Charles University

Faculty of Physical Education and Sport

Department of Physiotherapy

Physiotherapeutic Rehabilitation Plan for a Patient after Disc Herniation at L3/L4 with Radiculopathy.

Bachelor Thesis

Supervisor:

Mgr. Ilona Kučerová

Author:

Salem Baqhoum

Abstract

Title

Physiotherapeutic rehabilitation plan for a patient after disc herniation at l3/l4 with radiculopathy

Goal:

The purpose of thesis is to explain in a simplified manner the condition and the positive effect of physical therapy applied

Methods

This thesis is divided into two parts, a theoretical part that discusses the etiology of the diagnoses and the anatomy of the spine in general and the biomechanical and kinesiology of the lower back. The physiotherapeutic approach is also mentioned in the theoretical part. The second part reviews a patient diagnosed with the mentioned diagnoses, and describes the examinations, therapies and approaches used, the therapy sessions are divided into two parts, before and after the surgery, and finally there is the evaluation and effect of the treatment applied. During the therapy sessions the most important techniques used were joint mobilization and soft tissue techniques according to Lewit, PNF strengthening techniques, breathing exercises and ADL training.

Result

The patient showed some kind of improvements in the part of the joint play, release of the restricted fascia of lower back and the superficial sensation of the lower extremity. The patient is more aware and educated of his condition.

Declaration

The following thesis based on the physiotherapeutic rehabilitation plan for a patient after disc herniation at L3/L4 with radiculopathy, is written independently by my knowledge, with the supervision and guidance of Mgr. Ilona Kučerová.

All the therapy producers were applied according the listed bibliography and the knowledge I gained during my three years of Bachelor Physiotherapy studies at UK-FTVS.

Therefore, I hereby declare that no invasive methods were used and the following study was performed with the authorized approval of the patient and the ethics Committee.

Acknowledgement

My deepest appreciation and gratitude goes firstly to my parents and sisters who supported me during my studies in the Czech Republic. I also thank my classmates who made my stay here more pleasant full of unforgettable memories.

I would like to show my greatest appreciation to my supervisor Mgr. Ilona Kučerová , who provided much of her time for me to present this work to the fullest and shared with me a lot of her knowledge that will not help me only in my studies, but throughout my career.

I appreciate the feedback offered by the academic staff of physiotherapy department at the faculty throughout my three years of studies.

Index

Contents

1. Introduction

To begin with, the lower spinal disc serves as shock absorbers between the vertebrae, supports the upper body and allows movement in all direction [1]

Daily living of person can be effected due to complications like disc herniation and leak of the inner materials which can aggravate a nerve, trigger lower back pain and radiating pain to lower extremities.

Furthermore, radiculopathy is a term used for radicular pain which is often secondary to spinal nerve compression or inflammation. For lumbar spine, the radicular pain is radiating to the lower extremities, usually accompanied by numbness and tingling feeling, along with muscle weakness and loss of specific reflexes.

The following case study is based on the patient with diagnose of Lumbar disc herniation at l3/l4 with radiculopathy. The main objective of the study is to apply the physiotherapeutic plan and evaluate its effect on the patient. The case study includes both pre- and post- surgery rehabilitation therapy on the patient [31].

The bachelor thesis case study took place from the 15th of January till 26th of January and after the surgery on the 31st of January and 2nd February, 2018; at Oblastní Nemocnice Kladno; under the supervision of the supervisor Bc. Tomáš Modlinger.

2. General Information

2.1 Vertebral Column

The vertical column is divided into the cervical spine, thoracic spine and lumbar spine. Each spine consists of vertebrae. There are 33 vertebrae which are subdivided into 5 groups. These groups include: seven cervical vertebrae, twelve thoracic vertebrae and five lumbar vertebrae. The vertebral column is separated by intervertebral discs. It protects the spinal cord in the spinal canal. The symphysis between adjacent vertebral bodies is formed by a layer of cartilage on each vertebra body and an intervertebral disc, which is located between the layers of the vertebrae. The biggest role of vertebral column is that support the mass of the body and head, and resist the external forces, protects the nervous system, the spinal column with restricted mobility is no longer able to carry out its protective function (Lewit)

2.2 Spinal Curvature

When we observe the spine from the lateral view, an adult spine has natural S-shape curve. The neck (cervical) and low back (lumbar) regions have slight concave curve, and the thoracic and sacral regions have a gentle convex curve. The curves work like a coiled spring to absorb shock, maintain balance, and allow range of motion throughout the spinal column.

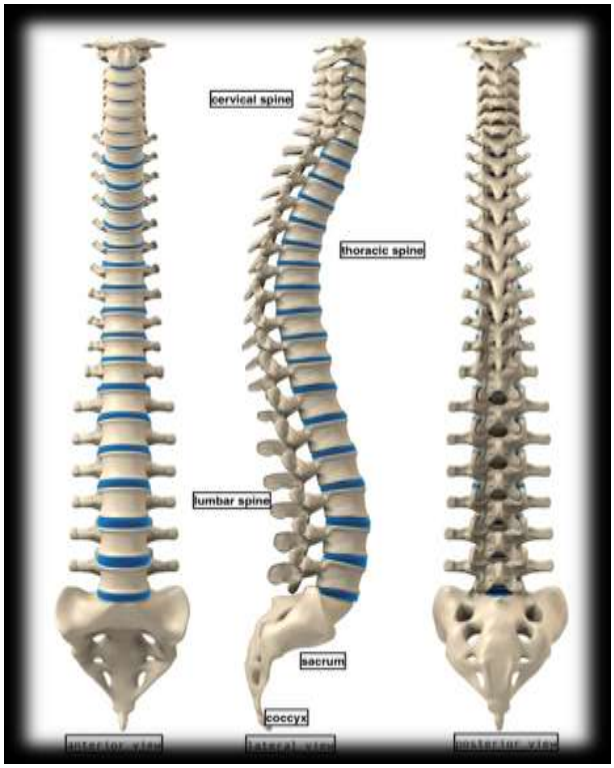

Figure 1 Spinal Curvature [1]

These curves of the spine depend on the position of the pelvis, for example; if the pelvis is in ante flexion it will increase the lumbar lordosis.

If there is a sideward tilt of the pelvis, it can lead to scoliosis. If any one of the curves becomes too large or even small, it becomes difficult to stand up straight and make the posture to be abnormal [27].

2.3 Anatomy of Lumbar Spine

2.3.1 Vertebral bodies

The lumbar spine is consist of five vertebral bodies that extends from the lower thoracic spine (upper back) to the sacrum (bottom of the spine They are the largest, in terms of size, out of all the vertebrae because the lumbar vertebrae must be able to support the weight of the body when a person is standing due to the effects of gravity. The lumbar vertebrae include a thick and stout vertebral body, a blunt, quadrilateral spinous process for the attachment of strong lumbar muscles, and articular processes that are oriented differently than those found on the other vertebrae. The vertebral body is large, wider laterally compared to longitudinally, and thicker in the front than in the back. It is also flattened or slightly concave superiorly and inferiorly, concave behind, and deeply restricted at the front and laterally [7].

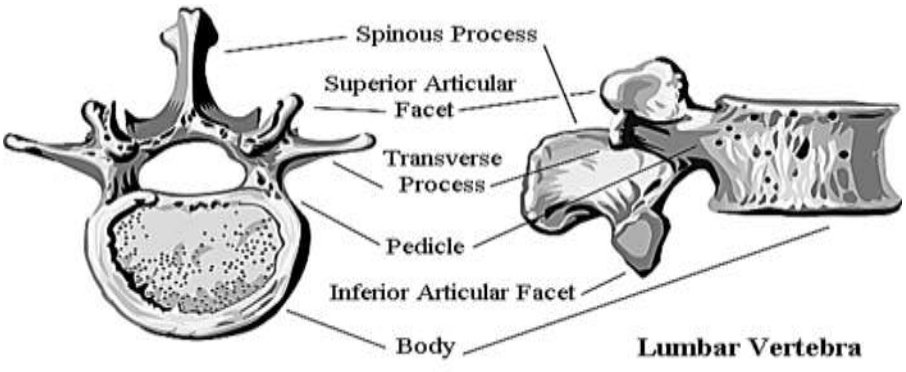

Figure 2 Lumbar Vertebrae [2]

2.3.2 Ligaments of the Vertebral Column

Ligaments are fibrous bands or sheets of connective tissue linking two or more bones, cartilages, or structures together.

Three of the more important ligaments in the spine are the Ligamentum Flavum, Anterior Longitudinal Ligament and the Posterior Longitudinal Ligament. The Ligamentum Flavum forms a cover over the dura mater: a layer of tissue that protects the spinal cord. This ligament connects under the facet joints to create a small curtain over the posterior openings between the vertebrae. The Anterior Longitudinal Ligament attaches to the front (anterior) of each vertebra. This ligament runs up and down the spine (vertical or longitudinal).The Posterior Longitudinal Ligament runs up and down behind (posterior) the spine and inside the spinal canal [7].

2.3.3 Joints of Lumbar Spine

Intervertebral joint is the space that is located between two vertebras. This space helps the movements to occur in the spine. The meeting points of the two spinal bones involved in forming an intervertebral joint are the vertebral body (the front portion) and the vertebral arch (the back portion). Between the vertebral bodies, the intervertebral discs absorb any forces applied to them. Zygapophysial joints or else known as facets joints are synovial joints and they are located between superior and inferior articular processes on vertebras. A thin articular capsule attached to the margin of the articular facets and encloses each joint. In lumbar regions, the joint surfaces are curved and adjacent

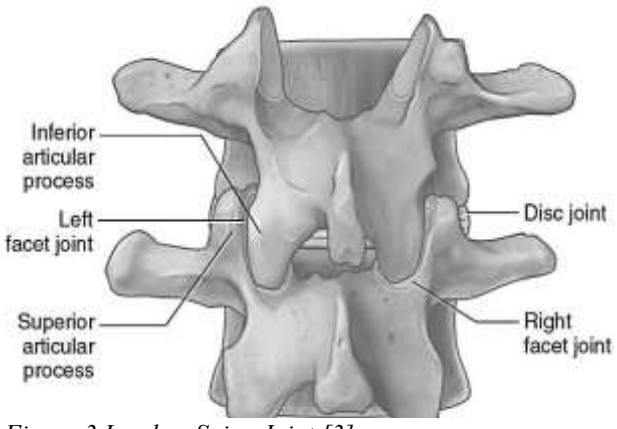

Figure 3 Lumbar Spine Joint [3]

processes interlock, thereby limiting range of movement, thought flexion and extension are still major movements in the lumbar region [7].

2.3.4 Spinal Nerves & Segmental Innervations

Spinal nerves are united ventral and dorsal spinal roots, attached in series to the sides of the spinal cord. There are 31 pairs of spinal nerves: 8 cervical (C1-C8), 12 thoracic (T1-T12), 5 lumbar (L1-L5), 5 sacral (S1-S5), 1 coccygeal (Co1). The peripheral nerves emerge through the intervertebral foramina. All ventral rami excluding T2-T12 are organized into nerve plexuses as they branching each other laterally to the vertebral column. Those plexuses are dividing into cervical (C1-C5), brachial (C5-T1), lumbar (L1-L4) and sacral (L5-S3) according to their localization. Practically, each spinal segment is functionally connected to a specific area of the skin(dermatome, see figure 4), the musculature (myotome), the skeleton (sclerotome), and the internal organs (enterotome).When a lesion occurs in any of the segments, the above factors are affected, to a higher or lower degree, according to the locality and severity of the lesion [22].

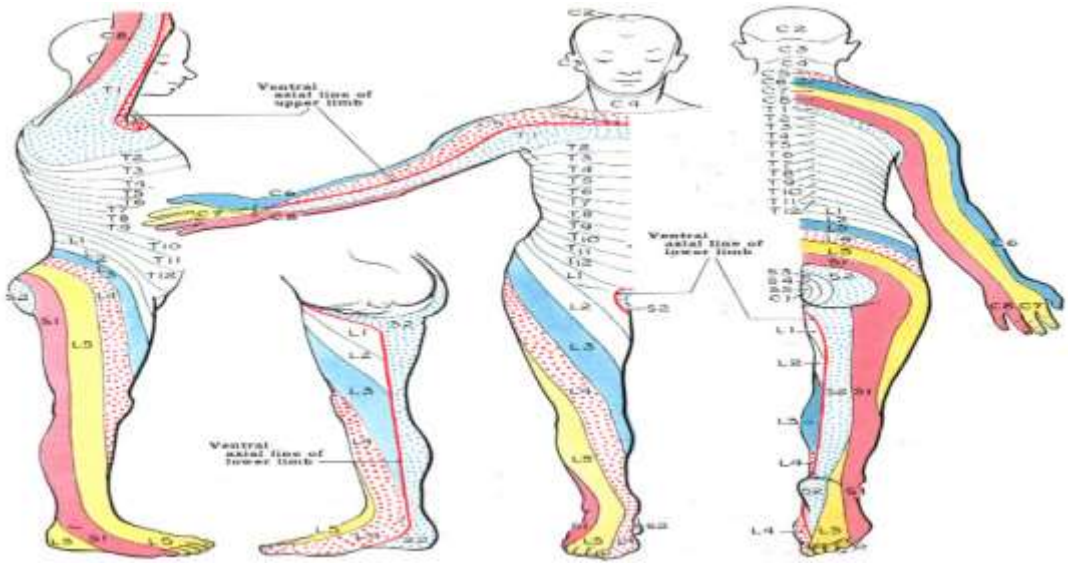

Figure 4 Skin Dermatomes [4]

2.3.5 Lumbar Plexus

The Lumbar plexus is formed by the ventral primary rami of L1, L2, L3 and a part of L4 and a part of L4 and frequently with a small contribution from TH12. Within the substance of the psoas major muscle, the rami branch into anterior and posterior divisions. Peripheral nerves from the anterior divisions innervate adductors muscles on the medial side of the thigh and those from the posterior divisions innervate the hip flexors and knee extensors on the anterior aspect of the thigh.

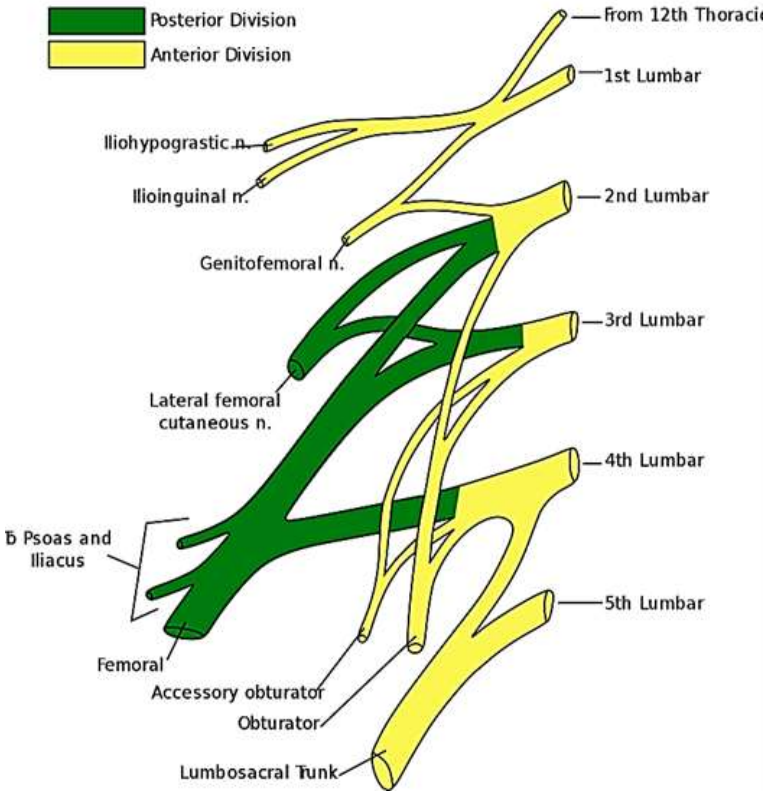

Figure 5 Lumbar Plexus [5]

The sacral plexus arises from the smaller part of the ventral primary ramus of L4 and from the entire ventral rami of L5, S1, S2 and S3.The L4 and L5 ventral rami unite to form the lumbosacral trunk, which enters the pelvic cavity. There, it is joined to by the ventral rami of S1, S2 and S3 forming the plexus, which then branches into anterior and posterior divisions. The anterior divisions and the peripheral nerves arising from them, innervate the posterior aspect of the thigh and the leg as well the plantar surface of the foot. The posterior divisions and the peripheral nerves arising from them, innervate the abductor muscles of the lateral side of the thigh, a hip extensor muscle posteriorly and the extensor, dorsiflexor muscle of the ankle and the toes anteriorly [7].

2.3.6 Fascia of Lumbar Spine

The thoracolumbar fascia (lumbodorsal fascia) is a membrane which covers the deep muscles of the back of the trunk. It consists of three layers, the anterior, posterior and the middle. The thickest layer of the thoracolumbar fascia is the posterior layer and the thinnest layer is the anterior [26].

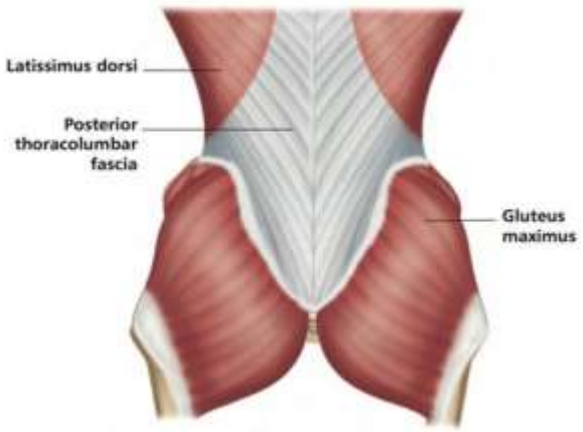

Figure 6 Thoracolumbar Fascia [6]

2.3.7 Muscles of the Spine

The muscles of the neck and trunk are names in pairs, each one of them located on either side of the spine. These muscles may cause lateral flexion and or rotation when they act unilaterally, and flexion and extension of the trunk when they act bilaterally. The origins and insertions of different muscle groups overlap each other, this makes it possible to move the vertebral column simultaneously and correctly. Trunk muscles maintain the normal curvature of the spine and working as postural muscles. The muscles of the vertebral column are arranged into two main layers; superficial and deep. The more superficial extrinsic back muscles are innervated by the ventral rami of the spinal nerves. The erector long spinae extends the spine, it is divided into three columns: Iliocostal is cervices, thoracic and lumborum, which

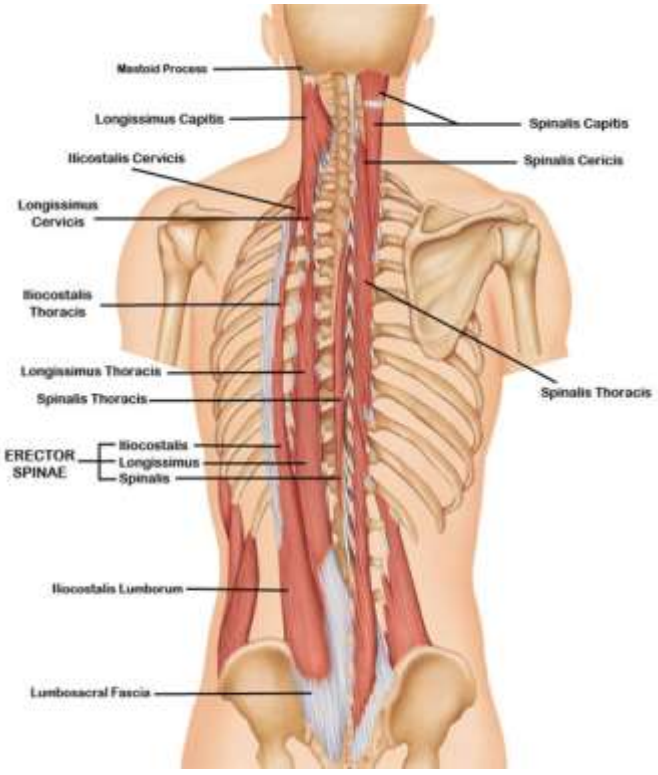

Figure 7 Spine Muscles [7]

extends, abducts and rotated the vertebral column. The deepest layers are the intrinsic back muscles; they are innervated by the dorsal rami of the spinal nerves and interconnect the vertebrae: Multifidus, interspinales and intertransversarii muscles, rotators, longus colli and longus capitis. They act as synergists in extension and rotation of the spine as well as spinal stabilizers. The lateral group consists of quadratus lumborum which extends the trunk bilaterally and lateral flexes the trunk with ipsilateral contraction, and psoas major which flexes the trunk [30].

2.3.8 Diaphragm

The diaphragm is an important muscle to be considered here, which is widely considered as a respiratory muscle only, but it also has postural and stabilizing functions. It is originates from 3 different parts, all of which insert in the central tendon. The sternal part is that originating at the rectus sheath and xiphoid process, the costal part originates at the 6th-12th ribs and indented with the transversus abdominis, while the lumbar part originates at the bodies and transverse processes of the 1st through the 3rd lumbar vertebrae and the 12th rib. As its fibers contract in inspiration, the dome shape of the diaphragm flattens against the abdominal viscera, compressing the abdomen, while the costal part eventually elevates the lower ribs and flares them outwards [30].

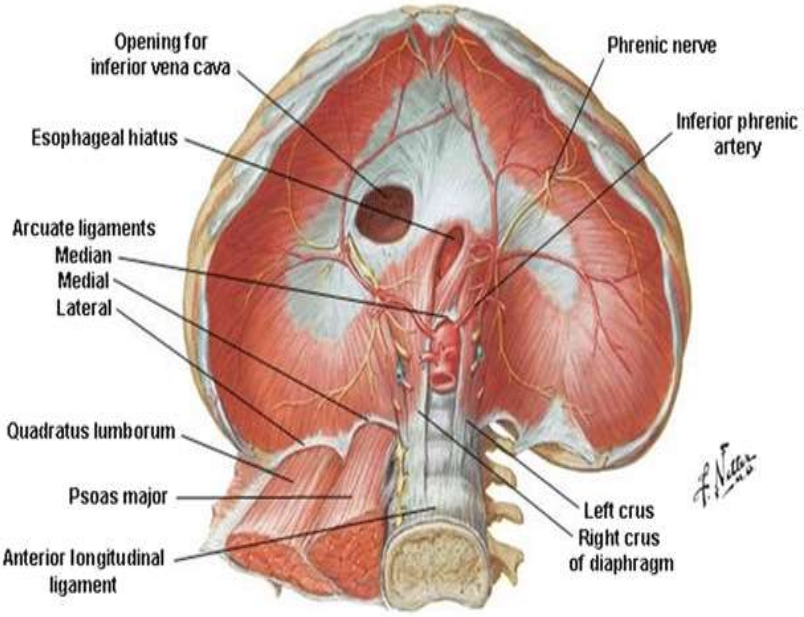

Figure 8 Diaphragm [8]

2.3.9 Pelvic Floor

The pelvic floor is the final component of the muscular mechanism of deep spinal stabilization, as it supports the pelvic visceral organs. The important muscles of the region for that purpose are the levator ani and coccyges muscles. The levator ani muscle is formed by the pubococcygeus and iliococcygeus muscles, which originate at the inner pubic bone near the symphysis and ischial spine, and insert at the inner surface of the coccyx. The coccyges muscle originates at the ischial spine and inserts at the sacrum and coccyx [30].

2.4 Biomechanics of Lumbar Spine & Intervertebral Disc

The lumbar vertebras in comparison with the thoracic and cervical vertebra are larger in size. The reason is that they reduce the amount of stress that is applied to the lumbar spine .They act as a weight –bearing component of the spine and assists also in load bearing. As it is described in the next paragraph the intervertebral discs and the facet joints help the spine to resist in tear and torsion forces [1].

The main role of the disc in the spine is to allow the motion and the flexibility of the spine. Another important role is that together with the facets joints, the carry all the load that is applied to the trunk. There are different types of loads and stresses that are applied to discs such as dynamic or static loads and shear stresses [1] [23].

The intervertebral disk, has no direct blood supply and relies on diffusion for its nutritional needs. Motion is important for the diffusion process. Sustained loading has showed to impair diffusion, with a prolonged recovery time needed for diffusion to return to unloaded conditions. [8].

The movements in the spine are flexion, extension, rotation and lateral flexion. These movements occur as a combination of rotation and translation in the following three planes of motion: sagittal, coronal and horizontal. These movements result in various forces acting on the lumbar spine and sacrum: compressive force, tensile force, shear force, bending moment and torsional moment. For example, with lumbar flexion, a compressive

force is applied to the anterior aspect of the disc and a distractive force is applied to the posterior aspect of the disc. The opposite forces occur with lumbar extension [1] [23].

The lumbar spine complex forms an effective load-bearing system. When a load is applied externally to the vertebral column, it produces stresses to the stiff vertebral body and the relatively elastic disc, causing strains to be produced more easily in the disc. Pressure within the nucleus pulposus is greater than zero, even at rest, providing a "preload" mechanism allowing for greater resistance to applied forces. Hydrostatic pressure increases within the intervertebral disc resulting in an outward pressure towards the vertebral endplates resulting in bulging of the annulus fibrosis and tensile forces within the concentric annular fibers. This transmission of forces effectively slows the application of pressure onto the adjacent vertebra, acting as a shock absorber. The intervertebral discs are an essential biomechanical feature, effectively acting as a fibrocartilage "cushion" transmitting force between adjacent vertebrae during spinal movement. The lumbar disc is more predisposed to injury compared with other spinal regions due to: the annular fibers being in a more parallel arrangement and thinner posteriorly compared with anteriorly, the nucleus being positioned more posteriorly, and the holes in the cartilaginous endplates [1] [21] [19]

2.5 Kinesiology of Lumbar Spine & Intervertebral Disc

The lumbar spine is the most loaded part of the spine with immense five lumbar vertebrae forming the lumbar lordosis. The most distal end of the lumbar spine is linked to the pelvic thru the lumbo-sacral joint supported by massive ligaments running from the processes L4-5 to the iliac crest and sacral bone. These ligaments play a role of limiting the movement range of the lumbo-sacral joint, more in the lateral flexion than in ventral flexion and extension. The lumbar spine especially lumbo-sacral joint, caries the whole weight of the upper part of the body [14]

When explaining the movement of the trunk and intervertebral disc, four muscle groups must be mentioned.

2.5.1 Extensors of the Lumbar spine

The posterior muscles of the trunk, function of theses muscles is related to extension of the vertebral column, when the sacrum is fixed they powerfully extend the lumbar and thoracic vertebral column, at the lumbosacral and thoracolumbar joints. Extension of the lumbar spine significantly affects the diameter of the intervertebral foramina and the potential for deforming the nucleus pulposus. Full extension, tends to deform the nucleus pulposus in an anterior direction. However, full lumbar extension has been shown to reduce pressure within the disc and in some cases to reduce the contact pressure between the disc placed nuclear materials and the neural tissues. The reduced contact pressure after sustained full extension may occur because the nuclear material is pushed forward and away from the neural tissues [14] [24] [11].

2.5.2 Lateral Flexors of the Lumbar Spine

Second group of muscles is the lateral muscles of the trunk, composed of two main muscles, (quadratus lumborum and psaos major). One quadratus lumborum flexes the trunk ipsilateral and is helped in this movement by the internal oblique and the external oblique. The psaos has a main role leading the trunk to lateral flexion ipsilateral and rotation contralateral. The quadratus lumborum has no effect on the lumbar lordosis while the iliopsoas can influence it [14] [24] [11].

2.5.3 Flexors of the Lumbar Spine

The muscles of abdominal wall consist of the rectus muscles lying in the anterior abdominal wall, the transversus abdominis forms the deepest layer of the lateral abdominal muscles, obliquus internus abdominis, obliquus externus abdominis. All these muscles play an important role of two main movements. Rotation and flexion of the trunk. The intervertebral joints have the tendency to resist when flexion movement is applied to the lumbar spine. It is important to mention that excessive or prolonged flexion of lumbar region generates increased compression force on the anterior side of the disc, ultimately deforming the gel-like nucleus pulposus in a posterior direction [14] [24] [11].

2.5.4 Rotators of the Lumbar Spine

Rotation of the lumbar spine is defined by a multi-regional diagonal motion caused by a unilateral muscle contraction. Almost all extensors of lumbar spine are able to cause an oblique direction contraction producing a rotation movement. As well as the anterior abdominal wall and lateral flexors [14] [24] [11].

Furthermore, an important point to mention regarding the kinesiology of the lumbar spine is the curvature of the lumbar spine, which depends on the position of the pelvic. The backward tilt of the pelvis decreases the lumbar lordosis and influences of whole body bearing, flattening of spinal curve increases the occurrence of discopathy. The forward tilt of the pelvis increases the lumbar lordosis, this position overloads the hip joint which over time can increase the risk of coxarthrosis. The sideway tilt causes a compensatory scoliosis of spine [14] [24] [11] [27].

2.6 Pathophysiology.

2.6.1 Disc Herniation

The intervertebral disc consists of two main characteristics: the annulus fibroses which is the tough circular exterior of the intervertebral disc that surrounds the soft inner core called the nucleus pulposus. These two components facilitate the spine movement and provide support to the vertebrae. When the nucleus pulposus is pressed or pushed out towards the annulus fibroses. Due to disc generation or trauma or even constant overload on the intervertebral disc it causes what is called disc herniation [4] [9].

A herniation can cause direct pressure on the nerve root , the nerve root extends down the leg and any type of pinching or pressure on the nerve on the lower spine can cause pain numbness tingling or weakness that radiate along the path of the nerve down the leg. However many people have showed in MRI scans, yet have no associated pain, so not all herniated discs will cause symptoms [4] [9].

Disc herniation can be classified into four stages depending on the way of the displaced material:

- Stage one: disc protrusion where the disk bulges without rupturing the annulus fibroses.

- Stage two: is called prolapse disc here the nucleus pulposus is displaced into the outermost layers of the annulus fibroses

- Stage three: the extrusion of the disc is the stage when the annulus fibroses is perforated and the gel-like material nucleus pulposus is pushed to the epidural membrane enclosing the nerve bundle

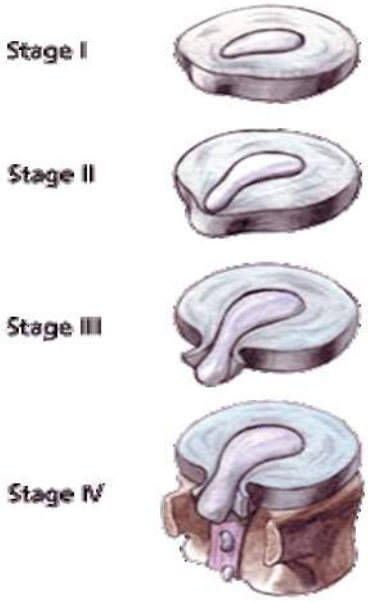

Figure 9 Disc Herniation Stages [9]

- Stage four: is called sequestration of the disc, in this stage the disc is fragmented, both nucleus pulposus and annulus fibroses can be found as free floating material in the spinal canal causing severe pain and significant neurological symptoms.[17] [21]

2.7 Treatment

2.7.1 Non- surgical treatment

Acute cervical and lumbar radiculopathies due to herniated disc are primarily managed with non-surgical treatments. In case there are not sever neurological deficits such as marked muscle weakness, impaired gait or cauda equine syndrome, conservative treatment in the first choice. Anti-inflammatory medications can be used to relief pain NSAIDs and physical therapy with specific exercises and appropriate rehabilitation plan can restore the muscles balance. These two approaches are the first-line treatment modalities. Epidural steroid injections and selective nerve root blocks are the second line modalities. These are good modalities for managing disabling pain. Patients who fail conservative treatment or patients with neurological deficits need timely surgical consultation [6] [29].

2.7.2 Surgical treatment

Surgical treatment is as always the last resort. If the patient is diagnosed with signs of neurological deficit or cauda equine syndrome. Surgical treatment for a herniated disc include three main surgical treatments that are commonly used; the standard lumbar discectomy microendoscopical lumbar discectomy and laminectomy with or without a foraminotomy with the use of tubular retractor systems [5] [15] [16].

2.7.3 Post-Operative Approach

Like any other operation the patient should undergo the recovery period with being at rest in bed combined with air clearance and lung function exercises after the anesthetics also deep vein thrombosis .In the rehabilitation after disc herniation surgery it is necessary to achieve the optimal core stability and promote better controlled postural and gait pattern. The treatment may include stretching of shortened muscles, strengthening of weakened muscles, regain the optimal range of motion, and most importantly is the optimal activation of deep stabilization system [11] [13].

2.7.4 Physiotherapeutic Approach

2.7.4.1 Spiral Stabilization of the Spine (Smíšek)

The method was developed in 1977 by MUDr. Richard Smíšek. Spiral Stabilization is a revolutionary exercise method for the treatment and prevention, through sufficient regeneration, of spinal disorders and also disorders in the main joints such as hip, knee, shoulder, highly effective movement program is using a unique spiral stabilization of the spine. The whole body's stabilizing muscles are connected together during optimal coordinated movement creating a dynamic stabilizing muscle corset. Using these muscle chains helps the body develop upward strength creating traction of the spine that relieves pressure on the intervertebral discs and joints and allows for their nutrition, regeneration and treatment. Muscle spirals also allow for optimal spinal movement while aligning the spine into a centralized axis. The exercises are done while performing reciprocal inhibition when muscles on one side of a joint are relaxing to accommodate contraction on the other side of that joint. The movement program is using all important elements of strengthening,

stabilization, stretching, relaxation, coordination and balance together in every exercise. The exercises can be easily learnt as natural movement coordination of the body regularly used during walking and running. To accelerate and enhance the positive effect of the exercises, Manual therapy (massage) is used as a part of the Spiral Stabilization method. Its main aim is to relax the tension in the muscles which have obstruct optimal movement during exercise and therefore inhibit the generation of spiral stabilization. The techniques are used in manual therapy are soft tissue massage releasing tensed muscles, manual stretching, post isometric relaxation, traction and mobilization.

Spiral Stabilization exercises are performed with an elastic cord. The cord allows for extensive movement against a low, but gradually increasing resistance that will activate the muscle chains and create traction of the spine relieving pressure on the intervertebral discs and joints.

Spiral stabilization can be beneficial to support correct posture, re-establishes the loss of natural movement, aligns the spine into centralized axis and extends upward, refines muscle chain formation relieving pressure on the intervertebral discs and joints and strengthens weak muscles. And other beneficial factors such as improve flexibility, developing natural coordination and balance [28]

2.7.4.1.1 Muscle Chains

An awareness of various muscle connections within the body is required in order to understand how Spiral Stabilization treatment works. These muscle connections called 'muscle chains', and are divided into two groups – vertical and spiral muscle chains (see figure 10). The body was originally designed to use the spiral muscle system (chains) to spirally stabilise the body during movement such as walking and running. Only in this way can the body maintain a pattern of completely natural human movement whilst regenerating the spine and the body. The shape and function of the spine are affected by the movement of the arm and shoulder. It is the backward movement of the arm and the shoulder (also the shoulder blade) that initiates the contraction and activity of the spiral chains – mainly the muscles between the shoulder blades (latissimus and trapezius muscles) and the external and internal oblique abdominal muscles and glutes. All this explains why Spiral Stabilization exercises require a unique spiral stabilisation of the spine during treatment. During exercise the whole body's stabilizing spiral muscles are connected together which

creates a dynamic stabilizing muscle corset. This corset engages the abdominal wall and narrows the waist. Contraction of spiral muscle chains help the body to develop upward strength which creates traction of the spine that relieves pressure on the intervertebral discs and joints. This allows for their nutrition, regeneration and treatment. Muscle spirals also allow for optimal spinal movement whilst aligning the spine into a central body axis [32].

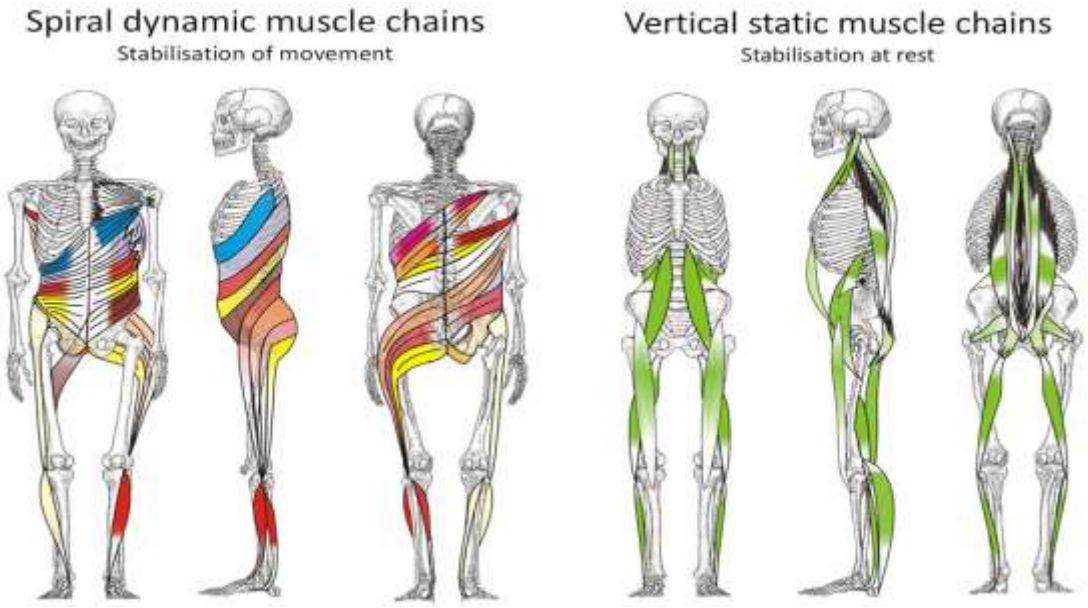

Figure 10 Muscles chain [10]

2.7.4.2 The Deep Core Stabilizing System

Learning how to activate the diaphragm and creating intra-abdominal pressure will lead to increased activation of the deep core stabilizing system. This is key for protecting the spine and leading to improved movement patterns and therefore increased power and performance overall. Core stability is not achieved purely by strength of abdominals, spinal extensors, gluts or any other muscles, case considering the fact that the central nervous system in not controlled by individual muscle ,but by individual movements . Core stabilization is accomplished through precise coordination of these muscles to generate intra-abdominal pressure (IAP). This is regulated by the CNS- the brain. Our sagittal stabilization begins at 6 weeks of life. Our spinal (core) stabilization is attributed to muscle complex called the Deep Stabilizing System of the Spine (DSSS). Deep spinal stabilizing system is more than just the 'deep muscles'. Deep Spinal (core) stabilization includes:

multifidi, deep neck flexors, diaphragm, abdominal wall, pelvic floor. When these muscles are automatically activated prior to movement, a stable base is generated. In proper stabilization, activity does not involve only one muscle but the whole chain working together. Functional stabilization is necessary for safe, purposeful movement. Through postural – locomotion kinematic chains, nearly every muscle is involved in stabilizing function. Create a proper IAP, is linked with the correct activation of diaphragm which has respiratory, postural stabilizing functions and coordination of both. Physiological movement of the diaphragm should be part of all movement and exercise. It is important to reach the ideal position of the spine, chest and pelvic by eliminating the open scissors of the diaphragm or rib flare. Sagittal stabilization can be achieved when the Spine is axially elongated, chest in expiratory position (rib cage down), parallel position of diaphragm and pelvic floor, equal distribution of IAP independent on respiration, equal activation of abdominal wall. [25] [2].

In order to improve and achieve optimal movement Quality should be over quantity. Muscles must be trained in both their stabilization and dynamic movement producing functions. Movement efficiency equals optimizing the distribution of internal forces of muscles that act on each segment of the spine and or any other joints or segments. As (Lewit) mentioned, if breathing is not normalized- no other movement pattern can be [8].

3. Case Study

3.1. Methodology

My clinical work placement to a place at Oblastní nemocnice Kladno. My clinical work was supervised by Mgr. Ilona Kučerová.

The sessions with my patient were seven, five before the surgery and two after the surgery. They were started on Monday 15th of January 2018 and they were continued day by day. Our last session was on Friday 2nd of February 2018.

Mainly the therapeutic procedures that I used were manually therapy which took place in our individual therapy room in the department of neurology. I used mostly my hands for the examination and therapy. Goniometers, measurement tape, neurological hammer were the tools that I used for the examination procedures.

The patient was fully aware of the examination and therapeutic procedures at any given time, no invasive methods were used and a proposed informed consent was also assigned by the patient and me.

My work has been approved by the Ethics Committee of the Faculty of Physical Education and Sport at Charles University, under the approval number 060/2018

3.2. Anamnesis

Examined person: Z.N **Date of birth**: 1964

Gender: Male **Code:** M511

Diagnosis: Disc herniation of L3/L4

3.2.1 Status Presence

Objective:

- **Height**:183cm
- **Weight:** 90kg
- **BMI:** 26.9
- **Pain Level** 7/10

Subjective:

- **Chief complaint:** Low back pain with radiating pain to both lower extremities, tingling sensation on the anterior aspect of the both ankles, worse in the left extremity.
- **Family anamnesis:** Father and Mother are healthy.
- **Occupational anamnesis:** Realtor agent.
- **Social anamnesis:** Lives with his wife.
- **Surgical anamnesis:** 5 years ago had a surgery was done for the medial collateral ligament of right knee.
- **Pharmacological anamnesis:** Zaldiar 2mg, Kalium chloratum, Helicid 20mg, Novalgin, Ketanol
- **Hobbies:** Plays hockey, often.
- **Abuses:** Electronic cigarette & alcohol occasionally.
- **Allergy :** None

3.2.2 History of Present Problem

A week ago patient was trying to lift off a heavy object and felt sudden pain in the low back area which started to radiate few days after to both his lower extremities, but more on the left side. The patient underwent an x-ray that did not show any pathology of the vertebral column. An MRI was done after which resulted that the patient is suffering from medial disc herniation of L3/L4.

3.2.3 Prior Rehabilitation

Five years ago, the patient had rehabilitation plan after the knee surgery.

3.2.4 Excerpt from Patient's Healthcare File

The MRI was performed on 16.01.2018, the intervertebral disc L3/L4 was herniated and compressing medially causing radicular pain. (Figure 11)

Figure 11 Patient's MRI

3.2.5 Indication of Rehabilitation

- Soft tissue techniques
- Manual therapy
- Mackenzie exercise
- Activation of deep stabilization system
- Strengthening and conditioning exercises

3.3. Initial Kinesiology Examination (Pre-surgery)

3.3.1 Postural Examination

- **Anterior view :**

· Narrow base of support

· Optimal feet arches

· No valgusity or varusity of the knee joint

· Left patella is higher than the right patella

· Symmetrical pelvic position

· Thorachobrachial angle is bigger on the left side

· Right nipple is slightly higher the left nipple while the left one slightly placed laterally

· Prominent lower ribs

· Prominent collarbones in both sides

· Symmetrical height of shoulders

· Optimal position of the head from this view

- **Lateral view**

Right side

· Optimal position of the ankle joint

· Slight knee flexion

· Slight increased anteversion of the pelvic

· Slight increased lordosis with flat L/Th and neutral kyphosis of Th spine

· Very slight shoulder protraction

· Forward holding of the head

Left side

· Optimal position of the ankle joint

· Slight knee flexion

· Slight increased anteversion of the pelvic

· Slight increased lordosis with flat L/Th and neutral kyphosis of Th spine

· Very slight shoulder protraction

· Forwarded holding of the head

- **Posterior view**

· Narrow base of support

· Symmetrical contour of the malleolus

· Symmetrical thickness of the Achilles tendon

· Optimal position of the ankle joint (no supination or pronation)

· Asymmetry of popliteal line

· No varusity or valgusity of both knees

· Symmetrical gluteal maximus muscles in shape

· Thorachobrachial angle is bigger on the left side

· The pelvic is symmetrical by aspection

· Prominent paravertebral muscles of the lumbar region

· Prominent paravertebral muscles of the thoracic region

· Asymmetry of scapula height as the medial border of the left scapula is slightly higher.

3.3.2 Dynamic Spine Examination

Flexion
During bending forward we could observe rotation of the trunk to the right side right paravertebral muscles were more prominent without activation of the lumbar spine , the patient could perform it without any pain
Extension
The movement was mainly occur at the thoraco-lumbar area with insufficient range of motion , the patient did not complain of pain
Lateral flexion
To the right : the movement wasn't fluent there was no curve in the lumbar spine and in the thoracic area the curve starts at the most proximal vertebrae , no pain was detected
To the left : the movement wasn't fluent the was no curve at any region of the spine no pain was detected

Table 1 Initial Dynamic Spine

3.3.3 Pelvic Examination

The patient had no asymmetry in pelvic as the ASIS was palpated and it was symmetrical as well for PSIS was symmetrical to; palpating the iliac crest was also symmetrical.

3.3.4 Spinal Distances

• **Thomayer's distance:** Positive. The patient was asked to bend forward carefully to measure the distance between his finger tips and the floor which was 23 cm
• **Shober's distance:** Positive less than 1cm was measured
• **Stibor's distance :** Positive 2cm were measured
• **Lateral flexion :** to the Right 10cm , to the Left 12cm

Table 2 Initial Spine Distances

3.3.5 Gait Examination

The patient performed the gait without any helping aids. Very narrow base of support and same angle between the feet , he performed it with short steps with relatively slow speed , the movement of the feet was impaired , the heel strike was absent in both feet he was moving directly to the flat foot and take off from that position without performing the toe off . No flat foot or valgusity or varusity was detected in knee and ankle. Minimal movement of the pelvic , the trunk remained in the ideal position no latero-flexion or rotation were absorbed , slight protraction of the head no excessive movement of the head was observed , the walking was stable without loss of balance . Walking backward was performed with the absent of hip extension compensated with slight leaning forward the trunk and exaggerated knee flexion , he was not able to perform neither the walking on tip toes nor the walking in heels , the patient's squat position wasn't optimal to perform walking in squat.

3.3.6 Balance & Perception Tests

- **Romberg I, II, III** were all negative.
- The patient couldn't stand on heels.
- **Standing on tiptoes** was performed in poor quality as the patient couldn't hold the position for so long.
- **Trendelenburg** was positive in both sides as the patient's pelvic dropped as soon as he lifted his leg.
- **Scale test** : Negative
  - Weight on first scale 90kg
  - Weight on second scale 90kg
  - Weight with each extremity in one scale : Right 48kg , Left 42kg

3.3.7 Breathing Assessment

Standing the patient was using mostly doing costal breathing from his upper thoracic region. Supine position the patient also was using the upper thoracic breathing.

3.3.8 Anthropometric Measurements of Lower Extremities

Right		Left
86cm	**The length of whole lower extremity (Anatomical)**	86cm
91cm	**The length of whole lower extremity (functional)**	91cm
45cm	**The length of the thigh**	45cm
36cm	**The length of the middle leg**	36cm
23.5cm	**The length of the foot**	23cm
49cm	**The circumference of the thigh 15cm above the patella**	49cm
46cm	**The circumference of the thigh 10cm above the patella**	46cm
35cm	**The circumference of the knee joint**	34.5cm
34cm	**The circumference of the calf**	33cm
24cm	**The circumference of the ankle**	24cm
23cm	**The circumference of the foot**	23cm

Table 3 Initial Anthropometric Measurements

3.3.9 Movement Stereotype Examination according to Janda

Movement	Observation
Hip extension	Faulty movement bilaterally .There was a delay of the activation of gluteal muscles with maximal activation of the lumbar paravertebral muscles with anteversion of the pelvic
Hip abduction	Faulty movement bilaterally. The patient started the movement with flexion of the knee and activation of quadratus lumborum, he couldn't demonstrate a fluent movement due to weakness of the hip abductors as shown in previous tests
Trunk flexion (curl up)	Faulty movement. Greater activation of the iliopsoas with the absence of abdominal muscle activation

Table 4 Initial Movement Stereotype

3.3.10 Range of Motion Examination

** Plastic goniometer was used to examine the ROM of joints.*

ACTIVE			
Movement	Right	Joint	Left
FLX - EXT	S: 10 – 0 – 50		S: 10 – 0 – 45
ABD – ADD	F: 15 – 0 – 30		F: 10– 0 – 30
IR – ER	T: 40 – 0 – 30	**HIP JOINT**	T: 40 – 0 – 30
FLX – EXT	S: 0 – 0 – 125	**KNEE JOINT**	S: 0 – 0 – 120
PFLX - DFLX	S : 20 – 0 – 35	**ANKLE JOINT**	S : 10 – 0 – 30
INV – EVE	R : 10 – 0 - 25		R : 5 – 0 - 20

Table 5 Initial Active ROM

PASSIVE			
Movement	Right	Joint	Left
FLX - EXT	S: 20 – 0 – 60		S: 20 – 0 – 60
ABD – ADD	F: 30 – 0 – 30	**HIP JOINT**	F: 30– 0 – 30
IR – ER	T: 45 – 0 – 35		T: 45 – 0 – 30
FLX – EXT	S: 0 – 0 – 140	**KNEE JOINT**	S: 0 – 0 – 135
PFLX - DFLX	S : 25 – 0 – 40	**ANKLE JOINT**	S : 20 – 0 – 40
INV – EVE	R : 15 – 0 - 30		R : 15 – 0 - 25

Table 6 Initial Passive ROM

3.3.11 Muscle Length Examination according to Janda

- Grade 0 – no shortness
- Grade 1 – slight / moderate shortness
- Grade 2 – marked shortness

RIGHT	MUSCLE	LEFT
Grade 0	**Gastrocnemius and plantaris**	Grade 0
Grade 0	**Soleus , popliteus**	Grade 0
	Hip flexor muscles:	
Grade 1	**-One joint muscles**	Grade 1
Grade 1	**-Two joint muscles**	Grade 1
Grade 1	**Adductors**	Grade 1
Grade 2	**Hamstrings**	Grade 2
Grade 2	**Paravertebral muscles**	Grade 2
Grade 1	**Quadratus lumborum**	Grade 1
Grade 1	**Piriformis**	Grade 1
	Pectoralis major:	
Grade 1	**-Sternal part**	Grade 1
Grade 1	**-Clavicular part**	Grade 1
Grade 1	**Pectoralis minor**	Grade 1
Grade 1	**Trapezius**	Grade1
Grade 1	**Levator scapulae**	Grade 1
Grade 1	**Sternocleidomastoid**	Grade 1
Grade 1	**Scalene**	Grade 0

Table 7 Initial Muscle Length

3.3.12 Muscle Strength Examination According to (Kendall

- Grade 0: No Contraction of the muscle.
- Grade 1: Contraction of the muscle felt but no movement seen.
- Grade 2: Position in horizontal plane with gravity.
- Grade 3: Against gravity.
- Grade 4: Against gravity with moderate resistance given.
- Grade 5: Against gravity with maximum resistance given.

Right	Peripheral innervation		Muscle	Segmental innervation								Left
				L1	L2	L3	L4	L5	S1	S2	S3	
-4	Gluteal	Inf	Gluteus Maximus					●	●	●		-4
+3		Sup	Gluteus Medius				●	●	●			+3
+3			Gluteus Minimus				●	●	●			+3
+3			Tensor Fascia Latae				●	●	●			+3
4	Lumb. Plexus		Iliopsaos	●	●	●	●					4
4			Quadratus Lumborum	●	●	●						4
5	Obturator		Adductors		●	●	●					5
5	Femoral		Quadratus Femoris		●	●	●					5
+4	Sciatic		Biceps Femoris					●	●	●	●	+4
+4			Semitendinosus , Semimembranosus				●	●	●	●		+4
-3	Common Peroneal	Deep	Tibialis Anterior				●	●	●			-3
-3			Extensor Hallucis Longous				●	●	●			-3
-3			Peroneus Tertius				●	●	●			-3
-3		SF	Peroneus Longous				●	●	●			-3
-3			Peroneus Brevis				●	●	●			-3
4	Tibial		Tibialis Posterior				●	●	●			4
4			Gastrocnemius						●	●		4
4			Soleus					●	●	●		4
4			Flexor Hallucis Longous					●	●	●		4
4			Flexor Hallucis Brevis				●	●	●			4
3			Plantar Interossei						●	●		3
3			Dorsal Interossei						●	●		3

Table 8 Initial Muscle Strength

3.3.13 Muscle Tone Palpation

Right			Muscle		Left		
Tonus	**Pain**	**Trigger points**			**Trigger points**	**Pain**	**Tonus**
Hypetone	Slight pain	Present	Trapezius	Upper	Present	Slight pain	Hypetone
Physiological	No pain	Present		Middle	Present	No pain	Physiological
Physiological	No pain	Absent		Lower	Absent	No pain	Physiological
Hypetone	No pain	Absent	Pec. Major	Clavicular	Absent	No pain	Hypetone
Hypetone	No pain	Absent		Sternal	Absent	No pain	Hypetone
Hypetone	No pain	Absent		Abdominal	Absent	No pain	Hypetone
Physiological	No pain	Absent	Sternocleidomastoid		Absent	No pain	Physiological
Physiological	No pain	Absent	Levator scapula		Absent	No pain	Physiological
Physiological	No pain	Absent	Pec minor		Absent	No pain	Physiological
Physiological	No pain	Absent	Rectus abdominis		Absent	No pain	Physiological
Physiological	No pain	Absent	Erector spinae	Thoracic	Absent	No pain	Physiological
Physiological	No pain	Absent		Lumbar	Absent	No pain	Physiological
Hypetone	No pain	Absent	Quadratus lumborum		Absent	No pain	Hypetone
Hypotone	No pain	Absent	Gluteus maximus		Absent	No pain	Hypotone
Hypotone	No pain	Absent	Gluteus medius		Absent	No pain	Hypotone
Physiological	Slight pain	Absent	Piriformis		Absent	Slight pain	Physiological
Physiological	Slight pain	Absent	Iliopsaos		Absent	Slight pain	Physiological
Physiological	No pain	Absent	Vastus medialis		Absent	No pain	Physiological
Physiological	No pain	Absent	Vastus lateralis		Absent	No pain	Physiological
Physiological	No pain	Absent	Hamstrings		Absent	No pain	Physiological
Physiological	No pain	Absent	Gastrocnemius		Absent	No pain	Physiological
Physiological	No pain	Absent	Soleus		Absent	No pain	Physiological
Physiological	No pain	Absent	Tibialis anterior		Absent	No pain	Physiological

Table 9 Initial Muscle Tone

3.3.14 Joint Play Examination

- **Lumbar spine**

  Springing test was applied and it was free in all segments

- **Ribs**

Examination of the 1st Rib : No restriction
Examination of the upper ribs : No restriction
Examination of the lower ribs : No restriction

Table 10 Initial Ribs Joint Play

- **Lower limb joints**

RIGHT	JOINT	LEFT
No blockage	**Patella caudal direction**	No blockage
No blockage	**Patella cranial direction**	No blockage
No blockage	**Patella medial direction**	No blockage
No blockage	**Patella lateral direction**	No blockage
Blocked	**Tibiofibular joint dorsal direction**	Blocked
Blocked	**Tibiofibular joint ventral direction**	Blocked
No blockage	**Talocrural joint**	Blocked
Blocked	**Lisfranc joint**	Blocked
Blocked	**Chopart joint**	Blocked
No blockage	**Proximal and distal phalanx of 1st – 5th digits in ventral direction**	No blockage
No blockage	**Proximal and distal phalanx of 1st – 5th digits in ventral direction**	No blockage
No blockage	**Proximal and distal phalanx of 1st – 5th digits in dorsal direction**	No blockage
No blockage	**Proximal and distal phalanx of 1st – 5th digits in medial direction**	No blockage
No blockage	**Proximal and distal phalanx of 1st – 5th digits in lateral direction**	No blockage
No blockage	**Metatarsophalangeal joints of 1st – 5th digits in ventral direction**	No blockage
No blockage	**Metatarsophalangeal joints of 1st – 5th digits in dorsal direction**	No blockage
No blockage	**Metatarsophalangeal joints of 1st – 5th digits in rotation**	No blockage

Table 11 Initial Lower Limbs Joint Play

- **The Sacroiliac joint**

Spine sign : No restriction in both sides
Rosina test : Negative in both sides
Examination of Sacroiliac joint (springing test of the Ilium against sacrum in supine position with one leg flexed) : No restriction in both sides
Examination of Sacroiliac joint (springing test in prone position for the superior part of the sacroiliac joint): No restriction
Examination of Sacroiliac joint (springing test in side-lying position of Ilium against sacrum): No restriction in both sides

Table 12 Initial Sacroiliac Joint Play

3.3.15 Subcutaneous Tissues & Fascia Examination according to Lewit

There were restriction in the caudal and cranial direction of the lumbar region.

3.3.16 Neurological Examination

Superficial Sensation :
L4 :both sides had normal physiological and equal sensation
L5: sensation is slightly decreased on the left extremity
L6 :both sides had normal physiological and equal sensation

Table 13 Initial Superficial Sensation

Deep Sensation :
With the patient eyes closed he was asked if he could feel the touch in his ventral aspect of both feet, he could feel the pain while slightly pricking his both feet with sharp object. Kinesthesia was negative as the patient could describe the motion that was applied to his big toe in both extremities. Joint position sense was also negative as his big toe was flexed and he was asked to do the same movement in the contralateral extremity , the patient failed to distinguish the two-point discrimination in the left and right lower extremities , the same for Graphesthesia , the patient couldn't distinguish the numbers drawn on his feet in both lower extremities both these tests were positive

Table 14 Initial Deep Sensation

Tendon Reflex :
For the Patellar reflex , the patient had the same physiological reflexes in both tendons left and right
For the Achilles tendon reflex the patient also had the same physiological reflex in both tendons
For the Medio planter reflex the patient had the same physiological reflex in both extremities

Table 15 Initial Tendon Reflex

Pathological Reflexes of the Lower Extremity:
Extension reflexology :
Babinski reflex : Negative
Roche reflex : Negative
Brissaud's reflex : Negative
Oppenheim's sign : Negative
Chaddock's reflex : Negative
Flexion reflexology :
Rossolimo's reflex : Negative
Zukovsky-Kornilov : Negative

Table 16 Initial Pathological Reflex

Assessment Using Tension Maneuvers
Lasègue's Sign : Negative , the patient felt the pain due to the tension of the hamstrings in both sides
Reverse Lasègue's Sign : Negative in both sides

Table 17 Initial Tension Manure Examination

3.3.17 Postural Stabilization & Postural reactivity Examination according to Kolář

Extension test :
The patient demonstrated the movement poorly , as there was significant activation of paravertebral muscles , there was no activation of the lateral group of abdominal muscles, there was no activation of the gluteal muscles with external rotation of the inferior angle of the both scapula
Diaphragm test :
The patient couldn't activate his diaphragm physiologically as he was activating the muscle with small resistance and poor coordination he couldn't maintain the ribs in caudal position as they migrated cranially during the test

Table 18 Initial Postural Examination

3.4. Initial Examination Conclusion

The patient was feeling pain in the area of low back that was radiating down to his anterior aspect of the left ankle; the patient did not mentioned or complained of any other complications. Before the patient underwent the surgery five physiotherapeutic therapy sessions were done, followed by two physiotherapeutic therapy sessions after the surgery.

After the initial Kinesiological examination the patient was suspected of disc herniation at the level of L4/L5 regarding the motor deficits he had. However, the result of the MRI on 16.01.2018 showed that he has medial disc herniation at L3/L4.

The examination concluded that, the patient had very narrow base of support that was result of the postural examination and gait examination. Limited ROM of the lower extremity was detected especially at the hip joint and the ankle joint. The result of neurological examination showed that the patient has impaired sensation in the anterior aspect of his left ankle. The patient did not have huge differences while examining the anthropometry measurements, as well as for the pelvic examination.

Further, concerning the joint play examination the patient did not have restricted sacroiliac joint as was expected , but he had restricted head of fibula in both direction in both extremities , and restriction in talocrural joint on the left side, as well in Lisfranc and Chopart joints in both sides. The patient's balance was optimal while performing the three degrees of Romberg test, the patient failed to demonstrate the standing on heels, but he was able to stand on tiptoes but not for so long, the Trendelenburg test was positive in both sides and that indicate weak hip stabilizers.

The patient wasn't using the abdominal breathing as the examinations showed, he also had poor activation of the diaphragm which is the primary breathing muscle.

Regarding the muscle length and muscle palpation, the patient had marked hypo tone in gluteus maximus, the accessory breathing muscles were examined as well because the following therapy goal is to focus on the breathing pattern as the examinations for breathing showed impaired breathing pattern and poor activation for diaphragm.

Lastly, regarding the muscle strength test, the patient had impaired muscle strength especially in the hip abductors and ankle extensors.

3.5. Short term Plan

- Pain relief
- Release soft tissue
- Relaxation of hyper toned muscles
- Stretching of shortened muscles
- Strengthening of weakened muscles
- Increase range of motion
- Regain the physiological tone of hypo tone muscles
- Improve breathing pattern
- Unblock restricted joints
- Improve posture
- Optimize the diaphragmatic activation
- Improve of movement pattern stereotypes
- Regain the physiological sensation

3.6. Long term Plan

- Maintain the results achieved by the short term plan
- Reeducation of optimal posture , ADL activities and correct wrong habitual patterns
- Education of self-therapeutic techniques for home rehabilitation
- Improve gait quality

3.7. Therapy Proposal

- Spiral stabilization (Smíšek method)
- PNF strengthening technique by Kabat
- Conditioning exercises
- Passive stretching of shortened muscles
- Mobilization of restricted joints according to Lewit
- Post isometric relaxation of hyper toned muscles
- Soft tissue techniques at the lumbar region according to Lewit
- Facilitation and stimulation techniques using Kenny method
- Core and deep stabilization system activation through correction of breathing
- Electrostimulation
- Education of patient self-therapy technique

3.8. Therapy Progress

3.8.1 Session 1 on 15.01.2018

Subjective: pain described as tingling on both ankles but more in the left side.

Objective: the patient wasn't in a good mood, but he was motivated to exercise.

Goal of today's therapeutic unit:

- Mobilization of restricted joints (head of fibula , talocrural joint , Lisfranc and Chopart joints according to Lewit)
- Strengthening weakened muscles (gluteus medieus , gluteus minimus) by applying PNF strengthening techniques
- Fascia release of the lumbar region
- Facilitation of m. Tibialis anterior , m.Extensor hallucis longous
- Activation of the diaphragm through breathing integration
- Spinal stabilization of the spiral muscle chain (Smíšek method)
- Spinal exercise according to McKenzie
- Educate the patient more about his diagnosis

Description of today's therapeutic unit:

- The session was started with the joint mobilization of the head of fibula , talocrural joint , interphalangeal and metatarsophalangeal joints in both sides
- Electrostimulation for m.Tibialis anterior, m.Extensor hallucis longous. 30Hz, 10sec ON/ 10sec OFF, for 15 mins.
- Fascia release in the lumbar region in caudal and cranial direction according to Lewit
- PNF for weakened muscles (Gluteus medius and gluteus minimus) of the left lower extremity using the repeated contraction through the 1st extension diagonal
- Breathing exercise. The patient in prone with flexed knees and asked to maintain the ribs in caudal direction and breathe in from the abdominal region, resistance was given on the Transverse Abdominis for better activation of the core, while the patient breathes into the resistance.
- The patient was introduced to the spiralstablization technique. The patient was instructed to hold the elastic rope that is tied in a stable object, he will start in neutral position as instructed, the he tries to internally rotate the shoulders flex the head forward and increase the thoracic kyphosis, and go back as he externally rotate his shoulders the head should be in neutral position with the chin tucked, maintain the shoulders and ribs caudally and natural position of pelvic in standing. Repeat the sequence for 10 minuets
- Application of McKenzie exercise in prone position and the patient tries to extend the back , the movement should be only mechanical without exaggerated activation of back extensors
- Kenny method of m. Tibialis anterior , m. Extensor hallucis longous

Self-therapy:

- Repeating the spiral stabilization exercise at his room every 6 hours for 10 minutes

Result:

Subjective: the patient was wondering if the demonstrated exercises will help him to cure, he could not tolerate the spiralstabilization exercises in standing.

Objective: increase in the elasticity of the lumbar fascia, the patient is still finding difficulties to perform optimal activation of core muscles in breathing.

3.8.2 Session 2 on 16.01.2018

Subjective: the patient described the pain that is better during the day but it's worse at night and after waking up

Objective: the patient wasn't careful about his way of getting up from the bed or sitting. He was more cooperative with me to exercise.

Goal of today's therapeutic unit:

- Mobilization of restricted joints (head of fibula , talocrural joint , Lisfranc and Chopart joint according to Lewit)
- Strengthening weakened muscles (gluteus medieus , gluteus minimus , Tibialis anterior and Extensor halluces longus) by applying PNF strengthening techniques
- Fascia release of the lumbar region
- Activation of the diaphragm through breathing integration
- Spinal stabilization of the spiral muscle chain (Smíšek method)
- Spinal exercise according to McKenzie
- Educate the patient of the optimal way to sit and get up from the bed in a way that is better for his case

Description of today's therapeutic unit:

- The joints were less restricted (head of fibula, talocrural joint, Lisfranc and Chopart joint) in both sides.
- Fascia release in the lumbar region in caudal and cranial direction according to Lewit

- Breathing exercise. The patient in prone with flexed knees and asked to maintain the ribs in caudal direction and breathe in from the abdominal region, resistance was given on the Transverse Abdominis for better activation of the core, while the patient breathes into the resistance
- PNF for weakened muscles (Tibialis anterior and Extensor halluces longus) of the left lower extremity using the repeated contraction through the 1st flexion diagonal
- PNF for weakened muscles (Gluteus medius and gluteus minimus) of the left lower extremity using the repeated contraction through the 1st extension diagonal
- The patient was asked to demonstrate the spiralstabilzation exercises from the first session , he was still performing it in a poor quality , as he is still performing in uncoordinated movement
- Application of McKenzie as it was indicated by the doctor. Exercise in prone position and the patient tries to extend the back , the movement should be only mechanical without exaggerated activation of back extensors

Self-therapy:

- Repeating the spiral stabilization exercise at his room every 6 hours for 10x repetition

Result:

Objective: Increase of the elasticity of the lumbar fascia, increase the joint play of the restricted joints, the patient is still finding difficulties to perform optimal activation of core muscles in breathing

3.8.3 Session 3 on 17.01.2018

Subjective: pain scale from 1 to 10, 10 is being extremely painful the patient described the radiating pain as 4 out of 10.

Objective: the patient overall condition is improving psychologically as he is much more motivated to exercise and push himself and also physiologically in his quality of abduction movement this allows to applicate more of new challenging exercise. The movement was more controlled than it was in the initial examination.

Goal of today's therapeutic unit:

- Mobilization of restricted joints (head of fibula , talocrural joint , Lisfranc and Chopart joints according to Lewit)
- Strengthening weakened muscles (gluteus medieus , gluteus minimus) by applying
- PNF strengthening techniques
- Fascia release of the lumbar region
- Facilitation of m. Tibialis anterior , m. Hallucis longous
- Activation of the diaphragm through breathing integration
- Spinal stabilization of the spiral muscle chain (Smíšek method)
- Spinal exercise according to McKenzie
- Optimize the tonicity of the hypotoned muscles
- Educate the patient about the most common faulty habitual pattern and correct them

Description of today's therapeutic unit:

- The session began with the joint mobilization of the head of fibula, talocrural joint, interphalangeal and metatarsophalangeal joints in both sides.
- Electrostimulation for m.Tibialis anterior, m m.Extensor hallucis longous. 30Hz, 10sec ON/ 10sec OFF, for 15 mins.
- Fascia release in the lumbar region in caudal and cranial direction according to Lewit
- Breathing exercise. The patient in prone with flexed knees and asked to maintain the ribs in caudal direction and breathe in from the abdominal region, resistance was given on the Transverse Abdominis for better activation of the core, while the patient breathes into the resistance
- PNF for weakened muscles (Gluteus medius and gluteus minimus) of the left lower extremity using the repeated contraction through the 1st extension diagonal
- Repeating of the spiral stabilization exercises. The patient will hold the elastic rope that is tied in a stable object, he will start in neutral position as he was instructed, then he try to internally rotate the shoulders flex the head forward and increase the thoracic kyphosis, and go back as he externally rotate his shoulders the head should be in neutral

position with the chin tucked, maintain the shoulders and ribs caudally and neutral position of pelvic in sitting. And repeat the sequence for 10 minutes.

- Application of McKenzie exercise in prone position and the patient tries to extend the back, the movement should be only mechanical without exaggerated activation of back extensors.
- Kenny method of m. Tibialis anterior , m. Extensor hallucis longous
- Exercise for stabilization the pelvic and trunk and targeting the hypotoned m. Gluteus maximus. The patient was asked to be in supine position with both knees flexed. And to raise his pelvis and his back from the bed with squeezing his buttocks. This exercise was applied only for one set 10x repetitions.
- The patient was shown some common habitual faulty movements, such as reaching an object above the head is better to place one leg forward and prevent hyper extension of the back and also not to flex the back while washing the teeth on the sink but try instead to place one leg forward and keep the back straight [3].

Self-therapy:

- Repeating the spiral stabilization exercise at his room every 6 hours for 10x repetition
- Stretching of the shortened hamstrings holding onto a supportive or wall, place his right leg on a slightly raised surface, like a step. Keep his. Slowly bend his left knee until you feel a very mild pulling or stretch on the back of his right thigh. To stretch a little more, he was instructed to bend forward slightly at his hips, keeping the back straight. And then repeat the same sequence in the other leg.

Result:

Subjective: the patient claimed that he feels relief after the lumbar fascia releasing and also relief after the lumbar traction.

Objective: The joint mobility is much better now with better as more springing was added. Instructed for Self-therapy as the patient seem more motivated.

3.8.4 Session 4 on 18.01.2018

Subjective: The pain level is still as the previous session.

Objective: The patient was having a visit at the rest area, observed that he was sitting on the edge of the chair, supporting himself on the table with his forearms with flexed back which could cause too much tension on his low back.

Goal of today's therapeutic unit:

- Mobilization of restricted joints (head of fibula , talocrural joint , Lisfranc and Chopart joints)
- Strengthening weakened muscles (gluteus medieus , gluteus minimus , Tibialis anterior and Extensor halluces longus) by applying PNF strengthening techniques
- Active movements using the RedCord
- Fascia release of the lumbar region
- Activation of the diaphragm through breathing integration
- Spinal stabilization of the spiral muscle chain (Smíšek method)
- Spinal exercise according to McKenzie

Description of today's therapeutic unit:

- Joint mobilization of the head of fibula, talocrural joint, interphalangeal and metatarsophalangeal joints of both sides.
- Breathing exercise. The patient in prone with flexed knees and asked to maintain the ribs in caudal direction and breathe in from the abdominal region, resistance was given on the Transverse Abdominis for better activation of the core, while the patient breathes into the resistance.
- Repeating of the spiral stabilization exercises. The patient will hold the elastic rope that is tied in a stable object, he will start in neutral position as he was instructed, then he try to internally rotate the shoulders flex the head forward and increase the thoracic kyphosis, and go back as he externally rotate his shoulders the head should be in neutral position with the chin tucked, maintain the shoulders and ribs caudally and neutral position of pelvic in sitting. And repeat the sequence for 10 minutes.

- PNF for weakened muscles (Gluteus medius and gluteus minimus) of the left lower extremity using the repeated contraction through the 1st extension diagonal
- PNF for weakened muscles (Tibialis anterior and Extensor halluces longus) of the left lower extremity using the repeated contraction through the 1st flexion diagonal
- Application of McKenzie exercise in prone position and the patient tries to extend the back , the movement should be only mechanical without exaggerated activation of back extensors
- Exercise for stabilization the pelvic and trunk and targeting the hypotoned m. Gluteus maximus. The patient was asked to be in supine position with both knees flexed. And to raise his pelvis and his back from the bed with squeezing his buttocks. This exercise was applied only for one set 10x repetitions
- Using the redcord the patient performed hip abduction of both extremities , 2x sets for each extremity with 10x repetitions
- Another exercise the targets more the gluteal muscles. The patient is in prone his feet in dorsal flexion supported on the toes and he was asked to squeeze his buttocks to activate the gluteal muscles.

Self-therapy:

- Education for self-induced PIR for quadratus lumborum.
- Repeating the spiral stabilization exercise at his room every 6 hours for 10x repetition

Results of today's therapeutic unit:

Subjective: the patient claimed that the tingling sensation is felt less

Objective: better demonstrating of the spiralstabilization exercise, but there is much work to do regarding the breathing exercise as the patient still performing it without optimal coordination.

3.8.5 Session 5 on 19.01.2018

Subjective: The patient decided to undergo the surgery

Objective : Examination of the joint play and it was free therefore it was not included in the therapy session , as well as for the fascia release but it was still included in the session as the patient feels a relief after it.

Goal of today's therapeutic unit:

- Fascia release of the lumbar region
- Activation of the diaphragm through breathing integration
- Spinal stabilization of the spiral muscle chain (Smíšek method)
- Spinal exercise according to McKenzie
- Educate the patient about the contraindication after surgery

Description of today's therapeutic unit:

- Fascia release in the lumbar region in caudal and cranial direction according to Lewit
- Breathing exercise. The patient in prone with flexed knees and asked to maintain the ribs in caudal direction and breathe in from the abdominal region, resistance was given on the Transverse Abdominis for better activation of the core, while the patient breathes into the resistance
- Exercising the spiralstablization technique. The patient will hold the elastic rope that is tied in a stable object, he will start in neutral position as he was instructed, then he try to internally rotate the shoulders flex the head forward and increase the thoracic kyphosis, and go back as he externally rotate his shoulders the head should be in neutral position with the chin tucked, maintain the shoulders and ribs caudally and natural position of pelvic in sitting. Repeat the sequence for 10 minuets
- Application of McKenzie exercise in prone position and the patient tries to extend the back, the movement should be only mechanical without exaggerated activation of back extensors.

- The patient was instructed to not sit after the surgery and to not flex the trunk. He was instructed about the correct way how to get up from the bed after the surgery.

Self-therapy:

- The patient was asked to keep repeating the breathing exercise as he was instructed in the session

Result:

Subjective: The patient was satisfied with the previous sessions as the pain level decreased.

Objective: the lumbar fascia was examined and it was less restricted compering with the first session, the patient's strength is not yet optimal. Patient's overall condition was improving session after session.

3.9. Kinesiological examination Post Surgery

3.9.1. Postural Examination

- **Anterior view :**

· Narrow base of support

· Optimal feet arches

· No valgusity or varusity of the knee joint

· Left patella is higher than the right patella

· Symmetrical pelvic position

· Thorachbrachial angle is bigger on the left side

· Right nipple is slightly higher the left nipple while the left one slightly placed laterally

· Prominent lower ribs

· Prominent collarbones in both sides

· Symmetrical height of shoulders

· Optimal position of the head from this view

- **Lateral view**

Right side

· Optimal position of the ankle joint

· Slight knee flexion

· Slight increased anteversion of the pelvic

· Slight increased lordosis with flat L/Th and neutral kyphosis of Th spine

· Very slight shoulder protraction

· Forwarded holding of the head

Left side

· Optimal position of the ankle joint

· Slight knee flexion

· Slight increased anteversion of the pelvic

· Slight increased lordosis with flat L/Th and neutral kyphosis of Th spine

· Very slight shoulder protraction

· Forwarded holding of the head

- **Posterior view**

· Narrow base of support

· Symmetrical contour of the malleolus

· Symmetrical thickness of the Achilles tendon

· Optimal position of the ankle joint (no supination or pronation)

· Asymmetry of popliteal line

· No varusity or valgusity of both knees

· Symmetrical gluteal maximus muscles in shape

· Thorachobrachial angle is bigger on the left side

· 4cm scar at the lumbar spine

· The pelvic is symmetrical

· Prominent paravertebral muscles of the lumbar region

· Prominent paravertebral muscles of the thoracic region

· Asymmetry of scapula height as the medial border of the left scapula is slightly higher.

3.9.2. Dynamic Spine Examination

Extension
The patient performed the movement with minimal ROM
Lateral flexion
To the right : minimal ROM without occurrence of the curve
To the left : minimal ROM without occurrence of the curve

Table 19 Dynamic Spine after surgery

3.9.3. Gait Examination

The patient performed the gait without any helping aids. Very narrow base of support and same angle between the feet, he performed it with optimal speed with longer steps, the movement of the feet was impaired, and the heel strike was minimal as the patient is now trying to make dorsi flexion of the ankle. No flat foot or valgusity or varusity was detected in knee and ankle. Minimal movement of the pelvic , the trunk remained in the ideal position no latero-flexion or rotation were absorbed , slight protraction of the head no excessive movement of the head was absorbed , the walking was stable without loss of balance . Walking backward was performed with the absent of hip extension compensated with slight leaning forward the trunk and exaggerated knee flexion , he was not able to perform neither the walking in tip toes nor the walking in heels , the patient's squat position wasn't optimal to perform walking in squat.

3.9.4. Balance & Perception Tests

- Romberg I, II, III were all negative
- The patient couldn't stand on heels
- Standing on tiptoes was performed in poor quality as the patient couldn't hold the position for so long.
- Trendelenburg was positive in both sides as the patient's pelvic dropped as soon as he lifted his leg.

3.9.5. Breathing Assessment

Standing the patient was using mostly the costal breathing from his upper thoracic region. Supine position the patient also was using the upper thoracic breathing.

3.9.6. Anthropometric Measurements of Lower Extremities

Right		Left
86cm	**The length of whole lower extremity (Anatomical)**	86cm
91cm	**The length of whole lower extremity (functional)**	91cm
45cm	**The length of the thigh**	45cm
36cm	**The length of the middle leg**	36cm
23.5cm	**The length of the foot**	23cm
49cm	**The circumference of the thigh 15cm above the patella**	49cm
46cm	**The circumference of the thigh 10cm above the patella**	46cm
35cm	**The circumference of the knee joint**	34.5cm
34cm	**The circumference of the calf**	33cm
24cm	**The circumference of the ankle**	24cm
23cm	**The circumference of the foot**	23cm

Table 20 Anthropometric after surgery

3.9.7. Movement Stereotype Examination according to Janda

Movement	Observation
Hip extension	Faulty movement bilaterally .There was a delay of the activation of gluteal muscles with maximal activation of the lumbar paravertebral muscles
Hip abduction	Faulty movement bilaterally. The patient did not start the movement with flexion of the knee as he did before the surgery , he couldn't demonstrate a fluent movement as he was not able to abduct his leg to the full ROM

Table 21 Movement Stereotype after surgery

3.9.8. Range of Motion Examination

** Plastic goniometer was used to examine the ROM of joints*

ACTIVE			
MOVEMENT	RIGHT	JOINT	LEFT
FLX - EXT	**S: 10 – 0 – 55**	**HIP JOINT**	**S: 10 – 0 – 45**
ABD – ADD	**F: 15 – 0 – 30**		**F: 10– 0 – 30**
IR – ER	**T: 40 – 0 – 30**		**T: 40 – 0 – 30**
FLX – EXT	**S: 0 – 0 – 125**	**KNEE JOINT**	**S: 0 – 0 – 120**
PFLX - DFLX	**S : 20 – 0 – 40**	**ANKLE JOINT**	**S : 10 – 0 – 30**
INV – EVE	**R : 10 – 0 - 25**		**R : 5 – 0 - 20**

Table 22 Active ROM after surgery

PASSIVE			
MOVEMENT	RIGHT	JOINT	LEFT
FLX - EXT	**S: 20 – 0 – 70**	**HIP JOINT**	**S: 20 – 0 – 70**
ABD – ADD	**F: 30 – 0 – 30**		**F: 30– 0 – 30**
IR – ER	**T: 45 – 0 – 35**		**T: 45 – 0 – 30**
FLX – EXT	**S: 0 – 0 – 140**	**KNEE JOINT**	**S: 0 – 0 – 135**
PFLX - DFLX	**S : 25 – 0 – 60**	**ANKLE JOINT**	**S : 20 – 0 – 40**
INV – EVE	**R : 15 – 0 - 30**		**R : 15 – 0 - 25**

Table 23 Passive ROM after surgery

3.9.9. Muscle Length Examination according to Janda

- Grade 0 – no shortness
- Grade 1 – slight / moderate shortness
- Grade 2 – marked shortness

RIGHT	MUSCLE	LEFT
Grade 0	**Gastrocnemius and plantaris**	Grade 0
Grade 0	**Soleus , popliteus**	Grade 0
Grade 1	**Adductors**	Grade 1
Grade 1	**Hamstrings**	Grade 1
	Pectoralis major:	
Grade 1	**-Sternal part**	Grade 1
Grade 1	**-Clavicular part**	Grade 1
Grade 1	**Pectoralis minor**	Grade 1
Grade 1	**Trapezius**	Grade1
Grade 1	**Levator scapulae**	Grade 1
Grade 1	**Sternocleidomastoid**	Grade 1
Grade 1	**Scalene**	Grade 0

Table 24 Muscle Length after surgery

3.9.10. Muscle Strength Examination according Kendall

- Grade 0: No Contraction of the muscle.
- Grade 1: Contraction of the muscle felt but no movement seen.
- Grade 2: Position in horizontal plane with gravity.
- Grade 3: Against gravity.
- Grade 4: Against gravity with moderate resistance given.
- Grade 5: Against gravity with maximum resistance given.

Right	Peripheral innervation		Muscle	Segmental innervation								Left
				L1	L2	L3	L4	L5	S1	S2	S3	
-4	Gluteal	inf	Gluteus Maximus					•	•	•		-4
+3		sup	Gluteus Medius				•	•	•			+3
+3			Gluteus minimus				•	•	•			+3
+3			Tensor Fascia latae				•	•	•			+3
4	Lumb. plexus		Iliopsaos	•	•	•	•					4
4			Quadratus lumborum	•	•	•						4
5	Obturator		Adductors		•	•	•					5
5	Femoral		Quadratus femoris		•	•	•					5
+4	Sciatic		Biceps femoris					•	•	•	•	+4
+4			Semitendinosus , semimembranosus				•	•	•	•		+4
+3	common peroneal	Deep	Tibialis Anterior				•	•	•			+3
+3			Extensor Hallucis longous				•	•	•			+3
-3			Peroneus Tertius				•	•	•			-3
-3		SF	Peroneus Longous				•	•	•			-3
-3			Peroneus Brevis				•	•	•			-3
4	Tibial		Tibialis posterior				•	•	•			4
4			Gastrocnemius						•	•		4
4			Soleus					•	•	•		4
4			Flexor hallucis longous					•	•	•		4
4			Flexor hallucis brevis				•	•	•			4
3			Plantar interossei						•	•		3
3			Dorsal interossei						•	•		3

Table 25 Muscle Strength after surgery

3.9.11. Muscle Tone Palpation

Right			Muscle		Left		
Tonus	**Pain**	**Trigger points**			**Trigger points**	**Pain**	**Tonus**
Hypetone	Slight pain	Present	Trapezius	Upper	Present	Slight pain	Hypetone
Physiological	No pain	Present		Middle	Present	No pain	Physiological
Physiological	No pain	Absent		Lower	Absent	No pain	Physiological
Hypetone	No pain	Absent	Pec. Major	Clavicular	Absent	No pain	Hypetone
Hypetone	No pain	Absent		Sternal	Absent	No pain	Hypetone
Hypetone	No pain	Absent		Abdominal	Absent	No pain	Hypetone
Physiological	No pain	Absent	Sternocleidomastoid		Absent	No pain	Physiological
Physiological	No pain	Absent	Levator scapula		Absent	No pain	Physiological
Physiological	No pain	Absent	Pec minor		Absent	No pain	Physiological
Physiological	No pain	Absent	Rectus abdominis		Absent	No pain	Physiological
Physiological	No pain	Absent	Erector spinae	Thoracic	Absent	No pain	Physiological
Physiological	No pain	Absent		Lumbar	Absent	No pain	Physiological
Hypetone	No pain	Absent	Quadratus lumborum		Absent	No pain	Hypetone
Hypotone	No pain	Absent	Gluteus maximus		Absent	No pain	Hypotone
Hypotone	No pain	Absent	Gluteus medius		Absent	No pain	Hypotone
Physiological	Slight pain	Absent	Piriformis		Absent	Slight pain	Physiological
Physiological	Slight pain	Absent	Iliopsaos		Absent	Slight pain	Physiological
Physiological	No pain	Absent	Vastus medialis		Absent	No pain	Physiological
Physiological	No pain	Absent	Vastus lateralis		Absent	No pain	Physiological
Physiological	No pain	Absent	Hamstrings		Absent	No pain	Physiological
Physiological	No pain	Absent	Gastrocnemius		Absent	No pain	Physiological
Physiological	No pain	Absent	Soleus		Absent	No pain	Physiological
Physiological	No pain	Absent	Tibialis anterior		Absent	No pain	Physiological

Table 26 Muscle tone after surgery

3.9.12. Scar Examination

The length of scar was measured: four (4) cm.

The scar was still covered, the skin around the scar was slightly swollen.

3.9.13. Joint Play Examination of Lower Extremities

RIGHT	JOINT	LEFT
No blockage	**Patella caudal direction**	No blockage
No blockage	**Patella cranial direction**	No blockage
No blockage	**Patella medial direction**	No blockage
No blockage	**Patella lateral direction**	No blockage
Blocked	**Tibiofibular joint dorsal direction**	No blockage
Blocked	**Tibiofibular joint ventral direction**	No blockage
No blockage	**Talocrural joint**	No blockage
No blockage	**Lisfranc joint**	No blockage
No blockage	**Chopart joint**	No blockage

Table 27 Joint play after surgery

3.9.14. Neurological Examination

Superficial Sensation :
L4 :both sides had normal physiological and equal sensation
L5: both sides had normal physiological and equal sensation
L6 :both sides had normal physiological and equal sensation

Table 28 Superficial Sensation after surgery

Deep Sensation :
With the patient eyes closed he was asked if he could feel the touch in his ventral aspect of both feet, he could feel the pain while slightly pricking his both feet with sharp object. Kinesthesia was negative as the patient could describe the motion when applied to his big toe in both extremities, Joint position sense was also negative as his big toe was flexed and he was asked to do the same movement in the contralateral extremity. The patient managed to distinguish the two-point discrimination in the left and right lower extremities. Graphesthesia the result was negative as the patient was able to distinguish the numbers drawn on his both feet.

Table 29 Deep Sensation after surgery

Tendon Reflex :
For the Patellar reflex , the patient had the same physiological reflexes in both tendons left and right
For the Achilles tendon reflex the patient also had the same physiological reflex in both tendons
For the Medioplanter reflex the patient had the same physiological reflex in both extremities

Table 30 Tendon reflex after surgery

3.9.15. Postural Stabilization & Postural reactivity Examination according to Kolář

Extension test :
The patient demonstrated the movement poorly , as there was significant activation of paravertebral muscles , there was no activation of the lateral group of abdominal muscles, there was no activation of the gluteal muscles with external rotation of the inferior angle of the both scapula
Diaphragm test :
The patient couldn't activate his diaphragm physiologically the patient wasn't optimally activating the muscle against resistance but he was able to maintain his ribs in caudal direction

Table 31 Postural Examination after surgery

3.10. Conclusion of examination after surgery

After surgery there was improvement in different areas, but there is a lot of progression to achieve. The patent report post-surgery shows that he also had stenosis of L5 that was not mentioned in his initial report.

The post-surgery kinesiological examinations concluded the following. The paravertebral muscles at the lumbar region are less prominent than it was before the surgery. The quality of the patient's gait has improved as now he is more aware of the dorsi flexion of the ankle. Slight increase of the ROM of the hip joint. The patient's superficial sensation of L5 has improved resulting of him having symmetrical physiological sensation in both lower extremities and optimal deep sensation. Restricted head of fibula on the right side only. The patient failed to demonstrate the standing on heels, but was able to stand on tiptoes but not for so long, the Trendelenburg test was positive in both sides. While assessing the diaphragm test according to Kolář the patient has improved but still lack of optimal activation of the diaphragm. Regarding the muscle length, there was improvement of the length of the hamstrings. For muscle palpation the patient has better but not physiological tone of the gluteus maximums. Further regard to the muscle strength the patient did not have marked improvement in the hip abductors or the ankle extensors.

3.11. Therapy sessions after surgery

3.11.1 Session 6 on 31.01.2018

Subjective: The patient was satisfied with the surgery and motivated for the therapy, the patient mentioned that the tingling at his ankles sensation is less in both sides.

Objective: The patient is aware of the virtualization, he needed assistant to take of his trouser, and the scar was still covered

Goal of today's therapeutic unit:

- Soft tissue of techniques around the scar
- Activation of the diaphragm through breathing integration
- Spinal stabilization of the spiral muscle chain (Smíšek method)
- Stretching of shortened muscles (Trapezius upper part , pectoralis major)

Description of today's therapeutic unit:

- Soft tissue techniques on the lumbar region and around the scar using the soft ball
- Breathing exercise. The patient in prone with flexed knees and asked to maintain the ribs in caudal direction and breathe in from the abdominal region, he was asked to push away against the restriction in the area of Transverse abdominis for better activation of the core.
- Exercising the spiralstablization technique. The patient will hold the elastic rope that is tied in a stable object, he will start in neutral position as instructed him, the he try to internally rotate the shoulders flex the head forward and increase the thoracic kyphosis, and go back as he externally rotate his shoulders the head should be in neutral position with the chin tucked, maintain the shoulders and ribs caudally and neutral position of pelvic in standing. Repeat the sequence for 10 minuets
- Passive stretching of trapezius upper part and m.Pectoralis major

Self-Therapy

- Iliopsoas stretch, in a lunge position with. Using something for cushioning like a blanket or a pillow. Then he should squeeze the glute. The patient should stabilize the pelvic with the core musculature and prevent it to anteriorly tilt.
- Stand facing a wall. Place his right palm on the wall, and flex the right knee and lean forward to feel the stretch, adjust the palm position to target different muscle fibers.

Result of today's therapeutic unit:

Subjective: the exercises were tolerable by the patient.

Objective: better coordination while performing the breathing exercise as well as for the spiral stabilization.

3.11.2 Session 7 on 02.02.2018

Subjective: the patient claimed that there's remarkable decrease of pain compering with three weeks ago

Objective: The patient strength is still not improved especially for the abductors, but he has better activation of the diaphragm

Goal of today's therapeutic unit:

- Fascia release of the lumbar region
- Activation of the diaphragm through breathing integration
- Spinal stabilization of the spiral muscle chain (Smíšek method)
- Joint mobilization
- Educate the patient about the ergonomics at his work

Description of today's therapeutic unit:

- Mobilization of restricted joints examined after surgery (head of fibula in ventral and dorsal direction)
- Soft tissue techniques on the lumbar region and around the scar using the soft ball
- Breathing exercise. The patient in prone with flexed knees and asked to maintain the ribs in caudal direction and breath in from the abdominal region , to increase the difficulty of the breathing exercise, asked the patient to hold the gymnastic ball between his feet with flexed hip while keeping the optimal position of ribs and pelvic.
- Repeating and controlling of spiral stabilization method as the previous sessions
- Instructed the patient some possible faulty movements that could occur in his working environment , such as reaching a drawer cabinet that is next to him , he shouldn't rotate only the trunk to reach it but move the whole body to face the drawer cabinet, the patient was instructed of the correct way to stand up from the chair which is to flex the knees over 90 degrees and shift the trunk forward then stand up, general instructions of working with computers ergonomics , of the

correct way to sit on chair while keeping the neutral curvature of the spine and place the office devices [3].

- Since the patient will be able to sit in one week he was instructed him not to sit on the sofas that drive the hip into more than 90 degree flexion because that will change the position of the pelvic and exert pressure on the spine [3]

Result of today's therapeutic unit:

Subjective: The patient is satisfied with the therapy sessions he had. He is looking forward to complete his rehabilitation plan.

Objective: This was the last session with the patient where the final examination that showed improvement, but not at every targeted goal.

3.12. Final Kinesiological Examination

3.12.1. Postural Examination

- **Anterior view** :
    - Optimal base of support
    - Optimal feet arches
    - No valgusity or varusity of the knee joint
    - Left patella is higher than the right patella
    - Symmetrical pelvic position
    - Thorachbrachial angle is bigger on the left side
    - Right nipple is slightly higher the left nipple while the left one slightly placed laterally
    - Prominent lower ribs
    - Prominent collarbones in both sides
    - Symmetrical height of shoulders
    - Optimal position of the head from this view

- **Lateral view**

Right side

- Optimal position of the ankle joint
- Slight increased ante version of the pelvic
- Slight increased lordosis with flat L/Th and neutral kyphosis of Th spine
- Optimal shoulder position
- Forwarded holding of the head

Left side

- Optimal position of the ankle joint
- Slight increased ante version of the pelvic
- Slight increased lordosis with flat L/Th and neutral kyphosis of Th spine
- Optimal shoulder position
- Forwarded holding of the head

- **Posterior view**
  - Optimal base of support
  - Symmetrical contour of the malleolus
  - Symmetrical thickness of the Achilles tendon
  - Optimal position of the ankle joint (no supination or pronation)
  - Asymmetry of popliteal line
  - No varusity or valgusity of both knees
  - Symmetrical gluteal maximus muscles in shape
  - Thorachbrachial angle is bigger on the left side
  - Four cm scar at the lumbar spine
  - The pelvic is symmetrical by aspection
  - Prominent paravertebral muscles of the lumbar region
  - Prominent paravertebral muscles of the thoracic region
  - Asymmetry of scapula height as the medial border of the left scapula is slightly higher.

3.12.2. Dynamic Spine Examination

Extension
The patient performed the movement with poor fluency , without pain
Lateral flexion
To the right : the curve mainly occur on the thoracic region
To the left : the curve mainly occur on the thoracic region

Table 32 Final Dynamic Spine

3.12.3. Spinal Distances

Thomayer's distance: positive. The patient was asked to bend forward carefully to measure the distance between his finger tips and the floor which was 21 cm
Shober's distance: positive less than 1cm was measured
Stibor's distance : positive 2cm were measured
Lateral flexion : to the right 17 cm , to the left 18

Table 33 Final Spine Distance

3.12.4. Gait Examination

The patient performed the gait without any helping aids. Optimal base of support, he performed it with optimal speed with longer steps, the movement of the feet was impaired, better activation of the m.tibialis anterior as the patient is able to perform minimal dorsi flexion, and the walking was stable without loss of balance. Walking backward was demonstrated, it was performed with minimal activation of hip extension, and he was not able to perform neither the walking in tip toes nor the walking in heels.

3.12.5. Balance & Perception Tests

- **Romberg I,II,III** were all negative
- **Standing on heels** the patient couldn't stand on his heels
- **Standing on tiptoes** was performed in poor quality as the patient couldn't hold the position for so long
- **Trendelenburg** was positive in both sides as the patient's pelvic dropped as soon as he lifted his leg

3.12.6. Breathing Assessment

In standing although, the patient was using mostly the costal breathing from his upper thoracic region, the patient was slightly using the diaphragmatic breathing as he is able to activate his abdominal muscles. In supine position the patient was using the upper thoracic breathing.

3.12.7. Anthropometric Measurements of Lower Extremities

Right		Left
86cm	**The length of whole lower extremity (anatomical)**	86cm
91cm	**The length of whole lower extremity (functional)**	91cm
45cm	**The length of the thigh**	45cm
36cm	**The length of the middle leg**	36cm
23.5cm	**The length of the foot**	23cm
49cm	**The circumference of the thigh 15cm above the patella**	49cm
46cm	**The circumference of the thigh 10cm above the patella**	46cm
35cm	**The circumference of the knee joint**	34.5cm
34cm	**The circumference of the calf**	33cm
24cm	**The circumference of the ankle**	24cm
23cm	**The circumference of the foot**	23cm

Table 34 Final Anthropometric

3.12.8. Movement Stereotype Examination according to Janda

Movement	Observation
Hip extension	Faulty movement bilaterally .There was a delay of the activation of gluteal muscles with maximal activation of the lumbar paravertebral muscles
Hip abduction	Faulty movement bilaterally. The patient did not start the movement with flexion of the knee as he did before the surgery , he couldn't demonstrate a fluent movement as he was not able to abduct his leg to the full ROM

Table 35 Final Stereotype

3.12.9. Range of Motion Examination

** Plastic goniometer was used to examine the ROM of joints*

ACTIVE			
MOVEMENT	RIGHT	JOINT	LEFT
FLX - EXT	**S: 10 – 0 – 55**	**HIP JOINT**	**S: 10 – 0 – 45**
ABD – ADD	**F: 15 – 0 – 30**		**F: 10– 0 – 30**
IR – ER	**T: 40 – 0 – 30**		**T: 40 – 0 – 30**
FLX – EXT	**S: 0 – 0 – 125**	**KNEE JOINT**	**S: 0 – 0 – 120**
PFLX - DFLX	**S : 20 – 0 – 40**	**ANKLE JOINT**	**S : 10 – 0 – 30**
INV – EVE	**R : 10 – 0 - 25**		**R : 5 – 0 - 20**

Table 36 Final Active ROM

PASSIVE			
MOVEMENT	RIGHT	JOINT	LEFT
FLX - EXT	**S: 20 – 0 – 70**	**HIP JOINT**	**S: 20 – 0 – 70**
ABD – ADD	**F: 30 – 0 – 30**		**F: 30– 0 – 30**
IR – ER	**T: 45 – 0 – 35**		**T: 45 – 0 – 30**
FLX – EXT	**S: 0 – 0 – 140**	**KNEE JOINT**	**S: 0 – 0 – 135**
PFLX - DFLX	**S : 25 – 0 – 60**	**ANKLE JOINT**	**S : 20 – 0 – 40**
INV – EVE	**R : 15 – 0 - 30**		**R : 15 – 0 - 25**

Table 37 Final Passive ROM

3.12.10. Muscle Length Examination according to Janda

- Grade 0 – no shortness
- Grade 1 – slight / moderate shortness
- Grade 2 – marked shortness

RIGHT	MUSCLE	LEFT
Grade 0	**Gastrocnemius and plantaris**	Grade 0
Grade 0	**Soleus , popliteus**	Grade 0
Grade 1	**Adductors**	Grade 1
Grade 1	**Hamstrings**	Grade 1
	Pectoralis major:	
Grade 1	**-Sternal part**	Grade 1
Grade 1	**-Clavicular part**	Grade 1
Grade 1	**Pectoralis minor**	Grade 1
Grade 1	**Trapezius**	Grade1
Grade 1	**Levator scapulae**	Grade 1
Grade 1	**Sternocleidomastoid**	Grade 1
Grade 1	**Scalene**	Grade 0

Table 38 Final Muscle Length

3.12.11. Muscle Strength Examination according Janda

- Grade 0: No Contraction of the muscle.
- Grade 1: Contraction of the muscle felt but no movement seen.
- Grade 2: Position in horizontal plane with gravity.
- Grade 3: Against gravity.
- Grade 4: Against gravity with moderate resistance given.
- Grade 5: Against gravity with maximum resistance given.

Right	Peripheral innervation		Muscle	Segmental Innervation								Left
				L1	L2	L3	L4	L5	S1	S2	S3	
-4	Gluteal	inf	Gluteus Maximus					•	•	•		-4
+3		sup	Gluteus Medius				•	•	•			+3
+3			Gluteus minimus				•	•	•			+3
+3			Tensor Fascia latae				•	•	•			+3
4	Lumb. plexus		Iliopsaos	•	•	•	•					4
4			Quadratus lumborum	•	•	•						4
5	Obturator		Adductors		•	•	•					5
5	Femoral		Quadratus femoris		•	•	•					5
+4	Sciatic		Biceps femoris					•	•	•	•	+4
+4			Semitendinosus , semimembranosus				•	•	•	•		+4
+3	common peroneal	Deep	Tibialis Anterior				•	•	•			+3
+3			Extensor Hallucis longous				•	•	•			+3
-3			Peroneus Tertius				•	•	•			-3
-3		SF	Peroneus Longous				•	•	•			-3
-3			Peroneus Brevis				•	•	•			-3
4	Tibial		Tibialis posterior				•	•	•			4
4			Gastrocnemius						•	•		4
4			Soleus					•	•	•		4
4			Flexor hallucis longous					•	•	•		4
4			Flexor hallucis brevis				•	•	•			4
4			Plantar interossei						•	•		4
4			Dorsal interossei						•	•		4

Table 39 Final Muscle Strength

3.12.12. Muscle Tone Palpation

Right			Muscle		Left		
Tonus	**Pain**	**Trigger points**			**Trigger points**	**Pain**	**Tonus**
Physiological	No pain	Present	Trapezius	Upper	Present	No pain	Physiological
Physiological	No pain	Present		Middle	Present	No pain	Physiological
Physiological	No pain	Absent		Lower	Absent	No pain	Physiological
Hypetone	No pain	Absent	Pec. Major	Clavicular	Absent	No pain	Hypetone
Hypetone	No pain	Absent		Sternal	Absent	No pain	Hypetone
Hypetone	No pain	Absent		Abdominal	Absent	No pain	Hypetone
Physiological	No pain	Absent	Sternocleidomastoid		Absent	No pain	Physiological
Physiological	No pain	Absent	Levator scapula		Absent	No pain	Physiological
Physiological	No pain	Absent	Pec minor		Absent	No pain	Physiological
Physiological	No pain	Absent	Rectus abdominis		Absent	No pain	Physiological
Physiological	No pain	Absent	Erector spinae	Thoracic	Absent	No pain	Physiological
Physiological	No pain	Absent		Lumbar	Absent	No pain	Physiological
Hypetone	No pain	Absent	Quadratus lumborum		Absent	No pain	Hypetone
Hypotone	No pain	Absent	Gluteus maximus		Absent	No pain	Hypotone
Hypotone	No pain	Absent	Gluteus medius		Absent	No pain	Hypotone
Physiological	Slight pain	Absent	Piriformis		Absent	Slight pain	Physiological
Physiological	Slight pain	Absent	Iliopsaos		Absent	Slight pain	Physiological
Physiological	No pain	Absent	Vastus medialis		Absent	No pain	Physiological
Physiological	No pain	Absent	Vastus lateralis		Absent	No pain	Physiological
Physiological	No pain	Absent	Hamstrings		Absent	No pain	Physiological
Physiological	No pain	Absent	Gastrocnemius		Absent	No pain	Physiological
Physiological	No pain	Absent	Soleus		Absent	No pain	Physiological
Physiological	No pain	Absent	Tibialis anterior		Absent	No pain	Physiological

Table 40 Final Muscle tone

3.12.13. Scar Examination

The length of scar was measured: four (4) cm.

The stitches were still not removed, the skin around the scar was slightly swollen. It wasn't painful on palpating

3.12.14. Joint Play Examination of Lower Extremities

RIGHT	JOINT	LEFT
No blockage	**Patella caudal direction**	No blockage
No blockage	**Patella cranial direction**	No blockage
No blockage	**Patella medial direction**	No blockage
No blockage	**Patella lateral direction**	No blockage
Blocked	**Tibiofibular joint dorsal direction**	No blockage
Blocked	**Tibiofibular joint ventral direction**	No blockage
No blockage	**Talocrural joint**	No blockage
No blockage	**Lisfranc joint**	No blockage
No blockage	**Chopart joint**	No blockage

Table 41 Final Joint Play

3.12.15. Subcutaneous Tissues & Fascia Examination according to Lewit

There were no restriction the caudal and cranial direction of the lumbar region.

3.12.16. Neurological Examination

Superficial Sensation :
L4 :both sides had normal physiological and equal sensation
L5: both sides had normal physiological and equal sensation
L6 :both sides had normal physiological and equal sensation

Table 42 Final Superficial Sensation

Deep Sensation :
With the patient eyes closed he was asked if he could feel the touch in his ventral aspect of both feet, he could feel the pain while slightly pricking his both feet with sharp object. Kinesthesia was negative as the patient could describe the motion that was applied to his big toe on both extremities. Joint position sense was also negative as the big too was flexed and he was asked to do the same movement in the contralateral extremity, the patient managed to distinguish the two-point discrimination in the left and right lower extremities. Graphesthesia result was negative as the patient was able to distinguish the numbers drawn on his both feet

Table 43 Final Deep Sensation

Tendon Reflex :
For the Patellar reflex , the patient had the same physiological reflexes in both tendons left and right
For the Achilles tendon reflex the patient also had the same physiological reflex in both tendons
For the Medioplanter reflex the patient had the same physiological reflex in both extremities

Table 44 Final Tendon Reflex

3.12.17. Postural Stabilization & Postural reactivity Examination according to Kolář

Extension test :
The patient demonstrated the movement poorly , as there was significant activation of paravertebral muscles , there was no activation of the lateral group of abdominal muscles, there was no activation of the gluteal muscles with external rotation of the inferior angle of the both scapula
Diaphragm test :
The patient couldn't activate his diaphragm physiologically the patient wasn't optimally activating the muscle against resistance but he was able to maintain his ribs in caudal direction

Table 45 Final Postural Examination

3.13 Conclusion of Final Examination

The patient displayed improvement in the objective as well as subjective factors of his condition. Specifically, the muscle strength of ankle extensors has improved, so has the possibility of execution of movement like heel gait. Additionally, the breathing coordination has improved with still yet a lot of progression to achieve, also posture has shown improvement.

Improved bilateral muscle tone of the gluteus maximus as well as restored physiological tonus of the upper trapezius. Fascia mobility of the low has markedly improved.

From the early stage in the therapy, pain and radicular symptoms showed excellent response to the combination of techniques applied.

Finally, perhaps the most important, significant increase has occurred in his performance and understanding of the correct ergonomics and mechanics of posture and standing up from sitting position. The integration of core stability and limb movement which requires not only deep musculature activity, but also spatial orientation and understanding of one's own body has increased dramatically on this patient.

4. Evaluation

4.1The Effect of Therapy

Examination	Initial examination	Final examination
Posture	Marked narrow base of support. Slight knee flexion. slight shoulder protraction	Optimal base of support. Optimal position of knee joint. optimal position of shoulder joint
Gait	Very narrow base of support. Absent of heel strike.	Optimal base of support. minor present of heel strike
Fascia examination	Restriction on the caudal and cranial direction	physiological elasticity of lumbar fascia
Muscle strength test	Tibialis anterior bilateral weakness grade -3.	Tibialis anterior bilateral weakness grade +3.
	Extensor Hallucis longus bilateral weakness grade -3.	Extensor hallucis longus bilateral weakness grade +3.
	plantar and dorsal interossei bilateral weakness grade 3	plantar and dorsal interossei bilateral weakness grade 4
Muscle length test	Bilateral shortness of hamstrings grade 2	Bilateral shortness of hamstrings grade 1
Muscle palpation	Present trigger points of upper trapezius	Absent trigger points of upper trapezius
Neurological examination	Impaired superficial sensation of L5 , less sensation of the left extremity	Symmetrical physiological superficial sensation of both sides
	Positive two joint discrimination	Negative two joint discrimination
	Positive Graphesthesia	Negative Graphesthesia

Table 46 Initial & Final Examination Comparison

5. Case Study Conclusion

Patient was suspected with disc herniation when he visited the physician the first time due to the symptoms he had and that what was conformed in the MRI he did.

Overall, it was an extremely interesting to know more about the etiology of disc herniation and the different physiotherapeutic approaches related to the diagnosis. The patient had five physiotherapy sessions before the surgery until the neurologist decided that the patient should undergo the surgery. I got the chance to work with the patient after the surgery as well.

I would like to thank the patient who was privilege to work and cooperate with me. His motivation gave the confidence to carry on the therapy sessions aiming for the best possible results.

It was a great experience to get the chance to apply the knowledge that I gained throughout my three years of studies at the faculty.

I also would like to thank Bc. Tomáš Modlinger who shared a lot of his knowledge with me during the two weeks of practice.

6. Bibliography

6.1 Literature References

[1] White, A. and Panjabi, M. (1990). *Clinical biomechanics of the spine*. Philadelphia: J. B. Lippincott

[2] Richardson, C., Hodges, P. and Hides, J. (2015). *Therapeutic exercise for lumbopelvic stabilisation*. Johanneshov: MTM.

[3] McKeown, C. (2008). *Office ergonomics*. Boca Raton, FL: CRC Press.

[4] Durrant, D. and True, J. (2012). *Myelopathy, radiculopathy, and peripheral entrapment syndromes*. Palm City, Fla.: Scholars Consortium.

[5] Kerr, D. (2012). *Local infiltration analgesia*. London: Informa Healthcare.

[6] Cooper, G. (2015). *Non-Operative Treatment of the Lumbar Spine*. Cham: Springer International Publishing.

[7] Schünke, M., Schulte, E. and Schumacher, U. (n.d.). *Thieme atlas of anatomy.*

[8] Lewit, K. (2010). *Manipulative therapy*. Edinburgh: Elsevier/Churchill Livingstone.

[9] Dawson, E. (2012, July 7). Herniated Discs: Definition, Progression, and Diagnosis. *Spine Universe.* Retrieved March 11, 2018 from http://www.spineuniverse.com/conditions/herniated-disc/herniated-discs-definition-progression-diagnosis

[10] Kendall, F. *Muscle testing and function with posture and pain*. Lippincott Williams.

[11] Kolář, P. (2013). *Clinical rehabilitation*. Prague: Rehabilitation Prague School.

[12] Perry, M. (2014). Lumbar disc protrusion. *Laser Spine Institute*. Retrieved March 11, 2018 from https://www.laserspineinstitute.com/back_problems/disc_protrusion/lumbar/

[13] Porter, S. (2008). *Tidy's physiotherapy* (14th Ed.). Edinburgh: Churchill Livingstone/Elsevier

[14] Neuman, D. (2009*). Kinesiology of musculoskeletal system, foundations of rehabilitation* (2nd Ed).Mosby Elsevier

[15] Caspar, W., Campbell, B., Baerbier, D.D. et al. (1991). The Caspar microsurgical discectomy and comparison with a conventional standard lumbar disc procedure.' *Neurosurgery*, 28, pp. 78–87.

[16] Li-Yang, D. et al. (2004) Recurrent lumbar disc herniation after discectomy: outcome of repeat discectomy'. *Surgical Neurology*, 64, pp. 226–231.

[17] Cele E., Johansson A.C., Filiz M. Disc herniation. *Physio-pedia*. Retrieved March 15.2018, form http://www.physiopedia.com/Disc_Herniaton#cite_note-McGill-0.

[18] Mc Kenzie, R.A. (1981).*The lumbar spine: mechanical diagnosis and therapy.* Spinal Publication

[19] Adams, M.A., Hutton, W.C. & Scott, J.R. (1980). *The resistance of flexion of lumbar intervertebral joint.*

[20] *National center for biotechnology information.* Retrieved March11, 2018 from http://www.ncbi.nlm.nih.gov/pubmed/7394664

[21] Postacchini, F. (1999). *Lumbar disc herniation*. Wien: Springer.

[22] Agur A., Dalley A., Moore K., (2010). *Clinically Oriented Anatomy*. 6th edition. Published by Lippincott Williams & Wilkins, the Point. Philadelphia, USA. ISBN: 978-1-60547-652-0

[23] Leveau B., (1977). *Biomechanics of human motion*. 2nd edition. Published by Williams & Lissner, W.B Company, USA. ISBN: 0-7216-5773-7.

[24] Neuman, D. (2009). *Kinesiology of musculoskeletal system, foundations of rehabilitation* (2nd Ed).Mosby Elsevier.

[25] Liebenson, C. (2007). *Rehabilitation of the spine, a practitioner's* manual (2nd Ed).Lippincot Williams & Wilkins.

[26] Izzo, J. (2013, January 8).Thoracolumbar fascia: the forgotten culprit of low back pain. *Traineradvice*. Retrieved March 24, 2018 from http://traineradvice.blogspot.cz/2013/01/thoracolumbar-fascia-forgotten-culprit.html

[27] Bridwell, K. (2014). Spinal curves. *Spine universe*. Retrieved March 22, 2018 from htp://www.spineuniverse.com/anatomy/spinal-curves

[28] *A-Method SPS.* Retrieved March 22, 2018 from http://www.spiralstabilization.com/en/

[29] Schoenfeld, A.J & Weiner, B.K. (2010) .Treatment of lumbar disc herniation: evidence based practice. *National center for biotechnology information.* Retrieved March 10, 2018 from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2915533/

[30] Hudák, R., Kachlík, D., Volný, O. and Ciszek, B. (2016). *Memorix anatom*y. Wrocław: Edra Urban & Partner.

[31] Ben-Yishay, A. (n.d.). Lumbar Radiculopathy. Retrieved March 15, 2018, from https://www.spine-health.com/conditions/lower-back-pain/lumbar-radiculopathy

[32] Spiral Stabilization. (n.d.). Retrieved March 17, 2018, from http://spiralstabilization.co.uk/

6.2 Figures References

[1] (2015). *Journal of Surgery*, 01-07. Retrieved March 15, 2018 from http://www.avensonline.org/fulltextarticles/JSUR-2332-4139-S1-0001.html.

[2] Round Back Deadlifts. (2015, June 17). Retrieved March 15, 2018, from http://robertsontrainingsystems.com/blog/round-back-deadlifts/

[3] Facet joint Archives. (n.d.). Retrieved March 15, 2018, from https://learnmuscles.com/blog/tag/facet-joint/

[4] Lower Limb Neurological Examination. (2014, September 05). Retrieved March 15, 2018, from https://dundeemedstudentnotes.wordpress.com/2014/09/05/lower-limb-neurological-examination/

[5] Lumbar Plexus. (n.d.). Retrieved March 15, 2018, from https://www.physio-pedia.com/Lumbar_Plexus

[6] White, C. (2017, April 20). Your Lats, Your Lifts, and the Coiling Core. Retrieved March 15, 2018, from https://breakingmuscle.com/fitness/your-lats-your-lifts-and-the-coiling-core

[7] Deep Muscles of the Back - Erector Spinae • Bodybuilding Wizard. (2014, April 18). Retrieved March 15, 2018, from http://bodybuilding-wizard.com/deep-muscles-of-the-back-erector-spinae/

[8] (n.d.). Retrieved March 15, 2018, from https://www.netterimages.com/diafragma-face-abdominal-labeled-anatomy-atlas-4e-brazil-general-anatomy-frank-h-netter-51081.html

[9] Lumbar Disc Herniation. (n.d.). Retrieved March 15, 2018, from http://www.spinesurgerydoctor.com/conditions/lumbar-disc-herniation.html

[10] Spiral Stabilization. (n.d.). Retrieved March 17, 2018, from http://spiralstabilization.co.uk/

7. Supplements

7.1 Figures List

7.2 Tables List

7.3 Abbreviations

- ABD – Abduction
- ADD- Adduction
- cm – centimeter
- CNS – Central Nervous System
- DFLX – Dorsi Flexion
- DSSS- Deep Stabilization System of the Spine.
- EVE- Eversion
- Ext - Extension
- ER- External Rotation
- Flx – Flexion
- IAP – Intera Abdominal Pressure
- Inf- Inferior
- IR- Internal; Rotation
- INV- Inversion
- L – Lumbar Spine
- MRI – Magnetic Resonance Imaging
- m. – muscle
- NSAID - nonsteroidal anti-inflammatory drug
- PFLX- Plantar Flexion
- PNF – Proprioceptive Neuromuscular Facilitation
- ROM –Range Of Motion
- SF – Superficial
- Sup – Superior
- TH – Thoracic Spine

CHARLES UNIVERSITY
FACULTY OF PHYSICAL EDUCATION AND SPORT
José Martího 31, 162 52 Prague 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: Case study of physiotherapeutic treatment of patient with disc herniation at L3/L4 with radiculopathy

Project form: Bachelor thesis

Period of realization of the project: January 2018 – February 2018

Applicant: Salem Baqhoum, UK FTVS – Physiotherapy

Main researcher: Salem Baqhoum, UK FTVS – Physiotherapy

Workplace: Oblastní Nemocnice Kladno

Supervisor: Mgr. Ilona Kučerová

Project description: physiotherapeutic rehabilitation plan for a patient after disc herniation at L3/L4 with radiculopathy. The aim of the study is to apply physiotherapy procedures and to observe and evaluate the results of rehabilitation therapy used. The methods that are used from the research are based on the knowledge which was obtained during the three years of bachelor study of physiotherapy program at UK FTVS
Characteristics of participants in the research: One male patient aged 53
Ensuring safety within the research: Non-invasive methods are used. Risks of therapy and methods will not be higher than the commonly anticipated risks for this type of therapy.
The research is taking place in physiotherapy department of Oblastní Nemocnice Kladno. All the precautions and risk prevention are followed according to the specific hospital rules, policies and signed documentation. All of rehabilitation regimes are designed, prescribed and implemented procedures including assessments, therapy, discussions and any kind of communication between patient and researcher are in presence of the responsible supervision of Mgr. Ilona Kučerová.
Ethical aspects of the research: Processing and retaining the data in an anonymised form will ensure personal data protection. The data will be used only in the bachelor thesis, and will not be published anywhere else. After the anonymization the personal data will be deleted. Photographs of the participant will be anonymised by blurring the face, parts of the body, or characteristics that could lead to identification of the person. Any non-anonymised photographs will be deleted after the end of the research.
I shall ensure to the maximum extent possible that the research data will not be misused.
Informed Consent: attached

It is the 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, 1st of February 2018 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.
PhDr. Pavel Hrásky, Ph.D.
Mgr. Eva Prokešová, Ph.D.
MUDr. Simona Majorová

The research project was approved by UK FTVS Ethics Committee under the registration number: 060/2018

Date of approval: 1. 2. 2018

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.

UNIVERZITA KARLOVA
Fakulta tělesné výchovy a sportu
José Martího 31, 162 52, Praha 6
– 20 –
Stamp of UK FTVS

Signature of the Chair of
UK FTVS Ethics Committee

INFORMOVANÝ SOUHLAS

Vážená paní, vážený pane,

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

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

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

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

Prohlašuji a svým níže uvedeným vlastnoručním podpisem potvrzuji, že dobrovolně souhlasím s prezentováním a uveřejněním výsledků vyšetření a průběhu terapie ve výše uvedené bakalářské práci, a že mi osoba, která provedla poučení, osobně vše podrobně vysvětlila, a že jsem měl(a) možnost si řádně a v dostatečném čase zvážit všechny relevantní informace, zeptat se na vše podstatné a že jsem dostal(a) jasné a srozumitelné odpovědi na své dotazy. Byl(a) jsem poučen(a) o právu odmítnout prezentování a uveřejnění výsledků vyšetření a průběhu terapie v bakalářské práci nebo svůj souhlas kdykoli odvolat bez represí, a to písemně zasláním Etické komisi UK FTVS, která bude následně informovat řešitele.

Místo, datum .....

Jméno a příjmení pacienta ..... Podpis pacienta: .....

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

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