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Post-operative physiotherapeutic intervention and management after proximal femur hemiarthroplasty, in elderly patient.

BACHELOR THESIS

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Supervisor: Doc. PaedDr. Dagmar Pavlu, Csc.

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ABSTRACT

Thesis Title: Post-operative physiotherapeutic intervention and management after proximal femur hemiarthroplasty, in elderly patient.

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Work placement: Ustředni Vojenská Nemocnice, Prague, 1200/1, 16200, Praha 6.

Název práce: Pooperační fyziotherapeutická péče a terapie pacienta vyššího věku po hemiarthroplastice proximálniho femuru.

Summary

The aim of this dissertation is to demonstrate, analyse and evaluate a case study of post operative physiotherapeutic intervention and management after proximal femoral hemiarthroplasty, in elderly patient.

This dissertation which was written and composed by myself is divided into two parts, the theoretical and the special. The first part describes all the anatomical structures of the hip joint including bones, joints, and soft tissue as well as neural and blood supply structures. The theoretical part also analyzes in depth from a biomechanical and kinesiology perspective the function of the hip joint and injury mechanisms in respect to a fracture event or age associated pathologies.

The special part is devoted to describe the medical history of my patient together with a detail report which clarifies all the applied procedures including initial and final examinations, daily assessments, therapies, conclusions, and data analysis of results.

Keywords: Femoral neck, fracture, hemiarthroplasty, conservative, treatment, management, elderly, terra-bands, rehabilitation, post-operative, care.

DECLARATION

I declare that this bachelor thesis was elaborated by me under the instructions of my supervisor Doc. PaedDr. Dagmar Pavlu, Csc. It is an original research, which refers on practice with patient after proximal femur hemiartropasty due to fractured and displaced femoral neck under the supervising of BS.c. Martin Lassner at the Ustředni Vojenská Nemocnice military hospital in Prague.

I also state that all the information, examination and therapeutic procedures, which are presented on this bachelor thesis, were performed based on knowledge that I received from the professors of the Charles University in Prague. 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 also declare that no invasive methods were used during my clinical practice and that the patient was fully aware of the examinations and therapeutic procedures at any time.

Prague, April 2016 Panagiotis Savvopoulos

ACKNOWLEDGMENT

I would like to express my very great appreciation to my professors for teaching all the principles on how to be awakened, determined, and passionate in my present and future academic pathway.

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Special thanks to my supervisor BS.c. Martin Lassner who guide me and help me to complete the practical part of my bachelor thesis.

Special thanks to my colleague Ioannis Hadjiyiannis, he stood like a brother all of these years and helped me a lot in time management and schedule organization.

DEDICATION

I dedicate this Thesis to my family and Ioannis Hadjiyiannis for the psychological and financial support during the three years of study and to my grandmother who passed away in 2000 from a medical error.

Table of Contents

1. Introduction

The objective of this dissertation thesis is to demonstrate, analyze and provide in depth information about physiotherapeutic intervention and management after a proximal femoral hemiarthroplasty in an elderly patient. The thesis is based on a case study in the period of my clinical work placement on the military hospital (Ustředni Vojenská Nemocnice) 2nd orthopedic surgery department, in Prague.

The thesis is divided into two major parts, the general and the special part. The general part provides the reader with the necessary theoretical knowledge of hip joint anatomical structure, functions and mechanical characteristics of all biomaterial constituents under variety of loads and description of all surgical interventions following a femoral neck arthroplasty with emphasis in proximal femoral hemiarthroplasty. The special part of this project composed of the case study including clinical examinations by physiotherapist and daily assessments, treatment goals, therapeutic procedures, results, evaluation of achieved data and future prognosis. Furthermore the second part contains bibliography in cited form of APA 6th edition, list of tables, list of images, abbreviations, and personal application together with permission from ethics committee.

I opted for this particular case of study for my dissertation (ή thesis) due to the exceptional age of the patient (elderly person) as it has been rarely studied in the literature.

2. General Part

2.1 Basic structure of the hip joint

The hip joint is a synovial joint or diarthrosis and consists of the convex part of the femur known as Head and the concave Acetabulum of the pelvis. It is classified as ball and socket joint. This arrangement allows a large amount of motion in all planes and axis significant for daily activities like walking, running, stairs climbing.Analyzing the hip joint from a macroscopic perspective we can divide into several categories: bones, cartilages, ligaments, tendons, muscles, bursa, nerves and blood supply. This division contributes to a better understanding how this joint works and behaves during loading, injury and recovery [14, 18].

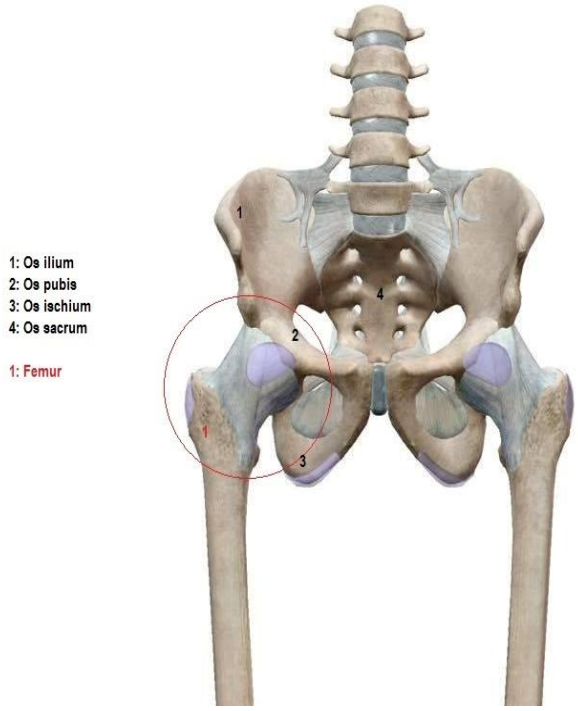

Image 1: 3D anterior representation of a male pelvis and lower limbs. The red circle represents the area of the hip joint [25].

2.1.1 Anatomy of Pelvic bones

The pelvic girdle is made up of bone pairs such as iliac bones which they form the superior part of the hip and they articulate posterior with the sacrum in the sacroiliac joints, the pubic bones which they form the anterior part of the hip joints and the Ischia bones which they form the lower and posterior part of the hip joints [18].

One bone from each pair contributes to the formation of the lunate surface of acetabulum. In this particular complex there is an articular part and a non-articular part [19]. Right to the center of the acetabulum there is a depressed space which is called accetabular fossa and is the non-articular part of the joint. The accetabular fossa is surrounded by a crescent shape surface, the lunate surface which forms the articular part of the joint [17, 18].

2.1.2 Anatomy of Femoral bone

The femur is the longest bone of the body located alone in the thigh of each lower limb. The proximal part of the femur consists of a spherical shaped head, a short and cylindrical neck which is in the middle between head and body (shaft) of the femur, and two trochanters; the greater which is an easily palpable bony landmark for clinicians at the lateral side of the hip joint and the lesser trochanter. The head of the femur consists of an articular and non-articular surface as well [17].

Directly in the center of the head there is a small depression which is called Fovea, and is the non-articular part of the bone. The rest of the head surface together with the lunate structure of the acetabulum forms the articulation of the hip joint. The shaft of the femur is almost cylindrical and slightly arch allows a large amount or reactive and ground forces to be absorbed from a biomechanical point of view [18, 24].

The distal part of the femur is larger in comparison with the rest bone and the proximal part and consists of two condyles the lateral and medial femoral which they serve as attachment points for muscles and bony structures for the knee joint articulation [17].

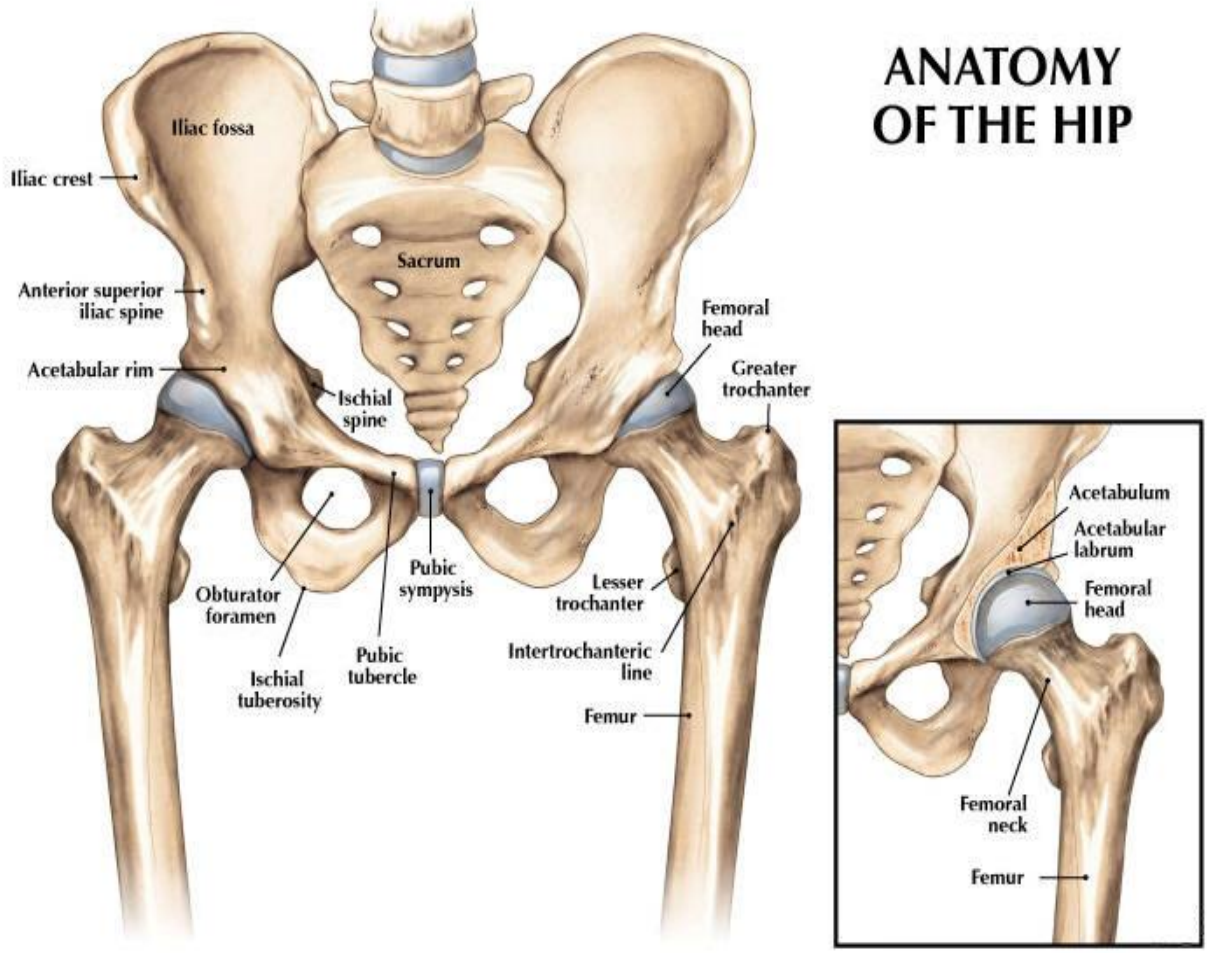

Image 2: Anatomy of the pelvis and hip joint, anterior view [17].

2.1.3 Contractile elements

The system of skeletal muscles in humans consists of approximately six hundredth and fifty muscles. Function of the muscles as primary mechanical effectors are to provide an active form of mechanical action and a mechanical output. Furthermore muscle function related to movement patterns are differentiated between agonistic effect and antagonism, synergism and stabilization function [8, 24].

2.1.4 Hip joint muscle anatomy and primary muscle function

The hip joint is surrounded by several large muscles. From the posterior side of the hip joint there are 3 muscles that form the buttocks, the gluteus Maximus, medius and minimus. With size relative to their names the medius is bigger than minimus and smaller than Maximus [9].

The major role of these muscles is to extend and abduct the hip from the middle line and to provide weight bearing stability during walking. In the deeper layers the lateral rotators of the hip joint are situated very close one another. Those muscles are: piriformis, superior and inferior gemelus and obturator internus. With their attachments on upper and medial surface of greater trochanter they assist as well in movements like extension, adduction and abduction when the thigh is flexed [17, 18].

The anterior part of the thigh it is formed primary by the Iliopsoas, Rectus femoris and a thin strapped muscle the Sartorius which they contribute mainly to hip flexion. Rectus femoris also belongs to the quadriceps femoris group including vastus lateralis, medialis and intermedialis and is responsible for knee extension [17].

The medial side of the hip joint is occupied by the muscle group of adductors. The majority of them originate from pubic symphysis and or linea aspera till several insertion points on the medial side of the femur; relative to their name they provoke adduction of the hip and assists as well in medial rotation of the joint [17, 18].

The lateral surface from the hip till the proximal end of femur and lateral condyle of tibia is covered from a thick band which is called iliotibial tract. Iliotibial tract provides a connection point for several large hip muscles for example the m tensor fascia lata with origin the anterior superior iliac spine and insert into the iliotibial band, together with the glutei medius and minimus not only abducts the thigh from the middle line but also assists in medial rotation and stabilization of the hip and the knee joint by tensing the iliotibial tract [17, 21].

Muscle	**Proximal attachment**	**Distal attachment**	**Innervations**	**Main action**
Pectineus	Superior pubic ramus	Pectineal line of femur	Femoral nerve (L2-L3) branches from obturator.	Adduction of the hip, flexion & medial rotation.
Psoas major	Transverse processes T12-L5	Lesser trochanter of femur	Lumbar nerves (L1, L2, L3)	Hip joint flexion & stabilization.

Psoas minor	Sides of T12-L1	Pectineal line & iliopectineal arch	Lumbar nerves (L1-L2)	Hip joint flexion & stabilization.
iliacus	Iliac crest, iliac fossa, anterior sacroiliac ligaments	Lesser trochanter of femur & tendons of psoas major	Lumbar nerves (L1-L2)	Hip joint flexion & stabilization.
Tensor fasciae latae	Anterior superior iliac spine &part of iliac crest	Iliotibial tract and lateral condyle of tibia	Superior gluteal nerve (L4 & L5)	Flexion of the thigh, abduction & medial rotation
Sartorius	Anterior superior iliac spine	Superior and medial surface of tibia	Femoral nerve (L2 & L3)	Flexion, abduction & lateral rotation of the hip joint.

Table 1: Anterior Thigh muscles with directly effect on the hip joint [17].

Muscle	**Proximal attachment**	**Distal attachment**	**Innervations**	**Main action**
Rectus femoris	Anterior inferior iliac spine	Base of patella and by patellar ligament to the tibial tuberosity	Femoral nerve (L2,L3,L4)	Extend the knee joint & together with the help of iliopsoas they assist the hip flexion.
Vastus lateralis				
Vastus medialis				
Vastus intermedius				

Table2: Anterior thigh muscles with indirect effect on the hip joint [17].

Muscle	Proximal attachment	Distal attachment	Innervations	Main action
Adductor longus	Body of pubis inferior to pubic crest	Middle third of linea aspera, femur	Obturator nerve (L2, L3,L4)	Adduction of the hip joint.
Adductor brevis	Inferior pubic ramus	Pectineal line & proximal linea aspera.	Obturator nerve (L2, L3,L4)	Adduction of the hip joint & minimal flexion.
Adductor magnus	Inferior pubic ramus & ischial tuberosity	Gluteal tuberosity, linea aspera, medial supracondylar line	Obturator nerve (L2, L3,L4)	Adduction of the hip joint & assists in hip flexion and extension.
Gracilis	Inferior pubic ramus	Superior and medial surface of tibia	Obturator nerve (L2, L3)	Adduction of the hip joint, flexion of the leg, medial rotation.
Obturator externus	Obturator foramen & obturator membrane	Trochanteric fossa of femur	Obturator nerve (L3,L4)	Lateral rotation of the hip joint.

Table 3: Medial thigh muscles with anterior and posterior attachments on femur and pelvic bones [17, 9].

Muscle	Proximal attachment	Distal attachment	Innervations	Main action
Semitendinosus	Ischial tuberosity	Medial surface of superior tibia.	Tibial division of sciatic nerve (L5,S1,S2)	Extension and medial rotation of the hip joint, flexion of the knee. Assistive extension of trunk.
Semimebranosus	Ischial tuberosity	Posterior part of medial condyle of tibia.	Tibial division of sciatic nerve (L5,S1,S2)	
Biceps femoris	*Long head:* Ischial tuberosity *Short head:* Linea aspera	Lateral side of the head of fibula.	*Long head:* tibial division(L5,S1,S2) *Short head:* common fibular (L5,S1,S2)	Extension of the hip joint and flexion of the knee joint. Assistive lateral rotation of the hip.

Table 4: Posterior thigh muscles [17].

Muscle	Proximal attachment	Distal attachment	Innervations	Main action
Gluteus maximus	Ilium &dorsal surface of sacrum, coccyx	Iliotibial tract and gluteal tuberosity of femur	Inferior gluteal (L5,S1,S2)	Extension and assistive lateral rotation of the hip joint
Gluteus medius	External surface of ilium	Lateral surface of the greater femoral trochanter	Superior gluteal nerve (L5, S1)	Abduction & medial rotation of the hip joint

Gluteus minimus	External surface of ilium, under medius	Superior border of the lateral surface of greater femoral trochanter	Superior gluteal nerve (L5,S1)	Abduction & medial rotation of the hip joint
piriformis	Anterior surface of sacrum	Superior border of the greater femoral trochanter	Ventral rami branches of S1,S2	Lateral rotation and extension of the hip, abduction of flexed thigh
Obturator internus	Obdurator membrane of pelvis	Medial surface of greater femoral trochanter	Obturator nerve L5,S1	Lateral rotation and extension of the hip, abduction of flexed thigh
Gemelli superior & inferior	Superior: ischial spine Inferior: ischial tuberosity	Medial surface of greater femoral trochanter	Obturator nerve L5,S1	Lateral rotation and extension of the hip, abduction of flexed thigh
Quadratus femoris	Lateral border of ischial tuberosity	Intertrochanteric crest of femur	L5,S1 branches	Lateral rotation of the hip joint, stabilization

Table 5: Gluteal region muscles [17, 9].

2.1.5 Interstitial system

The interstitial system is mainly composed of ligaments, cartilages, and bursa. The main role of them is to serve as mechanical connections between the system (A) skeletal elements and system (B) muscular elements with several mechanical functions [24].

2.1.6 Hip Joint ligaments

Ligaments are dense specialized connective tissue which play significant role in joints stability, range of motion and proprioception with various responses in biomechanical and physiological way to the complex functional tasks of the human body. A ligament consists of extracellular components such as: water, collagens type I 70%, lipids, proteoglycans and cellular components such as fibroblasts [24].

The ligaments connect bone to bone structures and at the hip joint there are several of them in the joint capsule and also around providing the proper biomechanical stability [10, 16].

Three strong bands of ligaments are the intrinsic factors which they connect the femur with the pelvic girdle. (See image 1). The crossed ischiofemoral ligament which originates from the acetabulum and inserts to the femoral neck, the Y-shaped iliofemoral ligament from the anterior inferior iliac spine to the lower intertrochanteric line, and the pubofemoral ligament which is attached to the ubturatorius crest and fused with the joint capsule [8, 14].

These ligaments play significant role in hip movements with the first and the third preventing over abduction and adduction of the lower limb and the second a hyperextension movement. There is a very small ligament as well at the center of the femoral head the so called ligamentus Teres; this tiny ligament carries a very small blood supply to the femoral head from a small branch of the femoral artery [18].

A very unique ligamentus structure is the labrum which is attached exactly to the acetabulum and forms a cap which provides better stabilization on the hip joint like a screw. This structure can be injured very easily from impact or repeating applied forces causing pain and discomfort during daily activities [18, 22].

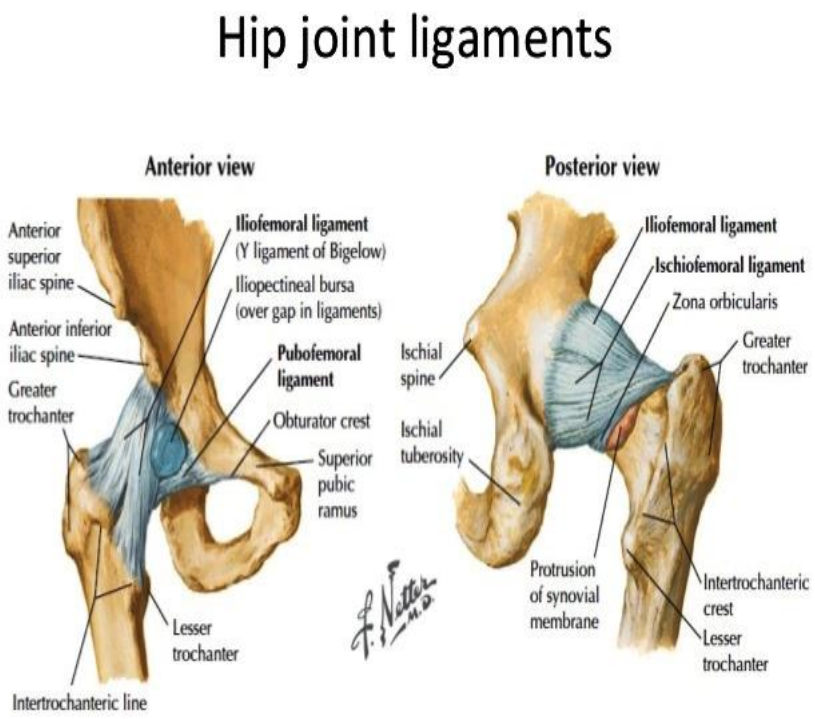

Image 3: Anterior and posterior view of hip joint ligaments [18].

2.1.7 Hip joint articular cartilage

An essentially articular cartilage composed mainly from collagen and proteoglycans, is a white tissue which serves as shock absorber and minimizes the friction forces, allows the smooth movement between two bony surfaces which they move against one another. Articular cartilage in the hip joint especially thick and covers the femoral head and the concave surface of the acetabulum [14, 18, 25].

2.1.8 Hip joint Bursa

Fluid field sacks which are located within the human body in places where an increased amount of friction occurs are called bursa. As the force of friction occurs between to surfaces which attempt to across one another and is dependent on the texture of both surfaces, bursa, lubricate the areas to reduce the amount of the force [15,18, 22].

The bursa is a physiological structure that produced by the body, relative to the hip joint from the anterior side there is the iliopectineal bursa which lies between the iliopsoas muscle and the underlying pubic bone of the pelvis. The Greater trochanteric bursa is located at the lateral side of the greater trochanter of the femur between the bone and the attachments of gluteus medius and minimus as well as the

proximal part of the iliotibial tract. As we mentioned before when friction occurs between muscles, tendons, bones and also skin lubrication is needed for the smoothest sliding between the surfaces. On the inferior posterior surface of the Ischia bone on the area so called “sitting bones” there is the ischiogluteal bursa with the same role as the previews structures [17].

Bursa is often irritated and inflamed due to various mechanisms and causing pain on the hip joint in a well-known pathology called bursitis, relative to the hip joint and the localization the name of the condition is relative to the homonymous structure [11].

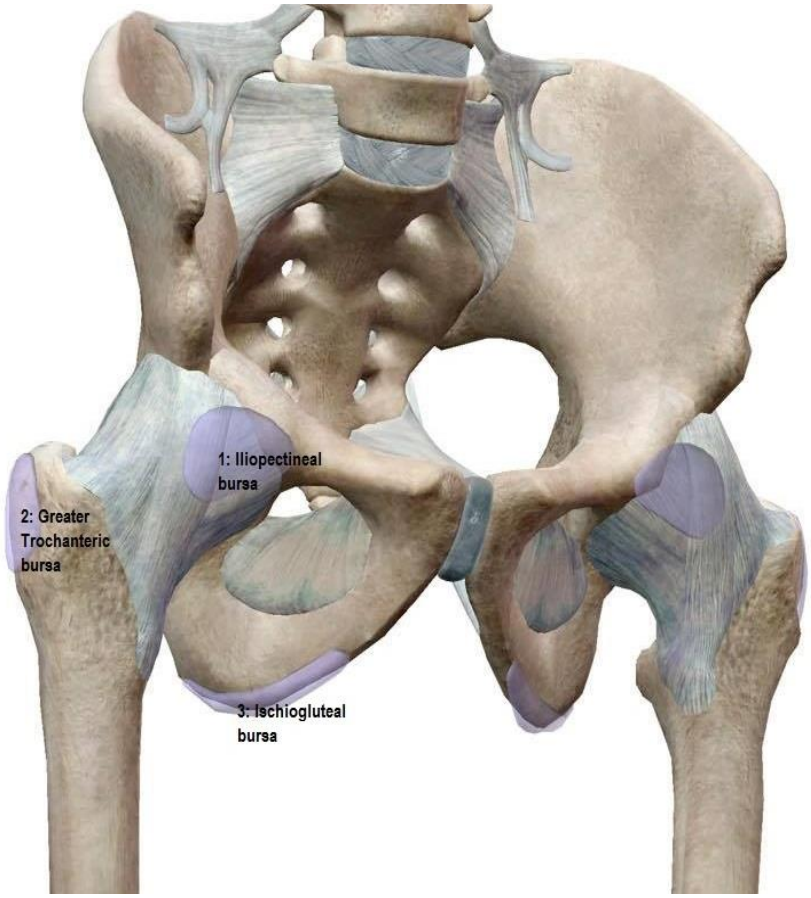

Image 4: 3D anterior- lateral representation of the hip joint with right sided iliopectineal, trochanteric an ischiogluteal bursa [25].

2.1.9 Information system and major innervations

Thin fibers or bundles that convey sensory impulses to the brain and motor impulses to the muscles or organs are called nerves. Nerves which are responsible for the transmission of information to the thigh muscles are passing throw the hip joint and pelvic structures [24].

We could distinguish three major nerves with origin from the segments L02 – L04 for the femoral and obturator nerve and from the segments L04-S03 for the Sciatic nerve. The three of them are major nerves of the lumbosacral plexus with both muscular and cutaneous distributions [12]. General efferent fibers, travelling in the same mixed peripheral nerves that convey sensory impulses to cutaneus nerves and transmitted to the muscles of the lower limbs [25, 18].

2.1.10 Femoral nerve motor and cutaneous distributions

Rises from psoas major muscle, passing the iliacus and descends behind the inguinal ligament to the femoral triangle. Femoral nerve is responsible for the innervations of the hip flexors and knee extensors muscles. Cutaneous distribution is responsible for the anterior and medial regions of the thigh, lower leg and foot [17, 18].

2.1.11 Obturator nerve motor and cutaneous distributions

The obturator nerve emerges from psoas major muscle and passes behind the common iliac arteries. Travels along the lesser pelvis and give innervations on the adductors muscles of the hip joint and cutaneous innervations over the medial side of the thigh [17, 18].

2.1.12 Sciatic nerve motor and cutaneous distributions

A large and thick nerve structure travels from the lower back and through the buttock goes down to the posterior back of the thigh. This structure is called sciatic nerve which later to the knee level splits into two branches the common fibular and tibia nerve. Sciatic nerve supplies with proper innervations muscles such as: semitendinosus, semimembranosus, and adductor Magnus thus its branches innervates the muscles of the distal leg and foot [18, 24].

Nerve	Origin	Distribution
Subcostal	Ventral ramus (T12)	Inferior skin to anterior iliac crest.
iliohypogastric	Lumbar plexus (L1)	Supero-lateral quadrant of buttock.
Ilioinguinal	Lumbar plexus (L1)	Skin over femoral triangle

Genitofemoral	Lumbar plexus (L1 & L2)	Femoral triangle, scrotum and labia majora.
Lateral femoral cutaneous	Lumbar plexus (L2 & L3)	Skin of anterior and lateral aspect of thigh
Anterior femoral cutaneous	Femoral nerve (L2-L4)	Skin of anterior and medial aspects of thigh.
Posterior femoral cutaneous	Sacral plexus (S1-S3)	Skin over posterior aspects of thigh, buttocks and popliteal fossa.

Table 6: Cutaneous innervations of the lower limb [17, 11].

Nerve	**Origin**	**Distribution**
Femoral	Lumbar plexus (L2-L4)	Anterior thigh muscles, hip and knee joints, skin of antero-medial aspect of thigh.
Obturator	Lumbar plexus (L2-L4)	Adductors of the hip joint
Sciatic	Sacral plexus (L4-S3)	Hamstrings except short head of biceps femoris.

Table 7: Deep innervations of the lower limb [17].

Nerve	**Origin**	**Distribution**
Clunial superior	Dorsal rami of L1-L3 nerves	All gluteal regions as far as greater trochanter.
Clunial middle	Dorsal rami of S1-S3 nerves	All gluteal regions as far as greater trochanter.
Clunial inferior	Ventral rami of S2-S3 nerves	All gluteal regions as far as greater trochanter.
Posterior cutaneous nerve	Sacral plexus S1-S3	Skin of buttocks through inferior branches, posterior aspect of thigh and calf.

Table 8: Cutaneous innervations of the gluteal region [17, 9].

Nerve	Origin	Distribution
Superior gluteal	Ventral rami of L4-S1 nerves	Gluteus medius and minimus and Tensor fasciae latae
Inferior gluteal	Ventral rami of L5-S2 nerves	Gluteus maximus
Nerve to Quadratus femoris	From pelvis through greater sciatic foramen deep to sciatic nerve	Inferior gemellus, quadratus femoris and hip joint.
Pudental	Ventral rami S2-S4	Perineum only
Nerve to obturator internus	Ventral rami L5,S1 & S2	Gemellus superior, obturator internus.

Table 9: Deep innervations of the gluteal region [17].

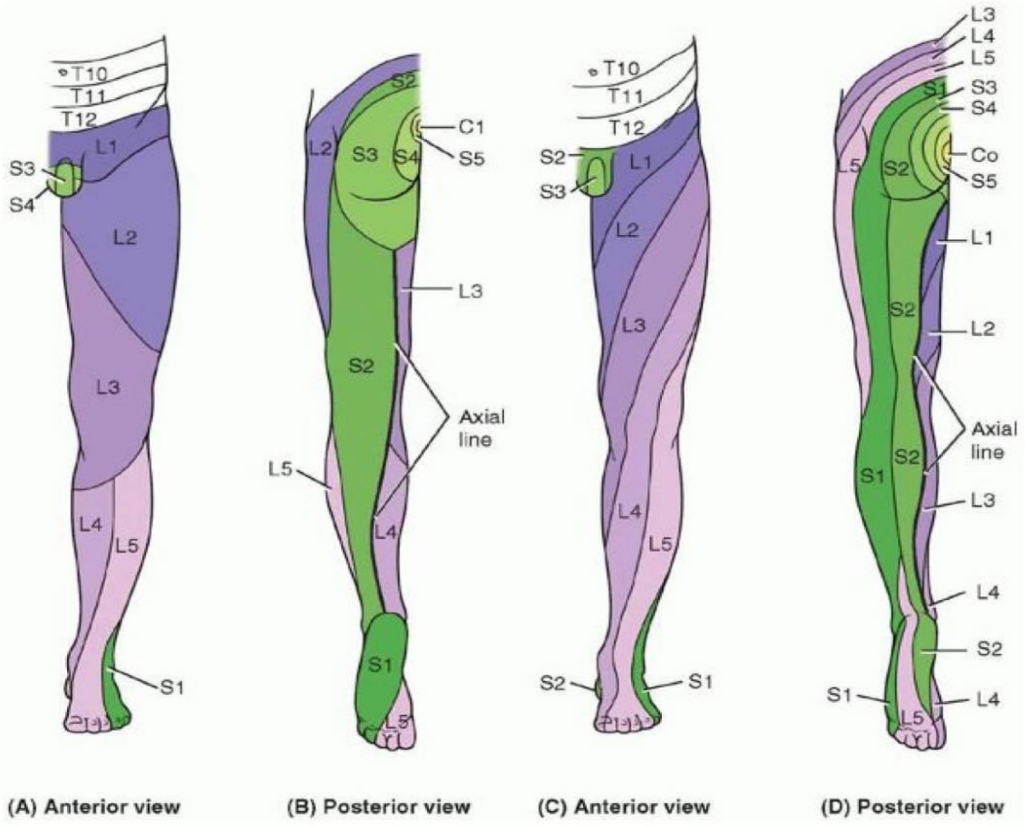

Image 5: Cutaneus innervations or dermatomes of the lower limb, A & B according to Foerster (1933), C & D according to Keegan and Garrett (1948) [17].

2.1.13 Blood supply of the lower limb

The vital properties of blood travel throw a large network of vessels within the body. Travelling along with the nerves we may distinguish the major vessels which they supply the lower limb of the human body with blood [24]. From the anterior aspect of the hip the large femoral artery is the continuation or the external iliac artery. Begins behind the inguinal ligament till the anterior and medial side of the thigh, and then continues throw an opening in the adductor Magnus to become popliteal artery [17]. Femoral artery could be very easy identified from anyone by placing the thumb on the front of the upper thigh [11, 12].

Relative to the deeper branch of the femoral artery the so called Profunda femoris is mainly a deep artery which lies next to the femoral artery and medial side of the femur to end at the lower 1/3 of the thigh [9, 18]. Branches of the Profunda femoris are called femoral circumflex. They are blood vessels which they wrap the femoral neck and mainly provide blood supply to muscles such as tensor fascia lata, vastus intermedialis and vastus lateralis [17, 18].

As we mentioned earlier within the ligamentum terres which is situated at the central top of the femoral head there is minor blood supply which is also provided from a small vessel as a part of this femoral circulation complex. Other vessels are formed within the pelvis such as internal iliac and internal pudental arteries with several branches mainly to provide with blood supply internal organs such as external and internal genitalia both in males and females. From the posterior side of the hip joint branches such as superior and inferior gluteal arteries which they provide with blood supply the gluteal and pelvic muscles [17]

Artery	**Origin**	**Distribution**
Femoral	External iliac artery to inguinal ligament	Supplies anterior and medial aspect of the thigh.
Deep artery of thigh	Femoral artery 4cm distal to inguinal ligament	Posterior, lateral and anterior compartments of thigh through adductor magnus.
Medial Circumflex femoral	From femoral artery	Blood to the head and neck of femur. Ascending joins to the inferior gluteal artery.

Lateral Circumflex femoral	From femoral artery	Anterior part of gluteal region, and winds around the femur. Descending and joins genicular anastomoses.
Obturator	Internal iliac artery	Adductors of thigh and muscle where attached to the ischial tuberosity.

Table 10: Arterial supply of thigh [17].

Artery	**Origin**	**Distribution**
Superior gluteal	Gluteal region through greater sciatic foramen and splits to superficial and deep branches.	Superficial: Gluteus maximus Deep: Gluteus medius, gluteus minimus, tensor fasciae latae.
Inferior gluteal	Gluteal region through greater sciatic foramen and descends on medial side of sciatic nerve.	Gluteus maximus, obturator internus, quadratus femoris, superior part of hamstrings.
Internal pudental	Gluteal region through greater sciatic foramen and descents posterior to ischial spine.	External genitalia and muscles in the perineal region only.

Table 11: Arterial supply of the gluteal region [17, 24].

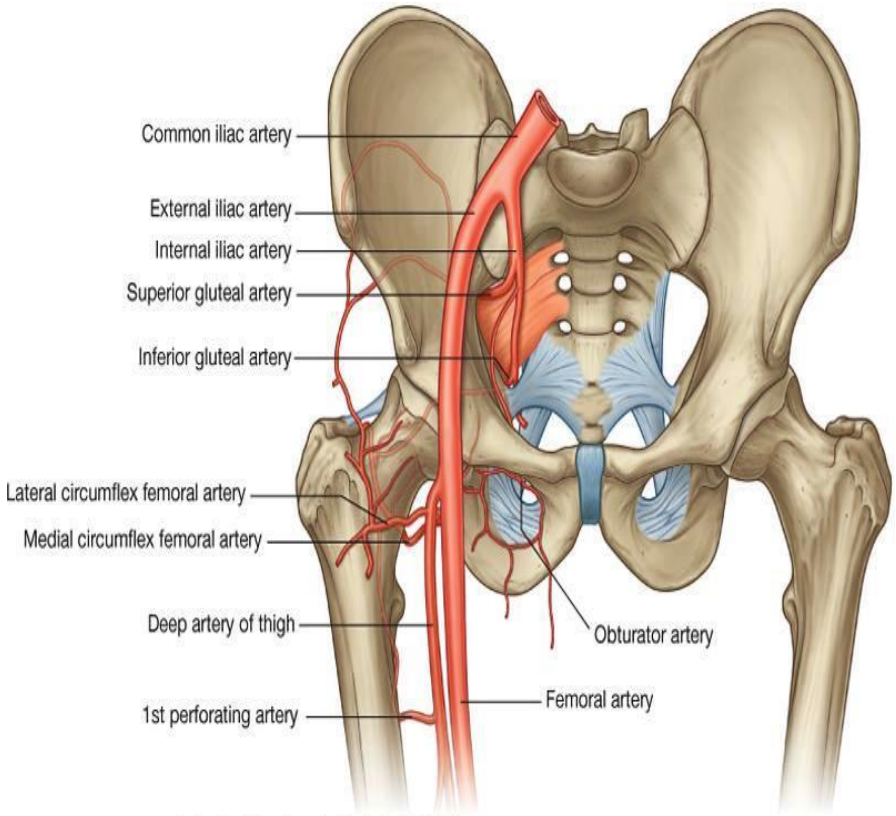

Image 6: Blood supply and major vessels of the hip and thigh region [17].

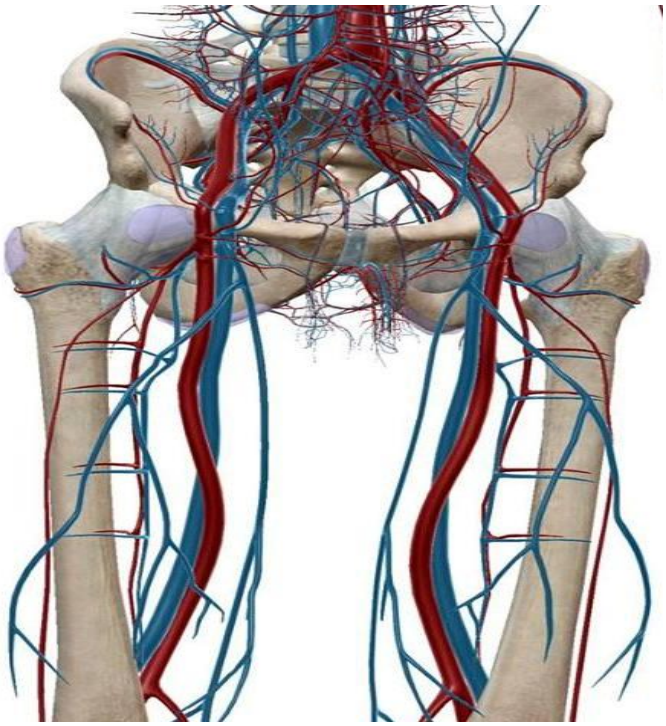

Image 7: 3D representation of the major vessels of hip and thigh region. Arteries presented with red color and veins with blue [25].

2.1.14 Vein Drainage of the lower limb

The veins are divided to superficial and deep groups. The superficial group is located in the subcutaneous tissue and the deep group is located in the deep fascia of the lower limb. The veins of the superficial group drain to the veins of the deep group, the veins of the deep system accompany the vessels of the arterial system and usually they have similar names [17, 24].

Starting with deep group in caudal- cranial direction the anterior tibial vein originates and receives blood from the dorsalis pedis veins which are located on the back of the foot and empties into the popliteal vein. The origin of the popliteal vein is defined by the junction of the posterior and anterior tibial vein. When the popliteal vein leaves the adductor canal becomes femoral vein. The femoral vein starts after the adductor canal and ends at the inferior margin of inguinal ligament, where it becomes external iliac vein [17].

The superficial group is mainly composed of two major channels, the greater saphenous vein and the small saphenous vein. The greater saphenous vein ascends anterior to the medial maleolous, passes posterior to the medial condyle of femur and ascends up to the leg, knee and thigh, to connect with the femoral vein [18].

The small saphenous vein arises on the lateral side of the foot from the union of the dorsal vein of the little toe and ascends posterior to the lateral malleolous as a continuation of the lateral margin vein then passes along the lateral border of the calcaneal tendon and ascends between the heads of gastrocnemius muscle. Ascends up the posterior surface of the leg and join the popliteal vein behind the knee joint [18].

2.1.15 Lymphatic Drainage of the lower limb

The lymphatic system plays major role in human body with several of functions such as fluid balance and homeostasis, fat absorption and immunological defense against foreign substances, viruses, bacteria and fungi [24]. The ninety per cent of the interstitial fluid is diffused back to the capillaries because of the difference in concentration gradient. However the ten per cent of the fluid entering the opened lymph vessels and becomes the so called lymphatic fluid [18].

The lymph vessels transfer the fluid in several locations within the human body for processing and control for any pathogenic factor. The lymphatic circulation is based in mechanical properties of skeletal muscles and smooth muscles within the

large vessels. Once the lymphatic system doesn't have any pump like the heart it uses the contraction of these muscle groups to propel and transfer the lymph to particular lymphatic centers for drainage [18].

The thoracic and intra-abdominal pressure has a significant influence as well, when the thoracic pressure drops then the lymph is pulled back into the thoracic duct and the one way valves prevent the lymph to travels in an opposite direction [11, 12].

Lymph nodes are encapsulated masses of lymph tissue found along the lymph vessels they are small bean shaped glands which are located widely throughout the body and they are only palpable when they are swollen, they can be swollen from several reasons as they serve as testing centers and filters [24].

The lower limb lymphatic vessels are divided into medial and lateral groups. The superficial lymphatic vessels, medial group, starting from the toes and accompany the great saphenous vein, they ascend and terminate into the inferior nodes of pelvic region. The lateral group ascends from the small saphenous vein and ascends and terminates mainly on the popliteal nodes. Furthermore in the pelvic region we can distinguish the superficial and deep inguinal nodes [18, 24].

The superficial lymph nodes are divided into upper and lower group, where the lower group receives lymph vessels from the free lower limb; the upper group receives from the gluteal region, the lateral and anterior abdominal wall, the external genitalia, and the lower part of anal canal. The lymph from the upper and lower superficial groups then is drained to the external iliac nodes and to the deep inguinal lymph nodes which are located around the femoral vessels in the femoral triangle and inguinal ligament [8, 17].

Lymph drainage techniques manual or instrumental used from all the clinicians for patients especially after surgery. The main goal is to reduce edema, prevent internal complications from infections, and speed up the rehabilitation process. Always in respect to specific contraindications which may vary according to the patient's medical history in many cases together with respiratory exercises and active movements of the lower limbs it seems to be very beneficial [4, 18].

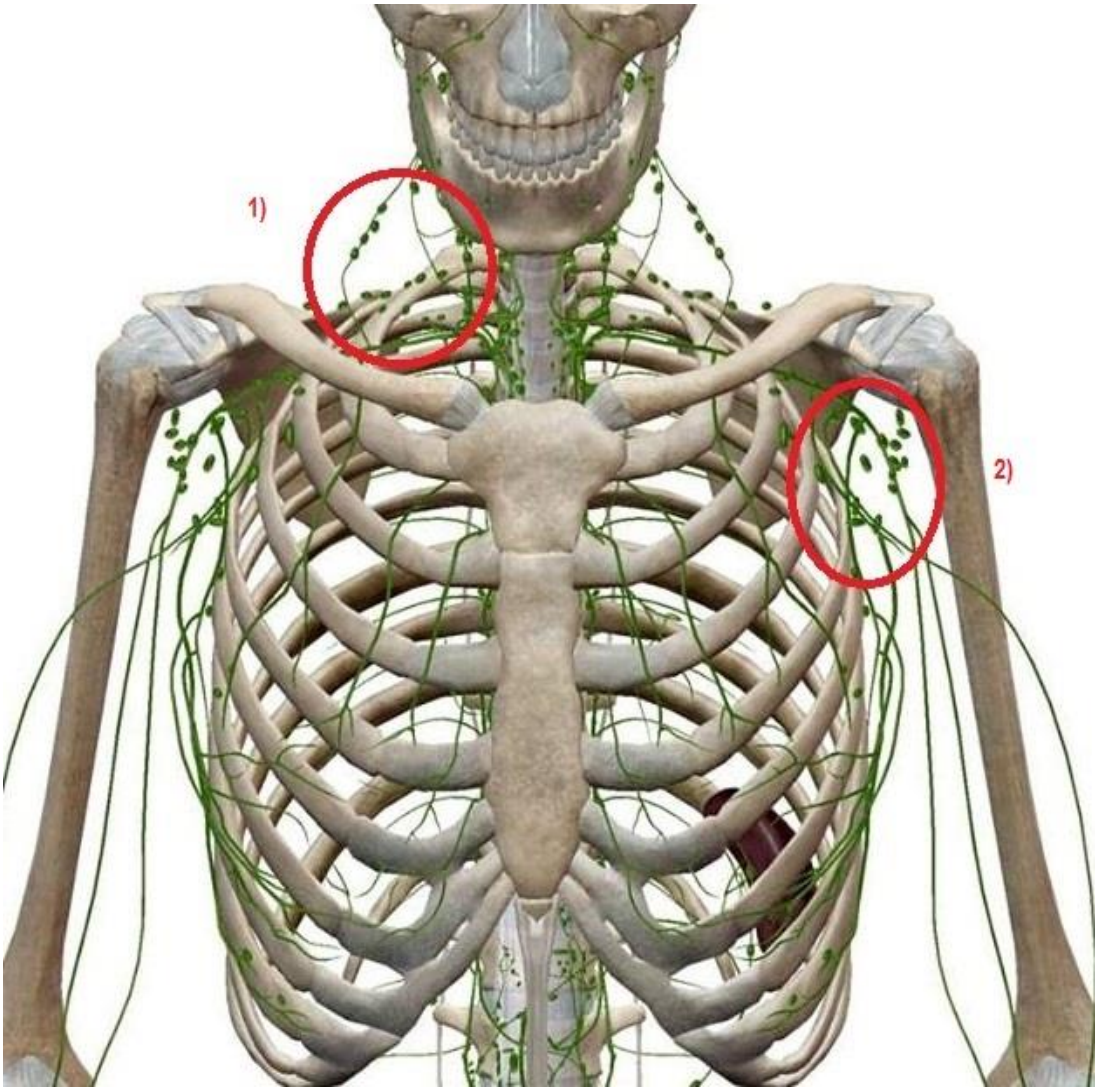

Image 8: 3D representation of the Upper quarter lymphatic system. The red circles demonstrate the lymphatic stations which they are commonly used from the clinicians during manual lymphatic drainage techniques. 1) Posterior and lateral superficial and deep lymph nodes. 2) Auxiliary superficial lymphatic nodes [25].

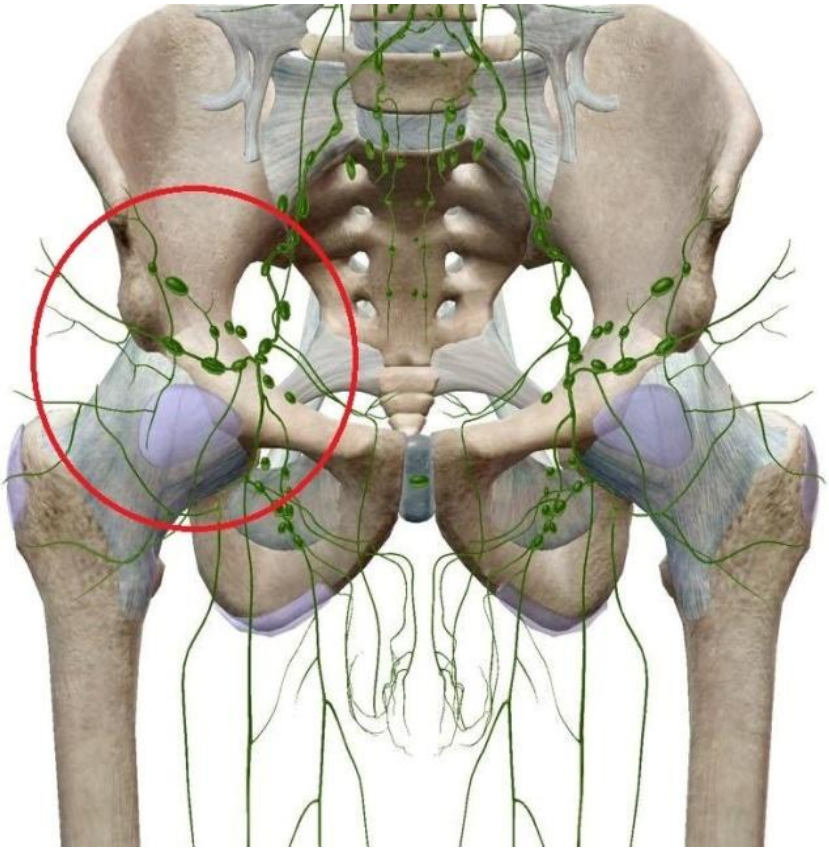

Image 9: 3D representation of the lower quarter lymphatic stations. Similar as the above picture the red circle represents the area of manual pressure which is used from the clinicians during therapy process on the superficial and deep inguinal lymphatic nodes [25].

2.2 Kinesiology of the hip joint, osteokinematic and arthrokinematic motion

2.2.1 Osteokinematics of the hip joint

The movements that occur around a center of rotation are called osteokinematic movements. The hip joint has a wide degree of freedom and allows us to perform movements all planes and axis. Those movements are: flexion, extension, abduction and adduction, lateral and medial rotation [14].

The degree of freedom is depended on many factors, such as the level of pathological or physiological state of a person, including also functional pathologies such as muscle tension, laterality, age, gender, employment, habits [11, 12]. Various authors attempted to describe the physiological range of motions based on statistic research of healthy groups and populations. Furthermore the assessment of

pathological symptoms such as pain relative to capsular patterns which are described during the years by very well-known and respectful authors requires further examinations and functional tests by the clinicians [9, 11, 14].

Motion	**Kendall**	**Janda**	**Magee**
Flexion	125°-135°	125°-135°	110°-120°
Extension	10°	10°-30°	10°-15°
Abduction	45°-55°	30°-50°	30°-50°
Adduction	10°	10°-30°	30°
Lateral rotation	45°	45°-60°	40°-60°
Medial rotation	45°	30°-35°	30°-40°

Table 12: Hip range of motions summary according to specific authors [9, 11, 14].

2.2.2 Capsular Patterns related with hip pathologies

According to various authors, different movement patterns approach the condition of a hip joint due to capsular pain.

Kapandji	**Cyriax**	**Kendall**	**Lewit**	**Janda**
Extension & Lateral Rotation & Abduction	Flexion & Abduction & Medial rotation	Medial rotation	Medial rotation & Extension & Flexion & Lateral rotation	Medial rotation & Abduction Extension

Table 13: Capsular patterns summary according to specific authors. [3, 8, 12, 21].

2.2.3 Arthrokinematics of the hip joint

As an osteokinematic motion is the primary movement of a joint; arthrokinematic motion describes mainly the sliding or translation, roll and spinning motions which occurs as a secondary motion between two surfaces [12].

Osteokinematic motion	Arthrokinematic motion
Hip abduction	Inferior glide of the femoral head
Hip adduction	Superior glide of the femoral head
Hip medial rotation	Posterior glide of the femoral head
Hip lateral rotation	Anterior glide of the femoral head
Hip flexion + medial rotation	Posterior glide of the femoral head
Hip extension + lateral rotation	Anterior glide of the femoral head

Table 14: Summary of arthrokinematic motions of the hip joint [10, 12, 14].

2.2.4 Convex and concave rule

The kalteborn's rule or the convex and concave rule is mainly the application of biomechanics principles of osteokinematic and arthrokinematic relationships in movement production. We assume that a curved surface is sliding in an opposite direction of the angular movement of the bone, and a hallowed concave surface, is sliding in the same direction as the osteokinematic movement of the joint occurs. [12].

This principle rule helps to determine the direction of mobilizing force during application of manipulative methods in order to restore the range of motion in a restricted joint [12]. However the validity of this particular rule is a topic of discussion in modern physiotherapy society, several evidenced based researches demonstrate heterogeneous results in specific joints examinations in comparison with the kalterborn's rule indications [2].

2.2.5 Hip joint congruency

Joint congruency means how well a convex and a concave surface fit with each other in relation with a position of a specific joint. Many factors contribute to this match such as the ration between the two bony surfaces, [21] as well as the physiological or pathological state of soft tissues which they are situated between or surround the joint. [3] We can distinguish two major position relative to the degrees of freedom of each joint or segment, those are the so called "open- packed position" or resting position and "close- packed position" [14].

Open or loose pack position exists when the joint is in maximum in-congruency, means that the supporting ligaments and parts of joint capsule are under minimal stress or strain. A closed pack position from the other hand is when the ligaments and joint capsule are taut and hold the joint surfaces in maximum contact.

Relative to the hip joint kinesiology and functional anatomy an opened- packed position is considered to be in: thirty degrees of flexion and abduction and slight lateral rotation and a closed-packed position in extension, medial rotation and abduction [10, 12, 14].

2.3 Biomechanics of the musculoskeletal system

2.3.1 Loads and energy absorption

To understand completely the human movement or injuries mechanisms clinicians should be interested on how forces act on and within the tissues. The degree of structural deformation of a material is depended mainly on the amount of force which is applied over time together with its microstructure [10].

A force which is applied in any biomaterial can create a variety of loads which they have the tendency to change its shape. Main axial loads which are created on and within the human muscle tissues are compression, tension, and shear. A combination of forces could create a combination of loads as well such as torsion and bending which is the result of tension and compression together and torsion [10].

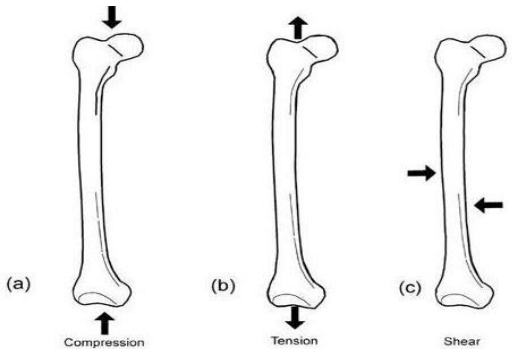

Image 10: Axial forces and loads on femoral bone [22].

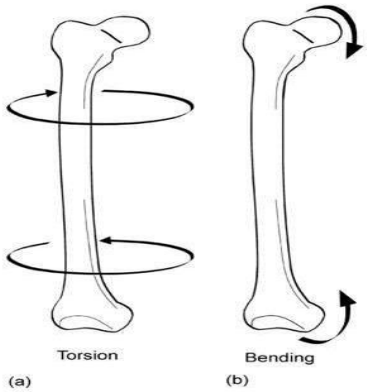

Image 11: Combined loads A) torsion and B) bending [22].

2.3.2 Mechanical strength and clinical significance

The work load which is needed to change the shape of a material is called stress and is defined as the work per unit area, is expressed by the formula ($\sigma = F/A$) and it could be measured in (N/m^2) or in System International by Pascal (Pa). The measure of material's deformation is called strain and it is calculated as the change in length (L) divided by the normal length (Lo) in a very simple formula: (L-Lo)/Lo [7].

The stress- strain relationship helps as to determine the stiffness of a material which is associated with the total mechanical energy which could be absorbed by a material, or its mechanical strength. In the field of clinical rehabilitation, physiotherapy or medicine the professionals are interested for the end elastic and plastic behavior of a material as well as the failure point which causes an injury inside the human body [10, 15].

2.3.3 Structural organization of soft tissue elements and mechanical characteristics

Soft tissue consists of a group of structures within the human body such as skin, sub skin, fascia, tendons, ligaments, and joint capsules. The composition of soft tissue is maddened up from collagen, mucopolyscharides, elastin and water. Different amount of the specific building blocks gives different behavior in energy absorption from external forces and energy production from the skeletal muscles [24].

In context collagen demonstrates increased modulus of elasticity during deformation range, increased hysteresis on elastic range and increased plastic behavior with failure at approximately 10% of its elongation [7].

Elastin has decreased modulus of elasticity, low hysteresis and an enormous amount of elastic behavior during elongation approximately 200% [16], after the yield point becomes stiff and ruptures. From that we could assume why muscle tendons are able to rapture with low load due to increased amount of collagen fibers and the inverse proportional relationship with the ligaments which they contain high amount of elastin and they are able to injured with high loads [9, 16] Similar composition also exists in particular cartilages which are a pores gel like substance composed of 2/3 of water, 1/3 of collagen and 40% of proteoglycans [24]

Cartilages are high depended in the rate of loading and demonstrate properties similar with the viscoelastic Kelvin's model. High rates of loading result in elastic

behavior, low rates of loading resulting viscoelastic behavior and creep, or no modulus of elasticity [7].

2.3.4 Structural organization of muscular elements and mechanical characteristics

For decades the leading theory of muscle contraction is the so called "sliding filament theory" which was first introduced in 1953 by Hugh Huxley and Jean Hanson [10]. A sarcomere is mainly composed of two kinds of proteins the myosin and actin which they are organized separately into thick and thin filaments. The sliding of actin (thin) filaments over the myosin (thick) filaments with relative constant length of both generates the mechanism of muscle contraction [24].

Three major physical relationships can distinguish the mechanical characteristics of a muscle. The force-velocity relationship, determines how the production of force is depended on type of muscle contraction and velocity variations.

The force-length relationship, documents how the optimal length of a muscle can affect dramatically the production of muscle tension. The force-time relationship, describes perfectly the delay of muscle activation and motor action potential. Deferent percentage of biological constituents demonstrates different mechanical characteristics in all biomaterials. Anisotropic behaviors in all kind of soft tissue are demonstrated as well as on the attachment points of a muscle. Muscle tendons are dense connective tissues similar in structure with ligaments but with different amount of extracellular and cellular components [10].

Tendons composed of 86% water and collagen, 2% elastin and 1% proteoglycans. [24] Due to the material constituents the stress and the strain in a tendon is depended on the rate of loading, force-time relationship and the final response. This viscoelastic behavior makes the clinicians to select a slow and passive instead of fast ballistic stretch due to higher compliance [10, 11, 12].

2.3.5 Structural organization of skeletal elements and mechanical characteristics

From a microscopic perspective the major building materials of bones are: calcium carbonate, calcium phosphate, collagen-protein tissue and water. Different amount of material constituents gives different amount of properties such as strength, flexibility, and stiffness. In general human bones could be divided in two major types according to the microscopic structure and architecture relative to their mineralization [24].

The porosity of each bone is determined by the amount of minerals which are contained within the bone. Cortical bones demonstrate 5-30% of non-mineral tissue. Cortical bones are prone to withstand an increased amount of stress loads and decrease amount of strain capability (2%). From the other hand the so called trabecular or spongy bones they are characterized by high porosity approximately 30-90%. Spongy bones in general could withstand a decreased amount of stress but a greater amount of strain (7%) in comparison with the first group and they develop four deferent subtypes (Short, flat, irregular or long bones) [18, 24].

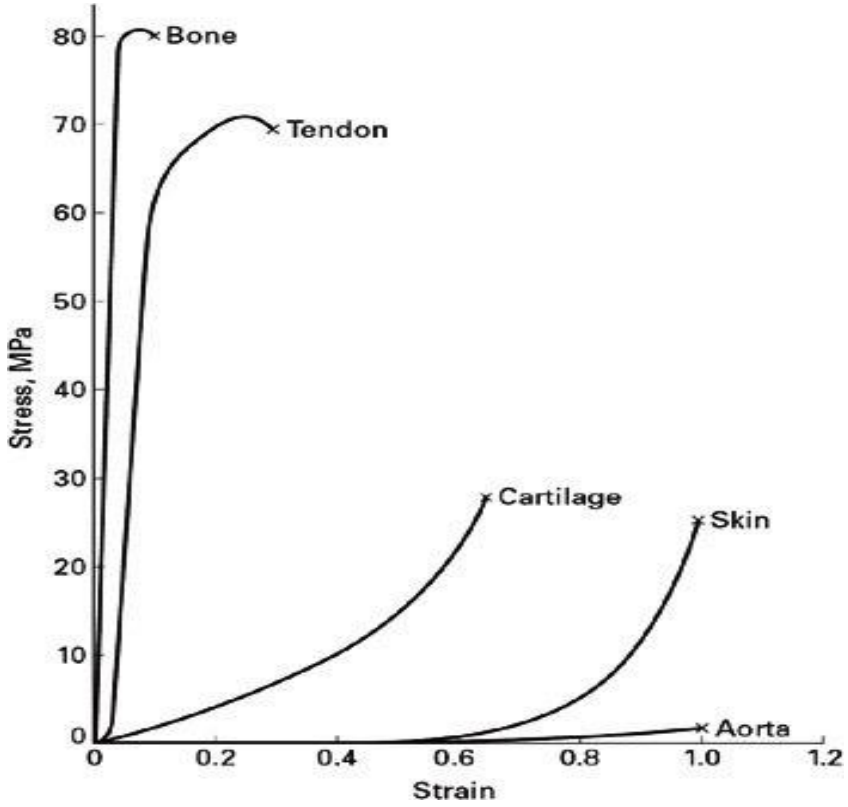

Image 12: Stress- strain responses of five different biomaterials [16].

Material	E (MPa)	Fracture-Stress (MPa)	Strain at fracture
Elastin	0,6	70	0,09
Collagen	1000		
Fibroin	10,000		
Cortical bone *Longitundinal* *Transverse*	 (14-24) x 10^3 (8-18) x 10^3	 150 50	~ 0.015

Cancelous bone *Longitundinal* *Transverse*	10-200	150 50	~ 0.015
Tendon	1,300	75	0,09

Table 15: Mechanical properties of some biomaterials within the human body [7].

2.3.6 Trauma mechanics and bone fractures

Bone fracture is one of the most common injuries among people from a variety of sustained loads. Such fractures may be the result of sport related accidents, vehicle accidents, and falls [13].

Hip fractures (pelvis & femur) are mostly related with falls in elderly population due to various intrinsic and extrinsic factors. The physiological bone changes related to aging process, such as mineral and water content, temperature, body location and underlying pathologies contribute to major complications as a consequence of a fall and is a major concern in public health worldwide [5]

There are various classifications of fractures, in general terms a fracture could be “open” or “closed” if the proximal or distal end of the bone penetrates the skin or not, an also displaced or not displaced. According to loading and energy absorption we can distinguish a bone fracture in two categories, direct and indirect fractures [5, 14].

The direct fractures is divided in two groups, low and high energy. Low energy usually involves falls in elderly population with transverse or little no communion of the bone. High energy is associated with soft tissue injury and high probability of comminuted image of the bone. Indirect fractures are associated with traction, bending, and torsion or combined forces may result in transverse, spiral or oblique fractures [5, 13].

Various classifications of bone fractures according to the clinical image and anatomical location exists. However the severity of a fracture has to be taken into consideration during classification as it implies the anticipated treatment difficulties, pre and post-operative complications and future prognosis [5, 19].

2.3.7 Hip fractures

2.3.7.1 Statistics and epidemiological characteristics of hip fracture

Stress fractures are the most common of all hip fractures resulting from full contact sports, twisted injuries, vehicle accidents and falls with higher rates in elderly population with most common in women due to osteoporosis and with a very high socioeconomic impact in developed countries [4, 5, 19].

Country	Men	Women
England	137,8 / 100,000	346 / 100,000
Greece	201,7 / 100,000	469,2 / 100,000
Sweden	302,7 / 100,000	709,5 / 100,000
Austria	567 / 100,000	759 / 100,000
Hungary	223 / 100,000	430 / 100,000

Table 16: Sample of random selected European countries, with standardized hip fractures rates (per 100.000) of population in relationship with gender difference [4].

Country	Men	Women
United states Minnesota	201,6 / 100,000	511,5 / 100,000
United states	197,2 / 100,000	553,5 / 100,000

Table 17: Epidemiology of standardized hip fractures rates (per 100,000) of population with difference in gender in USA [4].

2.3.7.2 AO Classification of hip fractures

The inconsistencies of various types of classification according to individual authors are corrected by the AO classification which classifies the morphology of the fracture. In general each bone is corresponding to a specific number from 1-8 and every part of the bone is assigned with numbers from 1-3.The type of the fracture is defined with letter series from A to C. for example, the number 3 is corresponding to the femur, 31 is corresponding to the proximal part of the femur, 31A means proximal femur fracture in the trochanteric area. More specific 31B means femur proximal and neck fracture, and 31C corresponding to femur proximal, head fracture [5, 6, 26].

2.3.7.3 Femoral neck fracture

Femoral neck fractures are the most high risk fractures in both young and elderly population due to vascular necrosis possibility. High energy neck fracture can

cause a vertical fracture of the femoral head and a vertical obliquity enough to injure or rapture the femoral circumflex artery and other minor blood vessels, causing a nonunion vascular necrosis [5, 6].

2.3.7.3.1 Classification of the femoral neck fracture

AO subgroups classification for femoral neck fractures:

• B1: Neck fracture, sub capital, with slight displacement.

• B2: Neck fracture, Trans cervical.

• B3: Neck fracture, sub capital with marked displacement.

There are four fracture types within the Garden's classification:

• Type I: incomplete and impacted in valgus

• Type II: fracture is complete and none displaced on at least two planes (anterior & lateral)

• Type III: Complete fracture and partially displaced the trabecular part of the femoral head is not in the same line with the acetabulum.

• Type IV: Completely displaced with no continuity between the proximal and distal fragments. The trabecular part of the femoral head remains parallel with the accetabular trabecular part.

Other medical terms in description of femoral neck fractures and similar with the Garden classification can be found as sub capital; Trans cervical; basicervical; intertrochanteric and sub trochanteric.

There are three fracture types within the Pauler's classification according to the obliquity of fractured compartment.

• Type I: An obliquity ranging from 0 to 30 degrees

• Type II: An obliquity ranging from 30 to 50 degrees

• Type III: An obliquity ranging from 70 degrees and more [1,4,5,19].

2.3.7.4 Symptoms and early diagnosis

Symptoms may vary according to the age, gender, and psychological state of the patient. Subjective symptoms such as pain and its intensity is strongly associated with the individual's interpretation of nociception, however the morphological changes and the affected tissue from the displaced compartments plays significant role in pain scale, often the patients may complain of radiating pain on the knee joint [11,24].

Objectives symptoms including visible deformations, inability for weigh bearing, leg shortening, edema or swollen due to inflammation, crepitus between the broken ends of the bone and muscle spasm which is produced by the body in order to stabilize and protect the affected parts and finally temporary loss of function in the affected segments or joints.[11, 13]. High risk symptom especially in high energy fractures is the hypovolemic shock due to bleeding from the injured bone, this shock state is frequent observe it after vehicle accidents and impacts [4].

Chronic or immediate functional symptoms may include muscle atrophy and weakness, compensatory postural mechanisms, development of myofascial trigger points and periosteal tender points, decreased range of motion in the affected or neighbor segments, and psychological disturbances such as frailty, anxiety, or even depression as a result of post traumatic shock [11, 21].

Early diagnosis and treatment plan is determined by the physical examination, history anamnesis, and symptoms evaluation which may indicates an acute X-ray interpretation, MRI or CT scan to determine bone and soft tissue abnormalities [11].

2.3.7.5 Surgical intervention and approach selection

The appropriate therapeutic approach is based on age, severity of the fracture and preexisting pathologies from the patient's history. Surgical intervention is required in simple displaced fractures, comminute, displaced and intra-articular fractures. Surgeons perform reposition and stabilization of the fragments with simple pinning or osteosynthesis [5].

The osteosynthesis approach and type of implants are carefully selected according to the age, severity and previous health condition of the patient for example in case of osteoporosis. A femoral neck fracture surgery is performed under general or spinal anesthesia. Hip pinning is recommended if the joint is minimally displaced and there is a sufficient bone density. A minimal incision is required for this approach on the lateral side of the thigh with several screws inserted to stabilize the displaced parts. There three quiet similar methods that could be solve the problem according to the surgeon's point of view. K- Wires, canulated screws, more likely for sub-trochanteric fractures, and dynamic hip screws (DHS). Other most common approaches for more severe displaced fractures are hip hemiarthroplasty and total hip replacement [6, 26, 19].

2.3.7.6 Dynamic hip screws (DHS)

Dynamic hip screw of DHS is generally used in extra-capsular fractures where the blood supply is disrupted or impaired. After fracture reduction and preliminary K-Wire fixation a guide is drilled into the femoral head in order to determine the length of the particular structure and the implant is rimmed or even tapped. The dynamic hip screw is then inserted and a barrel which is placed over the screw is fixed to the femur with screws. For the dynamic stabilization of the fracture a DHS compression screw may be implanted intra operatively. The dynamic approach allows faster dynamic movements, early mobilization and speeds up the healing process with minimum weight bearing restrictions [19, 26].

2.3.7.7 Total hip replacement (THR)

The usual method for displaced intra-capsular fractures with displacement is the total hip replacement especially if there is a co-existed arthritis or injury of the hip joint. The surgeon with a minimal three to six inches incision will replace the convex and concave part of the hip joint with artificial implants called prostheses with cement or screws [26].The modern anterior lateral approach now days have better functional and aesthetic result than the older methods because no muscles are detached or split during the incision. The weight bearing restrictions following the surgery are based on the type of the surgical approach, with or without cement where the second one requires less weight bearing to the affected side and more limitations for the post-operative treatment plan [1].

2.3.7.8 Partial hip replacement (Hemi-arthroplasty)

Hip hemiarthroplasty of partial hip replacement is suggested in mild displaced intra-capsular fractures with high risk of vascular necrosis. Also is used if the patient doesn’t suffer from osteoarthritis of the hip joint and has a relative active lifestyle. The procedure is performed with the patient in side lying position and the surgeon creates a small incision on direct lateral aspect of the thigh. Skin, subcutaneous tissue and fascia are divided to allow the access in gluteus medius muscle. The muscle is detached from the greater trochanter and the surgeons remove the femoral head and neck on the level of lesser trochanter and replace them with an artificial implant unipolar or bipolar with or without cement After the final reduction of the hip joint the gluteus medius is re-attached to the greater trochanter and the soft tissue including fascia, subcutaneous tissue and skin are closed with sutures [1, 5].

2.4 Physiotherapeutic intervention and management after femoral neck hemi-arthroplasty

2.4.1 Early post-operative care

The physiotherapeutic intervention starts at the same or the next day after the operation. Major possible complications have to be taken into consideration during the design of the treatment plan from the multidisciplinary team. Thrombus-embolism and respiratory complications such as pneumonia have to be prevented with the implementation of active or assistive-active exercises, lymphatic drainage for edema and swelling reduction together with respiratory physiotherapy. The patient should maintain optimal hydration levels and usually the nursing stuff administer the required anticoagulant medications and antibiotics. [11]

Another possible complication is the development of ulcers or decubitus especially in elderly and diabetic patients. Early verticalization and re- education of transfer skills should be applied and explained by a physiotherapy specialist usually from the first day after the operation. Scar tissue care for aesthetic reasons and prevention of adhesions should not be excluded from the daily regime. The hip joint's range of motion has to be restored while the stability should be maintained together with the functional properties of the muscles. [11, 22]

The exercises are implemented with respect to the physician's documented indications and contraindications as well as the patient's tolerance and physical or mental condition. Contraindicated movements in the operated limb are most of the times the same following a partial or total hip replacement. The clinicians should be aware for hip flexion over 90 degrees, hip joint adduction and medial or lateral rotation according to the surgical approach. The rotational component of the exercises usually is contraindicated in either medial or lateral direction especially in elderly patients due to poor cooperation with the clinicians. [22]

2.4.2 Late post-operative care and functional pathologies

The second week after the operation the patient can fully weight bear, thus, pain or joint restriction and myofascial trigger or tender points are common phenomenon among hospitalized patients. [12, 21]

Adapted changes may occur in the whole body to ensure the total stability or even as a protective mechanism prior to injury. The development of increased or decreased muscle tension in alternative patterns between tonic and phasic muscles

may give arise of postural instability, reflexive changes and peripheral symptoms. The validity of the symptoms is based usually on physiotherapist's experience and has a qualitative character. [21]

An evaluation of ADL and self-care activities is necessary and consultation from an occupational therapist is often needed. The social or psychological impact of an injury and a surgical procedure is often managed from psychologists and social workers especially in elderly population and individuals who are living by themselves.

2.4.3 Physiotherapeutic methods

Various techniques can be used to promote the bone and soft tissue healing such as physical agents including hydrotherapy, distant electrotherapy and pulsed magnetic fields if the implant is not ferromagnetic. Manual methods such as relaxation techniques in hypertonic muscles, soft tissue techniques and manual or instrumental lymphatic drainage are the milestone for a successful therapeutic plan due to therapist-patient interactions and effective results. Close kinetic strengthening and mobility exercises are preferable in hospitalized patients and more complex techniques are allowed under the supervision of a specialist and always in respect to tissue remodeling process. However latest evidence based researches indicates that the simple structured exercises produce small improvements in overall mobility after hip fracture surgery than the progressive resistance training which is much more beneficial. [7]

Manipulative methods and early mobilization in neighboring joints or segments seems to be beneficial in prevention of compensatory mechanisms and secondary changes. Direct mobilization on the affected area should be avoided until the bone healing and regeneration process complete. [12]

2.4.4 Home Considerations

The hip precautions should be continued after discharged. Physiotherapists and occupational therapist as a part of multidisciplinary team should cooperate with the patient or family members to prevent possible complications and facilitate the patient's daily activities. Several items and assistive devices can be used to ensure the safety of the patient within the house. For instance handrails, adjustable shower benches and grab bars or high sits could facilitate toileting and self grooming activities preventing possible over bending of the hip joint or low back more than ninety degrees angle. To avoid excessive stretched position all the sleeves and

frequent used items should be easily reachable by the patient. A good choice is to rearrange all the sleeves at the height of the shoulder or waist. [6]

For fall prevention is very important the floor of patient's residence to be always clean without slippery carpets, small objects or unnecessary furniture. Most of the elderly patients may suffer from impaired vision, mental problems and balance disturbances. For that reason a comprehensive geriatric care after hip fracture is necessary to decrease the rates of morbidity factors and a future emergency event. [11, 13]

3. Special Part: Case study

3.1 Methodology

The clinical work placement took place in military hospital (Ústřední vojenské nemocnice Praha) in the city of Prague. The work placement started at 4th of January 2016 and finished at 15th of January, in the department of orthopedic surgery, station number one. Each day of practice lasted for eight hours and the total number of hours of practice was 80. The subject of the particular case study was assessed and treated two times per day; the total amount of session was 14. The clinical practice took place under the supervision of my colleague Bsc. Martin Lassner.

Treatment proceeded by approval of the ethics committee of the faculty of physical education and sports at Charles university in Prague.

3.2 History anamnesis

Gender of the examined person: Male

Examined person: J.J

Year: 1921. 95 years old

Diagnosis: Fracture of femoral neck Dexter

Medical Code: (S7200)

3.2.1 Status presents

Height: 180cm

Weight: 64kg

BMI: 19,8

Heart Rate: 120/60 mmHg

BP: 86/min.

Temperature: 36, 0°c

Respiratory Rate: 20/ min.

3.2.2 History anamnesis

The subject experienced a harmfully fall in his home during the night. The subject stumbled on a small obstacle inside the house and fall down on the floor. He transferred immediately on the emergency department of military hospital on 24/12/2015 and the surgeons operated him in the same day. Additional the subject suffers from moderate chronic obstructive pulmonary disorder (COPD) for 40 years, the subject also suffers from hypertension which is controlled by medications. In general there are no other significant pathologies and his physical condition is relative good for his age. No mental or cognitive problems exist.

3.2.3 Present state

The subject presented bedridden, eleven days after hemi-arthroplasty operation with decreased morale and mood for communication. The subject presented with 15cm stitches to the right hip joint laterally at the area of greater trochanter. Mild hematoma occurred 10 cm caudally from the sutured area.

There was no pain of discomfort according to patient's description. The patient was not assisted by any intravenous application for nutrition or medication uptake. All the supplements and medications were introduced by the nursing stuff orally. His breathing pattern from the first sight was difficult, with excessive use of

upper respiratory area and visible activation of the neck and chest muscles, especially during attempting a semi sitting position from supine lying, in order to show as his operated leg for examination purposes.

3.2.4 Family Anamnesis

• The subject's father died at the age 68 years old due to complications from Cerebral Palsy.

• The subject's mother died at the age 88 years old due to last stage of multiple sclerosis.

• The subject is married and father of two daughters. He lives together with his wife in a single house on the country side of Czech Republic.

3.2.5 Operation Anamnesis

• Operation for kidneys abscess (1994)

• Operation for bilateral inguinal hernia (1996)

• Operation of the prostate due to hyperplasia (1994)

3.2.6 Allergies

In pollen, dust and passive smoking.

3.2.7 Medication:

EGILOK	25 mg	½- 0- ½
FORMANO	15mg	2-0-2
MITRAZAPIN SANDOZ	15mg	0-0-½
ZOXON 2	X	0-0½

Table 18: Patient's pharmacotherapy with specific dosages and daily frequency prescription by a medical doctor.

3.2.8 Social anamnesis

Married

3.2.9 Occupation anamnesis

Pensioner former office manager

3.2.10 Hobbies/Sport Activities

The subject used to be amateur athlete of volleyball since for 30 years.

3.2.11 Abuses

None

3.2.12 Previous Injuries

Nothing significant

3.2.13 Prior rehabilitation

None

3.2.14 Excerpt from patient's health care file

The first acute X-ray examination was performed in 24/12/2015 and demonstrates femoral neck fracture Dexter with clear image about the type and the severity of the injury, type I femoral neck fracture according to Denver's classification.

Image 13: Acute X-ray interpretation of the right hip Anterior-Posterior. (From patient's documentation)

Image 14: Post operative X-ray interpretation of the right hip Anterior-Posterior. As we described earlier the prosthesis replace the femoral head and it is composed of a metal stem which fits into the marrow cavity of femur and a metal ball that fits into the acetabulum. (From patient's documentation)

3.2.15 RHB indications according to the responsible doctor

Respiratory physiotherapy, Active and passive movements with precautions for the operated limb, restrictions prescribed from the surgeon tin avoidance of: flexion of the hip joint more than 90 degrees, adduction and lateral rotation of the hip joint. Improve the isometric strength, early verticalization, and gait training with assistive devices

3.2.16 Differential balance

From the physiotherapist's point of view the patient could have additional symptoms associated with functional pathologies. In relation to the reflex zones in the lumbar and upper thoracic area, joint kinetic and kinematic restrictions especially in the lumbar region and thoracic region due to joint and collagen tissue degeneration according to the physiological response of the human body in aging process. SIJ restrictions as compensatory mechanisms as well as pelvic asymmetries. Weakness the abdominal muscles, upper back muscles, Gluteus minimus and medius together

with atrophy or hypotrophy and tendency for hyper tonicity of rectus femoris and pectorals muscles as well as superficial and deep neck flexors from the difficulty breathing.

3.3 Initial kinesiology examination by physiotherapist

- Postural examination
- Gait Examination
- Anthropometric Measurement
- Range of motion examination
- Palpation
- Palpation Examination
- Movement patterns
- Joint Play Examination
- Neurologic Examination and functional muscle testing.

Examination by physiotherapist

3.3.1 Postural examination by observation: (the patient is supported with trolley cart)

Posterior View:

- Base of Support: Narrow base of support both feet are lateral deviated from the middle line.
- Shape and contours of the heels: The skin of the both heels is more pressed at the lateral side.
- Shape and position of the ankle joints: Pes Planus (pronated both)
- Shape and thickness of the Achilles tendon: normal both no deviations.
- Contour of the calf muscles: there is a slight visible difference between left and right, the right calm seems to be thiner.
- Shape and position of the knee joints: both in internal rotation visible also from popliteal line.
- Popliteal line: the lateral side of popliteal line in both knees is upper than the medial.

- Contour of the thigh muscles: the contour of thigh muscles seems to be decreased billateral.
- Subgluteal line: straight,
- Glutei muscles: decreased contour of glutei muscles and may trophicity. Visible skin ripples are demonstrated close to ischial tuberosity.
- Symmetry of thoracobrachial triangles: the distance between upper extremity and pleural area is wider due to the patient's support by the trolley cart.
- Position of the pelvis: Lateral tilt higher on the left side.
- Para vertebral muscles: the shape is normal in both sides, but on the upper back there is visible prominence of paravertebral muscles from the right side
- Curvature of the spine in the frontal plane: absence of lumbar concave curvature, increase convexity of the lumbar and thoracic spine and increase concaved curvature on the cervical region, stooped posture. There is visible scoliosis C-Type which starts approximately between the vertebrae T5-T3.
- Position of the scapula: Both scapula's are elevated and abducted. Visible winging of scapula is visible and prominent on the right side. Approximately 3 cm from the inferior angle of scapula there is a pressure ulcer which healing normally.
- Position of the shoulder girdle: from the back sides shoulder girdles seem to be protracted anteriorly and elevated because the biacromial picks are not clearly visible and higher than normal.
- Position of the upper limb: The upper limbs are both internal rotated with the forearms and the palms in between pronation and supination, holding the handles of the trolley cart. Both upper extremities are situated in approximately 20 degrees of abduction.
- Position and contour of the nuchal muscles: normal both sides.
- Position of the head: The curve of the neck seems to begin in a typical way in the lower cervical region. There is a sharp angulation occurs at approximately the sixth cervical vertebra. Above this level the curve seems to be very much increase due to protraction of the head. Also from the posterior observation the head seems to be slightly rotated to the right as the right side of the mandible bone is visible.

Front View:

- The base of support: Narrow base of support both feet are lateral deviated from the middle line.
- The position of the feet: pronated feet (Pes Valgus) the hallux toe is more pressed and adducted (both feet). On the left and right lower extremities both distal and proximal interphalangeal joints from the second till fourth digits demonstrate increased flexion and they can be characterized as hammer toes.
- Weight distribution: the weight distribution even with the support of the trolley cart seems to be 60-40%. With the biggest value on the non-operated side.
- Shape and position of the knee joints: Medial patella deviation significant sign for Bowlegs according to Kendall.
- Configuration of m. tibialis anterior: Symmetrical.
- Contour of the calf muscles: Non symmetrical picks the right contour seems to be slightly higher than the left.
- Shape of the thigh muscles: Decreased trophicity is also visible in both thigh muscles. The left quadriceps is slightly bigger than the right.
- Position of the pelvis: Anterior and lateral tilt is more visible from this referral point. The higher pick of the pelvis is on the left side.
- Position of the navel: Normal position of the both navel.
- Symmetry of thoracobrachial triangles: the distance between upper extremity and pleural area is wider due to the patient's support by the trolley cart.
- Position and symmetry of the chest: the upper thoracic region is smaller than and the lower ribs seem to be slightly flared out.
- Position of the collarbones and superclavicular holes: Normal, no deformities. The supraclavicular notches are more visible especially when the patient breathing in.
- Position of the shoulder girdle: Protracted and elevated shoulders (both).
- Position of the upper limbs: The upper limbs are both internal rotated with the forearms and the palms in between pronation and supination, holding the handles of the trolley cart. Both upper extremities are situated in approximately 20 degrees of abduction.
- Position of head: the head is protracted due to increase cervical lordosis and also rotated to the right side slightly from the middle line.

Lateral View (Left side)

- Weight distribution: the patient is supporting his weight now more on the left side with increased lateral rotation of the hip joint. No complains about pain or other discomfort was referred.
- Shape and contour of the shin: Normal, no deformities.
- Position of the knee joint: medial patella deviation.
- Contour of the thigh muscles: decreased contour of quadriceps and hamstrings is also visible from the lateral view on the left side.
- Position of the pelvis:. Anterior and lateral tilt of the pelvis with highest pick on the left side.
- Shape of the abdominal muscles: visible separation of rectus abdominis from external oblique left side. The abdominal wall is flat with inward movement during inspiration and the lower ribs are flared out.
- Position of the shoulder girdle: Protracted and elevated.
- Position and curvature of the Th/C and C spine: Increased thoracic kyphosis with the highest picks in the area of the T4-T5. The cervical region is characterized as lordotic with the head in protraction.
- Position of the head: The subject apparently is trying to correct the posture. There is visible excessive head protraction.

Lateral View (Right side)

- Weight distribution: Significant less weight bearing on the right lower extremity
- Shape and contour of the shin: Normal, no deformities.
- Position of the knee joint: Medial patella deviation.
- Contour of the thigh muscles: decreased contour of quadriceps and hamstrings is also visible from the lateral view on the right side.
- Position of the pelvis: Anterior and lateral tilt with the lowest pick on the right side.
- Shape of the abdominal muscles:. Visible separation of rectus abdominis from external oblique right side. The abdominal wall is flat with inward movement during inspiration and the lower ribs are flared out.
- Position of the shoulder girdle: Elevated and protracted.

- Position and curvature of the Th/C and C spine: Increased thoracic kyphosis with the highest picks in the area of the T4-T5. The cervical region is characterized as lordotic with the head in protraction.
- Position of the head: The subject apparently is trying to correct the posture. There is visible excessive head protraction, with few degrees of rotation towards to the right side.

Image 15: Postural examination by observation, posterior view. The patient is assisted by special trolley cart.

Image 16: Postural examination by observation, lateral view.

3.3.2 Gait analysis

The patient is verticalized without the help of health care professionals thus is able to walk only 20 meters with four axis support by a trolley cart. The patient's posture is characterized as stooped with a senile gait pattern. The base of support is very narrow and the center of mass is forwarded as the patient support his arms and his weight to the handlebars. The stride of the steps is small with decreased speed and short breaks of rest due to respiration difficulties and slightly dizziness. The patient spends significant time in stance than in walking because of fear of falls as he

mentioned. There is absence of the normal sequence of walking, the patients prefer to drug the legs and propel forward by the assistance of the wheels than to follow a standardized step pattern for proper walking. He doesn't complain about pain in the hip region or general in the operated leg, his bigger problem is the energy expenditure and respiratory insufficiency.

3.3.3 Anthropometric measurements

Measure	Left	Right
Anatomical Length	105 cm	103 cm
Functional length Omb.	100 cm	99 cm
Functional length	100 cm	98cm
Length of upper extremity	83 cm	83 cm

Table 19: Anthropometric measurements from patient's initial examination

Measure	Left	Right
Circumference of calf	31 cm	29 cm
Circumference of Quadriceps (15cm above patella)	33cm	32 cm
Quadriceps (10cm above patella)	31cm	30cm
Circumference of thorax	44 M	

Table 20: Anthropometric measurements from patient's initial examination circumference.

3.3.4 Range of Motion, Goniometry according to Kendall

Hip Joint			
Left side		**Right side**	
Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S: 10 – 0 – 90	10 – 0 – 90	5 – 0 – 70	5 – 0 – 75

F:20 – 0 – 0	25 – 0 – 0	10 – 0 – *0	15– 0 – *0
R: 30 – 0 – 30	40 – 0 – 40	0 – 0 – 0	0 – 0 – *0

Table 21: Range of Motion measurement by SFTR method for hip joint. Flexion over 90 degrees, Adduction and lateral or medial rotation on the operated leg are contraindicated according to the surgeon prescription.

Ankle Joint			
Left side		**Right side**	
Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S: 35 – 0 – 30	45 – 0 – 40	30 – 0 – 25	35 – 0 – 30
R: 10 – 0 – 20	15 – 0 – 30	10 – 0 – 10	15 – 0 – 20
Shoulder Joint			
Left side		**Right side**	
Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S: 20 – 0 – 120	30 – 0 – 130	20 – 0 – 120	30 – 0 – 125
F:90 – 0 – 30	100 – 0 – 30	90 – 0 – 30	100 – 0 – 30
R: 40 – 0 – 30	45 – 0 – 35	40 – 0 – 30	45 – 0 – 30
Elbow joint			
Left side		**Right side**	
Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S: 0 – 0 – 140	0 – 0 – 145	0 – 0 – 145	0 – 0 – 145

Radio ulnar joint			
Left side		**Right side**	
Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S: 90 – 0 – 90	90 – 0 – 90	90 – 0 – 90	90 – 0 – 90
Wrist Joint			
Left side		**Right side**	
Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S: 70 – 0 – 85	80 – 0 – 90	70 – 0 – 80	75 – 0 – 90
F: 20 – 0 – 30	20 – 0 – 30	15 – 0 – 30	20 – 0 – 30

Table 22: Range of Motion measurement by SFTR method for peripheral joints of interest.

3.3.5 Palpation

The palpatory examination was started from caudal to cranial direction.

- Palpation on the skin surface of both feet demonstrates stiff and dry epidermis with xerodermia.
- Gastrocnemius and soleus demonstrate hypotonic state with normal trophicity on both lower extremities with absence of neither trigger nor tender points.
- Quadriceps femoris ipsilateral side demonstrates hypotonicity with hypotrophy on both vastus medialis and lateralis with the presence of painful tender points along the muscle belly of vastus lateralis.
- Quadriceps femoris on the contralateral limb demonstrate hypotonic state with atrophy on both vastus medialis and lateralis. Neither trigger points nor tender points are present.
- Rectus femoris on the ipsilateral limb is hypotonic state, with no other functional pathologies in presence.

- Rectus femoris on the contralateral limb is in hypotonic state with small presence of pain (3/10) according to the patient's subjective feeling. No presence of other functional pathologies was estimated.
- General palpation in the area of the adductors on the ipsilateral limb demonstrate hypertonicity for both two joint and one joint muscles, no pain nor other functional pathologies were found.
- General palpation in the area of the adductors on the contralateral limb demonstrate hypertonicity for both two and one joint muscles with the presence of painful trigger point in the area of insertional point of adductor longus.
- Palpation of the the stitches to the contralateral limb, demonstrate 10 cm stitches with well healing process of the soft tissue, no resistance or skin defects are present. 10cm caudal there is a hematoma characterized by increased skin temperature and perspiration and blueness in comparison with healthy tissue.

3.3.6 Movement patterns examination according to Janda

- Neck flexion: the patient demonstrates chin lift during neck flexion in habitual way in the first, second and the third attempt of the procedure. Predominance of the sternocleidomastoid muscle is visible also during inhalation.
- Left shoulder joint abduction: the patient demonstrates predominant activation of the levator scapulae in approximate 60° of abduction.
- Right shoulder Joint Abduction: the patient demonstrates predominant activation of the levator scapulae in approximate 60° of abduction, with no activation of serattus anterior and the presence of excessive winging of scapula.

3.3.7 Joint Play Examination According to Lewitt

→ Observation of breathing wave as a part of examination of the Ribs: - Upper thoracic breathing, less movement in the 7th bicostal line and below.

Joint play examination of the true ribs:

- 1st rib blocked to the right side
- 4th rib blocked on the left during inhalation.
- 7th rib blocked on the right side during inhalation

Joint play examination of the thoracic and lumbar spine

- Thoracic vertebrae T3-T4 blocked
- Lumbar vertebrae L4-L5 blocked

The examination procedure were according to Lewit and modified by me for the examination purposes as the patient were only able to turn in side lying position. The pressure were applied not in caudal as the author describes but in ventromedial direction. Possible faulty reselts have to be taken into concideration.

Joint play examination of the knee joints

- Patella mobilization examination: No restrictions in any direction
- Tibiofibular joint mobilization examination: restricted in medial direction on the right lower extremity.
- Tibiofibular joint mobilization examination: Normal mobility in medial and ventral direction.

3.3.8 Neurological examination

Dermatomes	Left	Right
Dermatome of L1 segment	Normal sensation	Normal sensation
Dermatome of L2 segment	Normal sensation	Normal sensation
Dermatome of L3 segment	Normal sensation	Normal sensation
Dermatome of L4 segment	Normal sensation	Normal sensation
Dermatome of L5 segment	Normal sensation	Normal sensation
Dermatome of S1 segment	Normal sensation	Normal sensation
Dermatome of S2 segment	Normal sensation	Normal sensation

Table 23: Examination of specific dermatomes of interest on both lower extremities.

Deep Tendon Reflexes	Left side	Right side
Biceps brachii (C5-C6)	3	3
Triceps brachii (C7)	3	3
Knee reflex (L3-L4)	2	2
Ankle reflex (L5-S2)	2	2
Plantar reflex primitive	0	0

Table 24: Neurological examination of stretch reflexes (deep tendon).

Muscle Strength accord. Kendall	Left side	Right side
Serratus anterior	Fair +	Poor +
Biceps brachii	Good +	Good +
Triceps brachii	Good -	Good +
Quadriceps	Fair -	Poor +
Iliopsoas	Good	Fair -
Gastrocnemius + soleus	Good +	Good +

Table 25: Functional muscle testing according to subjective clinical interest.

3.3.9 Initial Examination's conclusion

The subject is characterized by decreased morale and pessimist thoughts about his present state and future self-care. Due to evidenced based kinesiology examination, the following data contribute to functional pathologies that they are associated with the physiological process of aging, past medical history, the incident of fall and the fracture of proximal femur and the post-operative phase of the patient. In general the subject's lower extremities are characterized as bowlegs according to Kendall with increase foot eversion and in this particular case study with claw toes as well.

As a sequence which may affects the patient's overall posture we can identify an anterolateral tilt of the pelvis with the highest pick on the left side and a stooped posture with increased convexity of the lumbar and thoracic spine together with a small functional scoliosis between approximately on the segments T3-T5 C-type which was justified as blocked during manipulative examination according to Lewitt together with movement defect in segments L4-L5.

The cervical spine is lordotic with excessive head protraction. Chain-like orthopedic deformities occur also on upper extremities with elevated and rounded shoulders, significant degree of winging of the right scapula and ventrally a less prominent upper thorax with the more prominent lower ribs indicating a pectus carinatum. Prove of the alter pathologies in the musculoskeletal system are evidenced also by the presence of predominant muscles and absence or delay activation of them according to Janda's movement pattern examination. More detailed the predominant sternocleidomastoid, levator scapulae muscle and delayed serratus anterior muscle during neck flexion, and shoulder abduction separately justifies the patient's trunk posture and even the subject's chronic respiratory insufficiency, together with alternative mechanisms of weakness and tightness which were evidenced by the subjective palpation examination the subject demonstrates decreased muscle tone with hypotrophy in knee and extensors with increased muscle tension in hip adductors bilateral. Interesting is the persistence of hypertonic and painful rectus femoris during palpation on both sides.

From the neurological point of examination the patients demonstrates slightly degree (2) of hyporeflexia of the knees and ankles deep tendon reflexes which maybe present due to movement dysfunctions on the corresponding segments as the patient doesn't suffer from any neurological pathology. The muscle strength testing doesn't demonstrate some severe neurological pathology, we assume that is normal in a patient of 94 years old his strength is relative good with the only exception the serratus anterior right side which is poor (+) and may indicates an MRI examination, and the Quadriceps femoris also at the right side which is characterized objectively as poor (+) as a post-operative functional reaction of the body.

3.4 Short-term and Long-term Physiotherapy Plan

3.4.1 Short term Physiotherapeutic plan

- Decrease subjective pain levels
- Prevention of thrombus embolism
- Prevention of decubitus and skin complications
- Early verticalization
- Gait training with limited weight bearing
- Maintain or increase muscle strength

- Improve respiratory efficiency
- Precautions for contraindications according to hip motion and vital signs.

3.4.2 Long term Physiotherapeutic plan

- Eliminate pain
- Gait training with full weight bearing
- Improvement of proprioception and prevention of falls
- Selection of proper assistive devices for better stability in ADL
- Return to ADL
- Education of family members about indoor and outdoor barriers which could be potential harmful for the patient.
- Referral to other members of multidisciplinary rehabilitation team for consultation.

3.5 Therapy sessions

Day 1st (4/01/2016)

Session 1

Time: 10.00

Subjective findings: The patient has decrease mood and morale comparing his past physical condition when he was a young athlete with his present state. He also expressed his disappointment about a potential restricted end-life time due to his injury. From a short motivational discussion the patient was encouraged to follow the daily regime.

- Physiological sensation in both lower extremities L1-S2.
- Physiological sensation in both upper extremities C2-C8

Objective findings: from the physiological parameters the patients was able to inhale 600 cc/s and exhale 550 cc/s. Temperature: 35,9 °C, HR: 120/60 mmHg The today's treatment plan was designed and applied according to the initial kinesiology examination evidences.

Treatment

- Scar tissue techniques according to Lewit, C and S shape on the area of the stitches for approximately 5 minutes.

- 4th rib mobilization technique according to Lewit during exhalation. (R)
- 7th rib mobilization technique according to Lewit during inhalation (R,L)
- T2-T3 springing mobilization modified according to Lewit's principles of caudal mobilization.
- T4-T5 springing mobilization modified according to Lewit's principles of caudal mobilization
- L4-L5 springing mobilization modified according to Lewit's principles of caudal mobilization.
- Tibiofibular joint mobilization therapy in medial direction according to Lewit on the right lower extremity.
- Myofacial manual therapy techniques for the ipsilateral quadratus femoris and controlateral adductor longus were applied. The techniques was according to Lewit.
- PIR for rectus femoris was applied in modified supine position with a wedge under the knee and self therapy principles according to Lewit. The technique was applied 3 times by the patient.
- Verticalization of the patient in sitting position and self mobilization technique according to Lewit for the first right rib. The repetitive mobilization was applied twenty times by the patient.
- Early verticalization and walking: The patient was verticalized in standing position and the first attempt to walk with French crutches was not successful as the patient was complained for weakness to support his weight on the forearms and difficult breathing accompanied with dizziness

Time: 14.00

Subjective findings: The patient has increased mood and expressed his satisfaction from the morning regime. He doesn't complain about pain, dizziness, or breathing difficulties. After a short discussion period we proceeded to active exercises program.

Treatment

- Scar tissue techniques according to Lewit, C and S shape on the area of the stitches for approximately 5 minutes.

- Ankle pumps: The patient is instructed to move actively both feet into dorsal and plantar flexion. With alternations between push the foot up and down several times for 1 minute x 3 sets. This particular exercise is repeated by the patient one every hour.
- Ankle rotation: Similar with ankle pumps execution, time and sets the patient is actively perform circumduction of both feet clockwise and counter clockwise for one minute. This exercise is repeated by the patient every one hour.
- Supported knee bends: The patient is instructed to slide his heel over the bed in 60 degrees ankle of the knee and the hip joint. No more than 90 and no more than the subjective pain threshold. 10 reps x 3 set unilateral alternations.
- Buttocks isometrics: the patient is instructed to contract his buttocks with max effort for 5 seconds. 4 set.
- Quadriceps isometrics: the patient is instructed to contract his quadriceps with max effort for 5 seconds. 4 set.
- Hip abduction: the patient is instructed to slide the heel to the edge of the bed without any rotational component and then return to the starting position. To avoid any further adduction a pillow was between the legs. 4 set x 8 rep.
- Bed transfer training: patient's education to change positions over the bed from supine-line to side-line with the operated leg uppermost and prone position with the use of an extra pillow between the legs to avoid adduction or rotation movements.
- Verticalization and walking: After a brief consultation with my supervisor we introduced to the patient the special trolley cart which can support the patient during walking and prevent possible falls. The patient is satisfied and more confident. The patient walked about 10 meters distance till the main corridor and back to his bed.

Day 2nd (5/1/2016)
Session 1st
Time: 10.00

Subjective findings: The patient has increased mood and positive thoughts about his progress. He doesn't complain about pain, dizziness, or breathing difficulties. After a short discussion period we proceeded to active exercises program.

- Physiological sensation in both lower extremities L1-S2.
- Physiological sensation in both upper extremities C2-C8

Objective findings: from the physiological parameters the patients was able to inhale 900 cc/s and exhale 750 cc/s. Temperature: 36, 0 °C, HR: 125/60 mmHg.

Deep Tendon Reflexes	Left side	Right side
Biceps brachii (C5-C6)	3	3
Triceps brachii (C7)	3	3
Knee reflex (L3-L4)	2	2
Ankle reflex (L5-S2)	2	2
Plantar reflex primitive	0	0

Table 26: Objective daily assessment of stretch reflexes (deep tendon)

- Scar tissue techniques according to Lewit, C and S shape on the area of the stitches for approximately 5 minutes.
- Ankle pumps: The patient is instructed to move actively both feet into dorsal and plantar flexion. With alternations between push the foot up and down several times for 1 minute x 3 sets. This particular exercise is repeated by the patient one every hour.
- Ankle rotation: Similar with ankle pumps execution, time and sets the patient is actively perform circumduction of both feet clockwise and counter clockwise for one minute. This exercise is repeated by the patient every one hour.
- Supported knee bends: The patient is instructed to slide his heel over the bed in 60 degrees ankle of the knee and the hip joint. No more than 90 and no more than the subjective pain threshold. 10 reps x 3 set unilateral alternations.
- Buttocks isometrics: the patient is instructed to contract his buttocks with max effort for 5 seconds. 4 set.
- Quadriceps isometrics: the patient is instructed to contract his quadriceps with max effort for 5 seconds. 4 set.
- Hip abduction: the patient is instructed to slide the heel to the edge of the bed without any rotational component and then return to the starting position. To avoid any further adduction a pillow was between the legs. 4 set x 8 rep.

- Bed transfer training: The patient due to this training learned to change positions over the bed during the day from supine to side-line with the operated leg uppermost and prone position with the use of an extra pillow between the legs to avoid adduction or rotation movements.
- Walking: The patient is able to walk with the special trolley cart for 10 meters distance. No complains only some slightly difficult breathing was referred.

Session 2nd

Time: 13.00

After a consultation with my supervisor i designed a more personalized program relative to the patient's needs with emphasis to the upper extremities, deep stabilization system and respiratory muscles. To ensure proper strength of upper limbs for using French crutches in the future and prevent falls, to increase respiratory capacity for optimal breathing, minimize the energy expenditure and fatigue process during walking. The particular program is supplementary to the daily regime which is followed in patients after surgery in UVN hospital.

Treatment

- Hand Grip exercise: the patient is instructed to squeeze a small soft ball on his palm slowly. 10 reps x 4 set on each hand to improve muscle strength of the forearm and finger flexors.
- Strengthening exercise for upper limbs modified according to PNF principles for 1st diagonal flexion pattern with the use of elastic Thera Band ®. (With resistance in pounds at 25% of Maximum elongation/ 3,0 Pounds) The patient performed 10 repetitions on each limb. 1 set bilateral.
- Strengthening exercise for upper limbs modified according to PNF principles for 1st diagonal extension pattern with the use of elastic Thera Band ®. With the same resistance as before the patient performed 10 repetitions on each limb. 1 set bilateral.
- Scapulae Retraction: The patient in supine position is instructed to shrug both scapulae together towards the spine and in the same time push the shoulder blades against the surface of the bed. Each repetition consists of 3-5 sec. hold. 8 reps bilateral.
- Double glutei bridges: The patient in supine position and with the lower

extremities flexed on knee and hip joints in 60 degrees angle and with a pillow between the legs to prevent adduction and rotation movements is instructed to lift the pelvis up for 3 seconds and slowly go down. 10 reps.

- Respiratory Training: A looped elastic resistance bandage was applied around the trunk, stretched approximately 20% of maximum elongation in the area of the lower abdomen. The patient is instructed to breath in the place where the resistances is felt and try to expand the band anterior and bilateral, and slowly breathe out.
- Verticalization and walking: The patient is able to walk approximately 10 meters distance with the trolley cart. No complains about dizziness or respiratory difficulties were referred.
- Feedback: After the second session the patient expressed his excitement about the type of the exercises and we had a short discussion about the old type of exercises that were used 20 years before when he was an athlete. Also he asked if it is possible to do some exercises by him during the day. After a short discussion with the my supervisor we consult the patient to do every hour the rehabilitation regime which is prescribed by the doctor and additional we introduced him the concept of ideo-motor exercises based on Carpenter effect which according to clinical researches seems to be beneficial in athletes with severe injuries.

Self-therapy program: (every 1 hour)

• Ankle Pumps	1minute bilateral x 3sets
• Ankle Rotations	1minute bilateral clock wise x 2 sets 1 minute bilateral counter clock wise 2 sets
• Supported knee bends	10 x 3 sets bilateral
• Buttocks isometrics	1 contr. 5 sec. x 4 sets bilateral
• Quadriceps isometrics	1 contr. 5 sec. x 4 sets bilateral
• Hip Abduction	8 reps x 4 sets

• Bed mobility transfers	• From supine to side lying • From side lying to prone • From prone to side lying • From side lying to supine
• Ideomotor exercises	• Imagine walking with crutches till the end of the room and back. • Imaging walking up stairs with crutches. • Imaging walking on the yard with crutches. • Imaging walking with crutches at home.

Table 27: Self therapy program indicated by physiotherapist.

Day 3rd (6/1/2016)

Session 1st

Time: 10.00

Subjective findings: The patient has increased mood and positive thoughts about his progress. He doesn't complain about pain, dizziness, or breathing difficulties. After a short discussion period we proceeded to active exercises program.

- Physiological sensation in both lower extremities L1-S2.
- Physiological sensation in both upper extremities C2-C8

Objective findings: from the physiological parameters the patients was able to inhale 900 cc/s and exhale 850 cc/s. Temperature: 36, 8 °C, HR: 120/65 mmHg.

Deep Tendon Reflexes	Left side	Right side
Biceps brachii (C5-C6)	3	3
Triceps brachii (C7)	3	3
Knee reflex (L3-L4)	3	3
Ankle reflex (L5-S2)	2	2
Plantar reflex primitive	0	0

Table 28: Daily assessment of stretch reflexes (deep tendon). Evaluation grades are according to Vele where grade 3 is considered to be normal and grade 2 hyporeflexia.

Treatment

- Scar tissue techniques according to Lewit, C and S shape on the area of the stitches for approximately 5 minutes.

Ankle Pumps	With Thera- Band loop 30% resistance of maximum elongation	2 sets bilateral
Ankle Rotation	Both Feet clockwise and counter clock wise bilateral	1 minute + 1 minute
Supported Knee Bends	With thera- band 30% resistance of maximum elongation .10 reps	2 sets bilateral
Double glutei Bridges	8 reps	2 sets
Quadriceps isometrics	8 reps	2 sets
Hip abduction	With the lower extremities flexed at the 60 degrees on the the knee and hip joints and with a closed loop of thera-band the patient perform abduction of the hips. 30% Resistance of maximum elongation. 8 Reps.	2 sets
Walking	30 meters walking with trolley cart. No dizziness or difficult breathing was referred.	

Table 29: Morning exercise program indicated by physiotherapist.

2nd session

Time: 13.00

Hand Grip strength	8 reps	2 set bilateral
PNF 1D flexion modification for upper extremities	8 reps (35% R)	2 set bilateral
PNF 1D extension Modification for upper extremities	8 reps (35%R)	2 set bilateral
Scapulae Retractions	8 reps	2 set bilateral
Double Glutei Bridges	8 reps	2 set bilateral
Respiratory exercises lower abdomen	20 breaths (40% of R)	60 seconds
Walking	The patient is able to walk 30 meters distance with the trolley cart.	

Table 30: Second session's exercise program indicated by physiotherapist.

Feedback: the patient is fully satisfied and he expressed his desire to try the French crutches for walking. Instead of this type of crutches we choose the High crutches because the center of gravity in patient's body is still more forward from the imaginary middle axis due to his stooped posture. With the high crutches we achieve better stability due to elevation of the COG during walking relative with the center of mass of patient's body.

*The self-therapy program is repeated by the patient as it is mentioned previously.

Day 4th (7/1/2016)

Session 1st

Time: 10.00

Subjective findings: The patient was already executing by himself the first exercises from the morning rehabilitation regime with great self confidence and big desire to try walking with crutches. From a brief discussion he referred that he feels slightly pain (2/10) on his upper back muscles to the right side.

- Physiological sensation in both lower extremities L1-S2.
- Physiological sensation in both upper extremities C2-C8

Objective findings: from the physiological parameters the patients was able to inhale 1000 cc/s and exhale 900 cc/s. Temperature: 36, 0 °C, HR: 120/60 mmHg. The patient's upper trapezius muscle from the right side doesn't demonstrate stiffness or during clinical examination. There is a slightly painful tender point in the area close to the deltoid tuberosity.

Deep Tendon Reflexes	Left side	Right side
Biceps brachii (C5-C6)	3	3
Triceps brachii (C7)	3	3
Knee reflex (L3-L4)	3	3
Ankle reflex (L5-S2)	2	2
Plantar reflex primitive	0	0

Table 31: Daily assessment of stretch reflexes (deep tendon). Evaluation grades are according to Vele where grade 3 is considered to be normal and grade 2 hyporeflexia.

Treatment:

- Soft tissue technique for tender points therapy according to Lewit in the area of deltoid tuberosity.
- PIR for the deltoid middle muscleaccording to Lewit modified in supine position in gravity induced position.
- Scar tissue techniques on the area of the stitches according to Lewit.

Ankle Pumps	With Thera- Band loop 40% resistance of maximum elongation	2 sets bilateral
Ankle Rotation	Both Feet clockwise and counter clock wise bilateral	1 minute + 1 minute
Supported Knee Bends	With thera- band 40% resistance of maximum elongation .10 reps	2 sets bilateral
Double glutei Bridges	8 reps	2 sets
Knee extensions sitting position.	8 reps (50% of maximum elongation)	2 sets bilateral
Hip abduction	With the lower extremities flexed at the 60 degrees on the the knee and hip joints and with a closed loop of thera-band the patient perform abduction of the hips. 40% Resistance of maximum elongation. 8 Reps.	2 sets
Hip Adduction	With the lower extremities flexed at 70 degrees angle on the hip and the knee joint and with a ball between the hips the patient is instructed to squeeze the ball between the legs and relax. 8 reps x 2 sets	
Walking	30 meters walking with trolley cart. No dizziness or difficult breathing was referred.10 meters walking with the assistance of high crutches	

Table 32: Daily exercise program indicated by physiotherapist.

2nd session:

Time: 14.00

Hand Grip strength	8 reps	2 set bilateral
PNF 1D flexion modification for upper extremities	8reps (50% R)	1 set bilateral
PNF 1D extension Modification for upper extremities	8 reps (40%R)	1 set bilateral
Scapulae Retractions	8 reps	1 set bilateral
Double Glutei Bridges	8 reps	2 set bilateral
Respiratory exercises middle Thorax	10 breaths (50% of R), relax. X 2	2 minutes
Walking	The patient is able to walk with the high crutches till the toilet and back. Total distance 18 meters. The patient is able to stand without crutches in erect position at the side of the bed for 1 minute without discomfort or dizziness.	

Table 33: Second session exercise program indicated by physiotherapist.

Feedback: The patient is fully satisfied with his progress and he said that he start to "feel" parts of his body that he almost forgot that they exist. This humoristic comment it was a big satisfaction for us also because the psychological factor and positive behavior plays significant role in the rehabilitation process. The patient doesn't complain for pain in the area of preexisting tender point, nor discomfort or dizziness.

Day 5th (8/1/2016)

Time: 9.00

1st session

Subjective findings: No pain or discomfort was referred. The patient

- Physiological sensation in both lower extremities L1-S2.
- Physiological sensation in both upper extremities C2-C8

Objective findings: from the physiological parameters the patients was able to inhale 1200 cc/s and exhale 950 cc/s. Temperature: 35, 9 °C, HR: 125/65 mmHg.

Deep Tendon Reflexes	Left side	Right side
Biceps brachii (C5-C6)	3	3
Triceps brachii (C7)	3	3
Knee reflex (L3-L4)	3	3
Ankle reflex (L5-S2)	2	2
Plantar reflex primitive	0	0

Table 34: Daily assessment of stretch reflexes (deep tendon). Evaluation grades are according to Vele where grade 3 is considered to be normal and grade 2 hyporeflexia.

Treatment

Ankle plantar Flexion	70% of Max R	8 reps x 2 sets
Ankle Dorsal Flexion	70% of Max R	8 reps x 2 sets
Ankle Rotations	--	2 minutes
Supported Knee bends	60% of Max R	8 reps x 2 sets
Knee extension Sitting	70 % of Max R	8 reps x 2 sets
Hip Abduction closed loop	60% of Max R	8 reps x 2 sets
Double Glutei Bridges	--	10 reps x 2 sets
Walking with high crutches	The patient is able to walk with the crutches for 30 meters without discomfort or dizziness. The patient is able to stand erect without crutches for 1 minute.	

Table 35: Morning exercise program indicated by physiotherapist

2nd session

Hand Grip strength	8 reps	2 set bilateral
PNF 1D flexion modification for upper extremities	8reps (50% R)	1 set bilateral
PNF 1D extension Modification for upper extremities	8 reps (50%R)	1 set bilateral
PNF 2D flexion modification for U.E	8 reps (30% R)	1 set bilateral
PNF 2D extension modification for U.E	8 reps (30%R)	2 set bilateral
Respiratory exercises middle Thorax	10 breaths (50% of R), relax. X 2	2 minutes
Double Glutei Bridges U.E in 90 degrees flexion	8 reps	2 set
Walking	The patient is able to walk with the high crutches. Total distance 30 meters. The patient is able to walk 5 steps up-stairs and 5 steps down-stairs with the assistance of high crutches and under supervision of us. The patient is able to stand without crutches in erect position at the side of the bed for 1 minute without discomfort or dizziness.	

Table 36: Second session physiotherapeutic program indicated by physiotherapist.

Feedback: The patient is fully satisfied about his future prognosis and he refereed that he feels able to play volleyball again with sense of humor.

3.6 Final kinesiology examination

Examination by physiotherapist

3.6.1 Postural examination by observation: (the patient is able to stand erect without support)

Posterior View:

- Base of Support: Normal width both feet are lateral deviated from the middle line.
- Shape and contours of the heels: The skin of the both heels is more pressed at the lateral side. With more pressure on the right heel.
- Shape and position of the ankle joints: Pes Planus (pronated both)
- Shape and thickness of the Achilles tendon: normal both no deviations.
- Contour of the calf muscles: normal both no visible deviation.
- Shape and position of the knee joints: slightly in internal rotation
- Popliteal line: the lateral side of popliteal line in both knees is slightly upper than the medial.
- Contour of the thigh muscles: the contour of thigh muscles seems to be equal bilateral.
- Subgluteal line: straight,
- Glutei muscles: decreased contour of glutei muscles and may trophicity. Visible skin ripples are demonstrated close to ischial tuberosity.
- Symmetry of thoracobrachial triangles: the distance between upper extremity and pleural area is wider due to the patient's support by the trolley cart.
- Position of the pelvis: Lateral tilt higher on the left side.
- Para vertebral muscles: the shape is normal in both sides, but on the upper back there is visible prominence of paravertebral muscles from the right side
- Curvature of the spine in the frontal plane: decreased lumbar curvature. There is a slightly visible scoliosis C-Type which starts approximately between the vertebrae L3-L5. There is a slight visible scoliosis which starts approximately C7-T4.
- Position of the scapula: Both scapula's are elevated and abducted. Visible winging of scapula is visible and prominent on the right side less than previously. With deviations now more on the left side. Approximately 3 cm from the inferior angle of scapula there is a pressure ulcer which healing normally.

- Position of the shoulder girdle: Both shoulders are in protraction less than previously. There is visible elevation of the left shoulder more than the right.
- Position of the upper limb: Both upper extremities are situated between pronation and supination of the forearms with the left arm more flexed on the elbow joint than on the right.
- Position and contour of the nuchal muscles: normal both sides.
- Position of the head: the head seems to be slightly rotated and protracted to the right as the right side of the mandible bone is visible.

Front View:

- The base of support: Normal width of base of support both feet are lateral deviated from the middle line.
- The position of the feet: pronated feet (Pes Valgus) the hallux toe is more pressed and adducted (both feet). On the left and right lower extremities both distal and proximal interphalangeal joints from the second till fourth digits demonstrate increased flexion and they can be characterized as hammer toes.
- Weight distribution: the weight distribution is 60-40 without support with the biggest value on the non-operated side.
- Shape and position of the knee joints: Medial patella deviation less than previously still sign for Bowlegs according to Kendall.
- Configuration of m. tibialis anterior: Symmetrical.
- Contour of the calf muscles: symmetrical picks
- Shape of the thigh muscles: Decreased trophicity is also visible in both thigh muscles. The left quadriceps is slightly bigger than the right.
- Position of the pelvis: Anterior and lateral tilt is more visible from this referral point. The higher pick of the pelvis is on the left side but less than previously.
- Position of the navel: Normal position of the both navel.
- Symmetry of thoracobrachial triangles: the distance between upper extremity and pleural area is normal.
- Position and symmetry of the chest: the upper thoracic region is smaller than and the lower ribs seem to be slightly flared out.
- Position of the collarbones and superclavicular holes: Normal, no deformities.

- Position of the shoulder girdle: Protracted and elevated shoulders more on the left side.
- Position of the upper limbs: both upper limbs are situated between pronation and supination. The patient has the tendency to slightly flex his left elbow.
- Position of head: the head is protracted due to increase cervical lordosis and also rotated to the right side slightly from the middle line.

Lateral View (Left side)

- Weight distribution: the patient is supporting his weight 60% on heel left lower extremity. No complains about pain or other discomfort was referred.
- Shape and contour of the shin: Normal, no deformities.
- Position of the knee joint: medial patella deviation.
- Contour of the thigh muscles: physiological contour according to the age and state of the patient.
- Position of the pelvis:. Anterior and lateral tilt of the pelvis with highest pick on the left side.
- Shape of the abdominal muscles: visible separation of rectus abdominis from external oblique left side. The abdominal wall is flat with inward movement during inspiration and the lower ribs are flared out.
- Position of the shoulder girdle: Protracted and elevated.
- Position and curvature of the Th/C and C spine: Increased thoracic kyphosis with the highest picks in the area of the T4-T5. The cervical region is characterized as lordotic with the head in protraction.
- Position of the head: The subject apparently is trying to correct the posture. In general there is less protraction than the initial results.

Lateral View (Right side)

- Weight distribution: less weight bearing on the right lower extremity 20%.
- Shape and contour of the shin: Normal, no deformities.
- Position of the knee joint: Medial patella deviation.
- Contour of the thigh muscles: slightly decreased contour of quadriceps and hamstrings is also visible from the lateral view on the right side.

- Position of the pelvis: Anterior and lateral tilt with the lowest pick on the right side.
- Shape of the abdominal muscles:. visible separation of rectus abdominis from external oblique right side. The abdominal wall is flat with inward movement during inspiration and the lower ribs are flared out.
- Position of the shoulder girdle: slightly elevated and protracted.
- Position and curvature of the Th/C and C spine: Increased thoracic kyphosis with the highest picks in the area of the T4-T5. The cervical region is characterized as lordotic with the head in protraction.
- Position of the head: The subject apparently is trying to correct the posture. There is slight head protraction, with few degrees of rotation towards to the right side.

3.6.2 Gait analysis

The patient is able to walk with high crutches (German) for thirty meters and straight and hard surface without discomfort or dizziness. The patient is able to walk upstairs and downstairs, five steps, supported by high crutches and under the supervision of my colleague. The subject using a two point alternative pattern of walking, both crutches are placed forward together with the operated leg in the same parallel line for better stability. The contact of operated leg with the floor seems to be ideal, visible sequence of heel strike, flat foot, heel off and toe off. The swing face of the non-operated leg is shorter in length and time for fall prevention.

General characteristics:

- Width of base of support: Narrower
- Stride length: Bigger in operated leg
- Speed: Constant and Slower than the normal
- Rhythm: Constant
- Type: 2 point alternative
- Body posture: stooped posture with less bending than previews the center of gravity is elevated and forward.

3.6.3 Anthropometric measurements

Measure	Left	Right
Anatomical Length	105 cm	103 cm
Functional length Omb.	100 cm	99 cm
Functional length	100 cm	98cm
Length of upper extremity	83 cm	83 cm

Table 37: Final examination of anthropometric measurements.

Measure	Left	Right
Circumference of calf	33 cm	31 cm
Circumference of Quadriceps (15cm above patella)	34cm	33 cm
Quadriceps (10cm above patella)	32cm	32cm
Circumference of thorax	44 m	

Table 38: Final examination of anthropometric measurements (circumferences)

3.6.4 Range of Motion by Goniometry according to Kendall

Hip Joint			
Left side		Right side	
Active Movement	Passive Movement	Active Movement	Passive Movement
S: 20 – 0 – 90	30 – 0 – 90	15 – 0 – 90	20 – 0 – 80
F:40 – 0 – 0	50 – 0 – 0	40 – 0 – *0	40 – 0 – *0
R: 45 – 0 – 40	55 – 0 – 45	0 – 0 – 0	0 – 0 – *0

Table 39: Final measure of range of motion on hip joint. Flexion over 90 degrees, Adduction and lateral or medial rotation on the operated leg are contraindicated according to the surgeon prescription.

Ankle Joint			
Left side		**Right side**	
Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S: 40 – 0 – 40	45 – 0 – 50	40 – 0 – 45	45 – 0 – 50
R: 15 – 0 – 20	20 – 0 – 30	15 – 0 – 15	20 – 0 – 30
Shoulder Joint			
Left side		**Right side**	
Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S: 25 – 0 – 140	30 – 0 – 150	30 – 0 – 135	30 – 0 – 145
F:90 – 0 – 35	90 – 0 – 40	90 – 0 – 30	90 – 0 – 40
R: 55 – 0 – 40	60 – 0 – 45	50 – 0 – 40	55 – 0 – 40
Elbow joint			
Left side		**Right side**	
Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S: 0 – 0 – 140	0 – 0 – 145	0 – 0 – 145	0 – 0 – 12
Radio ulnar joint			
Left side		**Right side**	
Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S: 90 – 0 – 90	90 – 0 – 90	90 – 0 – 90	90 – 0 – 90
Wrist Joint			
Left side		**Right side**	
Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S: 70 – 0 – 85	80 – 0 – 90	70 – 0 – 80	75 – 0 – 90
F: 20 – 0 – 30	20 – 0 – 30	15 – 0 – 30	20 – 0 – 30

Table 40: Final measure of range of motion on peripheral joints of interest.

3.6.5 Palpation:

The palpatory examination was started from caudal to cranial direction.

- Palpation on the skin surface of both feet demonstrates stiff and dry epidermis with xerodermia.
- Gastrocnemius and soleus demonstrate hypotonic state with normal trophicity on both lower extremities with absence of neither trigger nor tender points.

- Quadriceps femoris ipsilateral side demonstrates slight hypertonicity with still hypotrophy but less than before on vasti mediales and laterales without the presence of trigger or tender points and subjective pain feelings.
- Quadriceps femoris on the contralateral limb demonstrate norm tonic state with still relative atrophy on both vastus medialis and lateralis. Neither trigger points nor tender points are present.
- Rectus femoris on the ipsilateral limb is hypertonic state, with no other functional pathologies in presence.
- Rectus femoris on the contralateral limb is in hypertonic state with no presence of pain or discomfort during palpation.
- General palpation in the area of the adductors on the ipsilateral limb demonstrate hypertonicity for both two joint and one joint muscles, no pain nor other functional pathologies were found.
- General palpation in the area of the adductors on the contralateral limb demonstrates hypertonicity for both two and one joint muscles without the presence of functional pathologies.
- Palpation of the stitches to the contralateral limb, demonstrate 10 cm stitches with well healing process of the soft tissue, no resistance or skin defects are present. 10cm caudal there is a slight hematoma which is characterized by greenness and blueness. Vascular changes are observed.

3.6.6 Movement patterns examination according to Janda

- Neck flexion: the patient demonstrates chin lift during neck flexion in habitual way in the first attempt of the procedure. Predominance of the sternocleidomastoid muscle is visible also during inhalation. At the second and third attempt the patient is correcting his movement pattern by himself.
- Left shoulder joint abduction: the patient demonstrates predominant activation of the serattus anterior in approximate 60° of abduction.
- Right shoulder Joint Abduction: the patient demonstrates predominant activation of the levator scapulae in approximate 60° of abduction, with co- activation of serattus anterior and slightly winging of scapula but significant less than the initial results.

3.6.7 Joint Play Examination According to Lewitt

→ Observation of Breathing wave as a part of examination of the Ribs

Middle thoracic pattern of breathing.

Joint play examination of the true ribs:

No restrictions

- Joint play examination of the thoracic and lumbar spine

Restriction in segment T3-T4 mobilization examination

The examination procedure were according to Lewit in prone position.

- Joint play examination of the knees.

- Patella mobilization examination: No restrictions in any direction
- Tibiofibular joint mobilization examination: No restrictions in any direction
- Tibiofibular joint mobilization examination: Normal mobility in medial and ventral direction.

3.6.8 Neurological examination:

Dermatomes	Left	Right
Dermatome of L1 segment	Normal sensation	Normal sensation
Dermatome of L2 segment	Normal sensation	Normal sensation
Dermatome of L3 segment	Normal sensation	Normal sensation
Dermatome of L4 segment	Normal sensation	Normal sensation
Dermatome of L5 segment	Normal sensation	Normal sensation
Dermatome of S1 segment	Normal sensation	Normal sensation
Dermatome of S2 segment	Normal sensation	Normal sensation

Table 41: Final examination of specific dermatomes on both lower extremities.

Deep Tendon Reflexes	Left side	Right side
Biceps brachii (C5-C6)	3	3
Triceps brachii (C7)	3	3
Knee reflex (L3-L4)	3	3
Ankle reflex (L5-S2)	2	2
Plantar reflex primitive	0	0

Table 42: Final examination of stretch reflexes (deep tendon). Evaluation grades are according to Vele where grade 3 is considered to be normal and grade 2 hyporeflexia.

Muscle Strength accord. Kendall	Left side	Right side
Serratus anterior	Good	Fair + (Synkinesis)
Biceps brachii	Normal	Normal
Triceps brachii	Good +	Good +
Quadriceps	Good +	Good +
Iliopsoas	Normal	Good +
Gastrocnemius + soleus	Normal	Normal

Table 43: Final functional muscle testing on specific muscles of clinical interest

3.7 Evaluation of total therapy effects

Hip Joint			
Left side		Right side	
Active Movement	Passive Movement	Active Movement	Passive Movement
S: +10-0-0	+20-0-0	+10-0-+10	+15-0-X
F: +20-0-0	+25-0-0	+15-0-X	+25-0-X
R: +15-0-+10	+15-0-+5	X-X-X	X-X-X

Table 44: Summary of the achieved motion degrees in the hip joint, *X= Prohibited measurement

Ankle Joint			
Left side		**Right side**	
Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S: +10-0-+10	0-0-+10	+10-0-(+20)	+10-0-+15
R: +5-0-0	+5-0-0	+5-0-(+5)	+5-0-+10

Table 45: Summary of the achieved motion degrees in the Ankle joint.

Shoulder Joint			
Left side		**Right side**	
Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S: +5-0-+20	0-0-+2	+10-0-+15	0-0-20
F: 0-0- -5	+10-0-+10	0-0-+10	+10-0- +10
R: +15°-0-+10	+20-0-+10	+25-0-+10	+15-0-+10

Table 46: Summary of the achieved motion degrees in the shoulder joint.

Radio ulnar joint			
Left side		**Right side**	
Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S: 0 – 0 – 0	0 – 0 – 0	0 – 0 – 0	0 – 0 – 0
Wrist Joint			
Left side		**Right side**	
Active Movement	**Passive Movement**	**Active Movement**	**Passive Movement**
S: 0 – 0 – 0	0 – 0 – 0	0 – 0 – 0	0 – 0 – 0
F: 0 – 0 – 0	0 – 0 – 0	0 – 0 – 0	0 – 0 – 0

Table 47: Summary of the achieved degrees on peripheral joints of interest.

Anthropometric measure	Left Obtained Points	Right Obtained Points
Calf circumference	+1cm	+2cm
Quadriceps #1	+1cm	+1cm
Quadriceps #2	+1cm	+2cm
Thorax	+0cm	+0cm

Table 48: Achieved centimeters relative to circumference in both lower extremities and thorax.

Deep Tendon Reflexes	Left Obtained Points	Right Obtained points
Patella reflex	+1G	+1G

Table 49: Deep tendon reflex changes after the end of physiotherapeutic program.

Muscle Test	Left Obtained Points	Right Obtained Points
Serattus Ant.	+ 1G	+ 2G
Biceps Brachii	+ 0,5G	+ 0,5G
Triceps Brachii	+ 2G	+ 0,5G
Quadriceps F.	+3G	+ 2G
Iliopsoas	+ 1G	+ 2G
Gastrocnemius +Soleus	+0,5G	+0,5G

Table 50: Summary of earned grades relative to muscle strength according to Kendall.

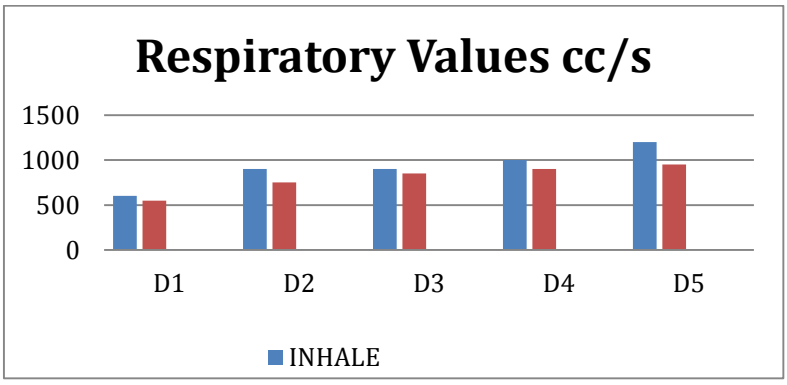

Table 51: Progression of respiratory efficiency from Day 1 to Day 5. Y axis: D= days. X axis: Respiratory values in cc/s.

3.7.1 Prognosis:

A femoral head hemiarthroplasty is a very efficient and one of the most common operations that I worked on as a physiotherapy practitioner during my academic studies. The future prognosis is influenced totally by the patient's characteristics such as age, gender, pre existing or underlying pathologies, motivation, and cooperation with the multidisciplinary rehabilitation team in the hospital and also after discharge. General in hip and also knee arthroplasties there is an increased risk of remission in younger male adult patients, from the other hand there is increased mortality in older male adults and decrepit patients.

In the particular case study the subject's future prognosis is relative good due to lack of any kind of abuses during its whole life and athletic life style which is a very important factor in order to avoid mortality due to post operative complications. The future prognosis is also influenced from the socioeconomic status of the patient. Not all the patients in general have the same access into healthcare high standard quality. The fact that the patient is characterized by decrepit age, necessitates the assistance and care by a specialist such as occupational therapist or social care giver.

A mismanagement of medication, lack of in-home adaptive changes according to patient's needs could lead to falls and consequently to life threatening conditions, or a future new surgical intervention.

4. Conclusion

The goals of rehabilitation reflect the typical progression for a patient after hemi or total arthroplastic surgical procedure, with special attention to prevent possible complications. More detailed, after the inpatient physiotherapeutic intervention the subject is able to complete all the activities of daily living, including walking with support, toileting with modified sit, grooming in sitting position, and eating by his self without the presence of pain or respiratory discomfort and dizziness. Thus a social caregiver or a trained family member is required to help him if it is needed.

The patient on 11/1/2016 was discharged from the UVN hospital and transferred to MOTOL hospital in order to continue his long term rehabilitation process. Most of the theoretical knowledge and all the techniques that I used for this particular study it were earned from my academic studies in Charles University in Prague.

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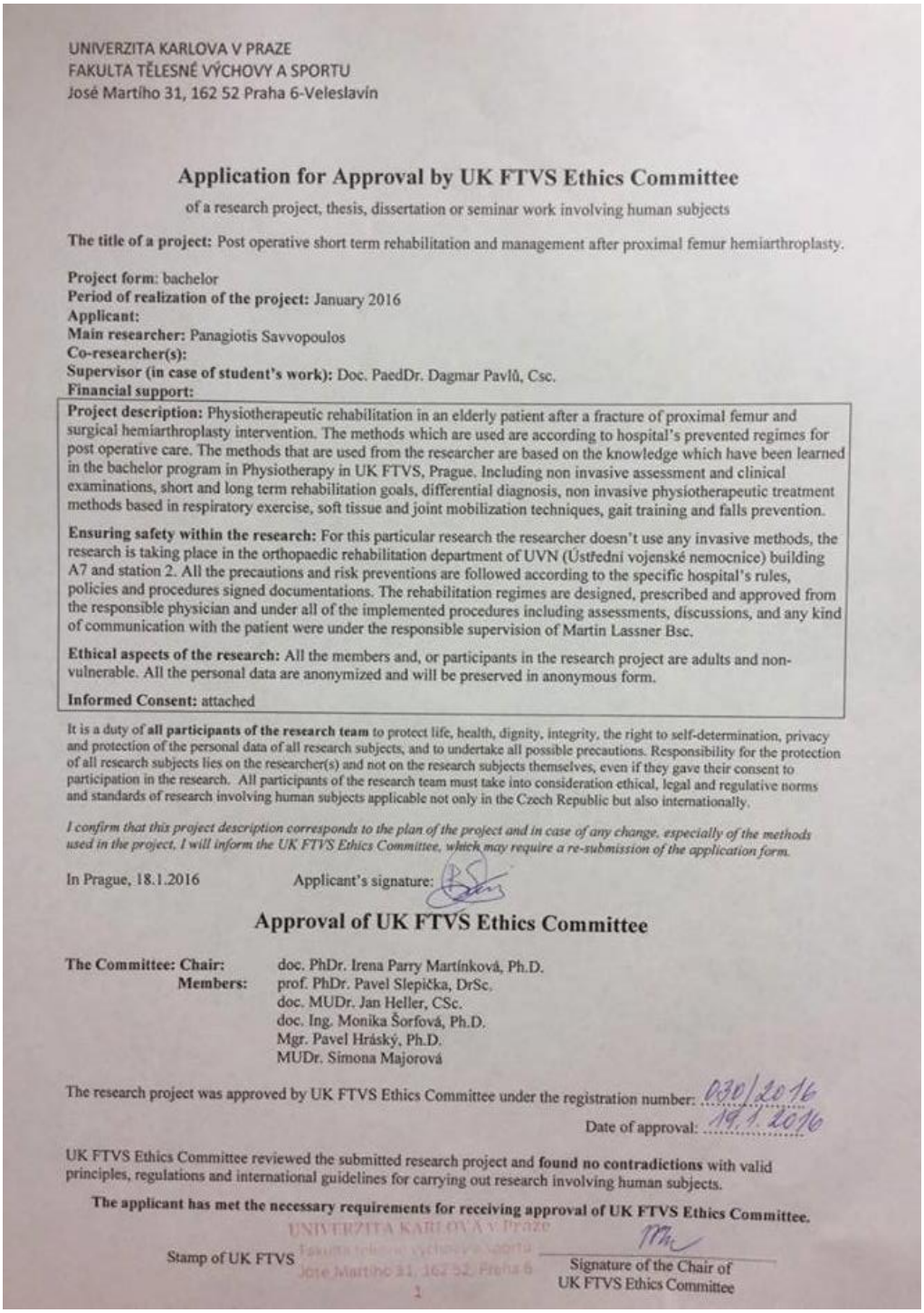
6. Supplements

6.1 Ethical Board



UNIVERZITA KARLOVA V PRAZE
FAKULTA TĚLESNÉ VÝCHOVY A SPORTU
José Martího 31, 162 52 Praha 6-Veleslavín

Application for Approval by UK FTVS Ethics Committee

of a research project, thesis, dissertation or seminar work involving human subjects

The title of a project: Post operative short term rehabilitation and management after proximal femur hemiarthroplasty.

Project form: bachelor
Period of realization of the project: January 2016
Applicant:
Main researcher: Panagiotis Savvopoulos
Co-researcher(s):
Supervisor (in case of student's work): Doc. PaedDr. Dagmar Pavlů, Csc.
Financial support:

Project description: Physiotherapeutic rehabilitation in an elderly patient after a fracture of proximal femur and surgical hemiarthroplasty intervention. The methods which are used are according to hospital's prevented regimes for post operative care. The methods that are used from the researcher are based on the knowledge which have been learned in the bachelor program in Physiotherapy in UK FTVS, Prague. Including non invasive assessment and clinical examinations, short and long term rehabilitation goals, differential diagnosis, non invasive physiotherapeutic treatment methods based in respiratory exercise, soft tissue and joint mobilization techniques, gait training and falls prevention.

Ensuring safety within the research: For this particular research the researcher doesn't use any invasive methods, the research is taking place in the orthopaedic rehabilitation department of UVN (Ústřední vojenské nemocnice) building A7 and station 2. All the precautions and risk preventions are followed according to the specific hospital's rules, policies and procedures signed documentations. The rehabilitation regimes are designed, prescribed and approved from the responsible physician and under all of the implemented procedures including assessments, discussions, and any kind of communication with the patient were under the responsible supervision of Martin Lassner Bsc.

Ethical aspects of the research: All the members and, or participants in the research project are adults and non-vulnerable. All the personal data are anonymized and will be preserved in anonymous form.

Informed Consent: attached

It is a duty of **all participants of the research team** to protect life, health, dignity, integrity, the right to self-determination, privacy and protection of the personal data of all research subjects, and to undertake all possible precautions. Responsibility for the protection of all research subjects lies on the researcher(s) and not on the research subjects themselves, even if they gave their consent to participation in the research. All participants of the research team must take into consideration ethical, legal and regulative norms and standards of research involving human subjects applicable not only in the Czech Republic but also internationally.

I confirm that this project description corresponds to the plan of the project and in case of any change, especially of the methods used in the project, I will inform the UK FTVS Ethics Committee, which may require a re-submission of the application form.

In Prague, 18.1.2016 Applicant's signature:

Approval of UK FTVS Ethics Committee

The Committee: Chair: doc. PhDr. Irena Parry Martínková, Ph.D.
Members: prof. PhDr. Pavel Slepička, DrSc.
doc. MUDr. Jan Heller, CSc.
doc. Ing. Monika Šorfová, Ph.D.
Mgr. Pavel Hráský, Ph.D.
MUDr. Simona Majorová

The research project was approved by UK FTVS Ethics Committee under the registration number: 030/2016
Date of approval: 19.1.2016

UK FTVS Ethics Committee reviewed the submitted research project and **found no contradictions** with valid principles, regulations and international guidelines for carrying out research involving human subjects.

The applicant has met the necessary requirements for receiving approval of UK FTVS Ethics Committee.

Stamp of UK FTVS

Signature of the Chair of UK FTVS Ethics Committee

6.2 INFORMOVANÝ SOUHLAS

Student: Panagiotis Savvopoulos

Pracoviště: Ustředni Vojenská Nemocnice, Prague, 1200/1, 16200, Praha 6.

V souladu se Zákonem o péči o zdraví a lidu (§ 23 odst. 2 zákona č. 20/1966 Sb.) a Úmluvou o lidských právech a biomedicíně č. 96/2001, Vás žádám o souhlas k vyšetření a následné terapii. Dále Vás žádám o souhlas k nahlížení do Vaší dokumentace osobou získávající způsobilost k výkonu zdravotnického povolání v rámci praktické výuky a o souhlas k fotodokumentaci. Při vyšetření a terapii nebudou použity žádné invazivní metody. Dále žádám o souhlas k uveřejnění výsledků vyšetření a terapie a fotografií v rámci bakalářské práce na FTVS UK. Získaná data nebudou zneužita a osobní data v této práci nebudou uvedena.

Dnešního dne jsem byla odborným pracovníkem poučena o plánovaném vyšetření a následné terapii. Prohlašuji a svým dále uvedeným vlastnoručním podpisem potvrzuji, že odborný pracovník, který mi poskytl poučení, mi osobně vysvětlil vše, co je obsahem tohoto písemného informovaného souhlasu, a měla jsem možnost klást mu otázky, na které mi řádně odpověděl.

Prohlašuji, že jsem shora uvedenému poučení plně porozuměla a výslovně souhlasím s provedením vyšetření a následnou terapií.

Souhlasím s nahlížením výše jmenované osoby do mé dokumentace, fotodokumentaci a s uveřejněním výsledků terapie v rámci studie.

Datum:…….

Podpis osoby, která provedla poučení: …….

Vlastnoruční podpis pacientky: ……

6.3 List of tables:

6.4 List of images:

6.5 List of abbreviation

ADL – Activities of Daily Living

BMI – Body Mass Index

BPM –Bits per Minute

CC/S -Cubic centimeters per second

HR – Heart Rate

PIR – Post isometric relaxation

RR- Respiratory Rate

PNF-Proprioceptive Neuromuscular Facilitation

R.O.M. – Range of motion

SFTR – Saggital, frontal,transverse, rotation method