Supine Hamstring Stretchis a very good exercise for stretching hamstrings. The patient can lie on the bed or on the floor with both legs bent and bring one knee to the chest having a straighten leg. Then the patient can pull slowly the leg to the head until he feels a stretch at the back of the thigh or behind the knee. No pain should be felt during the performance of this exercise, if so, the patient should interrupt the exercise. This exercise can be performed 2 till 3 times, 4 to 5 days per week.

After the fourth week and on strengthening exercises are given. The patient can return to sport activities. Symptoms like persistent swelling, redness around the knee and increasing pain should not be present.

Main strengthening exercises recommended from the American Academy of Orthopaedic Surgeons (AAOS, 2010) are half squats, hamstring curls, calf raises, leg extensions, straight leg raises, straight leg raises (prone position), hip abduction, hip adduction and leg presses.

Half Squats are very good for strengthening of quadriceps, hamstrings and gluteus. Usually in the beginning no equipment is needed, but when the exercise becomes easier to perform from the patient, the doctor and physical therapist can allow increasing the resistance by holding not heavy hand weights. The patient should have gained a good balance to perform this exercise. It is important for the physical therapist to give lots of instructions about how the back and leg should be kept while performing half squats. This exercise can be repeated three to ten times, four to five times per week.

Hamstring curls activate hamstrings and as in half squats ankle weight are added when the exercise becomes easier for the patient to perform. Resistance is increased gradually. For balance the patient can hold a wall or the back of a chair. The knees should be kept close together and the heel is raised toward the ceiling as far as possible and without any pain. The exercise can be repeated three to ten times, four to five days per week.

Leg extensions and *Straight Leg Raises* are performed to strengthen mainly quadriceps. As the exercise becomes easier for the patient to perform ankle weight can be added gradually. During the leg extension exercise the patients' sits up straight on a chair and slowly straighten and raise the affected leg as high as possible. This position is kept for about five seconds and then relaxes. The leg should not swing or use force to lift it higher. During straight leg raises, the patient can lie on the floor. The elbows should be kept under the

shoulder to support the upper part of the body. It is very important not to tense up in the neck and shoulders while performing this exercise. The patient keeps the affected leg straight and bends the other leg so that the foot reaches on the floor. Than tightening the quadriceps of the affected leg, slowly raises the leg 30-60cm off the floor. This position is held for five seconds and then relaxes. These exercises can be repeated for three to ten times, four to five days per week.

Hamstrings and gluteus can be strengthened using *straight leg raises in prone position.* The patient lies on the bed or on the floor keeping the pelvic bones on the floor and resting the head on the arms. After tightening the gluteus and hamstrings of the affected leg the patient raises the leg toward the ceiling as high as possible keeping this position for five seconds, and then relaxing for two seconds. This exercise can be repeated three to ten times, four to five days per week.

Hip abduction: It is very important that during the exercise, the patient should not inner rotate the leg. The patient lies on the side having the injured leg on the top and the bottom leg is blended. The top leg is kept straight and slowly the patient raises it up to 45°, keeping the knee unlocked. This exercise can be repeated three to twenty times, four to five days per week.

Hip adduction strengthens the adductors muscles who are very important stabilizators of the pelvic articulation. The patients lies on the side of the affected leg, having both legs straight. The uninjured leg is crossed in front of the injured one. The patient raises the injured leg 30-40 cm from the floor, holding this position for five seconds. Than relaxes for two seconds and repeats this exercises three to twenty times, four to five days per week.

Leg presses is performed using an elastic band of an acceptable resistance, so not to cause any pain. If the patient performs the exercise easily without any pain the level of resistance of the elastic bends is increased. In this exercise the quadriceps and hamstrings muscles are activated. The center part of the band is positioned in the arch of the food and the patients keep both ends. The patient lies on the floor or bad keeping the elbows bent and close to the body. After tightening the quadriceps muscle of the affected leg, he tries to bring the knee toward the chest and then flexing the foot slowly straighten the leg in front of him pushing against the band. This exercise should be performed slowly and without force or pain. Repetitions of this exercise and are three to ten sets, four to five days per week.The patient is advised to start running after two months of meniscectomy.

Outcome from a systematic and intensive rehabilitation program followed after knee menisci surgery, should be return to physical activities during the sixth to eighth week after

the surgery. The patients should not feel pain or have swelling in the knee. Knee mobility,strength and stability should be restored.

In a randomized controlled trial done by Goodwin (Goodwin, 2003) he came to the conclusion that a supervised physical therapy used in the early period after arthroscopic partial meniscectomy was in no great benefit to the patients. To achieve this conclusion Goodwin randomly divided the patients into two groups. One group, received 6 weeks of supervised physical therapy and a home program of exercises. The second group received only the home program of exercises. Lots of specialized tests and questionnaires were done and factors, like the number of days a patient needed to return to work after the surgery, were taken into consideration to measure the outcome of this study. Goodwin (Goodwin, 2003) came into the conclusion that between groups were found no differences of any of the outcomes measured.

Another very important part of the rehabilitation program is strengthening of the knee extensor muscles. Matthews and St Pierre in their study (Matthews, 2006) found out after measuring the knee extensor muscles with isokinetic test before and after the surgery that the muscle strength returns to its preoperative state within a period of 4 to 6 weeks and is still limited in function to 12 week comparing to the non-operated limb. It is very essential for sportsmen to restore the quadriceps normal strength in both limbs before returning to sports and to achieve this rehabilitation plays the main role.

A sportsman can return to sport when the muscle strength of quadriceps is at least 80% compared to the contralateral non operated limb. But still there are some limitations for the period a sportsman can return to competitions. It can't be done unless the quadriceps muscle strength in the operated limb is at least 90% comparing to the non-operated limb. Usually the patients return to their works after 1 or 2 weeks after the operation, to sports after 3 to 6 weeks and competitions in a 5 to 8 weeks' time (Fizzero, 2010).

A study done by Y. Ericsson, Ewa Roos and L. Dahlberg (Ericsson, 2006) concerning the muscle strength, functional performance, and self-reported outcomes four years after having an arthroscopic partial meniscectomy in middle aged patients was concluded that four years after the surgery of menisci, the quadriceps strength is reduced compared with the nonoperated leg. Concerning to Y.Ericsson, Ewa Roos and L. Dahlberg (Ericsson, 2006) this reduction of strength of quadriceps affects pain, knee function and quality of life of these patients. To asses this conclusion Knee Injury and Osteoarthritis Outcome Score (KOOS), isokinetic muscle strength testing, functional performance tests (one-leg rising test, square

hop test) were used. This study demonstrated that after knee injury and surgery, quadriceps muscles are more affected than hamstrings.

This insufficiency in quadriceps strength leads to increased physical stress with more cartilage impact loading. The maintenance of the knee stability may be also affected by a decrease of proprioceptive deficit

In order to strengthen quadriceps muscles electrical stimulation (ES) was used. There was evidence that ES accompanied with rehabilitation programmed exercises is effective in strength increasement (Imoto, 2011). Quadriceps muscle strength is very crucial for recovering physical function and is shown to be connected with abnormalities of walking speed and stability.

By the third to fifth week a jogging and running program can be started, always taking into the consideration the situation of the patient and how is he reacting to this mechanical force stresses. If the patient reacts properly without any swelling or pain, we can progress to running and later functional activities. As soon as the patient is in a very good shape, has good physical condition and has adequate coordination and strength, he can fully return to his functional activities, including sport participation.

Walking and running should be gradually involved in the exercise program after menisci surgery (Heqimi, 2006).Walking can be started in the second week after the surgery. The patient should not walk more than 10 minutes in the beginning. When the patient is well balance and has gain strength, gradually the walking period is prolonged. Running is an activity that should be avoided until six to eight weeks because of the shock forces that are transmitted to the knee while running.

6.2 Rehabilitation after meniscal repair

Regarding to weight bearing allowance for patients after meniscal repairs, there exist conflicting opinion regarding rehabilitation programs aiming ROM improvement and proper timing needed to return to physical activities. In his study David S. Logerstedt and co. (Logerstedt, 2010), emphasized that the early progressive knee motion should be compatible with the knee meniscal surgery and delay to activities may be accepted depending on the type of meniscus lesion and patient ability to load gaining.

Therapeutic exercises should consider strength and functional exercises to increase quadriceps and hamstrings strength and functional performance after meniscectomy. So in the

early phase after the surgery, partial loading might be allowed for four weeks and the patient can return to sports after 5 or 6 months.

But as it was mentioned above, this is not the only one aspect the rehabilitation program is followed. Other authors consider early full load bearing without brace and immediate mobilization of the operated knee, as very important. Heckman (Heckmann, 2006), highlights that rehabilitation after meniscus repair includes knee motion and quadriceps strengthening exercises initiated immediately from the first day postoperatively. Excessive weight bearing and compressive forces should be eliminated during gait because it might cause damages to the healing meniscus. In his study Heckmann (Heckmann, 2006) suggests that flexion up to 90 degrees should be allowed in the first two weeks after the operation, and this flexion should be increased up to 120 degrees in the third and fourth week, reaching its maximum from the first to second month after the operation. Immediate quadriceps strengthening isometric contraction exercises are recommended from the first day after the operation.

Always depending on the type of meniscal damage after the period of 3 to 5 weeks after the operation, a more completed strengthening rehabilitation program takes place. It might include *cup walking exercises,* which help the patient control their balance, heightened awareness of the operated limb and feeling the bodyweight over the operated knee. Other exercises aiming quadriceps muscle strengthening are wall sits, mini-squats, squat with little dumbbells, hamstring curls etc. Proprioceptive and balance exercises are important after the first month after the operation, even when the weight bearing is partial.

The full load is considered to be possible after the first 6 or 7 weeks, period when even different fitness machines like *leg press* can start to be used from the patients always respecting a consider number of exercises. For patients who were physically very active before the menisci operation, it is very important the period that they could return to jogging or sports. Heckmann (Heckmann, 2006) suggests that running can begin after the 26^{th} week and the return to full activity around 30 to 35 weeks after the operation, but this doesn't mean that it could not be delayed even up to 52week depending on the state the patient is.

Michaela Oravitan and Claudiu Avram (Oravitan, 2013) did a randomized, controlled, parallel group study to evaluate the effectiveness of electromyographic biofeedback (EMG-BFB) as part of a meniscal repair rehabilitation program. Their study consisted in dividing 64 patients who were diagnosed with meniscal tears, aged between 20-50 years old. These patients had an arthroscopic meniscal repair. The aim of the study was to compare the convalescence of patients with meniscal tears treated by meniscal suture and their

rehabilitation program included EMG-BFB, with a parallel group of patient whom followed the same rehabilitation program excluding EMG-BFB.

Table 1. Numbers of patients based on their meniscal tears location (Oravitan, 2013)

Injured meniscus	Localization of tear	Study group	Control group
Medial meniscus	Anterior horn	3	2
	Middle part	4	6
	Posterior horn	14	12
	Total	**21**	**20**
Lateral meniscus	Anterior horn	1	-
	Middle part	1	2
	Posterior horn	10	9
	Total	**12**	**11**

The early rehabilitation program followed by both groups after meniscal repair, was as shown in table 2.

Table 2: The early rehabilitation program followed by both groups after meniscal repair (Oravitan, 2013)

	Post-operative weeks			
	1-2	**3-4**	**5-6**	**7-8**
Range of motion				
0-90°	X	X		
0-120°			x	
0-123°				x
Weight-bearing				
¼ from body weight		X		
½ from body weight			x	
full weight-bearing				x
Scartissuemobilization	x	X	x	x
Physiotherapy				
Electrical muscle stimulation	x	X	x	x

Cryotherapy	x			
Stretching	x	X	x	x
Strengthening				
Quadriceps isometrics	x	X	x	
Hamstring isometrics	x	X	x	
Hip abduction and adduction	x	X	x	
Cycling		X	x	
Toe raises			x	x
Mini-squats			x	x
Lateral step-ups			x	x
CKC resistence exercise			x	x
Isokinetic exercises				x
Coordination				
Propriocetion training	x	X	x	x
EMG-BFB (only the study group)	x	X	x	x

CKC- closed kinetic chain exercises. X shows when the mentioned activity was accomplished.

The study group had EMG-BFB on daily bases, from the first till the eighth week. Each patient was instructed to perform an isometric contraction of the selected muscles, as soon as they heard an acoustic sound. In the screen the patients were able to follow the electrical potential of the contracted muscle. They would be able to keep the highest possible value of the electrical potential of contracted muscle. Another second acoustic signal was given to the patient, in order to relax the muscle. This cycle was repeated several times. The muscle chosen to contract were those showing a significative role in the knee dynamic stability and decreased load of passive knee structures (Williams, 2001).

Michaela Oravitan and Claudiu Avram (Oravitan, 2013) concluded their study that EMG-BFB increased the control the patients after meniscal repair had on their muscles during their everyday living activities, including sport. Sport as a physical activity acquiring better neuromuscular coordination and control, showed, that EMG-BFB is a helping part of

rehabilitation program after meniscal repair in achieving good neuromuscular coordination. EMG-BFB is seen as an effective part of rehabilitation program, because it helps muscle strengthening after meniscal operation and could increase knee muscles receptors feedback during exercises. It was observed a rise of the speed of muscle responded to acoustic stimulation given to start contraction and to relax. It is obvious that the speed of the response to the stimulus given (in our case, the acoustic stimulus) indicates the level of neuromuscular coordination recovery (Kamen, 2004).

The study found out that EMG-BFB is an instrumented process that helps patients with meniscal repair how to control their muscles (their contraction and relaxation) and increase the patients' perception of performing physical activities, such as sports, after a period of eight weeks of rehabilitation. The increase of both, the electrical potential in contraction of the knee stabilizators and, the speed of reaction to acoustic stimulus show an ability to develop muscular force faster and is a significant factor in performing physical activities that require neuromuscular control and coordination (Oravitan, 2013).

6.3 Rehabilitation after CMI

There are not so many studies done to determine the prognosis of patients after CMI or outcome of rehabilitation in these cases. Harston (Harston, 2012) underwent eleven studies with 520 subjects to analyze knee function, symptoms and period needed for the patients after CMI to return to activities. He came to the conclusion that there was a general improvement in patients after CMI, but there is poor information on the long-term prospective in this case, to better determine knee osteoarthritis prevention and if the patients return to activities earlier than those having meniscus repair or either total or partial meniscectomy.

6.4 Rehabilitation after allograft meniscal transplantation

Rehabilitation of meniscal injuries in the knee after allograft meniscal transplantation is a field, not yet so explored, due to lack of studies done in patients after this kind of operation. In the last 10-15 years this kind of intervention is developed as a surgical technique for those patients whose menisci have been severely damaged from traumas or previous unsuccessful meniscectomy intervention with early OA evolution and painful states. Heckmann (Heckmann, 2006), highlighted in his study that patients after meniscal transplantation need

for up to six weeks, long- leg brace and total weight bearing might be possible from the 5th or 6th week after the operation.

The range of motion increases by degrees little by little and after 6 weeks and the patient can restart sports after four months in order to strengthen the muscles and develop proprioception in the knee articulation. Before 6 months it is not recommended to perform squats, maximum flexion and return to racing sports. Based on the physical state of the patients the return to racing sports can be postponed even to 12 months.

7 Post-surgical rehabilitation of the knee menisci in Albania

7.1 Epidemiology of menisci injuries in Albania

As reported by Dr.Lluka Heqimi (Heqimi, 2006), injuries to the menisci are third most common injury to the knee in Albania, with an incidence of 10% to 12% and a prevalence of 41 cases per 100,000 persons. In his epidemiological study conducted on 2,000 patients in Albania from year 2000 till 2012 resulted that, the highest incidence of menisci is seen in young men around 25 years old playing sports involving pivoting, such as football, soccer and basketball. Sport in Albania is referred as an increased risk of meniscal injuries.

Among the injuries affecting the knee, Dr.Lluka Heqimi shows that most injuries involved anterior cruciate ligament (ACL) (26%), medial meniscus (15%) and lateral meniscus (3%). He also observes that 80% of patients with meniscal and ACL injuries require arthroscopic treatment.

7.2 Influence of meniscectomy in Albanian patients

In Albania there has been a study from the orthopaedic-traumatologic department of the state Hospital "Mother Tereza" in Tirana (Çaushi, 2005). This study analyzed 400 cases of menisectomy in the last 20 years and studied the connection between the influence that this intervention had had in the knee articulation. All the documentation of the patients chosen for this study were analyzed, such as anamnesis, clinical examinations, radiographies and MRI taken before and after the operation including all check-ins the patients had done through all these years.

From the study were expelled two groups of patients. Those that except menisci problems had hade before the operation other problems such as arthritis, osteochondritis, foreign bodies, and ligaments tears and those that have had other serious illness (severe heart disease, thrombosis etc.). This study took into consideration only those cases that have had pure menisecotomy. The patients were invited to undertake another control in "Mother Tereza" Hospital in Tirana. Only 168 patients came and were clinically controlled and had an X-ray. All the check-ins was done by one doctor. The other 234 patients didn't take part in

the study, due to different factors: present illness, wrong addresses given in the anamnesis, changed their apartments, immigrated, they had passed away and other personal reasons.

A questionnaire of 27 questions was given to these patients. This questionnaire had questions about preoperational phase, operational phase and the phase after the operation.

7.2.1. Pre operational phase

This phase includes all the information found in the anamnesis: type of damage, other traumas or operations, if hydroarthrosis or hemarthrosis were found before the intervention, how long did it take from the first symptom till the operation (latent period), age of the patient when operated, sex, profession, if the patient used at the time sport or attended other recreation activities.

Tab.3: Basic information of the patients taking part in Dr.Çaushi's study (Çaushi, 2005)

	Genre	Profession before the operation	Sports attended before the operation	Age when the patient was operated	Hemarthosis or hydroarthosis found in the knee before the operation	Latent period	Type of trauma
1.	Female	Sitting	Often	Less than 20 years old	Never	One month	Tear of meniscus without ligamentous damage
2.	Male	Standing	Not so often	20-29 years old	Once	1-6 months	Tear of meniscus with ligamentous damage

3.		Without physical activity	At all	30-39 years old	Twice	6-12 months	
4.		Difficult physical activity		more than 40 years old	Up to 5 times	1-3 years	
5.		Student			More than 5 times	more than 3 years	

7.2.2. Operational phase

Tab. 4: Information of type of tear, damaged menisus and kind of intervention the patients had (Çaushi, 2005)

	Type of tear	Damaged meniscus	Kind of intervention
1.	Frayed Edged	Right medial	Total meniscectomy
2.	Bucket-handle tear	Right lateral	Parcialmeniscectomy
3.	Parrot- break tear	Left medial	Suture repair
4.	Tear of the anterior part	Left lateral	
5.	Tear of the posterior part	Both medial menisci	
6.	Complex tear	Both lateral menisci	
7.		Both menisci of one knee articulation (both in the left or right knee)	

7.2.3. Post operation valuation

To achieve a post-operative valuation, the study was based on clinical and radiographic controls. In the clinical control the subjective and objective symptoms were valuated separately.

For the subjective symptoms was asked concerning to the type of pain: chronic one, during the day or the night, after physical effort or no pain was detected. The patients were also asked if the knee function was very good, sufficient for everyday activities but not comfort during movements or bad function of the knee limiting everyday activities. The doctor during his examination asked the patient, if any blocking of the knee was present. The evaluation of post-operative subjective symptoms was done based in the Tapper and Hoover scale. The radiologic and objective results were not included in the validation based on this scale, so to find the correlation with the subjective results.

1- **Excellent:** Patients do not have symptoms and any limitations or problems with the knee;
2- **Good:** Patients have little pain resembling more to discomfort in the knee during physical activities but do not have any limitations in the range of motions;
3- **Bad:** Patients have pain, especially during getting on and off the stairs. Pain often force patients to stop walking or moving the knee;
4- **Very bad:** Patients can't move, severe pain making the patients stays immobile for several hours' even days.

7.3 Objective symptoms

To compare the clinical and radiographic findings, the study was also based on the objective evaluation of the patients divided into four groups.

Tab.5: Group division of the patients concerning the points they gathered from the questionnaire given in the study done by Dr.Çaushi (Çaushi, 2005)

Group 1.	**Excellent**	**More than 40 points**
Group 2.	Good	More than 30 points
Group 3.	Bad	Less than 20 points
Group 4.	Very bad	Less than 10 points

The validation differs due to the various symptoms the patients have.

Tab.6: Evaluation of examination done by the doctor (Çaushi, 2005)

Knee stability (measured based on Lachman test, McMurray test and instability test)	**Verybad O points**	**Bad 5 points**	**Good 15 points**	**Very good 20 points**
Muscle hypothrophy (measured 10cm above the patella in m.quadricepsis)	**More than 2cm 0 points**	**Less than 2 cm 10 points**	**No hypothrophy 20 points**	
Knee flexion	**Less than 90˚ 0 points**	**Less than 120˚ 5 points**	**Normal 10 points**	

Crepitation of the knee articulation	**Many** **0 points**	**A few** **3 points**	**No crepitation** **5 points**	
Effusions of the knee	**Never** **5 points**	**1-2 times** **2 points**	**More than 3 times** **0 points**	

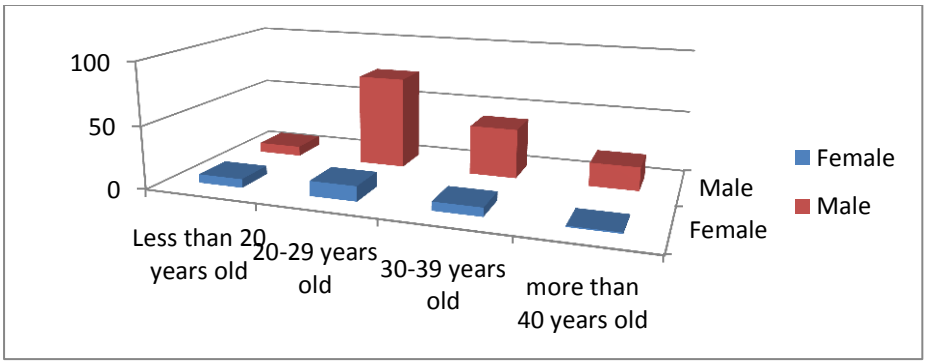
Total of points one patient could get is 100.

Except subjective symptoms and objective findings, the patients were also asked if they practiced any sport after the operation and if due to pain or other subjective symptoms of the knee, they were forced to change or leave their job. This information was added in the questionnaire. For each patient was written the time they had first post operatory symptoms (within 5 years, 5-10 years, 10-15years, 15-20 years or more than 20 years) and when they came for checkup after the operation (7-10 years, 10-15 years, 15-20 years or more than 20 years).All the patients went through a radiologic control of the knee, so to insure if any sign of osteoartrosis was found, if there were a narrowing of the articular area of the operated knee or other structural changes, like subcondral scleroris mainly in tibial plato.

7.4 Results of the impact of meniscectomy in Albanian patients

The results gained were achieved concerning to all the objective symptoms, subjective symptoms and radiologic findings obtained from the patients. The results that were obtained based on gender showed that from 168 cases, 141 (83.9%) were male and 27 (16.1%) were females. Their report was 5.2:1. The average age the patients had and operation of menisci was 28.78 ± 9.59 years old.

Graph 1:Age and gender of operated patients taking part in the study (Çaushi, 2005)



As we can see from the graph, more cases of the meniscotomy surgery done in the "Mother Tereza" hospital in Tirana were found in males aged between 20-29 years old. This due to the high physical activity they have in this period of life. Even the radiologic finding was much better in patients less than 40 years old. In patients more than 40 years old light tendency ofosteoarthritis was detected. From the study done by Prof. Dr.Gjergj Çaushi (Çaushi, 2005) were found that the patents were followed at a period varying from 7 to 27 years after the operation, with an average of 15 years. These controls concerned of only clinical tests performed from the orthopead. Severe pain or structure changes were reported from the patients or detected from the doctor, the patient had an X-ray done. From the statistics, most the patients just had the clinical tests performed. No rehabilitation procedures of physiotherapy were mentioned in this study, which is the only one done in Albania concerning operation of menisci and its effect after the meniscectomy. From the 168 patients that were analyzed, 91 patients (54.1%) had a meniscetomy in the right knee, 73 patients (43.5%) in the left one and 4 patients (2.4%) have done meniscectomy in both knees. More patients had the medial meniscus operated (viz. Table).

Tab.7: Medial meniscus resulting the most operated structure of the knee in Albania (Çaushi, 2005)

Number of patients	Medial meniscus	Lateral meniscus	M : L	Bilateral meniscectomy	
				Same knee articulation *(both right or both left)*	Different knee articulation*(in the right one and one in the left one)*
168 **100%**	122 72.6%	35 20.8%	3.5 : 1	7 4.2%	4 2.4%

The results after the medial menisesctomy have been better than in the lateral one ($p<0.05$). And the prognoses of bilateral meniscectomy have been worse than medial or lateral ones.

In the study done by Prof. Dr.Çaushi there was a significant connection between the postoperative symptoms and the latent period. If the patient had the latent phase less than one month, the prognoses were very good and no significant findings were detected in the X-ray. If the latent phase was 1-3 years in the radiography were seen arthritic changes and a tendency of narrowing the articulation surface. The worst group is the one having a latent phase of more than 3 years. They had the worst prognosis, narrowing of the articulation surface, arthritic changes, subchondral sclerosis and cysts. So the latent period till one year is the maximal limitto have a better prognosis after meniscectomy.

During the 20 years that the study took place total menicectomy was the most frequent operation done in Albania 43 % of patients, partial meniscectomy was the second with a 31% of cases and the last was local menisectomy with a 26 % of cases. Best prognoses were found in patients who had local meniscectomy. So it's obvious than the less part of meniscus we take from the knee the better prognosis.

Other factors that may have affected the prognosis after the surgery may be profession, sport and kind of tear. The study done in Albania by Prof.Doc. Çaushi showed that only 6 of 168 the patients (3.5%) changed work due to meniscectomy, but from the study

there was shown that profession doesn't increase the percentage of meniscectomy done in Tirana.

Sport was another factor that was analyzed. It was found that 69 patients (41.1%) played sports before the surgery: 58 played football and 11 other sports. After the meniscectomy 19 of these patients (18.8%) couldn't play anymore any kind of sport and 50 patients (81.2%) restarted their sportive activity.

Tab.8: The most frequent type of rupture in Albania were periphery and complex tears (Çaushi, 2005)

TYPE OF TEAR	NUMBER OF PATIENTS	PROCENTAGE
Frayed Edged	29 cases	17.3 %
Bucket-handle tear	57 cases	33.9 %
Parrot- break tear	12 cases	7.1 %
Tear of the anterior part	20 cases	11.9 %
Tear of the posterior part	20 cases	11.9 %
Complex tear	30 cases	17.9 %

Meniscectomy is becoming a routine operation in Albania. This make possible the decrease of total meniscectomy performed even if the tear of meniscus was little and partial or local meniscectomy was needed. Nowadays total meniscectomy is not the only way that the tears of menisci are repaired. Comparing to 20 years ago the number of total meniscectomy is decreased of 40 %. From the radiologic controls it was found that after the menisci surgery 60% of patients had arthritis, 28% had a high risk of it and only a little number didn't show any sign of arthritis. It should be emphasized that there is a close relation between the age the patient was operated, patients activity before and after the operation and type of operation the patient had.

The results of the study showed that the worse prognosis had patients, who were older than 40 years old, who had a high physical activity, chronically traumas, longer latent phase, complex tears, and total meniscectomy. It is important that after the meniscectomy to

strengthen quadriceps muscle as it takes a crucial part in knee stabilization. Age and profession didn't affect the prognosis.

7.5 Rehabilitation after menisci operation in Albania

Before starting the rehabilitation program, the orthopaedic surgeon and physical therapist need to explain to the patient the aim of the rehabilitation program and discuss together for the common rehabilitation goal. The exercises are supervised by a physical therapist at the direction of the orthopaedic surgeon. The physical therapist should help and instruct the patient to perform the exercises correctly without causing further damages in the knee articulation, to improve ROM, to minimize the post-operative symptoms and to help the patient return to active daily routine (Canaj, 1999). Concerning physiotherapy department in the state Military Hospital in Tirana, the following rehabilitation guideline is followed after partial meniscectomy:

In the first three days after the operation it is very important to rest properly, use negative thermotherapy, use compressive elastic bandage and keep the knee elevated. In the acute phase after the operation, even if the patient manifests symptoms like swelling or pain, the exercise program is not stopped, but continues taking into consideration the actual state of the patient. The patients may increase the intensity of the exercise program but this should be done always gradually and consulting with the orthopaedic surgeon (Shaqiri, 2005).

An interview was taken to Dr.Manushaqe Saraci (Saraci, 2013), head of the only physiotherapy department in Albania, part of the military hospital in Tirana. Dr.Saraci was asked about the rehabilitation program that patients follow after having a menisci surgery. Patients after menisci surgery stayed only 3 days in hospital following a simple rehabilitation program. Some of the patients didn't continue the rehabilitation program, as soon as they started to walk independently even painfully. Others, mostly patients who played sports, choose private physical therapist to follow them home or in their private rehabilitation clinics. So to the question about exact number of patients having a full rehabilitation program after menisci surgery, there is no statistical answer given.

Dr.Saraci in her interview (Saraci, 2013) said that in the physiotherapy department in Military Hospital in Tirana there is a rehabilitation program followed by patients. In the first postoperative day the patient was instructed how to care about the wound, loosen bandage if

swelling of the foot and ankle occur. The surgical dressing was removed three days after the operative day. Ice therapy begins directly after the surgery using ice packs every 3 hours. Patients were instructed to keep elevated the operated leg and not to place pillows under the knees in order not to flex or bent the knee. The pillows could be placed only under foot or ankle. Due to the culture bases it is very difficult for doctors and physical therapist to persuade Albanian patients not to bear more than 50% of patient's weight on the operative leg unless it is instructed by the doctor. As soon as they feel less pain or have the feeling that they can walk independently, they start not to use crutches and don't respect the instructions given to them. In lots of cases, they perform squats more than 90 degrees, sit or lie in the bed without elevated leg or walk for a prolonged time causing further problems and not allowing going further with the rehabilitation program.

From an interview taken from Dr.Arben Runa (Runa, 2013), head of surgery department in the Military Hospital in Tirana, Albania it is reported a low percentage of almost 5% of patients getting reoperated in the state hospital in Tirana. There are no exact number registered in the state hospital, cause in most cases the patients having a second surgery in the menisci choose private hospitals in Tirana, than state ones. In the last year the state military hospital does only open meniscectomy, and all the arthroscopic intervention are made in private hospitals. This shows a great insufficiency in Health Insurance System in Albania, making patients pay privately even in state hospitals. That's why they prefer private hospitals where they have even more modern and secure facilities, rather than state ones. Another problem raised from the Dr.Runa was that patients don't visit the doctor or physical therapist for post-operative visits.

In order to verify the post-surgical rehabilitation of the knee menisci in private hospitals in Tirana, another interview was done with Dr.Artan Bano (Bano, 2013), orthopaedic surgeon at private hospital "American Hospital" in Tirana. Dr. Bano in his interview said that in their hospital after the partial menisectomy there were also no contraindications or specific limitation concerning range of motion. It is the doctor, who decides the length of rehabilitation program, but usually the program should be continued for four to six weeks after the menisci surgery. The most important aim of the rehabilitation program during the first and second week are swelling and pain control, keeping the proper range of motion; especially extension (0-90˚). Rehabilitation program is started first post-operative day.

Exercises are of low intensity and without a lot of repetitions, unless otherwise is instructed from the doctor. The exercises are assisted twice by the physical therapist in the first three days. The patient is instructed to repeat the exercises twice alone. The patient is asked to perform as much as possible ankle pumps during the day to reduce any possibility of having blood clot in the calf. The patient should not feel unbearable pain, painful swelling or numbness of the leg, should not have fever, and color changes in the leg, continuous drainage or bleeding from incision, difficulty in breathing, excessive vomiting. In all these cases the rehabilitation program is interrupted and the doctor is contacted. Gradual strengthening exercises, stretching exercises and exercises helping to gain proper balance and proprioception. It is very important to reeducate gait stereotype. The patient usually returns to work after 7-10 days after the partial menisectomy.

During the second to fourth week after the surgery of menisci the pain and swelling should not be present and the patient starts to perform more strengthening exercises with higher intensity. Strengthening the muscles that stabilize the knee, help reducing stress on the knee joint and better absorbing shock.

Still main problem in private hospitals, concerning the rehabilitation program after the surgery of menisci, consists of the early leave of the patients from these hospitals. The costs of one night stay in private hospitals are very high, so the patients prefer to stay a maximum of 3-4 days and consulting the orthopaed surgeon and physiotherapist they take a list of exercises they need to perform and don't come back to controls, unless they have again pain or swellings. So, again the same problem is raised from the doctors and the physiotherapist working in hospitals. The outcome of the surgery or rehabilitation done during the acute phase is unknown.

Another situation is in the private clinics, where the patients come by their own will. Mostly the patients who come to follow post- surgery rehabilitation of the knee menisci, in private clinics in Albania are patients concerned about their diagnoses and the essential role of physiotherapy, sportsmen or young and physical active patients.

The guideline followed in a private clinic in Tirana, during the first till second week after the knee menisci surgery are the same as in private hospitals. The main difference is that in private clinics, the patients start the rehabilitation approximately after the first week of surgery. This indicates that a part of rehabilitation is done in hospitals, and the following rehabilitation is proceeded in private clinics.

During the second till fourth week after the knee menisci operation the main aim of physiotherapy is to restore the full range of motion of the knee, strengthening of the quadriceps femoris and hamstrings muscles, and restoring proper stabilization of the knee.

The following exercises are performed during the second till fourth week after the knee menisci operation:

Figure 25: Standing with one leg. Stabilization exercise

Figure 26: Balance exercise

Figure 27 : Balance exercise. a) both feet b) one foot(the operated one)

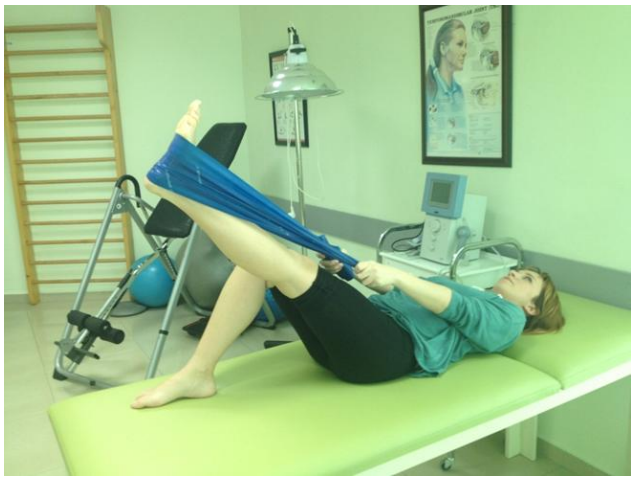


Figure 28 : Full leg extension. Hamstring stretching

Figure 29: Half Squats, strengthening of quadriceps, hamstrings and gluteus.

Figure 30 : Steps

Figure 31 : Lateral steps

Figure 32: Stationary bike

After the fourth week post-surgical rehabilitation of the knee menisci dynamic exercises are performed, resistance exercises, the patient should be able to sport. Long distance running is advised after the 8^{th} week, tennis after 6^{th}- 8^{th} week and football after the 8^{th} week.

7.6 Comparing post-surgical rehabilitation in Albania and standard guidelines concerning AAOS

Concerning the American Academy of Orthopaedic Surgeons (AAOS) (AAOS, 2010), after the knee menisci operation, an intensive rehabilitation program is very necessary to be followed in order to restore the knee mobility, return to everyday living activities, returning to sports, and what is most important to insure a healthy unlimited life for the patients. It is very important that every program should be supervised by the surgeon doctor and physical therapist, which are responsible about choosing proper exercises that will help the patient to achieve his rehabilitation goal.

In Albania after the knee menisci operation the rehabilitation program is started directly the first day after the operation. The first difference between guidelines of AAOS is that few orthopaedic surgeons, give to the physiotherapist a concrete rehabilitation program which is needed to be followed. The post-surgical rehabilitation program of the knee menisci is usually supervised only by the physiotherapist.

Concerning the AAOS (AAOS, 2010), the rehabilitation program starts with a two or three times per day exercise set, which lasts approximately 20 to 30 minutes each set of exercises. In the state Military hospital in Albania the patients gets a 30 min exercise program per day. Different situation is in the private hospitals, where the rehabilitation after the knee menisci is done twice per day. In the private clinics in Tirana, the rehabilitation program after the surgery of the knee menisci is done every day in the first week. Each therapy lasts 45 minutes. In the second till fourth week after the menisci surgery, the patients have therapy 3 times per week and after the fourth week, once per week. If the patient is followed in private physiotherapeutic clinics, the interaction between the physiotherapist and the orthopaedic surgeon is not present.

Concerning AAOS (AAOS, 2010), exercises for muscles quadrates femoris reinforcement are started immediately after the operation. Ankle pumps, hip exercises and

hamstring stretches, open and closed kinetic chain exercises are recommended from AAOS to be started on the first two or three days after the surgery. Step by step, other exercises are added, such as step-ups and step-downs, stationary bike, use of weights, balance exercising are also important to increase proprioception, and then activities that include dynamic balance training. Improving function, restoring knee stability, muscular strengthening, neuromuscular coordination and preventing further damages of the knee are the main goals of rehabilitation after surgery of the knee menisci.

Some of the above mentioned exercises are done in the state and private hospitals in Albania. The problem consist on the efficacy they are performed. In hospitals is a tendency to respect the painful situation the patients is after a menisci surgery. So, the physiotherapist tends to tolerate the neglection of the patient to do exercises that are painful, tiresome and difficult. In the state Military hospital I have noticed that the main goal of the patient is to sit and walk without being concerned of neuromuscular coordination, quadriceps strengthening or proper restoring the knee stability. The lack of physiotherapist insistation to perform the exercises in the proper way and timing, leads to further damages of the knee, even though the patient is able to walk and leave the hospital. Another situation is in the private clinics in Tirana. The main aim of the physiotherapist there is to increase the intensity of the exercises step by step, respecting always the aim of a proper rehabilitation program after the menisci surgery.

In the state Military Hospital there is a total absence of means that help the patient to perform proprioceptive, balance exercises or to stimulate sensor-motoric system. There are no balance pads, trampolines, gym balls or any other important mean to train dynamic balance and knee stabilization. All the patients who need to get this kind of rehabilitation program after the knee menisci need to follow rehabilitation program in private clinics.

8 Discussion

Choosing the optimal therapy for an injury depends on the accuracy of diagnosis, type of injury, physician experience and the cooperation of the patient. In acute injuries of the soft structures of the knee (menisci, ligament, cartilage) mostly this symptoms appear: pain, joint swelling, often with joint filling, locking, knee instability and reduced mobility. To consider an optimal therapy is very important a detailed joint examination including clinical and imagery examination (Shaqiri, 2005).

There are several tears that can be healed conservatively without any need of an operation. Indications for these cases involve absence of symptoms, small separations in the meniscal capsular zone (between the medial meniscus and the medial collateral ligament) and degenerative knee diseases. The most important procedures followed, if the meniscus is treated with a conservative intervention are the application of ice, wrapping, compression, and nonsteriodial anti-inflammatory drugs. Best results are obtained if these methods are combined with physical therapy to improve the range of motion, stability and muscular strength (Çaushi, 2005). Complications of the conservative care include progression of the lesion and joint degeneration, especially if there is a high loss of meniscal function (Logerstedt, 2010).

After failure of non-operative treatment, there are several current surgical methods used to repair meniscal tears. These methods include the open technique, the arthroscopic outside-in, the inside-out, and the all-inside technique (Ichinohe, 2000).

The rehabilitation program for menisci injuries has gone through a considerable evolution over the past several years. Comparing to the past, current treatments and methods being used, making possible a more rapid return to daily activities of the patient with a more significant reduced damaging effects. The goal of meniscal surgery is to restore a functional meniscus, to prevent the development of degenerative osteoarthritis in the involved knee (Brindle, 2001).

Factors like the type of meniscal tear, type of surgical intervention, patients functional needs, state of the knee articulation before the operation, motivation of the patient are crucial in deciding the rehabilitation protocol and proper timing of recovery needed after a surgery of

injured menisci. The goal of rehabilitation after the menisci surgery is to restore patient function based on individual needs (Canaj, 1999).

After the knee menisci surgery, a rigorous rehabilitation program is necessary to be followed in order to restore the knee mobility, return to everyday living activities, having a healthy unlimited life and returning to sports. It is very important that every program should be supervised by the orthopaedic surgeon doctor and physical therapist, which are responsible for choosing proper exercises that will help the patient to achieve his rehabilitation goal (Canaj, 1999).

Before starting the rehabilitation program the orthopaedic surgeon and physical therapist should explain to the patient the aim of post-surgical rehabilitation of the knee meniscus and discuss together for the common rehabilitation goal. The physical therapist should help and instruct the patient to perform the exercises correctly without causing further damages in the knee articulation. In the first three days after the operation it is very important to rest properly, use ice therapy, use compressive elastic bandage, keep the knee elevated and do the exact instructed exercises. If the patient manifest symptoms like swelling or pain, the exercise program is not stopped, but it is performed in a lower intensity. The patients may increase the intensity of the exercise program but this should be done always gradually and always consulting with the orthopaedic surgeon.

The reason why I chose to write about the rehabilitation program after meniscal surgery in Albania is due to the fact that Albania is my homeland and after the studies I will work there. During practices I had in Albanian hospitals back to my student period, I found it very difficult to consult any rehabilitation guidelines or to find proper literature concerning physiotherapy. So, if I needed to get informed about rehabilitation programs followed in different diagnoses, it was possible only by asking doctors or physiotherapists working in those hospitals. All information was based on their own experience and not in any scientific bases, such as studies, books or researches.

The aim of my work and my desire in the future is to further enlarge the problematic of my thesis in a Ph.D dissertation, trying to write about a strategy that should be followed to make the health system in Albania functional and rehabilitation an inseparable part of this system. I hope that this master thesis will help as a written material for all those Albanian students, who want to get some information in scientific bases not just by others experience.

During my personal experience working in hospitals in Tirana, I noticed a great tendency of the doctors to compare everything with American standards and guidelines. That is the reason why I decided to cite and compare Albanian standard with the American Academy of Orthopaedic Surgeons' (AAOS, 2010).

A study of Dr. Çaushi (Çaushi, 2005) which analyzed four hundred cases of menisectomy interventions done in Albania from 1985-2005, showed that from 168 cases that excepted to take part in his study 141 (83.9%) were male and 27 (16.1%) females having a report of 5.2:1. The average age of the patients having an operation of meniscus in Albania is 28.78± 9.59 years old.

Males aged between 20-29 years old were the largest group that had an operation of meniscus. This is connected with the fact that males in this age have high physical activity. From the study resulted that patients were followed 7 to 27 after the operation. This fact is in contradiction with the information given from the actual head of orthopaedic department in the Military Hospital, who claimed in the interview that one of the problems that the doctors have is that patients after the operation do not come for controls.

The largest number of operations done in the knee was of the medial meniscus of the right knee. From 168 patients participating the study, 91 of them (54.1%) had operated the right knee and 73 (43.5%) of them had operated the left knee and 4 patients (2.4%) had done meniscetomy in both knees. Medial meniscus was operated more than the lateral one having a report of 3.1:1, medial meniscus operation was 72.6% of cases and lateral one 20.8% of all cases. Only 7 (4.2%) patients had bilateral meniscectomy in the same knee articulation and 4 (2.4%) of patients. The period from the first symptom identified from the patient till the operation is called the latent period and there is a significant connection between the postoperative symptoms and the latent period. If the patients had the latent period less than one month, the prognosis was very good comparing to the others, having longer latent period than one month.

Sport was another factor that was analyzed. It was found that 69 patients (41.1%) played sports before meniscus operation. After menisectomy 19 of these patients (18.8%) couldn’t play anymore any kind of sport because of pain and 50 patients (81.2%) restarted their sport activity.

In Albania the most frequent type of meniscus tear is bucket-handle tear with 33.9% of cases, followed by frayed edged tear 17.3% of cases, complex tear 17.9% of cases, tear of anterior and posterior part 11.9% each and the last parrot-break tear with 7.1% of cases. Nowadays total meniscectomy is not the only way that the tears of menisci are repaired. Comparing to 20 years ago the number of total meniscectomy is decreased of 40 %. Best prognoses were found in patients who had partial meniscectomy.

From the radiologic controls it was found that after the menisci surgery 60% of patients had arthritis, 28% had a high risk of it and only a little number didn't show any sign of arthritis. It should be emphasized that there is a close relation between the age the patient was operated, patients activity before and after the operation and type of operation the patient had. The results of the study showed that the worse prognosis had patients, that were those older than 40 years old, who had a high physical activity, chronically traumas, longer latent phase, complex tears, total meniscectomy. Only 3.5% of all patients changed work after menisectomy.

Comparing all the materials analyzed in this thesis, gathered from different studies done in USA it also resulted that the most affected age was in active young people between 25-45 years old (Brindle, 2001). The most frequently damaged was also medial menisci rather than the lateral one with a report of 2.5: 1 for medial menisci damage (Joseph, 2009). The most frequent intervention was partial meniscectomy rather than total meniscectomy, which lead worse prognosis concerning higher risk of osteoarthrosis and knee instabilisation with higher risk of chronic traumas (Williams, 2001).

The main aim of this thesis was to compare the difference between the rehabilitation program followed after the knee menisci surgery in USA and Albania. Comparing the rehabilitation after the menisci operation in these two states was not easy. To find a standard rehabilitation program followed after the surgery of the knee menisci in USA, I was based in the standard guideline from American Academy of Orthopaedic Surgeons.

Factors like lack of standard guidelines in Albania, lack of medical journals, studies, specific literature for the topic presented in this thesis, headed me to search information needed from interviews I made or exchanging emails with doctors and physiotherapists, working in different Albanian state and private hospitals. Another source of information that I was based on during my thesis, was my own experience working even in the Military Hospital in Albania, and in private clinic.

An interview was taken to Dr.Manushaqe Saraci (Saraci, 2013), head of the only physiotherapy department in Albania, part of the Military Hospital in Tirana. Dr.Saraci was asked about the rehabilitation program that patients follow after having a menisci surgery. Patients after menisci surgery stayed only 3 days in hospital following a simple rehabilitation program and then some of them didn't continued the rehabilitation program as soon as they started to walk independently even painful. Others, mostly patients who played sports, choose private physical therapist to follow them home or in their private rehabilitation clinics. So to the question about exact number of patients having a full rehabilitation program after menisci surgery in the state Military Hospital, a not statistical answer was given.

Dr.Saraci in her interview (Saraci, 2013) said that the physiotherapy department in Military Hospital in Tirana, uses a rehabilitation program followed by patients after the operation of the knee menisci. In the first postoperative day the patient was instructed how to care about the wound, loosen bandage if swelling of the foot and ankle occur. The surgical dressing was removed three days after the operative day. Ice therapy begins directly after the surgery using ice packs every 3hours. Patients were instructed to keep elevated the operated leg and not to place pillows under the knees in order not to flex or bent the knee. The pillows could be placed only under foot or ankle. Due to the culture bases it is very difficult for doctors and physical therapist to persuade Albanian patients not to bear more than 50% of patient's weight on the operative leg unless it is instructed by the doctor. As soon as they feel less pain or have the feeling that they can walk independently, they start not to use crutches and don't respect the instructions given to them. In lots of cases, they perform squats more than 90 degrees, sit or lie in the bed without elevated leg or walk for a prolonged time causing further problems and not allowing going further with the rehabilitation program.

Exercise started second post-operative day. Exercises (straight leg raises, quad sets, heel slides, and ankle pumps) are of low intensity and without a lot of repetitions, unless otherwise is instructed from the doctor. The exercises were assisted once by the physical therapist in the first three days. The patient is instructed to repeat the exercises twice alone. The patient is asked to perform as much as possible ankle pumps during the day to reduce any possibility of having blood clot in the calf. The patient should not feel unbearable pain, painful swelling or numbness of the leg, should not have fever, and color changes in the leg, continuous drainage or bleeding from incision, difficulty in breathing, excessive vomiting. In all these cases the rehabilitation program is interrupted and the doctor was contacted.

Concerning physiotherapy department in the Military Hospital in Tirana a rehabilitation program after menisci surgery is followed having as purpose to strengthen the muscles that help knee stability. This was what I was told, but the reality was different. The post-surgical rehabilitation protocol after the knee menisci was not always respected from the patients and from the physiotherapist. Mainly the patients did come easy exercises to keep the operated leg active and some active movements of the operated leg without any specific aim.

Many studies led to the conclusion that surgery induces more often the development of post-operative degenerative conditions, if not correctly connected to a specific rehabilitation protocol (Frizziero, 2012). After my own experience in the state Military Hospital, observing the way the rehabilitation after the knee menisci surgery was performed, I come to the conclusion that a high percent of patients experiencing menisci damage in Albania will suffer from degenerative and knee instability complications, as a result of a non-effective rehabilitation program.

Knee instability is a very important factor that should be specifically accentuated during post-surgical rehabilitation protocols. Patients with knee OA report knee instability during daily living activities that directly affect their physical functions. Knee pain, decrease of the knee range of motion, loss of quadriceps strength are believed to have a reciprocal connection to OA contributing to physical functional limitation and progression of the menisci lesion. The physical function is also limited by swelling, pain, decreasment of the range of motion of the knee, tonus and coordination of the quadriceps femoris muscle.

From an interview taken from Dr. Arben Runa (Runa, 2013), head of surgery department in the Military Hospital in Albania, it is reported a low number of patients getting re-operated in the state hospital in Tirana. There are no exact number registered in the state hospital, due to the fact that the patients having a second surgery in the menisci choose private hospitals in Tirana, than state ones. During the last year the state Military Hospital does only open meniscectomies, and all the arthroscopic intervention are made in private hospitals.

Another problem raised from the Dr. Runa was that patients don’t visit the doctor or physical therapist for post-operative visits.

Comparing the guidelines from AAOS (AAOS, 2010) and Albanian State Military Hospital there are no theoretical differences in the rehabilitation protocol and exercises given to the patient after an operation of the knee menisci. The main difference is the fact that from my personal experience in Albania the rehabilitation protocol is not followed rigorously from the patients and physical therapist. The rehabilitation process unfortunately is not taken seriously even from doctors, physiotherapist and patients. All the elements of this triangle see the rehabilitation program as a form of financial profit. The patients do not take the proper rehabilitation care needed and the rehabilitation ends as soon as they leave the hospital, unless they decide to follow rehabilitation after operation of the knee menisci in a private clinic.

I have mentioned in my work that in Albania the patient pays each health service privately even though he pays the Health Care Insurance. So if he needs to get operated he pays money to all the operative staff starting from the surgeon to the nurse. Each injection he takes needs private "secret" payment to the nurse, so that's why I have mentioned that it is in our culture that as soon as the Albanian patient feels less pain and could even make one step alone, he has the tendency to push himself to the limits so he doesn't need to stay longer in the hospital and pay lot of money each day.

The economic situation is in a very irregular report. The average of an employee in Albania is around 200 euros per month. The physical therapist in Albania takes around 20 euros per therapeutic session. Approximately a patient after the menisci operation needs to be followed by a physical therapist at least 3 months, not to mention continuous exercise the patient should do as a preventive form of other injuries. Doing some easy calculations only in the first week the patient should pay twice per day 20 euros multiplicities seven days, it is 40euros x 7 days = 280 euro(all these not counting the money paid to nurses, sanitarians etc.). So the main thing multidisciplinary cooperation between the hospital staff and the patient completely misses. Even if the physical therapist goes and asks the doctor about the further proceed of the rehabilitation program, the answer the physical therapist takes is: do as you wish. So everybody does how he wishes.

In the state hospitals there is a total absence of means that help the patient to rehabilitate after a knee menisci surgery. All the patients who need to get a proper rehabilitation program after the knee menisci, including proprioceptive, balance exercises, strengthening exercises, stimulation of the sensor-motoric system or even physical therapy,

prefer to follow rehabilitation program in private clinics, where they could find all the facilities needed.

In the end, I cannot leave apart that a crucial role in the level of rehabilitation that patients get after the operation of the knee menisci is the level of professional education Albanian physiotherapist have.

I would like to conclude that post-surgical rehabilitation of the knee menisci in Albania is insufficient, due to economic and cultural factors present in Albania.

9 Conclusion

Comparing the guidelines of American Academy of Orthopaedic Surgons (AAOS) and the ones followed from the Physiotherapy Department near the Military Hospital in Albania, private hospital “American Hospital” in Tirana and private clinics, many differences were found out, concerning the level of rehabilitation and the health care the patients take after menisci surgery.

Economical factor is one reason that patients can’t afford to follow a long lasting rehabilitation program after the operation of a knee menisci. The lack of proper operation of the Health Insurance System in Albania, making the patients pay each health care themselves, is a restrictive factor in providing efficient rehabilitation care. In Albania is very necessary a complete renovation of the health care system so the patients do not need to pay about everything. This might be one of the most important reasons why the patients are not motivated to invest in their health even as a form of prevention, because everything costs so much comparing to their economic potential.

Therefore cultural factor also has its own impact. The patients tend not to follow full rehabilitation program after menisci surgery, and interrupt the program as soon as they start to walk independently taking the risk of further damages.

Another factor that should be pointed out is the professional level of Albanian physiotherapists.

Rehabilitation in Albania is in its beginnings and lots of improvements need to be done starting from a strict and serious work from the part of doctors, physiotherapists and universities graduating not qualified future physiotherapist.

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