CHARLES UNIVERSITY

FACULTY OF PHYSICAL EDUCATION AND SPORTS

Department of Physiotherapy

Case study of physiotherapy treatment of a patient with diagnosis of bilateral gonarthrosis – grade 3, with varus deformity of the right knee

Bachelor's thesis

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Abstract

Title: Case study of physiotherapy treatment of a patient with diagnosis of bilateral gonarthrosis – grade 3, with varus deformity of the right knee

Thesis aim: The aim of this thesis is to initially review the anatomy, kinesiology, and biomechanics underlying the patient's condition demonstrate and then analyze and evaluate the therapeutic units that were provided.

Clinical findings: This study was evaluating the state of a 72-year-old patient with the main diagnosis of bilateral gonarthrosis and additional conditions as shoulder pain and ankles stiffness. The assessment showed reduced mobility and joint play with differentiation in the condition of the muscles as well as misalignment of the knee joint. There was deformity of the right ankle joint and bilateral stiffness. The shoulder joint has been painful with decreased mobility and muscle impairments.

Methods: All the used procedures were based on the literature given thought by the Charles University in Prague, Faculty of Physical Education and Sports.

Result: Following 14 therapeutic sessions for all three problematic areas, the patient underwent great progress in terms of pain, range of motion and muscle imbalance in the shoulder and knee joints, and moderate progress in the ankle joints.

Conclusion: The therapies that were performed were effective in this concrete diagnosis of the patient.

Keywords: Gonarthrosis, Osteoarthritis, Knee joint, Varus deformity, Shoulder joint, Shoulder pain, Ankle stiffness

Abstrakt

Název: Kazuistika fyzioterapeutické péče o pacienta s diagnózou bilaterální gonartróza třetího stupně s varózní deformitou pravého kolene

Cílem práce: Cílem této práce je nejprve rešerše anatomie, kineziologie a biomechaniky ve vztahu k obtížím pacienta a následně analyzovat a vyhodnotit terapeutické jednotky, které mu byly poskytnuty.

Klinické podklady: Tato studie se zabývala hodnocením stavu 72-letého pacienta s hlavní diagnózou oboustranné gonartrózy a dalších nálezů, jako jsou bolesti ramen a tuhost kotníků. Hodnocení prokázalo sníženou pohyblivost kolenních kloubů spolu s četnými svalovými dysbalancemi a špatným postavením pravého kolenního kloubu. Dále byla zjištěna deformita pravého kotníku a bilaterální ztuhlost. Ramenní kloub byl bolestivý se sníženou mobilitou a svalovým postižením.

Metodika: Všechny použité postupy byly založeny na odborné literatuře Univerzity Karlovy v Praze, Fakulty tělesné výchovy a sportu.

Výsledek: Po 14 terapeutických sezení pacient vykázal velký pokrok ve všech třech problémových oblastech, zejména pokud jde o bolest, rozsah pohybu a svalové nerovnováhy v okolí ramenních a kolenních kloubů a pokrok v oblasti hlezenních kloubů.

Závěr: Terapie, které byly provedeny, byly v případě tohoto konkrétního pacienta s danou diagnózou účinné.

Klíčová slova: gonartróza, osteoartritida, kolenní kloub, varózní deformita, ramenní kloub, bolest ramene, ztuhlost hlezenního kloubu

Declaration

I hereby declare that this work is entirely individually my myself. I also state that all the information, examination and therapeutic procedures, which are presented in this dissertation, were based on my knowledge that I received from the professors of the Charles University in Prague at FTVS. The information that I used to write this bachelor thesis was sourced from the list of literature, which exists at the end of the thesis

I declare that no invasive methods were used during the practical approach and that the patient was fully aware of the procedures at any given time.

Prague, April 2017 **Sophia Tzioni**

Acknowledgement

I would like to show my great appreciation to my professors for educating and helping me during my studies. I would like also to thank my great supervisor PhDr. Lenka Satrapova, Ph.D., for guiding me through my bachelor thesis and supervision.

Special thanks to my beloved Oliver who stood by me and gave me strength, and being the reason I smile every day.

Dedication

There are a number of people without whom this thesis might not have been written I dedicate this dissertation to my mother, whom I love indefinitely and whatever I would write cannot express how thankful I am to her, to my father, who taught me how to be independent, to my two brothers Andreas and Michalis, who are the greatest brothers that I could have, and to my grandparents.

This thesis specially dedicated to my grandmother, Sofia, who even that she passed away, she is still my greatest inspiration.

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1 Introduction

My bachelor practice took place in FNKV - Kliniky rehabilitačního lékařství in Prague. This practice started on Monday 23rd of January 2017 and ended on Friday 3rd of February 2017.

The case study of physiotherapy treatment that I chose was for a patient with the main diagnosis of bilateral knee arthritis. The patient had with me 14 sessions of physiotherapy to improve his overall condition. On the first day 24/01/2017, we had just afternoon session because during the morning we took the anamnesis and did the examination of the patient. As well as the first day, on the last day 03/02/2017, we didn't do any therapy because we took the time to do our final kinesiologic examination.

The thesis is divided into three parts. Theoretical parts describe the anatomy, kinesiology, and biomechanics of the two main problematic areas as well as special chapter that includes the clinical presentation, pathogenesis, and intervention of the impaired joint. In the practical part, I analyzed every procedure I have done with my patient, all the examinations, conclusions, therapies, results, goals, and evaluation of the effect of the therapy are mentioned.

2 Knee Joint

The knee joint is the largest joint of the body and the most complex one. It is supported and kept in place completely by muscular and ligamentous tissues and due to the exclusive soft tissue support, it is regularly a subject of stress and strains. Anatomy, Kinesiology, Biomechanics and some Pathologies and Traumatology of the knee joints are described below [11].

1.1 Anatomy of the Knee joint

Primarily this joint can be considered as a hinge joint but because the hinge motion is uniaxial it is modified as synovial hinge joint [25].

2.1.1 Bony structures

Femur, tibia, and patella are the three bones that are forming this joint. As long bones we consider femur and tibia. Patella, or knee cap, is classified as sesamoid bone and is placed ventrally of the joint and is located on the quadriceps tendon which ends on the anterior surface of last bone of the knee which is the tibia bone [11].

The femur is the longest heaviest and strongest bone in the human body and it is also considered as the thigh bone. At the proximal end, it articulates with the pelvis. At the distal end there exist joint the medial and lateral condyles of the femur which are part of the joint.

The tibia or shin bone is responsible for the weight bearing. At the proximal end of the bone, there are located the medial and lateral condyles of the tibia with the depressed area between to be called intercondylar fossa. Laterally, starting inferiorly of the lateral condyle, the bone articulates with fibula and at the distal end articulates with talus [11, 25]

2.1.2 Joint Articulations

The knee joint is composed of three different locations of articulations. Initially, the medial condyle of the femur articulates with the medial meniscus and the medial condyle of tibia and all together they create a tibiofemoral joint. The second articulation is again tibiofemoral, but this time is between the lateral condyle of femur the lateral meniscus and the lateral condyle of the tibia. The intermediate patellofemoral joint is between the patellar surface of the femur and the small triangular bone, patella [11].

2.1.3 Articular Components

All joints to be better stabilized except bony and muscular support, they are maintained by capsule and ligaments and some of them also involve discs and bursae. However, because the knee joint is not supported by any bony structures it has a lot of ligaments and muscles or/and tendons [25].

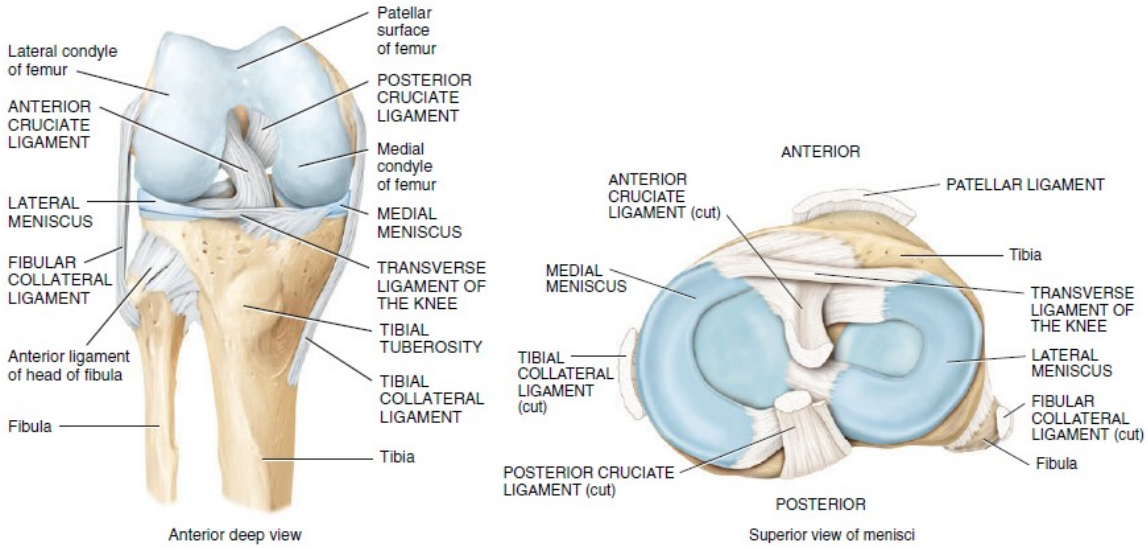


Figure 1: The knee joint articulation components [11].

2.1.3.1 *Capsule*

Articular capsule: Is a dual-layer sheath enclosing the joint. Though it is not indented, because excluding the small amount capsular fibers, it is surrounded by many

ligaments and tendons that are united with the other fibers and they are crossing the joint [11, 25].

2.1.3.2 *Ligaments*

Patellar ligament: As an extension of the quadriceps or patellar tendon the ligament is strengthening the anterior surface of the joint [25].

Popliteal ligaments: To support the posterior surface of the joint there are two popliteal ligaments. The broad flat Oblique ligament arises from the intercondylar fossa and lateral condyle and extends to the medial condyle of the tibia. The Arcuate popliteal ligament arises also from the lateral condyle of the femur but this one finishes on the fibular head. This ligament supports more the postero-lateral side [26, 27].

Collateral ligaments: Tibial and Fibular collateral ligaments exist to enhance the medial and lateral stability of the joint. The tibial ligament is flat, in contrast with the rounded fibular, and it extends from medial condyle of femur to the medial condyle of the fibula and it is attached on the medial meniscus. The fibular collateral ligament is arising from the lateral condyle of femur to the head of the fibula. Muscles that are crossing the knee joint are covering or are fused with the corresponding side's ligament [11, 26].

Intracapsular ligaments: Connection of femur and tibia within the capsule is achieved by the anterior and posterior cruciate ligaments and they cross on their way to the femur. The Anterior Cruciate Ligament (ACL) origins from the posterior part of the medial surface of the lateral condyle of the femur, to anteriorly of the intercondylar area of the tibia. The direction of the ligament is postero-lateral, prevents the sliding of tibia anteriorly and limits the hyperextension. The Posterior Cruciate Ligament (PCL) arises from a depressed point of the posterior intercondylar area of the tibia to tibia and lateral meniscus and inserts anteriorly of the lateral surface of a medial condyle of the femur. PCL extends anteromedially and prevents sliding of tibia posteriorly [11].

2.1.3.3 *Menisci*

Meniscal structures are two semicircular fibrocartilage discs, in the space between tibia and fibula and help with the compensation of the asymmetrical and misshapen bones

additionally with circulating the synovial fluid. Both are inserted on facets of the tibial plateau in the intercondylar area.

Medial Meniscus: A C-shape disc arises from the anterior intercondylar fossa and extends to the posterior intercondylar fossa of the tibia.

Lateral Meniscus: This disc in nearly circular but it is not completed. It is attached anteriorly and posteriorly of the intercondylar eminence of the tibia.

The menisci are connected anteriorly with the transverse ligament of the knee and by the coronary ligaments to the edges of the tibial head. One of their functions is to absorb the loading stresses of the body [11, 26, 27].

2.1.3.4 *Bursae*

There are many bursae in the joint. Those synovial membranes include the subpopliteal recess, infrapatellar bursa, the suprapatellar bursa, the infrapatellar bursa and the subcutaneous prepatellar bursa as well as other bursa associated with tendons and ligamentous tissues that are surrounding the joints [11].

2.1.4 Muscles Anatomy, Innervation, and Function

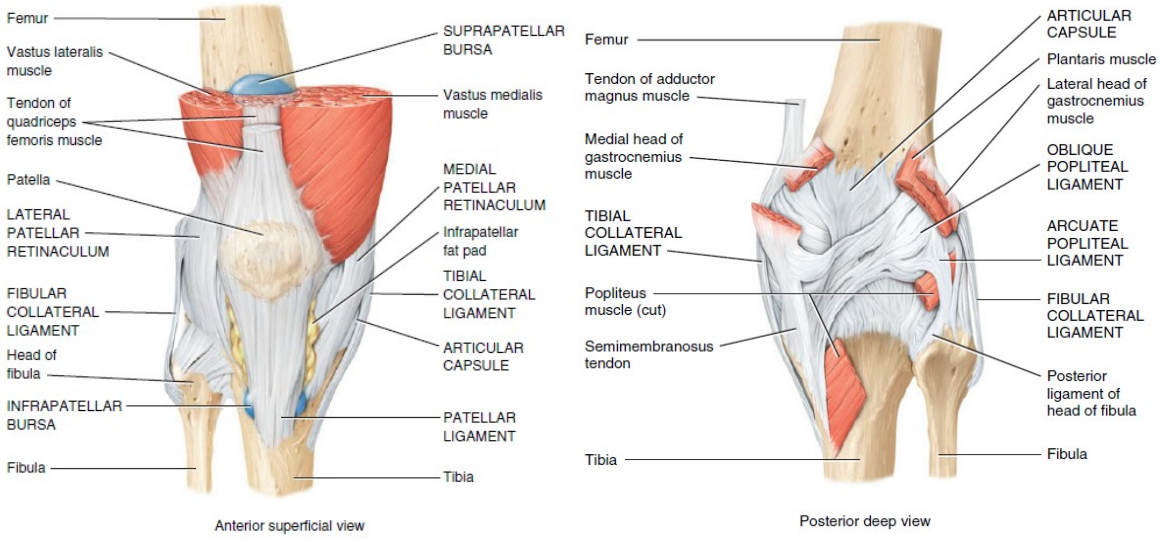


Figure 2: Muscle's attachments and articulation components [11].

Muscle	Origin	Insertion	Innervation	Action
Rectus Femoris	Anterior inferior iliac spine	Tibial tuberosity	Femoral nerve	Hip flexion, knee extension
Vastus Medialis	Medial lip of linea aspera	Tibial tuberosity	Femoral nerve	Knee extension
Vastus Lateralis	Lateral lip of linea aspera	Tibial tuberosity	Femoral nerve	Knee extension
Vastus Intermedius	Upper anterior femoral shaft	Tibial tuberosity	Femoral nerve	Knee extension
Biceps Femoris	Ischia tuberosity	Head of the fibula	Tibial portion of sciatic n.	Hip extension, knee flexion,
Semitendinosus	Ischia tuberosity	Pes anserinus	Tibial portion of sciatic n.	Hip extension, knee flexion,
Semimembranosus	Ischia tuberosity	Tibial medial condyle	Tibial portion of sciatic n.	Hip extension, knee flexion,
Sartorius	ASIS	Tibial proximal medial surface	Femoral nerve	Hip flex, ABD, ER, knee flex
Gracilis	Body & inferior ramus of pubis	Tibial proximal medial surface	Obturator nerve	Hip flex, ADD, knee flexion

Gastrocnemius	Medial/Lateral femoral condyle	Calcaneal tuberosity	Tibial nerve	Knee flexion, plantar flexion
Popliteus	Lateral femoral condyle	Posterior proximal tibia	Tibial nerve	Initiates knee flexion

Table 1: Muscle anatomy, innervation, and function [26].

1.2 Kinesiology of the Knee Joint

Even if the knee joint is a very complex of the human body, because of the almost hinge joint structure that it has, it is movable mostly in the frontal plane and just slightly in the transverse plane. Due to this small degree of internal and external rotation, some authors refer to it as trochoginglymus joint. Moreover, because of the bicondylar structure that it has, it can be also described as "double condyloid" [27].

2.1.5 Osteokinematics of the Knee Joint

The knee joint has two degrees of freedom. The first one is flexion and extension without any side to side motions like abduction and adduction, and it is performed in the sagittal plane. This sagittal motion can physiologically reach 135-0-0 (SFTR form) according to the American Academy of Orthopedic Surgeons (AAOS). The axis of this motion is not fixed relocates within the femoral condyles. Many authors describe slightly different ROM. A minor degree of hyperextension can be considered as physiological and again it depends on the source the amount of this normal hyperextension. Usually, 5 degrees is not considered as pathological. An amount of 10 or more degrees of hyperextension is not usual and it can be a sign of pathology [27].

The second degree of freedom is the internal and external rotation, which can be examined with the knee in minimal flexion. It is also called axial rotation as the axis of this motion is longitudinal. The amount of the rotation depends on the knee flexion. When the joint is straight or at full extension, then there is a maximal restriction of rotation, because of the blocking apparatus of the ligaments and higher bone congruity. However, when the knee is in 90 degrees of flexion, the rotation can reach 40 to 45 degrees with the external to

lead the motion in a ratio of 2:1 in comparison with internal rotation. The mechanism of the rotation can be either femoro-tibial or tibio-femoral and the determination of those is according to which bones are stationary and which is movable [27].

2.1.6 Arthrokinematics of the Knee Joint

In the knee joint, there are existing three types of arthrokinematics which are used during the movement of the joint in flexion, extension, internal and external rotations. Those arthrokinematic types are: gliding, rolling and spinning. With the same mechanism with rotation, the knee extension can be achieved also by tibial-on-femoral extension and femoral-on-tibial extension, again according to which bone is moving and which is stable. When the extension is performed the convex condyles of the femur are moving against the concave condyles of the tibia or vice versa. During tibial-on-femoral extensions, there is rolling and anterior sliding of the tibia on the articular surface of the femur. Moreover, meniscal cartilages are pulled anteriorly by quadriceps [25, 27].

Throughout the femoral-on-tibial motion, the mechanism is different. While extending the condyles of the femur are rolling anteriorly and gliding posteriorly. The meniscus is stabilized anteriorly by quadriceps. During the last degrees of the close chain motion - weight bearing - in extension, the femur slightly rotates on the tibia. Antithetical, while we are performing non-weight bearing extending motion the tibia rotates laterally on the femur. This rotation is a result of the bigger articular surface of the medial condyle of the femur. Because it extends more anteriorly the tibia is forced to follow [27].

When the joint reaches the last degrees of the extending motion the locking mechanism or “screw home”, as it is called, occurs. This helps our body to stand for a long time without using muscles. The initiation degree of the knee locking depends on the literature and it is usually between last 30 to 10 degrees of extension. The combination of lateral rotation and extension increases the stability of the contact area of the tibiofemoral joint is maximized. To unlock the joint the femur needs to rotate on tibia or vice versa [28].

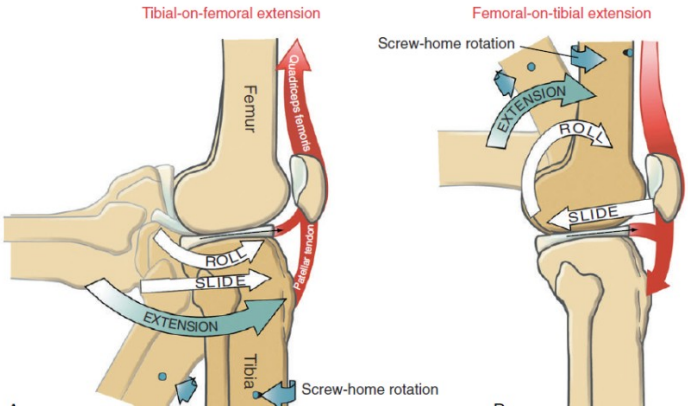


Figure 3: The active arthrokinematics of knee extension [27].

2.1.7 Functional Movement Ranges of the Knee Joint

Some of the ADL activities are using more ROM and some less. In our daily live we are not using the whole ROM of our lower limbs. Some examples for the sagittal motion of the knee are walking which uses 0-67 degrees, climbing stairs which use 0-83 degrees, going down the stairs uses 0-90 degrees (always depending on the height of the stairs), sitting on a chair uses 0-93 degrees (height of the chair is a factor as well), tying a shoe uses 0-106 degrees and lifting an object from the floor uses 0-117 degrees [29].

1.3 Biomechanics of the Knee Joint

2.1.8 Mechanical Loads

As it is described before the almost hinge joint has an upper convex surface and a lower concave one. Is an essential weight bearing joint and it has a large potential for torque development because it is positioned between the two longest bony levers [30].

The contact compression plays an essential role to the mechanical forces that are stressing the joint and they are proportional to the magnitude of the load as well as reciprocal proportional to the weight impact surfaces. In articulated models, the maximal stress in the center and the center distribution depends on the line of the load [30]. The forces that are acting on the joint under loading are compression and shear. In the muscles, the weight bearing and the tension force are increasing with the compression while

standing with knees extended. This compression has been counted as more than three times the body weight during gait stance phase and four times the body weight during stair climbing [31].

Meniscal cartilages have a major absorbing role of the knee forces. Their responsibility is to distribute the loads and reduce the magnitude of the stress to protect the articulation cartilages from damaging. Since they have such an essential role, it is not weird that people that have undergone meniscectomy operation have a higher risk of damage their cartilages [34].

As it is already described the medial plateau of the tibia bone has 60% greater surface area than the lateral one. Additionally to the area, even if the loads are more on the medial side, it has three times thicker articulation cartilage in comparison with the lateral ones, which helps to prevent the wear of them. [31] As the flexion of the knee joint approaching 90 degrees, the shear force, that is produced by the weight-bearing, in increasing as well. This shearing impact is forcing the femur to move anteriorly, and the ligaments are restricting. If the impact is extremely high the supporting structures that are holding the knee can be overstretched or ruptured. This excessive stress can appear to severe knee flexion like in deep or fully squads [32].

2.1.9 Varus and Valgus misalignments

This conditions can be congenital or because of muscular imbalance and can occur not only in knee joint but in other joints as well. Those two terms are defined by the American Academy of Orthopedic Surgeons as “Valgus: Angulation of a distal bone away from the midline in relation to its proximal partner. Genu valgum is a knock-knee deformity, with the abduction of the tibia in relation to the femur” and “Varus: Angulation of a distal bone toward the midline in relation to its proximal partner. Genu varum is a bowleg deformity, with adduction of the tibia in relation to the femur” [33].

The physiological angle of valgosity in the knee joint is 13-19 degrees. This is measured by the Q angle or patella-femoral angle. The angle is formed by drawing a line from ASIS to the center of the patella for the quadriceps muscle and a line from tibial

tuberosity to the center of patella again for patellar tendon. Women have a tendency for greater angle because they have wider pelvis [25].

From the biomechanical point of view, it can cause additional tensile stress on the stretched side. In the case of genu valgum condition there is higher tension on the medial side of the knee and in the case of genu varum, there is higher tension on the lateral side of the knee and a greater risk of developing iliotibial band friction syndrome. While a patient with misalignment is walking, the compressive forces of the knee joint are 2-3 times the body weight, and while performing other activities, like running or stair-climbing, this additional compression increases to 5-6 times the body weight [30].

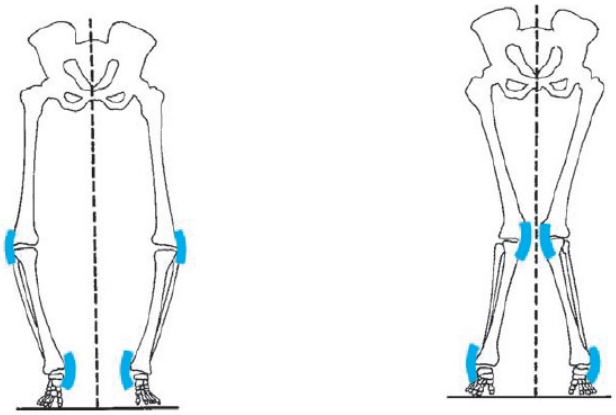


Figure 4: Varus & Valgus alignments with the strain areas highlighted [30].

2.1.10 Foot Pressure Distribution

In a research that was done in Japan, they were analyzing the foot pressure distribution in patients with gonarthrosis. When there is a deformity or misalignment at the knee joint consequently there will be differentiation in the alignment of the subtalar joint to supination or pronation. The research was more focused on mid stance, terminal stance, and pre-swing phases. After dividing the subjects into groups: group1-valgus deformity, group2-normal alignment, and group3-varus deformity, they started measuring [24].

Initially the supination and pronation index of the subjects which shows the percentage of the center of pressure (COP) from the medial edge of the foot in valgosity and from the lateral edge in varosity and classified them into four types. Following, they measured the foot pressure distribution of the point of the metatarsal head and divide the

results according to the system of Dr. Sakamoto into five types. The results showed that the group1 had the tendency to be on the medial and group3 to the lateral [24].

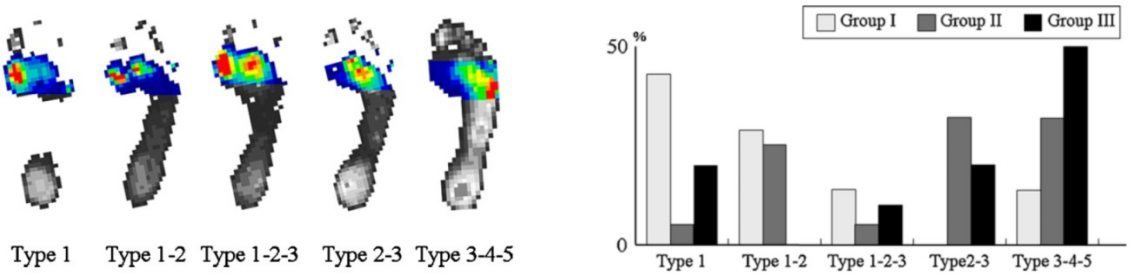


Figure 5: Classification and analyzing of foot pressure distribution [24].

They finished by assessing the passing point of the COP at the toe and dividing it into four types. Again the results were similar, as the group1 had the tendency to pass through the great toe and therefore medially, and group3 through the second toe [24].

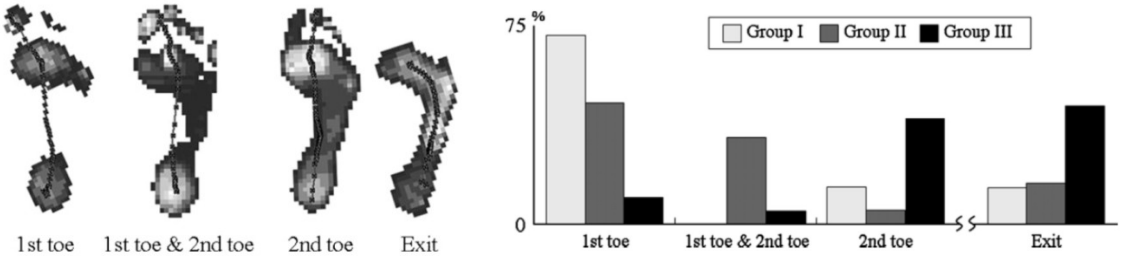


Figure 6: Classification and analyzing of passage point of COP at the toe [24].

2.1.11 Traumatology and trauma mechanisms

The location and structure in collaboration with the weight bearing and locomotion functions increase the chances of damaging its structures, and this is even more worsening when sports are involved as well. Usually the mechanisms of traumatizing this joint involve soft tissue stretching or tearing from the opposite side of the force impact. Below are described briefly some injuries' mechanisms [30].

2.1.11.1 *Ligament injuries*

Like it is said above the ligamentous structures are tearing when a force is coming from the opposite direction: the ACL damages result from posterior direction impact, the PCL damage from anterior direction impact and force from one side will result in injury to

the other's side ligament. Medial collateral rupture is much more common than the lateral one because the medial side is protected by the other leg. While skiing, a common way of damaging your knee can be when the ski ends in snow and the skier is falls [30].

2.1.11.2 *Meniscal injuries*

The damaging of the meniscus is the most common knee injury. Due to the attachment of the medial meniscus to the medial collateral ligament, ligament injury can simultaneous lead to a meniscal injury. Usually this type of damaging results when the foot is fixed on the ground holding the weight of the body which performs rotatory motion [30].

2.1.11.3 *Iliotibial band friction*

This can be considered as an overuse syndrome. One mechanism which leads to this condition is when the Tensor Fascia Latae muscle (TFL) by trying to stabilize the pelvis, while the knee is in weight bearing flexed position, the friction against the lateral condyle of the femur is increasing and produces tenderness in the lateral area of the knee. This is also called runner's knee [32]. Further, uncontrolled pronation of the food can cause medial rotation of the tibia and contribute to the occurrence of the syndrome. [33]

2.1.11.4 *Connection of the Injuries with the Knee OA*

Researchers have shown that injuries in the joint are related to osteoarthritis. Football players, who have decreased functionality of anterior cruciate ligament (ACL) or meniscus, will consequently have chronic switches in the loading of the knee. Those changes can provoke instability and degeneration of articular cartilage. OA in footballers is 5 to 12 times more frequent than in the general population. Also is diagnosed 4 to 5 years earlier. About 50% of partial or total meniscectomies have signs of gonarthrosis 5 to 20 years after the injury. Among former footballers, all players who had a meniscectomy show signs of OA 10 to 20 years after the operation, compared to 40% to those who had no meniscectomy [14]. In a study of patients with OA of the medial part of the knee they showed that there is higher incidence of iliotibial band friction syndrome because of the decreased medial joint space there was formation of varosity and consequently additional tension into the iliotibial band [40]

1.4 Special Chapter: Knee Osteoarthritis (OA)

2.1.12 Osteoarthritis

It is defined as a non-inflammatory disease that is described by the progressive dropping of joint articular cartilage that may provoke pain or deformities [4]. Osteoarthritis is classified into two different categories according to the cause. The first type is the primary or idiopathic which has no evident cause. Then is the secondary type in which the origin is more clearly defined predisposing pathology [5].

OA is affecting more the elderly population and is more prevalent in women than men. The disease can appear also in younger ages after an injury. The synovial joints are the ones that are getting progressively affecting and especially the weight-bearing joints. Additionally, with the degeneration of the cartilage's degeneration, there is the occurrence of spurs, osteophytes, a decrease of the joint space and secondary synovitis after progression of the disease. The evolution starts from the larger joints like hip and knee.

2.1.13 Gonarthrosis classification

The grading of the progression of the disorder is usually with the assistance of the radiographic images. Kellgren and Lawrence system is classifying osteoarthritis of the knee.

- Grade0: No changes.
- Grade1: Doubtful narrowing, possible osteophytes.
- Grade2: Definite osteophyte and possible narrowing.
- Grade3: Moderate multiple osteophytes, definite joint narrowing, some sclerosis and possible deformity of bone ends.
- Grade4: Large osteophytes, marked joint narrowing, severe sclerosis, and deformity.

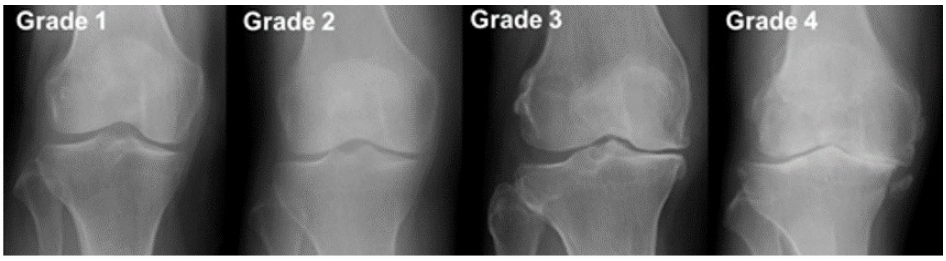


Figure 7: Kellgren & Lawrence's grading system [19].

2.1.14 Clinical presentation

OA is a disorder with usually similar dysfunctions of the body in most of the patients. The main feature is the pain of the affected joints. This pain is usually described as dull and ill. The feeling is deep in the area of the articulation and is commonly persisting at rest and at night due to the disappearing of the protective muscle splinting mechanism. In patients with not that much progression of the disease, the pain can get aggravated when is used and it relieves during resting. In advanced cases, it can be constant. Pain is mostly caused by osteophytes, micro fractures, synovitis and other but is not leading from the articular cartilage e nerve endings because of there no nerve endings and consequently no nociceptors there to provoke the pain [4].

Morning stiffness is being often noticeable and it lasts less than an hour. Moreover, patients with OA usually are experiencing decreased range of motion, muscle spasms, and contractures, asymmetric joint narrowing, subchondral bony sclerosis, subchondral bone cyst after leakage of synovial fluid and mechanical blockages that can result from osteophytes, spurs or loose bodies in the joint [4,8].

In a research of diagnosed patients with gonarthrosis (170 men / 488 women) and average age 55.5 years they self-reported pain and clinical symptoms. Female patients reported more frequent symptoms and there was a higher rate of pain while going upstairs and while squatting. In Table 2 there is the prevalence of gonarthrosis of the mentioned research [9].

	Women (n; %)	Men (n; %)
Pain during movement	185 (37.9)	27 (15.9)
Pain when going upstairs	204 (41.8)	34 (20.0)
Pain when squatting	196 (40.2)	19 (11.2)
Pain at rest	43 (8.8)	8 (4.7)
Bony tenderness	11 (2.3)	1 (0.6)
Bony enlargement	40 (8.2)	4 (2.4)
Crepitus	186 (38.1)	29 (17.1)
Stiffness < 30 minutes	86 (17.6)	12 (7.1)
Deformity	21 (4.3)	3 (1.8)
Any symptom/pain	304 (62.3)	59 (34.7)

Table 2: Self-reported pain and symptoms [9].

2.1.15 Risk factors

Even if the real cause is still unknown there are some factors that are increasing the risk of OA occurrence and progression. The idiopathic OA develops from a combination of joint trauma, obesity, aging, irritation, reduction of muscles strength and "wear and tear". The secondary OA results from metabolic, physical, or chemical injuries to the articulation. Those can occur after some bone malformation, metabolic or endocrine diseases, neuropathies, etc. [9].

2.1.15.1 *Aging*

Aging is not the absolute reason of OA, however, with a long time of using the joints and loading them asymmetrically, there is usually wears out of the joints. Although, daily use protects and helps the joints and articular cartilages to upkeep their condition rather than provoke erosion. Insufficient usage of the joint leads to degeneration of the cartilages as it was described by Harrison et al [10].Throughout the lifetime the amount of the synovial fluid in the joints is reduced, as well as the production of it, with a result of decreased ability to absorb the shocks. The cartilages of the articulations get thinner and the ligaments loss amount of their flexibility. Moreover, genetics play a role in the progression of those processes and that's why is different from person to person [11].

Among patients aged between 40 to 70, Table 3 shows the percentage of those who were diagnosed with osteoarthritis. The research also differentiates men and women, with the second to lead the prevalence.

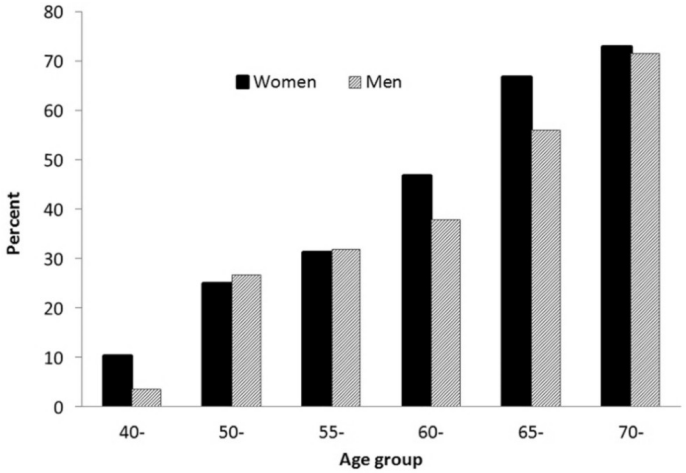


Table 3: Prevalence rate of diagnosed OA according to the age and gender [9].

2.1.15.2 *Abnormal loading*

Imbalance in the joint or asymmetric loading usually increases the risk of OA, as the overloaded place will get wear out and the progression of the degeneration will be faster. With the same mechanism, the body after a trauma or after a heavy manual labor, our body is changing its posture to adapt to the positions that we are forcing it to be and the position of the joints are not centralized any more with that to lead to shifting of the center of pressure (COP) of the joint. By overstressing the one side we are not just eroding the articular components but we are also changing the alignment of the joints [9].

Correspondingly, the obese people with 30 < BMI < 35 are at a higher risk of general OA, and their chances of developing gonarthrosis are four times higher than a healthy weight person according to Nuki G.(1999) [12].

In Table 4 there is the comparison of both genders and BMI. The study showed that as the BMI is increasing, the percentage of OA is also elevating, with the women again to be the leaders in most of the categories.

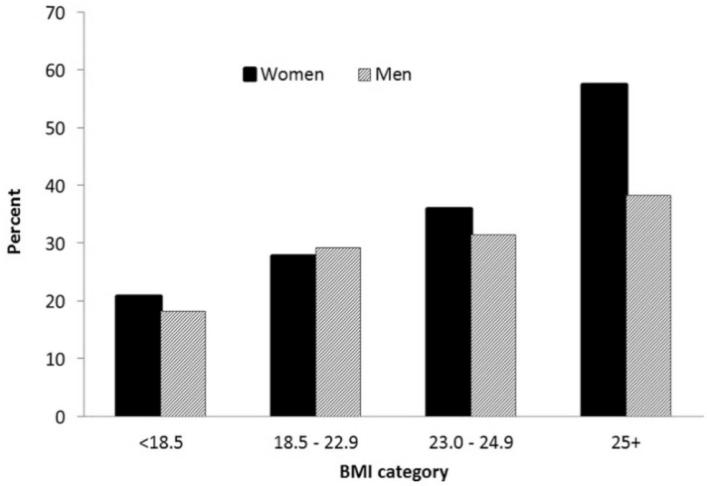


Table 4: Prevalence rate of people with OA in comparison with BMI [9].

Further, even if a joint is physiologically loaded, if the cartilages are in a pathological state (torn meniscus, osteophytes formation, etc.), there is also increased the risk of OA formation.

2.1.15.3 *Genetic factors*

In recent years there have been many studies to explain the genetic basis of OA, but until now the details of genetics are unknown. Known is that the disease is multifactorial and polygenetic, which means it occurs from the interaction of many genes [4].

2.1.16 Pathobiology

Articular cartilages are the center of progression of the OA disease. Generally, the pathological changes that occur in the joint are softening and focal decomposition of the cartilages of the articulation and the main complication is the inability of the articular cartilages to perform the shock absorption. To understand the degradation of the cartilages, the structure-function must be comprehended first [20].

Those cartilages are composed of a hydrated extracellular matrix which includes aggrecan, collagens, cells and some chondrocytes. Those chondrocytes contribute to the matrix degeneration. The aggrecan gel attracts water molecules through the aggragates and therefore it swells. This swelling provides tensile strength and stiffness. When the joint is

under loading, the matrix is getting under compression, so the water is forced out. The final step is regaining the prior form with the intrusion of water molecules [20].

When there is some trauma or inflammation of the synovium, there is releasing of some factors, from the subchondral bone and synovium, which provokes hyperactivity of the chondrocytes. Subsequently, the damaged program is activated and causes hypertrophy of chondrocytes. The activity of some enzymes cause inhibition of releasing aggrecan and degrade collagen and that leads to degeneration of the cartilage matrix and OA [4, 20].

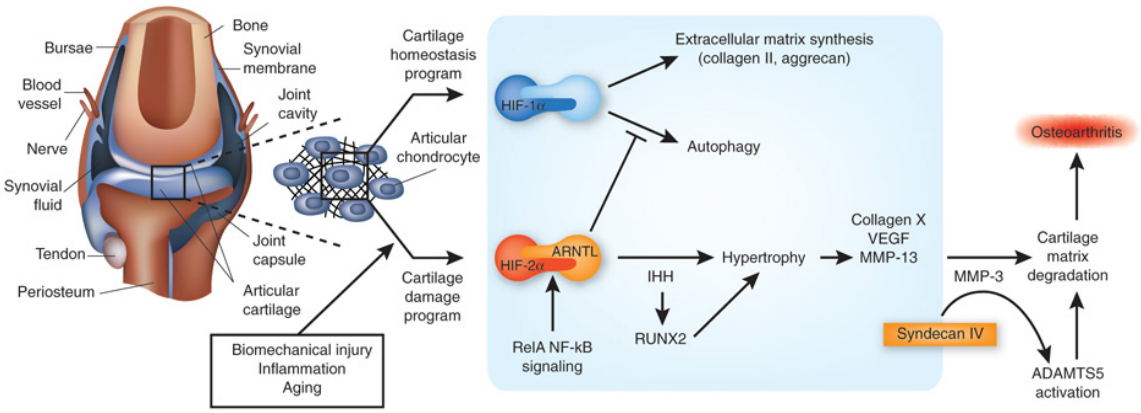


Figure 8: Cartilage matrix degeneration [20].

2.1.17 Structural changes

In people, without OA the joint space is filled with synovial fluid with lubricants. Although in osteoarthritic patients the lubricants are decreased and space narrows. More frictions occur in the joint and due to the narrowing. The subchondral bone thickens, becomes sclerotic and fragile. The formation of osteophytes at the margins that provoke pain and deformation of the joint is still unclear. Commonly they can be found at the periosteal junction and they are connected with inflammations as they cause activation of the synovium, which leads to synovitis. Regardless the pain, the inflammation and the limiting of the motion that they enhance, osteophytes can be considered as stabilizing structures. During standing and walking they distribute the biomechanical forces to prevent erratic movements. The inflammation of the synovium can be acute or chronic. It can also be the primary reason to initiate OA or the secondary result due to the cartilage breakdown.

Additionally, this inflammatory process cooperates to give rise to the symptoms of osteoarthritis like swelling of the joint, effusion and stiffness [4].

2.1.18 Diagnostic procedures

2.1.18.1 *Radiography*

The simplest and cheapest imaging diagnostic device. It is very effective to detect bony structures, like osteophytes, subchondral sclerosis, and cysts, and determine joint space. Although visualization is not possible and there is decreased the sensitivity of showing articular tissue damage. The rays travel and get absorbed by the tissues. The biggest absorption is in bones and this is why we have a clear image of them. Soft tissues as skin and organs cannot absorb and consequently the beams pass through them [15].

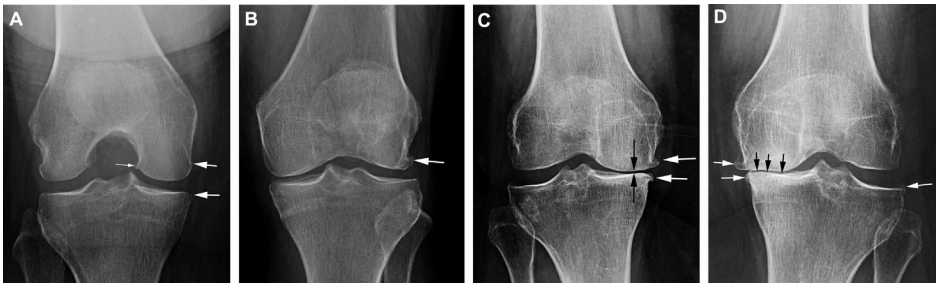
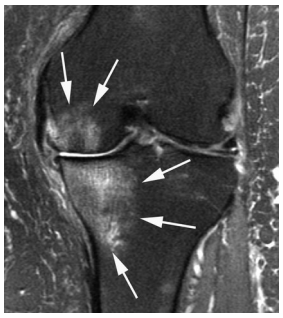


Figure 9: Example of the Kellgren-Lawrence classification system [15].

2.1.18.2 *MRI*

This is an expensive diagnostic method and it is less used in OA patients. It is a key imaging for research due to its ability to assess pathology in many structures. MRI is useful to detect bone marrow lesions and synovitis.

Simply say, this method is using magnetic radiation to align the hydrogen nucleus's of our body in magnetic vectors. When radiation energy is added, the hydrogen nucleus's start to spin and magnetic vectors change axis, and as soon as it gets switched off the magnetic vector returns to its resting state. The released energy is absorbed by the machine and because different tissues have different relaxation times, they can be identified separately and be translated into an image. Most diseases have increased water content, so MRI is a sensitive test for the detection of those diseases [21].



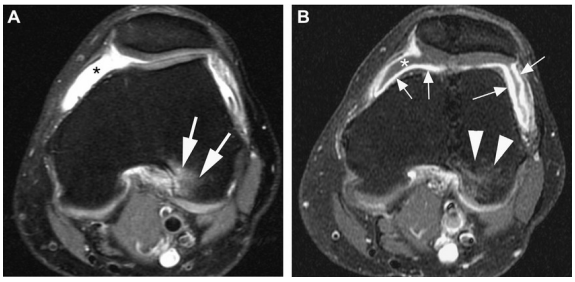


Figure 10: Large bone marrow lesions [15]. **Figure 11: Comparison of inflammatory manifestation [15].**

2.1.18.3 *Ultrasound(US)*

The US is a reliable and real-time imaging with low cost. It can detect inflammatory and structural abnormalities, without radiation exposure Nevertheless, there is limited ability to assess deep structures and the subchondral bone. In OA patients can identify synovial hypertrophy, increased vascularity and the synovial fluid in joints.

High-frequency sound waves travel through tissue. They can be absorbed or reflected and this reflected sound is used to translate the wave into an ultrasound image.

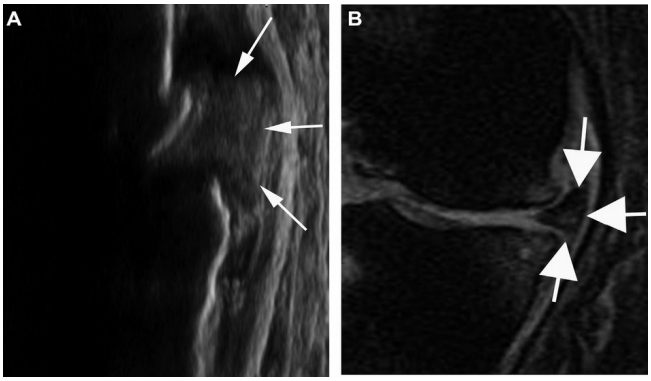


Figure 12: Assessment of meniscal extrusion by ultrasound [15].

2.1.18.4 *Nuclear Medicine*

Nuclear medicine imaging with radiotracers enables visualization of changes in osteophyte formation, subchondral sclerosis, subchondral cyst formation and bone marrow lesions as well as sites of synovitis. A major limitation is the poor anatomical resolution.

2.1.18.5 *Computer tomography (arthrography)*

CT arthrography is, for now, the most accurate method for assessing of superficial and focal cartilage damage, with high spatial resolution and high contrast between superficial and deep structures and it can also detect subchondral bone sclerosis and osteophytes. Due to the high cost, invasive nature and potential risk are rarely used in the large scale of OA studies. CT is computerized x-ray imaging procedure in which rays quickly rotated around the body and create with the help of the computer cross-sectional images of the body [15].

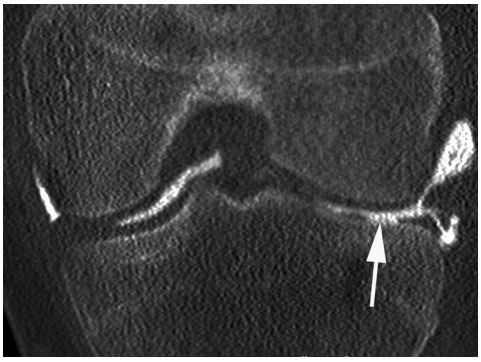


Figure 13: Focal full thickness defect at the lateral tibia [15].

2.1.18.6 *Arthroscopy*

Is a surgical procedure by inserting a small camera, arthroscope, into the joint there are real time pictures on a video monitor, and the surgeon uses these images to diagnose and treat the joint [4, 15].

2.1.19 Physiotherapeutic intervention for a Patient with Gonarthrosis

Physiotherapeutic treatments can help the body in general. By improving the posture, re-educating the patient to walk correctly and improve some musculoskeletal dysfunctions subsequently there will be a reduction of the asymmetric loads and therefore decrease the amount of the pain. Moreover, therapeutic modalities can improve the condition of the joint. With the progression of the degeneration of the cartilages, the musculoskeletal system changes to reduce the pain.

Soft Tissue Techniques (STT) are used to improve circulation so the wastes can easier leave the degeneration area and nutrition supply will be accelerated and release the restrictions of the skin and subskin. This can be performed not only in the area of the leg but also in the low back which is usually overloaded due to the abnormal posture. To perform STT we can use softball from periphery to the center or we can do superficial massaging therapy. Fascia releasing of the upper and lower leg will accelerate the restoring of the knee condition. Joints are stiff in OA disease in the knee joint but also in the area of the foot and ankle and maybe in the hip. The tibiofemoral joint is the most restricted. Other joints that are usually restricted are the subtalar, talocrural, patella, tibiofemoral, and the small joints of the feet. Patellar mobilization is also important to restore any malfunctioning of quadriceps.

In gonarthrosis patients to keep the maximal extension is good to use positioning or braces. Furthermore, the therapies can include optimizing the condition of the muscles mostly around the joint by stretching muscles like hamstrings and gastrocnemius and strengthening quadriceps. Regaining the Ettinger et al showed that quadriceps strengthening and aerobic exercises for patients with gonarthrosis improved the joint functional outcomes approximately 10% [22]. Moreover, the deep massaging was not proven efficient until recently which a study showed that classic massage in combination with active exercising can decrease pain and stiffness [41]. Proprioceptive and sensomotoric exercises are used not only to restore any instability but also to improve deficits of movement [23].

More modalities are used to improve the condition. Hydrotherapy is non-invasive and non-interventional that can have facilitation or relaxing effect depending on the temperature. Researchers showed that water buoyancy may decrease the weight that joints, bones, and muscles have to carry and make the ROM freer [42]. Negative thermotherapy can decrease the pain and increase the mobility. TENS electrotherapy is electrical currents, applied directly around the knee to decrease the pain. The Therapeutic US was recently researched and showed that decreases pain level and improves the aerobic condition. Low-frequency laser it has evidence to improve the mobility and significantly decrease the pain [6].

2.1.20 Other treatments

In view of the fact that the OA produces pain and limitations and it has no cure, different types of treatments are present to help the patients. The goal of those procedures is to reduce the pain, improve the mobility and minimize the disability [8].

2.1.20.1 *Pharmacological therapies*

Pharmacological intervention is still limited in pain relief and reduces the inflammatory processes. Initially, the joint treatment prescriptions involve oral agents like paracetamol, acetaminophen, acetaminophen-like analgesics and non-steroidal anti-inflammatory drugs (NSAIDs). There are new drugs so-called symptomatic slow-acting drugs (SYSADOA) but they have no evidence-based efficacy. Intra-articular injection of hyaluronan shows a delay of the disease's progression and reduction of some of the symptoms. An additional intervention can be the short-term management of acute pain with intra-articular injections of long acting steroids. Although the effect of them last just for a few weeks and high doses can lead to steroid arthropathy ruptures of tendons due to the increased amount of steroids in the joint [8].

2.1.20.2 *Surgical procedures*

This surgical option is attempted just if the non-operative treatments were not effective. The least invasive option is washing of the joint by removing fibrin and debris. Another option is osteotomy which is used in mild OA and there is the removal of the osteophytes. However, the most common an intensive procedure is total knee joint replacement, or arthroplasty, in which parts of an arthritic or damaged joint are removed and replaced with a metal, plastic or ceramic part, prosthesis [4, 8].

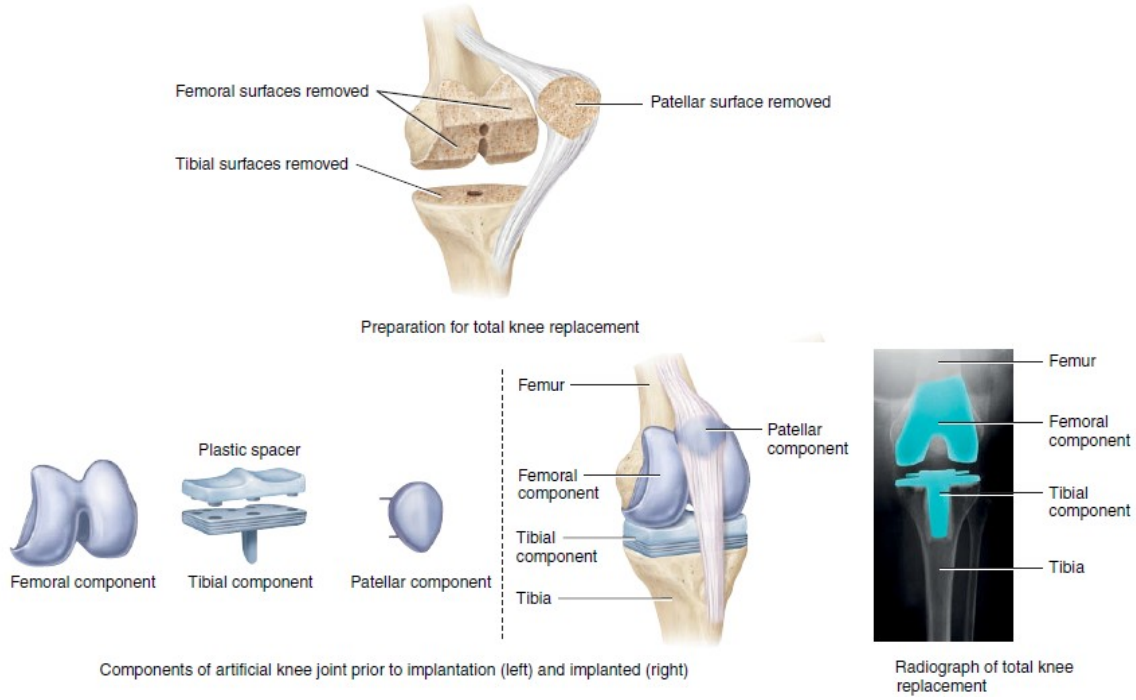


Figure 14: Total Knee Replacement [11].

2.1.20.3 *Alternative therapies*

Even if there is a variety of alternative therapies for managing OA, There are not sufficiently researched and their benefits are unclear. Some fields of these therapies are herbal remedies, massage therapy, chiropractic manipulations and acupuncture [8].

3 Shoulder Joint

The shoulder joint is structurally classified as a synovial ball-socket joint. It is also called glenohumeral (GH), described as the most flexible of the body and it connects the upper limb to the trunk. This connection is achieved through the scapular bone which is composing, with some other soft tissue structures, the shoulder girdle [13].

1.5 Anatomy of the Shoulder Joint

The composing structures of the glenohumeral joint are the scapula that is freely moved on the trunk and the humeral bone which is the longest bone of the upper extremity. Those structures are described below.

3.1.1 Bony structures

Scapula or shoulder blade is a large, triangular, flat bone placed cranially of the posterior thorax between the second and seventh ribs. On the posterior surface of it, there exists the spine of scapula which is a prominent ridge and divides the posterior surface to supraspinous fossa, above the spine, and infraspinous fossa, below the spine. On the anterior surface, there is a broad concavity which is called subscapular fossa. Acromion in an expanded process at the upper lateral corner, which articulates with clavicle or collarbone as it is called. Just below the acromion, there is a depression which is called glenoid cavity and that is the place that the joint is formed. The edges of the scapula have the names: superior border, inferior border, medial or vertebral border and lateral or axillary border according to their location. On the superior border, there is a prominent place which is called scapular notch and the suprascapular nerve passes through that. The coracoid process is an insertion point for ligaments and tendons. This is also a prominence but anterolaterally on the superior border this time [11, 25].

The second bone of the joint is the proximal part of the humerus, or the rounded humeral head which articulates with the glenoid cavity. Just below the head, there is the anatomical neck and then the surgical neck. Except the articulation with the scapula, the most distal part of humerus creates the elbow joint with the ulna and radius [11, 25].

3.1.2 Shoulder complex

The main articulation of the shoulder is the glenohumeral joint. Nonetheless, there are more articulations that are closely connected with the glenohumeral one. Those are acromioclavicular, sternoclavicular, and scapulothoracic [13].

3.1.3 Articular Components

Even if there are many ligaments to support the joint most of the stability is because of the tendons of the muscles. Still the joint is still very unstable and easily exposed to subluxations or dislocations. Studies have shown this is happening because the humeral head is disproportionately larger than the glenoid fossa and this is decreasing the stability of it [13]. The difference from the knee joint that was described before is that in the shoulder joint there are no meniscal tissues but there is labrum which has similar function [11].

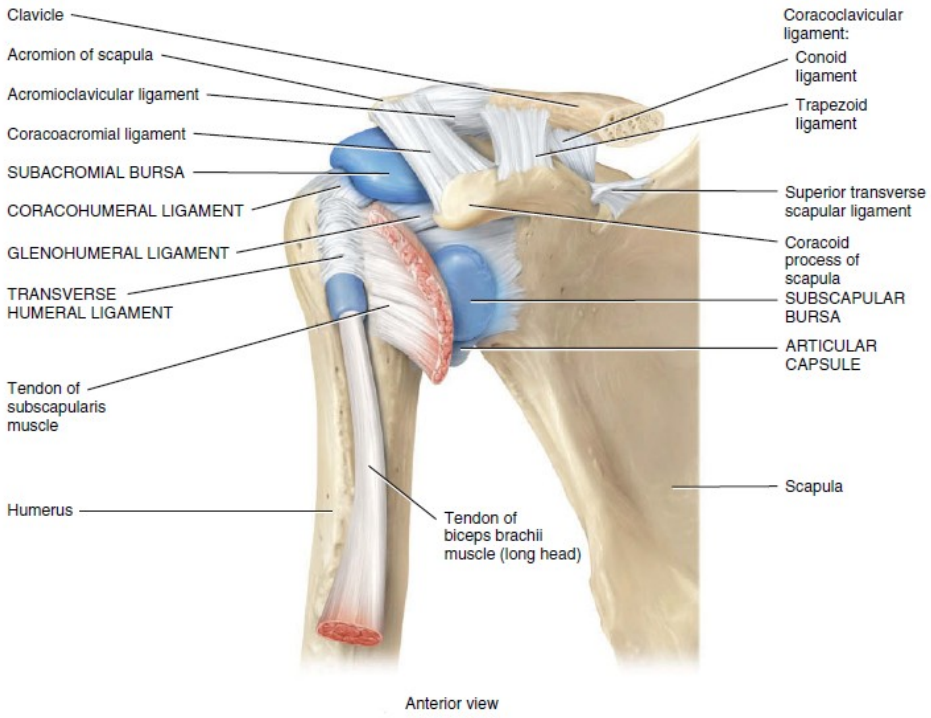


Figure 15: Articular components of the shoulder joint [11].

3.1.3.1 *Capsule*

The joint capsule is a loose thin-wall sac that attaches on the edges of the glenoid fossa and anatomical head. It is composed of a fibrous and synovial membrane. While the arm is hanging and pulled by the gravity the superior part is tight and the inferior is loose and reverse while we bring the arm in abduction. The inferior part is the most fragile area [11].

3.1.3.2 *Labrum*

Glenoid labrum is an arrow fibrocartilage ring that surrounds the lip of glenoid cavity that functions as a deepener of the articular cavity. [11]

3.1.3.3 *Ligaments*

Coracohumeral ligament: It extends from the lateral side of the coracoid process and continues until the anteromedially of the greater tubercle. It is a strong and broad ligament which strengthens the upper and anterior part of the articular capsule [11].

Glenohumeral ligaments: This not just one ligament but three thick ligaments anteriorly of the joint. They spread from the glenoid cavity to the minor tubercle and anatomical neck of the humerus, they are frequently blurred or absent and even if they are not strengthening much the joint they are essential in stabilization [11].

Transverse humeral ligament: From the greater tubercle to the lesser tubercle of the humerus exists a narrow sheet that functions as a band around tendons that holds them in place[11].

3.1.3.4 *Bursae*

In the glenohumeral joint there are four bursae: subscapular bursa, subdeltoid bursa, subacromial bursa, and subcoracoid bursa [11].

3.1.4 Muscles Anatomy and Function

Muscle	Origin	Insertion	Action
Deltoid	Clavicle, spine of scapula, acromion	Deltoid tuberosity	GH FLEX, ABD, IR, Horizontal ADD

Pectoralis major	Clavicle, sternum, first six ribs	Lateral bicipital groove	GH FLEX, EXT, IR, ADD, Horizontal ADD
Latissimus dorsi	Spinous process T7-L5, iliac crest, sacrum, 3 lower ribs	Medial bicipital groove	GH EXT, ADD, IR, Hyperextension
Teres major	Axillary border of scapula	Crest below lesser tubercle	GH EXT, ADD, IR
Supraspinatus	Supraspinous fossa	Greater tubercle	GH ABD
Infraspinatus	Infraspinous fossa	Greater tubercle	GH ER, Horizontal ADD
Teres minor	Axillary border of scapula	Greater tubercle	GH ER, Horizontal ADD
Subscapularis	Subscapular fossa of the scapula	Lesser tubercle	GH IR
Coracobrachialis	Coracoid process of the scapula	Medial surface of the humerus	Stabilizes the shoulder joint
Biceps brachii	Supraglenoid tubercle and coracoid process of scapula	Radial tuberosity of radius	GH FLEX
Triceps brachii long head	Infraglenoid tubercle of scapula	Olecranon process of ulna	GH EXT

Table 5: Muscle anatomy and function [26].

The rotator cuff is a tendinous band made of the tendons of the muscles: subscapularis, supraspinatus, infraspinatus, and teres minor, and help while rotation of the humerus to stay against the glenoid fossa [13].

3.1.5 Muscle Innervation

Nerve	Segments	Muscles
Medial Pectoral	C5, C6, C7	Pectoralis major
Lateral Pectoral	C8, T1	
Thoracodorsal	C6, C7, C8	Latissimus dorsi
Subscapular	C5, C6	Subscapularis, Teres major
Suprascapular		Supraspinatus, Infraspinatus
Axillary		Deltoid, Teres minor
Musculocutaneous		Biceps brachii
	C6, C7	Coracobrachialis
Radial	C7, C8	Triceps brachii

Table 6: Shoulder muscles innervation [25].

3.1.6 Blood Supply

The axillary wall is supplied by the axillary artery. This artery creates the anterior and posterior circumflex humeral arteries and extends to the brachial artery which provides the arm with blood. [16].

1.6 Kinesiology of the Shoulder Joint

The shoulder joint is one of the most freely movable of the joint as it can perform motions in all three planes, consequently, it has three degrees of freedom. Due to the ability to perform many motions, it is also very unstable [25].

3.1.7 Osteokinematics of the Shoulder Joint

The GH joint can perform four groups of movements: flexion-extension-hyperextension in the sagittal plane, abduction-adduction in the frontal plane, medial-lateral rotation in the transverse plane, and horizontal adduction-extension in abduction in the transverse plane. This joint can also do circumduction which is a combination of many other motions together [27].

Below are described the ROM of the shoulder joint according to the AAOS.in SFTR form. The horizontal abduction and extension in abduction have not been described by the AAOS, subsequently, on the table, there are according to Janda.

Motion	ROM
Flexion - Extension	60 - 0 - 180
Abduction - Adduction	180 - 0 - 0
Internal rotation - External rotation	90 - 0 - 70
Horizontal adduction - Extension in abduction	120 - 0 - 30

Table 7: ROM of the Shoulder joint [17, 18].

Abduction is usually accompanied with external rotation of the GH joint and that allows the posterior passing of the greater tubercle to the acromion and that prevents jamming against the subacromial space content. The scapula is turning upward about 60 degrees with maximal abduction [30].

3.1.7.1 *Scapulohumeral rhythm*

Inman and colleagues in (1944) reported that after about 30 degrees of abduction the scapulohumeral rhythm stayed remarkably constant, with a ratio of 2:1: for every 3 degrees of GH abduction, (2 degrees GH abduction and 1-degree scapular upward rotation). Consequently when the maximal abduction is performed ≃180 degrees then there will be 120 degrees of GH abduction and 60 degrees of upward rotation of the scapula [30].

3.1.7.2 *Sternoclavicular (SC) and Acromioclavicular (AC) joints*

The SC and AC joints are essential in the motion of the shoulder as the upward rotation of the scapula during abduction results after SC elevation and AC upward rotation. Throughout abduction, the clavicle is drawn back at the SC joint and posteriorly rotates around its axis, while scapula is posteriorly tilting and lateral rotating [30].

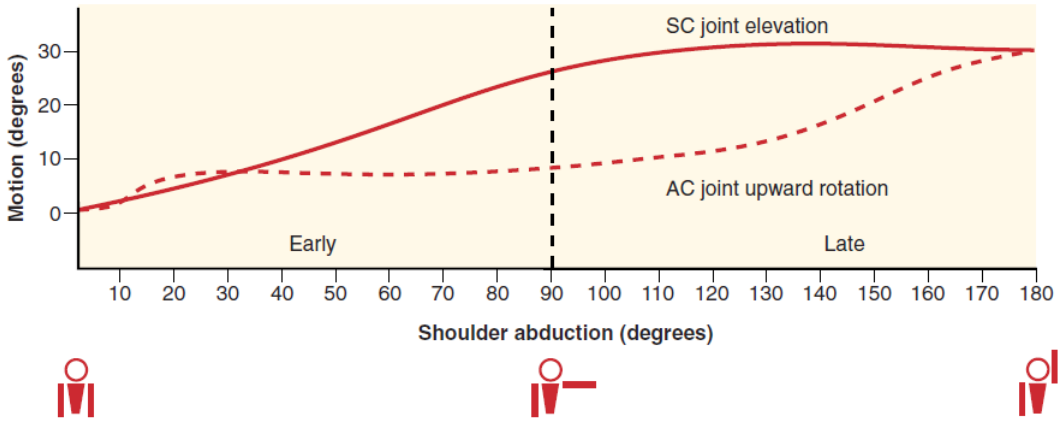


Figure 16: Relationship of SC elevation and AC superior rotation during maximal shoulder abduction [27, 35]

3.1.8 Arthrokinematics of the Shoulder Joint

The three arthrokinematic motions are gliding, spinning and rolling. The humeral head has a convex shape and the glenoid fossa concave, and as it is described by the concave-convex rule, the convex surface moves in opposite direction of the mobile body segment. Subsequently, with flexion or abduction the head glides caudally, with extension or adduction it glides cranially, with internal rotation it glides dorsally, with external rotation, it glides anteriorly, and with vertical pull, the head up will be pulled against the acromion process by the deltoid [13, 25, 27].

In abducting motion, the gliding and rolling are achieved by the rotator cuff, supraspinatus brings the head into fossa and the rest pull it in and downward against the concave fossa. In internal and external rotation there is rolling and sliding the same time and that allows greater transverse diameter of rolling on a smaller surface. Maximal external rotation provokes 1-2mm of posterior displacement. The amount of rotation and sometimes the way of motion is changing according to the position of the shoulder, e.g. rotation from 90 degrees of abduction, initiates with spinning [13, 25, 27].

3.1.9 Functional Movement Ranges of the Shoulder Joint

In a research from the Journal of Shoulder and Elbow Surgeons showed that a person needs about 120 degrees flexion, 45 degrees extension, 130 degrees abduction, 115 degrees horizontal adduction, 60 degrees external rotation, and 100 degrees internal rotation t perform the ADL activities [35].

Tasks of daily living	Measured humeral motion	Maximum motion to complete task (mean ± SEM)	
		Dominant arm	Nondominant
Place soup can on shoulder-level shelf	Forward flexion	105.4 ± 1.8	108.2 ± 1.7
	External rotation	33.9 ± 1.9	30.8 ± 1.2
Tuck in shirt behind back	Extension	45.5 ± 2.4	45.9 ± 3.2
	Internal rotation	88.3 ± 9.1	86.9 ± 8.7
Wash the middle of the back/unhook bra	Extension	46.8 ± 1.8*	45.8 ± 2.3
	Internal rotation	98.8 ± 10.0	102.2 ± 10.9*
Wash the back of the opposite shoulder	Forward Flexion	94.9 ± 2.4	92.6 ± 2.5
	Adduction	115.8 ± 2.2	115.9 ± 1.9*
Place hand behind head with elbow out to side	Abduction	127.3 ± 2.0	128.7 ± 1.5*
	External rotation (arm at 90°)	61.3 ± 2.3*	56.3 ± 2.2
Comb hair	Forward Flexion	107.8 ± 3.0	109.0 ± 2.6
	Adduction	86.1 ± 2.9	91.3 ± 2.4
Place soup can on overhead shelf	Forward Flexion	120.7 ± 1.5	125.6 ± 1.8
	External rotation	38.1 ± 2.2	32.1 ± 1.7
Place 1-gallon container on shoulder level shelf	Forward Flexion	105.9 ± 1.6 †	107.3 ± 2.3†
	External rotation	39.1 2.1	38.5 1.9
Reach overhead shelf without bending elbow	Forward Flexion	118.6 ± 1.4†	123.1 ± 1.6†
	External rotation	29.5 ± 2.0	26.2 ± 1.6
Place 1-gallon container on overhead shelf	Forward flexion	119.9 ± 1.9	126.8 ± 1.8*
	External rotation	41.8 ± 2.6	41.6 ± 1.6

ROM, range of motion; *SEM*, standard error of the mean.
* Maximum values for given humeral motion in any one plane.
† Statistically significant difference ($P < .05$).

Figure 17: Average ROM in dominant and non-dominant arms while performing tasks of daily living [35].

1.7 Biomechanics of the Shoulder Joint

The articulating components are not there just for stability but they also interact to absorb shocks and bear loads. Nevertheless, the GH joint is the leader of the arm's mechanical support, consequently, it undergoes bigger loads than the other joints [30].

3.1.10 Mechanical Loads

While moving the loads are distributed in different areas. When the body is in the upright position the arm can be measured as one to find the Center of Mass (COM). The torque at the joint is the product of the upper limb's weight and the perpendicular distance of the arm's COG and the shoulder. Therefore when the angle of the shoulder abduction is increasing the torque will respectively increase as well. Additionally, while the elbow is bent the measuring of the COM should be segmentally analyzed. The torque that will be therefore produced at the joint by each segmental part will be a product of each segmental weight and each segmental moment.

Through it seems weird that the arm is just 5% of the body the length of them is that long which creates a great moment and torque. This obligates the muscles to put larger effort to keep the shoulder in the position, and those pulling forces are measured to equal 50% of the body weight. While flexing the elbow the forces are approximately 25% of the body weight, but in this position, a rotational torque can be added which necessitates bigger muscle activation.

People who sit at a desk for many hours are advised be ergonomists to decrease the abduction to 20 degrees or less and flexion to 25 degrees or less. People that are holding their arms overhead they are at a higher risk to develop degenerative tendinitis of biceps or supraspinatus [30].

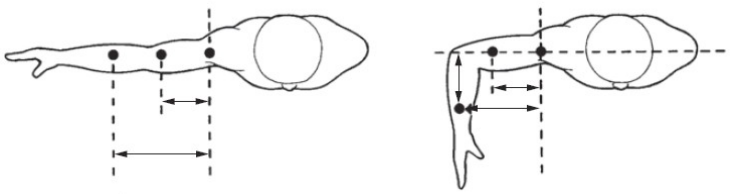


Figure 18: Illustration of torque calculation [30].

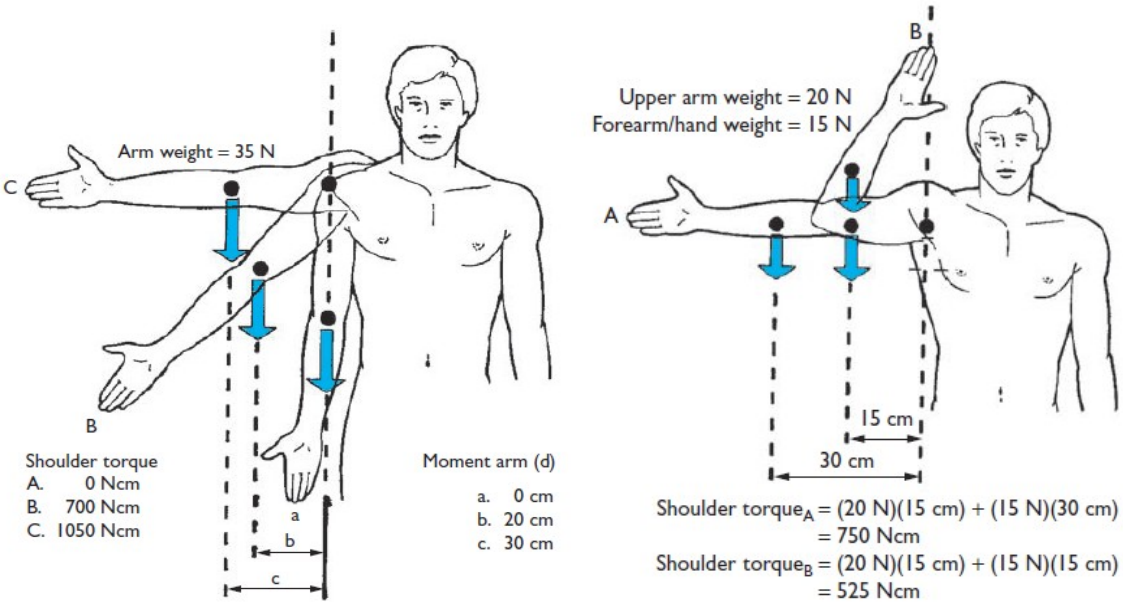


Figure 19: Examples of shoulder torque with the elbow straight and bent [30].

3.1.11 Traumatology and trauma mechanisms

Shoulder injuries are very often and mostly in sports. Traumatic injuries and overusing problems are included to the 8% to 13% of all sport medicine injuries [36]. Some common injuries are described below.

3.1.11.1 *Dislocations*

Dislocations may occur after injury. There are many risk factors that can contribute to the dislocation like insufficient glenoid fossa size or posterior tilting of the humeral head, rotator cuff failure, glenoid fossa anteversion or laxity of the structures that can be congenital. The mechanism of damage is usually depending on the direction of dislocation. Directions can be anterior, posterior, or inferior. The superior dislocation is prevented by the coracohumeral ligament. The most common mechanism is when there is an impact on the abducted and externally rotated shoulder. [37]

3.1.11.2 *Shoulder impingement syndrome*

This injury is more common in athletes of throwing as well as tennis plays, swimmers, and older golfers. There are two theories of the biomechanical development.

The first one suggests that due to genetic factors there is the formation of narrowed glenohumeral space so the rotator cuff and bursa are strained between acromioclavicular ligament, acromion, and head of the humerus. The second theory involves inflammation of the supraspinatus muscle as a result of overstretching, consequently the muscle cannot function as a stabilizer and therefore deltoid pulls the humeral head to keep it in the glenoid fossa. With this, during the abduction, it pulls it too high and the rotator cuff is wearing [30].

A research in swimmers showed that while the swimmers are in the recovering phase, serratus anterior turned the shoulder blade in order to let supraspinatus, infraspinatus and middle deltoid to easily perform abduction [38].

3.1.11.3 *Rotational Injuries*

When repeated forceful rotational motions occur in the shoulder joint injuries like tearing of labrum, rotator cuff and biceps or even calcification, degenerative diseases or bursitis can develop. The wearing of labrum can result after not enough stabilization of humerus, and that can lead to tearing as well. Tearing of the rotator cuff and mostly supraspinatus can be a consequence after extreme tension through the deceleration phase of angular motion. Biceps tendon tearing can progress with elbow hyperextension while throwing [39].

1.8 Special Chapter: Shoulder pain

3.1.12 Differential Diagnosis

The pain in the shoulder area can be a consequence of many injuries. Some of those diseases or injuries have already been mentioned like degenerative diseases, or tendon injuries and inflammations. The inventory is too long and that is why it is the 3rd most common reason for musculoskeletal consultation. People in construction work or hairdressing have a higher risk of developing shoulder pain. Some risk factors are lifting heavy objects, perform the same uncomfortable motions to uncomfortable positions. Psychosocial factors are also very essential [30].

3.1.13 Clinical Presentation

Due to the fact that there is no specific diagnosis, there can be a variety of clinical symptoms. Pain is always one of them but the location, quality, and radiation are very important to lead us to the "root" of it. Some other symptoms are: joint stiffness, reduced ROM, reduced stability, weakness, deformities, swelling and wasting [1].

3.1.14 Diagnostic Procedures

Except for the diagnostic machines that have been demonstrated before, for the shoulder there many physical examinations that we can provide. First of all, we have to take the history anamnesis to be sure that there are no red flags. If they are is recommended to start with blood tests and radiographs. If there are no red flags we can move on to the examination which includes:

- ROM of cervical spine assessment
- Observation for shoulders swelling, wasting, and deformity
- Palpation of the joints for tenderness, swelling, warmth, and crepitus
- Assessment of shoulder strength, stability, ROM and joint play on both sides
- Look for painful arc
- Perform any special test that can confirm some hypothesis [2]

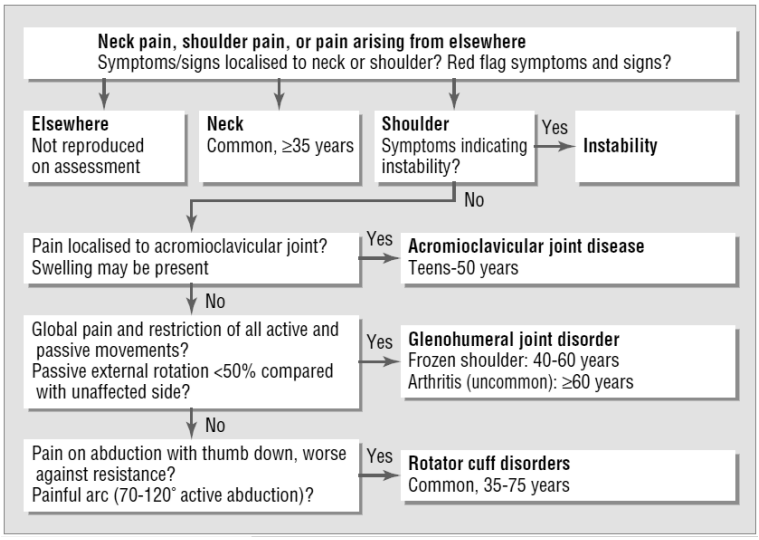


Table 8: Diagnosis of shoulder problems [2].

3.1.15 Physiotherapeutic Intervention for Non-Specific Shoulder Pain

Treating a non-specific shoulder pain is fully depended on the symptoms and maybe if there is any hypothesis of what the real problem is the therapy can be more focused on some part. In a research of the most used therapeutic trial, they found that exercising, ultrasound and active and passive mobilization are more frequently performed in patients with shoulder pain. All kind of intervention can be performed as long as they are effective for the patient [3].

In these cases of patients, we can use STT for the skin and subskin, fascia techniques, stretching and strengthening techniques according to the condition and which is the condition of each shoulder muscle. When there is a shoulder problem the GH, AC, and SC joints can be restricted so manual techniques can be used to increase the joint play off the restricted segment. Additionally, we can often find hypertonicity in trapezius, supraspinatus, infraspinatus, subscapularis, and deltoids. This abnormal tonus can be restored with the help of Post-isometric relaxation technique. Bobath concept and general proprioceptive exercises with traction, approximation and by using different proprioceptive apparatus can improve the function of the proprioceptors in the joint. This can also help with stabilization but also with correct usage of the muscles [23].

	Treatment session								Total number of sessions*	No. of patients†
	1	2	3	4	5	6	7	8		
No. patients at each session	**98**	**96**	**90**	**84**	**77**	**67**	**56**	**42**	**610**	
Education	83	53	16	16	12	11	9	4	204 (33%)	85
Exercise	77	56	37	37	32	27	22	18	306 (50%)	87
Passive mobilizations	34	39	42	43	35	26	19	13	251 (41%)	61
Active mobilizations	30	36	40	39	35	27	26	18	251 (41%)	56
Auto-mobilizations	4	7	11	14	11	10	7	5	69 (11%)	25
Ultrasound	28	35	39	36	37	32	27	19	253 (42%)	50
Acupuncture	2	3	7	8	8	8	8	4	48 (8%)	10
Neck treatment	12	14	15	12	10	7	4	3	77 (13%)	21
Hot/cold therapy	9	6	3	3	5	2	1	0	29 (5%)	12
Electrotherapy	2	4	2	2	1	1	2	3	14 (2%)	6
Other treatment	12	11	7	5	7	3	3	3	51 (8%)	15

*Calculated as the total number of sessions in which the individual modality was used.
†Calculated as the number of patients having at least one treatment session in which the modality was recorded.

Table 9: Treatment modalities through the trial period [3].

4 Case Study

1.9 Methodology

My bachelor practice took place in FNKV - Kliniky rehabilitačního lékařství in Prague. This practice started on Monday 23rd of January 2017 and ended on Friday 3rd of February 2017 (10 days of practice). Each day had a duration of 8 hours. The total amount of hours of practice was 80 hours.

My clinical work placement was supervised by Mgr. Lenka Samkova. The number of the sessions with my patient was fourteen.

The therapeutic procedures were applied in an individual therapy and exercise room. In the therapies, we used soft tissue techniques, fascia techniques, joint play mobilization, muscle relaxation, stretching, and strengthening techniques, sensomotoric and proprioceptive exercises, and general exercising. For the examinations, I also used instruments such as a goniometer, measurement tape, neurological hammer, vibration fork and plumb line.

My work has been approved by the Ethics Committee of the Faculty of Physical Education and Sport at Charles University.

1.10 Anamnesis (medical history)

4.1.1 Status present

4.1.1.1 *Objective:*

Year of birth: 1945

Height: 182cm

Weight: 85kg

BMI: 25,7kg/m^2

Crutches: forearm crutches

4.1.1.2 *Subjective*

The patient is experiencing normal arthritic pain bilaterally on his knees evaluated on the visual analog scale (VAS) as a constant 1 to 2 and his shoulder pain 1. When he is relaxed and usually in the morning is more painful for him and he is experiencing very often the morning stiffness. He is also experiencing a problem with walking because of the stiffness and deformities of his ankles and feet.

4.1.2 History Anamnesis

The patient was admitted to hospital with pain bilateral knees joints and slight pain in his left shoulder. The responsible doctor diagnosed gonarthrosis of his both knees. A few years ago he felt pain on his left shoulder but he didn’t experience any other limiting problems until two years ago that the pain occurred and increased.

4.1.3 Injury Anamnesis

When he was young he went through a window and needed stitches on left upper trapezius without any other deficits. In 1978 he was involved in a work accident that cost him multiple fractures of both ankles and tibiofibular joint of his right leg.In 2012 he injured his both knees with a result of hemarthrosis that resolved by medication.

4.1.4 Surgery Anamnesis

He had many surgeries to repair it and they finally fixated his both Achilles on his ankles to prevent further shortening of the triceps surae muscles. Followed the detection of the SDHs he had immediately non-invasive surgery with local anesthesia for evacuation of hematoma. Subsequent he developed hemiparesis of the right side that resolved again with no neurological deficits been left.

4.1.5 Medical Anamnesis

He has also been diagnosed with hyperplasia prostate and Atrial Fibrillation Paroxysmal (PAF). In 2011 he had Transient Ischemic Attack (TIA) that caused no neurological deficits. In June 2016 after qualitative disorder of consciousness, as soon as he reinstated his full consciousness he went to the hospital that he was diagnosed with Subdural Hematoma (SDH) in frontal and parietal lobes on the left side of his brain and a smaller hematoma in the parietal lobe.

1.1.1 Family Anamnesis

All his relatives are healthy with no serious medical condition.

4.1.6 Social Anamnesis

He lives in a flat, on the 4th floor with an elevator but he often uses the stairs.

4.1.7 Occupational Anamnesis

The patient had been working with trains but now he is retired.

4.1.8 Allergy Anamnesis

Iodine

4.1.9 Pharmacological Anamnesis

Detralex, Tanyz Eras, Betanistidin Actovis, Nebilet and injections of Fraxiparine.

4.1.10 Hobbies

Cycling until he had the hematomas that his doctors advised him to stop for some time.

4.1.11 Abuses

None

4.1.12 Prior rehabilitation

Two years ago he had physiotherapy sessions to relieve the stiffness from his ankles and to regain some more mobility, it helped with the stiffness but not with the mobility.

4.1.13 Excerpt from patient's health care file

None

4.1.14 RHB indications

The doctor prescribed sensomotoric exercises, correction of the walking stereotype, exercising on stationary bicycle and whirlpool for the lower extremities.

1.11 Initial Kinesiologic examination

4.1.15 Postural examination (static)

4.1.15.1 *Anterior view*

→ Base of support - ideal in length but the right heel is not the ground, just the toes and heads of metatarsals are in conduct with the ground

→ Shape of ankles - right ankle bigger than the left

→ Position and shape of the toes - pressed toes

→ Weight distribution - looks more weight on the left leg

→ Muscles tibialis anterior - atrophic, symmetrical

→ Contour of the calf muscles - right calf is in bigger varosity than the left

→ Position of knees - varus deformity in both knees with bigger on right

→ Position of patellae - both of them are medially shifted

→ Position of thighs - symmetrical

→ Pelvis - anti-clockwise rotated and tilted with the left side being slightly higher

→ Umbilicus is in ideal position

→ Symmetrical tension on both sides of abdomen

→ Right thoracobrachial triangle bigger than the left

→ Nipples are on the same level

→ Position of the collarbones - right slightly more protracted

→ Supraclavicular holes - symmetrical

→ Right shoulder higher and more protracted than the left

→ Symmetrical upper trapezius

→ Position of the head - slightly protracted

4.1.15.2 *Posterior view*

→ Base of support - ideal in length but the right heel is not the ground, just the toes and heads of metatarsals are in conduct with the ground

→ Shape and contours of the heels - right heel is above the ground about 2-3cm

→ Shape of ankles - right ankle bigger than the left

→ Achilles tendon - right in more varosity

→ Contour of the calf muscles - right calf is in bigger varosity than the left, same volume

→ Position of knees - varus deformity in both knees with bigger on right

→ Position of thighs - symmetrical

→ Subgluteal line - almost same height with the right to be marginally higher

→ Pelvis - anti-clockwise rotated and tilted with the left side being slightly higher

→ Gluteal muscles - symmetrical

→ Paravertebral muscles - symmetrical

→ Cervical vertebras - ideal shape

→ Thoracic vertebras - in a small degree of *C shape* scoliosis to the right with the top of the curve around the Th5-7

→ Lumbar vertebras - ideal shape

→ Right thoracobrachial triangle bigger than the left

→ Upper extremities - right arm is more forward than the left

→ Right scapula is slightly protracted

→ Symmetrical upper trapezius

→ Nuchal muscles - symmetrical

→ Head - protracted

4.1.15.3 *Side view*

→ Weight distribution - more to the left

→ Shape and position of the ankle - right ankle in plantar flexion and looks swollen

→ Shape and contour of the shin - atrophic on the anterior side

→ Position of the knee joints - minor hyperextension of right knee

→ Contour of the thigh muscles - symmetrical

→ Rotation of pelvis in anticlockwise direction

→ Cervical spines - in extension

→ Thoracic spines - in kyphosis with the top of the curve around Th4

→ Lumbar spines - flattening of the whole lumbar region

→ Shape of the abdominal muscles - prominent

→ Position of the shoulder girdle - right shoulder is more protracted

→ Acromion - right is higher than the left

→ Position of the head - protracted

4.1.16 Palpation of the pelvis

→ Right ASIS more prominent than the left

→ Right ASIS slightly higher than the left

→ Right iliac crest slightly higher than the left

→ Left PSIS is more prominent than the right

→ Right PSIS slightly higher than the left

→ Both PSIS are higher than both ASIS

4.1.17 Assessment of stereotype (pattern) of breathing

→ Standing - using upper thorax

→ Sitting - using abdomen

→ Lying - using mostly upper thorax and a bit the abdominal part

4.1.18 Gait analysis (without crutches and barefoot)

4.1.18.1 *Front view*

→ width of the base of support - normal

→ position of the feet: parallel

→ walking rhythm: longer time on his left leg

→ walking speed: normal

→ movement of the foot: with his left foot he hit the ground with heel strike then the flat foot occurs, then the loading response and then the whole foot leaves the ground, with the right foot he hits the ground with the toes and heads of the metatarsals, loads his weight on just those two and then he changes leg

→ axial position of the lower limb- neutral with knee varosity

→ position of the pelvis - anti-clockwise rotation

→ movements of the pelvis - lateral tilt with higher on the right side

→ position of the trunk - ideal position

→ movements of the trunk - lateral bending

→ abdomen muscles - symmetrical

→ position of shoulders - moving laterally with trunk

→ position of the head - protracted

→ movements of the head - no movement

→ movements of the upper extremity – synchronized

4.1.18.2 *Back view:*

→ width of the base of support - normal

→ position of the feet: parallel

→ walking rhythm: longer time on his left leg

→ walking speed: normal

→ movement of the foot: with his left foot he hit the ground with heel strike then the flat foot occurs, then the loading response and then the whole foot leaves the ground, with the right foot he hits the ground with the toes and heads of the metatarsals, loads his weight on just those two and then he changes leg

→ axial position of the lower limb- neutral with knee varosity

→ position of the pelvis - anti-clockwise rotation

→ movements of the pelvis - lateral tilt with higher on the right side

→ position of the trunk - ideal position

→ movements of the trunk - lateral movement

→ position of spine – the whole spine is stable with slight scoliosis

→ activity of back muscles - activated

→ position of shoulders - moving laterally with trunk

→ position of the head - protracted

→ movements of the head - no movement

→ movements of the upper extremity – synchronized

4.1.18.3 *Side view*

→ walking rhythm: longer time on his left leg

→ walking speed: normal

→ stride length - short steps

→ movement of the foot: with his left foot he hit the ground with heel strike then the flat foot occurs, then the loading response and then the whole foot leaves the ground, with the right foot he hits the ground with the toes and heads of the metatarsals, loads his weight on just those two and then he changes leg movement of the knee - ideal

→ position of the knee - right in very slight hyperextension

→ movement of the knee - biggest motion of all joints

→ position of the hip - ideal

→ movement of the hip - the extension part is briefly limited

→ position of the pelvis - anti-clockwise rotated

→ movements of the pelvis –lateral tilt, with higher on the right side

→ movement of the center of gravity – COG stays about in the same level

→ position of the trunk – ideal position

→ movements of the trunk – lateral movement

→ position of the head - protracted

→ movements of the head – no movement

→ movements of upper extremities - left swings less than the right small bilateral motions

→ stability of walking - difficulty in stability due to the small support of his right leg

4.1.18.4 *Modifications*

→ Walking with special shoes and crutches - extremely improved with the only problem of alternative elevation shoulders with a combination of some trunk lateral flexion.

→ Stairs with special shoes and crutches - he is doesn't know how to go upstairs and he is holding the wall aid and not the crutches and the first moving with his affected limb and then with the unaffected.

4.1.19 Dynamic Spine Examination

4.1.19.1 *Forward bending*

Patient performed the movement starting from zero position in sagittal plane slowly to his maximal forward flexion that reached about 10 cm above the ground level.There was no visible scoliosis in his spine while he was bent and his paravertebral muscles were symmetrically prominent. His biggest flexion of his spine was from the thoracolumbar junction to the lumbar spines. He returned back to zero position fluently without any pain.

4.1.19.2 *Backward bending*

Backward bending was very restricted with almost none actual extension. He was instructed to hold his buttocks and move to an extension. The paravertebral muscles were symmetrically activated. The biggest difference to an extension was at the cervical spine and then a tiny motion in the lumbar area. The whole thoracic spine stayed stiff. No pain.

4.1.20 Anthropometric Measurements

Measurements	R	L	Measurements	R	L
Anatomical length	101	101	Calf circumference	34	33,5
Functional length Asis-mall med	100	99	Ankle circumference	30	29
Functional length Umb-mall med	107	106	Foot circumference	26	25,5
Thigh length	53	53	Whole UE length	80	80
Middle leg length	49	49	Humerus length	33,5	33,5
Foot length	26	26	Forearm length	27	27

Circumf. *15cm above knee cap*	45	44	Relaxed arm circumf.	30	30
Circumf. *10cm above knee cap*	41	41	Contracted circumf.	33,5	33
Knee circumference	42,5	42	Forearm circumference	29	28

Table 10: Anthropometric measurements (cm).

4.1.21 ROM

Joint	Plane	Active Movement		Passive movement	
		R	L	R	L
Hip	Sagittal	15-0-110	10-0-95	20-0-115	20-0-100
	Frontal	10-0-20	10-0-20	10-0-25	15-0-20
	Transverse	20-0-10	25-0-15	25-0-15	30-0-30
Knee	Sagittal	-5-0-120	-5-0-135	-5-0-130	-5-0-140
Ankle	Sagittal	-20-20-20	10-0-20	-20-20-25	10-0-20
	Frontal	0-0-0	0-0-0	0-0-0	0-0-0
Shoulder	Sagittal	20-0-145	20-0-120	30-0-155	30-0-135
	Frontal	110-0-0	85-0-0	125-0-0	100-0-0
	Transverse	70-0-35	45-0-25	70-0-35	50-0-25
Elbow	Sagittal	-5-0-140	-5-0-130	0-0-145	0-0-135

	Transverse	40-0-45	40-0-45	45-0-45	45-0-45

Table 11: Range of motions in upper and lower extremities (degrees).

4.1.22 Movement patterns

4.1.22.1 *Hip extension*

R: During all the three tries of the hip extension the patient was activating the gluteal muscles with hamstrings the same time then immediately the lumbar area muscles and then the thoracic and shoulder blade muscles. There was slight anterior tilt of the pelvis after the first 10 degrees of motion and the whole movement reached 15-20 degrees.

L: First muscle to be activated in this pattern on his left side where the back muscles are activated first and the most obvious during the extensions is the anterior tilt of the pelvis. The motion is even less than the other side about 10.

4.1.22.2 *Shoulder abduction*

R: The glenohumeral junction was stiff with the scapula to move with the humerus without real pure abduction of the shoulder. There is big activation of the upper trapezius and also activation of the pectoral muscles. The movement is not in a frontal plane, as there are obvious flexion and some external rotation. With a semi-flexed elbow and elevated shoulder, the motion reaches about 110 degrees. Patient start to experiencing pain at the level of 90-100 degrees.

L: This side is worse with the scapula again to move complete with the humerus and there is even bigger flexion during the abduction and a little bit more flexion of the elbow. The motion reaches about 100 and there is more pain on this side. Again the trapezius is initially activated with shoulder elevation. There is pain which starts around 90 degrees.

4.1.23 Scar examinations

→ On patient right tibia there is the biggest surgical scar in his body about 12cm long almost 30 years old. It has white color and the sensation is normal. The scar is parallel with tibia on the medial side of the lower leg. It's a little bit moveable in medial and lateral direction and very restricted in both cranial and caudal direction

→ Past necrotic skin scar with the bone, on the anterior aspect of the right tibia. With dark brown color, 10 cm long and normal sensation, as the patient was insisting. It's barely movable to all the directions.

→ On the left Achilles, there is an upper left quadrant circular arc shape scar starting with the perpendicular to the Achilles and about 10cm above the floor. After the arc, it gets parallel with the Achilles on the medial side of the ankle. The whole length of the scar is about 9-10 cm long. This scar is as well almost 30 years old and it has a white color and normal sensation. The perpendicular part is very restricted in all directions but the parallel scar with the Achilles is more movable but again restricted to all directions and while lifting all the scar tissues were fixed.

→ A very old small scar exist on the left trapezius from anterior to posterior surface about 4 cm long.The scar is movable with very small restriction while we are lifting it. It has the color of the skin and normal sensation.

4.1.24 Fascia examination

4.1.24.1 *Extremities*

→ Upper arm:

R: no restriction neither medial nor lateral directions

L: restriction in medial direction

→ Upper leg:

R: no restriction neither medial nor lateral directions

L: no restriction neither medial nor lateral directions

→ Lower leg:

R: very restricted in both medial and lateral directions around the whole calf - necrotic tissue of scar - not able to move with the fascia

L: restricted in both medial and lateral directions

4.1.24.2 *Achilles tendon*

R: both medial and lateral directions are restricted with greater restriction on medial

L: the scar which is perpendicular to the Achilles restricts the tendon even more

4.1.25 Tone palpation

LE Muscles	R	L
Gluteus maximus:	N	↑
Iliopsoas:	N	↑

UE Muscles	R	L
Upper Trapezius	N	↑
Supraspinatus	N	↑

Tensor fasciae latae:	↑	N	Infraspinatus	↑	↑
Rectus femoris:	↑	N	Pectoralis major upper:	N	↑
Vastus medialis:	↓	N	Pectoralis major lower:	N	N
Vastus lateralis	N	N	Biceps brachii	N	↑
Adductors:	↑	↑↑	Deltoid anterior:	N	↑
Biceps femoris:	↑	N	Deltoid middle:	N	↑
Semi muscles:	N	N	Deltoid posterior:	N	N
Gastrocnemius:	↑	N	Triceps brachii	↑	↑

Table 12: Tonus of the upper and lower extremities muscles [45].

↓*-hypotosit,* N*-normal tonus,* ↑*-hypertonicsity,* ↑↑*- hyper-hypertonicity*

4.1.26 Length test

Muscles	R	L	Muscles	R	L
Gastrocnemius	2	2	Pectoralis major Clavicle part	1	1
Soleus	2	2	Pectoralis major Sternal part	1	1
One-joint hip flexors	1	2	Pectoralis major Rib part	2	2

Two-joint hip flexors	1	2	Pectoralis minor	2	1
Adductors	2	2	Teres major&Latissimus dorsi	Moderate	
Tensor fascia latae	1	0	Rhomboid major & minor	Moderate	
Hamstrings	2	2	Shoulder medial rotators	2	2
Piriformis	1	1	Shoulder lateral rotators	1	2

Table 13: Muscles length test according to Janda [44].

4.1.27 Strength test

LE Muscles	R	L	UE Muscles	R	L
Gluteus maximus:	4	4	Lateral rotators:	4-	3+
Iliopsoas:	4	4-	Medial rotators:	3+	3+
Tensor Fasciae Latae:	4-	4	Latissimus dorsi:	3+	3+
Quadriceps femoris:	4+	4+	Pectoralis major upper:	3	3
Hip adductors:	3+	3+	Pectoralis major lower:	4-	3+
Lateral rotators:	4-	4	Deltoid anterior:	4	4-
Medial rotators:	4-	4	Deltoid posterior:	4	4-
Lateral hamstrings:	4+	4+	Triceps:	4	4

Medial hamstrings:	4	4	Biceps&brachioradialis:	4+	4+
Ankle plantar flexors:	4-	4	Coracobrachialis:	4	4-

Table 14: Muscle strength testing according to Kendal [47].

4.1.28 Joint play examination

4.1.28.1 *Lower extremities*

→ Knee joint: both knees are restricted to both medial and lateral directions

→ Patellar joint: there is restriction just to caudal direction in both legs

→ Tibiofibular joint: restriction in ventrolateral and dorsomedial directions of both legs

→ Talocrural joints: no joint play on either of joints

→ Subtalar joint: no motion of the joint play, of supination and pronation of both right and left legs and restriction in dorsal and plantar flexion bilaterally

→ Chopart joint: right leg is restricted

→ Lisfranc joint: both transverse tarsal joints are restricted

→ Metatarsal joints: the only joint that is not restricted is the joint between 4^{th} and 5^{th} in both legs, all the other metatarsal joints are restricted

→ MTP joints: from the 1^{st} to the 3^{rd} toes on the right leg and until 5^{th} to left leg there is restriction of the joints

→ PIP joints: from the big toe to 5th toe of both side there is restriction

→ DIP joints: from the 2nd to 5th toe of both side there is restriction

4.1.28.2 *Sacroiliac joint:*

→ Restricted on both sides - examined in supine as it was the most comfortable position

4.1.28.3 *Upper extremities*

→ Glenohumeral joint: restricted in all directions in both extremities

→ Acromioclavicular joint: restricted both - examined by bringing examined side's elbow to the opposite shoulder

→ Sternoclavicular joint: not restricted

4.1.29 Neurological examination

4.1.29.1 *Deep tendon examinations*

Reflex		Response
Biceps	C5-6	2
Brachioradialis	C6	2
Triceps	C7	2
Wrist flexors	C8	2
Patella tendon	L2-4	2

Achilles tendon	L5-S2	2

Table 15: Deep tendon reflexes assessment according to DTR scale [46].

4.1.29.2 *Superficial sensation*

→ Light touch: Same feeling in all dermatomes of upper and lower extremities

→ Pain exam: Same feeling in all dermatomes of upper and lower extremities

4.1.29.3 *Deep sensation*

→ Kinesthetic sensation: Normal findings in toes and shin test

→ Vibration test: by using a tuning fork: Normal findings at metatarsals, ankles, knees, ASISs, and styloid processes of radius

4.1.29.4 *Pyramidal lesion tests:*

Signs of Pyramidal injuries of UE.	Right		Left	
	Positive	Negative	Positive	Negative
Juster Sign		●		●
Hoffmann Sign		●		●
Tromner Sign		●		●
Mayer Sign		●		●
Janisevski		●		●

Palm-chin Reflex		●		●
Thumb-chin Reflex		●		●

Figure 20: Pyramidal lesion tests for upper extremities [27, 46].

Signs of Pyramidal injuries in LE.	Right		Left	
	Positive	Negative	Positive	Negative
Extension response				
Babinski Reflex		●		●
Roche Reflex		●		●
Brissaud's Reflex		●		●
Sicard's Sign		●		●
Vitek's Bridge Phen.		●		●
Chaddock's Reflex		●		●
Oppenheim's Sign		●		●
Gordon Sign		●		●
Flexion response				
Rossolimo's reflex		●		●

Zukovsky-Kornilov		●		●
Mendel-Bechterew		●		●
Weingrow's Phen.		●		●

Figure 21: Pyramidal lesion tests for lower extremities [27, 46].

4.1.30 Special examinations

→ Two scale test: R:40kg - L:45kg - Within the normal limits

→ Vele test: R: G-2 - L: G-2 - Both sides have pressed toes

→ Single leg stance:

R: not able to perform the test at all

L: he is able to perform the test with good result bu with the knee in a little bit of shaking

→ Glenohumeral abduction:

R: with the proper fixation the pure abduction reaches 80 degrees

L: the pure abduction reaches 70 degrees and around this place the pain occurs

1.12 Examination conclusion

The patient is experiencing pain in his both knees due to his bilateral gonarthrosis and also left shoulder pain that can be a result of the deformity that he has in his right ankle. He is standing without contact with the floor with his right heel because of his deformity that was a result of surgeries after an accident. He has pressed toes that can be a result of shortening of the muscles or just to help him for stabilization and also almost all the joint from the toes to knees are restricted bilaterally. There is a small difference in the ankle circumference with the right one to be bigger but it seems to be because of the deformity because there is no other evidence of edema or any other reason that could cause swelling. His both ankles' ROM is eliminated and additionally, the overall ROM of his lower extremities is reduced but without any great asymmetries between the right and left a side. However, his weight distribution is within the normal limits. His right knee is in a greater amount of varosity than the left one. He has no difference in the anatomical length of his legs and his pelvis in anti-clockwise rotation with a slight amount of lateral tilt with his right side to be higher. The position of the pelvis can result from the shorter iliopsoas that was also visible during the testing of hip extension pattern. He also has bilateral restriction of the sacroiliac joint and positive single leg stance test on his right limb.

On his upper body he is bigger having troubles with his left shoulder but also he is experiencing some smaller amount of pain in his right one. He has a limitation in his ROM of all the joints with the greater limitation to be in the abduction. He has shorted pectoral muscles that result to the protraction of the shoulders and he additionally has a higher elevation of his right shoulder. While he was walking he was swinging his right arm more than the left one and that can be because of the pain of it can be an automatic mechanism of his body to increase the balance of his unsteady walking. Most of the muscles around his left shoulder were shorted and/or hypertonic on both arms, and the pattern of shoulder abduction was changed. The reason may be the shoulder pain which can be correlated with the ankle deformity. The scapulohumeral rhythm is poor and the glenohumeral joint stiff. The joint play of the glenohumeral and acromioclavicular joint is restricted bilaterally.

The patient has two very restricted surgical scars on his right and left legs, one scar of necrotic tissues also extremely restricted and one, not restricted scar on his left trapezius. During the dynamic spine examination in backward bending, there was no extension. Besides that, he experienced TIA and two SDHs he has no evidence of any neurological deficits.

1.13 Rehabilitation plans

4.1.31 Short term rehabilitation plan

- Decrease the pain
- Increase the ROM of the limited joints
- Improve the breathing pattern
- Increase the mobility of the scar tissues
- Improve the fascia movability
- Relax the hypertonic muscles
- Facilitate the hypotonic muscles
- Stretch the shorted muscles
- Strengthen the weakened muscles
- Trigger the proprioceptive activity

- Improve the joint play of the restricted joints

- Improve the deep core stabilization

4.1.32 Long term rehabilitation plan

- Eliminate the pain

- Optimize the condition of the joints and muscles.

- Re-educate the correct way of standing and sitting

- Re-educate correct way of walking

- Boost the confidence of the patient to exercise and be active

1.14 Therapy Progress

4.1.33 Day1 24/01/2017 Afternoon session

Subjective feelings: The patient seemed very excited about starting the therapies. He feels the pain as he said while walking.

Objective findings: The initial examination was performed the same day as the day of the therapy, during the morning session, so we didn't do any further examination for today's therapeutic unit.

The goal of today's therapy: Decrease the pain, reduce the stiffness of some of the restricted soft tissue, release the scar tissues, elongate the shorted muscles and increase the space of the knee joint.

Proposed therapy: Soft tissue techniques with the softball, soft tissue techniques for the scars, stretching exercises, manual therapy techniques according to Lewit.

Description of today's therapeutic unit:

Our today's therapy was focused on the lower part of the body.

- We started with STT with the softball as it can help to release some of the restricted tissues and increase the circulation of the lower extremities and accelerate the healing process. By applying moderate pressure through the softball to the skin I performed circular motion firstly from the ventral part of the body from the distal to the proximal area of the upper extremities. Initially, I just tried to release the dorsal surface, first laterally and the medially, then I move to the shin area again circular movements from distal to proximal first laterally and then medially and I finished with the same pattern of movements with the ball from the knee to the most proximal part of the pelvis. When I finished with the ventral parts of both lower limbs, I moved to the dorsal side which I followed the same sequence.

- Later I did STT on the scars of the legs by engaging a barrier by holding the tissues in C shape for 30 seconds and releasing. I did the same technique for all the 3 scars in all directions; medially, laterally, cranially and caudally. I also tried to do the lifting the tissues technique but it was not possible at this state.

- The next therapeutic procedure was stretching of the shortened hip flexors and triceps surae on both sides. We let the patient lie on the table in the Thomas test position, then by holding the non-treated leg we asked him to move to the side of the treated leg and more cranially and let the treated leg to fall outside of the treatment table. We asked him to not let his not treated leg and try to relax the treated one for 20-30 seconds. Then we moved to the other leg with the same technique. After that, we continued with stretching of the triceps surae the same way we perform the length test according to Janda. We reached the

stretched position of the muscles and we kept it there for 20-30 seconds. Then we did the same with the other leg.

- Our last procedure for today was the traction technique in a prone position by Lewit to increase the tibiofemoral joint space. The patient was lying in relaxed prone position and we just asked him to not add any effort to do something during this procedure. Then I lowered the table as much as I could and I passively flexed the knee joint to 90 degrees, fixed the distal part of the thigh with the plantar surface of my foot and try to lift the lower leg by holding it above the ankle joint. I kept the position until I could feel some release, but that was barely a release. The same technique was performed on the other leg as well.

Results of therapeutic unit: Today it was the first therapy so we didn't expect any big changes. The only small change could be the left iliopsoas length but the evaluation will be still the same as the initial examination.

Self-therapy: Self-stretching of both sides iliopsoas in the position we performed it during the therapeutic session as we saw that he was able to perform it well and we asked him to focus more on the relaxing of the treated leg. We recommend him to do 3 times each leg.

Notes: Patient looks very easy to cooperate with and he is always willing to do the exercises. This can help the therapy and increase the efficiency of our overall healing plan.

4.1.34 Day2 25/01/2017 Morning session

Subjective feelings: Patient says that he doesn't feel a big difference or improvement. He also was not able to perform his self-exercising because he had anesthesia for a procedure and he was feeling dizzy.

Objective findings: We re-examined the length of the hip flexors which was still the same on both legs. Additionally, we examined the scars where also there was no change since the previous examination.

The goal of today's therapy: Decrease the level of the pain, reduce the restriction of the scars, unblock the restricted joints, relaxation of hypertonic muscles and increase the length of the hip flexors and triceps surae.

Proposed therapy: Soft tissue techniques for the scars, joint mobilization according to Janda, PIR techniques according to Lewit, stretching exercises.

Description of today's therapeutic unit:

This therapeutic unit as all the morning therapeutic units was focused on the lower extremities problems.

- Today we started with soft tissue techniques to release the very big restriction of the scrt1`ars of the legs by engaging a barrier while holding the tissues in C shape for 30 seconds and wait for the releasing phase of the tissues. I did the same technique for all the 3 scars in all directions; medially, laterally, cranially and caudally. Today also the lifting of the tissues was not possible.

- Our second therapy for today was Joint play mobilization for the restricted joints of both lower extremities. We started from distal to proximal to additionally improve the blood circulation while we are working with the joints. We started from the distal and proximal interphalangeal joints of all the restricted toes and mobilizing them to all the restricted directions. Then we continued with the metatarsal joint by performing the fan-wise mobilization as well as mobilizing one against each other in both dorsal and plantar direction. Then we moved on to the tarsal bones and Chopart and Lisfranc joints which were very restricted. As soon as we tried to mobilize those we continued with mobilizing the subtalar and talocrural joints and then the tibiofibular joints which were mobilized in ventrolateral and dorsomedial directions. Then tried to increase the already reduced caudal joint play of the patellar joint, and we finished our joint mobilization with the knee joint to both medial and lateral directions. All the mobilizations were performed from both

restricted extremities. The fixation of the ankles is making our therapy less effective in my opinion.

- Then we proceed with post isometric relaxation of the hypertonic muscles to normalize their tonus. We performed this technique according to Lewit and it was for iliopsoas, rectus femoris, hamstrings, hip adductors and triceps surae just on the side that we found hypertonicity during the initial examination.

- The last therapy it was repeating the previous day's stretching exercises for lengthening of the hip flexors and triceps surae of both sides. We let the patient lie on the table in the Thomas test position, then by holding the non-treated leg we asked him to move to the side of the treated leg and more cranially and let the treated leg to fall outside of the edge of the treatment table. We asked him to not let his not treated leg and try to relax the treated one for 20-30 seconds. Then we moved to the other leg with the same technique. The last exercise was stretching of the triceps surae the same way we perform the length test according to Janda. We reached the stretched position of the muscles and we kept it there for 20-30 seconds. Then we did the same stretching exercises with the other leg.

Results of therapeutic unit: The scars are still very restricted and unmovable. We could see some small degree of increasing the ROM during the PIR techniques. However we will let the patient rest during the night and we will examine the muscles tomorrow during our morning, the lower extremities therapeutic unit.

Self-therapy: The patient had the same self-therapeutic exercise as yesterday; self-stretching of both sides iliopsoas in the position we performed it during the therapeutic session of the previous day and he was also asked today to focus more on the feeling of the relaxation of the treated leg. We recommended 3 times each side.

Notes: The patient was not able to relax properly during the PIR method. There were spasms of the treated muscles, so we will have to re-educate the patient of how to relax the muscles during our therapy.

4.1.35 Day2 25/01/2017 Afternoon session

Subjective feelings: This afternoon session is his second therapy today. He says that he feels fine after the morning session. No unusual symptoms or problems. He didn't do the self-therapy yet but he promised he will do it until the next day. He is in good mood.

Objective findings: We started our therapy by re-checking the active motions of the shoulder; flexion, extension, abduction, horizontal adduction, internal and external rotation. Our findings were about the same with our first examination.

The goal of today's therapy: Reduce the pain levels, release restricted tissues, elongate the shorted pectoral muscles relax the hypertonic muscles of the upper extremities and increase the joint play of the glenohumeral joint.

Proposed therapy: Soft tissue techniques with the softball, stretching exercises for the pectoral muscles, post isometric relaxation techniques for the hypertonic muscles of both sides and traction technique with a combination of PIR for the restricted shoulder joint.

Description of today's therapeutic unit:

The first therapeutic unit that is focused on the upper body.

- Our today's therapy started with soft tissue techniques with a softball to decrease the restriction of the soft tissues of the upper body and also improve the circulation of the blood. The patient is supine and by applying moderate pressure through the softball to the skin I began treating from the area of the pectoralis major. With small circular motions I had as my initial point the sternum and by following the direction of the pectoral fibers I

end up at the area of the shoulder area. Then I continue with the most later part of the upper trapezius muscle. With the same circular motions and by starting this time from the shoulder I end up with the lateral part of occiput where the trapezius muscle origins. The last part of soft tissues I tried to release by using the same technique it was the dorsal side of the trapezius, mostly the upper part, and as much as I could reach from the middle part of the trapezius while the patient was in prone position. Every time that I was done treating one of the parts of one side, I then continued by treating the other side before I moved on to another part.

- The next part of this therapy it was the stretching of the pectoral muscles. The patient was lying on the side of the treatment table with his treated arm to be hanging outside of the edge. He had his knees bent on a cylindrical cushion to prevent any lordosis of his low back. We stretch the pectoral muscles part by part by using the position of the length test by Janda. First, we did our fixation and then we stretched one side. We started with stretching the lower part of pectoralis major by leaving the arm hanging in the most elevated position, then we continued with the middle part and the arm in the middle position and then we finished with pectoralis major by stretching the upper part in a lower position. Lastly, we did the stretching of pectoralis minor by leaving the arm hanging fully outside of the table and parallel with it. Every time we asked the patient to keep the stretching for 20 seconds. When there was pain, we were reducing a little bit the ROM. As soon as we were done with the one side we were moving on to the other side.

- We followed with post isometric relaxation according to Lewit, to reduce the higher tonus of some muscles in the shoulder area. We performed this technique for supraspinatus muscle, trapezius muscle, internal rotators of the shoulder and external rotators of the shoulder. We were doing this until we were feeling some release of the tissues and see that the barrier was releasing.

- The final therapy for today was traction of the shoulder with a combination of PIR. The patient was supine with his arm abducted. I was sitting between the axilla and thorax to fixate the thorax. I grasped the distal humerus the wrist of the patient, I took up the slack

by performing traction of the arm and I asked the patient to slightly resist my motion. After that, I asked for slowly breathing in and hold, and then to relax while breathing out. I performed the same technique three times until I felt some releasing of the tissues during the relaxation phase.

Results of therapeutic unit: After this therapeutic unit I felt some nice releasing of the tissues while we were performing the PIR techniques. Even if the patient had a problem to understand the relaxing of the muscles as soon as he could achieve some relaxation the effect was obvious. Moreover, the traction of the shoulder was also hard for him to understand but at the end, I believe it will be effective.

Self-therapy: We didn't add any more exercises as he still has his morning exercise for stretching of the hip flexors muscles; self-stretching of both sides iliopsoas in the position we performed it during the therapeutic session of the previous day and he was also asked today to focus more on the feeling of the relaxation of the treated leg. We recommended 3 times each side.

Notes: There is some small problem of understanding the motions that we need him to perform, but maybe at the second or third try he makes it. We are still struggling with the relaxation phase.

4.1.36 Day3 26/01/2017 Morning session

Subjective feelings: Mr. K.J. came today in a very good mood. He said that he did his exercises. He says that his shoulder pain is decreased and that he feels like the therapy is effective also in the lower extremities. However, the pain in his knees remains the same as before.

Objective findings: After the PIR we performed yesterday and the stretching of the lower limbs we examined the tonicity of the hypertonic muscles and the length of the shorted muscles. Following the evaluation, we found that the length of the hip flexors is still the

same and the only change in a muscle was the reduction of the hypertonicity of the hip adductors which from hyper-hypertonic can be evaluated as just hypertonic. The scars of the extremities are still very restricted to all directions and there is no possibility of lifting them. We know that those scars are very old so the restriction of the tissues have been worsening for many years now and it will need a lot of time and many therapies until the tissues will release and be movable again. The joint play is better just on the distal and proximal interphalangeal joints. All the other lower extremities' joints are much restricted.

The goal of today's therapy: Decrease the pain, reduce the stiffness of the restricted soft tissue, increase the movability of the scars, increase the joint play of the joints that have restriction and improve the breathing mechanism while exercising.

Proposed therapy: Soft tissue techniques with the softball, soft tissue techniques for the scars, manual therapy techniques according to Lewit, exercising with a big swiss ball while activating the deep core stabilizers and using breathing.

Description of today's therapeutic unit: Today we repeated some procedures we have already performed in a previous therapeutic unit and we added some core stabilizing exercises with breathing.

- In our third therapy session for the lower extremities, we began with STT with a softball as it can help to release some of the restricted tissues and increase the circulation of the lower extremities and accelerate the healing process. By applying moderate pressure through the softball to the skin I performed circular motion firstly from the ventral part of the body from the distal to the proximal area of the upper extremities. Initially, I just tried to release the dorsal surface, first laterally and the medially, then I move to the shin area again circular movements from distal to proximal first laterally and then medially and I finished with the same pattern of movements with the ball from the knee to the most proximal part of the pelvis. When I finished with the ventral parts of both lower limbs, I moved to the dorsal side which I followed the same sequence.

- After that, I continued with soft tissue techniques on the scars of the legs by engaging a barrier by holding the tissues in C shape for 30 seconds and releasing. I did the same technique for all the 3 scars in all directions; medially, laterally, cranially and caudally. I tried to do the lifting tissues technique but it was not possible at this state.

- The next step was to proceed with joint play mobilization for the restricted joints of both lower extremities. We started from distal to proximal to additionally improve the blood circulation while we are working with the joints. We started from the distal and proximal interphalangeal joints of all the restricted toes and mobilizing them to all the restricted directions. Then we continued with the metatarsal joint by performing the fan-wise mobilization as well as mobilizing one bone against another, in both dorsal and plantar direction. Then we moved on to the tarsal bones and Chopart and Lisfranc joints. As soon as we tried to mobilize those we continued with mobilizing the subtalar and talocrural joints and then the tibiofibular joints which were mobilized in ventrolateral and dorsomedial directions. After that, we continued with the patellar joint and mobilization of the knee joint to both medial and lateral directions. Next, we added the sacroiliac joint mobilization in the prone position. All the mobilizations were performed from both restricted extremities. The fixation of the ankles is making our therapy less effective in my opinion.

- The last procedure for today was some basic exercises with the big swiss ball to activate the deep core stabilizers while breathing. With the patient supine, we started by placing the big swiss ball under his distal calf and heels. We started with simple breathing exercises. Firstly we instructed the patient to breathe from the upper ribs, then from the lower ribs and then from the abdomen. Afterward, I placed my hands on his upper chest and I asked him to breath under my hands. I did the same with the lower chest and the abdominal area. On the lower ribs I placed them dorsolaterally on the ribs and then on the abdomen I placed them alternative ventrally and laterally. As soon as we saw that the patient was able to perform the breathing exercises correctly we continued with the core activation. We asked him to try to keep his shoulders relaxed, activate abdominal muscles so the ribs will be pushed down to the table and let the lower extremities relaxed on the big

ball. He was instructed to do this exercise keep it there for about 10-15 seconds and then relax. We did this core activating exercise five times.

Results of therapeutic unit: After this therapeutic unit we saw some slight improvement in the mobility of the surgical scar on the right leg to the medial direction. The distal and proximal interphalangeal joints are much better but in some of them, there is still a restriction. The Lisfranc and Chopart joint start to show some signs of joint play. The patient also says that his feet don't feel that stiff.

Self-therapy: As self-therapy, we decided to ask the patient for some breathing exercises. We asked him to lie on his back with his knees flexed. Then he should place his both hands on his upper ribs and try to breathe under his palm. Then place his hands ventrolateral on the lower ribs and breath there and then place his hands on his abdomen and breathe in that area. He should breathe at each area ten times starting from the upper ribs and then move caudally. We recommended him to do this procedure three times per day, but to avoid doing it after he eats.

4.1.37 Day3 26/01/2017 Afternoon session

Subjective feelings: The patient came as usually in a good mood for therapy. He is always willing to do his exercises.

Objective findings: We began today by evaluating the active movements of the shoulder; flexion, extension, abduction, internal and external rotation. Some of the AM were improved. The improvement of the ROM is shown in the chart below.

	Movement	Initial examination		Today's examination	
		R	L	R	L
Shoulder joint	FLEX	145	120	150	125
	EXT	20	20	20	20
	ABD	110	85	110	90
	ADD	0	0	0	0
	IR	35	25	35	25
	ER	70	45	70	50

Table 16: Shoulder ROM assessment on 26/01/2017.

The goal of today's therapy: Decrease the pain, release restricted tissues, elongate the shorted pectoral muscles, relax the hypertonic muscles of the upper extremities, increase the joint play of the glenohumeral joint, improve the gait pattern, improve the walking on stairs pattern of the patient.

Proposed therapy: Soft tissue techniques with the softball, stretching exercises for the pectoral muscles, post isometric relaxation techniques for the hypertonic muscles of both sides and traction technique with a combination of PIR for the restricted shoulder joint, re-educate the gait pattern and the correct way of walking up and down the stairs.

Description of today's therapeutic unit:

This therapeutic unit is also similar procedures from other days. Additionally today we were trying to correct the walking pattern of our patient.

- We started with soft tissue techniques with a softball to reduce the restriction of the soft tissues of the upper body and also improve the circulation of the blood. The patient is supine and by applying moderate pressure through the softball to the skin I began in the area of the pectoralis major muscle. With small circular motions I had as my initial point the sternum and by following the direction of the pectoral fibers I end up at the area of the shoulder. Then I continue with the most later part of the upper trapezius muscle. With the same circular motions and by starting this time from the shoulder I end up with the lateral part of occiput where the trapezius muscle origins. The last part of soft tissues I tried to release by using the same technique it was the dorsal side of the trapezius, mostly the upper part, and as much as I could reach from the middle part of the trapezius while the patient was in prone position. Every time that I was done treating one of the parts of one side, I then continued by treating the other side before I move on to another part.

- The following part of this therapy it was the stretching of the pectoral muscles. The patient was lying on the side of the treatment table with his treated arm to be hanging outside of the edge. He had his knees bent on a cylindrical cushion to prevent any lordosis of his low back. We stretch the pectoral muscles part by part by using the position of the length test by Janda. First, we did our fixation and then we stretched one side. We started with stretching the lower part of pectoralis major by leaving the arm hanging in the most elevated position, then we continued with the middle part and the arm in the middle position and then we finished with pectoralis major by stretching the upper part in a lower position. Lastly, we did the stretching of pectoralis minor on by live the arm hanging fully outside of the table and parallel with it. Every time we asked the patient to keep the stretching for 20 seconds. When there was pain, we were reducing a little bit the ROM. As soon as we were done with the one side we were moving on to the other side.

- We proceeded with post isometric relaxation according to Lewit, to reduce the higher tonus of some muscles in the shoulder area. We performed this technique for supraspinatus muscle, trapezius muscle internal rotators of the shoulder and external rotators of the shoulder. We were doing this until we were feeling some release of the tissues and see that the barrier was moving.

- The next therapy was traction of the shoulder with a combination of PIR. The patient was supine with his arm abducted. I was sitting between the axilla and thorax to fixate the thorax. I grasped the distal humerus the wrist of the patient, I took up the slack by performing traction of the arm and I asked the patient to slightly resist my motion. After that, I asked for slowly breathing in and hold, and then to relax while breathing out. I performed the same technique three times until I felt some releasing of the tissues during the relaxation phase.

- Then we were trying to correct the walking mechanism of the patient, with always respect the deformities of his limbs. We were walking with the crutches and his shoes on, in the corridor of the hospital. The patient was instructed to try as much as he can to perform the dorsiflexion and plantarflexion of his both ankle joints. We were trying to stabilize his upper body to prevent the later flexion and the alternative shoulder elevation. Additionally, when he was trying to correct something he kept watching the floor and increases the kyphosis of his thoracic spine, so we were trying to help him look forward and straighten his spine. We were using the 2-point gait.

- Our last procedure was to correct the sequence of walking up and down the stairs. I was standing behind the patient to prevent any instability and falling off the stairs. Then I instructed him to lift first the leg that had the biggest problem and place it one step above. After that place the better leg on the step and then bring the crutches to the same step with his legs. While walking down the stairs, I was standing in front of him to protect again from falling. He was instructed to place the crutches one step lower, after that the most affected limb and then bring also the better limb to the same step as the other.

Results of therapeutic unit: The shoulder therapy seems to be very effective. The patient says that he feels better after every session. The ROM is increasing, the PIR is working effectively as well as the combined with the traction. The patient was following nicely the instructions for the walking.

Self-therapy: For today we asked him to keep in mind the correct way of walking and he should also do the breathing exercises that we set as our goal during the morning session; He was asked to lie on his back with his knees flexed. Then he should place his both hands on his upper ribs and try to breathe under his palm. Then place his hands ventrolateral on the lower ribs and breath there and then place his hands on his abdomen and breathe in that area. He should breathe at each area ten times starting from the upper ribs and then move caudally. We recommended him to do this procedure three times per day, but to avoid doing it after he eats.

Notes: The relaxation phase is still not perfect but is getting better as well as following the instructions correctly.

4.1.38 Day4 27/01/2017 Morning session

Subjective feelings: Patient came today for therapy and he said that he feels that his body is getting better, both the knee pain and the shoulder pain are decreased. He told us that he did his breathing exercises twice the day before and once today just before he came for his therapy.

Objective findings: He is correcting as much he can his walking pattern. Sometimes he forgets and looks down; consequently, he increases his back kyphosis. Almost all the DIP and PIP joints are released, as well as the MTP joints. The Lisfranc and Chopart joints are better movable. The ROM of the ankle is almost the same. Only the dorsiflexion of the right feet is increased from -20 degrees to -15 degrees. The surgical scar on the right tibia is better, easier to shift it to the medial direction. The other two scars on the legs are still

immobile. The left iliopsoas has a softer barrier but I would still evaluate them the same as the initial examination.

The goal of today's therapy: Decrease the pain, increase the movability of the scars, increase the joint play of the joints that have restriction, relax the hypertonic muscles, increase the tibiofemoral space, improve the breathing mechanism while exercising, improve the deep core stabilizers and improve the proprioceptive sensation

Proposed therapy: Soft tissue techniques for the scars, manual therapy techniques according to Lewit, PIR exercises for the hypertonic muscles, traction techniques for the knee joint according to Lewit, exercising with a big swiss ball while activating the deep core stabilizers and using breathing and Posturomed exercising.

Description of today's therapeutic unit:

Today, after the usual procedures we do to restore the musculoskeletal problems, we added more deep core exercises and proprioceptive exercises.

- I started today my therapy with STT on the scars of the legs by engaging a barrier by holding the tissues in C shape for 30 seconds and releasing. I did the same technique for all the 3 scars in all directions; medially, laterally, cranially and caudally. The scars are starting to get more movable.

- The second therapy was joint play mobilization for the restricted joints of both lower extremities. We started from distal to proximal to additionally improve the blood circulation while we are working with the joints. We started from the distal and proximal interphalangeal joints of all the restricted toes and mobilizing them to all the restricted directions. Then we continued with the metatarsal joint by performing the fan-wise mobilization as well as mobilizing one against each other in both dorsal and plantar direction. After we moved on to the tarsal bones and Chopart and Lisfranc joints. As soon

as we tried to mobilize those we continued with mobilizing the subtalar and talocrural joints and then the tibiofibular joints which were mobilized in ventrolateral and dorsomedial directions. Then I mobilized the patellar joint, and we moved on to the mobilization of the knee joint to both medial and lateral directions. The last mobilization technique was for the sacroiliac joint in prone position. All the mobilizations were performed to both restricted extremities.

- The next technique was post isometric relaxation of the hypertonic muscles to normalize their tonus. We performed this technique according to Lewit and it was for gluteal muscle, iliopsoas, rectus femoris, hamstrings, hip adductors and triceps surae just on the side that we found hypertonicity.

- We continued with traction techniques in a prone position by Lewit to increase the tibiofemoral joint space. The patient was lying in relaxed prone position and we just asked him to not add any effort to do something during this procedure. Then I lowered the table as much as I could and I passively flexed the knee joint to 90 degrees, fixed the distal part of the thigh with the plantar surface of my foot and try to lift the lower leg by holding it above the ankle joint. I kept the position until I could feel the releasing during the releasing phase of the knee joint. The same technique was performed on the other leg as well.

- Following the basic exercises we did yesterday we will continue with some more complex today after we finish the repeating. With the patient supine, we started by placing the big swiss ball under his distal calf and heels. We started with simple breathing exercises. Firstly we instructed just verbally the patient to breath from the upper ribs, then from the lower ribs and then from the abdomen, so it will open to all directions. Afterward, I placed my hands on his upper chest and I asked him to breath under my hands. I did the same with the lower chest and the abdominal area. On the lower ribs I placed them dorsolaterally on the ribs and then on the abdomen I placed them alternative ventrally and laterally. As soon as we saw that the patient was able to perform the breathing exercises correctly we continued with the core activation. We asked him to try to keep his shoulders relaxed, activate abdominal muscles so the ribs will be pushed down to the table and let the

lower extremities relaxed on the big ball. He was instructed to do this exercise and keep it there for about 10-15 seconds and then relax. We did this core activating exercise three times. Then we asked the patient to activate his core muscles the way we taught him and keep the position while I was trying to move the ball latero-laterally or craniocaudally. I was giving moderate pressure on the ball and the patient was keeping it at the place. We were performing this exercise for about 15 seconds and then relaxing. We did it 3 times. The next exercise was to activate his core muscles and move the ball actively latero-laterally. Exercising 15 seconds and then relaxing. He repeated 3 times. After that, we brought the ball more caudally and the contact was just on the heels with semi-flexed knees this time. Then he activated the core muscle and he was moving the ball craniocaudally and then caudocranially, 15 seconds exercising, then relaxing, and repeating 3 times. Today we added just those 3 new exercises so the patient will not get confused.

- Today, for our last procedure we introduced him the Posturomed. For the first time, we are doing just a few basic exercises. All the exercises were performed with his special shoes on. We asked the patient to get on the Posturomed. At the beginning, we confirmed that he was able to stand without any problem. Then we asked him to do walking in place, without displacement, for about twenty seconds. Then he was resting for twenty seconds and we did this circle 3 times. Our next exercise was walking on the place again but with high knees. We did the same circle 3 times again, 15 seconds and relaxing but after that the patient got tired, so that was enough for today.

Results of therapeutic unit: After the exercising, the patient got a little bit tired today. However, the joint play mobilization with a combination of the PIR seems to be working. We will let the patient rest during the weekend and we re-evaluate on our next session. I am expecting some decreasing of the knee pain.

Self-therapy: I would like him to work with his deep core muscles so he has to repeat the breathing exercises with activation of those muscles. I asked him to lie on his back with his knees flexed and activate his core muscles by bringing the ribs down to the table while he is activating his abdominal muscles. Then he should place his both hands on his upper ribs and try to breathe under his palm. Then place his hands ventrolateral on the lower ribs and

breath there and then place his hands on his abdomen and breathe in that area. He should breathe at each area ten times starting from the upper ribs and then move caudally. We recommended him to do this procedure three times per day, but to avoid doing it after he eats.

Notes: The patient is working hard and without complaining. They will also have group exercising on Saturday.

4.1.39 Day5 30/01/2017 Morning session

Subjective feelings: Patient came for the therapy today with a lot of confidence and increased mood. He said he had a very nice sleep during the weekend. The pain in the shoulder and knees is much decreased and he doesn't feel it that much during walking. As he said he did his exercises.

Objective findings: The mobility of the scars is improving well. Today we found out that the necrotic have some signs of releasing. However lifting is not possible to none of the scars. The ROM of the ankle joint is the same but today the AM was more fluent. The fascias of the left lower limb are more movable than the initial examination, the right side is still very restricted. Additionally, the distal interphalangeal and proximal interphalangeal joints are restored.

The goal of today's therapy: Decrease the pain, increase the movability of the scars and fascias, increase the joint play of the joints that have a restriction, relax the hypertonic muscles, increase the tibiofemoral space, improve the deep core stabilizers and improve the sensomotoric sensation.

Proposed therapy: Soft tissue techniques for the scars, soft tissue techniques for fascia according to Lewit, manual therapy techniques according to Lewit, PIR exercises for the hypertonic muscles, traction techniques for the knee joint according to Lewit, exercising with a big swiss ball while activating the deep core stabilizers and using breathing and sensomotoric exercises.

Description of today's therapeutic unit:

Today we started some sensomotoric exercises according to Janda & Vavrova.

- The first therapy today was soft tissue techniques on the scars of the legs by engaging a barrier by holding the tissues in C shape for 30 seconds and releasing. I did the same technique for all the 3 scars in all directions; medially, laterally, cranially and caudally.

- Today were performing also fascia techniques according to Lewit on the restricted fascia of the lower extremities. We were holding the fascia, we engaged the barrier by performing rotation about a longitudinal axis and then we were treating them by a wringing movement with both hands in opposite directions.

- The following therapy was joint play mobilization for the restricted joints of both lower extremities. We started from distal to proximal to additionally improve the blood circulation while we are working with the joints. The DIP and PIP joints are restored on both sides, so we started with the metatarsal joint by performing the fan-wise mobilization as well as mobilizing one against each other in both dorsal and plantar direction. Then we moved on to the tarsal bones and Chopart and Lisfranc joints. As soon as we tried to mobilize those we continued with mobilizing the subtalar and talocrural joints and then the tibiofibular joints which were mobilized in ventrolateral and dorsomedial directions. After that, we move to the patellar joint, and we finished our joint mobilization with the knee joint to both medial and lateral directions. All the mobilizations were performed for restricted parts of both extremities.

- The next technique was post isometric relaxation of the hypertonic muscles to normalize their tonus. We performed this technique according to Lewit and it was for gluteal muscle, iliopsoas, rectus femoris, hamstrings, hip adductors and triceps surae just on the side that we found hypertonicity.

- After relaxing the muscles and joints we continued with traction techniques in the supine position by Lewit to increase the tibiofemoral joint space. The patient was lying in relaxed prone position and we just asked him to not add any effort to do something during this procedure. Then I lowered the table as much as I could and I passively flexed the knee joint to 90 degrees, fixed the distal part of the thigh with the plantar surface of my foot and try to lift the lower leg by holding it above the ankle joint. I kept the position until I could feel the release of the knee joints. The same technique was performed on the other leg as well. The left leg had better releasing face.

- Today we just performed once the breathing exercises the same way we have been doing it the previous times. After that, we started again with the core activation the same way we did it before. Later we started to perform our exercises. We asked the patient to activate his muscles the way we thought him and keep the position while I was trying to move the ball latero-laterally or craniocaudally. I was giving moderate pressure on the ball and the patient was keeping it at the place. He was holding there for about 15 seconds and then relaxing. We did it 3 times. The next exercise was to activate his core muscles and move the ball actively latero-laterally. Exercising 15 seconds and then relaxing. He repeated 3 times. After that, we brought the ball more caudally and the contact was just on the heels with semi-flexed knees this time. Then he activated the core muscle and he was moving the ball craniocaudally and then caudocranially, 15 seconds exercising, then relaxing, and repeating 3 times. Those were repeating exercises. After that, we continued with our new ones. He let the lower legs on the big ball and after activating the core muscles he was instructed to push down to the ball without moving the rest of his body. Again 3 repetitions, 15 seconds activation and pushing and then relaxing. The next exercise was the bridge exercise with the feet on the ball. The patient did 5 repetitions and then resting. The whole circle was repeated 3 times. The last exercise is without the big ball. The patient keeps the feet on the treatment table with flexed knees. Between his knees, he places an oveball. Then he performs the bridge exercise but without letting the ball fall and he holds the position for 5 seconds. This was repeated 5 times.

- The last thing for today was to train the small foot according to Janda & Vavrova. First of all, we facilitated the plantar surface of the foot with a spikes ball in an upright sitting position. We asked the patient to place the spike ball underneath his heel and then start to move it actively forward and backward, about 15 times on both feet. Then we continued with the small foot in sitting position. We started with passive modeling, the plantar surface is on the ground and the toes look forward. I placed one hand behind the heel and with the other, I was holding and slightly squeezing together the metatarsals from above, after that, I did vibratory movements to shorten and lengthen the sole, and I repeated four times. Later we tried to do it semi-active - with the help of the patient but he was not able to do it so we repeated the passive modeling four more times. This exercise was performed on both sides.

Results of therapeutic unit: The condition of the patient is improving slowly but nicely. The fascias of the left lower leg are much more movable to the lateral direction. Additionally, the joint play of the MTP joints is restored, and the Lisfranc and Chopart joints are slightly restricted on the left side. There is also the better shifting of the tibiofibular joint to the dorsomedial direction. Moreover, the breathing exercises are performed correctly.

Self-therapy: For today the patient has to practice the short foot exercising. First, he should stimulate his plantar surface by brushing with his hand or taping it. Then he should fixate by place the back of his heel on the leg of the chair and then he has to try to activate the plantar muscles. He should do that 3-4 times, 3 times per day. The toes should be relaxed.

Notes: He has some difficulty controlling two - three tasks together.

4.1.40 Day5 30/01/2017 Afternoon session

Subjective feelings: No change since the morning session.

Objective findings: Like every time we were checking the AM of the shoulder. We also observed that the scapulohumeral rhythm has a more fluent motion on both sides. The pectoral muscles are still shorted.

	Movement	Initial examination		Today's examination	
		R	L	R	L
Shoulder joint	FLEX	145	120	150	130
	EXT	20	20	20	20
	ABD	110	85	110	90
	ADD	0	0	0	0
	IR	35	25	35	25
	ER	70	45	70	50

Table 17: Shoulder ROM assessment on 30/01/2017.

The goal of today's therapy: Decrease the pain, elongate the shorted pectoral muscles, relax the hypertonic muscles of the upper body increase the ROM of the shoulder and increase the joint play of the glenohumeral joint.

Proposed therapy: Stretching exercises for the pectoral muscles, post isometric relaxation techniques for the hypertonic muscles of both sides, PNF techniques for relaxation and increase of the ROM and traction technique with combination of PIR for the restricted shoulder joint

Description of today's therapeutic unit:

During this therapeutic unit, we added PNF techniques to increase the ROM.

- Today we began our treatment with stretching of the pectoral muscles. The patient was lying on the side of the treatment table with his treated arm to be hanging outside of the edge. He had his knees bent on a cylindrical cushion to prevent any lordosis of his low back. We stretch the pectoral muscles part by part by using the position of the length test by Janda. First, we did our fixation and then we stretched one side. We started with stretching the lower part of pectoralis major by leaving the arm hanging in the most elevated position, then we continued with the middle part and the arm in the middle position and then we finished with pectoralis major by stretching the upper part in a lower position. Lastly, we did the stretching of pectoralis minor on by live the arm hanging fully outside of the table and parallel with it. Every time we asked the patient to keep the stretching for 20 seconds. When there was pain, we were reducing a little bit the ROM. As soon as we were done with the one side we were moving on to the other side.

- We proceeded with post isometric relaxation according to Lewit, to reduce the higher tonus of some muscles in the shoulder area. We performed this technique for supraspinatus muscle, trapezius muscle internal rotators of the shoulder and external rotators of the shoulder. We were doing this until we were feeling some release of the tissues and see that the barrier was moving.

- Today we showed for the first time the proprioceptive neuromuscular facilitation. First of all, I showed the patient passively the first diagonal pattern of the upper extremity. Then after we performed it passively I explained the patient the principles of the contraction-relaxation technique and we performed it slowly together. When I was reaching the limitation I was asking for contraction to the opposite direction of our motion and then relaxation. We did about 5 times to both flexion and extension patterns. Then we did the same with the other arm. Afterward, we continued with the second flexion and extension diagonal patterns also on both arms. For the first time, we didn’t do any active PNF techniques.

- The last therapy was traction of the shoulder with a combination of PIR. The patient was supine with his arm abducted. I was sitting between the axilla and thorax to fixate the thorax. I grasped the distal humerus the wrist of the patient, I took up the slack by performing traction of the arm and I asked the patient to slightly resist my motion. After that, I asked for slowly breathing in and hold, and then to relax while breathing out. I performed the same technique I felt the releasing of the tissues during the relaxation phase.

Results of therapeutic unit: All the techniques show results the same time. The ROM is increasing after each therapy even a little bit and the pain is reducing.

Self-therapy: Patient should to the therapy was instructed during the morning session; practice the short foot exercising. First, he should stimulate his plantar surface by brushing with his hand or taping it. Then he should fixate by place the back of his heel on the leg of the chair and then he has to try to activate the plantar muscles. He should do that 3-4 times, 3 times per day. The toes should be relaxed.

4.1.41 Day6 31/01/2017 Morning session

Subjective feelings: He came today ready to practice and he said that he did his previous day's exercising, but it was very hard for him and he is not sure if he was doing it correctly. Although he mentioned that he was feeling much better, less stiff in his feet and less pain on both knees.

Objective findings: At the beginning of our session we examined the process of the ROM improvement. The Lisfranc and Chopart joints on the left side are not restricted anymore, but on the right side, they are. Also, the patellar and tibiofibular joint of the left leg are in much better condition but they are still restricted.

	Movement	Initial examination		Today's examination	
		R	L	R	L
Ankle joint	DORS	-20	10	-10	10
	PLANT	20	20	20	25
	INV	0	0	0	0
	EVER	0	0	0	0

Table 18: Ankle ROM assessment on 31/01/2017.

The goal of today's therapy: Decrease the pain, increase the movability of the scars and fascias, increase the joint play of the joints that have restriction, relax the hypertonic muscles, increase the tibiofemoral space, increase the ROM of the restricted joints, improve the deep core stabilizers and improve the sensomotoric and proprioceptive sensation.

Proposed therapy: Soft tissue techniques for the scars, soft tissue techniques for fascia according to Lewit, manual therapy techniques according to Lewit, PIR techniques traction techniques for the knee joint according to Lewit, exercising with AM and wobble board, sensomotoric exercises and proprioceptive exercises with Posturomed and rocket board.

Description of today's therapeutic unit:

As we continue with the therapies and the musculoskeletal condition is improving we are adding more coordinating exercise and proprioceptive and sensomotoric exercises to improve the quality of the movement.

- We started our therapeutic unit with soft tissue techniques on the scars of the legs by engaging a barrier by holding the tissues in C shape for 30 seconds and releasing. I did the same technique for all the 3 scars in all directions; medially, laterally, cranially and caudally. We were trying to lift the scar but that was to possible.

- Then performing also fascia techniques according to Lewit on the restricted fascia of the lower extremities. We were holding the fascia, we engaged the barrier by performing rotation about a longitudinal axis and then we were treating them by a wringing movement with both hands in opposite directions.

- The following therapy was joint play mobilization for the restricted joints of both lower extremities. We started from distal to proximal to additionally improve the blood circulation while we are working with the joints. The DIP, PIP, MTP are released on both sides. Lisfranc and Chopart joints are restricted just on the right leg. As soon as we tried to mobilize those we continued with mobilizing the subtalar and talocrural joints, then the tibiofibular joints which were mobilized in ventrolateral and dorsomedial directions and right patellar joint. We continue with joint mobilization with the knee joint to both medial and lateral directions and we finish with the mobilization of the sacroiliac joint in prone position. All the mobilizations were performed from both restricted extremities.

- We moved on to the post isometric relaxation of the hypertonic muscles to normalize their tonus. We performed this technique according to Lewit and it was for gluteal muscle, iliopsoas, rectus femoris, hamstrings, hip adductors and triceps surae just on the side that we found hypertonicity.

- Then we continued with traction techniques in a prone position by Lewit to increase the tibiofemoral joint space. The patient was lying in relaxed prone position and we just asked him to not add any effort to do something during this procedure. Then I lowered the table as much as I could and I passively flexed the knee joint to 90 degrees, fixed the distal part of the thigh with the plantar surface of my foot and try to lift the lower leg by holding

it above the ankle joint. I kept the position until I could feel some release. The same was performed on the other leg as well. On both legs, the releasing phase is better.

- Following, I let the patient sit straight on the table with his feet on the ground. I asked him to flex and extend his toes and bring the feet forward, two or three times. Then flex and extend again the toes and bring the feet backward. We did this exercise five times. After that, he has to bring the toes and the heel alternatively laterally and then alternatively medially. Afterward, we started exercising with ankle and plantar flexion. The patient performed 10 repetitions each leg, one by one so he could be more focused on each foot and on the quality of the movements.

- After the AM we moved on to sensomotoric exercises according to Janda & Vavrova. First of all, we stimulate the plantar surface of the foot but this time we did it with a wobble spikes board in an upright sitting position. The patient was actively dorsal and plantar flexing the ankle. Then we continued with the small foot in sitting position. We started with passive modeling, the plantar surface is on the ground and the toes look forward. I placed one hand behind the heel and with the other, I was holding and slightly squeezing together the metatarsals from above, after that, I did vibratory movements to shorten and lengthen the sole, and I repeated four times. Later we tried again to do it semi-active - with the help of the patient. This time I could feel barely the contraction while I was palpating. We repeated five times.

- The last procedure for today is used for proprioceptive stimulation. We began be redoing the exercises from the previous time. All the exercises were performed again with his special shoes on. We asked the patient to get on the Posturomed and we asked him to do walking in place, without displacement, for about twenty seconds, relaxing for twenty-second and repeat 3 times. Our next exercise was walking on the place again but with high knees, 3 circles of exercising, 15 second and relaxing. Then we started with the new exercises. We asked the patient to stand on the Posturomed with one leg for 5 seconds and then change leg. Repeat it 2 times each leg. After that, we asked him to step up and down of the Posturomed slowly and with controlled movement, he should step up and down 10

times then takes a break and then again. To increase the proprioception of the patient we added exercises with rocket board. We helped him get on the board while he was holding from the Swedish ladder - wall bar, and then we asked him to perform dorsal and plantar flexion. Then we told him to stop holding the bars and try to keep his. Sometimes he was losing it. Later we turned the rocket board and we asked him to shift his weight to the sides firstly by holding the bars and then releasing. We did those exercises 10 times each.

Results of therapeutic unit: The condition of the patient is improving. The patellar joint of both extremities is restored as well as the Lisfranc and Chopart joints. The scar tissues are getting also better with the scar on the left leg to be more movable on the parallel part with the Achilles to the medial direction and his perpendicular part with the Achilles to be more movable to the cranial direction. The fascia of the left leg on the part of the lower leg is not anymore restricted on the ventral side.

Self-therapy: For self-therapy, we asked the patient to do the AM of the feet by sitting straight on a chair with his feet on the ground and flex and extend his toes and bring the feet forward, two or three times. Then flex and extend again the toes and bring the feet backward. Repeat five times each leg. After that, he has to bring the toes and the heel alternatively laterally and then alternatively medially. Afterward, do ankle and plantar flexion. The patient should do 10 repetitions each leg, one by one so he could be more focused on each foot and on the quality of the movements.

Notes: Patient has a problem with the semi-active modeling of the small foot.

4.1.42 Day6 31/01/2017 Afternoon session

Subjective feelings: Patient said that the pain of the shoulder was all the time reducing and that he feels the effectiveness of the therapy.

Objective findings: The ROM of the shoulder of the patient is increasing. Below in the chart, there are the findings after examination of the active ROM. Additionally, today we

checked the tonus of the upper extremities and we found that the tonus of the supraspinatus muscles and pectoral muscles is better than how it was.

	Movement	Initial examination		Today's examination	
		R	L	R	L
Shoulder joint	FLEX	145	120	160	140
	EXT	20	20	25	20
	ABD	110	85	115	100
	ADD	0	0	0	0
	IR	35	25	40	25
	ER	70	45	70	50

Table 19: Shoulder ROM assessment on 31/01/2017.

The goal of today's therapy: Decrease the pain, release the restriction of the soft tissues, elongate the shorted pectoral muscles, increase the ROM of the shoulder and improve the coordination of the movements.

Proposed therapy: Soft tissue techniques for the restricted tissues, stretching exercises for the pectoral muscles, PNF techniques for relaxation and increase of the ROM and exercises with a swiss ball.

Description of today's therapeutic unit:

Today we started exercising with the big swiss ball to correct the movement patterns.

- Today we started with soft tissue techniques with a softball to reduce the restriction of the soft tissues of the upper body and also improve the circulation of the blood. The patient is supine and by applying moderate pressure through the softball to the skin I began in the area of the pectoralis major. With small circular motion I had as my initial point the sternum and by following the direction of the pectoral fibers I end up at the area of the shoulder. Then I continue with the most later part of the upper trapezius muscle. With the same circular motion and by starting this time from the shoulder I end up with the lateral part of occiput where the trapezius muscle starts. The last part of soft tissues I tried to release by using the same technique it was the dorsal side of the trapezius, mostly the upper part, and as much as I could reach from the middle part of the trapezius while the patient was in prone position. Every time that I was done treating one of the parts of one side, I then continued by treating the other side before I move on to another part.

- Later we did stretching of the pectoral muscles. The patient was lying on the side of the treatment table with his treated arm to be hanging outside of the edge. He had his knees bent on a cylindrical cushion to prevent any lordosis of his low back. We stretch the pectoral muscles part by part by using the position of the length test by Janda. First, we did our fixation and then we stretched one side. We started with stretching the lower part of pectoralis major by leaving the arm hanging in the most elevated position, then we continued with the middle part and the arm in the middle position and then we finished with pectoralis major by stretching the upper part in a lower position. Lastly, we did the stretching of pectoralis minor on by live the arm hanging fully outside of the table and parallel with it. Every time we asked the patient to keep the stretching for 20 seconds. When there was pain, we were reducing a little bit the ROM. As soon as we were done with the one side we were moving on to the other side.

- Then we continued with proprioceptive neuromuscular facilitation. First of all, I repeated passively the first diagonal pattern of the upper extremity. After that, we started the contraction-relaxation technique and we performed it slowly together. When I was

reaching the limitation I was asking for contraction to the opposite direction of our motion and then relaxation. We did about 5 times to both flexion and extension patterns. Then we did the same with the other arm. Afterward, we continued with the second flexion and extension diagonal patterns also on both arms.

- To improve the coordination of the shoulder movements we were exercising with the swiss ball. We let the patient sit on the table in an upright position with his lower limbs in right ankles and the feet on the ground. Then we placed the hand on a medium size swiss ball so the arm will be in abduction about 60 degrees in the frontal plane. We asked him to move the ball forward and backward controlled and slowly, 15 times, after that push on the ball and hold for 5 seconds and repeat 6 times. The last exercise for today was to hold the ball in place while I am trying to move it with light pressure. Then do the same exercises on the other arm.

Results of therapeutic unit: Our therapy of PIR with a combination of PNF is helping the patient a lot. It increases the range of motion and it improves the relaxing of the muscle to help them normalize the tonus. As the musculoskeletal condition is improving the pain is also decreasing.

Self-therapy: Today we just need him to focus on the morning exercising; AM of the feet by sitting straight on a chair with his feet on the ground and flex and extend his toes and bring the feet forward, two or three times. Then flex and extend again the toes and bring the feet backward. Repeat five times each leg. After that, he has to bring the toes and the heel alternatively laterally and then alternatively medially. Afterward, do ankle and plantar flexion. The patient should do 10 repetitions each leg, one by one so he could be more focused on each foot and on the quality of the movements.

4.1.43 Day7 01/02/2017 Morning session

Subjective feelings: Our patient came to our therapeutic room with increased mood and with less pain.

Objective findings: To begin today we started examining the tonus of the muscles. Our results are shown in the table below. There are some differences since the initial examinations. Some muscles are in better condition with an exception of the semi-muscles that today I found them hypertonic.

	Muscles	Initial examination		Today's examination	
		R	L	R	L
Muscle Tone	Gluteus maximous:	N	↑	N	N
	Iliopsoas:	N	↑	N	↑
	Tensor fasciae latae:	↑	N	↑	N
	Rectus femoris:	↑	N	↑	N
	Vastus medialis:	↓	N	N	N
	Vastus lateralis	N	N	N	N
	Adductors:	↑	↑↑	↑	↑
	Biceps femoris:	↑	N	N	N
	Semi muscles:	N	N	↑	↑
	Gastrocnemius:	↑	N	↑	N

Table 20: Muscle tone assessment on 01/02/2017.

The goal of today's therapy: Decrease the pain, increase the movability of the scars, elongate the shorted muscles, increase the joint play of the restricted joints, increase the

tibiofemoral space, improve the breathing mechanics, the deep core stabilizers, and the proprioceptive sensation.

Proposed therapy: Soft tissue techniques for the scars, stretching exercises, manual therapy techniques according to Lewit, traction techniques for the knee joint according to Lewit, breathing exercises, proprioceptive exercises with Posturomed and rocket board.

Description of today's therapeutic unit:

- We started our therapeutic unit with soft tissue techniques on the scars of the legs by engaging a barrier by holding the tissues in C shape for 30 seconds and releasing. I did the same technique for all the scars in all directions; medially, laterally, cranially, caudally.

- The next therapy it stretching exercises for the lengthening of the hip flexors and triceps surae of both sides. We let the patient lie on the table in the Thomas test position, then by holding the non-treated leg we asked him to move to the side of the treated leg and more cranially and let the treated leg to fall outside of the treatment table. We asked him to not let his not treated leg and try to relax the treated one for 20-30 seconds. Then we moved to the other leg with the same technique. The last exercise was stretching of the triceps surae the same way we perform the length test according to Janda. We reached the stretched position of the muscles and we kept it there for 20-30 seconds. Then we did the same stretching with the other leg. Stretching of the gastrocnemius muscle is hard.

- The following therapy was joint play mobilization for the restricted joints of both lower extremities. We started from distal to proximal to additionally improve the blood circulation while we are working with the joints. As soon as we tried to mobilize those we continued with mobilizing the subtalar and talocrural joints and then the tibiofibular joints which were mobilized in ventrolateral and dorsomedial directions. We finished with the knee joint to both medial and lateral directions and the sacroiliac mobilization in the prone position. All the mobilizations were performed for both restricted extremities.

- Then we continued with traction techniques in a prone position by Lewit to increase the tibiofemoral joint space. The patient was lying in relaxed prone position and we just asked him to not add any effort to do something during this procedure. Then I lowered the table as much as I could and I passively flexed the knee joint to 90 degrees, fixed the distal part of the thigh with the plantar surface of my foot and try to lift the lower leg by holding it above the ankle joint. I kept the position until I could feel some release. The same was performed on the other leg as well. On both legs, the releasing phase is better.

- Today we repeated the breathing exercises the same way we have been doing it the previous times. After that, we started again with the core activation the same way we did it before. Later we started to perform our exercises. We asked the patient to activate his muscles the way we thought him and keep the position while I was trying to move the ball latero-laterally or craniocaudally. I was giving moderate pressure on the ball and the patient was keeping it at the place. He was holding there for about 15 seconds and then relaxing. We did it 3 times. The next exercise was to activate his core muscles and move the ball actively latero-laterally. Exercising 15 seconds and then relaxing. He repeated 3 times. After that, we brought the ball more caudally and the contact was just on the heels with semi-flexed knees this time. Then he activated the core muscle and he was moving the ball craniocaudally and then caudocranially, 15 seconds exercising, then relaxing, and repeating 3 times. Next, he should let the lower legs on the big ball and after activating the core muscles he was instructed to push down to the ball without moving the rest of his body. Again 3 repetitions, 15 seconds activation and pushing and then relaxing. The next exercise was the bridge exercise with the feet on the ball. The patient did 5 repetitions and then relaxing. The whole circle was repeated 3 times. The last exercise is without the big ball. The patient keeps the feet on the treatment table with flexed knees. Between his knees, he places an overball. Then he performs the bridge exercise but without letting the ball fall and he holds the position for 5 seconds. This was repeated 7 times.

- The last procedure for today is used for proprioceptive facilitation, with his special shoes on. We asked the patient to get on the Posturomed Then we asked him to do walking in place, without displacement, for about twenty seconds. Then he was resting for twenty-

second and we did this circle 3 times. Our next exercise was walking on the place again but with high knees. We did the same circle 3 times again, 15 seconds and relaxing. Then we started with the new exercises. We asked the patient to stand on the Posturomed with one leg for 5 seconds and then change leg. Repeat it 4 times each leg. After that, we asked him to step up and down of the Posturomed slowly and with controlled movement, he should step up and down 10 times then takes a break and then again. Then we continued with the rocket board exercises. We helped him get on the board while he was holding from the Swedish ladder - wall bar, and then we asked him to perform dorsal and plantar flexion. Then we told him to stop holding the bars and to it. Later we turned the rocket board and we asked him to shift his weight to the sides firstly by holding the bars and then releasing. We did those exercises 15 times each.

Results of therapeutic unit: No matter how we are trying to elongate the shorted triceps surae muscles we are not effective. The joint play is much improved with the sacroiliac joints to be not restricted anymore on both sides. The left tibiofibular is as well restored.

Self-therapy: The self-therapy for today will be from the afternoon session.

4.1.44 Day7 01/02/2017 Afternoon session

Subjective feelings: Patient came excited for his shoulder exercises.

Objective findings: Like every time we started with re-evaluating the ROM of the active movements. The shoulder blade, while we were examining the shoulder abduction, was more fluent in both sides and the glenohumeral joint was not that stiff. The scapulas were moving symmetrically when I asked for bilateral abduction.

	Movement	Initial examination		Today's examination	
		R	L	R	L

Shoulder joint	FLEX	145	120	160	145
	EXT	20	20	25	25
	ABD	110	85	115	100
	ADD	0	0	0	0
	IR	35	25	40	30
	ER	70	45	70	60

Table 21: Shoulder ROM assessment on 01/02/2017.

The goal of today's therapy: Decrease the pain, relax the hypertonic muscles, increase the ROM of the shoulder, increase the glenohumeral space and relax the muscles around, strengthening and improve the coordination of the movements, improve the gait pattern, improve the walking on stairs pattern of the patient.

Proposed therapy: PIR techniques for the hypertonic muscles, PNF contraction-relaxation techniques to relax the muscles and increase the ROM, non-specific mobilization of the scapulas according to Lewit, traction of the shoulder joint according to Lewit, PNF slow reversal techniques for strengthening and exercises with the swiss ball and re-educate the gait pattern and the correct way of walking up and down the stairs.

Description of today's therapeutic unit:

More strengthening techniques are induced to our therapies.

- Today the first therapy was with post isometric relaxation according to Lewit, to reduce the higher tonus of some muscles in the shoulder area. We performed this technique for supraspinatus muscle, trapezius muscle internal rotators of the shoulder and external

rotators of the shoulder. We were doing this until we were feeling some release of the tissues and see that the barrier was moving.

- Then we proceeded with proprioceptive neuromuscular facilitation. Initially, I repeated passively the first diagonal pattern of the upper extremity. After that, we started the contraction-relaxation technique and we performed it slowly together. When I was reaching the limitation I was asking for contraction to the opposite direction of our motion and then relaxation. We did about 5 times to both flexion and extension patterns. Then we did the same with the other arm. Afterward, we continued with the second flexion and extension diagonal patterns also on both arms.

- The next therapy was the non-specific mobilization of the shoulder blade. With the patient prone, I was performing circling movements of the shoulder blade by holding it and the ipsilateral arm. I did the same for both sides.

- My following therapy after the relaxation was traction of the shoulder with a combination of PIR. The patient was supine with his arm abducted. I was sitting between the axilla and thorax to fixate the thorax. I grasped the distal humerus the wrist of the patient, I took up the slack by performing traction of the arm and I asked the patient to slightly resist my motion. After that, I asked for slowly breathing in and hold, and then to relax while breathing out. I performed the same technique on both arms until I felt the releasing of the tissues during the relaxation phase.

- Then I started with PNF techniques for strengthening. I used the slow reversal technique in both first and second diagonals. The patient knew the motion so I asked him to perform the first diagonal while I will be resisting. After that, we did the second diagonal. Those procedures were performed 3 times each diagonal for each upper extremity.

- To improve the coordination of the shoulder movements we performed our exercises with the swiss ball. We let the patient sit on the table in an upright position with

his lower limbs in right ankles and the feet on the ground. Then we placed the hand on a medium size swiss ball so the arm will be in abduction about 60 degrees in the frontal plane. We asked him to move the ball forward and backward controlled and slowly, 15 times, after that push on the ball and hold for 5 seconds and repeat 6 times. The last exercise for today was to hold the ball in place while I am trying to move it with light pressure. Then do the same exercises on the other arm.

- Then we were trying to correct the walking mechanism of the patient, with always respect the deformities of his limbs. We were walking with the crutches and shoes in the corridor of the hospital. The patient was instructed to try as much as he can to perform the dorsiflexion and plantarflexion of his both ankle joints. We were trying to stabilize his upper body to prevent the later flexion and the alternative shoulder elevation. Additionally, when he was trying to correct something he kept watching the floor and increases the kyphosis of his thoracic spine, so we were trying to help him look forward and straighten his spine. We were using the 2-point gait.

- Our last procedure was to correct the sequence of walking up and down the stairs. I was standing behind the patient to prevent any instability and falling off the stairs. Then I instructed him to lift first the leg that had the biggest problem and place it one step above. After that place the better leg on the step and then bring the crutches to the same step with his legs. While walking down the stairs, I was standing in front of him to protect again from falling. He was instructed to place the crutches one step lower, after that the most affected limb and then bring also the better limb to the same step as the other.

Results of therapeutic unit: After the therapeutic procedures today we checked the length of the upper limb muscles. We found changes in pectoralis major muscles on both sides. They got improved to grade 1 according to Janda.

Self-therapy: Pendulum exercise; We asked the patient to do lateral flexion his body to the side that wants to treat while and let his arm be pulled by the gravity. Then he should swing the arm but without activating many his muscles. The same exercise should be performed

on the other arm as well. He should do 10 times swinging forward-backward, latero-laterally and the 10 circles to each side but with the arm, all the time relaxed. Alternatively, he can lay prone on the edge of the bed with his arm hanging down and do the same exercises.

4.1.45 Day8 02/02/2017 Morning session

Subjective feelings: He came today and told us that he did our self-exercises and that the pain of the knees is much reduced.

Objective findings: The tonus of the muscles is improving except the semi muscles. The joint play from the most distal joint of the lower extremities until Chopart joints is restored bilaterally. Also the ROM of the ankle joint is boosting. The objective findings are shown in the chart below.

	Movement	Initial examination		Today's examination	
		R	L	R	L
Ankle joint	DORS	-20	10	-5	15
	PLANT	20	20	25	25
	INV	0	0	5	5
	EVER	0	0	5	5

Table 22: Ankle ROM assessment on 02/02/2017.

The goal of today's therapy: Decrease pain, improve the breathing mechanism while activating the core muscles while exercising, improve ROM, improve proprioceptive and sensomotoric sensation, increase the knee joint space.

Proposed therapy: Breathing exercises, deep core stabilizers activation exercises with big swiss ball, active movements, sensomotoric exercises, proprioceptive exercise with Posturomed and rocket basket, traction techniques for the knee joint according to Lewit.

Description of today's therapeutic unit:

This is our last therapy for the lower extremities so we are repeating some exercises that he can also perform also at home.

- Today we started by repeating the breathing exercises the same way we have been doing it the previous times. After that, we started again with the core activation the same way we did it before. Later we started to perform our exercises. We asked the patient to activate his muscles the way we thought him and keep the position while I was trying to move the ball latero-laterally or craniocaudally. I was giving moderate pressure on the ball and the patient was keeping it at the place. He was holding there for about 15 seconds and then relaxing. We did it 3 times. The next exercise was to activate his core muscles and move the ball actively latero-laterally. Exercising 15 seconds and then relaxing. He repeated 3 times. After that, we brought the ball more caudally and the contact was just on the heels with semi-flexed knees this time. Then he activated the core muscle and he was moving the ball craniocaudally and then caudocranially, 15 seconds exercising, then relaxing, and repeating 3 times. He let the lower legs on the big ball and after activating the core muscles he was instructed to push down to the ball without moving the rest of his body. Again 3 repetitions, 15 seconds activation and pushing and then relaxing. The next exercise was the bridge exercise with the feet on the ball. The patient did 5 repetitions and then relaxing. The whole circle was repeated 3 times. The last exercise is without the big ball. The patient keeps the feet on the treatment table with flexed knees. Between his knees, he places an overball. Then he performs the bridge exercise but without letting the ball fall and he holds the position for 7 seconds. This was repeated 8 times.

- Following, I let the patient sit straight on the table with his feet on the ground. I asked him to flex and extend his toes and bring the feet forward, two or three times. Then

flex and extend again the toes and bring the feet backward. We did this exercise five times. After that, he has to bring the toes and the heel alternatively laterally and then alternatively medially. Afterward, we started exercising with ankle and plantar flexion. The patient performed 10 repetitions each leg, one by one so he could be focused.

- After the AM we moved on to sensomotoric exercises according to Janda & Vavrova. First of all, we stimulate the plantar surface of the foot but this time we did it with a wobble spikes board in an upright sitting position. The patient was actively dorsal and plantar flexing the ankle. Then we continued with the small foot in sitting position. We started with passive modeling, the plantar surface is on the ground and the toes look forward. I placed one hand behind the heel and with the other, I was holding and slightly squeezing together the metatarsals from above, after that, I did vibratory movements to shorten and lengthen the sole, and I repeated four times. Later we tried again to do it semi-active - with the help of the patient. This time I could feel some more contraction while I was palpating. We repeated five times.

- Then we proceeded procedure for today is used for proprioceptive facilitation, with his special shoes on. We asked the patient to get on the Posturomed Then we asked him to do walking in place, without displacement, for about twenty seconds. Then he was relaxing for twenty-second and we did this circle 3 times. Our next exercise was walking on the place again but with high knees. We did the same circle 3 times again, 15 seconds and relaxing. Then we started with the new exercises. We asked the patient to stand on the Posturomed with one leg for 5 seconds and then change leg. Repeat it 6 times each leg. After that, we asked him to step up and down of the Posturomed slowly and with controlled movement, he should step up and down 10 times then takes a break and then again. Following we moved to rocket board exercises. We helped him get on the board while he was holding from the Swedish ladder - wall bar, and then we asked him to perform dorsal and plantar flexion. Then we told him to stop holding the bars and to it. Sometimes he was losing his balance. Later we turned the rocket board and we asked him to shift his weight to sides firstly by holding the bars and then releasing. We did those exercises 15 times each.

- We finished our last therapy for the lower extremities with traction techniques in a prone position by Lewit to increase the tibiofemoral joint space. The patient was lying in relaxed prone position and we just asked him to not add any effort to do something during this procedure. Then I lowered the table as much as I could and I passively flexed the knee joint to 90 degrees, fixed the distal part of the thigh with the plantar surface of my foot and try to lift the lower leg by holding it above the ankle joint. I kept the position until I could feel some release. The same technique was performed on the other leg as well.

Results of therapeutic unit: Better quality of the exercises.

Home self-therapy: For home exercising, I would recommend the patient some easy stretching and strengthening exercises.

a. Stretching of calf muscles:

The patient is standing with his back straight in front of a wall. He moves the not treated leg little bit more to the wall and the back leg straight behind him with the whole sole on the ground (if he is able to with his deformity). Then he pushes with his pelvis forward to the wall but without moving his feet. He should hold there 20-30 seconds and then relax for 20 more seconds. 2 repetitions each leg. (Figure 20-A)

b. Stretching of hamstrings muscles:

The patient should lie down and then lift the leg that he wants to treat and grasp it with his both hands. The knee of the treated leg should be straight. However, the other leg can be straight or flexed. For our patient, because of his lordosis, he should keep the second leg bent. He should hold 20-30 seconds and then the other leg. 2 repetitions each leg. (Figure 20-B)

c. Stretching of quadriceps muscles:

The patient is standing and holding from the wall or on a chair to balance himself. Then he has to flex one of his knees, grasp his foot from behind and try to bring his heel to his gluteal muscles without arching his back. He then holds this position for 20-30 seconds and then he does the same with the other leg. 2 repetitions each leg. (Figure 20-C)

d. Strengthening of calf muscles:

By holding a chair the patient should stand straight and look forward. He should slightly bend his not treated knee so it won't be touching the ground. He should start performing plantar flexion to elevate his heel from the ground and then go back again. 10 repetitions 2 sets each leg. (Figure 20-D)

e. Strengthening of hamstrings:

For this exercise, he should hold a chair or a wall again and by keeping his body straight he should bend his knee to bring it to the ceiling but without arching the back. He should try to keep his knees together. This exercise has to be repeated 10 times 2 sets each leg. (Figure 20-E)

f. Strengthening of quadriceps:

This time the patient is seated on a chair with his spine in an upright position and his lower extremities in right ankles. Then he slowly straitens his leg from the knee and then back to the ground. He should repeat 10 times 2 sets each leg. (Figure 20-F)

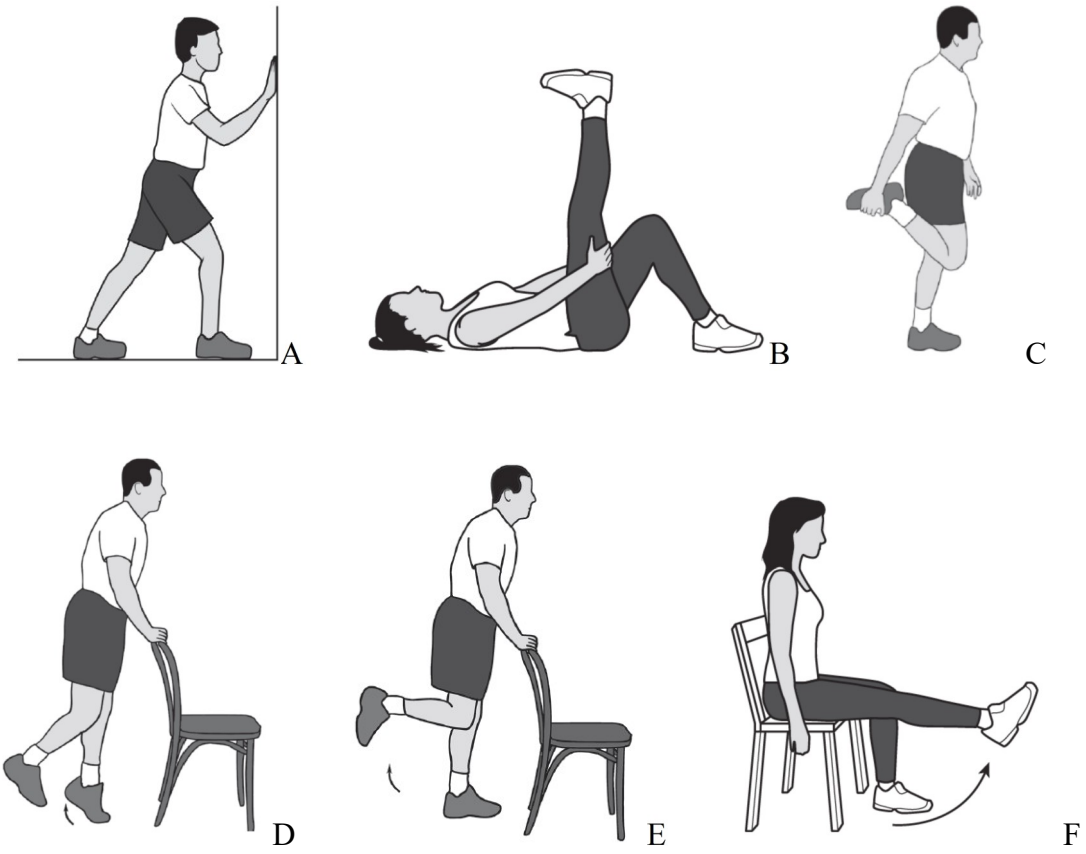


Figure 22: (A) Stretching of gastrocnemius,(B) Stretching of hamstrings,(C) Stretching of quadriceps, (D) Strengthening of calf muscles,(E) Strengthening of hamstrings,(F) Strengthening of quadriceps [47].

4.1.46 Day8 02/02/2017 Afternoon session

Subjective feelings: He is always on time and ready for exercising without complaining.

Objective findings: Today except for the AM ROM we are also examining again the tonus. Better tonicity was today found on the medial and lateral rotators muscles. Moreover, the acromioclavicular joint of the right extremity is restored.

	Movement	Initial examination	Today's examination

		R	L	R	L
Shoulder joint	FLEX	145	120	165	155
	EXT	20	20	30	30
	ABD	110	85	115	105
	ADD	0	0	0	0
	IR	35	25	45	30
	ER	70	45	70	60

Table 23: Shoulder ROM assessment on 02/02/2017.

The goal of today's therapy: Decrease the pain, relax the hypertonic muscles, release the restriction of the restricted soft tissues, increase the ROM of the shoulder, increase the glenohumeral space, strengthening and improve the coordination of the movements

Proposed therapy: Soft tissue techniques with a softball, PIR techniques for the hypertonic muscles, traction of the shoulder joint according to Lewit, PNF slow reversal techniques for strengthening and exercises with the swiss ball

Description of today's therapeutic unit:

During our last therapy, we were helping the musculoskeletal system as much as we could and we were performing some more exercises that can be used also for ADL.

- We started with soft tissue techniques with a softball to reduce the restriction of the soft tissues of the upper body and also improve the circulation of the blood. The patient is supine and by applying moderate pressure through the softball to the skin I began in the

area of the pectoralis major. With small circular motions I had as my initial point the sternum and by following the direction of the pectoral fibers I end up at the area of the shoulder. Then I continue with the most later part of the upper trapezius muscle. With the same circular motions and by starting this time from the shoulder I end up with the lateral part of occiput where the trapezius muscle origins. The last part of soft tissues I tried to release by using the same technique it was the dorsal side of the trapezius, mostly the upper part, and as much as I could reach from the middle part of the trapezius while the patient was in prone position. Every time that I was done treating one of the parts of one side, I then continued by treating the other side before I move on to another part.

- We moved to post isometric relaxation according to Lewit, to reduce the higher tonus of some muscles in the shoulder area. We performed this technique for supraspinatus muscle, trapezius muscle internal rotators of the shoulder and external rotators of the shoulder. We were doing this until we were feeling some release of the tissues and see that the barrier was moving.

- The next therapy was traction of the shoulder with a combination of PIR. The patient was supine with his arm abducted. I was sitting between the axilla and thorax to fixate the thorax. I grasped the distal humerus the wrist of the patient, I took up the slack by performing traction of the arm and I asked the patient to slightly resist my motion. After that, I asked for slowly breathing in and hold, and then to relax while breathing out. I performed the same technique on both arms until I felt the releasing of the tissues during the relaxation phase.

- Then I started with PNF techniques for strengthening. I used the slow reversal technique in both first and second diagonals. The patient knew the motion so I asked him to perform the first diagonal while I will be resisting. After that, we did the second diagonal. Those procedures were performed 5 times each diagonal for each upper extremity.

- For our last procedure, I let the patient sit in an upright position in front of the treatment table which is beneath the height of his chest. Then I placed the hand of the

patient on an overball in front of him with his elbow extended. Firstly I asked the patient to move the ball to the sides as much as he could without any pain, 10 repetitions each arm. Subsequently, I told the patient to push with his elbow extended to the ball initially while the ball is straight in front of the shoulder and then move it a little bit more laterally and the push again to the ball. He should continue more and more lateral to his full ROM, without any provocation of pain. For the next exercise, I placed the ball in front of his shoulder with his hand on it and I asked him to move the ball forward and backward, 10 repetitions each arm, again painless. After that I asked him, while he had the ball in front of his shoulder, to perform circular movements by flexing the elbow and extending in abduction the shoulder, 6 circles to each side, each arm. Then I went to the other side of the table and I placed my arms in front of him above the table. I asked the patient to grasp the swiss ball and bring it to my hand, once to my right hand and once in my left hand. While he was moving the ball I was arranging my hands in different heights and distances away from me. We performed the same exercises with his other arm, always with respect to the pain and limitations of the patient.

Results of therapeutic unit: Tomorrow morning the result will be shown in the final kinesiologic examination.

Home Self-therapy: Patient told us that he owns an overball ball, so he can use it to do the same exercises we have been doing here. Also, we added some stretching and strengthening exercises.

a. Stretching of the medial and lateral rotators

The patient is lying on his shoulder in right ankle abduction, as is shown in the picture (if it hurts he should decrease the amount of abduction) and he has his elbow in 90 degrees of flexion. He uses the above arm to push his arm down close to the belly and he holds there for 20-30 seconds. Then he brings it to the starting position and he pushes it down close to his head and again holds 20-30 seconds. Repeat 4 times each arm. (Figure 21-A)

b. Pendulum exercise

This is the same exercise as the patient had yesterday for self-therapy. Another alternative is that the patient can just lean slightly forward and let his affected arm hang free. Then perform the same movement; front-back, latero-lateral and circular motions to both directions. He should repeat 10 times each motion with each arm. (Figure 21-B)

c. Strengthening of scapular muscles

The patient is lying prone with his arms along his body. Then he activates his scapular muscles so his shoulder blades will move close to each other. He should hold there for 6 seconds and then relax 6 seconds. Repeat this exercise 10 times. (Figure 21-C)

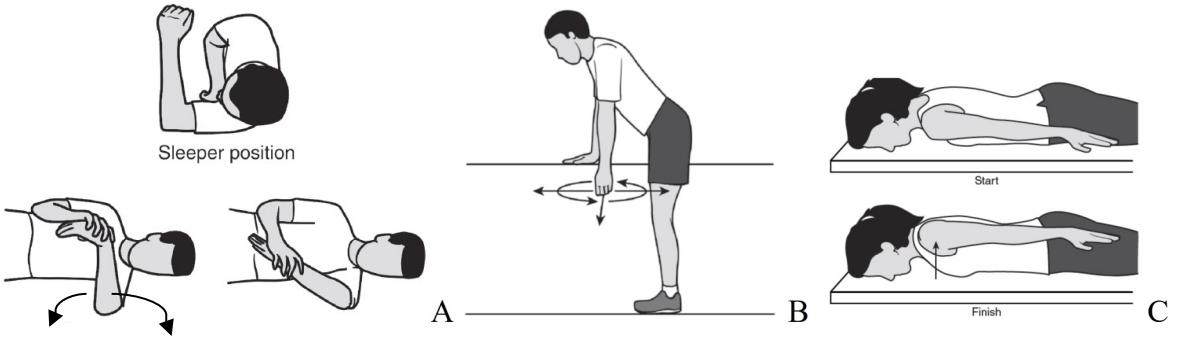


Figure 23: (A) Stretching of medial and lateral rotators, (B) Pendulum, (C) Strengthening of scapular muscles [47].

Notes: We gave the patient the home self-therapy from today to do them and show them to us again tomorrow so we will be sure that he performs the exercises correctly.

1.15 Final Kinesiologic examination

4.1.47 Postural examination (static)

4.1.47.1 *Anterior view*

→ Base of support - the distance between his heels is in ideal range but still, the right heel is above the ground level

→ Shape of ankles - right is bigger than the left

→ Position and shape of the toes - pressed toes

→ Weight distribution - just from observation he seems to have more on the left

→ Muscles tibialis anterior - symmetrical

→ Contour of the calf muscles - varosity of the right calf

→ Position of knees - bigger varus deformity on right

→ Position of patella's - both medially shifted

→ Position of thighs - symmetrical

→ Pelvis - tilted with the right side a little bit higher, anti-clockwise rotated

→ Umbilicus is in ideal position

→ Symmetrical tension on both sides of abdomen

→ Thoracobrachial triangle - right bigger than the left

→ Nipples - same level

→ Position of the collarbones - right slightly protracted

→ Supraclavicular holes - symmetrical

→ Position of shoulders - right slightly protracted

→ Symmetrical upper trapezius

→ Position of the head - slightly protracted

4.1.47.2 *Posterior view*

→ Base of support - the heel of the right foot is not on the ground

→ Shape and contours of the heels - right heel is above the ground level 2-3cm

→ Shape of ankles - right bigger than the left

→ Achilles tendon - right in varosity

→ Contour of the calf muscles - symmetrical

→ Position of knees - bigger varus deformity on right knee

→ Position of thighs - symmetrical

→ Subgluteal line - symmetrical

→ Pelvis - anti-clockwise rotated

→ Gluteal muscles - symmetrical

→ Paravertebral muscles - symmetrical

→ Cervical vertebras - ideal shape

→ Thoracic vertebras - ideal shape

→ Lumbar vertebras - ideal shape

→ Right thoracobrachial triangle bigger than the left

→ Upper extremities - right arm is hanging a little bit more forward

→ Position of scapulas - symmetrical

→ Symmetrical upper trapezius

→ Nuchal muscles - symmetrical

→ Head - protracted

4.1.47.3 *Side view*

→ Weight distribution - looks to lean more on his left side due to right ankle fixation

→ Shape and position of the ankle - right foot is plantarflexed and is bigger than the left

→ Shape and contour of the shin - ideal

→ Position of the knee joints - small amount of hyperextension of the right knee

→ Contour of the thigh muscles - symmetrical

→ Rotation of pelvis in anticlockwise direction

→ Cervical spines - in extension

→ Thoracic spines - in kyphosis with the top of the curve around Th4 but the kyphosis is reduced in comparison to the initial kinesiologic examination

→ Lumbar spines - ideal

→ Shape of the abdominal muscles - prominent

→ Position of the shoulder girdle - symmetrical

→ Acromion - right is slightly protracted

→ Position of the head - protracted

4.1.48 Palpation of pelvis

→ Right ASIS more prominent than the left

→ Right and left ASIS are in the same height

→ Right and left iliac crest are at the same level

→ Left PSIS is more prominent than the right

→ Right and left PSIS are on the same level

→ Both PSIS are higher than both ASIS

4.1.49 Assessment of stereotype (pattern) of breathing

→ Standing- using all his 3 parts

→ Sitting- using more his lower thoracic part and abdominal part

→ Lying - using more his lower thoracic part and abdominal part

4.1.50 Gait analysis (without crutches and barefoot)

4.1.50.1 *Front view*

→ width of the base of support - normal

→ position of the feet: parallel

→ walking rhythm: longer time on the left leg

→ walking speed: normal

→ movement of the foot: on his left foot he has initial contact with the floor with his heel, after that he is placing his whole foot on the ground, then he puts his weight on it during the loading response phase and finally he leaves the ground by first lifting the heel and then by performing slight toe off, his right foot motion is different because of the deformity that he has. The patient hits the ground with the plantar surface of the metatarsals continues with the toes, moves on to the loading of his limp and finishing with a slight toe off again

→ axial position of the lower limb- knee varosity

→ position of the pelvis - anti-clockwise rotation

→ movements of the pelvis - lateral tilt with higher on the right side

→ position of the trunk - ideal position

→ movements of the trunk - less lateral tilt than at the initial examination

→ abdomen muscles - symmetrical

→ position of shoulders - no much motion - just moving with the trunk

→ position of the head - protracted

→ movements of the head - no much movement

→ movements of the upper extremity – synchronized

4.1.50.2 *Back view*

→ width of the base of support - normal

→ position of the feet: parallel

→ walking rhythm: longer time on his left leg

→ walking speed: normal

→ movement of the foot: on his left foot he has initial contact with the floor with his heel, after that he is placing his whole foot on the ground, then he puts his weight on it during the loading response phase and finally he leaves the ground by first lifting the heel and then by performing slight toe off, his right foot hits the ground with the plantar surface of the metatarsals continues with the toes, moves on to the loading of his limp and finishing with slight toe off again

→ axial position of the lower limb- knee varosity

→ position of the pelvis - anti-clockwise rotation

→ movements of the pelvis - lateral tilt with higher on the right side

→ position of the trunk - ideal position

→ movements of the trunk - less tilting than before movement

→ position of spine – stable in all cervical, thoracic and lumbar parts

→ activity of back muscles - activated

→ position of shoulders - no much motion

→ position of the head - protracted

→ movements of the head - no much movement

→ movements of the upper extremity – synchronised

4.1.50.3 *Side view*

→ walking rhythm: longer time on his left leg

→ walking speed: normal

→ stride length - short steps

→ movement of the foot: on his left foot he has initial contact with the floor with his heel, after that he is placing his whole foot on the ground, then he puts his weight on it during the loading response phase and finally he leaves the ground by first lifting the heel and then by performing slight toe off, his right foot hits the ground with the plantar surface of the metatarsals continues with the toes, moves on to the loading of his limp and finishing with slight toe off again

→ position of the knee - bearly in hyperextension

→ movement of the knee - biggest motion of all joints and in varosity more on right

→ position of the hip - ideal

→ movement of the hip - ideal

→ position of the pelvis - anti-clockwise rotated

→ movements of the pelvis –lateral tilt, with higher on the right side

→ movement of center of gravity – COG stays about in the same level

→ position of the trunk – ideal position

→ movements of the trunk – less motion than before

→ position of the head - protracted

→ movements of the head – no much movement

→ movements of upper extremities - symmetrical but no much motion

→ stability of walking - difficulty in keeping the stability due to the small support of his right leg

4.1.50.4 *Modifications*

→ Walking with special shoes and crutches - walking is very improved, the lateral flexion of the trunk is minimized, there is still some shoulder elevation but the patient is really trying to improve

→ Stairs with special shoes and crutches - he learned the right sequence, he had no idea of how to go up or down the stairs before, the pain is reduced

4.1.51 Dynamic Spine Examination

4.1.51.1 *Forward bending*

The movement was performed in the almost full range of motion with distance about 5-7cm distance from the ground. It was performed in the sagittal plane with no interruptions in his low-velocity maximal flexion. Symmetrical position of the back muscles without scoliosis or any deficit. Most of the motion was observed at the level of Th7-12. He returned smoothly to the initial position without any pain.

4.1.51.2 *Backward bending*

The extension of the spine with holding the buttocks was increased in comparison with the initial examination of the movement. He is still restricted symmetrically. The muscles activation is also symmetrical. The most motion was carried out at the area of the cervical spine. Also, there was an extension of the thoracolumbar region, from Th8-L3/4. The whole movement to extension and back was painless.

4.1.52 Anthropometric Measurements

Measurements	R	L	Measurements	R	L
Anatomical length	101	101	Calf circumference	34,5	34
Functional length Asis-mall med	100	99	Ankle circumference	30	29
Functional length Umb-mall med	107	106	Foot circumference	26	26

Thigh length	53	53	Whole UE length	80	80
Middle leg length	49	49	Humerus length	33,5	33,5
Foot length	26	26	Forearm length	27	27
Circumf. *15cm above knee cap*	45	45	Relaxed arm circumf.	31,5	31,5
Circumf. *10cm above knee cap*	42	42	Contracted circumf.	34	34
Knee circumference	42	42	Forearm circumference	29	28

Table 24: Anthropometric measurements of upper and lower extremities (cm).

4.1.53 ROM

Joint	Plane	Active Movement		Passive movement	
		R	L	R	L
Hip	Sagittal	20-0-130	10-0-120	20-0-135	20-0-130
	Frontal	35-0-25	20-0-30	40-0-25	35-0-25
	Transverse	30-0-30	25-0-20	35-0-35	30-0-30
Knee	Sagittal	0-0-135	0-0-140	-5-0-140	-5-0-145
Ankle	Sagittal	-5-5-25	15-0-25	-5-0-25	15-0-25
	Frontal	5-0-5	5-0-5	5-0-5	10-0-10
Shoulder	Sagittal	30-0-170	30-0-160	30-0-170	30-0-165

	Frontal	120-0-0	105-0-0	135-0-0	110-0-0
	Transverse	70-0-45	65-0-30	75-0-50	70-0-35
Elbow	Sagittal	5-0-145	5-0-140	0-0-150	0-0-140
	Transverse	40-0-45	40-0-45	45-0-45	45-0-45

Table 25: ROM assessment (degrees).

4.1.54 Movement patterns

4.1.54.1 *Hip extension*

R: Patient performed the motion by activation first the gluteal muscles simultaneously with the hamstring. Then there was activation of the paravertebral muscles in the thoracic and lumbar area first on the ipsilateral side and then on the contralateral side. The shoulder girdle muscles were activated at the end of the motion. The hip extension was about 15 degrees.

L: When the motion started there was the slight anterior tilt of the pelvis with the paravertebral muscles of the lumbar area on the ipsilateral side to be activated at once with the gluteal muscles. Then the hamstrings and then the rest of the paravertebral muscles with the shoulder girdle muscles. This pattern extended about 15 degrees.

4.1.54.2 *Shoulder abduction*

R: The motion was performed with a slightly flexed elbow. The scapulohumeral rhythm was good for the first 60-70 degrees and since then the glenohumeral joint got stiff again and moved with the scapula. The motion of the scapula was not fluent after that point and did some interrupted movements. There was slight activation of the trapezius muscle with obvious elevation and protraction of the shoulder. However, the motion was

performed almost in the frontal plane and reached 160 degrees of abduction. In that stage, there was a slight pain.

L: Scapulohumeral rhythm is correctly visible until the level of 50-60 degrees of abduction. Subsequently, the rhythm stops to be fluent and symmetric and it starts to be interrupted and a little bit jerky. He again completed the motion in a range of 150 degrees with slight flexion of the elbow joint where the pain started. The muscles around the shoulder girdle started to be activated or even over activated around 60 degrees.

4.1.55 Scar examinations

→ The surgical scar of the right tibia has normal temperature and sensation. It's restricted to the lateral direction mostly at the area of proximal and distal ends and slightly restricted at the area of the middle part. The medial shifting is achievable. Lifting the scar is still restricted. Cranial and caudal directions are now moderately movable.

→ A scar of necrotic tissue on the anterior side of the right tibia has changed its color to a lighter shade of brown. The temperature and sensation are symmetrical with the rest. Lateral direction shifting of the tissue is restricted and slightly the medial direction. Cranially and caudally was barely moving and it was not possible to lift the tissue.

→ The second surgical scar around the Achilles tendon is still restricted. However, its temperature and sensation are the same, as well as the color of the scar. The perpendicular part was better movable to the cranial and caudal directions and also it was better while lifting it but it remained restricted. Medial and lateral directions are restricted. The parallel with Achilles part was better movable to the medial and lateral direction and it was harder to shift the scar cranially or caudally. Lifting this part was not effortless but the tissues next to the scar could be raised - not the line of the scar.

→ Trapezius's scar has as well normal temperature and sensation and owns the color of the skin. It is not restricted and movable to all directions. Moreover raising is normal.

4.1.56 Fascia examination

4.1.56.1 *Extremities*

→ Upper arm:

R: no restriction neither medial nor lateral directions

L: no restriction neither medial nor lateral directions

→ Upper leg:

R: no restriction neither medial nor lateral directions

L: no restriction neither medial nor lateral directions

→ Lower leg:

R: restricted in both direction but with the lateral to be worse

L: slight restriction in lateral direction

4.1.56.2 *Achilles tendon*

R: no restriction neither medial nor lateral directions

L: restricted to the lateral direction where there is the scar

4.1.57 Tone palpation

LE Muscles	R	L	UE Muscles	R	L
Gluteus maximous:	N	N	Upper Trapezius	N	N
Iliopsoas:	↑	↑	Supraspinatus	N	↑
Tensor fasciae latae:	↑	N	Infraspinatus	↑	N
Rectus femoris:	N	N	Pectoralis major upper:	N	N
Vastus medialis:	N	N	Pectoralis major lower:	N	N
Vastus lateralis	N	N	Biceps brachii	N	N
Adductors:	↑	↑	Deltoid anterior:	N	↑
Biceps femoris:	N	N	Deltoid middle:	N	↑
Semi muscles:	↑	↑	Deltoid posterior:	N	N
Gastrocnemius:	↑	N	Triceps brachii	↑	↑

Table 26: Tonus of the upper and lower extremities muscles [45].

↓-*hypotosit,* N-*normal tonus,* ↑-*hypertonicity,* ↑↑- *hyper-hypertonicity*

4.1.58 Length test

Muscles	R	L	Muscles	R	L
Gastrocnemius	2	2	Pectoralis major Clavicle part	1	1

Soleus	2	2	Pectoralis major Sternal part	1	1
One-joint hip flexors	1	1	Pectoralis major Rib part	1	1
Two-joint hip flexors	1	1	Pectoralis minor	2	1
Adductors	1	1	Teres major&Latissimus dorsi	Moderate	
Tensor fascia latae	1	0	Rhomboid major & minor	Moderate	
Hamstrings	1	1	Shoulder medial rotators	1	1
Piriformis	1	1	Shoulder lateral rotators	1	2

Table 27: Muscles length test according to Janda [44].

4.1.59 Strength test

LE Muscles	R	L	UE Muscles	R	L
Gluteus maximus:	4	4	Lateral rotators:	4-	4
Iliopsoas:	4	4	Medial rotators:	4-	4-
Tensor Fasciae Latae:	4	4	Latissimus dorsi:	3+	3+
Quadriceps femoris:	4+	4+	Pectoralis major upper:	3+	3+
Hip adductors:	4-	4-	Pectoralis major lower:	4	4
Lateral rotators:	4	4-	Deltoid anterior:	4	4

Medial rotators:	4-	4	Deltoid posterior:	4-	4-
Lateral hamstrings:	4+	4	Triceps:	4	4
Medial hamstrings:	4	4	Biceps&brachioradialis:	4	4+
Ankle plantar flexors:	4-	4	Coracobrachialis:	4	4

Table 28: Muscle strength testing according to Kendal [47].

4.1.60 Joint play examination

4.1.60.1 *Lower extremities*

→ Knee joint: right knee is restricted to both directions and left just to medial

→ Patellar joint: none of them restricted

→ Tibiofibular joint: just the right is restricted in ventrolateral

→ Talocrural joints: no joint play on left and restricted on right

→ Subtalar joint: restricted bilaterally

→ Chopart joint: no restrictions

→ Lisfranc joint: no restrictions

→ Metatarsal joints: no restrictions

→ MTP joints: no restrictions

→ PIP joints: no restrictions

→ DIP joints: on the right foot there is restriction to the 2nd and 3rd toe, left is free

4.1.60.2 *Sacroiliac joint*

→ No restrictions

4.1.60.3 *Upper extremities*

→ Glenohumeral joint: on left shoulder, there is restriction in all directions, on right there is restriction just to caudal direction

→ Acromioclavicular joint: just the left side is restricted

→ Sternoclavicular joint: no restrictions

4.1.61 Neurological examination

4.1.61.1 *Deep tendon examinations*

Reflex		Response
Biceps	C5-6	2
Brachioradialis	C6	2
Triceps	C7	2
Wrist flexors	C8	2
Patella tendon	L2-4	2

Achilles tendon	L5-S2	2

Table 29: Deep tendon reflexes assessment according to DTR scale [46].

4.1.61.2 *Superficial sensation*

→ Light touch: Same feeling in all dermatomes of upper and lower extremities

→ Pain exam: Same feeling in all dermatomes of upper and lower extremities

4.1.61.3 *Deep sensation*

→ Kinesthetic sensation: Normal findings in toes and shin test

→ Vibration test: by using a tuning fork: Normal findings at metatarsals, ankles, knees, ASISs, and styloid processes of radius

4.1.61.4 *Pyramidal lesion tests:*

Signs of Pyramidal injuries of UE.	Right		Left	
	Positive	Negative	Positive	Negative
Juster Sign		●		●
Hoffmann Sign		●		●

Tromner Sign		●		●
Mayer Sign		●		●
Janisevski		●		●
Palm-chin Reflex		●		●
Thumb-chin Reflex		●		●

Table 30: Pyramidal lesion tests for upper extremities [27, 46].

Signs of Pyramidal injuries in LE.	Right		Left	
	Positive	Negative	Positive	Negative
Extension response				
Babinski Reflex		●		●
Roche Reflex		●		●
Brissaud's Reflex		●		●
Sicard's Sign		●		●
Vitek's Bridge Phen.		●		●
Chaddock's Reflex		●		●
Oppenheim's Sign		●		●

Gordon Sign		●		●
Flexion response				
Rossolimo's reflex		●		●
Zukovsky-Kornilov		●		●
Mendel-Bechterew		●		●
Weingrow's Phen.		●		●

Table 31: Pyramidal lesion tests for lower extremities [27, 46].

1.16 Examination conclusion

The patient is standing with his right heel 2-3 cm above the ground level and his right ankle is bigger than the left by 1 cm. Those are present after his injury in 1978. His toes are pressed and according to Vele test are evaluated as grade two on both sides. He seems to have his weight shifted on his left leg to prevent the deformed foot from being in stress, however, the two scales test showed very good results. His right knee is in a greater amount of varus deformity than the left and also in bigger hyperextension. There is a rotation of his pelvis in an anti-clockwise direction and a small degree of lateral tilt with the right side higher than the left. As a result of this, there is also a small difference of the functional lengths with the right side to be longer by one centimeter. ROM is mostly restricted in hip flexion, extension, and abduction and there is a great restriction in the ankle joint in dorsal and plantar flexion as well as inversion and eversion. By evaluating the hip extension pattern we found that even if the amount of movement was symmetrical the quality of the left side was poor with the pelvis to performing initially anterior tilt, that can be a consequence of the shorted iliopsoas, and the activation was firstly from the back muscles and then gluteal and hamstrings. The fasciae of the lower legs were restricted on the right side to both medial and lateral directions and on the left side just to the lateral

direction. Achilles was just restricted on the left extremity to both directions. There was hypertonicity of the iliopsoas muscles on right side, and adductors and semi-muscles bilaterally, as well as shortness of most of the muscles with the greater to be on the triceps surae. The strength of the lower extremities is very good for his age. After our effective therapy, his joint play is not that much restricted now. There is still a restriction in both knee and subtalar joints, and only on the right leg in the talocrural and tibiofibular joint, in ventrolateral direction.

During the gait examination, there is dysfunction of the right leg's walking sequence with the foot to begin the motion by performing the initial contact with the metatarsal heads and continue by placing the toes and then just lifting the foot. He spends more time on his left side and he seems to lean more to the left side to reduce the amount of weight that he is placing on his right knee and ankle. The right side's knee is in varosity and slight hyperextension while the pelvis and trunk are in a minor degree of lateral tilt. Throughout the walking he was elevating his shoulders alternatively, his head was in protracted position and the COG was approximately at the same level. The walking without his special shoes and crutches was difficult and a great percentage of effort was needed to prevent the losing of balance. This can result from the decreased support of his right extremity. While he was using his assistive devices, special shoes, and crutches, he was more balanced and there were less trunk lateroflexion and shoulder elevation. The walking on stairs was correct.

On his upper body, his right shoulder was more protracted than the left during the postural examination. The range of motion of the shoulder was restricted mostly in abduction and more through the internal rotation than the external. The muscle condition was considerable fine as the tone of the triceps brachii was higher and the strength of the pectoralis major and latissimus dorsi was reduced. There was also shortness on his upper part as it was in the lower part of his body. The joint play of the glenohumeral joint is restricted on the right arm just in caudal direction, on the left arm in all directions and in the acromioclavicular joint on left side. While we were checking the glenohumeral abduction his right arm reached 90 degrees of pure passive abduction and his left reached

70 degrees. The problematic shoulder abduction was evaluated during the examination of the movement patterns and the results except the restricted ROM was the on his right side the scapulohumeral rhythm was good until about 60 to 70 degrees. Afterward, there was stiffness on the glenohumeral joint. The motion of the scapula was not fluent and it was interrupted sometimes. As the movement was reaching the end there was activation of the trapezius muscle. On the left side, where the situation with the pain is worse, the scapulohumeral rhythm was correct until it achieved about 50 to 60 degrees of motion. Then it got stiff on the glenohumeral joint, like on the other side, and the scapula was jerkier in his motion with the trapezius to be over activated. The pain began as the patient accomplished 150 degrees of movement.

The breathing mechanism of the patient was correct in the standing position but he was not using the upper part of his thorax while sitting and lying. During the dynamic spine examination, we found just restriction on his motion in both bending forward and backward. The three of the scars that he has are still restricted to the necrotic tissue to be the most restricted of all. The patient had no evidence of neurological deficits.

1.17 Evaluation of the Effect of the Therapy

The condition of the patient has been getting better throughout our therapies. On his lower body posture, there was not a big difference. He is still unable to stand on his right leg during the single leg stance test. However, I don’t believe that the position of his ankles can improve a lot more than what we have achieved because of the metal fixation. We managed to increase the range of motion in all the joints of the lower extremities. Some muscles that used to be much shorted, after the therapy techniques that we performed got a little bit more elongated but because of the prolonged period that they were shorted they will need many more therapies to increase and maybe some muscles will reach a good length for a man in this age. The joint play of the lower extremities is restored in most of the joints. There is still a problem with the knee and ankle joints, on the right side to be worse. The fascias of the lower leg are still restricted.

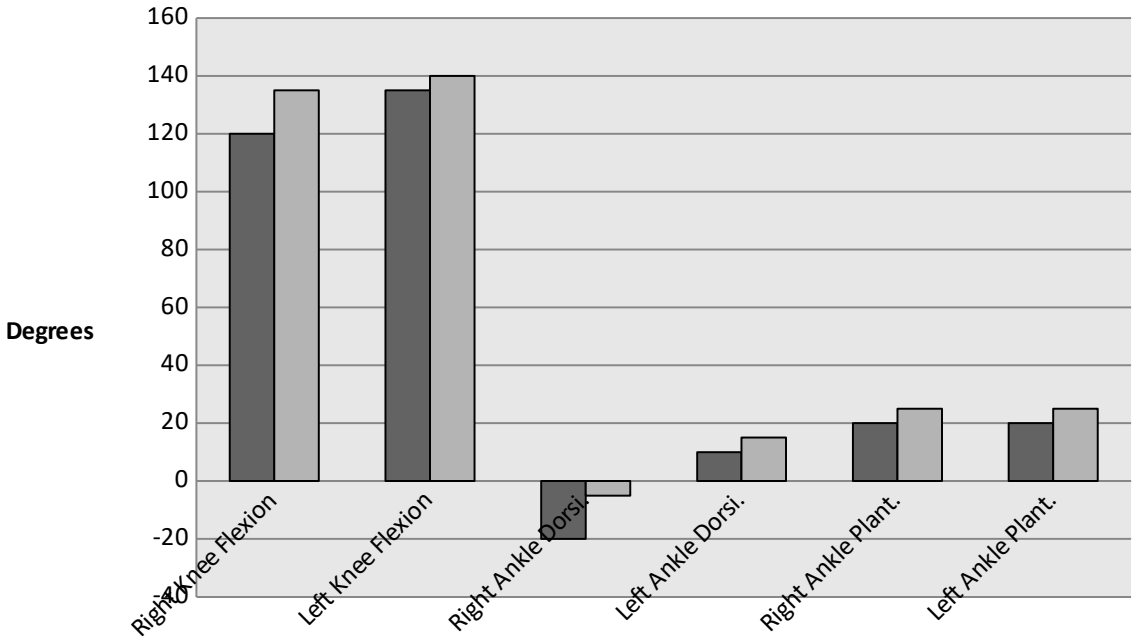


Table 32: Knee and Ankle ROM comparison. Data from Initial and Final Kinesiologic Examination.

On the upper part of his body, we decrease the pain a lot and the patient was very pleased with that. Moreover, the range of motion of the shoulder got much improvement with the patient to be able to do many movements that were very restricted and very painful before the therapy. When he came to the hospital had a lot of hypertonic muscles around the shoulder and we managed to normalize the tonus. There is no more restriction in fascias and the glenohumeral restriction is decreased. During the shoulder abduction pattern, the patient still has a poor scapulohumeral rhythm which got better and pain starts later. The glenohumeral joint play is still restricted in all direction on the left side and just in caudal direction on the right side. Patient seems to regain function coordination and strength after the therapies.

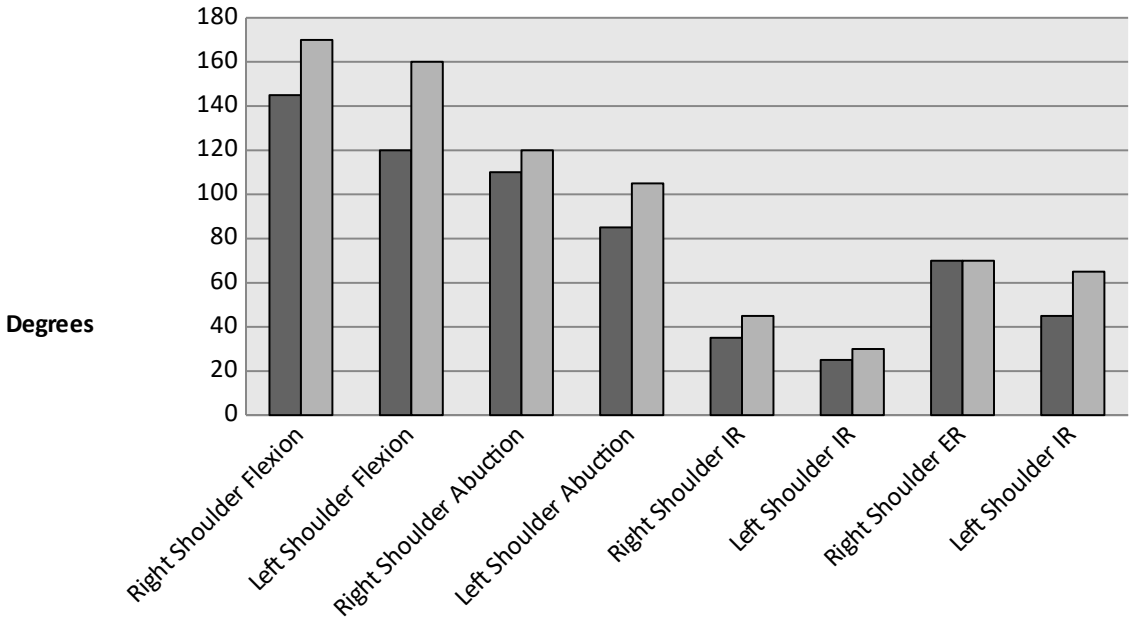


Table 33: Shoulder ROM comparison. Data from Initial and Final Kinesiologic Examination.

During walking there was slightly better motion than before the therapies and that was a result of all the procedures we performed with of re-education of the walking. We also achieved to synchronize the swinging of the arms and decrease the lateroflexion of trunk and elevation of the shoulder. The breathing got optimized with the patient to be able to control and work with it properly. The mobility of the scar was improved in some parts. The surgical scar on the right tibia was much more movable but the necrotic tissues even if they are not that much restricted as they were, the patient will need a lot of more therapies to get it movable to all directions.

5 Conclusion

The therapy that I performed was effective and my patient was pleased. We were achieving all our goals and we were performing all our proposed therapies, consequently, we achieved as much as we could in 2 weeks period. Those significant results may not have

been achieved if my patient was not cooperating, therefore I am thankful that my patient was so active and ready for exercising

During the practice, I gained a lot of how to deal with the patients with different disorders. The experience is valuable and by being able to practice every day my theoretical and practical knowledge was confidence for further independent work. My supervisor Mgr. Lenka Samkova was the entire time ready to help me and review with me everything. She showed me different techniques and ways to approximate various problems. Working with a different language speaking person also showed me other paths of communication that I can also use while my practice.

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7 Supplements

1.18 Ethical Board

1.19 INFORMOVANÝ SOUHLAS

Vážená paní, vážený pane,

v souladu se Všeobecnou deklarací lidských práv, zákonem č. 101/2000 Sb., o ochraně osobních údajů a o změně některých zákonů, ve znění pozdějších předpisů, Helsinskou deklarací, přijatou 18. Světovým zdravotnickým shromážděním v roce 1964 ve znění pozdějších změn (Fortaleza, Brazílie, 2013) a dalšími obecně závaznými právními předpisy Vás žádám o souhlas s prezentováním a uveřejněním výsledků vyšetření a průběhu terapie prováděné v rámci praxe na ……., kde Vás příslušně kvalifikovaná osoba seznámila s Vaším vyšetřením a následnou terapií. Výsledky Vašeho vyšetření a průběh Vaší terapie bude publikován v rámci bakalářské práce na UK FTVS, s názvem ……

Získané údaje, fotodokumentace, průběh a výsledky terapie budou uveřejněny v bakalářské práci v anonymizované podobě. Osobní data nebudou uvedena a budou uchována v anonymní podobě. V maximální možné míře zabezpečím, aby získaná data nebyla zneužita.

Jméno a příjmení řešitele .....
Podpis:.....

Jméno a příjmení osoby, která provedla poučení.....
Podpis:.....

Prohlašuji a svým níže uvedeným vlastnoručním podpisem potvrzuji, že dobrovolně souhlasím s prezentováním a uveřejněním výsledků vyšetření a průběhu terapie ve výše uvedené bakalářské práci, a že mi osoba, která provedla poučení, osobně vše podrobně vysvětlila, a že jsem měl(a) možnost si řádně a v dostatečném čase zvážit všechny

relevantní informace, zeptat se na vše podstatné a že jsem dostal(a) jasné a srozumitelné odpovědi na své dotazy. Byl(a) jsem poučen(a) o právu odmítnout prezentování a uveřejnění výsledků vyšetření a průběhu terapie v bakalářské práci nebo svůj souhlas kdykoli odvolat bez represí, a to písemně zasláním Etické komisi UK FTVS, která bude následně informovat řešitele.

Místo, datum .....

Jméno a příjmení pacienta .....

Podpis pacienta: .....

Jméno a příjmení zákonného zástupce .....….

Vztah zákonného zástupce k pacientovi ..... Podpis: .....

1.20 Table of Figures

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1.22 List of Abbreviations

OA - Osteoarthritis

MRI - Magnetic Resonance Imaging

US - Ultrasound

SC - Sternoclavicular

AC - Acromioclavicular

RHB - Rehabilitation

ROM - Range of Motion

SFTR - Sagittal-Frontal-Transverse-Rotation

ACL - Anterior Cruciate Ligament

PCL - Posterior Cruciate Ligament

ASIS - Anterior Superior Iliac Spine

PSIS - Posterior Superior Iliac Spine

FLEX - Flexion

EXT - Extension

ABD - Abduction

ADD - Adduction

ER - External Rotation

IR - Internal Rotation

DORSI - Dorsiflexion

PLANT - Plantarflexion

INVE - Inversion

EVER - Eversion

AAOS - American Academy of Orthopedic Surgeons

ADL - All Day Living

COP - Center of Pressure

COG - Center of Gravity

COM - Center of Mass

TFL - Tensor Fascia Latae

BMI - Body Mass Index

CT - Computer Tomography

STT - Soft Tissue Techniques

NSAIDs - Nonsteroidal Anti-Inflammatory Drugs

SYSADOA - Symptomatic Slow-Acting Drugs

GH - Glenohumeral

VAS - Visual Analog Scale

PAF - Paroxysmal Atrial Fibrillation

TIA - Transient Ischemic Attack

SDH - Subdural Hematoma

UE - Upper Extremities

LE - Lower Extremities

MTP - Metatarsophalangeal

DIP - Distal Interphalangeal

PIP - Proximal Interphalangeal

DTR - Deep Tendon Reflexes

PIR - Post Isometric Relaxation

PNF - Proprioceptive Neuromuscular Facilitation

AM - Active Movements