CHARLES UNIVERSITY IN PRAGUE
FACULTY OF PHYSICAL EDUCATION AND SPORTS

The case study of the physiotherapeutic treatment of a patient with cervicobrachial syndrome combined with deformities and degenerative changes of the spine

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Title: The case study of the physiotherapeutic treatment of a patient with cervicobrachial syndrome combined with deformities and degenerative changes of the spine.

Thesis aim: The following case study has been conducted during the month of January 2011 on a 67 years old patient addressed to the Centrum Léčby Pohybového Aparátu for the rehabilitation of a cervicobrachial syndrome. The thesis first reviews the actual knowledge in terms of kinesiology, neurology, biomechanics and pathology underlying the patient's condition; in addition, an attempt to expose the risk factors of developing such a disorder has been done. In a second part, the treatment course, including the anamnesis, the kinesiologic examinations and the therapy itself is related in details.

Clinical findings: The patient presented an altered posture of swayback type, characteristic muscles imbalances accompanying such a disorder and in addition a lumbar scoliosis and arthrosis in several joints. The pain as related by the patient, has been determined as radiating along the C7 dermatome, and ranked at 8 at its maximal onset on the visual analogue pain scale. Reflex changes as well as inflammatory processes have also been noted.

Results: After 9 therapy sessions spread over a month, the patient displayed remarkable progresses in terms of pain relief, posture improvement and correction of muscles imbalances.

Methods: Along with the therapeutic methods taught at the Faculty of Physical Education and Sport, the chosen procedures included: post isometric relaxation and stretching by Lewit, soft tissues techniques by Lewit, sensomotoric training, proprioceptive neuromuscular facilitation by Kabat, thermotherapy, mobilization by Lewit and ergodynamics education. To enhance the effects of the therapy, the patient has been in addition required to perform home therapies as instructed during the sessions. Finally, a strict evaluation of the pain in the beginning and ending of each therapy session has been done in order to evaluate the therapy's effects.

Conclusion: The results as assessed in the end of the thesis demonstrate the effectiveness of both the chosen therapeutic procedures and strategy of rehabilitation.

Key Words: Cervicobrachial syndrome, cervical spine, lumbar spine, degenerative changes, visual analogue pain scale, spondylosis.

☙ DECLARATION ❧

I declare that I worked out my thesis separately, under the guidance of a consultant Mgr. Lenka Satrapová. I used only cited professional and literary sources and no information has been misused, all were authorized and adequately documented.

Prague, the 8th of August 2011 Carine Jiquelle

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I would like to express my keenest recognition to my partner, without whom I would have never become and remained a student from the Charles University. I warmly thank in addition my friends for their patient yet persistent correcting of my English and teaching me of their fascinating cultures.

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I would like to deeply thank my teachers, who have thought me to require the finest cares for my patients. Finally, I address my deepest gratitude to my supervisor, Mgr. Lenka Satrapova, for her sincere commitment, professionalism and general optimism and kindness during the realisation of this thesis.

☙TABLE OF CONTENT❧

1. Introduction

The vertebral column possesses a pivotal position within the locomotor apparatus as it constitutes a structural and functional supporting base for the whole body, links dynamically the upper and lower extremities and constitutes the protective structure of the spinal cord. As a result, any dysfunction or change in its physiological functioning is most likely to extend and cause further pathological changes in terms of locomotion and neurological involvements.

As it will be exposed in a special part, the case study that has been conducted in the Centrum Léčby Pohybového Aparátu during the month of January 2011 perfectly illustrates such pathological processes and highlights the difficulties of a conservative treatment for this type of condition. It will be preceded by a first general part, in will we will review the relevant knowledge concerning the vertebral column and more specifically the cervical and lumbar column. We will then treat generally the possible degenerative changes of the spinal column and finally tackle the general pathogenesis of one pathological condition that may arise from those degenerative changes: the cervicobrachial syndrome.

2. General part

2.1. Review of the relevant knowledge

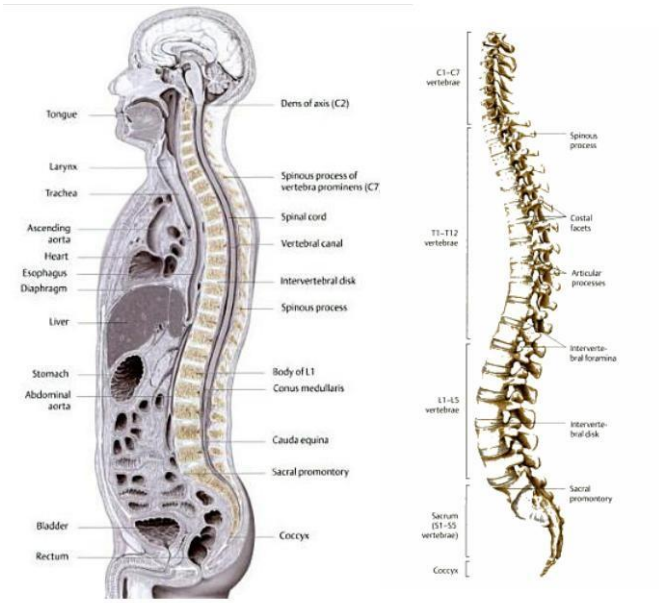
In this part we will review the relevant knowledge concerning the spine as a whole in terms of anatomy, kinesiology and neurology. We will precise some specificities displayed by the cervical and the lumbar spine in order to support the presentation that is done in the following parts of this work.

2.1.1. Anatomy of the spine

2.1.1.1. General

The vertebral column is constituted generally by a pile of 33 distinctively shaped bones, the vertebrae and 23 articular structures, the intervertebral discs. Because of the curves and structural differences that it physiologically shows, the vertebral column is classically divided in 5 regions which are the cervical, thoracic, lumbar, sacral and coccygeal portions forming the cervical lordosis, thoracic kyphosis, lumbar lordosis (Putz and Pabst, 2006).

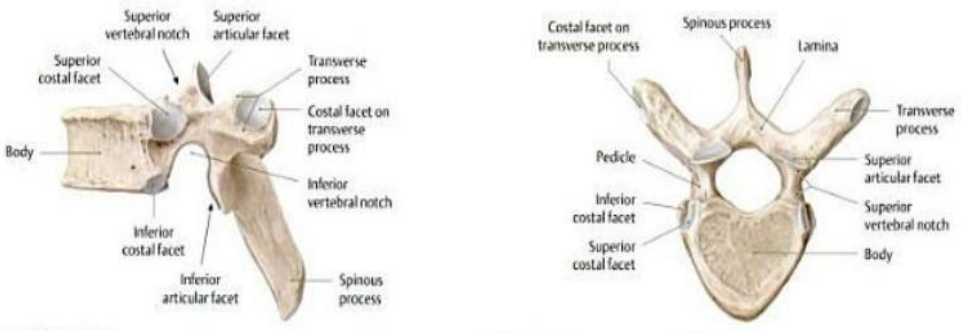
At the level of the locomotor apparatus, it constitutes a structural and functional supporting base for the whole body, and links dynamically the upper and lower extremities. In addition, it provides through the spinal canal a protection to the nervous structures of the spinal cord, from which arise the spinal nerves through the intervertebral foramen (Oatis, 2009).



Picture 1 – Illustration of the vertebral column as seen in midsagittal section through adult male (right) and detailed osteology of the vertebral column (left) modified from *Atlas of Anatomy* by Gilroy, MacPherson and Ross, 2008

The joints in the spine are responsible for first flexibility allowing flexion, extension, lateral bending and rotation and second load transmission and shock absorption for axial and torsional sprains (Oatis, 2009).

2.1.1.2. The typical vertebrae



Picture 2 - Illustration of a typical vertebra (T6) on a left lateral view (right) and a superior view (left), modified from Atlas of Anatomy by Gilroy, MacPherson and Ross, 2008.

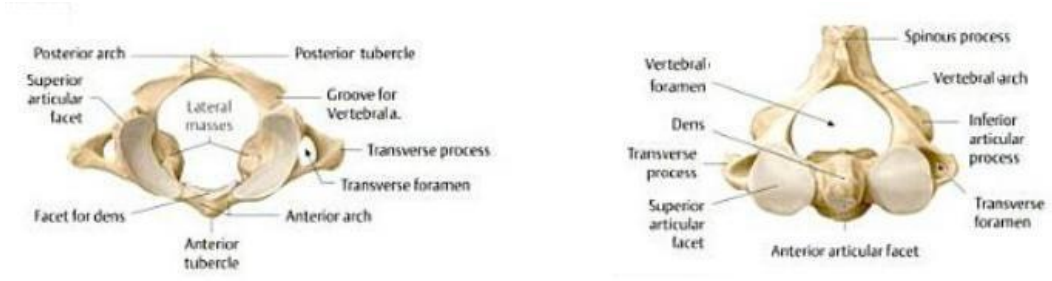
The typical vertebra consists of:

- a body composed of spongy bone, more or less cylindrical in form and which, by its union with the vertebral arch through the pedicles, encloses the vertebral foramen, in which passes the spinal cord and its meningeal covering; the continuity of these gap through the pile of vertebrae forms the vertebral canal in which the spinal cord goes through (Platzer et al., 2004).
- from the lateral surface of the vertebral arch, arises the transverse processes, while the spinous process starts at its most dorsal part (Platzer et al., 2004).
- from the pile of vertebrae, at the level of the pedicle, is formed between each of them the intervertebral foramina, from which exits the nerve root (Putz and Pabst, 2006). The size of the intervertebral foramina depends on the discs height and the pedicle shape. It decreases by 20% with extension and increases by 24% with flexion (Oatis, 2009).
- between the lamina and the pedicle on each side is observable a superior and inferior notch which, when articulated between the superior (concave) and the inferior (convex) facets of the vertebrae, define the facet joints also called zygapophyseal joints (Putz and Pabst, 2006); at the level of the pedicles, they guide the intervertebral motion through their orientation in the transverse and frontal plane (Oatis, 2009).

2.1.1.3. Particularities of the cervical vertebrae

The cervical spine is made of 7 cervical vertebrae, displaying several particularities in terms of shape and movement (Putz and Pabst, 2006; Oatis, 2009).

- the first vertebra called atlas, which articulates with the occiput through the atlanto-occipital joint. It does not possesses any vertebral body but a posterior and anterior arch linking, laterally the lateral masses. The anterior arch presents anteriorly the anterior tubercle and posteriorly the articular facet for the dens of axis. The posterior arch presents posteriorly the posterior tubercle, sort of diminished spinous process. The lateral masses are noticeable by the existence of reduced transverse processes at the base of which we can find the articular surfaces for the occipital condyle superiorly and the articular surface of axis inferiorly and presenting a transverse foramen giving passage to the vertebral artery (Mambrini, 2000).
- the second cervical vertebra called axis, is very similar to the first cervical vertebra in terms of specificities at the exception of marked projection called dens axis, which articulates with the anterior arch of the atlas (Mambrini, 2000).



Picture 3 - Illustration of the first cervical vertebrae atlas (right) and the second cervical vertebra axis (left) in superior view, modified from Atlas of Anatomy by Girloy, MacPherson and Ross, 2008

Other cervical vertebrae are only distinct of the typical vertebrae by (Putz and Pabst, 2006):

- a smaller vertebral body, which, presents at its side edges superiorly and inferiorly a hook-shaped process called uncinate processes (from C3 to T1), limiting the lateral flexion.
- less developed and more plane spinous processes (at the exception of the one of the seventh cervical vertebra, referred to as the vertebra prominens because of its protruding spinous process, easily palpable).
- thinner vertebral arches.

- the existence of a transverse foramen as in atlas and axis, through which passes the vertebral artery.

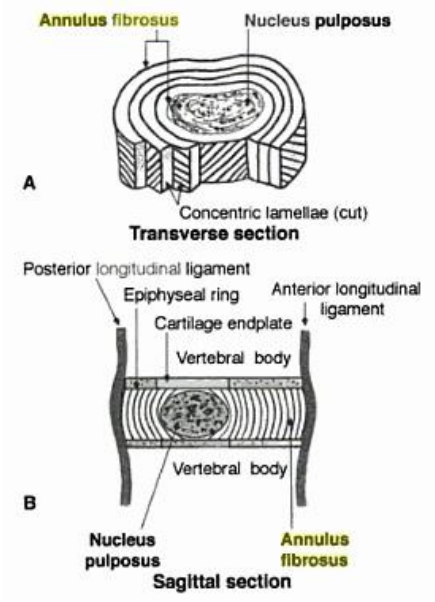
It has to be noticed that atlas and axis are specialized to allow a greater range of motion than normal vertebrae, thus permitting the nodding and rotation movements of the head (Oatis, 2009). They are moreover neurologically important as the brain stem extends down to the axis (Mambrini, 2000).

2.1.1.4. The intervertebral discs

The 23 intervertebral discs constitute 20 to 30% of the height of the spinal columns and their thickness varies from 3mm in the cervical region to 5mm in the thoracic region and 9mm in the lumbar region (Oatis, 2009).

They physiologically comprehend:

- the nucleus pulposus which is located in their centre except in the lumbar spine, where they lie slightly more posteriorly; it is made up mainly of water (80 to 90%) and proteins that confer them a gelatinous mass and fluid maintaining capacity; it this acts as a hydrostatic unit that allows a uniform distribution of the pressure throughout the vertebral disc (Oatis, 2009; Platzer et al., 2004).



Picture 4 - Scheme of the intervertebral disc in transverse section (A) and sagittal section (B), from Dance Anatomy and Kinesiology by Clippinger, 2007

- the annulus fibrosus which encloses the nucleus, which is made up of collagen arranged in sheets called lamellae, themselves organized in concentric rings, they are both connected to the end plate ant the vertebral body (Oatis, 2009; Platzer et al., 2004).

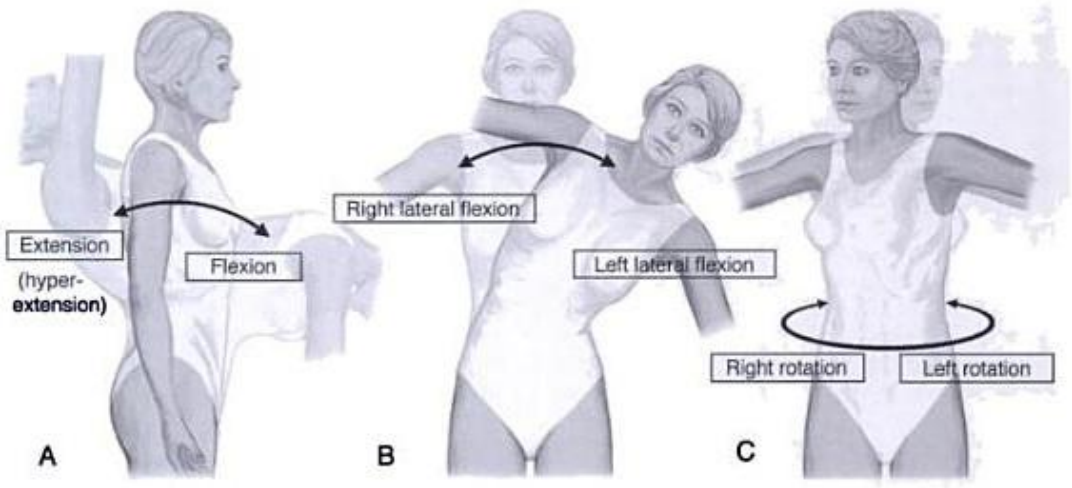
- the vertebral end plate which provides nutrients to the intervertebral discs as a whole as they are not vascularised (Oatis, 2009; Platzer et al., 2004).

The compressive stresses exerted on the intervertebral discs translate into tensile stresses in the annulus fibrosus, thus making the disc stiffer and adding stability and support to the spine (Oatis, 2009).

2.1.2. Kinesiology of the spine

2.1.2.1. Global and segmental movements of the spine

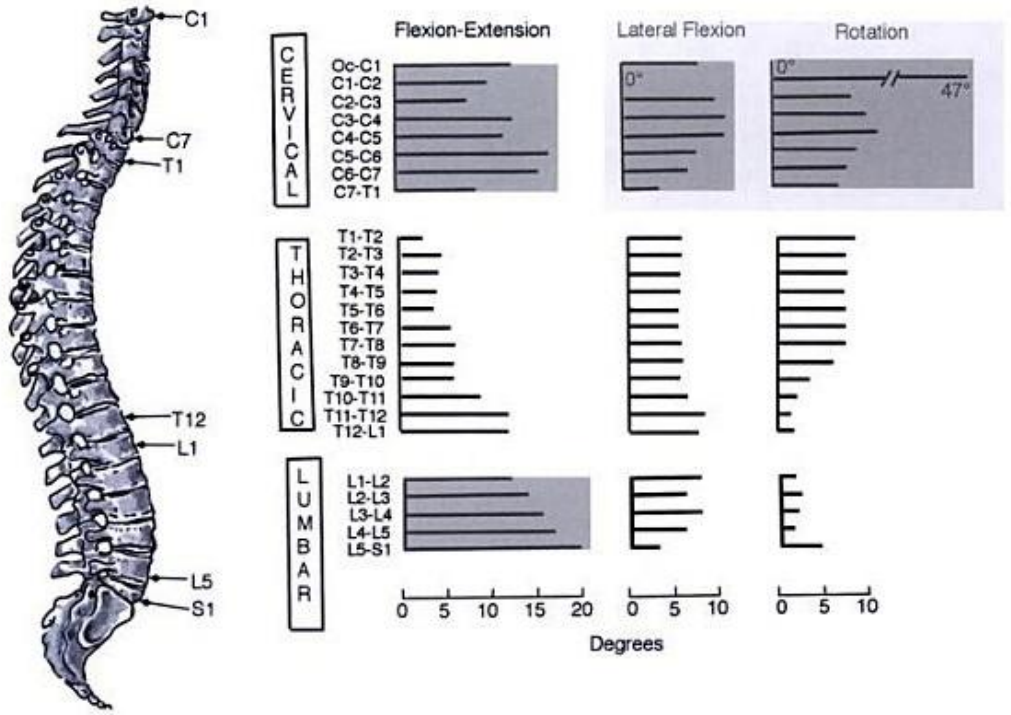
Movements of the spine can be described either as global, as in movement analysis and evaluation of the quality of muscle activations or segmental, which is rather the subject of rehabilitation, research and injury prevention. While the formers involves ligaments, muscles and the several joints and vertebrae that constitute the vertebral column, the latter occur only within one motion segment, namely two adjacent vertebrae and their related soft tissues (including the interposed intervertebral disc) (Clippinger, 2007).



Picture 5 – Illustration of the movements of the spine, from Dance Anatomy and Kinesiology by Clippinger, 2007

Nevertheless, those segmental or global movements, occurring within or along the spine can be roughly categorized in the same way and are the extension/flexion, the lateral flexion and the rotation (small gliding movements are also noticed within motion segments) (Clippinger, 2007). Although they are roughly the same type, spinal movements occur to different extent in different motion segments, and moreover in the different regions of the spine. Thus, the cervical spine represents the most movable portion of the spine while the thoracic cage's mobility is restrained by the rib cage. In a

more detailed way, flexion and extension are globally freer in the cervical spine and then the lumbar spine, rotation is limited in the lumbar region and lateral flexion remains less important in the thoracic than in the cervical region due to the restriction opposed by the rib cage (Clippinger, 2007).



Picture 6 – Illustration of the segmental movements of the spine, from Dance Anatomy and Kinesiology by Clippinger, 2007

2.1.2.1. Stabilization of the spine

In this light, as theorized by Panjabi, the stability of the spine is provided by a passive, active and neural control system as follows:

- the passive system comprising the vertebrae, intervertebral discs, zygapophyseal joints and ligaments.
- the active system comprising the muscles and tendons surrounding and acting on the spinal column.
- the neural system comprising the peripheral nerves and the central nervous system which direct and control the active system in providing dynamic stability (Panjabi, 1992).

2.1.2.3. Particularities of the cervical spine

The cervical spine constitutes the osseous axis of the neck and links the basis of the skull to the thorax. It is made of 7 cervical vertebrae, displaying several particularities in terms of shape and movement. It has a complex structure reflecting its role in orientating the head in a three-dimensional space and cannot be considered as similar to the lumbar spine (although they are both showing a lordosis) in its functional morphology and kinematics (Oatis, 2009).

On a kinesiological point of view, the cervical spine is described as two distinct units: the suboccipital region (made of atlas and axis) and the lower cervical vertebral column; both fulfilling different roles in terms of movements and stabilization. The suboccipital region provides stability for the balance of the head, yet allowing mobility (nodding motion) thanks to a cooperative action of the pivotal joints and a specifically shaped atlas and axis. On the other hand, the lower cervical vertebral column supports the axial load of the head and vertebrae above, keep the head upright, support the reactive forces of muscles but provide mobility for the head thanks to saddle-like joints between vertebral bodies and zygapophyseal joints permitting predominantly flexion, extension and rotation in the plane of the facets (Oatis, 2009).

2.1.3. Neurology of the spine

The nervous system is classically subdivided into two systems, distinct by their functions and locations: the central nervous system (composed of the brain, and the spinal cord) and the peripheral nervous system.

2.1.3.1. The spinal cord

The spinal defines a long, thin tubular bundle of nervous tissue belonging to the central nervous system and extending from the foramen magnum at the base of the skull till the second or first lumbar vertebrae in the vertebral column and connecting the brain to the peripheral nerves. The spinal cord prolongs the medulla oblongata of the brain stem and measures about 45cm long in men and 43cm long in women to finish in the

conus medullaris in a fibrous extension known as the filum terminale (Mumenthaler et al. 2006).

The spinal cord is protected by three layers of tissues called meninges and directly surrounding the cord. They are the dura mater (outermost layer covering the epidural space filled with adipose tissue and many venous plexus), the arachnoid (middle layer covering the subarachnoid space filled with cerebrospinal fluid) and the pia mater (innermost layer) (Pabst and Putz, 2006).

The blood supply of the spinal cord is made by the two anterior spinal arteries (from the vertebral arteries) and the two posterior spinal arteries with many anastomosis forming the vasocorona. An anterior root forming a large artery in the lumbar intumescence is called the spinal artery of Adamkiewitz (Rohkamm, 2004).

The spinal cord has three major functions which are:

- serving as a conduit for motor information through the descending pathways.
- serving as a conduit for sensory information through the ascending pathways (ventral spinocerebral tract below L2, dorsal spinocerebral tract between L2 and T1, cuneocerebellar tract above T1).
- serving as a centre for the coordination of certain reflexes, through the action of interneurons (Rohkamm, 2004).

2.1.3.2. The spinal nerves

The spinal nerve roots constitute the initial segment of the peripheral nervous system. Spinal nerves are formed by anterior and posterior roots at a single level of the spinal cord, emerging from the spinal canal through the corresponding inferior (except for C1) intervertebral foramina, where they are in close proximity to the intervertebral discs and facet joints (Mumenthaler et al., 2006).

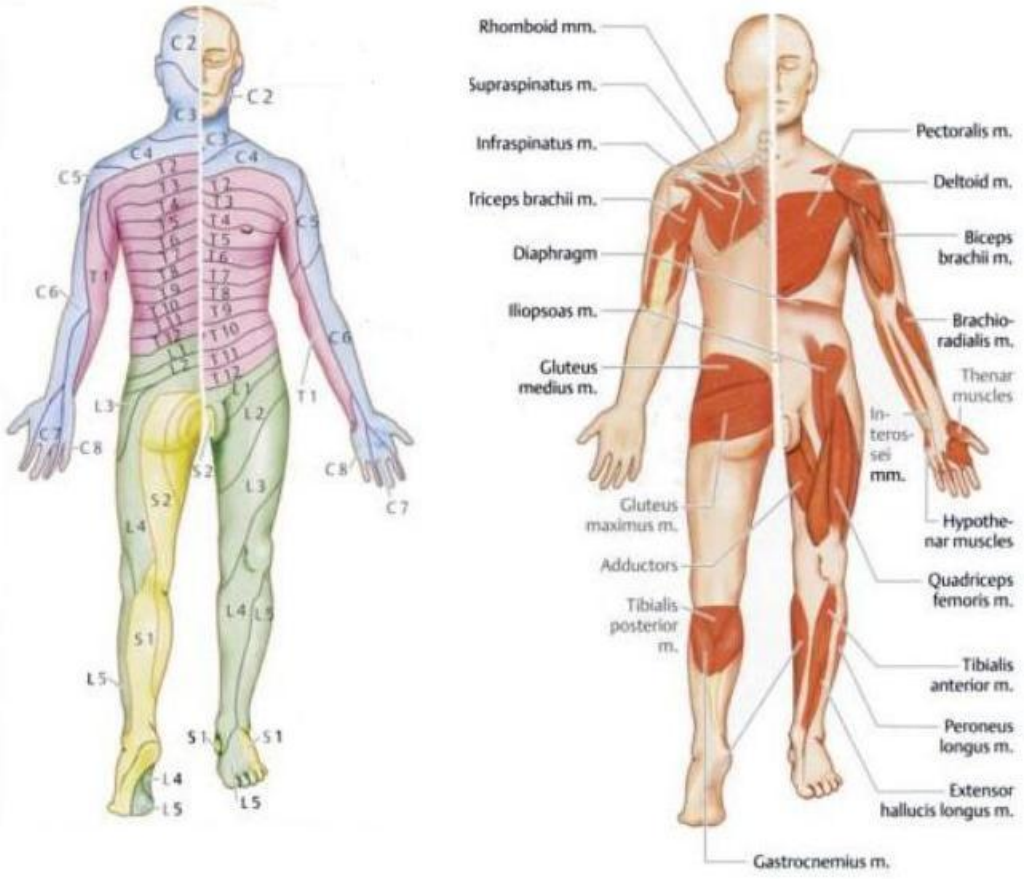
We count 31 spinal nerves which are named according to the level of the spine from which they originate; all of them contain efferent sensory and afferent motor nerve fibres:

- 8 pairs of cranial nerves the first one arising from above the first cervical vertebrae.
- 12 pairs of thoracic nerves, containing from T1 until L2 or L3 efferent fibres of the sympathetic nervous system.

- 5 pairs of lumbar nerves, containing from T1 until L2 or L3 efferent fibres of the sympathetic nervous system.
- 5 pairs of sacral nerves.
- 1 pair of coccygeal nerves (Charles R. Clark, 2004; Pabst and Putz, 2006)

In their further course, the fibres of the spinal nerve roots of multiple segments form plexuses (brachial, sacral...) from which they are then distributed to the peripheral nerves; thus the areas innervated by the nerve roots differ from those innervated by the peripheral nerves. Nevertheless, in the same manner, lesions of the peripheral nervous system cause flaccid weakness, sensory deficits and autonomic disturbances in variable distributions and combination depending on their localization and extent (Mumenthaler et al., 2006).

2.1.3.3. Dermatomes and myotomes



Picture 7 - Map of the dermatomes and example of myotomes, from Rohkamm, Color Atlas of Neurology, 2004

The developmental neurology and embryology allow to distinguish neurotomes. Each neurotome, namely nerve plexus along the spinal column, is connected to:

- specific internal organs and define thus enterotomes, in other word, the visceral territory of a spinal nerve.
- specific muscles and define then myotomes which are muscular distributions of a single spinal nerve; although they do no present a clearly defined segmental pattern, some of the myotomes are of specifically clinical importance such as C6 for the biceps brachialis, brachioradialis, radial extensors of the wrist, C7 for the triceps, ulnar extensors of the wrist, finger extensors or C8 for the finger flexors.
- specific surfaces of the skin and define thus dermatomes which are cutaneous areas whose sensory innervations is derived from a single spinal nerve; it results in a division of the skin reflecting the segmental organization of the spinal cord and its associated nerves; by extent, any pathological process affecting the spinal cord and/or the spinal nerve roots at their exit of the vertebral foramina displays a band-like pattern that is characteristics of a nerve root (Rohkamm, 2004).

2.2. The onset of degenerative changes within the spine

2.2.1. Introduction

As defined by Grieve, degeneration is characterized by slow, destructive changes which are not balanced by the physiological regeneration that occurs in younger tissues (Frontera et al., 2008). Degenerative changes thus refer to pathological processes, closely related or even confused with age-related changes as their likelihood of occurrence increases with life-span (low before 30 years old, almost absolute after 75 years old) and occurring within a biological system or structure (Aufderheide et al. 2003); Nevertheless, it differs from normal aging in that it affects a whole system while degeneration takes place in isolated portions of a system (Frontera et al., 2008).

In the case of the spine, degenerative change are most of the time termed as rheumatologic processes called spondylosis affecting both bones and soft tissues structures along very well defined patterns of location and prognosis. Moreover, various studies have determined that certain factors contribute to the more or less prompt development of those changes. Thus we will attach to describe in a first part the types

and locations of degenerative changes that are observable in the spine and in a second part to specify some of the factors that contribute to their development.

2.2.2. Localization of the degenerative changes in the spine

2.2.2.1. Degenerative changes affecting the inter-vertebral discs

During growth and skeletal maturation the boundary between annulus and nucleus becomes less and less obvious, ultimately degenerative changes affect both structures in distinct ways:

- at the level of the nucleus pulposus, the amount of hydrophilic proteins decreases, hence the hydration of the disc itself because of compressive loading, which decreases its mechanical functions in the motion segment causing spondylosis (Urban and Roberts, 2003).
- at the level of the annulus, the structure becomes irregular, bifurcating and interdigitating and the collagen and elastin networks tend to be disorganized (Urban and Roberts, 2003).

Degeneration of the intervertebral discs triggers a cascade of biochemical and biomechanical changes leading among others to a decreased disc height. As a result, abnormal load distribution in the motion segments causes spondylosis, that is, degenerative osteoarthritis of the joints between the centre of the spinal vertebra and/or neural foraminae and narrowing of the latter. Discs degeneration also leads to the development of herniations (soft discs), discs calcification, posteriorly directed bone ridges (hard discs), hypertrophy of the facets and the uncinate joints and ligament flava thickening. Discs herniation leads to laxity of the supporting ligaments, bringing about anterolisthesis or retrolisthesis of vertebrae in flexion and extension respectively (Urban and Roberts, 2003).

Degenerative changes of the intervertebral disc have been found to occur preferentially in specific locations of the vertebral column that are submitted the most to flexion, namely in the cervical, lower thoracic and lumbar regions of the spine (Van Goethem et al., 2007).

2.2.2.2. Degenerative changes affecting the facet (zygapophyseal) joints

Facet joints osteoarthritis mostly occurs in the presence of disc degeneration and is thus said to be secondary to mechanical changes in the loading of the facet joints. In addition, it most, similarly to the intervertebral disc degeneration, it frequently involves the lordotic segment of the cervical and lumbar regions of the spine (Van Goethem et al., 2007).

Although normal age-related changes include change in architecture of the joint, lost of cartilage, disappearing of meniscus of the joint and thickened subarticular bone in adulthood, degenerative changes are markedly different (Haughton, 2011). Osteophyte formation, hypertrophy of the articular processes osteosclerosis, erosions of articular cartilage, joint effusion calcification of the joint capsule and ligamentum flavum are the principal findings in degenerated zygapophyseal joints.

Osteophyte, namely excrescent new bone formation, arise from the margin of the joint and protrude ventrally from the anteromedial aspect of the facet joint thus possibly narrowing the lateral recesses and intervertebral foramina causing central or lateral spinal stenosis. Hypertrophy of the articular processes on the other hand lead to distortion of articular surfaces and ultimately to pain, abnormal mechanical stress and nerve root compression (Van Goethem et al., 2007).

2.2.2.3. Degenerative changes affecting the ligamentum flavum

The ligamentum flavum loses its homogenous appearance with age and small cysts, collections of fat and calcifications are observable; it may ultimately widen or hypertrophy causing spinal stenosis (Haughton, 2011).

2.2.3. Focusing on two contributing factors to the development of degenerative changes of the spine

2.2.3.1. Broad review of contributing factors to the development of degenerative changes of the spine

As developed above, degenerative and age-related changes differ despite their extreme correlation. Although sometimes not implicated, aging nevertheless remain an essential (but not unique) factor associated to their occurrence.

Indeed, the social and preventive medicine describes several others participating factors among which traumatic events in the form of repeated minor injuries or major ones, stress and strains forces exerted on the spine in erect posture, calcium or other metabolites deficiencies, genetic predispositions, weight and incorrect postural behaviours such as lordosis, scoliosis, have been found to enhance the onset of those changes (Saxon et al, 2010; Kumar, 1992, Grogan et al, 1997).

Along with the purpose of this report, namely to settle the theoretical basis of the pathological conditions presented in the special part, we will clarify first the concept of aging and then expose the characteristics of the lumbar scoliosis, which define two main factors contributing to the development of degenerative diseases of the spine.

2.2.3.2. The aging process

2.2.3.2.1. Definition

Aging is defined by Shock as the *"irreversible progressive changes that take place in the performance of a cell, tissue, organ, or […] individual […], with the passage of time. As the probability of an individual's death increases with age, most of the changes associated with aging are apt to represent decrements in performance".* (Shock, 1983). The process itself, as well as the speed at which it occurs, namely its rate, relies on genetic programming as well as environmental factors such as personal habits, nutrition, exercise amount, and environmental exposures. (Shock, 1983; Frontera et al., 2008). Many authors associate age-related changes to degenerative ones as the occurrence of the latter is almost constant after a certain age. Nevertheless, geriatrics

distinguishes and theorizes several types of aging, in which the likelihood of pathological processes remains high but of varied nature and extent.

2.2.3.2.2. Physiological and pathological aging

Changes that occur during aging can be analyzed in terms of universal changes that are independent of diseases and environmental factors (so-called normal aging) or in terms of consequences of lifestyle, environmental factors and pathological processes. The latter affecting unavoidably each individual but at different period, length, recurrence and degree of severity, a successful aging (in opposition to a usual aging) can be observed. A successful aging as defined by Rowe would thus be characterized by minimal or no physiologic losses in a particular organ system. On the other hand, usual aging would concern the majority of the elderly who would display significant declines in various physiologic functions. (Rowe, 1988; Frontera et al. 2008).

2.2.3.2.3. Characteristics of the normal aging

The normal aging involves gradual decreases in organ system capabilities and homeostatic controls that are relatively benign in the absence of diseases. At the level of the individual, functional alterations that are entailed to aging concern all types of systems: from the hepatic system to the pulmonary system and cardiovascular system through the sensory and thermoregulatory system. For the purpose of this study, we will detail here only the ones closely related to the practice of physiotherapy:

- the thermoregulatory system changes related to aging consist in: impaired temperature regulation, diminished sensitivity to temperature, abnormal autonomic vasomotor control, diminished sweating, vulnerability to hyper and hypothermia.
- the sensory system changes related to aging consist in: diminished vibratory perception, diminished touch sensitivity, diminished deep pain perception, deterioration of vision in terms of acuity, light perception, visual field, adaptation and deterioration of hearing in terms of discrimination and acuity.
- the neurologic system changes related to aging consist in: decrease in short-term memory, loss of speed of motor activities and impairments in stature, proprioception

and gait due to decline in nerve conduction velocity, basal ganglia decreased functions, and in correlation to decreased level of activity.

- the musculoskeletal system changes related to aging consist in: from the standpoint of the muscular system there is a decreased number of motor units, decreased muscle mass, decreased muscle fibre size, number of myofibril and concentration of mitochondrial enzymes; there is also a decreased muscle strength about 20 to 30% between 60 and 90 years. Nevertheless, muscle endurance appears to remain stable. From the standpoint of the skeletal system, there is a high prevalence of osteoporosis (loss of calcium from bone after 35 years old and finally osteopenia), osteoarthritis (correlated to the loss of hydration, reduced flexibility in cartilages) in weight-bearing joints as the result of cumulative weight loading stress if primary and unusual patterns of stress if secondary and loss of strength and water content in tendons and ligaments (Frontera, et al., 2008; Saxon et al., 2010).

2.2.3.3. An example of spinal deformity: the lumbar scoliosis

2.2.3.3.1. Definition

The scoliosis defines a three dimensional lateral curvature of the vertebral column, associated to structural deformities of the bony structures with rotation of the vertebral bodies (COFER, 2005). It has to be noticed that, besides the “true” scoliosis as defined above, the term scoliosis can also refer to a scoliotic bearing (functional scoliosis) in which case the curvature of the spine is not fixed by structural deformities of the vertebral bodies or intervertebral discs, the curvature is moderated and the disorder remains not progressive. (Mahaudens, 2009). For the purpose of this paper, we will concentrate on adult scoliosis, namely scoliosis or scoliotic conditions diagnosed during the adulthood, as juvenile or adolescent types slightly differ in terms of epidemiology, evolutivity and more generally clinical approach.

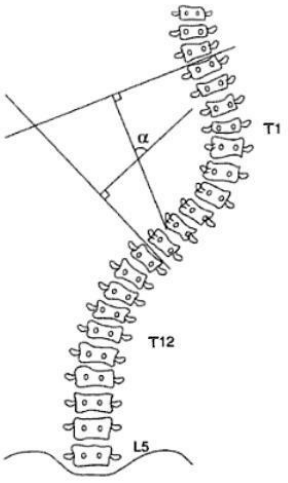
2.2.3.3.2. Classification

As it differs in terms of treatment, prevalence and examination, the scoliosis is generally classified according to two distinct parameters that are:

- the level of the vertebral column in which is present the curvature (either cervical, cervicothoracic, thoracic, thoracolumbar, lumbar and lumbosacral) (Rowe et al, 2004). For the purpose of this paper, we will focus on the lumbar scoliosis.

- the direction of the deviation(s) namely the plane into which the concavity of the curve projects for instance, a dextroscoliosis refers to a scoliosis for which the concavity is projected on the patient's right side, a sinistroscoliosis refers to a scoliosis for which the concavity is projected on the patient's left side. It is also possible to describe the scoliosis in terms of anterior and posterior deviations, which are then called respectively lordoscoliosis and kyphoscoliosis (Rowe et al, 2004).

In addition to these parameters, the scoliosis is clinically described in terms of severity, compensation and evolutivity:



Picture 8 – Representation of the calculation of the Cobb angle (α), modified from COFER, Précis de Rhumatologie, 2005

- the severity of the scoliosis is measured by the Cobb angle, which is determined by using the X-Ray imaging of the vertebral column. The Cobb angle defines the one made between the intersection of the two tangential lines passing through the superior and inferior end plates of respectively the apical vertebrae below and under the deformation. We can thus distinguish three degrees of scoliosis which are the mild one (below 20°), moderated (between 20 and 30°) and severe (above 30°) (COFER, 2005).

- the scoliosis can be either balanced or unbalanced, namely with more or less important compensatory curvatures that restore to a certain point the balance of the trunk (COFER, 2005).

- the evolutivity, namely the increase in degrees per year of the curvature showed by the spine, depends on the patient's age and is higher and more frequent in younger patients but more rapid if occurring in older patients (Rowe et al, 2004).

2.2.3.3.3. Etiology

Idiopathic scoliosis, namely a lateral curvature of the spine in an otherwise healthy individual and for which another recognizable cause has been identified, remains the most common of all forms of lateral deviation of the spine. Other, rarer possible causes include neuromuscular origins, congenital defects, neurofibromatosis mesenchymal disorders (SOSORT, 2008). The scoliosis thus appears as a consequence of those pathologies and can thus be defined as secondary (contrary to idiopathic ones which would be referred to as primary) (Rowe et al, 2004).

Moreover, specifically for scoliosis diagnosed in adults, which remains the object of interest for this work, clinicians expressly distinguish two types (COFER, 2005):

- the scoliosis “de novo”, namely discovered during the adulthood, with no history of such deformity during childhood or adolescence, caused by age-related degenerative changes of tissues and for which the prognosis is poor when associated to a decrease of lumbar lordosis (Mahaudens, 2009).
- the degenerative scoliosis which appeared first during the childhood and which aggravates during the adulthood (COFER, 2005).

2.2.3.3.4. Epidemiology

Still focusing on adult scoliosis, it has been showed that its prevalence is correlated and increases with the age of the study population and ranks from 1,4 to 9%. (Amundson and Asher, 2002). Specifically for degenerative scoliosis, the condition is extremely correlated to low back pain and even radicular pain (especially among women with more unstable deformities) and has a tendency to evolve to disk degenerative diseases (Amundson and Asher, 2002). The condition seems to affect more women than men, especially when diagnosed at young age (COFER, 2005). Finally, thoracolumbar scoliosis, namely with a double curvature are the most frequent (COFER, 2005).

2.2.3.3.5. Diagnosis

The physical examination of the patient with spine lateral deviation is done in a standing position with bare feet and focuses on:

- a complete postural examination including the examination of the pelvis position by the palpation of iliac spines and assessment of the equal level of the iliac crests, the intergluteal fold and the gluteal folds on each side (COFER, 2005).
- the anthropometric evaluation focuses on an eventual discrepancy of length of the lower limbs and on the measurement of the spinal imbalance by the evaluating the distance right or left from the gluteal cleft with a line (plumb line) from C7 to the ground (Borenstein et al., 2004).
- a forward bending test allows to detect or to evaluate the extent of the hunchback (showed by the prominence of one side of the rib cage) which is correlated to the vertebral rotation (COFER, 2005); if the scoliosis is only functional, no hunchback is observable; in the same manner, the deviation of a scoliotic bearing disappears in supine position (Borenstein et al., 2004).

In addition a neurological examination can be performed to detect individuals who may be experiencing signs of nerve root compression and a pulmonary evaluation is appropriate for individuals showing more severe curvatures. Finally a X-Ray examination is performed with an erect full-length antero-posterior and lateral view of the thoraco-lumbar spine and allows to determine the Cobb angle as specified above (Borenstein et al., 2004).

2.2.3.3.6. Treatment

Possible treatment and therapeutic approaches proposed to patient suffering from adult scoliosis highly depend on the extent of the curvature showed by the spine. They include physiotherapeutic methods aiming at balancing tissues restrictions, muscles shortenesses and avoiding the pain triggered by the deformity (manipulations, massage, postural re-education and ergonomics, strengthening, soft tissues techniques...), surgical operations (spinal fusion) and/or stabilization by means of orthesis, specific corstets (Mahaudens, 2009).

2.3. When degenerative changes lead to pathological conditions: the example of the cervicobrachial syndrome

2.3.1. Symptoms

2.3.1.1. General

The cervicobrachial syndrome is characterized by pain and sensory and/or motor disturbances that radiate from the cervical spine into the upper limb, in a more or less clear radicular pattern; it has to be noticed that sympathetic disturbance can also be observed (acrocyanosis, damp and coldness of the hand). In the initial phase, the main symptoms usually consist of abnormal posture and pain of the neck. A feeling of tension and swelling (without clinical findings) can be reported. The condition further leads to shoulder stiffness and occasionally to muscle atrophy (sometimes even arising without any other symptom but a history of radiating pain). In addition, associated pain interscapular pain is commonly found and associated conditions such as subacromial syndromes and radial humeral epicondylitis are relatively common although they are rather the result of local degenerative changes in the rotator cuff and the tendinous insertion of the extensor carpi radialis muscle (Kraemer, 2008; Maigne, 2006).

2.3.1.2. Sensory-motor disturbances according to the affected nerve root

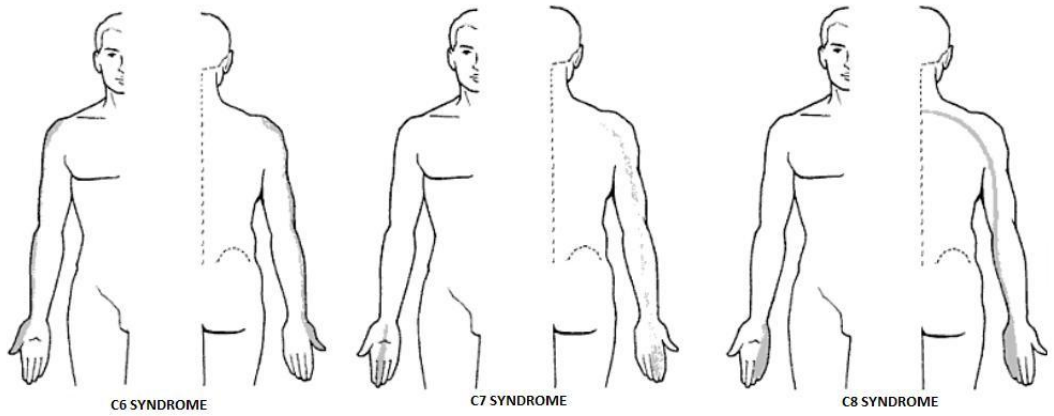
As the cervicobrachial syndrome is the result of nerve root irritation, the symptomatology varies according to the segment of the spine that is affected, in terms of sensory disturbances in the cutaneous distribution of the branch and motor disturbances in its muscular distribution. In addition, due to their intrinsic characteristics and the varied stress forces that are exerted on them, the vulnerability of the spinal segment to pathological changes is different. Hence, according to the spinal nerve that is affected, we find distinct clinical pictures and incidence (Maigne, 2006).

The C5 syndrome comprehends about 5% of all the cases; the pain and sensory disturbances are along the anterior surface of the shoulder, eventually along the external border of the elbow, motor disturbances are found in the deltoid, supraspinatus,

rhomboid minor and sometimes biceps brachi (hence the abduction and the external rotation are impaired); no pathological reflex can be elicited.

The C6 syndrome comprehends about 30% of all the cases; the pain and sensory disturbances are along the antero-external aspect of the shoulder and the external arm of the arm until the thumb; motor disturbances and eventual hypotrophies are found in the biceps, brachioradialis, thenar region of the hand (hence the elbow flexion and the supination of the forearm are impaired); an abolishment or diminished reflex at the bicipital and styloradial levels can be observed.

The C7 syndrome comprehends about 30% of all the cases; the pain and sensory disturbances are found in the cervico-thoracic area, the posterior aspect of the shoulder, the arm, the forearm, the wrist , and the second, third and eventually fifth digits; motor disturbances and eventual hypotrophies are found in the intrinsic muscles of the hand, the extensors of the hand and of the fingers (hence the extension of the elbow, of the wrist and the fingers is impaired), the tricipital reflex might be abolished or



Picture 9 – Illustration of the pain and sensory disorders distribution according to the nerve root which is affected, modified from Maigne, *Douleurs d'origine vertebrale: comprendre, diagnostique et traiter*, 2006

disminished.

The C8 syndrome comprehends about 15% of all the cases; the pain and sensory disturbances are found on the internal aspect of the arm, forearm, on the wrist and the 5th finger; motor disturbances and eventual hypotrophies are found in the intrinsic muscles of the hand and especially in the hypothenar area. The cubitopronator reflex might be abolished or disminished.

It has to be noticed that in about 20% of the cases, the origin is polyradicular and the cervicobrachialgia displays mixed symptoms according to the spinal segments that are affected. (Lazennec et al, 2009; Kraemer, 2008).

2.3.2. Etiology

To remain specific on the object of this paper, it has to be noted that the cervicobrachial syndrome can be either the clinical expression of degenerative changes of the cervical spine (cervical arthritis, in 85% of the cases) or secondary to tumoral, infectious or traumatic disorders that arose previously (in 15% of the cases) (Morillon et al, 2008). For the purpose of this study and in line with the preceding parts, we will only consider the first type of cervicobrachial syndrome.

Cervicobrachialgia, when resulting from arthritic processes of the cervical spine, is of two distinct origins:

- the cervicobrachialgia due to soft disc protrusion is characterized by a radicular compression by a "soft" hernia which is constituted of discal substance coming from the nucleus pulposus after fissuring of the annulus fibrosus of an intervertebral cervical disc. The X-Ray imaging does not show any arthritic changes of the spine, at least at the concerned segment. It is a more rare condition, affecting younger individuals and preferentially men over women; it is sometimes the result of a traumatic event which is either direct (whiplash injuries for instance) or after a strenuous effort when lifting up an object; the soft disc protrusion can be enhanced by the practise of extreme sport (Mazières et al, 2002).
- the cervicobrachialgia due to cervical arthrosis is characterized by a radicular compression by "hard" hernia with degenerated substance of the disc and osteophytes of the uncovertebral junctions; it affects preferentially older individuals, around 50 years and rather women than men; it is the inflammatory process that is put forward as the cause of the pain. The latter usually ease then disappear within 3 to 6 weeks, sometimes with remaining parasthesias (Maigne, 2006).

2.3.3. Diagnosis

2.3.3.1. Key points of the diagnosis

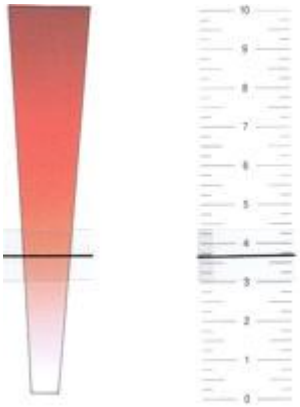
The settling of a diagnosis relies on the interview of the patient, especially to determine the type of pain, the conditions of the onset of the disorder and the possible

influencing factors and is backed up by a physical examination, a neurological examination with testing of reflexes and sensitivity and the use of medical imaging.

The physical examination focuses especially on (Fast and Segal, 2008):

- a palpation to determine the presence of trigger points, tender spots (which are of diagnostic significance when found unilaterally or distributed along a dermatome) over the cervical paraspinal muscles, trapezius muscles or muscles supplied by the compromised root.
- a testing of muscle strength, especially of shoulder abduction, flexion and extension of elbow, and flexion of fingers to reveal any weakness in myotomal distribution and thus to help to determine the level of the nerve root irritation.
- a specific provocative test, such as the Spurling test, performed by providing simultaneous axial loading and tilting of the head towards the symptomatic side in the upright position elicits neck and radicular pain when positive (Xhardez, 2009).

The medical imaging mean that remains the mostly used is the radiograph. Nevertheless, X-Ray pictures, because they only allow observing the vertebral components but not the intervertebral discs, spinal cord or peripheral nerves, remain of limited use. However, in the case of such syndrome, the examiner shall research signs of degenerative changes under the form of narrowed intervertebral discs, calcification, osteophytes or ossified soft tissues. Frequently there is no good correlation between the symptoms and the extent of the degenerative changes that are observed. The MRI on the other hand constitutes the diagnostic modality of choice as it allows to observe nervous as well as cartilaginous and to better assess the level of nerve irritation (Fast and Segal, 2008).



Picture 10 - Mechanism of the VAPS (here is presented a chromatic pain scale), available at: http://oto.sagepub.com/content/137/4/545.abstract

Finally, the pain itself can be evaluated by several modalities among which we can quote the numerical rating scale, the visual analogue pain scale. With the NRS, the patients are asked to indicate how strong is their pain on a scale from 0 to 10, the former representing no pain at all and the latter the worst pain imaginable. With the VAPS, the patients are asked to mark on a 10cm

line anchored at one end by the label “no pain” and at the other “worst pain imaginable” the level of their pain. However, older patients usually present difficulties to understand the VAPS instructions (Piovesan and Silberstein, 2006).

2.3.3.2. Differential Diagnosis

The differential diagnosis of the cervicobrachial syndrome includes, for the most common conditions, the rotator cuff injury, the Parsonage-Aldren-Turner syndrome, the thoracic outlet syndrome and the carpal tunnel syndrome (Mazières et al, 2002). All of these disorders differ from the cervicobracial syndrome by the level of the nerve root irritation or the mechanism of the pain.

The rotator cuff designates the supporting and strengthening structure of the shoulder joint, made up of the capsule of the joint blended with muscles (supraspinatus, infraspinatus, teres minor and subscapularis) and their tendons. When injured of affected by degenerative changes, it leads to inflammation of the anatomical structures followed by pain and muscles weakness that can resembles a C5 or C6 radicular affection (Forthomme, 2009).

The Parsonage-Aldren-Turner syndrome, also called brachial neuritis or brachial plexitis results of the idiopathic irritation of the brachial plexus causing acute pain, muscle weakness and amyotrophy along a C5 root distribution. Although the exact cause is not known, it has been correlated to bacterial, viral infections, childbirth incidents, traumatic episodes or cancerous diseases (Xhardez, 2009).

The thoracic outlet syndrome define compressive disorders in the space between the clavicle and the first rib affecting vascular and nervous structures, resulting in pain, parasthesias, muscle weakness and atrophy, most likely along a C8 nerve root distribution. It can be elicited by performing the Adson’s test or the Roos test (Xhardez, 2009). The former triggers radial artery decreased pulse with abducted, extended and externally rotated arm and head rotated to the side being tested in case of TOS. In the latter, the patient affected by TOS displays inability to perform the test or parasthesias and other sensory and vascular changes when he/she is required to abduct the arms at 90° and to open and close the hands for 3 minutes. (Ombregt et al. 2002)

The carpal tunnel syndrome results of the compression of the median nerve in the carpal tunnel under the flexor retinaculum and displays sensory motor disturbances similar to the C6 syndrome (Xhardez, 2009).

2.3.4. Treatments

2.3.4.1. Pharmaceutical treatment

The pharmaceutical treatment depends on the intensity of the painful phenomenon and is aimed at treating both the inflammatory processes and the pain (Maigne, 2006).

Non steroideal anti-inflammatory drug have both analgesic and anti-inflammatory properties but present the disadvantage to have adverse effects on the gastrointestinal and renal systems; furthermore, their superiority over the use of aspirin haven't been proved and their functioning in such disorders remains unclear; among those medications we can quote Diclofenac, primalary used for chronic arthritic conditions, Ibuprofen used for mild to moderate painful conditions and Meloxicam, used for the treatment of osteoarthiric pain (Bryant and Knights, 2010).

Analgetics are prescribed as first line of the treatment in the initial stages of the disease; they can be either narcotics or non-narcotics according to the extent of the pain the patient complains of. The former class is nevertheless prescribed for a smaller duration. (Cohen and Jouve, 2008).

Spasmolytics, also called myorelaxants are indicated to relieve the muscle tensions resulting of reflex changes in the area of the disorder and to decrease the onset of further pathological conditions arising from altered posture in relation to the primary disorder. They present a main adverse effect consisting in drowsiness and thus are rather prescribed to be taken at night. (Bryant and Knights, 2010)

Injections of anesthetics or corticoid drugs are done at the intervertebral foraminal region, the uncovertebral region, or periradicularly under fluoroscopic or ultrasonographic guidance. They are directed towards the peripheral nociception as well as aimed at affecting the transmission and processing of pain signals (Papagallo, 2004); to stop chronical processing of the syndrome, they are to be done daily for the first 10

days. The patient has to be placed in an anti-loading position of the affected place for at least 30 to 60 minutes, ideally using Glisson traction (Kraemer and Theodoridis, 2009).

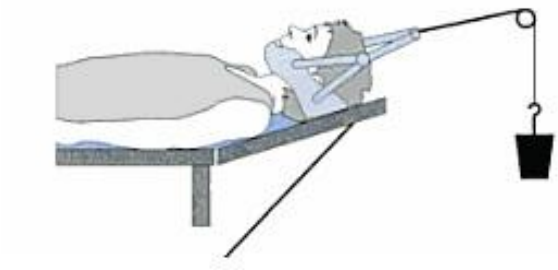
2.3.4.2. Physiotherapeutic (conservative) treatment

The initial treatment focuses on:

- postural and ergonomic advice for the maintenance and posture of the neck, ideally in straight position with the chin tucked in, during working and activities of daily living (Cohen and Jouve, 2008; Joshi and Kotwal, 1999).
- the avoidance of any stress or loading on the neck, incorrect movement patterns correction and prescription of relative rest; eventually a cervical collar can be used (Cohen and Jouve, 2008; Joshi and Kotwal, 1999).
- the release of the pain and control of the inflammation by using thermotherapy procedures (hotpacks, cryopacks, parafango, infrared lights...) and electrotherapy procedures (intereferential currents, TENS, diapulse...) (Cohen and Jouve, 2008)
- release of the muscle spasms by using trigger point therapy, acupuncture,... (Cohen and jouve, 2008; Joshi and Kotwal, 1999)

With the decrease of the pain and the increased compliance of the patient to mobilization, the therapy moves on to:

- manual medicine with deep and sedative massage including effleurage, circular kneading or frictions to release the muscle spasms and pain (Joshi and Kotwal, 1999).
- manual or mechanical cervical spine traction with neck flexion to relieve the nerve compression by widening the intervertebral foramen and joints facets; is applied strictly in the axial direction in sitting or standing position; it generally relieve the direct and indirect pressure on the nerve roots and decreases muscle spasms, by helping to resorb the oedema, by stretching the nuchal musculature and inter and paravertebral ligaments, and by correctly repositioning the intervertebral joints. (Kraemer, 2008; Cohen and Jouve, 2008).



Picture 11 - Glisson traction, from Kraemer, *Intervertebral Disk Diseases: Causes, Diagnosis, Treatment and Prophylaxis,* 2008

- exercise program with preferentially isometric contra-

ctions to maintain or optimize the strength, endurance and tone of the cervical muscles (Joshi and Kotwal, 1999).

- PNF techniques to elongate the tighten tissues to their normal range, minimise the periarticular fibrous contracture, regain normal length of the muscles, increase the circulation to deeper neck tissues and improve the posture and functions of the neck (Joshi and Kotwal, 1999).

- finally, manual resistance techniques such as post isometric relaxation or soft tissues techniques by Lewit can be used in order to restore the mobility of soft tissues namely skin, subcutaneous connective tissues, fascias and muscles in order to promote the functional range of movement of the articulation of interest and/or the surrounding ones as they might suffer as the state becomes chronic.

2.3.4.3. Surgical (non conservative) treatment

The surgical treatment is rarely indicated but in case of severe or progressive neurologic (motor, sensory) deficits and persistent pain that does not respond to conservative measures. The resection of osteophytes by anterolateral and transdiscal way, which permits excellent access to structures such as discs and spondylotic spurs, is eventually associated to an arthrodesis, namely artificial fusion to stabilize the affected portion of the spine. The latter procedure, although it promotes early pain relief and enhanced muscles strength, displays several long-terms disadvantages among which stiffness, loss of range of motion, and next-level degeneration over the years. Hence the cervicobrachial syndrome when caused by soft disc protusion is preferentially surgically treated by disc replacement that is reaized with a posterior approach (COFER 2005; Fast and Segal, 2008).

3. Special part

3.1. Methodology

The case study has been conducted on Mr. M. B. born on the 28th of March 1944, diagnosed on the 22nd of December 2010 by an orthopaedist with an unspecified dorsalgia (M54.9), also established as a vertebrogenic algic syndrome by the physician affiliated to the rehabilitation centre. The rehabilitation itself occurred during the month of January 2011 in an outpatient department specialized in locomotor apparatus pathologies (Centrum Léčby Pohbového Aparátu, Praha).

An attempt has been done to stick the therapy's schedule, in line with the patient's availability, to three sessions per week, (out of 9 sessions, whereas initially 6 was planed); fitting the usual course of the disease with acute, subacute and sequealar phases. First with close together meetings, appointments have been slightly separated to enhance the strategy of rehabilitation, all of the sessions lasting about one hour and a half.

With of view to the therapy itself, I have been allotted the use of a private practice with a therapy table, but also of a shared gym with all utilities and of a shared electrotherapy room including all devices. The material used during the therapy course consisted of:

- a therapy table
- a neurological hammer
- a goniometer
- a mat
- Voltaren cream
- a middle-sized hot pack
- a flexibar
- an overball
- an electrotherapy device, BTL type
- a visual analogic pain scale (VAPS)

The rehabilitation itself has mobilized previously instructed therapies at the Charles University (soft tissues techniques by Lewit, post isometric relaxation by Lewit, manual methods by Lewit, proprioceptive neuromuscular facilitation by Kabat), as well

as self experimented ones at the occasion of clinical work placements (overball exercises along others). On the other hand, due to the patient's attributes, therapeutical procedures have been widely based on self reproducible exercises at home and advise in personal health practices.

For the purpose of this study, the patient has been requested to give his informed consent in written form (see attached) and the project itself has been approved by the Ethics Committee of the Faculty of Physical Education and Sport of the Charles University on the 17th of January 2011.

3.2. Anamnesis

3.2.1. Pain anamnesis

Pain history: The patient relates at first an acute pain of shooting type on the left side, arisen the morning of the 22nd of December 2010, after a basket ball game he participated the day before. Ranked to 8 on the visual analogue pain scale (VAPS) at its height, the pain led him to first consult in the emergency service of the Motol Hospital on the same day.

Pain status: The pain is now felt all day long, with a fluctuating intensity, ranked to 3-4 on the VAPS, and preventing (waking up) the patient from lying on his left side at night. Mr. M. B. relieves the pain by resting his left arm and mentions the infiltrations practised by the orthopaedist sensibly diminished the ache.

3.2.2. Medical anamnesis

Family anamnesis: Mr. M. B. relates heart problems running in his family, with both his father and mother deceased (respectively 1 and 30 years ago) from heart attack and brothers also suffering from heart problems.

Personal anamnesis: The patient suffers from arthosis in numerous joints, notably the hips and shoulders. He also has been recently diagnosed with a mild scoliosis of the lumbar spine.

Trauma anamnesis: Mr. M. B. relates several injuries to the ankles, fracture of the right wrist, a dislocation of the right shoulder, a torn anterior cruciate ligament of the left lower limb but cannot precisely relates the date at which they occurred.
Surgical anamnesis: The patient underwent an anterior cruciate ligament replacement of the left lower limb several years ago.
Allergological anamnesis: No allergies that he knows of.
Pharmacological anamnesis: Mr. M. B. currently undergoes a treatment with Diclofenac and Myolastan pills.
Abuses: Mr. M. B. occasionally drinks alcohol and doesn't smoke.
Note: Mr. M. B. Is right handed and right footed.

3.2.3. Work and social anamnesis

Work anamnesis: Mr. M. B. formerly was a high-level football player and now works as a faculty teacher; owing to his duties, he mostly keeps a sitting position, the latter triggering pain when he leaves his arms hanging down from the chair. He goes to work by tramway or metro and reports pain when standing and holding the bar.
Social anamnesis: Mr. M. B. lives with his wife in an apartment during the week and goes on weekends to his country house; he practises irregularly football about two times a week and frequently does some gardening and renovation works, however the onset of ache had him suspending these activities. He also recount pain at the occasion of several activities of daily living such as lifting up heavy objects (speaks about saucepan when cooking for instance) or shaving (his cheek being difficult to grasp), lifting the head when he wears glasses.

3.2.4. Previous rehabilitation

Mr. M. B. relates several previous rehabilitations recommended notably after the anterior cruciate ligament replacement he underwent and the shoulder dislocation and wrist fracture he suffered from. Regarding the present pathology, Mr. M. B. has already attended four therapy sessions, suspended for two weeks and with no result but a worsening of the pain during the interruption. The therapy consisted in acupuncture and manipulations from what he can recall.

3.2.5. Documentation of patient

3.2.5.1. Reports of consultation

The report of consultation at the emergency service of the Motol hospital and dated from the 22nd of December 2010 mentions an acute pain in the left shoulder, relieved when raising up the arm. No swelling or trophical change is observed. After inspection and ECG examination, the possibility of cardiac disorder is dispelled and a diagnosis of vertebrogenic algic syndrome is settled (under the reference M54.9 dorsalgia). Recommendation is given for a physiotherapy treatment.

The report of consultation at the emergency service of the Motol hospital and dated from the 29th of December 2010 states a deterioration of the condition despite the intake of Ipubrofen (although the patient first requested Novalgin). Qualified of shooting type, the pain is said to be localized in the left shoulder and the posterior arm down to the level of the elbow. The palpation at the paraspinal level triggers ache especially in the C6-T1 area and a sensitivity of the outside part of the left arm from the elbow to the ulnar side; there is no contracture and a worsening of the pain when lying on the left side is recorded. A diagnosis of vertebrogenic algic syndrome is settled and a treatment by ibalgin (ibuprofen) 200mg (three pills daily) and dorsiflex (myorelaxant) 200mg (four pills daily) is prescribed. Recommendation is given for a consultation with a neurologist.

The report of consultation at the neurology department of the Clinicum A.S. and dated from the 30th of December 2010 mentions the absence of paresis in lower and upper extremities and a negative testing for reflex syndrome but a limitation of the dynamics of the cervical spine. A treatment with infiltrations to cervical spine and foot with mesocaine, analgin and dolmina has been realized. The neurologist evokes the possibility of cervico brachial syndrome.

The report of consultation at the orthopaedic department of the Motol Hospital dated form the 2nd of January 2011 mentions a diminished pain. A sensitivity to palpation on the left side of the back till T5 with spasms of the paravertebral muscles is noticed. After X ray examination, arthrosis of the shoulder, degenerative changes of the cervical spine (lordosis) and scoliosis of the T9-T12 with presence of osteophytes spine

are highlighted. The previously prescribed treatment and diagnosis are maintained and a control in neurology or physiotherapy is recommended.

The report of consultation at the outpatient department of the CLPA, dated form the 3rd of January 2011 resumes the previous observations and concludes to a cervicobrachial syndrome due to degenerative changes and cervical spine polydiscopathy. A prescription of Dolmina, Mesocaine, Analgin and Algetic infusions is given with an accompaniment by physiotherapy.

3.2.5.2. X ray pictures

The X ray pictures n°1 and 2 (see appendix), realized on the 2nd of January of this year, corresponds to a lateral view of the cevical spine showing a noticeable waist of substance of the vertebral discs affecting C4 to C7. An inverted lordosis of the cervical spine is noticed, particularly at the level C4-C2. The X-ray picture n° 3, realized on the 2nd of January of this year, corresponds to a posterior view of the cervical spine showing, there again, a polydiscopathy of this portion of the vertebral column, particularly pronounced on the lower cervical and upper thoracic spine.

The X ray picture n°4 and 5 realized on the 2nd of January of this year, show respectively a lateral and posterior view of the thoracolumbar spine. They reveal:

- flattening of the lumbar lordosis,
- scoliosis, concave to the right and convex to the left from T7 to T12
- partially increased opacity of the bone tissue in T9 and following vertebrae
- waist of substance in the vertebral discs, especially from T3 to T5

3.2.6. Indication of rehabilitation

The prescription of physiotherapy dated from the 28th of December 2012 recommends mobilization, soft tissues techniques, electrotherapy with interferential current ranking from 50 to 100 Hz and sensomotoric training.

3.2.7. Differential considerations

The ache which Mr. M. B. suffers from is most likely to be brought about the severe and extended polydiscopathy he presents, and furthermore by the pathological changes this chronic condition might have elicited. Nevertheless, the acute nature of the pain, its distribution and its sudden onset leads up to consider the eventuality of other or additional troubles. These would then be possibly of traumatic or rheumatologic origin and promoted or amplified by the already existing polydiscopathy. Notably the radiating type of pain and the acute nature of the trouble bring up the possibility of a radiculopathy, a thoracic outlet syndrome or a quadrilateral space syndrome. It has to be noticed that considering the relatively chronic and extensive arthrosis Mr. M. B. presents, the diagnosis of such conditions might be jeopardized by the profusion of pathological signs.

3.3. First kinesiologic examination

3.3.1. Status praesens

Patient's information:
- name and surname: M. B.
- sex: M
- date of Birth: 28.3.1944.

General information:
- height: 1,69 m
- weight: 70 kg
- body Mass Index: 24,50 $kg.m^{-2}$

Diagnosis: Dorsalgia, unspecified M54.9

Main complain: Mr. M. B. comes under the indications of an orthopaedist after a diagnosis of an unspecified dorsalgia previously settled on the 22nd of December 2010. He complains about an acute pain in the left shoulder and posterior part of the upper arm ranked at 5 on the VAPS this day.

3.3.2. Postural examination

- back view (see appendix n°3): calves facing outward (medially rotated femur), discrepancy in sizes of the tiles (right superior to the left), deformity of the spine (scoliosis with convexity to the left) in the lumbar level abducted scapula with protracted shoulders, skin folds at the thoraco-lumbar level
- left side view (see appendix n°3): slightly forward position of the right leg in comparison to the left one, slightly hyper-extended knees, flattening of lumbar spine and extended kyphosis of the thoracic spine, marked protraction of the head
- right side view (see appendix n°3): slightly hyper-extended knees, flattening of lumbar spine, extended kyphosis of the thoracic spine, marked protraction of the head
- front view (see appendix n°3): outward position of the right foot in comparison to the left one, discrepancy between the tiles on the right and left side (right superior to the left), ribs flaring, slight rotation of the head to the right side, a reverse type of breathing is noted.

3.3.3. Pelvis palpation

The palpation of the iliac spines shows a slight anterior tilt of the pelvis. No lateral tilt to either side can be detected.

3.3.4. Gait examination

The non modified gait examination reveals a poor synkinesis of the arms, more pronounced on the left side. The stance and swing phases of the gait appear to be physiological.

3.3.5. Dynamic spine tests

- lateral flexion to the left: extremely limited (45cm in latero flexion whereas the norm is comprehended between 20 and 25cm), poor mobility of the spine except in the low thoracic section.

- lateral flexion to the right: extremely limited (46 cm in lateroflexion whereas the norm is comprehended between 20 and 25cm) , poor or no mobility of the spine in the upper thoracic section, the majority of the movement occurring in the low lumbar section.
- anteflexion: limited (14cm in Thomayer's distance), occurring mostly in the lower thoracic section of the spine, the hanging down position of the arms triggering pain.
- retroflexion: limited, triggers muscle spasm in the upper paravertebral muscle of the left side, painful to the left shoulder and occurring mostly in the upper lumbar section of the spine.

3.3.6. Basic movement patterns examination

The basic movement patterns examination (see table below) reveals an alteration of the trunk flexion with a poor stabilization of the abdominal wall, an alteration of the neck flexion with overuse of the neck superficial flexors, an alteration of the shoulder abduction on the left side but not on the right side and a no fixation of the scapula during the performance of push ups, the movement triggering pain.

	LEFT	RIGHT
TRUNK FLEXION	- rib flaring and impossibility to perform through the whole range	
NECK FLEXION	- slight neck protraction and visible scalenes and sternocleido- mastoid contraction in the initiation of the movement	
SHOULDER ABDUCTION	- scapula external rotation in the earlier stage of abduction; movement initiated by both the posterior deltoid and the rhomboids, early intervention of upper trapezius with shoulder elevation	- normal sequence of activation of muscles
PUSH UPS	- poor or no fixation of scapulas which are both deviated internally - no pain during the test	

Table 1 – Observations recorded during the testing of basing movement patterns, at the first examination

3.3.7. Hypermobility special tests according to Janda

The hypermobility special tests (see table below) reveal an absence of hypermobility background and rather a certain stiffness of the tested joint, with difficulty of performance of the movements but absence of pain.

TEST	OBSERVATIONS	RESULTS
BACKWARD BENT:	reaches 45° of angle with the table	grade A
FORWARD BENT:	cannot touch the floor	grade A
LATERAL TRUNK FLEXION:	to the left: doesn't reach the intergluteal line	grade A
	to the right: reaches the intergluteal line	grade A
ROTATION OF THE TRUNK:	to the left: reaches about 80°	grade A
	to the right: reaches about 60°	grade A
ROTATION OF THE CERVICAL SPINE:	to the left: reaches 70°	grade A
	to the right: reaches 50°	grade A
EXTENSION OF METACARPO-PHALANGEAL JOINTS:	reaches about 50°	grade A
ELBOWS JOINT EXTENSION OF CLASPED FOREARMS:	cannot join elbows in either position	grade A
HORIZONTAL ADDUCTION IN SHOULDER JOINT:	left shoulder: reaches more than the fossa jugularis	grade B
	right shoulder: reaches more than the midline of the clavicle	grade B
CONTACT OF HANDS BEHIND THE TRUNK:	with the left arm elevated: hands remain about 10 cm away	grade A
	with the right arm elevated: hands remains about 5 cm away	grade A
SCARF TEST:	left arm: barely touches the spine	grade A
	right arm: barely touches the spine	grade A

Table 2 – Observations and results of the hypermobility special tests, at the first examination

3.3.8. Range of motion test according to Kendall

The results are given in degrees and according to the SFTR method of report for the shoulder and the elbow joint (see table below). They reveal a globally lowered ROM of the cervical spine, (but especially in rotation and flexion to the right) and a decreased ROM of the left shoulder in all directions, the right one reaching physiological values, except in external and internal rotation. The ROMs of the elbows appear to be within the norms.

CERVICAL SPINE				
MOVEMENTS AND NORMS	TO THE RIGHT		TO THE LEFT	
	ACTIVE	PASSIVE	ACTIVE	PASSIVE
Rotation (norm: 80)	60	65	80	80
Lat. Flex. (norm: 45)	40	40	30	40
	ACTIVE		PASSIVE	
Flexion (norm: 50)	30		35	
Extension (norm: 60)	40		40	
SHOULDER JOINT				
NORMS	RIGHT		LEFT	
	ACTIVE	PASSIVE	ACTIVE	PASSIVE
S: 45-0-180	S: 170-0-20	S: 170-0-25	S: 180-0-30	S: 180-0-30
F: 150-0-0	F: 150-0-0	F: 160-0-0	F: 130-0-0	F: 140-0-0
T: 90-0-40	T: 80-0-20	T: 80-0-20	T: 90-0-20	T: 90-0-25
Rr: 90-0-70	Rr:60-0-45	Rr: 60-0-50	Rr: 65-0-70	Rr: 65-0-70
ELBOW JOINT				
NORMS	RIGHT		LEFT	
	ACTIVE	PASSIVE		ACTIVE
S: 0-0-145	S: 0-0-140	S: 0-0-140	S: -5-0-140	S: -5-0-145

Table 3 – Results of the ROM by goniometry, at the first examination

3.3.9. Manual muscle strength test according to by Kendall

For the upper extremities (see tables 4 and 5), values are reported according the "Spinal Nerve and Muscle Chart" by Kendall to infirm or confirm an eventual motor nerve involvement. Values below 4 have been circled.

For the lower extremity and trunk (see table below), report is inspired of the "Neck, Trunk and Lower Extremity Muscle Chart" by Kendall.

TRUNK AND NECK MUSCLES		
RIGHT	**MUSCLE / MUSCLE GROUP**	**LEFT**
5	trapezius upper fibres	5
Normal	back extensors	Normal
4+	quadratus lumborum	4
trunk rising rectus abdominis and internal oblique: 2+		
leg lowering rectus abdominis and external oblique: 5		
3	trunk lateral flexion	3
LOWER LIMBS MUSCLES		
RIGHT	**MUSCLE / MUSCLE GROUP**	**LEFT**
4-	Iliopsoas	4-

Table 4 – Manual muscle testing results for the lower extremity and the trunk, at the first examination

The results do not demonstrate any weakness of the muscles in correlation to a specific nerve palsy. Yet, a weakness of the stabilizators of the scapula muscles, especially on the left side and of the upper abdominal girdle is found.

	MUSCLE STRENGTH GRADE	**LEFT ARM**	PERIPHERAL NERVES																				KEY D = dorsal prim. Ramus V = ventral prim. Ramus PR = plexus root ST = superior trunk P = posterior cord L = lateral cord M = medial cord								
				D	V	V	V	PR	PR	ST	ST	P	P	P	L	M	P	L	P	LM	M										
			T	1												1			1	1	1									
			Cervical	1-8	1-8	1-4	3, 4, 5	5, 6, 7, 8	4, 5	5, 6	4, 5, 6	4, 5, 6, 7	5, 6, 7, 8	5, 6, 7	5, 6, 7	6, 7, 8	5, 6,	4, 5, 6, 7	5, 6, 7, 8	5, 6, 7, 8	7, 8									
		MUSCLE	Cervical	Cervical	Cervical	Phrenic	Long thoracic	Dors. Scap.	N. to subclav.	Suprascpaular	U. Subscapular	thoracodorsal	L. subscapular	Lat. Pect.	Med. Pect.	Axillary	Musculocutan.	Radial	Median	Ulnar	SPINAL SEGMENT									
																						C1	C2	C3	C4	C5	C6	C7	C8	T1
		Head and neck extensors	●																			**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**
Cervical nerves		Infrahyoid muscles			●	●																**1**	**2**	**3**						
		Rectus capitis ant. and lat.			●																	**1**	**2**							
		Longus capitis			●																	**1**	**2**	**3**	4					
		Longus colli		●																			**2**	**3**	**4**	**5**	**6**	7		
		Levator scapulae			●			●																**3**	**4**	**5**				
		Scalena ant. med. and lat		●																				3	**4**	**5**	**6**	**7**	**8**	
		Sternocleidomastoid			●																	1	**2**	3						
	3-	Trapezius lower, middle			●																		2	**3**	**4**					
		Diaphragm				●																		3	**4**	**5**				
Brachial plexus	5	Serratus anterior					●																			**5**	**6**	**7**	**8**	
	3-	Rhomboid major and minor						●																	4	**5**				
		Subclavius							●																	**5**	6			
	5	Supraspinatus								●															4	**5**	6			
	5	Infraspinatus								●															4	**5**	**6**			
		Subscapularis									●		●													**5**	**6**	7			
	4	Latissimus dorsi										●															**6**	**7**	**8**	
	4+	Teres major											●														5	**6**	7		
	5	Pectoralis major upper												●												**5**	**6**	**7**		
	5	Pectoralis major lower												●	●													**6**	**7**	**8**	**1**
	5	Pectoralis minor													●													6	**7**	**8**	1
Axil.	5	Teres minor														●										**5**	**6**			
	5	Deltoid														●										**5**	**6**			
	4	Coracobrachialis															●										**6**	**7**		
	5	Biceps															●									**5**	**6**			
	5	Brachialis															●									**5**	**6**			
Radial	3-	Triceps																●									6	**7**	**8**	1
	3-	Anconeus																●										**7**	**8**	
	5	Brachialis (small part)																●								**5**	**6**			
	5	Brachioradialis																●								**5**	**6**			
	5	Extensor carpi rad. longus																●								5	**6**	**7**	8	
	5	Extensor carpis rad. brevis																●								5	**6**	**7**	8	
	4+	Supinator																●								5	**6**	7		
	5	Extensor digitorum																●									**6**	**7**	**8**	
	5	Extensor digit minimi																●									6	**7**	**8**	
	4+	Extensor carpi ulnaris																●									6	**7**	**8**	
	5	Abductor pollicis longus																●									6	**7**	**8**	
	5	Extensor pollicis brevis																●									6	**7**	**8**	
	5	Extensor pollicis longus																●									6	**7**	**8**	
	5	Extensor indicis																●									6	**7**	**8**	
Median	5	Pronator teres																		●								**6**	**7**	
	4	Flexor carpi radialis																		●								**6**	**7**	8	
	4	Palmaris longus																		●								6	**7**	**8**	1
	4+	Flexor digitorum sup.																		●									**7**	**8**	**1**
	5	Flexor digitorum prof. I, II																		●									7	**8**	1
	5	Flexor pollicis longus																		●								6	7	**8**	1
	5	Pronator quadratus																		●									7	**8**	1
	5	Abductor pollicis brevis																		●								6	7	8	1
	5	Opponens pollicis																		●								6	7	8	1
	5	Flexor pollicis brevis (sup. H)																		●								6	7	8	1
	5	Lumbricales I, II																		●								6	7	**8**	1
Ulnar	4+	Flexor carpi ulnaris																			●								7	**8**	1
	5	Flexor digitorum prof. III, IV																			●								7	**8**	**1**
		Palmaris brevis																			●								7	**8**	**1**
	4+	Abductor digiti minimi																			●								7	**8**	**1**
	5	Opponens digiti minimi																			●								7	**8**	**1**
	4	Flexor digiti minimi																			●								7	**8**	**1**
	5	Palmar interossei																			●									**8**	**1**
	5	Dorsal interossei																			●									**8**	**1**
	5	Lumbricales III, IV																			●								7	**8**	**1**
	5	Adductor pollicis																			●									**8**	**1**
	5	Flexor pollicis brevis (deep H)																			●									**8**	**1**

Table 5 - Manual muscle testing and nerve involvement results for the left arm, at the first examination

	MUSCLE STRENGTH GRADE	RIGHT ARM	PERIPHERAL NERVES																			KEY D = dorsal prim. Ramus V = ventral prim. Ramus PR = plexus root ST = superior trunk P = posterior cord L = lateral cord M = medial cord									
				T	D	V	V	V	PR	PR	ST	ST	P	P	P	L	M	P	L	P	LM	M									
			Cervical	1													1			1	1	1	SPINAL SEGMENT								
		MUSCLE		1-8	1-8	1-4	3, 4, 5	5, 6, 7, 8	4, 5	5, 6	4, 5, 6	4, 5, 6, 7	5, 6, 7, 8	5, 6, 7	5, 6, 7	6, 7, 8	5, 6,	4, 5, 6, 7	5, 6, 7, 8	5, 6, 7, 8	7, 8										
			Cervical	Cervical	Cervical	Phrenic	Long thoracic	Dors. Scap.	N. to subclav.	Suprascpaular	U. Subscapular	thoracodorsal	L. subscapular	Lat. Pect.	Med. Pect.	Axillary	Musculocutan.	Radial	Median	Ulnar	C1	C2	C3	C4	C5	C6	C7	C8	T1
		Head and neck extensors	●																		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**
Cervical nerves		Infrahyoid muscles			●	●															**1**	**2**	**3**						
		Rectus capitis ant. and lat.			●																**1**	**2**							
		Longus capitis			●																**1**	**2**	**3**	4					
		Longus colli		●																		**2**	**3**	**4**	**5**	**6**	7		
		Levator scapulae			●			●															**3**	**4**	**5**				
		Scalena ant. med. and lat		●																			3	**4**	**5**	**6**	**7**	**8**	
		Sternocleidomastoid			●																1	**2**	3						
	3-	Trapezius lower, middle			●																	2	**3**	**4**					
		Diaphragm				●																	3	**4**	**5**				
Brachial plexus	5	Serratus anterior					●																		**5**	**6**	**7**	**8**	
	3+	Rhomboid major and minor						●																4	**5**				
		Subclavius							●																**5**	6			
	5	Supraspinatus								●														4	**5**	6			
	5	Infraspinatus								●														4	**5**	**6**			
		Subscapularis									●		●												**5**	**6**	7		
	4-	Latissimus dorsi										●														**6**	**7**	**8**	
	4+	Teres major											●												5	**6**	7		
	5	Pectoralis major upper												●											**5**	**6**	**7**		
	5	Pectoralis major lower												●	●											**6**	**7**	**8**	**1**
	5	Pectoralis minor													●											6	**7**	**8**	1
Axil.	5	Teres minor														●									**5**	**6**			
	5	Deltoid														●									**5**	**6**			
	4	Coracobrachialis															●									**6**	**7**		
	5	Biceps															●								**5**	**6**			
	5	Brachialis															●								**5**	**6**			
Radial	4	Triceps																●								6	**7**	**8**	1
	4	Anconeus																●									**7**	**8**	
		Brachialis (small part)																●							**5**	**6**			
	5	Brachioradialis																●							**5**	**6**			
	5	Extensor carpi rad. longus																●							5	**6**	**7**	8	
	4+	Extensor carpis rad. brevis																●							5	**6**	**7**	8	
	5	Supinator																●							5	**6**	7		
	5	Extensor digitorum																●								**6**	**7**	**8**	
	5	Extensor digit minimi																●								6	**7**	**8**	
	5	Extensor carpi ulnaris																●								6	**7**	**8**	
	5	Abductor pollicis longus																●								6	**7**	**8**	
	5	Extensor pollicis brevis																●								6	**7**	**8**	
	4+	Extensor pollicis longus																●								6	**7**	**8**	
	5	Extensor indicis																●								6	**7**	**8**	
Median	5	Pronator teres																		●						**6**	**7**		
	5	Flexor carpi radialis																		●						**6**	**7**	8	
	4+	Palmaris longus																		●						6	**7**	**8**	1
	4+	Flexor digitorum sup.																		●							**7**	**8**	**1**
	4+	Flexor digitorum prof. I, II																		●							7	**8**	1
	5	Flexor pollicis longus																		●						6	7	**8**	1
	5	Pronator quadratus																		●							7	**8**	1
	5	Abductor pollicis brevis																		●						6	7	8	1
	5	Opponens pollicis																		●						6	7	8	1
	5	Flexor pollicis brevis (sup. H)																		●						6	7	8	1
	5	Lumbricales I, II																		●						6	7	**8**	1
Ulnar	5	Flexor carpi ulnaris																			●						7	**8**	1
	4+	Flexor digitorum prof. III, IV																			●						7	**8**	**1**
		Palmaris brevis																			●						7	**8**	**1**
	4+	Abductor digiti minimi																			●						7	**8**	**1**
	5	Opponens digiti minimi																			●						7	**8**	**1**
	4+	Flexor digiti minimi																			●						7	**8**	**1**
	5	Palmar interossei																			●							**8**	**1**
	5	Dorsal interossei																			●							**8**	**1**
	5	Lumbricales III, IV																			●						7	**8**	**1**
	5	Adductor pollicis																			●							**8**	**1**
	5	Flexor pollicis brevis (deep H)																			●							**8**	**1**

Table 6 - Manual muscle testing and nerve involvement results for the right arm, at the first examination

3.3.10. Joint play examination according to Lewit

	JOINT	JOINT PLAY/MOVEMENT	RESULT
CERVICAL SPINE AND C TH CROSSING	C0-C1	Rotation	Not restricted
		Lateroflexion	Restricted
		Anteflexion	Restricted
		Retroflexion	Not restricted
	C2-C3 TO C5-C6	Anterior direction	Restricted
		Posterior direction	Restricted
		Laterolateral direction	Not restricted
	C6 to T1	Ventrodorsal direction	Restriction of C6-C7
		Laterolateral direction	
TRORACIC SPINE		Extension	Restricted in a T1-T8 portion
		Flexion	Restricted
		Lateroflexion to the left	Restricted from T1 to T5 and T8 to T12
		Lateroflexion to the right	Restricted in the whole thoracic spine
		Rotation to the right	Restricted from T1 to T8
		Rotation to the left	Restricted in the whole thoracic spine
RIBS	1st rib	(in sitting position)	Not restricted
	3rd to 5th ribs	By means of overtake phenomenon	Not restricted
	10th to 12th ribs	(in sitting position)	Not restricted
UPPER EXTREMITY	Left scapula	(in prone lying position)	Not restricted and without crepitation
	Left shoulder	Caudal direction	Restricted
		Ventral direction	Restricted
		Dorsal direction	Restricted
		Lateral direction	Restricted
	Left elbow	Radial direction	Not restricted
		Ulnar direction	Not restricted
	Wrist	Dorsal direction	Not restricted
		Palmar direction	Not restricted

Table 8 – Results of joint play examination, at the first examination

The joint play examination (see table above) demonstrate a global restriction of the cervical spine joint play, of the thoracic spine of the left shoulder. The ribs mobility and elbow appear to be satisfying.

3.3.11. Soft tissues examination and muscle palpation

- Chest examination:
    - hypertonicity of pectoralis major and minor without hypertrophy

- restricted fascia in caudocranial direction in the area of the sternum, in caudo cranial direction in the clavipectoral area

- Back:
  - hypertonicity and hypertrophy of the erector spinae on both sides and more pronounced on the T4-T12 section of the spine
  - hypotonus of subacromial muscles
  - trigger points at the palpation of the lower angle of scapula, paravertebral muscles in the upper thoracic section,
- Neck examination:
  - no restriction of the cervico-thoracic fasci in latero medial direction but slight restriction in craniocaudal one, whic triggers pain to the elbow
  - hypertonus of upper trapezius of both arms
  - inflammatory changes in the nape of the neck, with slight elevation of temperature of both arms
- Upper extremity:
  - marked hypotonus of both triceps, especially on the left side with trigger points and painfull palpation,
  - important waist of muscle on the internal aspect of the upper arm
  - no restricted fascia on the upper arms, forearm or wrist

3.3.12. Basic neurological examination

- subjective light touch test:
  - nape of the neck and shoulder area: the subject doesn't relate any discrepancy when simultaneously touched on both sides of the body, along the dermatomes projections
  - upper extremity: the subject doesn't relate any discrepancy when simultaneously touched on both sides of the body along the dermatomes projections but mentions continuous pain along the C6-C7 dermatomes down to the elbow (which resembles the axillary nerve projection)
- pain sensibility test:

	LEFT UPPER EXTREMITY	RIGHT UPPER EXTREMITY
SHOULDERS (C4)	Unpleasant sensation	No pain
INNER ASPECT OF FOREARM (C6-T1)	No increasment of pain	No pain
OUTER ASPECT OF FOREARM (C6-T1)	No pain	No pain
THUMB (C6-C8)	No pain	No pain
LITTLE FINGER (C6-C8)	No pain	No pain

Table 9 – Results of the pain sensibility testing, at the first examination

- position sense test: poor recognition of the position of the thumb on the left arm; more proximal joints show normal function

- movement sense test: impossibility to recognize the movement of the thumb and of the first finger on the left arm, more proximal joint show normal function

- deep tendon reflex examination (see results below):

	LEFT UPPER EXTREMITY	RIGHT UPPER EXTREMITY
BICIPITAL REFLEX (C5-C6)	Normal response	Normal response
TRICIPITAL REFLEX (C6-C7)	Slightly delayed	Normal response
CARPO-METACARPAL REFLEX (C8-D1)	Normal response	Normal response

Table 10 – Results of the deep tendon reflex examination, at the first examination

3.3.13. Specific tests

The specific test results (see below) exclude the possibility of thoracic outlet syndrome but highlight the existence of a nerve irritation on the left side.

NAME	DIFFERENTIAL DIAGNOSIS	LEFT UPPER EXTREMITY	RIGHT UPPER EXTREMITY
ADSON TEST	Thoracic outlet syndrome	Negative	Negative
ROOS TEST	Thoracic outlet syndrome	Negative (note the patient relates pain)	Negative
SPURLING TEST	Radiculopathy	Positive	Negative

Table 11 – Specific tests (Adson's test, Root test and Spurling's test) results, at the first examination

3.3.14. Conclusion of the initial kinesiologic examination

The first kinesiological examination has been performed on the 11th of January 2011 and completed on the 12th on a 67 years old patient, suffering from arthrosis and a lumbar scoliosis and consulting for an irradiating pain in the C7 dermatome area.

The patient shows a posture of sway back type with the usual muscles imbalances characterizing this kind of faulty alignment. The manual muscle testing, when combined to the use of a spinal nerve chart does not establish any specific nerve palsy; it nevertheless backs the results of the postural examination, revealing notably a global weakness of the abdominals and scapula stabilizators. In addition, the patient presents a rotation of the trunk to the left side and a reversed type of breathing. Inflammatory changes in the area of the neck and left shoulder are observed and trophical changes and waist of muscle, logically attributable to aging, are noticed. The palpation shows hyperalgic zones on the scapular area on the left side, the posterior part of the upper arm and along paravertebral muscles, especially in the upper thorax. The examination hasn't revealed any background of hypermobility but rather a generalized stiffness of the joints with restriction of the joint play in the upper thoracic spine, lower cervical spine and shoulder. The basic neurological examination reveals a slightly decreased proprioception on the left arm and specific tests reveal a nervous (especially at the C6-C7 level) but not vascular compression.

The diagnosis of acute vertebrogenic algic syndrome as settled by the last consulted the physician, is confirmed. In addition, the presence of morphological changes, in absence of muscle weakness in relation to a specific radicular involvement leads to classify it as a cervicobrachial syndrome with sensory disturbances of probable C7 or C8 origin.

3.4. Short term and long term physiotherapeutic plan

While the short term rehabilitation plan is to be aimed at treating the pain Mr. M. B. complains about, the long term one focuses on the correction of further postural disbalances which, if not treated might jeopardize and diminish the benefits of the early therapy. Hence the short term therapy plan emphasises the treatment of the shoulder and

cervical spine whereas the long term strategy focuses on more general corrections of the posture.

Short term rehabilitation plan: decrease of pain correction of postural disbalances with an emphasise on the shoulder and neck

- during the acute, hyperalgic phase:
    - decrease of the pain
        - thermotherapy (hot pack)
        - electrotherapy (crossed interferential current)
    - decrease of the inflammation:
        - Voltaren application
    - relaxation of shortened muscles:
        - PIR
    - increase of the soft tissues' mobility
        - soft tissues techniques according to Lewit
    - prevention of any further state's degradation:
        - relative rest (physical activity cessation)
        - postural reeducation in lying and sitting position
- during the subacute phase:
    - decrease of the pain:
        - thermotherapy (hotpack)
        - electrotherapy (interferential current)
    - increase of the range of motion:
        - PIS on shortened muscles (neck, arm, foream)
        - manual methods according to Lewit (mobilization, manipulation, tractions)
    - strengthening of the weak muscles:
        - PNF according to Kabbat
        - workout exercises
    - improvement of the posture of the shoulder:
        - shoulder centration exercises
    - improvement of the proprioception of the upper limb:
        - sensomotoric training

Long term rehabilitation plan: correction of postural disbalances with an emphasize on the lumbar spine and lower limbs

- increase of the range of movement:
    - PIS of the shortened muscles
    - manual methods
    - specific exercises
- strengthening of the week and elongated muscles
    - PNF according to Kabat
    - specific exercises

3.5. Therapy progresses

3.5.1. Tuesday the 11th of January: initial kinesiologic examination (see above)

3.5.2. Wednesday the 12th of January

- goals of the therapy:
    - end of initial kinesiologic examination
    - decrease of the pain
    - relaxation of hyperalgic zones
    - decrease of the inflammation
- session:
    - application of hot pack for 10 minutes over the left shoulder area
    - soft tissues techniques according to Lewit on the neck, chest, shoulder, upper arm on the left side
    - application of Voltaren cream over the neck, shoulder upper arm on the left side
    - electrotherapy: crossed interferential current of 100 Hz, applied up to sensitive level for 10 minutes
    - education to appropriate postural behaviours in lying and sitting position:
        - in lying: the patient is asked to sleep prone lying, use a small pillow supporting only the neck but not lifting the head above the trunk, he may use a pillow to support his left arm as well

- in sitting position: the patient is asked to use a chair with arms when working, being in close contact with the desk and correcting the position of his neck so that there is no protraction of the head

- results:
  - objective: the pain, ranked at 5 on the VAPS in the beginning of the session is decreased to 3 in the end; the palpation shows less inflammation of the tissues around the nape of the neck and left scapular area in the end of the session.
  - subjective: the patient relates the warmth feels pleasant during the application of the hotpack
- self therapy:
  - the patient is asked to take hot shower for 5 to 10 minutes, mornings and evenings, with the spray of water directed on the nape of the neck and the upper trunk
  - recommendation for application before the sleep of Voltaren over the painfull area is done
  - the patient is asked to stop any sports activity (during which the optimal position of the head is not managed and thus which might trigger or increase the pain)
  - the patient is finally asked to pay attention to his posture and follow the given instructions in regard to the correct postural behaviours

3.5.3. Thursday the 13th of January

- goals of the therapy:
  - decrease the pain
  - relaxation of hyperalgic zones
  - decrease of the inflammation
  - increase of the ROM of the cervical spine and shoulder joint
- session:
  - application of hot pack for 10 minutes over the left shoulder area
  - soft tissues techniques according to Lewit on the chest, shoulder, upper arm and nape of the neck on the left side

- application of Voltaren cream over the neck, shoulder, upper arm on the left side
- PIR (trapezius, short extensors of the cervicocranial junction, triceps, internal and external rotators of the shoulder, pectoralis minor, major, trapezius)
- manual methods according to Lewit:
    - traction of the cervical spine with soft tissues kneading
    - traction of the cervical spine in sitting position
    - scapular mobilization
    - mobilization of the thoracic spine into retroflexion into sitting position
    - mobilization of the thoracic spine into flexion in sitting position
    - mobilization of the thoracic spine into rotation in sitting position
    - mobilization of the shoulder in laterolateral caudal and dorsoventral direction
- electrotherapy: crossed interferential current of 100 Hz, applied up to sensitive level for 10 minutes

- notes: Mr. M. B. seems confident in his treatment and asks about advises for his posture and strategies to relieve the pain at home
- results:
    - objective: the pain ranked at 4 in the beginning of the session is ranked at 3 in the end; the palpation reveals less inflammation of the nape of the neck and of the shoulder. The passives ROM of the shoulder and of the rotation of the cervical spine are increased into 5 to 10 degrees.
    - subjective: the patient relates in the beginning of the session a better in his pain since the previous day.
- self therapy:
    - recommendation for application before the sleep of Voltaren over the painful area is done
    - self therapy for short extensors of the neck is demonstrated and required to be applied once daily until the following therapy session, with three repetitions
    - reminder of good postural behaviours
    - cessation of sports activity is at new asked
    - advise to continue the hot shower twice daily is given
    - advise to use an electric blanket (as Mr. M. B. tells he possess one), in case of pain.

3.5.4. Monday the 17th of January

- goals:
    - decrease of the pain
    - relaxation of hyperalgic zones
    - decrease of the inflammation
    - increase the ROM of the cervical spine and shoulder joint
    - correction of the faulty alignment of the spine
    - strengthening of the abdominal wall, long extensors of the neck
- session:
    - application of hot pack for 10 minutes over the left shoulder area
    - application of Voltaren cream over the neck, shoulder, upper arm on the left side
    - PIR (triceps, internal and external rotators of the shoulder, short extensors of the cervicocranial junction, erector spinae)
    - manual methods according to Lewit:
        - traction of the cervical spine with soft tissues kneading
        - traction of the cervical spine in sitting position
        - mobilization of the thoracic spine into retroflexion into sitting position
        - mobilization of the thoracic spine into flexion in sitting position
        - mobilization of the thoracic spine into rotation in sitting position
        - mobilization of the shoulder in laterolateral caudal and dorsoventral direction
    - breathing exercise with abdominal contraction 5 repetitions , 4 times (for description, see appendix “exercises description”)
    - chin down exercise, 10 repetitions, 2 times (for description, see appendix “exercises description”)
- results:
    - objective: the pain ranked at 5 on the VAPS in the beginning of the session decreases to 3 in the end. Increase of the passive ROM of the shoulder to internal and external rotation into 5 to 20 degrees. The realization of the basic pattern movement to neck flexion remains wrong.

- notes: the patient performs with extreme difficulties the holding of the abdominal wall during the breathing exercises (needing my help for the first 10 repetitions approximately). He also relates difficulty to perform the chin down exercise and needs several demonstrations to perform it correctly.
- self therapy:
    - Mr. M. B. is asked to perform the breathing exercise with abdominal contraction twice daily with 10 to 15 repetitions and helping himself by decreasing the lower rib cage with his hands during expiration. A recommendation is done so that he doesn't hold his breath or decrease or rise the abdominal wall during the exercise.
    - Mr M. B. is asked to perform the chin down exercise using a pillow twice daily with 10 to 15 repetitions. I recommend him not press only with the chin or only with the forehead and tell that it must be a movement of the whole head
    - recommendation for application before the sleep of Voltaren over the painful area is done and then on mornings and evening before the following session.

3.5.5. Wednesday the 19th of January

- goals:
    - decrease of the pain
    - strengthening of stabilizators of scapula
    - relaxation of hyperalgic zones
    - correction of faulty alignement of the cervical spine
    - increase proprioception of the upper limb
- session:
    - PIR (triceps, erector spinae)
    - PNF according to Kabat for scapula second diagonal flexion pattern (hold relax active method)
    - manual methods according to Lewit:
        - traction of the cervical spine with soft tissues kneading
        - traction of the cervical spine in sitting
        - mobilization of the thoracic spine into retroflexion into sitting position
        - mobilization of the thoracic spine into flexion in sitting position

- mobilization of the thoracic spine into rotation in sitting position
- mobilization of the shoulder in laterolateral caudal and dorsoventral direction

- centration of shoulder exercise in closed chain 10 repetitions, 2 times (for description, see appendix, "exercises description")
- breathing exercise with abdominal contraction 10 repetitions, 3 times
- chin down exercise 10 repetitions, 3 times
- use of flexibar (triggers pain)
- electrotherapy: crossed interferential current of 100 Hz, applied up to sensitive level for 10 minutes

- results:
  - objective: the examination of the basic movement pattern to shoulder abduction in the end of the session gives better results than in the beginning. In addition, the pain ranked at 4 on the VAPS in the beginning of the session, reaches 2 to 3in the end.

- notes: the patient has a tendency to lean forward during the expiration when he realizes the centration shoulder exercise.
- self therapy:
  - the patient is asked to reproduce the centration of shoulder, the chin down and the breathing with abdominal contraction exercises twice to three times daily, each with 10 repetitions.

3.5.6. Friday the 21st of January

- goals:
  - decrease of the pain
  - correction of faulty alignment posture in upper trunk
  - increase proprioception of the upper limb
- session:
  - manual methods according to Lewit:
    - traction of the cervical spine with soft tissues kneading
    - traction of the cervical spine in sitting
    - mobilization of the thoracic spine into retroflexion into sitting position

- mobilization of the thoracic spine into flexion in sitting position
- mobilization of the thoracic spine into rotation in sitting position

- PNF for scapula second diagonal flexion pattern (hold relax active method)
- centration shoulder exercise 10 times, 1 repetition
- chin down exercise with modification (with circles) 15 times, 1 repetition (for description see appendix "exercises description")
- breathing exercise with abdominal contraction with modification (lifting of the arms) 5 times, 3 repetitions (for description, see appendix "exercises description")
- electrotherapy: crossed interferential current of 100 Hz, applied up to sensitive level for 10 minutes

- note: the patient relates a worsening of the pain, that lasted about 4 to 5 hours, in the cervical spine and shoulder after the previous session. He nevertheless tells that he feels much better and ranks the pain to 2 on the VAPS. The patient needs helps to hold the abdominal wall during the modified breathing exercise but finally performs the last two times perfectly. In addition, the patient relates the electrotherapy doesn't help according to him and that he feels displeasing sensation after the therapy is applied.
- results:
  - objective: the pain remains at 2 on the VAPS at the end of the session. The basic movement examination into neck flexion and shoulder abduction shows for both better control of the movement.
- self therapy:
  - the patient is asked to perform at home twice daily the centration shoulder, breathing with abdominal contraction and chin down exercises, with for each of them 10 to 15 repetitions (stop is recommended in case of pain).

3.5.7. Monday the 24th of January

- goals:
  - increase the proprioception of the upper arm
  - strengthening of the stabilisators of the scapula
  - strengthening of the lower abdominals

- session:
    - manual methods according to Lewit:
        - traction of the cervical spine with soft tissues kneading
        - traction of the cervical spine in sitting
        - mobilization of the thoracic spine into retroflexion into sitting position
        - mobilization of the thoracic spine into flexion in sitting position
        - mobilization of the thoracic spine into rotation in sitting position
    - PNF second diagonale flexion pattern for scapula (hold relax active method)
    - PNF first diagonale extension pattern rhythmic stabilization method
    - chin down exercise with modification (8 shape) (for description, see appendix "exercise description)
    - flexibar training (for description, see appendix "exercise description")
        - with right hand towards the floor
        - with left hand towards the floor
        - with both hands towards the floor
        - with both hands down and up
        - with both hands moving down to up and vice versa with quick stop and hold on request
- results:
    - objective: the performance of the trunk flexion is better after the therapy session. The pain is ranked at 3 in both the beginning and the end of the session
- self therapy:
    - the patient is asked to perform at home twice daily the centration shoulder, breathing with abdominal contraction (with modification) and chin down exercises with modification (8 shape), with for each of them 10 to 15 repetitions (stop is recommended in case of pain).

3.5.8. Wednesday the 26th of January (due to personal schedule problems, cancelled)

3.5.9. Friday the 28th of January

- goals:
    - correction of the faulty alignment posture
    - increase of the proprioception of the upper limb
    - strengthening of weak muscles of the pelvic area
- session:
    - PIR (pronators of the forearm, erector spinae, gastrocnemius, hamstrings)
    - PNF first diagonal extension pattern for the upper limb rhythmic stabilization method
    - PNF for the pelvis into posterior depression with hold relax active method
    - chin down exercise with modification (8 shape) (for description, see appendix "exercises description")
    - flexibar training (for description, see appendix "exercises description")
- notes: in the beginning of the session, the patient complains about pain in the lateral epicondyle of both arms and doesn't relate any specific event during the week end.
- results:
    - objective: the pain is initially ranked at 3 in the beginning of the session and decreases to 2 in the end.
    - subjective: the patient relates release sensation during PIR for pronators
- self therapy:
    - the patient is asked to perform at home twice daily the centration shoulder, breathing with abdominal contraction and chin down exercises, with for each of them 10 to 15 repetitions.
    - self stretching for gastrocnemius, hamstrings and is demonstrated and the patient is required to do it once a day, without saccade movements.

3.5.10. Monday the 31st of January: final kinesiologic examination

3.6 Final kinesiologic examination

3.6.1. Status praesens

Patient's information:

- name and surname: M. B.
- sex: M
- date of Birth: 28.3.1944.

General information:

- height: 1,69 m
- weight: 70 kg
- body Mass Index: 24,50 $kg.m^{-2}$

Diagnosis: Dorsalgia, unspecified M54.9

Main complain: Mr. M. B. comes under the indications of an orthopaedist after a diagnosis of an unspecified dorsalgia previously settled on the 22nd of December 2010. He complains about an acute pain in the left shoulder and posterior part of the upper arm ranked at 2 on the VAPS this day.

3.6.2. Postural examination

- back view (see appendix n°3): inward rotation of the calves, discrepancy in size of the tiles (left one being smaller than right one), protraction of the lower angle of scapula on the right side, correct position of shoulders
- left side view (see appendix n°3): moderated protraction of the head, no protraction of shoulder, correct position of the legs, flattening of the lumbar spine is still present
- right side view (see appendix n°3): outward rotation of the right knee, flattening of the lumbar spine, correct position of shoulder, normal kyphosis of the thoracic spine, normal lordosis of the cervical spine.
- front view (see appendix n°3) : outward rotation of the right knee, slight discrepancy of the tiles, the right one being bigger, correct head position, slight rotation of the trunk to the left.

3.6.3. Pelvis palpation

The pelvis palpation shows a less important anterior tilt of the pelvis. No lateral tilt to either side is felt.

3.6.4. Gait examination

The normal gait examination shows a slightly altered synkinesis of the arms with the left one being more mobile than the right one. . The stance and swing phases of the gait appear to be physiological.

3.6.5. Dynamic spine tests

- lateral flexion to the left: limited despite and ranked to 44cm in lateroflexion distance, poor mobility of the spine except in the low thoracic section and lumbar section.
- lateral flexion to the right: limited and ranked at 44cm in lateroflexion distance, poor mobility of the spine except in the lumbar section.
- anteflexion: limited, ranked at 6cm in Thomayer's distance, occurring mostly in the lower thoracic section and the lumbar spine; no pain is related.
- retroflexion: limited but without pain, occurring mostly in the upper lumbar section of the spine, the cervical spine.

3.6.6. Basic movements pattern examination

The basic movement patterns examination (see table below) shows a global improvement of the patterns with corrections of faulty sequences: the shoulder abduction, and neck flexion appears to be physiological; the trunk flexion and push ups, even if altered, show a better control and a better sequence of recruitment of muscles.

	LEFT	RIGHT
TRUNK FLEXION	- performed through the whole range but with rib flaring	
NECK FLEXION	- no protraction or tremor is observed - no pain is related	
SHOULDER ABDUCTION	- correct external rotation of the scapula in coordination with the arm elevation - correct sequence of activation of muscles	- normal sequence of activation of muscles
PUSH UPS	- the fixation of the scapulas breaks in the later stage of the movement - no pain during the test	

Table 12 - Observations recorded during the testing of basic movements patterns, at the final examination

3.6.7. Hypermobility special tests according to Janda

The hypermobility special tests (see table below) reveal globally a certain stiffness of the joint and no background of hypermobility.

TEST	OBSERVATIONS	RESULTS
BACKWARD BENT:	reaches 45° of angle with the table	grade A
FORWARD BENT:	cannot touch the floor	grade A
LATERAL TRUNK FLEXION:	to the left: doesn't reach the intergluteal line	grade A
	to the right: reaches the intergluteal line	grade A
ROTATION OF THE TRUNK:	to the left: reaches about 80°	grade A
	to the right: reaches about 60°	grade A
ROTATION OF THE CERVICAL SPINE:	to the left: reaches 70°	grade A
	to the right: reaches 50°	grade A
EXTENSION OF METACARPO-PHALANGEAL JOINTS:	reaches about 50°	grade A
ELBOWS JOINT EXTENSION OF CLASPED FOREARMS:	cannot join elbows in either position	grade A
HORIZONTAL ADDUCTION IN SHOULDER JOINT:	left shoulder: reaches more than the fossa jugularis	grade B
	right shoulder: reaches more than the midline of the clavicle	grade B
CONTACT OF HANDS BEHIND THE TRUNK:	with the left arm elevated: hands remain about 5 cm away	grade A
	with the right arm elevated: hands remains about 5 cm away	grade A
SCARF TEST:	left arm: touches the spine	grade A
	right arm: touches the spine	grade A

Table 13 - Observations and results of the hypermobility special tests, at the final examination

3.6.8. Range of motion test according to Kendall

The results are given in degrees and according to the SFTR method of report for the shoulder and the elbow joint (see table below). They reveal values that are within or close to the physiological norms.

CERVICAL SPINE				
MOVEMENTS AND NORMS	TO THE RIGHT		TO THE LEFT	
	ACTIVE	PASSIVE	ACTIVE	PASSIVE
Rotation (norm: 80)	65	75	80	80
Lat. Flex. (norm: 45)	45	45	30	45
	ACTIVE		PASSIVE	
Flexion (norm: 50)	55		60	
Extension (norm: 60)	50		50	
SHOULDER JOINT				
NORMS	RIGHT		LEFT	
	ACTIVE	PASSIVE	ACTIVE	PASSIVE
S: 45-0-180	S: 175-0-45	S: 170-0-25	S: 190-0-30	S: 190-0-40
F: 150-0-0	F: 160-0-0	F: 160-0-0	F: 150-0-0	F: 155-0-0
T: 90-0-40	T: 85-0-45	T: 85-0-45	T: 85-0-55	T: 90-0-50
Rr: 90-0-70	Rr: 75-0-45	Rr: 75-0-45	Rr: 90-0-70	Rr: 85-0-75
ELBOW JOINT				
NORMS	RIGHT		LEFT	
	ACTIVE	PASSIVE	ACTIVE	PASSIVE
S: 0-0-145	S: 0-0-140	S: 0-0-140	S: 0-0-135	S: -5-0-145

Table 14 - Results of the ROM by goniometry, at the final examination

3.6.9. Manual muscle strength test according to Kendall

For the lower extremity (see table below), report is inspired of the "Neck, Trunk and Lower Extremity Muscle Chart" by Kendall.

TRUNK AND NECK MUSCLES		
RIGHT	**MUSCLE / MUSCLE GROUP**	**LEFT**
5	trapezius upper fibres	5
Normal	back extensors	Normal
4	quadratus lumborum	4
trunk rising rectus abdominis and internal oblique: 3+		
leg lowering rectus abdominis and external oblique: 4+		
4	trunk lateral flexion	3
LOWER LIMBS MUSCLES		
RIGHT	**MUSCLE / MUSCLE GROUP**	**LEFT**
4-	Iliopsoas	4

Table 15 - Manual muscle testing results for the lower extremity and the trunk, at the final examination

For the upper extremities (see tables below), values are reported according the "Spinal Nerve and Muscle Chart" by Kendall to infirm or confirm an eventual motor nerve involvement. Values below 4 have been circled.

	MUSCLE STRENGTH GRADE	LEFT ARM	PERIPHERAL NERVES																			KEY D = dorsal prim. Ramus V = ventral prim. Ramus PR = plexus root ST = superior trunk P = posterior cord L = lateral cord M = medial cord								
				D	V	V	V	PR	PR	ST	ST	P	P	P	L	M	P	L	P	LM	M									
			T	1												1			1	1	1									
			Cervical	1-8	1-8	1-4	3, 4, 5	5, 6, 7, 8	4, 5	5, 6	4, 5, 6	4, 5, 6, 7	5, 6, 7, 8	5, 6, 7	6, 7, 8		5, 6,	4, 5, 6, 7	5, 6, 7, 8	5, 6, 7, 8	7, 8									
		MUSCLE		Cervical	Cervical	Cervical	Phrenic	Long thoracic	Dors. Scap.	N. to subclav.	Suprascapular	U. Subscapular	thoracodorsal	L. subscapular	Lat. Pect.	Med. Pect.	Axillary	Musculocutan.	Radial	Median	Ulnar									
																						C1	C2	C3	C4	C5	C6	C7	C8	T1
		Head and neck extensors	●																			**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**
Cervical nerves		Infrahyoid muscles			●	●																**1**	**2**	**3**						
		Rectus capitis ant. and lat.			●																	**1**	**2**							
		Longus capitis			●																	**1**	**2**	**3**	4					
		Longus colli		●																			**2**	**3**	**4**	**5**	**6**	7		
		Levator scapulae			●			●																**3**	**4**	**5**				
		Scalena ant. med. and lat		●																				3	**4**	**5**	**6**	**7**	**8**	
		Sternocleidomastoid			●																	1	**2**	3						
	4-	Trapezius lower, middle			●																		2	**3**	**4**					
		Diaphragm				●																		3	**4**	**5**				
Brachial plexus	5	Serratus anterior					●																			**5**	**6**	**7**	**8**	
	4	Rhomboid major and minor						●																	4	**5**				
		Subclavius							●																	**5**	6			
	5	Supraspinatus									●														4	**5**	6			
	5	Infraspinatus									●														4	**5**	**6**			
		Subscapularis										●		●												**5**	**6**	7		
	4	Latissimus dorsi											●														**6**	**7**	**8**	
	5	Teres major												●												5	**6**	7		
	5	Pectoralis major upper													●											**5**	**6**	**7**		
	5	Pectoralis major lower													●	●											**6**	**7**	**8**	**1**
	5	Pectoralis minor														●											6	**7**	**8**	1
Axil.	5	Teres minor															●									**5**	**6**			
	5	Deltoid															●									**5**	**6**			
	4	Coracobrachialis																●									**6**	**7**		
	5	Biceps																●								**5**	**6**			
	5	Brachialis																●								**5**	**6**			
Radial	3+	Triceps																	●								6	**7**	**8**	1
	4	Anconeus																	●									**7**	**8**	
	5	Brachialis (small part)																	●							**5**	**6**			
	5	Brachioradialis																	●							**5**	**6**			
	5	Extensor carpi rad. longus																	●							5	**6**	**7**	8	
	5	Extensor carpis rad. brevis																	●							5	**6**	**7**	8	
	5	Supinator																	●							5	**6**	7		
	5	Extensor digitorum																	●								**6**	**7**	**8**	
	5	Extensor digit minimi																	●								6	**7**	**8**	
	5	Extensor carpi ulnaris																	●								6	**7**	**8**	
	5	Abductor pollicis longus																	●								6	**7**	**8**	
	5	Extensor pollicis brevis																	●								6	**7**	**8**	
	5	Extensor pollicis longus																	●								6	**7**	**8**	
	5	Extensor indicis																	●								6	**7**	**8**	
Median	5	Pronator teres																		●							**6**	**7**			
	5	Flexor carpi radialis																		●							**6**	**7**	8		
	4-	Palmaris longus																		●							6	**7**	**8**	1	
	4	Flexor digitorum sup.																		●								**7**	**8**	**1**	
	5	Flexor digitorum prof. I, II																		●								7	**8**	1	
	5	Flexor pollicis longus																		●							6	7	**8**	1	
	5	Pronator quadratus																		●								7	**8**	1	
	5	Abductor pollicis brevis																		●							6	7	8	1	
	5	Opponens pollicis																		●							6	7	8	1	
	5	Flexor pollicis brevis (sup. H)																		●							6	7	8	1	
	5	Lumbricales I, II																		●							6	7	**8**	1	
Ulnar	5	Flexor carpi ulnaris																			●							7	**8**	1	
	4+	Flexor digitorum prof. III, IV																			●							7	**8**	**1**	
		Palmaris brevis																			●							7	**8**	**1**	
	4+	Abductor digiti minimi																			●							7	**8**	**1**	
	5	Opponens digiti minimi																			●							7	**8**	**1**	
	4	Flexor digiti minimi																			●							7	**8**	**1**	
	5	Palmar interossei																			●								**8**	**1**	
	5	Dorsal interossei																			●								**8**	**1**	
	5	Lumbricales III, IV																			●							7	**8**	**1**	
	5	Adductor pollicis																			●								**8**	**1**	
	5	Flexor pollicis brevis (deep H)																			●								**8**	**1**	

Table 16 - Manual muscle testing and nerve involvement results for the left arm, at the final kinesiologic examination

	MUSCLE STRENGTH GRADE	RIGHT ARM	PERIPHERAL NERVES																				KEY D = dorsal prim. Ramus V = ventral prim. Ramus PR = plexus root ST = superior trunk P = posterior cord L = lateral cord M = medial cord	SPINAL SEGMENT								
			T	D	V	V	V	PR	PR	ST	ST	P	P	P	L	M	P	L	P	LM	M												
			Cervical	1												1			1	1	1												
		MUSCLE		1-8	1-8	1-4	3, 4, 5	5, 6, 7, 8	4, 5	5, 6	4, 5, 6	4, 5, 6, 7	5, 6, 7, 8	5, 6, 7	5, 6, 7	6, 7, 8	5, 6,	4, 5, 6, 7	5, 6, 7, 8	5, 6, 7, 8	7, 8												
			Cervical	Cervical	Cervical	Phrenic	Long thoracic	Dors. Scap.	N. to subclav.	Suprascpaular	U. Subscapular	thoracodorsal	L. subscapular	Lat. Pect.	Med. Pect.	Axillary	Musculocutan.	Radial	Median	Ulnar													
		Head and neck extensors	●																			**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**
Cervical nerves		Infrahyoid muscles			●	●																**1**	**2**	**3**						
		Rectus capitis ant. and lat.			●																	**1**	**2**							
		Longus capitis			●																	**1**	**2**	**3**	4					
		Longus colli		●																			**2**	**3**	**4**	**5**	**6**	7		
		Levator scapulae			●			●																**3**	**4**	**5**				
		Scalena ant. med. and lat		●																				3	**4**	**5**	**6**	**7**	**8**	
		Sternocleidomastoid			●																	1	**2**	3						
	4	Trapezius lower, middle			●																		2	**3**	**4**					
		Diaphragm				●																		3	**4**	**5**				
Brachial plexus	4+	Serratus anterior					●																			**5**	**6**	**7**	**8**	
	4+	Rhomboid major and minor						●																	4	**5**				
		Subclavius							●																	**5**	6			
	5	Supraspinatus								●															4	**5**	6			
	5	Infraspinatus								●															4	**5**	**6**			
		Subscapularis									●		●													**5**	**6**	7		
	4-	Latissimus dorsi										●															**6**	**7**	**8**	
	4+	Teres major											●													5	**6**	7		
	5	Pectoralis major upper												●												**5**	**6**	**7**		
	5	Pectoralis major lower												●	●												**6**	**7**	**8**	**1**
	5	Pectoralis minor													●												6	**7**	**8**	1
Axil.	5	Teres minor														●										**5**	**6**			
	5	Deltoid														●										**5**	**6**			
	4	Coracobrachialis															●										**6**	**7**		
	5	Biceps															●									**5**	**6**			
	5	Brachialis															●									**5**	**6**			
Radial	5	Triceps																●									6	**7**	**8**	1
	5	Anconeus																●										**7**	**8**	
		Brachialis (small part)																●								**5**	**6**			
	5	Brachioradialis																●								**5**	**6**			
	5	Extensor carpi rad. longus																●								5	**6**	**7**	8	
	4+	Extensor carpis rad. brevis																●								5	**6**	**7**	8	
	5	Supinator																●								5	**6**	7		
	5	Extensor digitorum																●									**6**	**7**	**8**	
	5	Extensor digit minimi																●									6	**7**	**8**	
	5	Extensor carpi ulnaris																●									6	**7**	**8**	
	5	Abductor pollicis longus																●									6	**7**	**8**	
	5	Extensor pollicis brevis																●									6	**7**	**8**	
	5	Extensor pollicis longus																●									6	**7**	**8**	
	5	Extensor indicis																●									6	**7**	**8**	
Median	5	Pronator teres																		●							**6**	**7**		
	5	Flexor carpi radialis																		●							**6**	**7**	8	
	4+	Palmaris longus																		●							6	**7**	**8**	1
	4	Flexor digitorum sup.																		●								**7**	**8**	**1**
	4+	Flexor digitorum prof. I, II																		●								7	**8**	1
	5	Flexor pollicis longus																		●							6	7	**8**	1
	5	Pronator quadratus																		●								7	**8**	1
	5	Abductor pollicis brevis																		●							6	7	8	1
	5	Opponens pollicis																		●							6	7	8	1
	5	Flexor pollicis brevis (sup. H)																		●							6	7	8	1
	5	Lumbricales I, II																		●							6	7	**8**	1
Ulnar	5	Flexor carpi ulnaris																			●							7	**8**	1
	5	Flexor digitorum prof. III, IV																			●							7	**8**	**1**
		Palmaris brevis																			●							7	**8**	**1**
	4+	Abductor digiti minimi																			●							7	**8**	**1**
	5	Opponens digiti minimi																			●							7	**8**	**1**
	5	Flexor digiti minimi																			●							7	**8**	**1**
	5	Palmar interossei																			●								**8**	**1**
	5	Dorsal interossei																			●								**8**	**1**
	5	Lumbricales III, IV																			●							7	**8**	**1**
	5	Adductor pollicis																			●								**8**	**1**
	5	Flexor pollicis brevis (deep H)																			●								**8**	**1**

Table 17 -- Manual muscle testing and nerve involvement results for the right arm, at the final kinesiologic examination

The results do not demonstrate any weakness of the muscles in correlation to a specific nerve palsy. The values recorded for the stabilizators of the scapula show a decreased strength. The muscles of the abdominal girdle, if not normal, are satisfying.

3.6.10. Joint play examination according to Lewit

	JOINT	JOINT PLAY/MOVEMENT	RESULT
CERVICAL SPINE AND C TH CROSSING	C0-C1	Rotation	Not restricted
		Lateroflexion	Restricted
		Anteflexion	Restricted
		Retroflexion	Restricted
	C2-C3 TO C5-C6	Anterior direction	Restricted
		Posterior direction	Not restricted
		Laterolateral direction	Not restricted
	C6 to T1	Ventrodorsal direction	Restriction of C6-C7
		Laterolateral direction	
TRORACIC SPINE		Extension	Restricted in a T1-T6 portion
		Flexion	Restricted
		Lateroflexion to the left	Restricted from T4 to T12
		Lateroflexion to the right	Restricted from T1 to T10
		Rotation to the right	Restricted from T1 to T8
		Rotation to the left	Restricted from T1 to T8
RIBS	1st rib	(in sitting position)	No restriction
	3rd to 5th ribs	By means of overtake phenomenon	No restriction
	10th to 12th ribs	(in sitting position)	No restriction
UPPER EXTREMITY	Left scapula	(in prone lying position)	No restriction and without crepitation
	Left shoulder	Caudal direction	Not restricted
		Ventral direction	Not restricted
		Dorsal direction	Not restricted
		Lateral direction	Not restricted
	Left elbow	Radial direction	Not restricted
		Ulnar direction	Not restricted
	Wrist	Dorsal direction	Not restricted
		Palmar direction	Not restricted

Table 18 - Results of joint play examination, at the final examination

The results of the joint play examination (see table above) demonstrate a restriction of the cervical spine, of the left shoulder. The ribs mobility, elbow and ribs is physiological.

3.6.11. Soft tissues examination and muscle palpation

- Chest examination:
    - no restriction of upper thoracic fascia to either direction in the sternum areaand the clavipectoral area
    - normotonus of the serratus anterior and pectoral muscles on both sides
- Back:
    - normotonus of the erector spinae on both sides but hypertrophyon the T4-T10 section of the spine
    - hypotrophy of subacromial muscles on the left side, normotonus of the subacromial muscles on the right side.
    - the Kibler's fold performance provokes redness at the upper thoracic level on both sides, especially on the paravertebrals muscles area.
- Neck examination:
    - no restriction of fascias in lateromedial or craniocaudal direction
    - no difference of temperature can be felt
    - hypertonus of upper trapezius , more pronounced on the left side
- Upper extremity:
    - waist of muscle on the internal part of the upper arm , especially on the left side
    - pain felt at the palpation of the triceps
    - easily movable fascia on the whole upper extremity on both sides

3.6.12. Basic neurological examination

- Subjective light touch test:
    - nape of the neck and shoulder area: the patient doesn't relates any discrepancy when touched on both sides of the body.
    - upper extremity: The patient doesn't relate any discrepancy or pain when touched on each sides of the body.
- Pain sensibility test:

	LEFT UPPER EXTREMITY	RIGHT UPPER EXTREMITY
SHOULDERS (C4)	No pain	No pain
INNER ASPECT OF FOREARM (C6-T1)	Slight changed perception	No pain
OUTER ASPECT OF FOREARM (C6-T1)	No pain	No pain
THUMB (C6-C8)	No pain	No pain
LITTLE FINGER (C6-C8)	No pain	No pain

Table 19 - Results of the pain sensibility testing, at final examination

- position sense test: changed recognition of the position of the thumb and 5th finger (distal phalanx) on both arms; other joints show normal results.

- movement sense test: recognizes the movement of the fingers on both arms, the answers are faster for the right arm.

- deep tendon reflex examination:

	LEFT UPPER EXTREMITY	RIGHT UPPER EXTREMITY
BICIPITAL REFLEX (C5-C6)	Normal response	Normal response
TRICIPITAL REFLEX (C6-C7)	Normal response	Normal response
CARPOMETCARPAL REFLEX (C8-D1	Normal response	Normal response

Table 20 - Results of the deep tendon reflex testing, at the final examination

3.6.13. Specific tests

The specific tests results (see table below) demonstrate a nerve irritation on the left side of the cervical spine. They exclude in addition a thoracic outlet syndrome.

NAME	DIFFERENTIAL DIAGNOSIS	LEFT UPPER EXTREMITY	RIGHT UPPER EXTREMITY
ADSON TEST	Thoracic outlet syndrome	Negative	Negative
ROOS TEST	Thoracic outlet syndrome	Negative	Negative
SPURLING TEST	Radiculopathy	Positive	Negative

Table 21 - Specific tests (Adson's test, Root test and Spurling test) results, at the final examination

3.6.14. Conclusion of the final kinesiologic examination

The final kinesiologic examination has been performed on the 31st of January 2011 after 9 therapy session on Mr. M. B., initially consulting for an irradiating pain in the C7 dermatome area.

The values and observations globally demonstrate an improvement of the patient's conditions (discussed more in the part 2.7.). from the mobility, movability of the joints and the postural point of view to the reflex changes in the neck and subscapular areas. The posture examination nevertheless reveals a still modified posture with decreased curves of the spine; in addition, the manual muscle testing show decreased, yet correct grades for scapula stabilizators muscles and abdominal girdle.

Finally, signs of pseudo radicular syndrome in the cervical region appear to be still present but less easily elicited.

3.7. Evaluation of the effects of the therapy

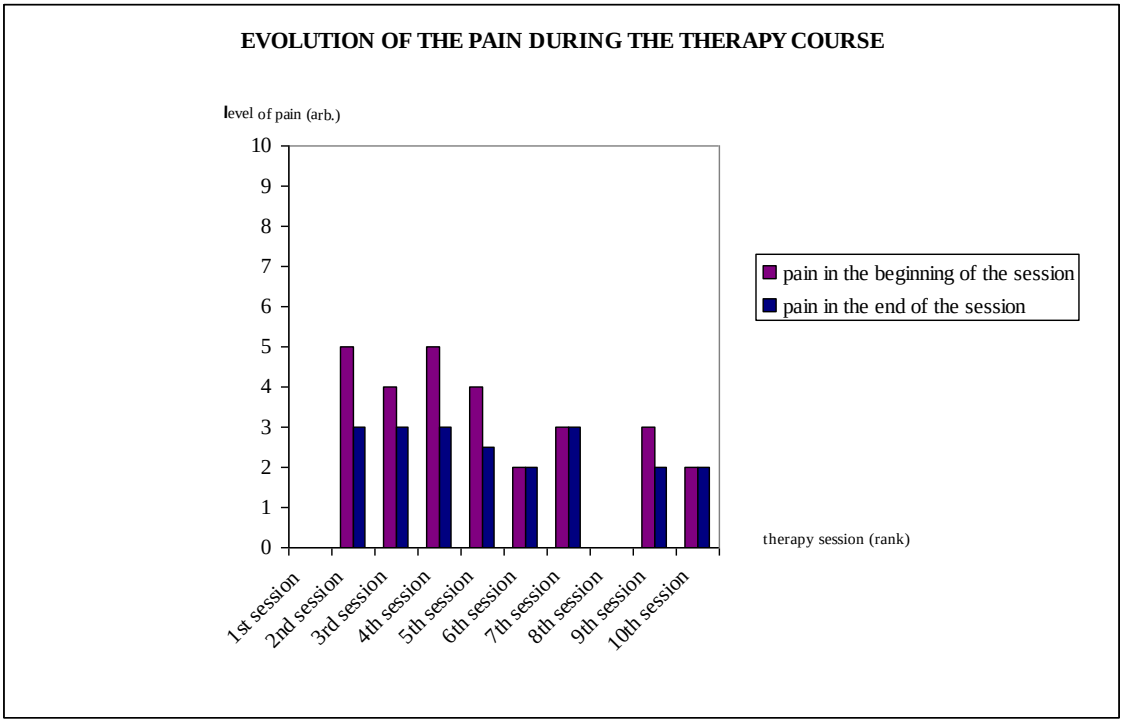
The main concern of the patient remaining the relief of the pain through the whole rehabilitation, I chose to measure it thanks to a visual analogic pain scale in the beginning and the end of each therapy session. The document n°1 presents an histogram of the level of pain evolution over the therapy sessions. It highlights the effectiveness of the chosen therapies for each session but also a durable decrease of the pain along with the therapy course.

In addition, the comparison of the results and values obtained at the first and final kinesiologic examinations show further improvement:

- an enhanced mobility of the acral joints and a lowering of the stiffness of the static and dynamic posture which is demonstrated by the correlation of the ROM and joint play values and visible at the examination of the gait and posture examination. The dynamic spine test furthermore indicates an improvement of the vertebral column mobility, especially in terms of lateroflexion.
- an improvement of the muscular condition (see table below) allowing a more physiological stabilization of the shoulder and the lower trunk.

- the decreasing of the pain (as shown by the study of the results given by the VAPS scale) and the decreasing of the reflex changes is backed up by the results of the basic neurological examination and of the soft tissues and muscle palpation.

Nevertheless, the special tests still highlight a radicular involvement, in addition, the joint mobility and ROM of the cervical spine remains decreased in comparison to the norm.



Graphic 1 - Histogram representing the evolution of the pain during the therapy course

Despite the effectiveness of the therapy in terms of postural changes and pain relief, it seems to me that an attempt of variation of the therapeutic methods could have enhanced the therapy results. Thus, I consider that the application of the proprioceptive neuromuscular facilitation for the head and neck (to correct the posture of the neck) or Schrott technique (to correct the scoliosis) could have been beneficial to my patient.

	RIGHT		LEFT	
	BEFORE	AFTER	BEFORE	AFTER
trapezius lower, middle	3-	4	3-	4-
rhomboids major, minor	3+	4+	3-	4
latissimus dorsi	4-	4-	4	4
Coracobrachialis	4	4	4	4
Triceps	4	5	3-	3+
Anconeus	4	5	3-	4
palmaris longus	4+	4+	4	4-
flexor digitorum superior	4+	4	4+	4
flexor digiti minimi	4+	5	4	4
quadratus lumborum	4+	4	4	4
Iliopsoas	4-	4-	4-	4
rectus abdominis an internal obliques		before: 2+		after: 3+
rectus abdominis and external obliques		before: 5		after: 4+
trunk lateral flexion		before: 3		after: 3

Table 22 - Comparison of the values obtained at the manual muscle testing before and after therapy

4. Conclusion

The actual professional simulation, based on the management of a patient's specific treatment course, allowed me to acknowledge new aspects and particularities of settling and organizing a rehabilitation plan.

Indeed, the case of Mr. M. B. displayed several difficulties in terms of strategy of treatment but also communication, because of his age, type of pathology and associated ones and of course because of the difference of native language. I noticed an occasional poor understanding of the instructions that I attributed to some extent to the old age of my patient but also to a relative depressed mood probably due to the long-lasting pain caused by the pathology itself. I nevertheless found it overriding to attempt to create and maintain a constant dialogue with the patient, so that the therapeutic plan fits with his needs and fulfil his expectations.

Moreover, the algic syndrome which Mr. M. B. suffered from was accompanied by other degenerative pathologies, which, if not treated could have led to a worsening of the condition that Mr. M. B. consulted for. It emerged then that the case of Mr. M. B. would require a global approach. It appeared in addition that the pain, although constituting the major symptom of the condition, required an attempt of objective assessment (fulfilled here by using the VAPS), in order to be used as a factor of therapy's effectiveness evaluation.

Nevertheless, the relatively small amount of therapy session, which I however increased, didn't permit to achieve the objectives of the long-term rehabilitation plan. Thus I encouraged Mr. M. B. to perform at home the exercises that I demonstrated and not to hesitate to consult a physician in case of new acute onset of the pain or any muscle weakness or bizarre sensation.

On the other hand, the professional practise, within a medical structure, appeared in my opinion, to require skills that are not so central when exercising on classmates: speed of execution, respect of the planned length of the session and displaying of creativity for new exercises. I thus understood that the respect to the time allotted per session is a non-negotiable data when preparing and realizing it and that it is more easily reached when aiming at the accuracy of each therapeutic technique that is used.

On a more general point of view, the case of Mr. M. B. illustrated well, in my opinion, the difficulty that encounters the practitioner when confronted to an unspecified algic syndrome. It highlights the necessary cooperation between the physician and the physiotherapist to eventually perform further examinations and refine the diagnosis along with the therapy course. Because of their intrinsic characteristics, the cervicobrachial syndrome, and furthermore the algic syndrome remain some of the most challengeable, yet very interesting conditions to treat as a physiotherapist.

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6. Appendix

Appendix n° 1: Approval of the Ethics Board Committee

CHARLES UNIVERSITY IN PRAGUE
FACULTY OF PHYSICAL EDUCATION AND SPORT
José Martího 31, 162 52 Praha 6-Veleslavín
tel. +420 2 2017 1111
http://www.ftvs.cuni.cz/

Application for Ethics Board Review

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

Project title: Case study of a patient with unspecified dorsalgia

Nature of the research project: Bachelor's thesis

Author : Carine Jiquelle

Supervisor : Mgr. Lenka Satrapová

Research project description : Case study of physiotherapy treatment of a patient with the diagnosis of unspecified dorsalgia (M54.9) will be conducted under the expert supervision of an experienced physiotherapist at the Centrum Léčby Pohybového Aparátu.
No invasive method will be used. Personal data obtained during the investigation will not be published.
Draft Informed Consent (enclosed).

Date: Author's signature:

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

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

The Ethics Board at the Faculty of Physical Education and Sport, Charles University, approved the research project.
Approval number: 020 / 2011
Date: 20. 1. 2011

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

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

Signature, REB Chairman

Official school stamp
UNIVERZITA KARLOVA v Praze
Fakulta tělesné výchovy a sportu
sekretariát děkana
José Martího 31, 162 52, Praha 6

Appendix n° 2: Informed consent/ Informovaný Souhlas

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

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

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

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

Datum: ……..

Osoba, která provedla poučení : ……

Podpis osoby, která provedla poučení : ……

Vlastnoručni podpis pacienta/tky : ……..

Appendix n°3: List of abbreviations

- 1D: first diagonal of the upper/lower limb
- C: cervical
- CLPA: Centrum Léčby Pohybového Aparátu
- C-TH: cervico-thoracic
- L: lumbar
- MRI: magnetic resonance imaging
- PIR: post isometric relaxation
- PIS: post isometric stretching
- PNF: proprioceptive neuromuscular facilitation
- ROM: range of motion
- T: thoracic
- TOS : thoracic outlet syndrome
- VAPS: visual anaologic pain scale

Appendix n°4: X- Ray pictures

Photo 2 - X-Ray picture n°1 of the cervical spine in lateral view performed on the 02.01.2011

Photo 1 - X-Ray picture n°2 of the cervical spine in lateral view performed on the 02.01.2011

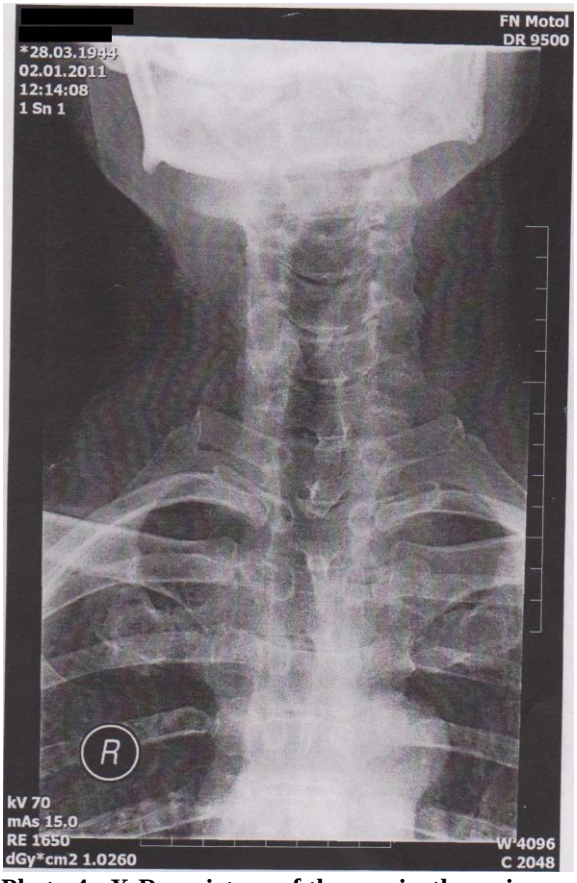

Photo 4 - X-Ray picture of the cervicothoracic spine in dorsal view performed on the 02.01.2011

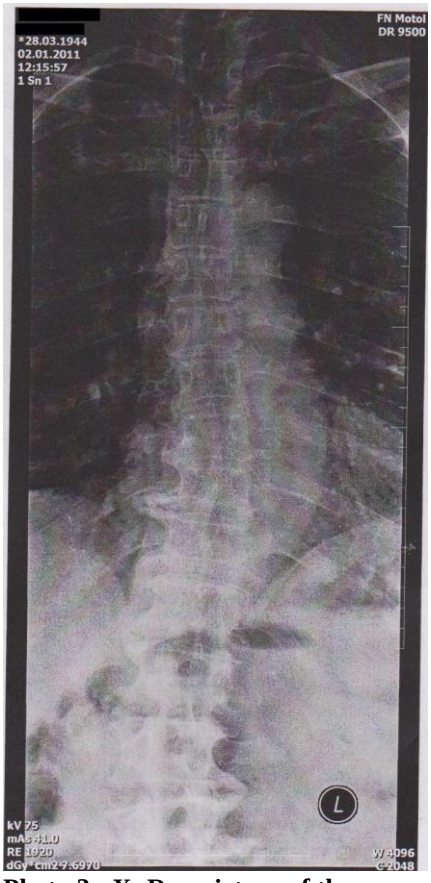

Photo 3 - X- Ray picture of the thoracolumbar spine in dorsal view performed on the 02.01.2011

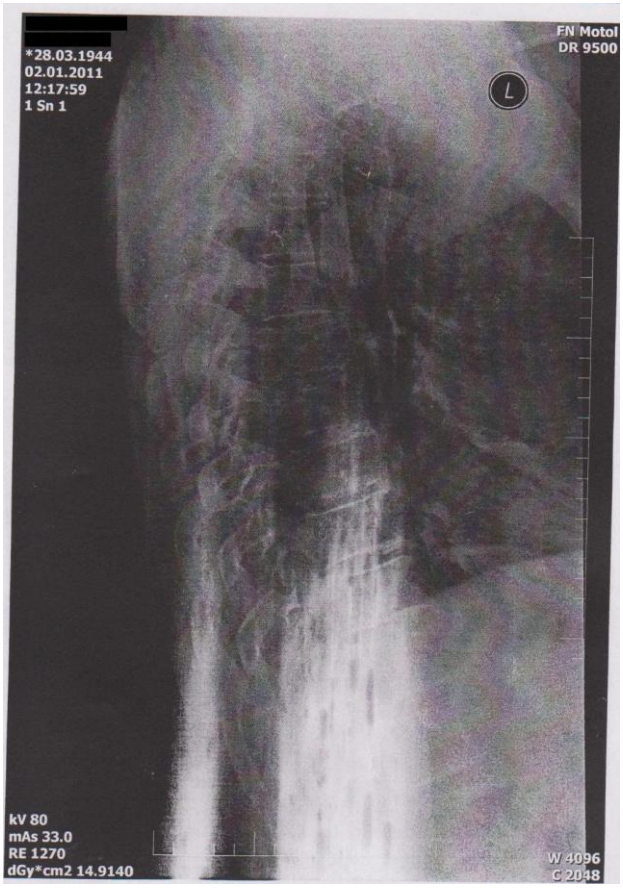

Photo 5 - X-Ray picture of the thoracolumbar spine in lateral view

Appendix n°5: Postural examination

- first kinesiological examination

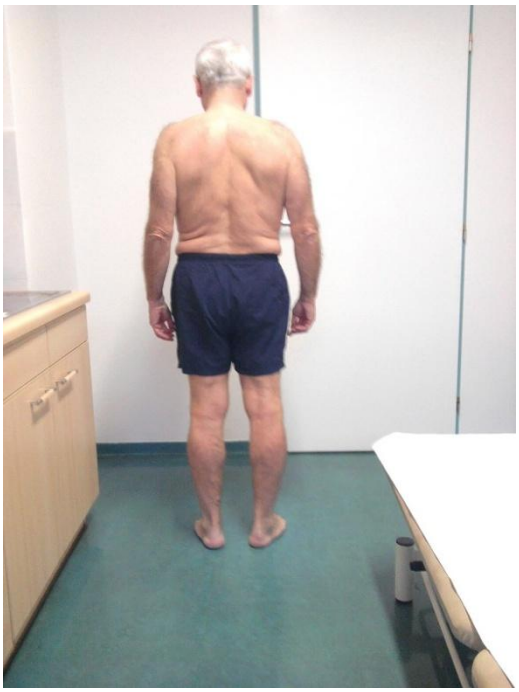

Photo 6 - Back view of the posture at the first kinesiologic examiation

Photo 7 - Left view of the posture at the first kinesiologic examiation

Photo 8 - Right view of the posture at the first kinesiologic examination

Photo 9 - Front view of the posture at the first kinesiologic examiation

- final kinesiologic examination

Photo 10 - Back view of the posture at the final kinesiologic examiation

Photo 11 - Left view of the posture at the final kinesiologic examiation

Photo 12 - Right view of the posture at the final kinesiologic examination

Photo 13 - Front view of the posture at the final kinesiologic examiation

Appendix n°6: Exercises description

Breathing with abdominal contraction

- starting position: patient lies on his back with knees bent and hands resting below the ribs
- movement:
    - patient tightens abdominal muscles to squeeze ribs down and towards the umbilicus
    - patient holds 5 seconds and then relaxes

Photo 14 - Breathing with abdominal contraction exercise: starting position (left), movement (right)

Chin down

- starting position:
    - patient lies on his back with bent knees
    - hands resting besides the body and head supported by an overball
- movement:
    - patient presses the overball with the whole head
    - patient holds 5 seconds and then relaxes

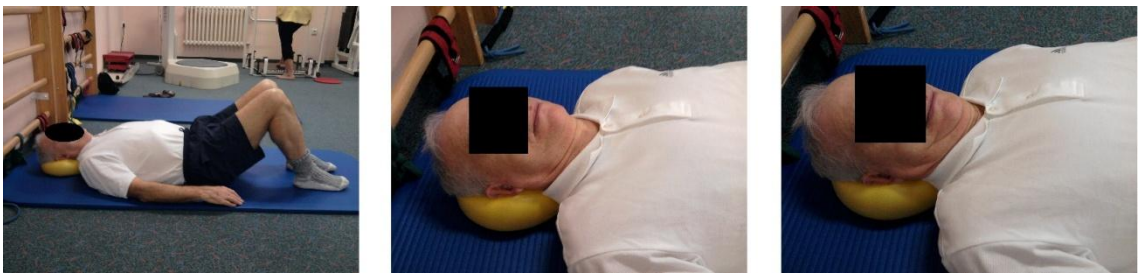

Photo 15 - Chin down: starting position (left), starting position (middle), movement (right)

Centration of shoulder in closed chain

- starting position:
    - patient faces the wall, legs slightly apart
    - arms are perpendicular to the body with slight flexion of the elbow, slight internal rotation of the hands
- movement:
    - patient holds with the arms against the wall without moving the body
    - patient holds 5 to 10 seconds and then relaxes
    - patient is instructed to breath normally during holding

Photo 16 - Centration of shoulder in closed chain: starting position

Chin down modified with circles

- starting position:
    - patient lies on his back with bent knees
    - hands resting at the body sides and head supported by an overball
- movement:
    - patient presses the overball down with the whole head
    - patient holds and draws a circle with his head to the right side
    - relaxation
    - patient presses the overball down with the whole head
    - patient holds and draws a circle with his head to the left side
    - relaxation

Photo 17 - Chin down modified with circles: description

Breathing with abdominal contraction modified with lifting of the arms

- starting position: patient lies on the back with knees bent and hands resting below the ribs
- movement:
    - patient tightens abdominal muscles to squeeze ribs down towards the umbilicus
    - patient holds and lifts up the arms
    - patient then brings it back to the starting position within 10 seconds


Photo 18 - Breathing exercise modified: starting position (left), movement (right)

Chin down modified eight shape

- starting position:
    - patient lies on his back with bent knees
    - hands resting at the body sides and head supported by an overball
- movement:
    - patient presses the overball with the whole head
    - patient holds and draws the shape of an eight with his head to the right side
    - relaxation
    - patient presses the overball with the whole head
    - patient holds and draws the shape of an eight with his head to the left side
    - relaxation

Photo 19 - Chin down modified with eight shape: description

Flexibar training

For the flexibar training, the patient is asked to maintain a vibration in the bar while performing movement of the arms. The patient is required to keep a god postural alignemen and is instructed to hold his shoulder fixed and to allow movement only in the acral parts of the upper limb. Training of the coordination is performed by asking the patient to carry two devices at the same time.

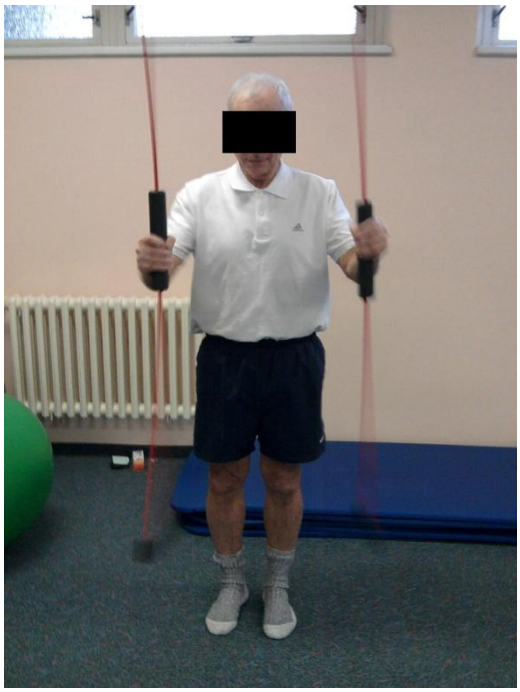

Photo 20 - Flexibar training: example of movement

Appendix n° 7: List of llustrations

Pictures:

Photos:

Tables :

Graphics :