Complex approaches and treatment of low back pain

Bachelor Thesis

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Declaration

I declare that this Bachelor Thesis is based entirely on my own individual work, and on my own practice that took place at Fakultní Nemocnice Vinohrady in Prague from 4.2.2008 – 15.2.2008. By the help of different books and websites, listed in the literature list in the end of this thesis, I managed to find all information needed for development of this Bachelor Thesis.

Prague, April 2008

...........................................

...........Martina Skvadlo................
Acknowledgement

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Martine Skudal

Prague, April 2008
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1. Abstract

Title: Complex approaches and treatment of low back pain

Thesis Aim: In the thesis I discuss about chronic low back pain. I have shown my result after 12 therapeutic sessions with one patient that had status post operationally treated radicular syndrome of L4/L5.

Clinical findings: The patient is a 27 year old girl, and her occupation is working as a car seller. Early in January 2008, her radiographies revealed lumbar dislocation, L4/L5. She had operation in the middle of January. According to the examination, muscle imbalances were detected especially in thoracolumbar and abdominal region. Her body was shifting to the left. Joint play restrictions were present in the C0 – C1 articulation, and in sacroiliac joint. She tested positive S reflex, and slightly hypertonus anal reflex. She felt stiff in costae and in coccyx. Reflex changes were detected in lumbar region. She revealed that sexual intercourse was unpleasant and that her menstruation was irregular after operation, until she started with contraceptives. Trigger points were detected in paravertebral muscles and in upper trapezius. Hypertonus were palpated in neck extensors, hip adductors, and pelvic muscles and in quadratus lumborum. Hypotonus with atrophy were palpated in the abdominal muscles.

Methods: The therapy included 12 sessions with the patient during two weeks, with mostly two sessions each day. Strength and stabilization exercises were performed for the whole body. Balance training, and sensor motor stimulation exercises were also performed. PIR technique were necessary for the hypertonus muscles, stretching techniques to elongate the shortened muscles, mobilization of restricted joints and strengthening exercises of the weak muscles. Breathing exercises for proper activation of the abdominal muscles. Massage and hot towel technique for relaxation of painful muscles and stiff fascia.

Result: After 12 session's improvement were detected in the final kinesiological examination. Shortened muscles were elongated, hypertonic muscles were relaxed, restricted ROM of head was increased, joint restrictions in C0 – C1 were mobilized, and strength of weakened muscles was improved. State of patient improved a lot during the 12 sessions.

Key words: chronic low back pain, status post radicular syndrome, deep stabilization system.
2. Preface

Complex approaches and treatment of low back pain, aim at clinical findings and different methods used for improvement of low back pain. It consists of two main sections. The first section is again divided into two head lines. The first involves the anatomical picture of the low back area; including bone structures, joints, and ligaments, movement of the vertebral column, vasculature system, nerves and muscles. The second headline, complex approaches and treatment of low back pain, involves information about causes and symptoms of low back pain.

The second main section reveal the anamnesis and examination of the patient, which include postural, gait, anthropometrical, strength, ROM, neurological, joint play, etc. There is also a detailed explanation of the rehabilitation sessions, which took place over a period of 14 days. The therapy involved mostly relaxation (PIR), mobilisation of joints, strength and stability, improvement of breathing technique, sensory motor stimulation training, and massage and fascia treatment. The result of the therapy and improvements take place in the final kinesiologic examination.
3. General part

3.1 Anatomy of the vertebral column

3.1.1 Vertebrae
The vertebral column in an adult typically consists of 33 vertebrae arranged in five regions: 7 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 4 coccygeal. Significant motion occurs only between the 25 superior vertebrae. Of the 9 inferior vertebrae, the 5 sacral vertebrae are fused in adults to form the sacrum and, after approximately age 30, the 4 coccygeal vertebrae fuse to form the coccyx. The lumbosacral angle occurs at the junction of, and is formed by, the long axis of the lumbar region of the vertebral column and the sacrum. The vertebrae gradually becomes larger as the vertebral column descends to the sacrum and then become progressively smaller toward the apex of the coccyx. The change in size is related to the fact that successive vertebrae bear increasing amounts of the body’s weight as the column descends. The vertebrae reach maximum size immediately superior to the sacrum, which transfers the weight to the pelvic girdle at the sacroiliac joint. (1)(2)

The vertebral column is flexible because it consists of many relatively small bones, called vertebrae that are separated by resilient IV discs. The 25 cervical, thoracic, lumbar, and first sacral vertebrae also articulate at synovial zygapophysial joints, which facilitate and control the vertebral column’s flexibility. Although the movement between two adjacent vertebrae is small, in aggregate the vertebrae and IV discs uniting them form a remarkably flexible and rigid column that protects the spinal cord they surround. (1)(2)

3.1.2 Structure and function of the vertebrae
A typical vertebra consists of a vertebral body, a vertebral arch, and seven processes. The vertebral body is the more massive, roughly cylindrical, anterior part of the bone that gives strength to the vertebral column and supports body weight. The size increases as the column
descends, most markedly from T4 inferiorly, as each bear progressively greater body weight.\(^{(1)}\)\(^{(2)}\)

The vertebral body consists of vascular, trabecular (spongy, cancellous) bone enclosed by a thin external layer of compact bone. The trabecular bone is a meshwork of mostly tall vertical trabeculae intersecting with short, horizontal trabeculae. The interstices of these trabeculae are occupied by red marrow that is among the most actively haematopoietic tissues of the mature individual. One or more large foramina in the posterior surface of the body accommodate basivertebral veins that drain the marrow.\(^{(1)}\)\(^{(2)}\)

Figure 2.\(^{(15)}\)

cartilage (vertebral "end plates"), which are remnants of the cartilaginous model from which the bone develops. At the periphery an epiphysial rim or ring of smooth bone, derived from an annular epiphysis, is fused to the body. The annular epiphysis and their cartilaginous remnants serve as growth zones, and provide some protection to the vertebral bodies and permit some diffusion of fluid between the IV discs and the capillaries in the vertebral body. The superior and inferior epiphyses usually unite with the centrum, the primary ossification centre for the central mass of the vertebral body.\(^{(1)}\)\(^{(2)}\)

The vertebral arch is posterior to the vertebral body and consists of two (right and left) pedicles and lamina. The pedicles are short, stout cylindrical processes that project posterior from the vertebral body to meet to broad, flat plates of bone, called lamina, which unite in the midline. The vertebral arch and the posterior surface of the vertebral body form the walls of the vertebral foramen. The succession of the vertebral foramina in the articulated vertebral column form the vertebral canal (spinal canal), which contains the spinal cord and the roots of the spinal nerves that emerge from it, along with the membranes (meninges), fat, and vessels that surround and serve them. The vertebral notches are indentations observed in lateral views of the vertebrae superior and inferior to each pedicle between the superior and inferior articular processes posteriorly and the corresponding projections of the body anteriorly. The superior and inferior vertebral notches of adjacent vertebrae and the IV discs connecting them form the intervertebral foramina, in which the spinal (posterior root) ganglia are located and through which the spinal nerves emerge from the vertebral column with their accompanying vessels.\(^{(1)}\)\(^{(2)}\)
Seven processes arise from the vertebral arch of a typical vertebra:

- One median spinous process projects posteriorly (and usually inferiorly, typically overlapping the vertebrae below) from the vertebral arch at the junction of the lamina.
- Two transverse processes projects posterolaterally from the junctions of the pedicles and lamina.
- Four articular processes: two superior and two inferior – also arise from the junctions of the pedicles and lamina, each bearing an articular surface (facet).

The former three processes, one spinous and two transverse, afford attachments for deep back muscles and serve as levers, facilitating the muscles that fix or change the position of the vertebrae.\(^{1(2)}\)

The latter four (articular) processes are in apposition with corresponding processes of the vertebrae adjacent (superior and inferior) to them, forming zygapophysial (facet) joints. Through their participation in these joints, these processes determine the types of movement permitted and restricted between the adjacent vertebrae of each region. The articular processes also assist in keeping adjacent vertebrae aligned, particularly preventing one vertebrae from slipping anteriorly on the vertebrae below. Generally, the articular processes bear weight only temporarily, as when one rises from the flexed position, and unilaterally when the cervical vertebrae are laterally flexed to their limit. However, the inferior articular processes of the L5 vertebrae bear weight even in the erect posture.\(^{1(2)}\)

### 3.1.3 Lumbar vertebrae

Lumbar vertebrae are located in the lower back between the thorax and sacrum. Because the weight they support increases toward the inferior end of the vertebral column, lumbar vertebrae have massive bodies, accounting for much of the thickness of the lower trunk in the median plane.
Their articular processes extend vertically, with articular facets sagitally orientated initially, but becoming more coronal orientated as the column descends. The L5 – S1 facets are distinctly coronal in orientation. In the more sagitally oriented superior joints, the laterally facing facets of the inferior processes of the vertebra above are "gripped" by the medially facing facets of the superior processes of the vertebra below, in a manner that facilitates flexion and extension, allows lateral flexion, but prohibits rotation. The transverse processes project somewhat posterolaterally as well as laterally. On the posterior surface of the base of each transverse process is a small accessory process, which provides an attachment for the medial intertransverse lumbarum muscle. On the posterior surface of the superior articular processes are mammillary processes, which give attachment to the multifidus and medial intertransverse muscles. Vertebra L5 is the largest of all moveable vertebrae: it carries the weight of the whole upper body. L5 is distinguished by its massive body and transverse processes. Its body is markedly deeper anteriorly; therefore, it is largely responsible for the lumbosacral angle between the long axis of the lumbar region of the vertebral column and that of the sacrum. Body weight is transmitted from L5 vertebra to the base of the sacrum, formed by the superior surface of S1 vertebra. (1) (2)

3.1.4 Joints of the vertebral bodies

The joints of the vertebral bodies are symphyses (secondary cartilaginous joints) designed for weight bearing and strength. The articular surfaces of adjacent vertebrae are connected by IV discs and ligaments. The IV discs provide string attachments between the vertebral bodies, uniting them into a continuous semi rigid column and forming the inferior half of the anterior border of the IV foramen. In aggregate, the discs account for 20 – 25 % of the length (height) of the vertebral column. As well as permitting movement between adjacent vertebrae, their resilient deformability allows them to serve as shock absorbers. Each IV disc consist of an annulus fibrosus, an outer
fibrous part, composed of concentric lamellae of the fibro cartilage, and a gelatinous central mass, called the nucleus pulposus.\(^{(1)}\)\(^{(2)}\)

The annulus fibrosus is a fibrous ring consisting of concentric lamellae of fibro cartilage forming the circumference of the IV disc. The annuli insert into the smooth, rounded epiphysial rims on the articular surfaces of the vertebral bodies formed by the fused annular epiphysis. The lamella fibres run obliquely from one vertebra to another. The fibres of one lamella run at right angels to those of the adjacent ones. This arrangement allows some movement between adjacent vertebrae, while providing a strong bond between them.\(^{(1)}\)\(^{(2)}\)

The nucleus pulposus is the central core of the IV disc. Their semi fluid nature is responsible for much of the flexibility and resilience of the IV disc and of the vertebral column as a whole. Vertical forces deform the discs, which though serves as shock absorbers. The pulpy nuclei become broader when compressed and thinner when tensed or stretched. Compression and tension occur simultaneously in the same disc during anterior and lateral flexion and extension of the vertebral column. During these movements, as well as during rotation, the turgid nucleus acts as a semi fluid fulcrum. Because the lamellae of the annulus fibrosus are thinner and less numerous posteriorly than they are anteriorly or laterally, the nucleus pulposus is not centred in the disc but more posterior placed. The nucleus pulposus is avascular; it receives its nourishment by diffusion from blood vessels at the periphery of the annulus fibrosus and vertebral body. The discs vary in thickness in different regions; they are thickest relative to the size of the bodies they connect. Their relative thickness is clearly related to the range of movement, and their varying shapes produce the secondary curvatures of the vertebral column. The discs are thicker anteriorly in lumbar regions.\(^{(1)}\)\(^{(2)}\)

3.1.5 Ligaments
The anterior longitudinal ligament is a strong, broad fibrous band that covers and connects the aterolateral aspects of the vertebral bodies and IV discs. The ligament extends from the pelvic surface of the sacrum to the anterior tubercle of the vertebrae C1 and the occipital bone anterior to the

\[\text{Figure 6.}\] (16)
foramen magnum. The ligament prevents hyperextension of the vertebral column, maintaining stability of the joints between the vertebral bodies. The anterior longitudinal ligament is the only ligament that limits extension; all other IV ligaments limit forms of flexion. (1) (2)

The posterior longitudinal ligament is a much narrower, somewhat weaker band than the anterior longitudinal ligament. The posterior longitudinal ligament runs within the vertebral canal along the posterior aspect of the vertebral bodies. It is attached mainly to the IV discs and less so to the posterior aspects of the vertebral bodies from C2 to the sacrum, often bridging fat and vessels between the ligament and the bony surface. This ligament weakly resists hyperflexion of the vertebral column and helps prevent or redirect posterior herniation of the nucleus polposus. It is well provided with nociceptive (pain) nerve endings. (1) (2)

3.1.6 Joints of the vertebral arches

The joints of the vertebral arches are the zygapophysial joints (facet joints). These articulations are plane synovial joints between the superior and the inferior articular processes of adjacent vertebrae. Each joint is surrounded by a thin, loose joint (articular) capsule. The loosest the more possible range of movement. The capsule is attached to the margins of the articular surfaces of the articular processes of adjacent vertebrae. Accessory ligaments unite the lamina, transverse processes, and spinous processes and help stabilize the joints. (1) (2)

The zygapophysial joints permit gliding movements between the articular processes; the shape and disposition of the articular surfaces determine the types of movement possible. The range of movement is determined by the size of the IV discs relative to that of the vertebral body. In the lumbar region, these joints bear some weight, sharing this function with the IV discs particularly during lateral flexion. The zygapophysial joints are innervated by articular branches that arise from the medial branches of the posterior rami of the spinal nerves. As these nerves pass posterioinferiorly, they lie in grooves on the posterior surfaces of the medial parts of the transverse processes. Each articular is supplies two adjacent joints; therefore, each joint is supplied by two nerves. (1) (2)

3.1.7 Accessory ligaments of the intervertebral joints

The lamina of adjacent vertebral arches are joined by broad, pale yellow elastic tissue called the ligament flava. These yellow ligaments extend almost vertically from the lamina above to the lamina below, those of opposite sides meeting and blending in the midline. The ligament binds
the lamina of the adjoining vertebrae together, forming alternating sections of the posterior wall of the vertebral canal. The ligament flava are thickest in the lumbar region. These ligaments resist separation of the vertebral lamina by arresting abrupt flexion of the vertebral column and thereby preventing injury to the IV discs. The strong elastic ligament flava help preserve the normal curvatures of the vertebral column and assist with straightening of the column after flexing. Adjoining spinous processes are united by weak, almost membranous interspinous ligaments and strong fibrous supraspinal ligaments. The thin interspinous ligaments connect adjoining spinous processes, attaching from the root to the apex of each process. The cord-like supraspinal ligament, which connects the apices (tips) of the spinous processes from C7 to the sacrum, merges superiorly with the nuchal ligament, the strong, broad, median band at the back of the neck. The intertransverse ligaments, connecting adjacent processes, are thin and membranous in lumbar region. 

Figure 7. (18)

3.1.8 Movements of the vertebral column
The range of movement of the vertebral column varies according to the region and the individual. The normal range of movement possible in healthy young adults is typically reduced by 50% or more as they age. The mobility results primarily from the compressibility and elasticity of the IV discs. The physiological movements of the vertebral column are flexion, extension, lateral flexion and extension, and rotation. The range of movement is limited by:

- Thickness, elasticity, and compressibility if the IV discs.
- Shape and orientation of the zygapophyssial joints.
- Tension of the joint capsules of the zygapophyssial joints.
- Resistance of the back muscles and ligaments (e.g., the ligament flava and the posterior longitudinal ligament).
- Attachment to the thoracic (rib) cage.
- Bulk of surrounding tissue.
Movements between adjacent vertebrae occur at the resilient nuclei pulposi of the IV discs and at the zygaphophysial joints. The latter joint permits some movements and restricts others. With the exception perhaps of C1 – C2, movement never occurs at a single segment of the column. Movement between adjacent vertebrae are relatively small, especially in the thoracic region, the summation of all the small movements produces a considerable range of movement of the vertebral column as a whole. Movements of the vertebral column are freer in the cervical and lumbar regions than elsewhere. (1) (2)

Flexion of the vertebral column is greatest in the cervical region. The sagittally orientated joint planes of the lumbar region are conducive to flexion and extension. Extension of the vertebral column is most marked in the lumbar region and is usually more extensive than flexion; however, the interlocking articular processes here prevent rotation. The lumbar region, like the cervical region, has IV discs that are large relative to the size of the vertebral bodies. Lateral flexion of the vertebral column is greatest in the cervical and lumbar regions. (1) (2)

The thoracic region, in contrast, has IV discs that are thin relative to the size of the vertebral bodies. Relative stability is also conferred on this part of the vertebral column, through its connection to the sternum by the ribs and costal cartilages. The joint planes here lie on an arc that is centred on the vertebral body, permitting rotation in the thoracic region. This rotation of the upper trunk, in combination with the rotation permitted in the cervical region and that at the atlantoaxial joints, enables the torsion of the axial skeleton that occurs as one looks back over the shoulder. However, flexion is limited in the thoracic region, including lateral flexion. (1) (2)

3.1.9 Vasculature of the vertebral column
Vertebrae are supplied by periosteal and equatorial branches of the major cervical and segmental arteries and their spinal branches. In lumbar spine those arteries involve lumbar arteries arising from aorta, as they cross the external surfaces of the vertebrae. Spinal branches enter the IV foramina and divide. Smaller anterior and posterior vertebral canal branches pass to the vertebral body and vertebral arch, respectively, and give rise to ascending and descending branches that anastomose with the spinal canal branches of adjacent levels. Anterior vertebral canal branches send nutrient arteries anteriorly into the vertebral bodies that supply most of the red marrow of the central vertebral body. The larger branches of the spinal branches continue as terminal radicular or segmental medullar arteries distributed to the posterior and anterior roots of the spinal nerves and their coverings and to the spinal cord, respectively. (1) (2)
**Red = Artery**
**Blue = Vein**

1 Carotid Artery
2 Aortic Arch
3 Thoracic Aorta
4 Abdominal Aorta
5 Iliac Artery
6 Internal Jugular Vein
7 Superior Vena Cava
8 Inferior Vena Cava
9 Iliac Vein

Spinal veins form venous plexuses along the vertebral column both inside and outside the vertebral canal. These plexuses are the internal vertebral venous plexus and external vertebral venous plexuses, respectively. These plexuses communicate through the intervertebral foramina. Both plexuses are densest anteriorly and posteriorly and relatively sparse laterally. The large, tortuous basivertebral veins form within the vertebral bodies. They emerge from foramina on the surfaces of the vertebral bodies (mostly the posterior aspect) and drain into the anterior internal vertebral venous plexuses, which may form large longitudinal sinuses. The intervertebral veins receive veins from the spinal cord and vertebral venous plexuses as they accompany the spinal nerves through the IV foramina to drain into the vertebral veins of the neck and segmental veins of the trunk. (1) (2)
3.1.10 Nerves of the vertebral column

Other than the zygapophyseal joints (innervated by articular branches of the medial branches of the posterior rami), the vertebral column is innervated by (recurrent) meningeal branches of the spinal nerves. These rarely described or depicted branches are the only branches to arise from the mixed spinal nerve, arising immediately after it is formed and before its division into anterior and posterior rami or from the anterior ramus immediately after its formation.

Two to four of these fine branches arise on each side at all vertebral levels. Close to their origin, the meningeal branches receive communicating branches from the nearby grey rami communicantes. As the spinal nerves exit the IV foramina, most of the meningeal branches run back through the foramina into the vertebral canal. However, some branches remain outside the canal and are distributed to the anterolateral aspect of the vertebral bodies and IV discs. They supply the periosteum and especially the annuli fibrosis and anterior longitudinal ligament. Inside the vertebral canal, transverse, ascending, and descending branches distribute nerve fibres to the:

- Periosteum (covering the surface of the posterior vertebral bodies, pedicles, and lamina).
- Ligament flavum
- Annuli fibrosis of the posterior and posterolateral aspect of IV discs.
- Posterior longitudinal ligament.
- Spinal dura mater.
- Blood vessels within the vertebral canal.

Nerve fibres to the periosteum, annuli fibrosis and ligaments supply pain receptors; those to the annuli fibrosis and ligaments also supply receptors for proprioception (the sense of one’s position). Sympathetic fibres to the blood vessels stimulate vasoconstriction. (1)(2)
### 3.1.11 Muscles of the vertebral column:

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Origin</th>
<th>Insertion</th>
<th>Nerve supply</th>
<th>Main action(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Erector spinae</strong></td>
<td>Arises by a broad tendon from posterior part of iliac crest, posterior surface of sacrum, sacroiliac ligaments, sacral and inferior lumbar spinous processes, and supraspinous ligament</td>
<td>Iliocostalis: lumborum fibers run superiorly to angles of lower ribs.</td>
<td>Posterior rami of spinal nerves</td>
<td>Acting bilaterally: extend vertebral column and head; as back is flexed, control movement by gradually lengthening their fibers. Acting unilaterally: laterally flex vertebral column</td>
</tr>
<tr>
<td>Iliocostalis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Longissimus</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spinalis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Deep layer**

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Origin</th>
<th>Insertion</th>
<th>Nerve supply</th>
<th>Main action(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transversospinalis</td>
<td>Tranverse processes</td>
<td>Spinosous processes of more superior vertebrae</td>
<td>Posterior rami of spinal nerves</td>
<td>Extension Multifidus: stabilizes vertebrae during local movements of vertebral column Multifidus: stabilizes vertebrae and assist with local extension and</td>
</tr>
<tr>
<td>Multifidus</td>
<td>Multifidus: from posterior sacrum, posterior superior iliac spine of ilium, aponeurosis of erector spinae, sacroiliac ligaments, mammillary processes of</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotatores (brevis and longus)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minor deep layer</td>
<td>Lumbar vertebrae, transverse processes of T1-T3</td>
<td>Superior to origin. Rotatores: fibers pass superomedially to attach to junction of lamina and transverse process or spinous process of vertebra immediately (brevis) or 2 segments (longus) superior to vertebra of origin</td>
<td>Rotatory movements of vertebral column; may function as organs of proprioception</td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Interspinalis</td>
<td>Superior surfaces of spinous processes of cervical and lumbar vertebrae</td>
<td>Inferior surfaces of spinous processes of vertebrae superior to vertebrae of origin</td>
<td>Posterior rami of spinal nerves</td>
<td>Aid in extension and rotation of vertebral column</td>
</tr>
<tr>
<td>Intertransversarii</td>
<td>Transverse processes of lumbar vertebrae</td>
<td>Transverse process of adjacent vertebrae</td>
<td>Posterior rami and anterior rami of spinal nerves</td>
<td>Aid in lateral flexion of vertebral column; acting bilaterally, stabilize vertebral column</td>
</tr>
<tr>
<td>Levatores costarum</td>
<td>Tips of transverse processes of C7 and T1-T11 vertebrae</td>
<td>Pass inferolaterally and insert on rib between tubercle and angle</td>
<td>Posterior rami of C8-T11 spinal nerves</td>
<td>Elevate ribs, assisting respiration; assist with lateral flexion</td>
</tr>
<tr>
<td>Muscle</td>
<td>Origin</td>
<td>Insertion</td>
<td>Nerves</td>
<td>Action</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Rectus abdominis</td>
<td>From costal cartilage of ribs 5–7, the xiphoid process, the intervening ligaments</td>
<td>Descends to the pubic crest</td>
<td>Intercostals nerves (T5 – T12)</td>
<td>Flexion, Lateral flexion</td>
</tr>
<tr>
<td>External oblique</td>
<td>From external surface of lower eight ribs</td>
<td>To linea alba and anterior iliac crest</td>
<td>Intercostals nerves (T5 – T12)</td>
<td>Flexion, lateral flexion, rotation to opposite side</td>
</tr>
<tr>
<td>Internal oblique</td>
<td>Inguinal ligament, iliac crest, and the lumbodorsal fascia</td>
<td>Linea alba and the lower four ribs</td>
<td>Internal abdominal oblique: intercostals nerves (T10 – T12 and L1)</td>
<td>Flexion, lateral flexion, rotation to the same side</td>
</tr>
<tr>
<td>Quadratus lumborum</td>
<td>Last rib, transverse processes of the first four lumbar vertebrae</td>
<td>Iliolumbar ligament, adjacent iliac crest</td>
<td>T12 and L1 – L3</td>
<td>Lateral flexion</td>
</tr>
<tr>
<td>Psoas major</td>
<td>Sides of twelfth thoracic and all lumbar vertebrae</td>
<td>Lesser trochanter of the femur</td>
<td>Direct branch from the lumbar plexus (L1 – L3)</td>
<td>Flexion</td>
</tr>
</tbody>
</table>

(1) (2) (11)
3.2 Complex approaches and treatment of low back pain

3.2.1 Radicular Syndrome
Radicular Syndrome is a combination of changes usually seen with compromise of a spinal root within the intraspinal canal; these include neck or back pain and, in the affected root distribution: dermatomal pain, paresthesias, or both; decreased deep tendon reflexes; occasionally myotomal weakness. (13)

3.2.2 Radicular pain
Pain in the motor system is due to nociceptive stimulation of pain receptors. How does pain occur in true mechanical root compression such as disc prolapse? Nerve compression alone causes paresis and anaesthesia, but no pain. Disc prolapse cannot impinge on the nerve root before acting on the dura and the dural sheaths. These dura and the dural sheaths structures are richly supplied with pain receptors and by every movement of the legs and trunk, the dural sheaths are being rubbed over the prolaps. Lasegue's sign indicates meningeal involvement. (4)

Pain is also primarily due to stimulation of pain receptors, even if there are clear neurological signs of nerve root involvement. The radiating pain in patients with radicular
syndrome is best localized by the use of autodermography. This is due to the fact that a nerve root does not contain fibres from one segment only, but transitory fibres from neighbouring segments are usually also present. An exception to this theory is that nerve root varies considerably in thickness: if a root is very thick on one side its neighbour is likely to be much thinner. On the other hand, if the L5 root is thick on the right, this needs not be on the left. If a very thin root is compressed or cut, there will be very little or no sensory change, but if a very thick root is involved there will be hardly any transitory fibres in the neighbouring root or roots; there will be marked hypoesthesia and some dysesthesia originating in the transitory fibres. A nerve root is not necessarily mono-segmental. (4)

Referred pain coming from receptors (i.e. dural sheaths), is felt in one segment only and therefore radiates only in the dermatome corresponding exactly to the compressed root. This is what we call a radicular syndrome, which is a combination of pain originating from pain receptors with irradiation in the segment, and of neurological signs of root compression (hypoesthesia, dysesthesia and paresis). (4)

The improvement of muscle strength in weak muscles and even of the tendon reflexes after manipulation, agrees with the showing that, in true radicular syndromes with clinical signs of muscle weakness, nerve conduction velocity may be normal. This may be interpreted as mere reflex inhibition. The prognosis of radicular syndromes might be worse in those cases where there is decreased conduction velocity. (4)

3.2.3 Vertebrae dislocation

Spine dislocation is when a vertebra in the human spine is forced out of the regular position. A total dislocation means there is no contact between any of the articulated surfaces of the vertebra whereas a partial dislocation suggests a degree of contact. There are a great number of nerves and blood vessels surrounding the area, any of which can be irritated or even compressed by the dislocation. The ligaments and tendons that have been stretched by the joint being forced apart can lose some of their elasticity resulting in a permanently weakened joint. Fast treatment leads to recovery within 6 weeks. Pain relief is usually first course of treatment. (12)
There is a slightly higher prevalence of spinal dislocation amongst adolescents due to lifestyle choices such as sports, careless driving and the influence of drink and drugs. The nature of spinal dislocations is usually accompanied with fracture.\textsuperscript{(12)}

This injury causes very high levels of pain, immobility of the affected joint and sometimes a very distinct deformity. Nausea and vomiting can also present due to the shock and high pain levels. A noticeable deformity and swelling and bruising around the site are very common; in spinal fractures these signs can be difficult to spot.\textsuperscript{(12)}

Treatment of spinal dislocation: most common course of treatment is to decompress, reduce and stabilise the spinal structures. This can be achieved by traction, spinal fusion, removal of the compressing tissue and realignment of the spine. Interventions include hands – on manipulation and spinal fusion. Manipulation is usually performed under the anaesthetic as the pain experiences can be excruciating. Dislocations of the thoracic, lumbar and sacral spine are very uncommon. Thoracic dislocations account for around 80% of the paraplegia sufferers.\textsuperscript{(12)}

Prevention: learning and demonstrating correct techniques at tackling or performing particularly difficult moves in sports is the best way to avoid injury.\textsuperscript{(12)}

Dislocation of vertebrae in the thoracic and lumbar regions is uncommon because of the interlocking of their articular processes. The transition from the relatively inflexible thoracic region to the much more mobile lumbar region occurs abruptly.\textsuperscript{(1)}

Failure of fracture of the interarticular parts of the vertebral lamina of L5 (spondylosis of L5) may result in forwards displacement of the L5 vertebral body relative to the sacrum (SI vertebrae) – spondylolisthesis. Spondylosis of L5, or susceptibility to it, probably results from a failure of the centrum of L5 to unite adequately with the neural arches at the neurocentral joint during development. Spondylolisthesis at the L5 – S1 articulation may result in pressure on the spinal nerves of the cauda equine as they pass into the superior part of the sacrum, causing back and lower limb pain.\textsuperscript{(1)}

3.2.4 Backache

For anamnesis it's important not only the factors acting upon the mechanical functioning of the spinal column, but also those that affect the (autonomic) nervous system – the weather, cold or heat, infection, hormonal changes (including menstruation), and psychological factors.\textsuperscript{(4)}
3.2.5 Low – back pain
The most powerful forces (muscles) act in the low back region, where the trunk has its greatest mobility and where the movement of the lower extremities must be transferred to the trunk. All this explains the great vulnerability of the region and the chances for many pathogenic factors. The term low – back pain includes pain radiating to both sides, towards hips or groin, or even to the thighs, and that the pain is usually asymmetrical. (4)

3.2.6 Low back pain due to ligament and muscular overstrain
In this type of low-back pain, not only need there be no morphological lesion, but the spinal column may be functioning normally, at least at the outset. The cause of strain may be exogenic, like excessively heavy physical labour, or more frequently work performed under conditions causing overstrain by faulty posture or bad movement patterns. More frequently, this overstrain is due to faulty static’s and/or movement patterns acquired during ontogenesis, such as difference in leg length, juvenile osteochondrosis, muscular imbalance, hypermobility, obesity etc., the common denominator is muscular and ligament overstrain. (4)

3.2.7 A tender coccyx
This condition may accompany the preceding one. It is low-back pain due to a tender coccyx of which the patient is often unaware. What patients believe is coccygeal pain may be due to painful lower sacroiliac dysfunction, to a positive “S”-reflex or even to a painful ischial tuberosity. Nor is injury the most frequent cause. Psychological tension and anxiety are frequent. (4)

3.2.8 A painful hip joint
Like pain originating in the coccyx, the patient frequently feels a painful hip joint as low-back pain. A painful hip joint should not be equated with coxarthrosis, although it may (but need not) be the initial stage of that disease. In 59 cases of painful hip with no (43) or very slight (16)
changes at X-ray examination, low-back pain was the most frequent complaint (33) (Lewit, 1977). For this reason examination of the hip joint (like that of the coccyx) is routine procedure in cases of low-back pain, and a painful hip joint may be the only relevant clinical finding. (4)

3.2.9 Blockage of the joints of the lumbar spine and of the sacroiliac joints
Low-back pain due to blockage of apophyseal joints and to blockage of the sacroiliac joints shares a common therapeutic approach on these conditions also have some clinical features in common. (4)

3.2.10 Low-back pain due to disc lesion
The cases grouped under this heading are those in which there is no radicular syndrome. It is essential to know when a disc lesion should be suspected in lumbago even without signs of root compression. If this is the case, it's necessary to deal with a lesion not only of function but (also) of structure. (4)

3.2.11 Pelvis distortion
Even if the case is one of low-back pain, this condition is always secondary. Although in itself a highly characteristic sign, the clinical picture corresponds to the lesion, which is causative and must be treated. If treatment is correct the pelvic distortion subsides spontaneously. In young people in particular, however, it is a hint that there is a lesion in the craniocervical junction that requires treatment. Adolescent with pelvic distortion frequently suffer from algomenorrhoea. This may be related to iliac spasm which is most frequently due to concomitant lumbosacral movement restriction. (4)

3.2.12 Innominate shear dysfunction (Greenman)
Innominate shear dysfunction, described by Greenman (1986), is another type of positional change of the pelvis, usually of traumatic origin. There can be a shift a shift at the symphysis, but
usually it is asymmetry at the anterior superior iliac spines, which on one side appears to be flatter and more lateral, while on the other side is more prominent and more medial. Increased muscular tone on the side of the more prominent spina and hypotonus on the opposite side is the rule in the lower abdomen. For treatment very simple reposition manoeuvres are used. (4)

The clinical picture is as rule one of severe low back-pain frequently with root lesions, and even cases of failed low-back operation. In such cases treatment of this lesion can be very effective. (4)

3.2.13 Dysfunction of the abdominal and gluteal muscles with a forward-drawn position and symphysial shift

There is a shift at the pubic symphysis and the ischial tuberosity, which goes hand in hand with muscular spasm: incoordination of the gluteal and abdominal musculature and a characteristic forward-drawn position. TrP are found regularly in the straight abdominal muscles which are tense (at least on one side); the abdomen is drawn in and there is little or no abdominal respiration. Attachment points of the straight abdominal muscles are tender at palpation in particular at the symphysis. At the same time there is hypertonus of the gluteal muscles, at least on one side, and on that side there is increased resistance against cranial shift of the gluteal muscles (a pathological barrier). On the side of hypertonus the ischial tuberosity appears to be lower. There is an apparent shift on the symphysis, too, at palpation. Forward-drawn position (owing to tension in the abdominal muscles) necessarily causes tension in the whole of the back and dorsal neck musculature. (4)

3.2.14 The “S”-reflex

In 1989, Silverstolpe described a reflex response to snapping palpation of a TrP in the mid-thoracic region, more frequently on the left side, causing contraction of the low lumbar erector spinae with dorsiflexion of the buttocks. When this reflex was present, he found a tender point situated laterally of the spina iliaca posterior superior at the level of the coccyx on the same side. If this was so, the patient felt a sharp pain if pressure was exerted with one finger on the sacrotuberous ligament. The palpating finger is displaced at the side of the coccyx pressing in a cranial direction on the ventral aspect of the sacrum. There the therapist meets resistance and the patient reacts painfully. Silverstolpe gives massage to the tender point: in our experience it is sufficient to wait at the barrier for release. The moment this reaction takes place, the TrP in the
thoracic region vanishes as well as the TrP at the buttock. This constitutes the therapeutic manoeuvre for what the authors call "pelvic dysfunction". As this phenomenon concerns postural muscles, patients may complain of symptoms in all sections of their spinal column as well as at the coccyx. (4)

3.2.15 Combined lesions
A combination of disorders is the rule, because all the structures involved in low-back pain are closely related forming chain reactions, so that if one link does not function properly, others are likely to function. (4)

In low-back pain due to overstrain, muscular imbalance and faulty static's may produce ligament overstrain and frequently pain in the spinous processes. However, joint blockage in any segments, too, is frequently the result of muscular imbalance, faulty static's or both. On the other hand, it may also be the cause of the imbalance. All of these disorders of function in the strict sense of the word may be, and often are, connected with disc lesions. (4)

3.2.16 Core musculature
The core has been defined as the lumbo-pelvic-hip complex, and the thoracic and cervical spine. The core is where the body's center of gravity is located and where all movement begins. An efficient core is necessary for maintaining proper muscle balance throughout the entire kinetic chain. (14)

There are 29 muscles that attach to the lumbo-pelvic-hip complex. In the muscles of the lumbo-pelvic-hip complex establish neuromuscular efficiency throughout the entire kinetic chain. This allows for efficient acceleration, deceleration, and stabilization during dynamic movements, as well as the prevention of possible injuries. (14)

The musculature of the core is divided into two categories: the stabilization system and the movement system. The stabilization system is primarily responsible for stability of the lumbo-pelvic-hip complex, whereas the movement system is responsible for the movement of the core. (14)
The core operates as an integrated functional unit, whereby the stabilization system must work in concert with the movement system. When working optimally, each structural component distributes weight, absorbs force, and transfers ground-reaction forces. These interdependent systems must be trained appropriately to allow the kinetic chain to function efficiently during dynamic activities. This means that we must work from the inside (stabilization system) out (movement system). Training the muscles of the movement system before training the muscles of the stabilization system would not make structural, biomechanical, or logic sense. This would be analogous to building a house without a foundation. One must be stable first to move efficiently. (14)

Figure 15. Loading of the lumbosacral junction without (top pic.) and with (bottom pic.) the support of the abdominal wall. (4)
Muscles of the core stabilisation systems:
- Transversus abdominis
- Internal oblique
- Lumbar multifidus
- Pelvic floor muscles
- Diaphragm
- Transversospinalis

Movement system:
- Latissimus dorsi
- Erector spinae
- Iliopsoas
- Hamstrings
- Hip adductors: add. magnus, add. longus, add. brevis, gracilis, pectineus
- Hip abductors: gluteus minimus, gluteus medius, tensor fascia latae
- Rectus abdominis
- External oblique

The core is formed by the pelvic floor, the deep abdominal muscles, the diaphragm, the deep layers of the erector trunci and the deep neck flexors;

In close connection are the iliopsoas, the quadratus lumborum and the superficial layers of the thoracolumbar erector trunci. In a caudal direction we find TrP’s in the adductors, the hamstrings (fibula) and in the muscles of the feet;

In a cranial direction in the pectoralis, subscapularis, the scaleni, trapezii, the sternomastoids and in the masticatory muscles. Movement restriction is regularly found at the feet, the fibula, in the lumbo-sacral and thoracolumbar region, at the cervico-thoracic junction, in the cervical region, in particular at the cranio-cervical junction.

3.2.17 The significance of constitutional hypermobility

Hypermobility is frequently an even more difficult problem, compared to movement restriction (blockage) and short muscles, and its with considerable significance for pathogenesis. Sachse (1969) distinguishes the following:
1. Local pathological hypermobility, which may be primary or secondary (compensatory, in the vicinity of a restricted joint); the latter is particularly characteristic of the spinal column.

2. Pathological generalized hypermobility, frequent in certain congenital and neurological conditions.

3. Constitutional hypermobility, which is most important from our point of view. In itself it is a variant of the norm, but under conditions of mainly static strain its pathogenic importance becomes evident. Overall mobility is greatest in childhood and decreases with age, being generally greater in women than in men. (4)

There are conditions in which hypermobility may even be an advantage, for instance in certain sports, in gymnastics, etc. and in employment where mobility is a requirement. It is accompanied by decreased stability, however, and as in most occupations today static posture predominates, these individuals are less able to adapt to static overstrain. As ligamentous laxity is usually accompanied by weakness of the postural muscles, the consequence is overstrain, resulting in pain. Some jobs are particularly unsuitable for such patients: they should not be dentists, for instance, or telephonists, or have to spend long periods bent over a desk or a machine. In some very pronounced cases there is a condition of general instability, a lack of coordination which can be interpreted as a type of minimal brain dysfunction. (4)

Observations by Janda (1978) are of great relevance: in patients with poor motor patterns, inclined to imbalance of the muscle groups, he found (1) minor neurological disturbances which he termed “microspasticity”, in which movements were not fully coordinated and appeared clumsy; (2) slight sensory impairment, in particular of proprioception; (3) worse adaptation to stress situations as a result of poorly coordinated behaviour. (4)

3.2.18 Gynaecological disorders and low-back pain
Gynaecological disorders have always been traditionally associated with low-back pain, and this is certainly no mere coincidence: there are significant clinical correlations. The usual pattern includes lesions of the lumbosacral junction, the sacroiliac joint (in young women frequently pelvic distortion), a tender coccyx, spasms of iliaceus, muscular imbalance of pelvic muscles, and ligament pain. (4)

1. Low back pain may be precipitated by gynaecological conditions such as pregnancy,
parturition, gynaecological disease or operation.

2. In a very large number of patients low-back pain of locomotor origin is mistakenly ascribed to gynaecological disturbances. One reason for this may be spasms of iliacus which is palpated as a site of tender resistance in the hypogastric region.

3. Menstruation pain with otherwise normal gynaecological findings, especially when localized in the low back, is usually of vertebrogenic origin and often the first clinical manifestation of dysfunction in the lumbosacral region. Labour pains felt in the low back in an otherwise normal delivery can be a similar pointer. (4)
4. Special part

4.1 Anamnesis

Student: Martine Skudal  
Study year: 3rd year physiotherapy

Workplace: Fakultní Nemocnice Vinohrady

Examined person: M. P. (female)

Date of birth: 1981

Diagnosis: Low back pain

Family anamnesis:

Father: high BP, heart attack at the age of 47
Mother: healthy

Psychosocial anamnesis:

Occupation: car seller
Exercise: fitness, figure skating and tennis on hobby basis

Abuses:

Irregular smoker between the ages of 18 – 22
Alcohol: only at special happenings.

Personal anamnesis:

Common childhood diseases
Borreliose: at the age of 24

August 2007: Local tickling pain in the lumbar region occurred after a hiking trip in cold weather. After long walks or when driving the pain proceeded to the lower extremities, to the posterior side of calf, down to the toes. Often toilet visits.
15.01.08: operation for protrusion of intervertebral disc L4/L5.
After operation she has no pain, but it is a little uncomfortable when lying on her back or when walking or standing for a long time.
She is living with her boyfriend, in a flat with no stairs.
Gynaecological:
Before operation: bleeding 2 days each month
After operation: bleeding 21 days the first month. She has now started on contraceptives.
No children

Diet:
Weight: 56 kg.
Height: 175 cm.

Pharmacology:
Contraceptive pills

Previous rehabilitation:
After the pain started she began swimming two times per week. She also received acupressure and massage.

Statement from the patient’s medical documentation:
Blood pressure: 125/75
Puls: 93
Temperature: normal

Indication of rehabilitation:
Spine: shifting to the left.

Present state:
She feels healthy and her mood is good, but her body is stiff and rigid.
No pain, but the spine shifting to the left and the scar decreases her mobility.

4.2 Initial kinesiologic examination:
4.2.1 Static standing evaluation: (6)

![Figure 13. (M. Skudal, 06.02.08)](image1)

![Figure 14. (M. Skudal, 06.02.08)](image2)

<table>
<thead>
<tr>
<th>Result on right side:</th>
<th>Dorsal view</th>
<th>Result on left side:</th>
</tr>
</thead>
<tbody>
<tr>
<td>external rotation of foot</td>
<td>Heel shape and position</td>
<td>lateral bearing</td>
</tr>
<tr>
<td>slightly thicker</td>
<td>Achilles tendon</td>
<td>Symmetrical</td>
</tr>
<tr>
<td>symmetrical</td>
<td>Calf</td>
<td>more elevated</td>
</tr>
<tr>
<td>asymmetric; slightly slimmer,</td>
<td>Popliteal lines</td>
<td>asymmetrical; short adductors:</td>
</tr>
<tr>
<td>short adductors: hypertrophy</td>
<td></td>
<td>hypertrophy</td>
</tr>
<tr>
<td>asymmetric; hypertrophy</td>
<td>Thigh contour</td>
<td>slight elevated</td>
</tr>
<tr>
<td>asymmetric, elevated</td>
<td>Subgluteal lines</td>
<td>Asymmetrical</td>
</tr>
<tr>
<td>asymmetric, elevated</td>
<td>Gluteal muscle tone</td>
<td></td>
</tr>
<tr>
<td>Elevated</td>
<td>Iliac crests</td>
<td>Greater outline</td>
</tr>
<tr>
<td>the spine is shifting to the left</td>
<td>Trunk outlines</td>
<td></td>
</tr>
<tr>
<td>the spine is shifting to the left</td>
<td>Spinosus processes</td>
<td>The spine is shifting to the left</td>
</tr>
<tr>
<td>the spine is shifting to the left</td>
<td>Scapula angels</td>
<td>Elevated</td>
</tr>
<tr>
<td>the spine is shifting to the left</td>
<td>Scapulas medial margin</td>
<td>more pronounced</td>
</tr>
<tr>
<td>Present</td>
<td>Scapula alata bilat</td>
<td>Present</td>
</tr>
<tr>
<td>less elevated</td>
<td>Shoulder position</td>
<td>Elevated</td>
</tr>
<tr>
<td>symmetrical</td>
<td>Auricles</td>
<td>Symmetrical</td>
</tr>
</tbody>
</table>

(TAB. 1)
**Result on right side:**
- Medial baring, flat longitudinal sole arch
- Symmetrical
- Symmetrical
- Asymmetric; slightly slimmer, short adductors: hypertrophy
- Asymmetric, elevated
- Asymmetric; hypertrophy, overworked
- Symmetrical
- Symmetrical
- Symmetrical
- Symmetrical
- Slightly elevated, slightly protracted
- Slight pronation
- Symmetrical

**Frontal view**
- Sole weight baring
- Calf
- Patella
- Thigh contour
- Ante superior iliac spine
- Umbilicus
- Abdominal muscles tone
- Sternum
- Nipple
- Pectoralis muscle tone
- Clavicles
- Shoulder position
- Dominant hand
- Face symmetry

**Result on left side:**
- Lateral baring
- Symmetrical
- Symmetrical
- Asymmetrical; short adductors: hypertrophy
- Asymmetrical
- Asymmetrical; hypertrophy, overworked
- Symmetrical
- Symmetrical
- Symmetrical
- Symmetrical
- Elevated, slightly protracted
- Symmetrical

**Figure 15.** (M. Skudal, 06.02.08)

**Figure 16.** (M. Skudal, 06.02.08)

(TAB. 2)
Figure 17. (M. Skudal, 06.02.08)

(TAB. 3)

<table>
<thead>
<tr>
<th>Side View</th>
<th>Result:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head: retro F</td>
<td></td>
</tr>
<tr>
<td>C lord: hypo</td>
<td></td>
</tr>
<tr>
<td>C - Th: flat</td>
<td></td>
</tr>
<tr>
<td>Elbow joint: semi F</td>
<td></td>
</tr>
<tr>
<td>Th kyphosis: flat</td>
<td></td>
</tr>
<tr>
<td>Th/L: flat</td>
<td></td>
</tr>
<tr>
<td>L lord: flat</td>
<td></td>
</tr>
<tr>
<td>Knee joint position:</td>
<td>right: semiflexion left:</td>
</tr>
<tr>
<td></td>
<td>hyperextension</td>
</tr>
</tbody>
</table>

(TAB. 4)

<table>
<thead>
<tr>
<th>Static Pelvis examination</th>
<th>Result:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posterior superior iliac spine</td>
<td>asymmetric, right elevated</td>
</tr>
<tr>
<td>Posterior inferior iliac spine</td>
<td>asymmetric, right elevated</td>
</tr>
<tr>
<td>Iliac crests</td>
<td>right elevated</td>
</tr>
<tr>
<td>Ante superior iliac spine</td>
<td>asymmetric, right elevated</td>
</tr>
</tbody>
</table>

(TAB. 5)

<table>
<thead>
<tr>
<th>Evaluation with scales</th>
<th>Result:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left:</td>
<td>32 kg</td>
</tr>
<tr>
<td>Right:</td>
<td>24 kg</td>
</tr>
</tbody>
</table>
4.2.2 Gait examination: \(^{(6)}\)

Walking on lateral side of left foot, particular heel and leg loading
Slight external rotation of the left foot
Instability in left lower extremity
Slightly more shifting to the left in the upper body
Asymmetrical movement of upper extremity
She has a stiff walking pattern, but with soft contact to the ground.

Walking on toes:
- Left: instability

Walking on heels:
- Whole body: slightly unstable

4.2.3 Anthropometric measurement: \(^{(6)}\)

<table>
<thead>
<tr>
<th>Length measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standing: 175 cm.</td>
</tr>
<tr>
<td>Sitting: She wasn’t able to sit</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Length of lower extremities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anatomical length:</td>
</tr>
<tr>
<td>Right: 83 cm | Left: 83 cm</td>
</tr>
<tr>
<td>Functional Length:</td>
</tr>
<tr>
<td>Right: 91 cm | Left: 90.5 cm</td>
</tr>
<tr>
<td>Thigh; trochanter major \rightarrow head of fibula:</td>
</tr>
<tr>
<td>Right: 47.5 cm | Left: 47 cm</td>
</tr>
<tr>
<td>Middle leg; knee joint \rightarrow malleolus lateralis:</td>
</tr>
<tr>
<td>Right: 43.5 cm | Left: 43 cm</td>
</tr>
<tr>
<td>Foot; heel to longest toe:</td>
</tr>
<tr>
<td>Right: 24.5 cm | Left: 24 cm</td>
</tr>
</tbody>
</table>
(TAB. 8 & 9)

<table>
<thead>
<tr>
<th>Circumference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thigh; 15 cm above knee joint:</td>
</tr>
<tr>
<td>Right: 42 cm.</td>
</tr>
<tr>
<td>Thigh; 10 cm above knee joint:</td>
</tr>
<tr>
<td>Right: 39 cm.</td>
</tr>
<tr>
<td>Knee:</td>
</tr>
<tr>
<td>Right: 35 cm.</td>
</tr>
<tr>
<td>Calf:</td>
</tr>
<tr>
<td>Right: 34 cm.</td>
</tr>
<tr>
<td>Ankle:</td>
</tr>
<tr>
<td>Right: 31 cm.</td>
</tr>
<tr>
<td>Foot:</td>
</tr>
<tr>
<td>Right: 22 cm.</td>
</tr>
</tbody>
</table>

4.2.4 ROM: (5)

Goniometry of active movement

Hip ROM

(TAB. 10)

<table>
<thead>
<tr>
<th>Right</th>
<th>Hip:</th>
<th>Left</th>
</tr>
</thead>
<tbody>
<tr>
<td>10°</td>
<td>Extension</td>
<td>10°</td>
</tr>
<tr>
<td>120°</td>
<td>Flexion</td>
<td>115°</td>
</tr>
<tr>
<td>35°</td>
<td>Abduction</td>
<td>40°</td>
</tr>
<tr>
<td>10°</td>
<td>Adduction</td>
<td>10°</td>
</tr>
<tr>
<td>40°</td>
<td>Lateral rotation</td>
<td>45°</td>
</tr>
<tr>
<td>40°</td>
<td>Medial rotation</td>
<td>35°</td>
</tr>
</tbody>
</table>

Spine distances

<table>
<thead>
<tr>
<th>Latero – flexion:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right: 56 cm</td>
</tr>
</tbody>
</table>

Flesch de forestier: 3 cm

Cepoj’s distance: 1 cm

38
4.2.5 Hypermobility: (6)

- Rotation of cervical spine: Grade B - moderate hypermobility
- Extension in MCP joints: Grade C - noticeable hypermobility
- Elbow joint extension of clasped forearms: Grade C - noticeable hypermobility
- Horizontal ADD in shoulder joint: Grade C - noticeable hypermobility
- Contact of hands behind trunk: Grade B - moderate hypermobility
- Scarf test – contact of hand around neck: Grade C - noticeable hypermobility

4.2.6 Examination of shortened muscles: (6)

(TAB. 11)

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastrocsoleus</td>
<td>0 - no shortness</td>
</tr>
<tr>
<td>Hip flexors</td>
<td></td>
</tr>
<tr>
<td>Rectus femori</td>
<td>0 - no shortness</td>
</tr>
<tr>
<td>Iliopsoas</td>
<td>0 - no shortness</td>
</tr>
<tr>
<td>Tensor fascia lata</td>
<td>0 - no shortness</td>
</tr>
<tr>
<td>Adductors</td>
<td>1 - moderate shortness</td>
</tr>
<tr>
<td>Hamstrings</td>
<td>0 - no shortness</td>
</tr>
<tr>
<td>Erector spinae</td>
<td>1 - moderate shortness</td>
</tr>
<tr>
<td>Quadratus lumborum</td>
<td>2 - marked shortness</td>
</tr>
<tr>
<td>Piriformis</td>
<td>2 - marked piriformis</td>
</tr>
<tr>
<td>Upper trapezius/levator scapulae</td>
<td>2 - marked shortness</td>
</tr>
<tr>
<td>Pectoralis</td>
<td>2 - marked shortness</td>
</tr>
<tr>
<td>Sternocleidomastoid</td>
<td>0 - no shortness</td>
</tr>
<tr>
<td>Short deep cervical extensors</td>
<td>1 - moderate shortness</td>
</tr>
<tr>
<td>Tibialis anterior</td>
<td>0 - no shortness</td>
</tr>
<tr>
<td>Vasti (vastus medialis obliquus)</td>
<td>0 - no shortness</td>
</tr>
<tr>
<td>Gluteus maximus</td>
<td>0 - no shortness</td>
</tr>
<tr>
<td>Gluteus medius and minimus</td>
<td>0 - no shortness</td>
</tr>
<tr>
<td>Abdominal wall</td>
<td>0 - no shortness</td>
</tr>
<tr>
<td>Deep neck flexors (longus colli and capitis)</td>
<td>0 - no shortness</td>
</tr>
<tr>
<td>Scalenes</td>
<td>0 - no shortness</td>
</tr>
</tbody>
</table>
4.2.7. Muscle strength testing: (5)

(TAB. 12)

<table>
<thead>
<tr>
<th>Right:</th>
<th>Lower extremities</th>
<th>Left:</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Rectus abdominis</td>
<td>5</td>
</tr>
<tr>
<td>4+</td>
<td>Quadratus lumborum</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Iliopsoas</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Gluteus maximus</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>Gluteus mini. – med.</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Adductors</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Obturator externus</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Tensor faciae latae</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Quad. Femoris</td>
<td>5</td>
</tr>
</tbody>
</table>

(TAB. 13)

<table>
<thead>
<tr>
<th>Right:</th>
<th>Upper extremeties</th>
<th>Left:</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Sternocleidomasto.</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Trapezius</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Serratus anterior</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Rhomboids</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>Trapezius pars. med.</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Trapezius pars. Cran</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Trapezius pars. Caud</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Pectoralis major</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Infraspinatus</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Subscapularis</td>
<td>5</td>
</tr>
</tbody>
</table>

4.2.8. Basic neurological examination: (6)

4.2.8.1 Palpation, assessment of muscle tone:

(TAB. 14)

<table>
<thead>
<tr>
<th>Right side:</th>
<th>Muscles</th>
<th>Left side:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertonus, TrP</td>
<td>Paravertebral muscles in lumbar region</td>
<td>Hypertonus, TrP</td>
</tr>
<tr>
<td>Hypertonus, TrP</td>
<td>Quadratus lumborum</td>
<td>Hypertonus</td>
</tr>
<tr>
<td>Hypertonus</td>
<td>Piriformis</td>
<td>Hypertonus</td>
</tr>
<tr>
<td>Hypertonus</td>
<td>Iliacus</td>
<td>Hypertonus</td>
</tr>
<tr>
<td>Hypertonus</td>
<td>Hip adductors</td>
<td>Hypertonus</td>
</tr>
<tr>
<td>Hypotonus with atrophy</td>
<td>Abdomen</td>
<td>Hypotonus with atrophy</td>
</tr>
<tr>
<td>Hypotonus</td>
<td>Gluteus maximus</td>
<td>Hypotonus</td>
</tr>
</tbody>
</table>

40
4.2.8.2 Modalities of sensation

- Position sense: could identify the toes positions.
- Sensory extinction: decreased sensation in L4 dermatome; medial side of calf.

4.2.8.3 Dynamic standing evaluation:

(TAB. 15)

<table>
<thead>
<tr>
<th>Dynamic standing evaluation</th>
<th>Result:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal walking: very good</td>
<td>Very good</td>
</tr>
<tr>
<td>Romberg’s sign: negative</td>
<td>Negative</td>
</tr>
<tr>
<td>Trendelenburg: positive</td>
<td>Positive</td>
</tr>
</tbody>
</table>

- On right leg: pelvis is shifting out
- On left leg: upper body is shifting to the left

**Figure.** (M. Skudal, 06.02.08)
### 4.2.8.4 Reflexes

(TAB. 16)

<table>
<thead>
<tr>
<th>Tendon and periost reflexes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patellar (quadriceps):</td>
</tr>
<tr>
<td>Right: negative – 3</td>
</tr>
<tr>
<td>Left: negative - 3</td>
</tr>
<tr>
<td>Ankle (Achilles):</td>
</tr>
<tr>
<td>Right: negative – 3</td>
</tr>
<tr>
<td>Left: negative - 3</td>
</tr>
<tr>
<td>Plantar flexion:</td>
</tr>
<tr>
<td>Right: negative – 3</td>
</tr>
<tr>
<td>Left: negative - 3</td>
</tr>
<tr>
<td>Anal reflex:</td>
</tr>
<tr>
<td>Hypertonus, but not as bad as expected</td>
</tr>
<tr>
<td>The S – reflex</td>
</tr>
<tr>
<td>Positive</td>
</tr>
</tbody>
</table>

**Pathological reflexes**

- **Babinski:**
  - Right: negative – 3
  - Left: negative - 3

- **Oppenheim:**
  - Right: negative – 3
  - Left: negative - 3

- **Chaddock:**
  - Right: negative – 3
  - Left: negative - 3

**Superficial reflexes**

- **Abdominal:**
  - **Epigastric:** Negative – 3
  - **Mesogastric:** Negative – 3
  - **Hypogastric:** Negative – 3

### 4.2.8.5 Pyramid declining phenomena

**Lower extremities:**

- Barré’s sign: negative, she was able to hold legs
- Phenomenom of retardation: negative, she was able to move in same speed and direction.
- Laségue's sign: negative, she felt no pain
4.2.9 Examination of scar: (6)

Scar is ok, slight decreased mobility. Reflex changes in underlying tissues.

4.2.10 Joint play: (7)

(TAB. 17)

<table>
<thead>
<tr>
<th>Cervical spine</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlanto-occipital joint:</td>
<td></td>
</tr>
<tr>
<td>Anti flexion:</td>
<td>50 % blockage, stiff end</td>
</tr>
<tr>
<td>Lateral flexion to left side:</td>
<td>50 % blockage, stiff end</td>
</tr>
<tr>
<td>Sacroiliac joint</td>
<td>Blockage in dorsal direction and in cross manoeuvre</td>
</tr>
</tbody>
</table>

4.2.11 Conclusion of initial kinesiology examination:

- Subjectively she feels discomfort when lying on her back or when walking or standing for a long time. In this case the main complaint is decompensated scoliotic position of column, following low back pain and stiffness of muscles and joints, due to muscle imbalance in thoracolumbar region and of the abdominal muscles. According to the examination, muscle imbalances were detected especially in thoracolumbar and abdominal region. Joint play restrictions were present in the C0 – C1 articulation, and in sacroiliac joint. She tested positive S reflex, and slightly hypertonus anal reflex. She felt stiff in costae and in coccyx. Reflex changes were detected in lumbar region. She revealed that sexual intercourse was unpleasant and that her menstruation was irregular after operation, until she started with contraceptives. Trigger points were detected in paravertebral muscles and in upper trapezius. Hypertonus were palpated in neck extensors, hip adductors, and pelvic muscles and in quadratus lumborum. Hypotonus with atrophy were palpated in the abdominal muscles.

- The patient declared that in some positions, like lying on her back or when standing or walking for a long time, she got tired in her low back. Some days she experienced stiff muscles in feet and palms. The stiff muscles pain started after the operation, 15. January
2008. By choosing comfortable positions, she avoids increased strain on her body, and the pain diminishes.

- The patient’s family had no similar anamnesis or postural problems.
- She only uses contraceptive pills. It can influence laxicity of ligaments.
- She is a non smoker and only drinks alcohol at special occasions.
- Muscular imbalance is present in the following muscles:
  - Superficial Abdominal Muscles; external abdominal oblique, internal abdominal oblique, transverse abdominis
  - Medial group; rectus abdominis
  - Deep Abdominal Muscles: quadratus lumborum
- The scar is healing properly and looks good. Decreased mobility and with reflex changes present in the surrounding tissue (lumbar region, pelvic region).
4.3 Short-term and long-term rehabilitation plan:

Short-term plan:
- Improve the tonicity between abdominal muscles (decrease rectus, increase transversus)
- Improve the tonus between abdominal muscles
- Increase the stability of muscles in Th-L region, in all directions.
- Relaxation of the fascia around scar to decrease the reflex changes in lumbar, sacral, glutei and inquina region.
- Improve the scar mobility.
- Improve mobilisation in feet, head of fibula, SI joint, lumbar vertebrae, costae and AO joint.
- Improve breathing pattern (low abdominal and thoracic).
- Decrease tonus of right piriformis, left iliacus, and short adductors in hip and abdominal muscles.
- Strengthening of gluteus maximus, rhomboids, and abdominal muscles.

Long-term plan:
- Improve the posture of spine. The upper body is shifting to the left in coronal plane. The plan is to unite the whole body around the longitudinal axis.
- Improve the position of scapulae and shoulders. The shoulders are protracted and the medial border of scapulae’s are pronounced. The plan is to retract the shoulders and strengthen the rhomboids, after improved stability in Th-L region.
- Improve the cooperation between different body parts: pelvis, abdomen, scapulae, shoulders, and spine.
- Decrease reflex changes around scar.
- Increase stability of trunk.
- Improve walking: static and dynamic phase.
4.4 Rehabilitation:

Wednesday, 06.02.08:

Present status: She felt good today

Goal of today’s therapy unit:
- Improve breathing technique, for proper activation of m. transverse abdominals and facilitation of diaphragmatic breathing.
- Improve strength and stability of generally whole body
- Improve the sensory motor stimulation

Procedure:
- 1. Therapy session:
  - Breathing exercises in supine lying
  - Strength and stability exercise, with big ball
  - Strength of lower extremities: extensors, quadriceps, adductors (by Kendall)
  - Sensory motor stimulation: Rocker board, active and active assisted modelling of the small foot.

Results:
- The therapy session went good
- She improved her breathing technique, with proper activation of m. transverse abdominals and facilitation of diaphragmatic breathing
- The sensory motor stimulation exercises were effective.

Thursday, 07.02.08

Present status: She felt stiff in costae

Goal of today’s therapy unit:
- Decrease reflex changes in thoracolumbal and pelvic region
- Decrease pain in costae
- Increase strength and stability in thoracolumbar region
- Increase sensory motor stimulation
- Improve breathing technique
Procedure:
1. Therapy session:
   - Mobilisation of scar
   - Reflex massage of the fascia in thoracolumbar and pelvic region (by Sherbak)
   - Mobilisation of shoulder joint (by Mojzisová).

2. Therapy session:
   - Posture mat: for stabilization of whole body
   - Strength and stability exercise with big ball.
   - Sensory motor stimulation; balance exercise on blue soft pads.
   - Breathing exercises

Results:
- Decrease of pain in costae
- The sensory motor simulative exercises showed good results
- She improved her breathing pattern

Friday, 08.02.08

Present status: She felt good today, but with a stiff neck

Goal of today's therapy unit:
- Relaxation of muscles

Procedure:
1. Therapy session:
   - Posture examination
   - Weight; left side: 32, right side: 24
   - PIR: quadratus lumborum – due to hypertonus/ over worked (both sides)
   - Mobilisation/Examination of neck: atlanto-occipital joint, 50 % blockage
   - PIR: neck extensors, look up – look down – due to stiff neck, heading to the left
   - PIR: trapezius, right and left side. Over worked

Results:
- She felt more relaxed in the hypertonic muscles
Monday, 11.02.08

**Present status:** She felt good today

**Goal of today’s therapy unit:**
- Increase sensory motor stimulation
- Decrease pain in costae
- Improve stability of the body
- Increase strength and stability in thoracolumbar region
- Improve breathing technique

**Procedure:**
1. Therapy session:
   - Posture + lateral flexion of spine
   - Weight; left side: 30, right side: 26
   - Sensory motor stimulation: active modelling of the small foot + with support by a stick – for improving the stabilization
   - Mobilisation of shoulder joint (by Mojzísová).
2. Therapy session:
   - Posture mat: for stabilization of whole body
   - Strength and stability exercise with big ball.
   - Balance exercise on blue soft pads.
   - Breathing exercises

**Results:**
- Sensory motor stimulation was effective
- Her breathing patterns were good
- Decrease of pain in costae

Tuesday, 12.02.08

**Present status:** She’s got a cold, and felt stiff in both lower extremities and in palms

**Goal of today’s therapy unit:**
- Decrease pain in both lower extremities
- Relaxation of pelvic muscles
- Decrease pain in palms
Procedure:

1. Therapy session:
   - Hot towel therapy on the feet (by Brugger), and massage and mobilisation of the joints.
   - Mobilisation of both fibular heads (by K. Lewit).
   - Massage of both calf muscles.
   - Tense coccyx
   - PIR: of gluteus and pelvic muscles, and piriformis.
   - Mobilisation examination of SI joint
   - Sitting for the first time after operation

2. Therapy session:
   - Pain in both palms
   - Hot towel therapy in both palms, and massage in between metatarsal joints.
   - PIR: right and left hand flexors, and subscapularis.

Results:

- The pain in lower extremities and palms disappeared

Wednesday, 13.02.08

Present status: She had no pain today, but still has a cold

Goal of today’s therapy unit:

- Relaxation of calf muscles
- Decrease pain in costae
- Improve sitting posture

Procedure:

1. Therapy session:
   - Hot towel therapy on the calf’s (by Brugger), and massage and mobilisation of the calf muscles.
   - Mobilisation (by K. Lewit) and massage in between metatarsal joints.
   - Examination and mobilisation of scar was not painful.

2. Therapy session:
   - Mobilisation of scapulae’s in prone position (by K. Lewit).
   - Mobilisation of shoulders in side lying position (by Mojzisová)
- Mobilisation of shoulder in sitting position (by Mojzísová)
- Training correct sitting position (by Brugger)

Results:
- Relaxation of calf muscles
- Decrease of pain in costae
- The sitting posture looked quite good

Thursday, 14.02.08

Present status: She felt good, but with tension in the costae

Goal of today's therapy unit:
- Decrease tender feeling in costae
- Relaxation of upper trapezius

Procedure:
1. Therapy session:
   - Mobilisation of shoulder in sitting position (by Mojzísová), for painful costae
   - Massage of upper trapezius, because it is in hypertonus.
   - Mobilisation of shoulder in side lying, prone, and supine position (by Mojzísová), for the costae
   - Relaxation of upper thorax

Results:
- Decrease of pain in costae
- Relaxation of trapezius

---

Friday, 15.02.08

Present status: She had pain in costae

Goal of today's therapy unit:
- Decrease the pain in costae
- Improve muscle length of ER in hip
- Relaxation of paravertebral muscles
- Improve blockage in SI joint
- Decrease reflex changes in thoracolumbar and pelvic region
- Strengthening the adductors of scapula

**Procedure:**

1. Therapy session:
   - Mobilisation of shoulders in prone and side lying position (by Mojzísová)
   - PIS: stretching of ER in hip, in prone position
   - Massage of the paravertebral muscles on the right side in thoracic region, because they are in hypertonus.
   - Mobilisation of hip joint in supine position (by Mojzísová), for the blockage of SI joint
   - Mobilisation of spine, counter clockwise mobilisation (by K. Lewit)
   - Soft tissue therapy of the fascia in thoracolumbar and pelvic region
   - Isotonic contraction of the adductors of scapulae’s

**Results:**

- Decrease of pain in costae
- Increased ER in hip
- Relaxation of paravertebral muscles
4.5 Final kinesiologic examination

4.5.1 Static standing evaluation: (6)

(TAB. 18)

<table>
<thead>
<tr>
<th>Result on right side:</th>
<th>Dorsal view</th>
<th>Result on left side:</th>
</tr>
</thead>
<tbody>
<tr>
<td>external rotation of foot</td>
<td>Heel shape and position</td>
<td>lateral bearing</td>
</tr>
<tr>
<td>slightly thicker</td>
<td>Achilles tendon</td>
<td></td>
</tr>
<tr>
<td>Symmetrical</td>
<td>Calf</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Popliteal lines</td>
<td>more elevated</td>
</tr>
<tr>
<td>asymmetric; slightly</td>
<td>Thigh contour</td>
<td>asymmetrical; short adductors:</td>
</tr>
<tr>
<td>slimmer, short adductors:</td>
<td>Subgluteal lines</td>
<td>hypertrophy</td>
</tr>
<tr>
<td>hypertrophy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Symmetrical</td>
<td>Posterior superior iliac spine</td>
<td>symmetrical</td>
</tr>
<tr>
<td>Symmetrical</td>
<td>Posterior inferior iliac spine</td>
<td>symmetrical</td>
</tr>
<tr>
<td>asymmetric: slightly</td>
<td>Iliac crests</td>
<td>asymmetrical</td>
</tr>
<tr>
<td>elevated</td>
<td>Trunk outlines</td>
<td>greater outline</td>
</tr>
<tr>
<td>The spine is shifting a little</td>
<td>Spinosus processes</td>
<td>the spine is shifting a little to the left</td>
</tr>
<tr>
<td>to the left</td>
<td>Scapula angels</td>
<td>elevated</td>
</tr>
<tr>
<td></td>
<td>Scapulas medial margin</td>
<td>more pronounced</td>
</tr>
<tr>
<td>Present</td>
<td>Scapula alata bilat</td>
<td>present</td>
</tr>
<tr>
<td>less elevated</td>
<td>Shoulder position</td>
<td>elevated</td>
</tr>
<tr>
<td>Symmetrical</td>
<td>Auricles</td>
<td>symmetrical</td>
</tr>
</tbody>
</table>
Result on right side: | Frontal view | Result on left side:  
---|---|---  
medial baring | Sole weight baring | lateral baring  
symmetrical | Calf | symmetrical  
symmetrical | Patella | symmetrical  
asymmetric; slightly slimmer, short adductors: hypertrophy | Thigh contour | asymmetrical; short adductors: hypertrophy  
asymmetrical, elevated | Ante superior iliac spine | asymmetrical  
| Umbilicus | shifting to left side  
asymmetrical; hypertrophy | Abdominal muscles tone | asymmetrical; hypertrophy  
symmetrical | Sternum | symmetrical  
symmetrical | Nipple | symmetrical  
symmetrical | Pectoralis muscle tone | symmetrical  
symmetrical | Clavicles | symmetrical  
slightly elevated, slightly protracted | Shoulder position | elevated, slightly protracted  
slight pronation | Dominant hand |  
symmetrical | Face symmetry | symmetrical
(TAB. 20)

<table>
<thead>
<tr>
<th>Side View</th>
<th>Result:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head:</td>
<td>retro F</td>
</tr>
<tr>
<td>C lord:</td>
<td>Hyper</td>
</tr>
<tr>
<td>C - Th:</td>
<td>Flat</td>
</tr>
<tr>
<td>Elbow joint:</td>
<td>semi F</td>
</tr>
<tr>
<td>Th kyphosis:</td>
<td>Flat</td>
</tr>
<tr>
<td>Th/L:</td>
<td>Flat</td>
</tr>
<tr>
<td>L lord:</td>
<td>Flat</td>
</tr>
<tr>
<td>Knee joint position:</td>
<td>Right: semiflexion</td>
</tr>
<tr>
<td></td>
<td>left: hyperextension</td>
</tr>
</tbody>
</table>

(TAB. 21)

<table>
<thead>
<tr>
<th>Static Pelvis examination</th>
<th>Result:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posterior superior iliac spine</td>
<td>symmetrical</td>
</tr>
<tr>
<td>Posterior inferior iliac spine</td>
<td>asymmetrical</td>
</tr>
<tr>
<td>Iliac crests</td>
<td>right: slightly elevated</td>
</tr>
<tr>
<td>Ante superior iliac spine</td>
<td>asymmetric, right elevated</td>
</tr>
</tbody>
</table>

(TAB. 22)

<table>
<thead>
<tr>
<th>Evaluation with scales</th>
<th>Result:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left:</td>
<td>29 kg</td>
</tr>
<tr>
<td>Right:</td>
<td>27 kg</td>
</tr>
</tbody>
</table>

4.5.2 Gait examination

Walking on lateral side of left foot
Slight external rotation of the left foot
Small instability in left lower extremity
Slightly shifting to the left in the upper body
Asymmetrical movement of upper extremity
She has a more relaxed walking pattern, and with soft contact to the ground.

Walking on toes:
- Left: slightly unstable

Walking on heels:
- Whole body: slightly unstable
4.5.3 Anthropometric measurement:

(TAB. 23)

<table>
<thead>
<tr>
<th>Spine distances</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Latero – flexion:</td>
<td></td>
</tr>
<tr>
<td>Right: 48 cm</td>
<td>Left: 49 cm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flesch de forestier:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2 cm</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cepoj’s distance:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2 cm</td>
<td></td>
</tr>
</tbody>
</table>

(TAB. 24)

Length measurement

<table>
<thead>
<tr>
<th></th>
<th>Standing:</th>
<th>Sitting:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>175 cm.</td>
<td>90 cm.</td>
</tr>
</tbody>
</table>

(TAB. 25)

Length of lower extremities

<table>
<thead>
<tr>
<th>Anatomical length:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Right: 83 cm</td>
<td>Left: 83 cm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Functional Length:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Right: 91 cm</td>
<td>Left: 90.5 cm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thigh; trochanter major → head of fibula:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Right: 47.5 cm</td>
<td>Left: 47 cm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Middle leg; knee joint → malleolus lateralis:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Right: 43.5 cm</td>
<td>Left: 43 cm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Foot; heel to longest toe:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Right: 24.5 cm</td>
<td>Left: 24 cm</td>
</tr>
</tbody>
</table>

4.5.4 ROM:

Goniometry of active movement

Hip ROM

(TAB. 26)

<table>
<thead>
<tr>
<th>Right</th>
<th>Hip:</th>
<th>Left</th>
</tr>
</thead>
<tbody>
<tr>
<td>10°</td>
<td>Extension</td>
<td>10°</td>
</tr>
<tr>
<td>120°</td>
<td>Flexion</td>
<td>120°</td>
</tr>
<tr>
<td>40°</td>
<td>Abduction</td>
<td>40°</td>
</tr>
<tr>
<td>10°</td>
<td>Adduction</td>
<td>10°</td>
</tr>
<tr>
<td>45°</td>
<td>Lateral rotation</td>
<td>45°</td>
</tr>
<tr>
<td>40°</td>
<td>Medial rotation</td>
<td>35°</td>
</tr>
</tbody>
</table>
4.5.5 Hypermobility: (6)

- Rotation of cervical spine: Grade B - moderate hypermobility
- Extension in MCP joints: Grade C - noticeable hypermobility
- Elbow joint extension of clasped forearms: Grade C - noticeable hypermobility
- Horizontal ADD in shoulder joint: Grade C - noticeable hypermobility
- Contact of hands behind trunk: Grade B - moderate hypermobility
- Scarf test – contact of hand around neck: Grade C - noticeable hypermobility

4.5.6 Examination of shortened muscles: (6)

(TAB. 27)

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastrocsoleus</td>
<td>0 - no shortness</td>
</tr>
<tr>
<td>Hip flexors</td>
<td></td>
</tr>
<tr>
<td>Rectus femori</td>
<td>0 - no shortness</td>
</tr>
<tr>
<td>Iliopsoas</td>
<td>0 - no shortness</td>
</tr>
<tr>
<td>Tensor fascia lata</td>
<td>0 - no shortness</td>
</tr>
<tr>
<td>Adductors</td>
<td>1 - moderate shortness</td>
</tr>
<tr>
<td>Hamstrings</td>
<td>0 - no shortness</td>
</tr>
<tr>
<td>Erector spinae</td>
<td>1 - moderate shortness</td>
</tr>
<tr>
<td>Quadratus lumborum</td>
<td>1 - moderate shortness</td>
</tr>
<tr>
<td>Piriformis</td>
<td>1 - moderate piriformis</td>
</tr>
<tr>
<td>Upper trapezius/levator scapulae</td>
<td>1 - moderate shortness</td>
</tr>
<tr>
<td>Pectoralis</td>
<td>2 - marked shortness</td>
</tr>
<tr>
<td>Sternocleidomastoid</td>
<td>0 - no shortness</td>
</tr>
<tr>
<td>Short deep cervical extensors</td>
<td>1 - moderate shortness</td>
</tr>
<tr>
<td>Tibialis anterior</td>
<td>0 - no shortness</td>
</tr>
<tr>
<td>Vasti (vastus medialis obliquus)</td>
<td>0 - no shortness</td>
</tr>
<tr>
<td>Gluteus maximus</td>
<td>0 - no shortness</td>
</tr>
<tr>
<td>Gluteus medius and minimus</td>
<td>0 - no shortness</td>
</tr>
<tr>
<td>Abdominal wall</td>
<td>0 - no shortness</td>
</tr>
<tr>
<td>Deep neck flexors (longus colli and capitis)</td>
<td>0 - no shortness</td>
</tr>
<tr>
<td>Scalenes</td>
<td>0 - no shortness</td>
</tr>
</tbody>
</table>
4.5.7. Muscle strength testing: *(5)*

(TAB. 28)

<table>
<thead>
<tr>
<th>Right:</th>
<th>Lower extremities</th>
<th>Left:</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Rectus abdominis</td>
<td>5</td>
</tr>
<tr>
<td>5 -</td>
<td>Quadratus lumborum</td>
<td>5 -</td>
</tr>
<tr>
<td>5</td>
<td>Iliopsoas</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Gluteus maximus</td>
<td>5</td>
</tr>
<tr>
<td>5 -</td>
<td>Gluteus mini. – med.</td>
<td>5 -</td>
</tr>
<tr>
<td>5</td>
<td>Adductors</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Obturator externus</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Tensor faciae latae</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Quad. Femoris</td>
<td>5</td>
</tr>
</tbody>
</table>

(TAB. 28)

<table>
<thead>
<tr>
<th>Right:</th>
<th>Upper extremeties</th>
<th>Left:</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Sternocleidomasto.</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Trapezius</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Serratus anterior</td>
<td>5</td>
</tr>
<tr>
<td>4 +</td>
<td>Rhomboids</td>
<td>4 +</td>
</tr>
<tr>
<td>4 +</td>
<td>Trapezius pars. med.</td>
<td>4 +</td>
</tr>
<tr>
<td>5</td>
<td>Trapezius pars. Cran</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Trapezius pars. Caud</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Pectoralis major</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Infraspinatus</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Subscapularis</td>
<td>5</td>
</tr>
</tbody>
</table>

4.5.8. Basic neurological examination: *(6)*

4.5.8.1 Palpation, assessment of muscle tone:

(TAB. 29)

<table>
<thead>
<tr>
<th>Right side:</th>
<th>Muscles</th>
<th>Left side:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertonus, TrP</td>
<td>Upper trapezius</td>
<td>Hypertonus, TrP</td>
</tr>
<tr>
<td>Hypertonus, TrP</td>
<td>Paravertebral muscles in lumbar region</td>
<td></td>
</tr>
<tr>
<td>Hypertonus</td>
<td>Quadratus lumborum</td>
<td>Hypertonus</td>
</tr>
<tr>
<td>Hypertonus</td>
<td>Piriformis</td>
<td>Hypertonus</td>
</tr>
<tr>
<td>Hypertonus</td>
<td>Iliacus</td>
<td>Hypertonus</td>
</tr>
<tr>
<td>Hypotonus with atrophy</td>
<td>Abdomen</td>
<td>Hypotonus with atrophy</td>
</tr>
</tbody>
</table>
4.5.8.2 Modalities of sensation

- Position sense: could identify the toes positions.
- Sensory extinction: normal sensation in L4 dermatome; medial side of calf.

4.5.8.3 Dynamic standing evaluation:

(TAB. 30)

<table>
<thead>
<tr>
<th>Dynamic standing evaluation</th>
<th>Result:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Normal walking: very good</td>
<td>Very good</td>
</tr>
<tr>
<td>- Romberg’s sign: negative</td>
<td>Negative</td>
</tr>
<tr>
<td>- Trendelenburg: positive</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>- On right leg: pelvis is shifting out</td>
</tr>
<tr>
<td></td>
<td>- On left leg: upper body is shifting to the left</td>
</tr>
</tbody>
</table>

Figure 20. (M. Skudal, 15.02.08)  
Figure 21. (M. Skudal, 15.02.08)
4.5.8.4 Reflexes

(TAB. 31)

<table>
<thead>
<tr>
<th>Tendon and periost reflexes</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patellar (quadriceps):</strong></td>
<td></td>
</tr>
<tr>
<td>Right: negative – 3</td>
<td>Left: negative - 3</td>
</tr>
<tr>
<td><strong>Ankle (Achilles):</strong></td>
<td></td>
</tr>
<tr>
<td>Right: negative – 3</td>
<td>Left: negative - 3</td>
</tr>
<tr>
<td><strong>Plantar flexion:</strong></td>
<td></td>
</tr>
<tr>
<td>Right: negative – 3</td>
<td>Left: negative - 3</td>
</tr>
</tbody>
</table>

**The S – reflex**
Positive

**Pathological reflexes**

<table>
<thead>
<tr>
<th>Babinski:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Right: negative – 3</td>
<td>Left: negative - 3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Oppenheim:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Right: negative – 3</td>
<td>Left: negative - 3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chaddock:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Right: negative – 3</td>
<td>Left: negative - 3</td>
</tr>
</tbody>
</table>

**Superficial reflexes**

<table>
<thead>
<tr>
<th>Abdominal:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Epigastric:</td>
<td>Negative – 3</td>
</tr>
<tr>
<td>Mesogastric:</td>
<td>Negative – 3</td>
</tr>
<tr>
<td>Hypogastric:</td>
<td>Negative – 3</td>
</tr>
</tbody>
</table>

4.5.8.5 Pyramid declining phenomena

**Lower extremities:**
- Barré’s sign: negative, she was able to hold legs
- Phenomenom of retardation: negative, she was able to move in same speed and direction.
- Lasègue’s sign: negative, she felt no pain

4.5.9 Examination of scar: (6)

Scar is fine, increased mobility. Still some reflex changes present in the underlying tissues.
4.5.10 Joint play: (7)

<table>
<thead>
<tr>
<th>Cervical spine</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlanto-occipital joint:</td>
<td></td>
</tr>
<tr>
<td>Ante flexion:</td>
<td>no blockage, but stiff end</td>
</tr>
<tr>
<td>Lateral flexion to left side:</td>
<td>no blockage, but stiff end</td>
</tr>
<tr>
<td>Sacroiliac joint</td>
<td>blockage in dorsal direction</td>
</tr>
</tbody>
</table>

4.5.11 Conclusion of final kinesiology examination:

In her final kinesiology examination she showed a lot of improvement. First of all, in her posture examination it is great improvement of the spine. The protraction of shoulder was still present. Shortened muscles are elongated, especially the ER’s in hip. Hypertonic muscles are more relaxed, such as quadratus lumborum, piriformis, and paravertebral muscles. The restricted ROM is increased. And she improved her physical strength of generally the whole body. There are no longer blockage of CO –C1, both in ante flexion and lateral flexion. The joint play is firm and soft. Blockage of sacroiliac joint on right side was still present. The muscular pain in palms and feet is decreased. No decreased sensitivity in L4 dermatome.
4.6 Therapy effect

After the 12 rehabilitation sessions the patient had improvements. The most fascinating finding was of the decompensated scoliotic position of spine. Although, the spine still has to be corrected more, after two weeks it became less decompensated and gave a more erect picture. The muscular imbalance in thoracolumbar and abdominal region was decreased. And she improved her physical strength of generally the whole body, which is extremely important for good developing of the stabilization system, followed by movement system. The joint play of C0 – C1, both in ante flexion and lateral flexion felt softer, with no blockages present. Blockage of sacroiliac joint on right side was still present. The protraction of shoulder was still present, but with continuing relaxation and strengthening in that area, we will see improvements. Previous hypertonic muscles; paravertebral, piriformis, and pectoralis, became more relaxed, and the muscular pain in palms and feet decreased. She admitted that both the physically and mentally shape had increased.
4.7 Prognosis

The prognosis for this patient is very good for my patient. She had great improvement during her 14 days of therapy, as you can see on the before and after pictures (in initial and final kinesiology examination). If she continues the autotherapy program she will improve her posture even more. As the posture will become more erect, the blockages, the muscular imbalance and the hypertonic muscles will disappear. If she improves her general physical fitness level, it will prevent further problems in the future.
5. Conclusion

During my two weeks of clinical practice, at Fakultní Nemocnice Vinohrady, I gained great knowledge. I saw much, and I did a lot, both with my own patient and with all the other patients which were there, with different problems. Different problems, made it very interesting for me. Even though the Czech language sat its limitations, when communicating with patients, they showed a positive attitude. This made it easier for me, as a student in a foreign country, to be able to perform my best. It was very exciting to get my own patient, be in charge of the examination and decide most of her therapy. The most productive part was to see her improvement in posture position. It's amazing what therapy can do to a person. My patient was willing to cooperate and motivated for improvements, together with the therapy it gave good results.

My adviser at Vinohrady Nemocnice, Mgr. Vendula Jezková, guided and helped me during my practice. She advised me both in a professional and humanistic way, which was really determining for the therapy success and for fulfilling the goals of my practice.
6. List of literature

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15. BROWN, J. J., MD FACR, Mallinckrodt Institute of Radiology, Washington University School of Medicine, St. Louis, MO. Review provided by VeriMed Healthcare Network. Available at: www.nlm.nih.gov/.../ency/fullsize/9538.jpg


Application for
Opinion of UK FTVS Ethic Committee
On the project of Bachelor Thesis including human participants

Title: Radicular Syndrome

Project form: Bachelor Thesis

Author: (crucial author) Martina Skudal

Supervisor (in case of student project) Hgr. Klará Fialčová

Project description
The case report of rehabilitation the patient with anamnesis elaborated with the vocational sight of physiotherapist in Health care unit. No one invasive procedure will be applied.

Proposal of Agreement (enclosed)

Prague 07.04.08

Author's signature: Martina Skudal

Statement
UK FTVS Ethic Committee

Committee members: Ass. Prof. Staša Bartůňková, M.D., CSc.
Prof. Ing. Václav Bunc, CSc.
Prof. PhDr. Pavel Slepička, DrSc
Ass. Prof. Jan Heller, MD., CSc.

The project was authorized by Ethic Committee UK FTVS with reference number: 01/2008

Date: 4.4.2008

Ethic Committee UK FTVS evaluated submitted project and found no discrepancy to valid principles, instructions and international guidelines for biomedical research, including human participants.

Author of project fulfilled necessary conditions for the agreement of Ethic Committee.

Signature of EC chairman

International student office
Phone: 00420220172350
E-mail: assistantofstfa@ftvs.cuni.cz
7.2 List of abbreviations

1) IV: intervertebral
2) L5: fifth lumbar vertebra
3) T4: fourth thoracic vertebra
4) Co: occipital bone
5) C1: first cervical vertebra (atlas)
6) C2: second cervical vertebra (axis)
7) C7: seventh cervical vertebra
8) C8: eighth cervical vertebra
9) T1: first thoracic vertebra
10) T3: third thoracic vertebra
11) T4: fourth thoracic vertebra
12) T5: fifth thoracic vertebra
13) T10: tenth thoracic vertebra
14) T11: eleventh thoracic vertebra
15) T12: twelfth thoracic vertebra
16) L1: first lumbar vertebra
17) L3: third lumbar vertebra
18) L4: fourth lumbar vertebra
19) L5: fifth lumbar vertebra
20) S1: first sacral vertebra
21) SI: sacroiliac joint
22) BP: blood pressure
23) Kg: kilogram
24) Cm: centimeter
25) F: flexion
26) C: cervical spine
27) Th: thoracic spine
28) L: lumbar spine
29) MCP: metacarpalphalangeal joint
30) AO: atlantoccipital joint
31) m: muscle
32) PIR: post-isometric relaxation
33) ROM: range of motion
34) SCM: sternocleidomastoid
35) B: brevis
36) L: longus
37) ER: external rotators
38) PIS: post-isometric stretching
39) TrP: trigger points
40) ADD. Adduction
41) ABD: abduction