Charles University

Faculty of Physical Education and Sports

Case study: Physiotherapy Treatment of a Patient after Lumbar Disk Surgery

Bachelor Thesis
April 2012, Prague

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Abstract.

Title:

Case study: Physiotherapy Treatment of a Patient after Lumbar Disk Surgery.

Thesis aim:

The aim of the thesis is to explore the case and physiotherapeutic approach to a patient after lumbar disk surgery.

Methods:

The thesis contains a theoretical part and a practical part. The theoretical part aims to explain the various backgrounds of a lumbar disc herniation, the etiology and epidemiology, and the anatomical, biomechanical and kinesiological factors that may result or lead to a disc herniation. Rehabilitation and treatments of states after spinal surgery are also discussed.

The practical part consists of a case study of a patient after lumbar spine surgery and describes the examinations, therapies and approaches for treatment. At last there is a conclusion of therapeutic effects.

During the four therapy sessions, the main techniques used where soft tissue techniques, mobilization and PIR according to Lewit (37), PNF strengthening techniques (1), breathing exercises and education on transfers.

Result:

After therapy, one could see some improvements in the release of restrictions during joint play, the release of reflex changes, and that the patient was more independent in transfers and her lower back pain had dramatically decreased after the surgery.

Conclusion:

The patient showed a good recovery after the surgery, she felt a relief of pain in her lower back and gluteal area. I treated this patient for a total of four days, so I tried to treat the most important parameters first, such as the restrictions of joints in lower extremity and the reflex changes. Educations on transfers were also an important part of this rehabilitation stay. The patient is very motivated to continue with the exercises, and will be continuing with rehabilitation in Kladruby.

Keywords:

Case study, rehabilitation post lumbar surgery, disc herniation, physiotherapy.

Declaration

I hereby declare that this work is entirely my own, individual work based on knowledge gained from books, journals, reports and by attending lectures and seminars at FTVS.

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

Prague, April 2012

Acknowledgements

I would like to thank my family and friends for their support and motivation. It has been wonderful to study in Prague, and I will cherish those memories. I am grateful for the chance to study and learn.

A special section in this paragraph should be devoted to Mgr. Agnieszka Kaczmarská PhD, who is a very talented physiotherapist, a great teacher and a helpful and generous person. I am thankful for your help and guidance.

Thank you.

Solveig Sandstad,

Prague, April 2012.

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Introduction.

Low back pain including cases of lumbar disk herniation is a very serious health issue and socioeconomic problem in the world today. It is the second most common reason for visiting a physical (38). The cost of healthcare is therefore large (13), and is estimated to be around 25 billion dollars in the United States per annum alone. The professions that contribute to the health care of these patients are mostly physiotherapists, surgeons and physicians. It is important that physiotherapists educate themselves about the clinical course and treatment of low back pain, so we can be able to prevent a chronic state of the condition. Both costs of health care and number of patients suffering from low back pain can be reduced with good professional expertise.

The objective of this thesis is to highlight the physiotherapeutic approaches for patients post lumbar spine surgery. The base of the thesis will be the theoretical part which contains the anatomy, kinesiology and the biomechanics of the lumbar spine. After this I will discuss the pros and cons of spinal surgery versus conservative treatments. The differential diagnosis of lumbar herniation will be discussed as well. The last part of this theoretical base will be the various approaches on treatment of states pre and post lumbar surgery.

The main part of the thesis is the case study of a patient post foraminotomy, it discusses the examination and therapy progress of the patient. The clinical practice took place at the neurosurgical department in the military hospital, Ústřední vojenské nemocnice, in Prague. A full examination and therapy execution was performed and evaluations of therapy progress with conclusions of the therapy program are included to highlight the main improvement. The thesis is equipped with a list of literature, figures, tables and explanations of abbreviations that can be found in the supplement.

General part.

Definitions.

There are many different definitions describing terms like herniation, protrusion, prolapse and sequestration. In this thesis I will use the terms according to these definitions:

Herniation: "Herniated lumbar disc is a displacement of disc material, nucleus pulpous or annulus fibrosis, beyond the intervertebral disc space (19)."

Protrusion: "Nuclear material is contained by the outer layers of the annulus and supporting ligamentous structures (5, 35)."

Prolapse: "Frank rupture of the nuclear material into the vertebral canal (40)".

It may be divided further into:

- **Extrusion:** "Extension of nuclear material beyond the confines of the posterior longitudinal ligament or above and below the disk space, as detected on MRI, but still in contact with the disc (65)."
- **Free sequestration:** "The extruded nucleus has separated from the disk and moved away from the prolapsed area (46)."

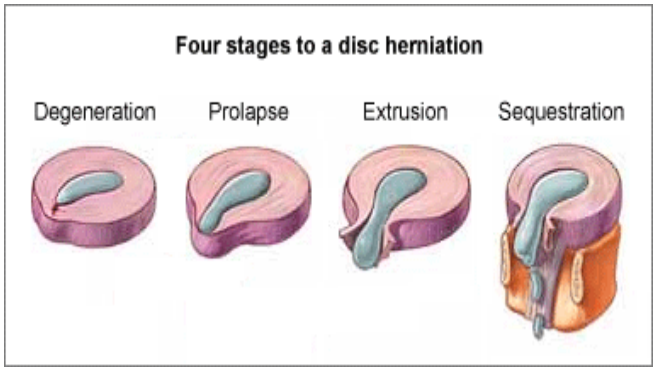

Figure 1: Four stages to a disc herniation (62).

2.1 Etiology and epidemiology.

The cause of a disc herniation is that the nucleus of the disc is pushed out toward its outer rings, called the annulus. This can be due to tear and strain over time, or to a sudden injury. The pressure against the outer layers of the annulus causes pain and irritation on neural structures. This may cause sciatica, which is pain radiation down the leg or legs (69).

Lumbar disk herniation is one of the most common diseases of the spine, and it is one of the most common reasons for low back pain in Europe and as well as in the United States. Low back pain in general is the leading reason why people visit their physicians in the United States (69). The lifetime prevalence of low back pain in America varies from 60-80 % (17, 33). Disk herniation is most commonly seen in patient in the age of 40-45, with a male: female ration of 2:1 (59). The intervertebral disks which are most affected is L4-5 or L5/S1, studies have shown that 95 % of lumbar disk herniation occurs at these sites (44). Fortunately lumbar disc herniation can regress over time (78), up to 75% of disc herniations resolve within 6 months (69). Only 10 % of patients may need surgery (23).

2.2 Pathophysiology of radiculopathy, clinical picture and risk factors of low back pain.

When the nucleus of the disc herniates out its place, it may touch the outer layer of the annulus. The outer layers of the annulus contains pain generators, so when the herniated disc presses on these structures, it causes pain. Structures which can be responsible for pain in the lumbar spine are the anterior and posterior longitudinal ligaments, the facet synovium, nerve roots and muscles. When the herniated disc presses on the nerve roots, inflammation can occur, the biochemical components which may cause this process is for example nitric oxide, glycoproteins and phospholipase A2 (69).

Clinical picture (35).

The symptoms of a herniated disc can be revealed according to the level of the spine where the herniation is located, but it is important to know that not all patients with lumbar disc herniation show symptoms. The most common direction of herniation is in posterolateral direction, this means that the symptom is often produced at the segment below. For example in a posterolateral herniation of L4-L5, the symptoms may be visible at the L5 nerve root level (69).

- Pain: The pain may arrive from the pressure and irritation of the neural structures. Often in lumbar disc herniations, the pain in the leg is worse than in the low back.
- Paresthesia of leg or legs.
- Decreased sensation in the relevant dermatome area in which the herniation was located.
- Decreased deep tendon reflexed, especially patella and achilleas reflexes.
- Numbness or weakness of muscles in the lower extremity, eg. Quadriceps, triceps surae, tibialis anterior and posterior, peroneus and flexors of the toes. If the muscles of the big toe and ankle are weak it may cause drop foot.
- Loss of bowel or bladder control.

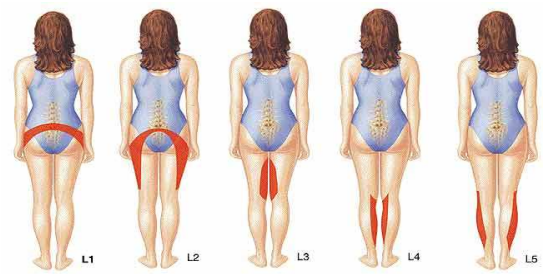

Figure 2: Lumbar herniated problem areas (74).

2.3 Diagnosis and clinical examination of lumbar disk herniation.

To diagnose a symptomatic lumbar disk herniation one need to collect important data from the anamnesis as well as do a thorough clinical examination. The most important factors from a personal history is the location of the pain, the severity of the pain, if the pain is worse is combined with some activity or during a specific time of the day. It will be important to ask if the pain is propagating to the legs, if the pain increases or decreases during specific movements such as flexion of the spine or sitting. Red flags that can indicate an intervertebral disc herniation may be thoracic pain, night pain, previous history of cancer, trauma, infection and cauda equina syndrome (20).

Imaging methods such as MRI is useful to see if the disk has herniated and to which extent (9).

Examinations include: (35, 41)

- Posture and dynamic spine test.
- Two scale test.
- Gait evaluation and gait modification such as walking on toes and heels and with bend knee, to direct you to which segmental level the injury may have occurred.
- Palpations of muscles of the lower extremity and trunk are important to check if there is any hypertonicity or trigger points. Reflex changes should also be checked.
- Range of motion test of lower extremity.
- Muscle strength examination will tell you which muscles are weak or strong, which will in turn help you point out the neurological level of the disc herniation.
- Neurological examination consists of deep tendon reflexes, superficial and deep sensation.
- Joint play of the small joints of the foot, sacroiliac joint and the lumbar spine should be done to see if there are any blockages.
- Provocation tests such as the straight leg test and Bragard test can be used as a good indicator for lumbar disc herniation.

2.4 Anatomy of the lumbar spine

The vertebral column consists of 7 cervical, 12 thoracic, 5 lumbar and 5 fused sacral and 4 fused coccygeal vertebrae. Between each of the vertebrae, there is an intervertebral disc. The intervertebral discs account for 25% of the length of the spine (53).
When you look at the spine laterally, you can see four curvatures: Anterior convexities in the cervical and lumbar region and anterior concavities in the thoracic and sacral region. These curves of the spine depend on the position of the pelvis, for example; if the pelvis is in anteflexion it will increase the lumbar lordosis. If there is a sideward tilt of the pelvis, it can lead to scoliosis. Lordosis with anterior tilt of pelvis predisposes the patient to low back pain.
The deviation of these curvatures may lead to compensatory mechanisms. This may cause an asymmetry activity which is the result by some muscular imbalance.
The curvature helps to contribute the weight-bearing of the spine, if the vertebral column was completely straight it would cause a massive strain to the spine (76).

Each spinal segment consists of an anterior pillar and two posterior thinner pillars. The active segment consists of the intervertebral disc, intervertebral foramen, ligaments, articular processes, and the deep short intervertebral muscles. The passive segment consists of the vertebral body (68, 76).

The lumbar spine links the thoracic spine with the pelvis. The lumbar spine is the most loaded part of the spine, therefore one can find the biggest vertebral bodies in the lumbar spine. The superior and inferior surfaces are almost parallel with the vertebral bodies.

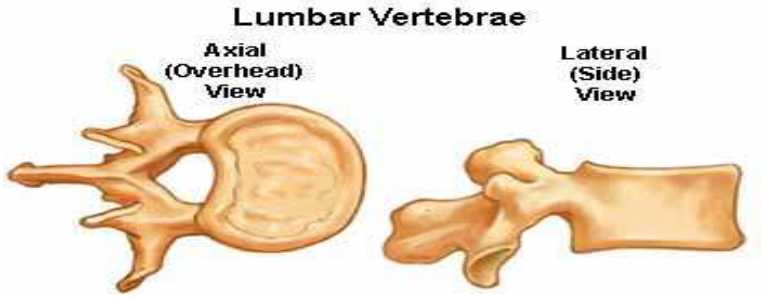

Figure 3: Each lumbar vertebrae shared a back structure (67).

The intervertebral disc has two functional structures: The annulus fibrous is the outer part of the disc. It consists of an outer ring of collagen surrounded by and wider zone of fibrocollagen. The annulus has about 20 rings, if you see the annulus from above, it looks like a three which is around 20 years old. It also contains cartilage end plates which is arranges in different directions. This arrangement of fibers limits range of motion and rotation between the vertebras (53).

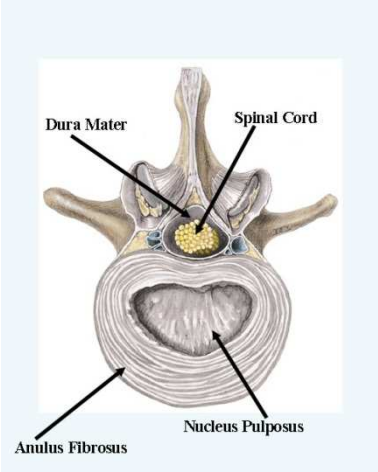

Figure 4: A nucleus pulpous (70).

The nucleus pulpous lies in the center of the disc, it is gelatinous and absorbs the compression forces between the vertebras. The nucleus of a healthy disc contains of 90 % water. Changes in posture alter the internal disc pressure, causing a so-called “pumping action” in the disc. The influx and outflux of water transports nutrients and gets rid of waste products. Along with the age the water absorption of the discs decreases (2). Injury, altered posture and body position, smoking and exposure to vibration can also affect the nutrition of the discs. Degenerative changes in the annulus fibrous can lead to herniation of the nucleus pulpous (58).

The 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 (45).

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: Iliocostalis cervicis, thoracis and lumborum, which 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 (44, 68).

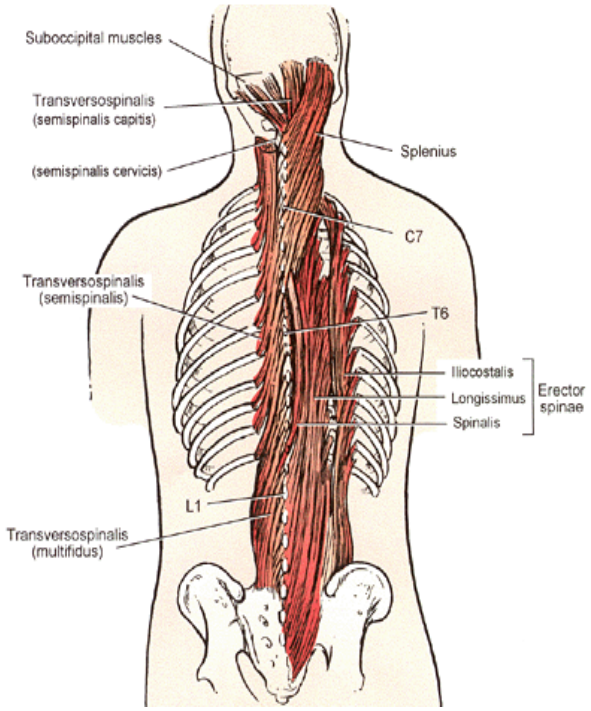

Figure 5: Spine muscles for extension of spine, back view (18).

Ligaments of the spine.

The joints of the spine are supported by many ligaments. Here are the major:
Anterior and **posterior longitudinal ligaments** lie on the anterior and posterior surfaces of the vertebral bodies and extend along the vertebral column. The anterior longitudinal ligament is attached to the base of the skull and extends and attaches to the anterior surface of the sacrum. It is attached to the intervertebral disc and to the vertebral bodies.

The posterior longitudinal ligament goes from the body of axis and extends along the posterior surfaces of the vertebral bodies to the sacrum. The anterior longitudinal ligament is strong, while the posterior longitudinal ligament is weaker.

The **ligamentum flavum** passes between the laminae of adjacent vertebrae. They are thin and broad and consist of elastic tissue which is stretched during spinal flexion, and shortened during extension.

Other ligaments of the spine are: supraspinous ligament, interspinous and ligamentum nuchae. Their function is to stabilize the spine. The supraspinous ligaments attaches to the spinous processes along the spine. This ligament is bigger in the cervical region and there it is called the nuchae ligament (28).

Lumbar and sacral plexus.

The lumbar and sacral plexuses arise from the lumbar and sacral segments of the spinal cord. The ventral rami of these nerves supply the pelvis and lower limb. The lumbar plexus is formed by the ventral rami of T12-L4. The main nerves in this plexus are genitofemoral nerve, lateral femoral cutaneous nerve and femoral nerve. Segment L4-5 forms the lumbosacral trunk the main nerve emerging from there is the sciatic nerve and the pudendal nerve. The sacral nerves reach from S1-S4. The sciatic nerve is divided into two branches: the common fibular nerve and the tibial nerve (44).

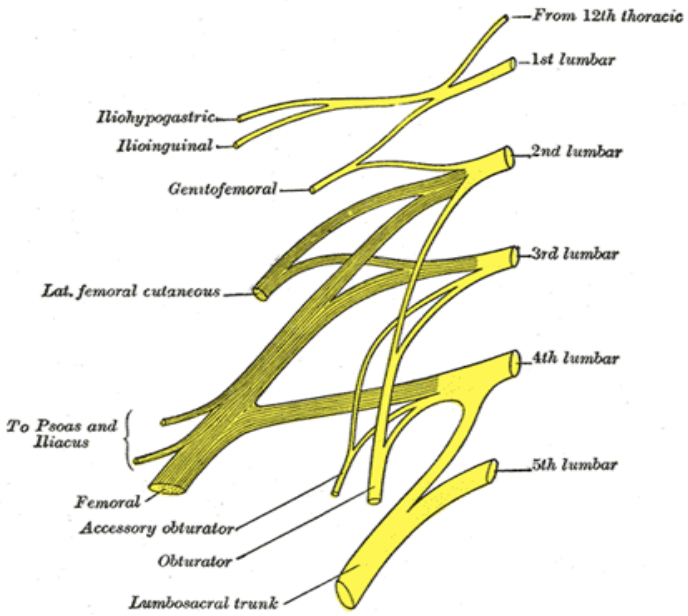

Figure 6: Plan of lumbar plexus (12).

Kinesiology.

Movements of the lumbar spine include flexion, extension, lateral flexion and rotation. Movements in a specific region of the spine depend on the shape of the joint surfaces that is why there is more movement available in the cervical region than in the lumbar. Movements of the lumbar spine: flexion 60° – extension 35°- lateral flexion 20°. Axial rotation: 5° (76).

<u>The influence of pelvis on the stabilization:</u>

The pelvis acts as a supporting base for the trunk, and it also transmits the forces from the vertebral column to the lower extremities. The position of the pelvis plays an important role for posture. An alteration of the position of the pelvis can cause muscular imbalances and scoliosis.

The pelvis bottom: consists of two important muscles; coccygeus and levator ani. If there is spasm of these muscles it can lead to postural and breathing alterations. This in turn can also cause low back pain (53).

2.5 Biomechanics of the lumbar spine

The vertebral column provides a mechanical linkage between the upper and lower extremities.

A motion segment of the spine is two adjacent vertebrae and the soft tissue between them, this motion segment is the functional unit of the spine. Each motion segment has tree joints; the vertebral body and the right and left facet joints between the superior and inferior articular processes. As mentioned above the lumbar vertebral bodies are larger in size and orientation of the articular processes than the thoracic or cervical vertebral bodies, this reduced the amount of stress to these vertebrae. The change of orientation of the facet joints limits the range of motion in different parts of the spine.

The vertebral body acts as the primary weight-bearing component of the spine, the facet joints assists in load bearing. The intervertebral discs and the facet joints help the spine to resist tear and torsion.

Loads on the spine.

There are many forces acting on the spine; the weight of the body, tension of the muscles and ligaments around the spine, intraabdominal pressure and the external forces that act on the spine.

During standing, the center of gravity is slightly anterior to the vertebral column, this result in a constant forward torque on the spine. The axial pressure increases while bending forward to 58kg/cm2. Straightening of the spine back from this forward position loads the spine with 107kg/cm2. The most risky movement is quick rotation combined with flexion. Compression of the lumbar spine increases with sitting, and even more accompanied with flexion of the trunk. Many students sit in this position while studying or attending a class when they are tired. The speed of performed motion is also important when it comes to loads on the spine. If one lift an object rapidly with a jerky motion it leads to an increased shear force on the spine, and also tension in the paraspinal muscles. (28).

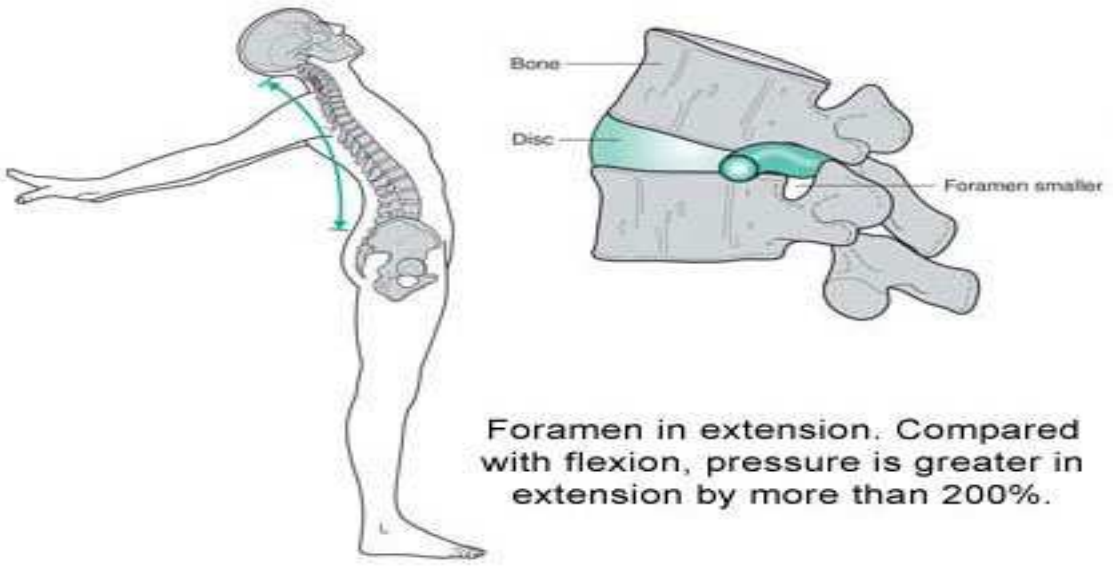

Figure 7. Effects of lubar extension (69).

Chart: Loads on Discs

POSITION	kg's
lying on back	25
standing	75
sitting	140
sitting bent forward	185
sitting slouched	275
walking	85
coughing/sneezing	110
bending forward	150
lifting with the back bent	220
lifting 20 kg with back bent	340

Figure 8. Chart over loads on discs (75).

2.6 Risk factors and differential diagnosis for low back pain. (35, 56)

- Obesity can be a risk factor due to heavy loads for the body, which in turn can overload structures. Keeping a healthy weight has been proven to reduce the risk of getting a disk herniation.
- Smoking has been in some studies linked low back pain. The reasons may be that smoker can develop hypertension which can be associated with low back pain, also they may have a sedentary life study without any physical activity (83).
- Occupation that includes long standing or sitting or lifting of heavy objects can be a cause of low back pain.
- Age, the risk for developing low back pain increases with age due to a degeneration of the spine.
- Genetics: A family history of spinal stenosis or degenerative spine disorders can increase the risks.
- Gender has shown to have an effect on the development of low back pain. Men are more prone to get LBP, also women who have had more than two pregnancies have a higher risk of developing low back pain.
- Low or zero activity level can cause low back pain, because it can weaken the core muscles of the trunk.
- Good posture is very important for prevention of LBP, faulty posture causes overload on important structures of the spine.
- Injuries to the spine can cause sudden structural changes. Injuries may occur during some sport activity. Sport activities which have high risk for injury are rugby, snowboarding, gymnastics or football.
- Stress and depression can be a predisposition for low back pain due to tension and overload of muscles or lack of physical activity.
- Spinal conditions such as spondylitis, spinal stenosis, scoliosis and osteoporosis can cause low back pain.
- Cancer can cause structural changes which can affect the spine. A benign spinal tumor can press on neural structures or irritate nerve roots.
- Ankylotic spondylitis can cause deformation of the SI joint and lumbar spine.
- A muscular strain or muscular overload.

An important note is that including these factors there may be a possibility of multiple processes in play for the individual patient.

Pain in the back may also be caused by some organs, there are many organs located in the retroperitoneum that can cause back pain. Renal pain for example, caused by stones in the renal system or renal tumors, is usually felt in the back. Pancreatic pain associated with pancreatic cancer or pancreatitis refers to the back. Enlarged lymph nodes in the pre and para-aortic area may produce pain back and may be a sign of some malignancy (44).

It is important for physiotherapists to distinguish the cause of the back pain as either originating from the musculoskeletal system or of some internal origin. This can help diagnose possible pathologies originating from the internal system.

2.7 Surgical vs. conservative treatment

Surgical procedures, their indications, methods and results.

There are three main surgical procedures that are commonly used for lumbar disk herniations; the standard lumbar discectomy, microendoscopical lumbar discectomy and laminectomy with or without a foraminotomy with the use of tubular retractor systems.

Disk herniation is a known problem, and is seen in 1 out of 10,000 in the population. Surgery may be indicated for 10 % of those cases (23).

Usually surgical treatment is performed when there is no improvement seen with conservative treatments. This is the cause with patient showing symptoms. However, we know that lumbar disk herniation is often seen on imaging studies even without symptoms. 75 % of disk herniations resolve or regress within 6 months (69). With this fact we see that clinical improvements is common in most people, but there is a ten percent chance that some people will still have severe pain after 6 weeks. These people usually have to consider surgery (69). In another source written by Craig Liebenson (38), surgery is not indicated for patients with low back pain before trying 2 years of conservative treatment first.

Historically the first published description of a lumbar discectomy was in 1941 by Barr and Mixter (3). Compared with recent times the technique has been widely modified; by Caspar (10) and Yasargil (82) in Europe and by Williams (81) in the United States in the 1970s, they developed the techniques with a microscope.

In 1997 (4) the microendoscopic discectomy was introduced which helped develop the minimally invasive surgical approaches. Foley et al took this technique one step further and developed the use of the microendoscope and tubular retractor system to perform lumbar discectomy and laminectomy (43).

Lumbar discectomy is the most common lumbar surgical procedure to these recent times It was firstly used for intervertebral disc herniation. The more recently developed microdiscectomy surgery has gained more popularity in the recent years, therefor we can see a decrease in the number of performed standard discectomies (10).

In the article written by Jordan, Morgan and Weinstein, one randomized control trial was described as to the effectiveness of a lumbar discectomy. The results showed that improvements were reported after 1 year, but not after 4 and 10 years, compared to conservative treatment. Three RCT were explained in the article by Jordan, Morgan and Weinstein, and there was found no significant differences in clinical outcomes between standard discectomy and microdiscectomy. There is not found any RCT as to the comparing of conservative treatment versus microdiscectomy (31).

Long-term outcomes after discectomy of the lumbar disc have been discussed in an article by Yorimitsu, Toyama, and Hirabayashi. It was a follow-up study for 10 years. Their evaluation methods they used were the Japanese Orthopedic Association scoring system, which contains examinations and questionnaires. Radiography was also used. The results were that 74.6% of the patients had residual low back pain, but only 12.7% had severe low back pain. Their findings suggested that although the long-term outcomes of a standard discectomy were good (82).

However there can always be complications post surgery. The complications and failures of total disc replacement can be as follows – implant failure, vertebral body fracture, infections, iatrogenic deformity, negative host response, neurologic injury, osteolysis and scoliosis (72). It can also be because of surgery at the wrong level, or segmental instability. Wrong preoperative diagnosis and wrong surgical indications may also lead to a failure in surgery (39).

Standard discectomy has a 10% to 15% failure rate. It has been reported that there is a reoperative risk connected with discectomy, recurrent disk herniations is usually a reason for that (39).

The use of the microendoscope and tubular retractor system has been popular in recent years. It is a minimal invasive surgery, which gives a good direct view of surgical images, as well as reduced surgical trauma to the tissue as well as reduced postoperative morbidity. These techniques have been developed to minimize iatrogenic trauma. This technique can also be used for other spinal disorder than lumbar disk herniation, such as lumbar spinal stenosis, foraminal narrowing and facet joint cysts (23, 43).

By performing the microdiscectomy by tubular retractors, many patients may have a quicker recovery period compared to a standard discectomy (48). This procedure offers advantages in obese or geriatric patients because open spinal surgery has been associated

with longer operative time, greater blood loss and a longer post-operative rehabilitation (43).

The indications for the microendoscopic surgery of the lumbar disc herniation are that the patient has a single level disk herniation and has a stable spine. The preoperative imagining should also correlate with the clinical examinations. [i] [ii] Other indications are radicular symptoms with leg pain more severe than back pain, positive straight leg test, root dysfunction and failure to improve after at least 6 weeks of conservative medical treatment (23).

To conclude, microsurgery has been seen as a successful surgery of the lumbar spine. In varies studies it has proven to be a safe procedure by minimizing the surgical trauma, as well a showing good long-term results.[iii] Patients have been shown to improve when it comes to pain and somatic anxiety after having a microdiscectomy. Studies have shown that depression and distress are common psychological factors with low back pain. The effects of the surgery may then lead to increased mental well-being (36).

Decompressive surgery of the lumbar spine.

Indications for decompressive surgery for lumbar spinal stenosis are leg pain, neurological deficits, and a severe spinal stenosis. Walking and standing is not possible for more than 5 minutes (49). As in the indications of microdiscectomy and the standard discectomy, the surgical options are usually recommended after the patient had tried at least 6 weeks of conservative treatment first. The patient who is suffering from spinal stenosis is usually older, this is why it is important to optimize their physical health before the surgery.

Conservative treatment.

The approaches to nonoperative treatment of lumbar disk herniation are multidisciplinary and may consist of physiotherapy, corticosteroid injections, anti-inflammatory drugs and bed rest (69). The physiotherapist's role is to treat and control the symptoms and on restoring function.

When it comes to bed rest there is both advantages and disadvantages. With today's medical knowledge we know that immobility can cause harm on the body, such as contractures, thromboembolisms and weakened muscles. However a study of Pearce and Moll (55) showed that 70% of patients treated with strict bed rest improved and the 30% of the patients had a poor response. This may indicate that bed rest to some extent is useful, because it stops the biomechanical stressors on the body that may result in the disk herniation. Studies have shown that patients with acute back pain have a greater chance of developing chronic pain, if they stay in bed, rather than active patients (63). There is no evidence that staying is harmful for acute LBP or sciatica (24).

Oral medications used for treatment of low back pain is divided into classes, these contain non-steroidal anti-inflammatory drugs, muscle relaxants, acetaminophen and opioid analgesic drugs. NSAIDs are seen to be effective in the acute stages of a lumbar disk herniation, and it works as anti-inflammatory, analgesic and antipyretic. NSAID has a so called ceiling effect, so it can only reach a certain point of effect, therefore an increase of the dose due to great pain is not going to relieve the pain. Acetaminophen is also an analgesic and antipyretic drug and it is effective for mild to moderate pain, opioid analgesic drugs are however used for moderate to severe drugs, and are known to be very addictive. Long-term use is therefore not recommended. Muscle relaxants work centrally to inhibit muscle contraction and causes nonspecific sedation. They can only be used for maximum 1 week (6).The main principle of usage of oral medications is in the acute phase post lumbar disk herniation, in order to minimize the worst pain and for the patient to remain active.

Inflammation around the spine is one of the factors that includes in the pathology of the lumbar disk herniation that is why corticosteroids are used to reverse this process and to relieve pain. Corticosteroids can be administered in three ways: orally, intramuscularly and epidurally. Oral corticosteroids are considered a safe way to insert the drug, due to the

avoidance of complications that more invasive methods could create, however there are many adverse effects by using oral corticosteroids.

Intramuscular injections of corticosteroids can be effective with patients with lumbar disk herniation, an old study from 1975 showed that introducing dexamethasone gave a significant release of pain, this study also proved that inflammation is an important part of the pain (22). Mr. Valat and Ms. Rozenberg (64) discuss in their article the outcome of local corticosteroid injections for sciatica and low back pain. The studies have given strong evidence for a good short term analgesic effect for patients with sciatica and LBP.

Peridural and epidural injections of steroids have been used for over 40 years for the treatment of low back pain. There have been disagreements on whether the treatment is efficient or not: the range of success varies from 33-77%. The studies vary so much because techniques used often varies and the diagnosis of low back pain may have been diffuse (66). The main actions of these injections are blocking the sodium channel, which inhibits the firing of neurons, it also improved blood flow and reduced endoneurial pressure in the dorsal root ganglion, which is thought to be one of the pathogenic factors of a lumbar disk herniation, blocks small diameter C fibers and suppresses ectopic discharges. However, there is no evidence that corticosteroids affect the natural history of disk regression. The contraindications to epidural steroids are as following: known hypersensitivity to the drug, infection, local cancer and bleeding disorders. The combination of epidural steroid injections and physical therapy is often used to treat lumbar radicular pain, in 2010 there was a study by Thackeray et al, and they examined the effectiveness of physical therapy as an adjunct therapy to selective nerve root block. The results however concluded that physical therapy does not give any added benefits (71).

When it comes to adverse effects, it is proven that short-term usage is more safe than long-term. Stated adverse effects are among others altered blood pressure, electrolyte levels, peptic ulcer disease, osteoporosis and psychosis. If the anesthetic is injected into the intravascular space without intent there is risk of severe mental status changes, seizures, respiratory failure and death (15). Other complications as a result of these injections were found in a study of Botwin et al (7) in 2000, they included increased back pain, increased blood sugar, headaches and vasovagal reactions.

In summary, even with its controversy, epidural steroid injections can benefit patients with radicular symptoms, whose symptoms do not improve with conservative treatment. The goal of these steroid injections is not to remove physical activity, but to control the pain so that the patients can improve their functional levels.

I would say that the most important part of the conservative treatment lies in physical management. The goal of physiotherapy is to treat and reduce the symptoms, restore function and help the patient create a life with physical activity. The main focus of therapy is to increase trunk stability, reduce muscle shortness and strengthen weak muscles, as well to educate the patient on correct posture and breathing types.

Tractions have proved effective because it reduced disk pressure and stretches the soft tissue of the lumbar spine, this is however contraindicated if the patient has osteoporosis, spinal infection or spinal instability.

Modalities of physical therapy may be indicated for the treatment of lumbar disk herniation. Cryotherapy may be used in the acute phases of the herniation for decreasing muscles spasm and pain (61).

Rehabilitation and physical management of lumbar disk herniation will be discussed thoroughly in chapter 2.8.

A comparison of the results from surgical procedures and conservative treatment.

Peul et al in their research of 2008, they tried to evaluate the effects of early lumbar disc surgery compared with prolonged conservative care for patients with sciatica caused by lumbar disc herniation with a two year follow-up. They concluded that an early surgery for sciatica led to a faster recovery and relief of the leg pain. This is a positive outcome for the patients who don't want to wait for the natural cause of the condition or for those who do not wish to try conservative treatment (57).

A comparison with other studies show that prolonged conservative treatment results in similar outcomes to those who have early surgery, however these results converged after four years, so most of the patients with severe sciatica chose to have the early surgery instead.[iv] On the contrary there has been more recent studies that show worse results are prolonged conservative treatment compared with surgery. Research by Nygaard (51) et al and Sell (50) has suggested that delayed surgery after eight 8-12 months compared to early

surgery gave worse results. This suggests that prolonged conservative treatment for longer than 8-12 months may be difficult for people with severe sciatica.

However, there have been studies that discuss the contrary, for example from the randomized trials by Weinstein et al (80), Osterman et al (52) and Butterman (8). They all have the general conclusion that prolonged conservative treatment do not result in an unsatisfactory outcome, they concluded that early surgery within 6-12 weeks does not lead to marked functional improvement the first two years.

Jordan, Morgan and Weinstein is describing in their article that a standard discectomy showed improvement of function after 1 year compared to conservative treatment, but not after 4 and 10 years.

Jordan, Morgan and Weinstein are explaining three randomized control trials that found no significant differences in clinical outcomes between standard discectomy and microdiscectomy, also the adverse effects were similar in both procedures (31).

According to Hahne and Ford research has shown that the prognoses for patients with lumbar disc herniation after receiving conservative treatments are good (25).

Rehabilitation after surgery.

In a study by Newsome et al (50), the results of immediate exercise after a single-level microdiscectomy are explored. There were 30 participants over a three month period, the follow-up rate was of 93% after 4 weeks and 77 & at 3 months. The patients were randomly put into an intervention group which did exercises within 2 hours of the surgery, and a control group with exercises on the 1st operative day. The results suggested that immediate exercise following the surgery enabled the patients to become independently more mobile and return to work sooner.

Aerobic exercise starting one month after a single-level lumbar microdiscectomy, has proven to reduce leg and lower back pain, improve functional recovery and motivation for patients (21).

According to Estadt (17), chiropractic care can help relieve lower back pain that may have been the result from a herniated disc. Active rehabilitation was also an important part of Estadt's case study. He described that patient education on proper posture, lifting

techniques and core stabilization exercises is a vital part of recovery and management of a patient post lumbar surgery.

Straight leg raise exercises may help release the lower back and leg pain and as well be used as a physical management after spinal decompression surgery (26).

2.8 Rehabilitation and physical therapy.

Therapeutic exercise has shown in many studies to be effective for preventing and treating lumbar disk herniation. The first randomized controlled trial was in 1986, testing the effects of exercise in patients with herniated lumbar disks. There were in total 126 patients, whom were divided into nonoperative and operative groups. The nonoperative groups were given nonspecific exercises, and of these patient 25% were now "cured" and 36% had seen improvements after the training. The surgical group however proved better results after one year, but the effects after 4 years showed no greater difference. Other studies in more recent times have been done, and also here effects of exercise have been shown satisfactory, for example in the study of Saal and Saal in 1989. The patients in this trial got intensive therapy including spine stabilization exercises. In this group 90 % of the patients reported good or excellent outcomes and 92 % returned to work (65).

In the book "Rehabilitation of the Spine" by Liebenson et al (38) several techniques for rehabilitating the spine are described. Spinal segmental stabilization training is focusing on the importance of stability of the spine by controlling by the trunk muscles. Functional stability training is also an important part of treating and preventing spine-related pain and disability. Firstly the therapist identifies the main functional deficits of the patients, and the goal of this training is to regain optimal function of the spine. There has been many evidence based research written about the effectiveness of spine stability training, for example in the study by Yilmaz et al in 2003. They followed patients after lumbar microdiscectomy for 8 weeks, the patients were divided into two groups, and one group was given exercise and the other none. The results showed that the group whom had done the exercises had a significant reduction in pain, increased function and mobility than the group with no exercise.

Exercises that increases lumbar stability is important to prevent low back pain and disk herniation, this can include strengthening of rectus abdominis, obliqus and transvere abdominis, back extensors and quadratus lumborum. Cholewicki described in his work the

importance of co-activation of the paraspinal and abdominal muscles (11). Prevention of lumbar disc herniation can be done by keeping a good posture. This will reduce the strain on the spine. Through exercise one can prevent low back pain to strengthen your core muscles and trunk stability.

The McKenzie method is used by many physiotherapists. The target group for this technique is for patients with low back or neck pain. The main goal is to instruct the patients in self-management skill, with various exercises (38). McKenzie said once, "If you adopt certain positions or perform certain movements that cause your back to "go out", then if we understand the problem fully we can identify other movements and other positions that, if practiced and adopted, can reverse the process. You put it out, you put it back in" (47).

Spinal traction has been proven effective for pain associated with lumbar disc herniation. Traction can be defined as a drawing tension applied to a body segment (14). The traction is performed manually by the therapist. The effects on the spine are many: On the bone, the bone changes according to Wolff's law which states that bone remodels itself and provides increased strength along the lines of the mechanical forces placed on it. The ligaments of the spine are stretched by traction, which can be done if the ligaments were shortened by an injury or by some long term postural strain. The effects of traction on the intervertebral disks are shown to be very good, the disk is normally working as a shock-absorber against the compressive forces on the spine, spinal traction technique will help reduce the compressive forces on the disk and increase the disk space. This will contribute to decrease the herniation, and help to get the disk nucleus to a central position. Traction also has an effect on the muscular system. The vertebral muscles are stretched which leads to muscle relaxation and increased muscular blood flow and activation of muscle proprioceptors.

Traction treatment techniques that can be used for treating a patient with lumbar disk herniation are lumbar positional traction, either by putting your knees to the chest, or in sidelying with a roll or a pillow between the iliac crest and the ribs. This position increases the intervertebral foramen. Positional tractions can also be done using an inversion traction apparatus. If the therapist wants to create a comfortable therapy on the patient, manual lumbar tractions may help relieve the pain.

The indications for traction are among many: disk herniation, degenerative joint diseases, subacute pain, joint hypomobility, and muscle strain or ligament contractures. The contraindications are for example fractures, vertebral joint instability, tumors, osteoporosis, pregnancy, cardiac or pulmonary problems, infections and any pathological vascular conditions (60).

In an article by Unul et al, traction has been shown to be a very effective treatment for patients with acute LBP (73).

When it comes to physical therapy modalities, infrared heating-modalities are effective for low back pain because it causes heat in the tissues, but in the acute phase heat-inducing therapeutic modalities such as whirlpools or ultrasound should be avoided because it can result in some inflammatory processes. Short-term and long-term diathermy has the same effect heat inducing effect. Ultrasound has an analgesic effect and has a greater debt of penetration, than any other electromagnetic modality (60, 73).

As mentioned in the chapter about conservative treatment, cryotherapy may be used in the acute phases of the herniation for decreasing muscles spasm and pain. In an article by Unlu et al (73), three physical therapy modalities were compared in the treatment of acute pain in lumbar disc herniation; Low-power laser, ultrasound and traction. The study showed that all of the three modalities were effective in the treatment of acute LDH. MRI scans after the treatment showed a morphological regression of the herniated discs. There were no specific therapies that were more outstanding than the other. This concludes that ultrasound, LPL and traction can be important in the treatment of acute LDH.

When treating the spine it is important to remember that the spine behaves like one segmental structure, if we want to treat the lumbar spine for example for a patient with low back pain, we always need to check the sacro-iliac, thoracic and cervical part of the spine, as well as the shoulder and hip joint. It is important to differentiate if the problems originate in the hip joints or in the lumbar spine, because the course of therapy is different (26, 44).

In the end it is important to note that the patients should be treated individually, because non-specific therapy may lead to a worsening of the situation.

Special part

3.1 Methodology

I underwent the clinical practice at the Ústřední vojenské nemocnice in Prague. From the 02.01.2012 to the 13.01.2012. I worked in the Neurosurgical department of the hospital, where there are three main sections; one of them is the intensive care unit, with patient whom recently had surgery, and two rehabilitation wings. The patients have been treated for various diagnoses, but the majority of the diagnosis seen in the department was cervical and lumbar disc herniations, spinal stenosis, and some peripheral nerve and spinal cord injuries. The age of the patients vary from 18-70.

The hospital also has an out-patient service, where the patients post-surgery may come and get treatment.

My patient presented with a state post lumbar spine surgery. Initial kinesiological examination was conducted, partly in middle of the practice due to limitations and pain; this was followed by four sessions of therapy, including a final kinesiological examination at the end. The clinical practice was under the supervision of Mgr. Agniezcka Kaczmarska.PhD. My patient was informed about the process before the work.

Ethics Committee of the Faculty of Physical Education and Sport – Charles University, Prague Approval number: 023/2012.

3.2 Anamnesis.

Performed 04.01.12.

Person being diagnosed: P.K. **Year:** 1966.

Diagnosis: M 511 Disc protrusion L5/S1.

Present state: The patient is 165 cm, 60 kg, BMI 22.0. Today 04.01 was the first post-operative day. The patient had a foraminotomy after having been diagnosed with a large protrusion of L5/S1.

The pain-level at the first day after surgery was 4, out of a scale of 10. She feels stiff pain in her lower back and in the gluteal area, the pain did not propagated to the lower extremity. Before the surgery however she felt pain in the left hip joint and posterior part of thigh. The main position when problems were present was in sitting, she was not able to work as an accountant due to this.

History of the present problem:

The patient started to have the low back pain and pain in the left hip 3 years ago, she was treated with strong analgesics and conservative treatments until recent times.

In January 2011 the patient fell on the back and hip, analgesic injections (Mesocain) were inserted into the paravertebral area of the lumbar spine, surgery was indicated right after the fall, but she wanted to try conservative treatment first. But after no success she got a foraminatomy January 2012.

She arrived to the neurosurgical department on the 2nd of January, after having been diagnosed with a large protrusion of the vertebral disc L5/S1 left side, with a big irritation of the S1 root. A foraminotomy were done, and the surgery was successful.

Family history: Father died of a brain stroke.

Medical history: At the age of 7 she was diagnosed with scoliosis, she got special treatment for it, and was not attending the physical education in school. After a period of three years she got a control examination and it was states that her scoliosis was not present any longer and that the problems due to it had resolved. She was then able to do sports normally again.

In 2004 she started to have problems with incontinency, it was diagnosed as stress incontinency, and in March the same years she was operated for it. The problems reoccurred the following year, so she was then re-operated with the same procedure in 2005.

Surgical history:

- In 1988 she got her tonsils removed.
- In 1988 she also removed a fibular adenoma.
- March 2004 she had a reconstructive surgery of the urethra and plastics of the sphincter. The incontinency returned the year after and needed to have the same surgery in 2005 as well.
- Microdiscectomy 3rd of January 2012.

Pharmacology history:

Dextralex - a vascular protecting agent.

Citralex – antidepressants.

Ketonal forte – analgesic, anti-inflammatory and antipyretic activity, a NSAID drug.

Apo-ome – controls gastric acid production.

Calcichew – treatment and prevention of vitamin D/calcium deficiency.

Neurol – used for sleeping problems.

Dithiaden – anti-allergic or anti-emetic (effective against vomiting and nausea).

Korylan – effective on pain and fever.

Social history: The patient is married, and has a son. She enjoys gardening. She says the back problems propagated when she had to bend and sit on the knees in the garden. The apartment they live in has stairs, but she did not mention any difficulties walking on them.

Occupational history: She was working as an accountant previously, but she will retire due to her health issues.

ADL: After the surgery the patient is able to take care of herself in the sense of dressing, grooming, going to the toilet alone. She felt a little week when carrying the food tray and heavy things. Gait is performed well, she is able to go for walks by herself.

Abuses: Smoker.

Allergies: Citrus.

Previous rehabilitation: From the end of March to the end of May 2011 she stayed in a rehabilitation center Kladruby. She went through various treatments, among them the Mackenzie technique, exercises for trunk stability and exercises for prevention of root fixation.

Patient's health documentation extract: In January 2011 x-ray photos taken in the orthopedics department found atrophic changes in the left hip joint, grade 1-2, with ossification around the joint capsule. The same time, January of 2011, the doctors found a protrusion in the intervertebral disc of L5/S1. The protrusion was of 9mm. After conservative treatment the following three months the protrusion had gone back to 7mm. 18.06.11. Discopathy found in the segment L5/S1 postero-medially, pressure changes were also found on the dural sack and secondary narrowing of the spinal canal. Circular protrusion found in the level L4/5, as well as thickening of the ligaments of L4/5.

Indication towards RBH:

1. Exercises on the bed, thromboembolic prevention.
2. Breathing exercises.
3. Education of transfers; verticalization on the 2nd day after surgery.
4. Manual therapy.
5. Treatments for possible muscle imbalances.

Physiotherapy indicated once a day.

Differential considerations:

- Decrease of sensation in the dermatome of the affected nerve root.
- Motor function deficits in lower extremity, especially in quadriceps, triceps surea and gluteal muscles.
- Blockages of joints of the foot and ankle, and as well in thoracic region.
- Weakness and muscle imbalance; especially in triceps surea, quadriceps and gluteals.
- Reflex changes in feet and calfs.
- Pain and tenderless in the area of the scar and lower back.
- Decreased range of motion in joints of lower extremity.
- Loss of tendon reflexes, depending on the segmental level of the lesion.
- Instability of the spine, which can have caused structural changes of fascia, muscles, and in turn compression on neural structures.

Note. Since most of the prolapsed discs are posterolateral, the neurological features are often unilateral. (Reference: Essential Neurology; will be in the reference list)

Differential diagnosis.

1) The scoliosis she had in her childhood may well have caused the intervertebral discs stress and tear.

2) The patient has had problems with stress incontinency and has had surgeries for it. The urogenital problems may have caused abdominal and trunk muscle imbalances, which can result in low back pain.

3) The patient had a fall on her buttocks January 2011, this trauma may have caused the herniation, and it could as well have cause a change in the position of the SI joint and pelvis, causing muscle imbalance and pain.

3.3 Initial kinesiological examination

Note. The majority of the initial examinations were done *04.01*. The rest of the initial examinations were done on the 5th, due to limitations and pain the first operative day, as a control examination. The examinations are divided into: **initial**, **control** and **final**.

Present state:

Height: 165 cm

Weight: 60 kg

BMI: 22.0

Wednesday 4th of January was the first post-operative day. The patient had a foraminotomy after having been diagnosed with a large protrusion of L5/S1. Subjective anamnesis on the first post-operative day: she feels some stiffness and pain in the lower back, around the scar, and gluteal area. From a pain scale of 0-10, where 10 is severe pain, she says she feels the pain on a level of 4 on the VAS scale.

Her main complaint was that she was not able to sit for a longer time at once, and that she the constant pain is limiting her in daily activities.

- Posture evaluation

According to Kendall, (34).

Posterior view:

- Narrow base of feet.
- Left calf hypertrophic.
- Patellar lines aligned.
- Hypotrophic gluteal muscles, but in alignment.
- Right scapula winged.

Lateral view:

All joints are in good alignment to each other: ankle, knee, hip and shoulder joint.

Good position of the head, no forward position.

Anterior view:

- Patellas is in alignment.
- Trunk rotated slightly to the right.
- Clavicles aligned.

Pelvic examination.

- Crests are in alignment.
- Anterior superior iliac spine is more up on the right side.
- Posterior superior iliac spine is more down on the right side.

- Gait evaluation

A*ccording to Kendal,l (34).*

As a part of the neurological examination, various gait modifications can help us find out the segmental level in which the neurological deficit is in.

The patient performed gait with bend knees: Level of L4.

- Walking on heels: L5.
- Walking on tiptoes: S1.

The patient felt pain in the left leg during deep toe walking. She was able to walk on heels and with bend knees without any problems.

Results: The patient did not have any difficulties performing these modifications of gait.

Length and width of steps are equal and normal. There was little rotation of the trunk, and short swing of arms.

Balance and proprireceptive tests.

- Tredelenburg test both legs were negative.
- Vele's test was negative.
- Rhomberg position 1,2,3 were also negative.

- Neurological examination

Reflexes:

Deep tendon reflexes.

- Patella: present on both sides.
- Achilleas absent bilateral.

Superficial sensation in the relevant dermatomes:

- L1,L2, L3, L4, L5, S1, S2.
- She had sensation in all the dermatomes, felt the same temperature and pressure on both legs.

Deep sensation:

- Position sense: The heel along the tibia: The patient is placing her right heel on the left tibia and trying to follow the length of the tibia. Done on both legs. The patient was able to do this.
- Movement position sense: Holding one arm up, and following with the other arm in the same position. The patient was able to perform it.

Breathing examination: Upper thoracic breathing, one can see contraction and activity of the sternocleidomastoideus in lying position.

Anthropometry performed in lying position.

	Right lower extremity	**Left lower extremity**
Thigh circumference	44 cm	46 cm
Knee circumference	34 cm	34 cm
Calf circumference	33 cm	36 cm
Ankle circumference	22 cm	22 cm
Metatarsal circumference	22 cm	22 cm

Table 1. Anthropometry of the lower extremity.

Functional length: Anterior superior iliac spine to the medial malleolus: 85 cm right leg, 84 cm left leg. *Anatomical length:* Trochanter to lateral malleolus: 78 cm both legs.

Palpation of muscles

	Right side			**Left side**		
Quadriceps	**Tonus**	**Pain**	**Trg. point**	**Tonus**	**Pain**	**Trg. point**
Tensor fascia lata	Physiological	No	No	Physiological	No	No
Gluteus medius	Physiological	No	No	Hyper	Slight	No
Gluteus maximus	Hypo	No	No	Hypo	No	No
Iliop psoas	Physiological	No	No	Physiological	No	No
Quadratus lumborum	Physiological	No	No	Hyper	Yes	No
Piriformis	Hyper	No	No	Hyper	No	No
Gastrocnemius	Physiological	No	No	Hyper	Tense feeling	
Soleus	Hyper	No	No	Hyper	Slight	No
Tibialis anterior	Physiological	No	No	Hyper	No	No
Rectus abdominis	Physiological	No	No	Physiological	No	No
Hamstrings	Hyper	No	No	Hyper	No	No

Peroneus longus	Physiological	No	No	Physiological	No	No
Erector spinae thoracic part.	Physiological	No	No	Physiological	No	No

Table 2.

Palpation of muscles in LE.

Examination of reflex changes.

Kibler's fold: Restrictions on the ventral and dorsal part of calves. Restrictions found in upper thoracic part.

Skin mobility and elasticity: Restrictions in calves in all directions. Fascia: restriction of the thoracal fascia in caudal and cranial direction.

ROM

	Right lower extremity		**Left lower extremity**	
Movement	**Active**	**Passive**	**Active**	**Passive**
Hip flexion (w/knee flexed)	80°	90°	70°	80°
Hip extension	10°	10°	5°*	10°*
Hip abduction	30°	40°	20°*	30°*
Hip adduction	10°	10°	10°	10°
Internal rotation of hip	30°	40°	30°	35°
External rotation of hip	40 °	45 °	40 °	40°
Knee flexion	110°	120°	110°	120°
Knee extension	0°	0°	0°	0°
Dorsal flexion of ankle	20°	20°	10°	15°

joint				
Plantar flexion	35°	40°	30°	40°
Eversion of the foot	10°	20°	10°	10°
Inversion of the foot	30°	40°	30°	35°

Table 3. Range of motion of the lower extremity.

*= Movement accompanied with pain **Note**. The tests were done orientationally, due to the type of diagnosis and time limitations. [v]

Special tests:

Lassegue's test: Right 60 degrees. Left 40 degrees: Both negative.

Positive **Bragard's test** on left foot.

Joint play

Performed according to Lewitt, (37).

Explanation to tables: 0= No blockage X= Restricted XX= Blockage with pain

Proximal and distal phalanges, right lower extremity.					
Digit	**1st**	**2nd**	**3rd**	**4th**	**5th**
Dorsal	0	X	0	0	0
Ventral	0	0	X	0	0
Lateral	0	0	X	0	0
Proximal and distal phalanges, left lower extremity.					
Digit	**1st**	**2nd**	**3rd**	**4th**	**5th**
Dorsal	0	X	XX	0	0

Ventral	0	0	XX	0	0
Lateral	0	0	XX	0	0

Table 4. Joint play in IP joint, Right and left lower extremity

Metatarsophalangeal joints 2-5th digit

Metocarpophalangeal joints 2-5th digit, right lower extremity				
Digits	**2nd**	**3rd**	**4th**	**5th**
Dorsopalmar	X	XX	0	0
Rotation	X	XX	0	0
Meatarsophalangeal joints 2-5th digit, left lower extremity				
Digits	**2nd**	**3rd**	**4th**	**5th**
Dorsopalmar	X	XX	0	0
Rotation	X	XX	0	0

Table 5. Joint play of metatarsophalangeal joints 2-5th digit right and left lower extremity.

Metatarsophalangeal joint of the thumb

Metacarpophalangeal joint of the thumb		
	Right thumb	**Left thumb**
Rotation	X	X

Table 6. Joint play of metatarsophalangeal joint of the thumb.

Joint:	**Right**	**Left**

Head of fibula		
Dorsal direction	**X**	**X**
Ventral direction	**X**	**X**

Table 7. Joint play of fibula.

Joint:	**Right**	**Left**
Lisfranc joint		
Ventral	**X**	**X**
Plantar	**X**	**X**

Table 8. Joint play of Lisfranc joint.

Joint:	**Right**	**Left**
Talocrural joint		
Dorsal	**0**	**0**

Table 9. Joint play of talocrural joint.

Joint play of thoracic spine.

Springing examination in Th region, found blockages in the segments Th4-6.

Joint play of *SI* and *lumbar spine* was not done due to stiffness and pain.

Muscle strength test

Performed according to Kendall. (34)

	Right side	**Left side**
Quadriceps	5	5
Tensor fascia lata	5	5

Gluteus medius	4	4-
Gluteus maximus	4	3+
Iliop psoas	5	5
Quadratus lumborum	4	3+ *
Piriformis	5	4+
Gastrocnemius	5	4+
Soleus	5	5
Tibialis anterior	4	4-
Peroneus longus	4	4
Flexor hallucis longus	4+*	4-*
Flexor hallucis brevis	4+*	4*
Extensor halluces longus	4	4
Plantar interossei	4+	4+
Dorsal interossei	5	5
Rectus abdominis	4+	
Hamstrings	4	4

Table 10. Muscle strength test performed according to Kendall.

(*) = with pain

Conclusion initial kinesiological examination.

Posture evaluation shows hypotonic gluteal muscles and winging right scapula.

The patient has a upper thoracic breathing pattern, with visible activity of sternocleidomastoideus.

Gait evaluation by means of gait modifications (testing knee bend, heel and toe-walking) shows no neurological deficits.

Neurological examination revealed absent achilleas reflexes bilateral. Superficial and deep sensations were without any deficits.

Antropometry show no major dys-alignments, only a slightly more trophic left calf circumference, by 3cm.

By palpation, I found hypertrophic triceps surea, bilateral, but more on left leg, hypotrophic gluteal muscles, and hypertrophic hamstrings.

Reflex changes found in both calves, with restriction of fascia and skin in all directions.

ROM orientation found restriction in eversion and DF of feet, more on left, and pain when performing hip flexion with knee flexed, with knee extended, there was tension in hamstrings, more on left leg. The range of motion was slightly more decreased on left leg than on the right.

Positive Bragard's test on left leg.

Joint play of feet showed blocked 2nd and 3rd metatarsophalangeal joints, as well as the IP joint, in all directions. There were also blockages of fibula in both directions as well as the lisfranc joint. During the springing examination of the thoracic spine I also found some blockages of Th4-6.

Muscle strength test shows weak gluteal muscles, weak left tibialis anterior, and left quadratus lumborum. The last mentioned muscle were also tense and painful. She also felt some slight pain in left flexor hallucis longus during the testing.

3.4 Short-term plan

– Exercises for trunk stability: may be done by means of PNF techniques for pelvis for activation of the deep stabilization system.

– Mobilize restricted joint movements present, increasing restricted ROM.

– Mobility exercises for the joints of the foot and the ankle.

– Working with the muscle imbalance found in the upper and lower extremity.

– Increase muscle strength of abdominals and gluteals and therefore gain spinal stability.

– Traction techniques for reducing the pain in the left trochanter area.

Long-term plan:

– Torsion and mobility exercises for the spine.

– Exercises for the deep stabilization system.

– Core stability in sitting and standing.

– Educate the patient on good posture in sitting and standing.

– Educate the patient on good self-therapy exercises she can use when she goes home again after the stay at the rehabilitation clinic.

3.5 Therapy proposal

- PNF by Kabat, hold-relax-active movement and and rhythmic stabilization for muscle strength, especially for gluteal and abdominal muscles.
- Scar therapy when the bandage is removed, soft tissue techniques by Lewitt[vi] on lumbar and sacroiliac spine.
- Relaxation of quadratus lumborum by means of a PIR component of the pelvis technique in PNF. [vii]
- Spinal stability exercises by McKenzie.
- Exercises for pelvic floor and the gynecological area by Mojžíšova.

- PNF for pelvic movements of anterior elevation and posterior depression, using hold-relax active movement technique.

Physical therapy:

- Superficial heat: hot packs: indications: analgesic, reduction of muscle spasm. Applied for 20-30 minutes.
- Ultrasound (deep heat): analgesic effect. Apply 0, 5 to 2,0 W per cm2 for 10-15 min.
- Whirlpools. 30 min, 37 degrees.

3.6 Therapy progress

Day to day therapy

Date: 04.01.12. First meeting with this patient today

Subjective: Patient feels a stiff pain in her lower back and in the gluteal area, the pain did not propagated to the lower extremity.

Goals of today's therapy: Start with the initial examinations, apply therapy on the most outstanding parameters. Educations on transfers; from prone to standing and assistance to walking.

Therapy applied:

- Education of transfers, from prone position to standing and visa versa. Helping the patient in assisted walking.
- Education for thromboembolic prevention exercises: DF, PF and circular movements of ankles.
- Assisted stretch of calves in the direction of dorsal flexion and plantarflexion.
- Breathing therapy: Localized breathing and diapragmic breathing: breathing out the anesthetics.
- PIR on left triceps muscle.
- Mobilization techniques of metatarsophalangeal joints, lisfranc joint and fibula, focusing on left foot.
- Soft tissue technique; on skin, sub skin and fascia. Kibler's fold and facial stretch techniques on both calves.

Results: The restrictions of the fascia in both calves were released slightly, but one can still feel the tightness in calves, especially the left. After mobilizations of the acral part, the restrictions were less, especially in dorsiflexion of the ankle and eversion.

The patient felt a release of tension in the left triceps muscle, and felt that the therapies performed were pleasant.

The patient is able to transfer from prone to a standing position without any further problems, she is able to walk without any big pains.

Self therapy:

– After spinal surgery it is important to do prevent any damages to the spine by quick movements, such as flexion or torsion. Therefor the patient is taught how to transfer from the bed without performing these movements. The patient goes into a prone lying position, then he puts one leg on the floor, then the other, while having a straight spine.

- The patient is assisted on how to do thromboembolic exercises with DF, PF and circular movements of ankles.

– Breathing exercises: The patient is instructed on how to do localized breathing by places her hand on the abdomen, thorax or the upper chest. She exercises on breathing into her own palm.

Date: 05.01.12

Subjective: Patient feels no severe pains in her lower back and gluteal area today. The tension she felt around the scar area has improved.

Objectives: Today I performed more examinations as a control, due to have not been able to perform all the examinations the first day due to pain.

Control examination:

Joint play: Slight restriction and stiffness in Th4/5 region.

Muscle strength test: weakness of tibialis anterior, gluteals, hamstrings, quadratus lumborum.

Note. Gradings and overview of all muscles is in table 13.

Goals of today's therapy: Strengthen the weakened muscles showed in examination by means of PNF technique.

Therapy applied:

- PIR triceps.
- PNF first diagonal for strengthening tibialis anterior with Hold Relax Active movement technique.
- PNF technique for pelvis: activation of abdominal muscles: Rythmic stabilization in middle position, without movement of pelvis.
- Soft tissue technique; on skin, subskin and fascia. Kibler's fold and fascial stretch tecniques on both calves.
- Breathing therapy; localized breathing and practicing breathing wave.
- Exercises for the pelvic floor in side lying.
- Strengthening of gluteal muscles in prone position against resistance.

Result: The patient is able to do the exercises well, she will be able to go them as autotherapy: exercises such as the isometric exercises for gluteals and abdominals, and for the pelvic floor muscles in side lying position.

Self-therapy: isometric exercises for gluteals, abdominals and the deep stabilization system.

- Continuation of the breathing exercises with practicing the breathing wave and localized breathing.

Date: 06.01.12

Status:

Subjective: Patient feels some pain in the left greater trochanter area, and also the feeling of having cramps in the 2nd and 3rd metatarsophalangeal joints.

Objectives/examinations:

- Lassegue's test: Right: 70 degrees, left 50 degrees.
- Negative Bragard's test on left foot.
- Muscle strength examination for gluteus medius: Grading 4 according to Kendall.
- Springing examination of thoracic spine show blockages in area of Th4-6.

Goals of today's therapy:

Therapy applied:

- Springing mobilization of thoracic spine.
- Exercises for prevention of root fixation. Straight leg raise with dorsiflexion.
- Traction of the hip joint in the axis of collum femoris. Patient in supine position with flexed knee over therapists shoulder. Manual contact with both hands in the inguinal area, the tractions was also applied with parts of PIR.

Dorsal and plantar fan: With thumbs and thenars on dorsal side of metatarsal bones with 2nd – 5th fingertips on plantar side of metatarsal heads. The thumbs and thenars separate metatarsal bones. The fingertips push on the heads.

- Mobilization of metatarsophalangeal heads in dorsal and plantar directions.
- Eccentric and concentric strengthening of gluteal medius in side lying position.

Results: Control examinations show improvement in the special tests examined; Lassegue's and Bragards's test. Patient felt a release in the thoracic region after the mobilization and the cramps in the foot were not present after therapy. The pain in her left trochanter area was slightly released as well.

Self-therapy: Exercises for prevention of root fixation were instructed and she is also to do this alone.

Date: 09.01.12

Subjective: Today is the last day of the patient, she is happy that she is going home, and excited about her upcoming stay at the rehabilitation center Kladruby. She is happy that the worst pain in her lower back and gluteal area is gone and that she is able to perform more daily activities.

Objectives/examinations:

- Muscle strength test for tibialis anterior show improved strength.
- Soft tissue examinations show a release of tension and of reflex changes in calves.
- Lassegue's test: Right: 90 degrees, left 70 degrees.

Goals of today's therapy: Help and instruct the patient to walk in stairs and educate how to sit properly in bed. Perform final kinesiological examinations.

Therapy applied:

- Education on walking in stairs.
- Education on how to do unloaded sitting in bed.
- Isometric contraction exercises for gluteals and abdominals.
- Diaphragmatic breathing: Therapist put both palms on the site of the diapraphragma: patient does maximal inspiration and expires while therapist does vibration movement with palms.
- Rhythmic stabilization exercises in a sitting position: patient works against resistance, which is put on various points on the trunk.

Results: Patient feels no pain when she is sitting in bed, she has good stabilization in both sitting and standing. She is able to walk up some stairs, but feels slight pain in her left hip.

Self-therapy:

Patient places hands on abdomen, thorax, patient tried to breathing toward the palm.

- Isometric contraction exercises for gluteals and abdominals.
- For control of pelvic movements: patient lies in supine position, and slowly performs anteversion and retroversion of the pelvic. Can be performed three times daily.

– During sitting and standing I am asking the patient to be aware of her posture: avoid sitting in a kyphotic position, forward head position and that she contracts her abdominals and trunk muscles when standing and walking to activate the deep stabilization system.

3.6 Final examinations.

Changes from the Initial Kinesiological Examination are marked with* bold *letters.

- Posture evaluation

According to Kendall.[viii]

Posterior view:

- Narrow base of feet.
- Left calf **less** hypertrophic.
- Patellar lines aligned.
- Hypotrophic gluteal muscles, but in alignment.
- Right scapula winged.

Lateral view:

All joints are in good alignment to each other: ankle, knee, hip and shoulder joint.

Good position of the head, no forward position.

Anterior view:

- Patellas are in alignment.
- Trunk rotated slightly to the right.
- Clavicles aligned.

Pelvic examination.

- Crests are in alignment.
- Anterior superior iliac spine is more up on the right side.
- Posterior superior iliac spine is more down on the right side.

- Gait evaluation

A*ccording to Kendall.*

As a part of the neurological examination, various gait modifications can help us find out the segmental level in which the neurological deficit is in.

The patient performed gait with bend knees: Level of L4.

- Walking on heels: L5.
- Walking on tiptoes: S1.

The patient felt pain in the left leg during deep toe walking. She was able to walk on heels and with bend knees without any problems.

Results: The patient did not have any difficulties performing these modifications of gait.

Length and width of steps are equal and normal. There was little rotation of the trunk, and short swing of arms.

Balance and proprireceptive tests.

- Tredelenburg test both legs were negative.
- Vele's test was negative.
- Rhomberg position 1,2,3 were also negative.

- Neurological examination

Reflexes:

Deep tendon reflexes.

- Patella: present on both sides.
- Achilleas absent left, **present right achilleas reflex.**

Superficial sensation in the relevant dermatomes:

- L1,L2, L3, L4, L5, S1, S2.
- She had sensation in all the dermatomes, felt the same temperature and pressure on both legs.

Deep sensation:

- Position sense: The heel along the tibia: The patient is placing her right heel on the left tibia and trying to follow the length of the tibia. Done on both legs. The patient was able to do this.

- Movement position sense: Holding one arm up, and following with the other arm in the same position. The patient was able to perform it.

Breathing examination:

- Upper thoracic breathing.
- Hypertonic sternocleidomastoids. (Visible only in lying position).

Anthropometry performed in lying position.

	Right lower extremity	**Left lower extremity**
Thigh circumference	44 cm	46 cm
Knee circumference	34 cm	34 cm
Calf circumference	33 cm	**34** cm
Ankle circumference	22 cm	22 cm
Metatarsal circumference	22 cm	22 cm

Table 11. Anthropometry of the lower extremity.

Functional length: Anterior superior iliac spine to the medial malleolus.

- 85 cm right leg.
- 84 cm left leg.

Anatomical length: Trochanter to lateral malleolus: 78 cm both legs.

Palpation of muscles

	Right side			**Left side**		
Quadriceps	**Tonus**	**Pain**	**Trg. point**	**Tonus**	**Pain**	**Trg.point**
Tensor fascia lata	Physiological	No	No	Physiological	No	No
Gluteus medius	Physiological	No	No	Hypertone	Slight	No
Gluteus maximus	Hypotone	No	No	Hypotone	No	No
Iliop psoas	Physiological	No	No	Physiological	No	No
Quadratus lumborum	Hypertone	No	No	Hypertone	Yes	No
Piriformis	Hypertone	No	No	Hypertone	No	No
Gastrocnemius	Physiological	No	No	**Physiological**	Tense feeling	
Soleus	**Physiological**	No	No	**Physiological**	Slight	No
Tibialis anterior	Physiological	No	No	Hypertone	No	No
Rectus abdominis	Physiological	No	No	Physiological	No	No
Hamstrings	**Physiological**	No	No	**Physiological**	No	No

Peroneus longus	Physiological	No	No	Physiological	No	No
Erector spinae, thoracic part.	Physiological	No	No	Physiological	No	No

Table 12. Palpation of muscles in the LE.

Examination of reflex changes.

Kibler's fold: **The restrictions and reflex changes found in both calves are now released.**

Skin mobility and elasticity: **Released restrictions of both calves.**

Fascia: **Release of restriction of thoracal fascia in caudal direction.**

ROM

	Right lower extremity		**Left lower extremity**	
Movement	**Active**	**Passive**	**Active**	**Passive**
Hip flexion (w/knee flexed)	**90°**	**120°**	**90°**	**110°***
Hip extension	10°	10°	5°*	10°*
Hip abduction	30°	40°	20°*	30°*
Hip adduction	10°	10°	10°	10°
Internal rotation of hip	30°	40°	30°	35°
External rotation of hip	40 °	45 °	40 °	40°
Knee flexion	110°	120°	110°	120°

Knee extension	0°	0°	0°	0°
Dorsal flexion of ankle joint	15°	20°	**20°**	**20°**
Plantar flexion	35°	40°	30°	40°
Eversion of the foot	10°	20°	10°	**20°**
Inversion of the foot	30°	40°	30°	35°

Table 13. Range of motion of the lower extremity.

*= Movement accompanied with pain

Note. The tests were done orientationally, due to the type of diagnosis and time limitations. [ix]

Special tests:

Lassegue's test: Right 60 degrees. Left 40 degrees: Both negative.

Positive **Bragard's test** on left foot.

Joint play

Performed according to Lewitt. [x]

Explanation to tables: 0= No blockage X= Restricted XX= Blockage with pain

Proximal and distal phalanges, right lower extremity.					
Digit	**1st**	**2nd**	**3rd**	**4th**	**5th**
Dorsal	0	**0**	0	0	0
Ventral	0	0	**0**	0	0

Lateral	0	0	**0**	0	0
Proximal and distal phalanges, left lower extremity.					
Digit	**1st**	**2nd**	**3rd**	**4th**	**5th**
Dorsal	0	**0**	**0**	0	0
Ventral	0	0	**0**	0	0
Lateral	0	0	**0**	0	0

Table 14. Joint play in IP joint, Right and left lower extremity.

Metatarsophalangeal joints 2-5th digit

Metocarpophalangeal joints 2-5th digit, right lower extremity				
Digits	**2nd**	**3rd**	**4th**	**5th**
Dorsopalmar	**0**	**0**	0	0
Rotation	**0**	**0**	0	0
Meatarsophalangeal joints 2-5th digit, left lower extremity				
Digits	**2nd**	**3rd**	**4th**	**5th**
Dorsopalmar	**0**	**0**	0	0
Rotation	**0**	**0**	0	0

Table 15. Joint play of metatarsophalangeal joints 2-5th digit right and left lower extremity.

Metatarsophalangeal joint of the thumb

Metacarpophalangeal joint of the

thumb		
	Right thumb	**Left thumb**
Rotation	**0**	**0**

Table 16. Joint play of metatarsophalangeal joint of the thumb.

Joint: **Left**		**Right**
Head of fibula		
Dorsal direction	**0**	**0**
Ventral direction	**0**	**0**

Table 17. Joint play of fibula.

Joint: **Left**		**Right**
Lisfranc joint		
Ventral	X	X
Plantar	**0**	**0**

Table 18. Joint play of Lisfranc joint.

Joint: **Left**		**Right**
Talocrural joint		
Dorsal	**0**	**0**

Table 19. Joint play of talocrural joint.

Joint play of thoracic spine.

Springing examination in Th region, **blockaged released in the Th4-6 region.**

Joint play of *SI* and *lumbar spine* was not done due to stiffness and pain.

Muscle strength test

Performed according to Kendall.

	Right side	**Left side**
Quadriceps	5	5
Tensor fascia lata	5	5
Gluteus medius	4	**4**
Gluteus maximus	4	**4**
Iliop psoas	5	5
Quadratus lumborum	4	3+ *
Piriformis	5	4+
Gastrocnemius	5	4+
Soleus	5	5
Tibialis anterior	4	**4**
Peroneus longus	4	4
Flexor hallucis longus	4+*	4*
Flexor hallucis brevis	4+*	4*
Extensor halluces longus	4	4

Plantar interossei	4+	4+
Dorsal interossei	5	5
Rectus abdominis	4+	
Hamstrings	4	4

Table 20. Muscle strength test performed according to Kendall.

(*) = with pain

Scale test. *Performed on 09.01.*

Right side	**Left side**
20 kg	23kg

The “acceptable” rule is that the weight can vary by 10 % of the total weight, so for this patient, it is ok. [xi]

Conclusion final kinesiological examination.

The effect of the therapy will show in graphs in the section below. To summarize the final examination I would say that the parameters which have changes the most is –

The reflex changes in both calves have been released.

Right achilleas reflex is now present.

Range of motion has now increased in hip flexion, dorsiflexion of foot bilateral and eversion of left foot.

By means of **joint play** the restrictions found in both feet are now released, especially 2nd and 3rd metatarsophalangeal joints in all directions, fibula bilateral mostly in ventral direction. The restricted thoracal vertebras of th4-6 are also released.

Muscle trophy in left triceps has decreased, and increased strength of tibialis anterior is shown.

3.7 Evaluation of the effect of therapy

The patients post spinal surgeries are in the rehabilitation department for one to two weeks. The most important goals here are to release possible pain, educate them on transfers, and prevent any post-surgical complications such as thromboembolism and breathing difficulties. My patient was a very good patient in the sense that she understood well the exercises she was shown and that we could see she had a good background with various conservative treatments.

My patient had many favorable prognostic factor: she has a high motivational level to recover and return to function. She has a good fitness level. She spend one year prior to the surgery going through consistent conservative treatments. Due to her background with a plenty variety of exercises, she will be able to help herself with exercise in the recovery period. She was known to many of the exercises shown to her, and she was able to perform them correctly. I think it will benefit her that she postponed the surgery for one year, in order to try conservative treatments first, this have prepared her body for the surgery and the recovery process.

After the surgery she got rid of the worst pains in the lower back and gluteal area. The recovery time and process also will depend of the severity of the spinal pathology and the effect of the surgery. But in the medical reports the surgery was stated as successful.

From the background of this information, I believe the patient has a good prognosis if one looks back and compared to the severity of her previous low back pain level.

She may not be able to work again, as an accountant, but with a decreased pain level she might be able to do daily activities and sports without any further problems.

<u>This is the biggest changes of the therapeutic exercises:</u>

The reflex changes in both calves have been released.

Right achilles reflex is now present.

Range of motion has now increased in hip flexion, dorsiflexion of foot bilateral and eversion of left foot.

By means of **joint play** the restrictions found in both feet are now released, especially 2nd and 3rd metatarsophalangeal joints in all directions, fibula bilateral mostly in ventral direction. The restricted thoracal vertebras of Th 4-6 are also released.

Muscle trophy in left triceps has decreased, and increased strength of tibialis anterior is shown.

Summary of the thesis.

This thesis consists of a case study of physiotherapy treatment of a 45 year old female, with the diagnosis of a disc protrusion L5/S1.

The general part of the thesis explains and discusses the anatomy, kinesiology, biomechanics and pathologies of the lumbar spine. Rehabilitation and treatment related to post-surgical interventions is also discussed. The main aim of the thesis is to get an overview of the diagnosis lumbar herniation, in order to get better at diagnosing it and treating it for other patients in the future.

The specialized part was the case study itself, and consisted of the patient's anamnesis, differential consideration, initial kinesiological examinations, therapy proposals, short-term and long-term rehabilitation plans, therapy processes and a final kinesiological examination.

In the initial examination showed that the patient had some blockages of the small joint of the foot, and DF and PF of ankle, reflex changes in both calves with restrictions of fascia in all directions, weakness of gluteal muscles, and hypertrophy of left triceps muscle.

During the 4 therapy sessions, the main techniques used where soft tissue techniques, mobilization and PIR by Lewit, PNF strengthening techniques by Kabat, breathing exercises and education on transfers.

After therapy, one could see some improvements in the release of restrictions during joint play, the release of reflex changes, and that the patient was more independent in transfers and her lower back pain had dramatically decreased.

The patient is very motivated to continue with the exercises, and will be continuing with rehabilitation in Kladruby.

I have learned a great deal from this internship, from the different proceedings to various diseases after surgery, which standard exercises that should be performed and which techniques are most effective. I got to attend an operation, a discectomy, which I was very

excited about, it was wonderful to see how far medicine has gotten with its advanced procedures.

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6.1 Supplements

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6.3 List of abbreviations.

ABD- Abduction

ADD- Adduction

ADL- Activities of daily living

BMI- Body mass index

Cm- Centimeters

DF- Dorsal flexion

ER- External rotation

E- Extension

F- Flexion

FTVS- Fakulta Telesne Vychovy a Sportu

IR- Internal rotation

LE- Lower extremity

NSAID- Non-steroidal anti-inflammatory drugs

PIR- Post-isometric relaxation

PF- Plantar flexion

PNF- Proprioceptive neuromuscular facilitation

RHB- Rehabilitation

ROM- Range of motion

SI- Sacro-iliac

Th- Thoracic

TrPt- Trigger point

VAS- Visual analogue scale

6.4 Surgical approaches described in detail.

An outline of a training model for discectomy for surgical trainees:

First one cuts through the subcutaneous fat and lumbar fascia with a midline incision, the incision is about 2 cm. then the paraspinal muscles are dissected from the spinous processes and laminae. The paraspinal muscles are pulled laterally. After that the flavum ligament is cut from the surface of the lamina. The nerve root is retraced medially, then the intervertebral disk is exposed. Here the surgeons cut the posterior longitudinal ligament so that the disc space can be entered. The disc material is removed and replaced with an artificial disk (4, 32).

Microdiscectomy by tubular refractor.

The patient is positioned on a Wilson frame on a Jackson table. Fluoroscopy is used for confirmation of the correct surgical level and for refractor positioning. An incision of 1 cm is done ipsilateral to the pathology. Dilators are places to dilate the muscle and soft tissue, and the tubular retractor is places over these dilators. The fragment of the disk hernia is removed and the surgical instruments are removed (4).

There are some differences between the two previously explained techniques. In the standard discectomy the muscles are remove from the spinous process and lamina and retracted laterally, but by using the tubular retractor the muscles remain attach to the spinous process. The retractor is placed between the fibers of the para-spinous muscles. In this may no muscle is detached, but split. This may lead to less postoperative pain (43).

<u>These are the steps of one of the techniques performed for a lumbar laminectomy:</u>

1) Positioning of the patient prone. There is various types of frames that can be used, for example a kneeling-type frame by Orthopaedic System, Inc. or a four-poster frame by U.S.A. Medical. The benefits of the prone position is to allow some flexion at the hip in order to relax the iliopsoas, to let the abdomen hang free and to give the anterior pressure over the chest and lower extremities.

2) Posterior spinal exposure, the goal is to minimize blood loss and muscle dissection. Cutting of the skin is made at a subdermal level, and then the surgeons dissect the

subcutaneous tissue with an electrocautery. After this the dorsolumbar fascia is identified, the fascia is released from the spinous processes, where is eventually joins the lamina.

3) Spinous process resection. The spinous processes in the operated segment are resected using a bone cutting angled rongeur.

4) Laminae thinning, the laminae of the last lumbar vertebras; L3-5 is often thick and hypertrophic in spinal stenosis patients. The thinning of the laminae is used with rongeurs.

5) Midline bilateral laminectomy: After the bone is removed and the laminae thinned, the laminectomy is performed, starting caudally. The flavum ligament is released and the laminar bone is removed by angled Kerrison punchers.
6) Lateral decompression or foraminotomy: After the midline bilateral laminectomy, the caudal equina is depressed. In lateral decompression each nerve root in the area must also be decompressed with or without a foraminotomy.

7) Autogenous fat grafting: After the lateral decompression part, fat grafts are taken from the subcutaneous layer and placed on the surgical area. The reason of this is to avoid excessive epidural scarring.

8) Wound closure, optimal closing of the wound is to make the wound water thigh, drainage of the subfascial layer is places which will be removed on the first or second post-operative day.

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Application for Ethics Board Review

of the research project, doctoral research, master degree research, undergraduate research, involving human subjects

Project title: Case study of a patient post lumbar foraminotomy.

Nature of the research project: Undergraduate research.

Author: Solveig Sandstad.

Supervisor: Mgr. Agnieszka Kaczmarska.PhD.

Research project description
Case study of a physiotherapeutic treatment plan for a patient post foraminotomy. The patient chose surgical treatment of the diagnosis lumbar disc herniation after undergoing three years of conservative treatment. The practice was conducted under the supervision of my advisor Ms. Kaczmarska at the Ústřední vojenské nemocnice in Prague.

No invasive methods were used. Personal data obtained during the investigation will not be published.

Informed consent (attached)

Date: 25.01. Author's signature: SSandstad

Faculty of Physical Education and Sport, Charles University in Prague
ETHICS BOARD REVIEW

Ethics Board members: Doc. MUDr. Staša Bartůňková, CSc.
Prof. Ing. Václav Bunc, CSc.
Prof. PhDr. Pavel Slepička, DrSc.
Doc. MUDr. Jan Heller, CSc.

The Ethics Board at the Faculty of Physical Education and Sport, Charles University, approved the research project.
Approval number: 023/2012
Date: 30. 1. 2012

The Ethics Board at the Faculty of Physical Education and Sport, Charles University, reviewed the submitted research project and **found no contradictions with valid principles**, regulations and international guidelines for biomedical research involving human subjects.

The chief investigator of the project met the necessary requirements for receiving the Ethics Board approval.

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José Martího 31, 162 52, Praha 6
Official school stamp

Signature, REB Chairman

INFORMOVANÝ SOUHLAS

V souladu se Zákonem o péči o zdraví lidu (§ 23 odst. 2 zákona č.20/1966 Sb.) a Úmluvou o lidských právech a biomedicíně č. 96/2001, Vás žádám o souhlas k vyšetření a následné terapii. Dále Vás žádám o souhlas k nahlížení do Vaší dokumentace osobou získávající způsobilost k výkonu zdravotnického povolání v rámci praktické výuky a s uveřejněním výsledků terapie v rámci bakalářské práce na FTVS UK. Osobní data v této studii nebudou uvedena.

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

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

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

Datum:……

Osoba, která provedla poučení:……

Podpis osoby, která provedla poučení:……

Vlastnoruční podpis pacienta /tky:…….