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PRM programme for in - patients after spinal lumbar surgery

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Content

I. Summary

Background: The Programme is performed in the National Rehabilitation centre „Vaivari". The organization of the Programme is based on: National Regulation, on the White Book on Physical and Rehabilitation Medicine in Europe, and on International scientific guidelines and recommendations.

Target population and procedure: The Programme is focused on adult patients after lumbar surgery of any gender and age, suffering from neurological deficit, causing person's moving or self-care impairment. The patients are selected in the hospital by the attending surgeon or neurologist together with the PRM doctor who performs the assessment of patient's functioning disorders, rehabilitation potential and indications, who designs the rehabilitation plans in the hospital and for further rehabilitation, and who manages the transfer of the patient to the rehabilitation centre. General practitioner can send a patient to the PRM doctor who then completes the assessment of the functioning disorders, potential, indications and admits the patient to the rehabilitation programme.

The Programme is funded by the National Health Insurance. Safety and patient rights are defined by National regulations. Each patient signs an informed consent.

The main goals of the Programme are: to reduce impairment, to reduce pain, to provide improvement of functional abilities in activity and participation domains, to help the patient to return to productive life, to reduce sick-leaves duration and working absenteeism, to prevent pain recurrence and chronic evolution, to adapt physiotherapy program for persons with low back pain.

The Department permanent manpower consists of 4 PRM specialists, 6 physiotherapists, 2 occupational therapists, 1 neurologist, 1 psychologist, 1 nutritionist, 1 social worker, 5 nurses, 5 nurse assistants, 3 massage specialists, 1 physiotherapist of swimming pool and fitness gym, 1 secretary. Consultants from other departments and University clinics are also involved on demand. The rehabilitation team is often complemented with assistive technicians.

The approach to the Programme is multi-professional. The PRM specialist has an overall leadership on the team and is "the patient's manager". He/she is responsible for the initial patient's evaluation, the setup of an appropriate strategy, the team coordination and further patient's follow-up.

Patient's assessment is based on the evaluation presented in the White Book on Physical and Rehabilitation Medicine in Europe, appendix IV and suggested in International guidelines. The members of the team evaluate the patient subsequently. On the basis of this comprehensive evaluation, the initial PRM strategy is adjusted and the rehabilitation plan is confirmed. It may be adapted according to patient's clinical and functional findings, after regular team meetings.

Treatment methods to achieve rehabilitation goals, physiotherapy, occupational therapy, phycology, psychiatry, hydro procedures and physical modalities are used. Return to work and prevention are based on effort training, consultations for working place adjustments and ergonomics. All patient's medical and functional information, assessment and further monitoring data is recorded manually into a standardised medical documentation. A standardised discharge report with further recommendations is written in several copies, for the patient and for his/her GP. All the Programme documents are stored in the clinical archive and are accessible for periodic internal or external audit and outcomes assessment.

Long term outcomes monitoring: patient has follow-up reassessment of PRM doctor 6-12 months after discharge of in-patient rehabilitation centre. PRM doctor decides if the patient needs further rehabilitation and should it be done as an outpatient or in-patient rehabilitation.

II. General foundations of the Programme

A. PATHOLOGICAL AND IMPAIRMENT CONSIDERATIONS

1. Aetiology

Lower back pain can be caused by a variety of problems with any parts of the complex, interconnected network of spinal muscles, nerves, bones, discs or tendons in the lumbar spine. Typical sources of low back pain include:

- The large nerve roots in the low back that go to the legs may be irritated
- The smaller nerves that supply the low back may be irritated
- The large paired lower back muscles (erector spinae) may be strained
- The bones, ligaments or joints may be damaged

Many lower back problems also cause back muscle spasms, which don't sound like much but can cause severe pain and disability. (1)

- **Sprains and strains** account for most acute back pain. Sprains are caused by overstretching or tearing ligaments, and strains are tears in tendon or muscle. Both can occur from twisting or lifting something improperly, lifting something too heavy, or overstretching. Such movements may also trigger spasms in back muscles, which can also be painful.
- **Intervertebral disc degeneration** is one of the most common mechanical causes of low back pain, and it occurs when the usually rubbery discs lose integrity as a normal process of aging. In a healthy back, intervertebral discs provide height and allow bending, flexion, and torsion of the lower back. As the discs deteriorate, they lose their cushioning ability.
- **Herniated or ruptured discs** can occur when the intervertebral discs become compressed and bulge outward (herniation) or rupture, causing low back pain.
- **Radiculopathy** is a condition caused by compression, inflammation and/or injury to a spinal nerve root. Pressure on the nerve root results in pain, numbness, or a tingling sensation that travels or radiates to other areas of the body that are served by that nerve. Radiculopathy may occur when spinal stenosis or a herniated or ruptured disc compresses the nerve root.
- **Sciatica** is a form of radiculopathy caused by compression of the sciatic nerve, the large nerve that travels through the buttocks and extends down the back of the leg. This compression causes shock-like or burning low back pain combined with pain through the buttocks and down one leg, occasionally reaching the foot. In the most extreme cases, when the nerve is pinched between the disc and the adjacent bone, the symptoms may involve not only pain, but numbness and muscle weakness in the leg because of interrupted nerve signaling. The condition may also be caused by a tumor or cyst that presses on the sciatic nerve or its roots.
- **Spondylolisthesis** is a condition in which a vertebra of the lower spine slips out of place, pinching the nerves exiting the spinal column.
- **Spinal stenosis** is clinical syndrome of back, buttock, or lower extremity pain caused by narrowing of spinal canal or nerve root impingement (1). Associated pain syndromes include radicular pain (radiating leg pain present regardless of activity) and neurogenic claudication (leg pain brought on by walking or standing and relieved by rest or flexion). It may also be associated with numbness, weakness, and impaired walking.[i]
- **Vertebral fracture** is a fracture of vertebra most commonly related to osteoporosis but can also be due to trauma, infection, or cancer. (2)
- **Scoliosis** is a lateral curvature of spine (Cobb angle) ≥ 10 degrees in coronal plane while standing.(3)

The pelvis anatomy and position, defined by the pelvis incidence, interact with the spinal organization in shape and position to regulate the sagittal balance between both the spine and pelvis. Sagittal balance of the human body may be defined by a setting of different parameters such as (a) pelvic parameters: pelvic incidence (PI), pelvic tilt (PT) and sacral slope (SS); (b) C7 positioning: spino-pelvic angle (SSA) and C7 plumb line; (c) shape of the spine: lumbar lordosis.[1]

According to the SS value, Roussouly et al. described four types of lumbar lordosis. Regarding sacral slope, lumbar lordosis can be classified into four types. When the sacral slope is low, lumbar lordosis can either be both short and curved with a low apex and a backward tilt (type 1) or both long and flat with a higher position of the apex (type 2). When the sacral slope increases, lumbar lordosis increases in angle and number of vertebrae with an upper apex, with a progressively forward tilt (types 3 and 4). Depending on the shape and position of the pelvis, and because of the relation between sacral slope and pelvic tilt, the morphology of lumbar lordosis could be the main mechanical cause of degenerative diseases of the lumbar spine.[2]

The relation between lumbar lordosis and sacral slope was originally demonstrated by Stagnara et al.[3]. The more SS was tilted, the more the lumbar curvature was high (“dynamic back”); contrarily, when SS was rather horizontal, lumbar curvature was flat (“static back”). Several studies presented this strong correlation between SS and the global angle of lordosis [4] [5].

When the lumbar spine is hypolordotic and flat, the action of CF (contact forse) is mainly on the anterior column (vertebral bodies and discs) and its distribution favors the resultant force perpendicular to the discs, increasing the disc pressure. On the other hand, if lumbar lordosis is hypercurved, CF acts mainly on the posterior elements (facet joints, spinous processes) and, at the extremities of the curve, the vertebral units are greatly tilted (Fig. 8). The distribution of CF favors the sliding force resultant, increasing the stress on the facets and decreasing the disc pressure. When the tilt is forward, there is a risk of anterolisthesis; if the tilt is posterior, there is a risk of retrolisthesis. If we consider that the mechanical stresses may play a role in degenerative spine progression, hypolordosis may favor degenerative discopathies ; inversely, long hyperlordosis may induce posterior facets arthritis, Baastrup disease and listhesis. [6]

- Obesity and decrease in trunk muscle strength are important factors in chronic low-back pain, and a trunk muscle strengthening program will be helpful in reducing the pain.[7]
- Of importance, the theoretical PT and SS values for a given PI value must be known before the intervention in order to perioperatively restore the appropriate LL value. Only LL restoration will allow the pelvis to rotate forward to return to the normal theoretical PT and SS values, because PI is a constant anatomical parameter.[8]
- Study demonstrated that the lower EV (end vertebra) disc degeneration strongly correlated with sagittal imbalance in patients with DLS (degenerative lumbar scoliosis), implying that disc degeneration may be regarded as a potential risk factor for sagittal imbalance. This result strengthened the importance of not selecting the lower EV as the lower instrumented vertebra

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[1] Biomechanical analysis of the spino-pelvic organization and adaptation in pathology. Pierre Roussouly and João Luiz Pinheiro-Franco (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3175914/)

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[6] Biomechanical analysis of the spino-pelvic organization and adaptation in pathology. Pierre Roussouly and João Luiz Pinheiro-Franco (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3175914/)

[7] Isokinetic Measurement of Trunk Muscle Strength in Women with Chronic Low-Back Pain
Bayramoğlu, Meral MD; Akman, Mahmut N. MD; Klnç, Şehri MDıı; Çetin, Nuri MD; Yavuz, Nur MD; Özker, Rdvan MDı

[8] Evidence showing the relationship between sagittal balance and clinical outcomes in surgical treatment of degenerative spinal diseases: a literature review International Orthopaedics
January 2015, Volume 39, Issue 1, pp 87–95

during the surgical decision making, which may lead to deterioration of sagittal balance. Disc degeneration was also strongly correlated with sagittal malalignment, as demonstrated by a more positive SVA (sagittal vertical axis) , decreased TK (thoracic kyphosis) and LL, providing insight into reasons for low quality of life in elderly patients with DLS.[9]

- Deconditioning is a complex process of physiological change following a period of inactivity, bedrest or sedentary lifestyle. It results in functional losses in such areas as mental status, degree of continence and ability to accomplish activities of daily living. It is frequently associated with hospitalization in the elderly. The most predictable effects of deconditioning are seen in the musculoskeletal system and include diminished muscle mass, decreases of muscle strength by two to five percent per day, muscle shortening, changes in periarticular and cartilaginous joint structure and marked loss of leg strength that seriously limit mobility. The decline in muscle mass and strength has been linked to falls, functional decline, increased frailty and immobility. [10]

- Low back pain may continue or even increase after spine surgery:

  - Disc degeneration:

Disc degeneration is a common process starting early in life. Often disc herniation is an early step in disc degeneration, which may cause pain or stenosis. How quickly this subsequent disc degeneration occurs following a disc herniation and subsequent surgical treatment and whether certain spinal procedures increase the rate of degeneration remain unclear. (50)

The most common pathologic condition at the adjacent segment is hypertrophic degenerative arthritis of the facet joints, spinal stenosis, severe disc degeneration and degenerative spondylolisthesis. (77)

    - Loss of height after herniation removal

Height loss after disc hernia and discectomy os pertinent, since it can produce foraminal stenosis, anular bulging, and lateral recess stenosis with delayed onset of recurrent radiculopathy in the same rostral root distribution. Discectomy resulted in a mean 18% loss of height at 3 months and a 26% loss of height at 2 years.

The late radiographic evaluation, from 7 to 54 months postoperatively, showed an average decrease of 1%, or 0.1 mm for each level. At late follow-up, no correlation could be found between the time from the operation and disc space height. One hundred percent of patients developed disc space height decreases during the postoperative period, with 46% of levels being narrower than their preoperative height at last follow-up. (58)

    - Local compression and arthrosis

Although the most common source of midline axial back pain remains muscular or ligamentous strain, chronic pain associated with specific postural changes can be attributed to either facet joints or intervertebral discs. More specifically, discogenic pain is classically associated with sitting intolerance and flexion of the spine, as compared with pain with spinal extension in cases of facet syndrome. As the body's largest avascular structure, the intervertebral disc is prone to decreased nutritional uptake and subsequent degeneration. Repetitive motions in the spine from activities of daily life can create shear forces, resulting in microtrauma to the disc. Breakdown of proteoglycans and hydrophilic proteins in the nucleus pulposus leads to disc desiccation, which in turn initiates a cascade of disc height loss, progressive disc collapse, and immobility of the functional spinal unit. This decreased motion may actually lead to mechanical stability through the formation of osteophytes across the affected disc space and gradual resolution of pain, despite continued or progressive degeneration. (59)

  - Recurrence of hernation

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[9] Coronal curvature and spinal imbalance in degenerative lumbar scoliosis: disc degeneration is associated. 2014 Nov 15;39(24):E1441-7. Bao H1, Zhu F, Liu Z, Zhu Z, He S, Ding Y, Qiu Y

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The most common complication after lumbar discectomy is reherniation. (56)

Recurrence of hernia usually occurs within 1 or 2 years of surgery. In the Maine lumbar spine study, while at the end of 10 years, 25% of surgical patients had undergone at least one additional lumbar spine operation. (59)

The rate of recurrent disc herniation after lumbar discectomy is 5 to 15%. (51-54)

Clinical definition of recurrent disc hernation is disc herniation at the previously operative site and side. It has been suggested that the mean interval for recurrent pain associated with recurrent herniated discs is 18 months. (55)

The recurrence rate and reoperation rate for LDH after MED were comparable to those of conventional discectomy. More than half of the cases of recurrence occurred at an early postoperative phase, and patients with caudally migrated LDH experienced recurrence significantly more often than those with rostrally migrated or nonmigrated LDH. (57)

Aggresive emptying of the disc space reduces recurrence of reherniation. The percentage of disc material removed correlate with loss in disc space height, but disc space height loss does not correlate with back pain. In a prospective outcomes study including five institutions and 2-yer follow-up, it was found that those patients with recurrence (10.2%) had less disc volume removed (13% of the disc volume) compared to the patients without recurrence (28% of disc volume removed). (59)

- Instability

Nucleotomy as treatment for lumbar disc prolapse in combination with initial segment degeneration may lead to segmental instability. Dynamic stabilization systems restrict segmental motion and thus prevent further degeneration of the lumbar spine. They are designed to avoid the disadvantages of rigid fixation, such as pseudarthrosis and adjacent segment degeneration. (49)

Degenerative spondylolisthesis is seen in the older spine and is related to long-standing intersegmental instability from degenerative facet or disk disease. The most common level affected in a degenerative slip is the L4–L5 level. (61)

- Damage of posterior muscles

The posterior muscles include the latissimus dorsi and the paraspinals. The lumbar paraspinals consist of the erector spinae (iliocostalis, longissimus, and spinalis), which act as the chief extensors of the spine, and the deep layer (rotators and multifidi). The multifidi are tiny segmental stabilizers that act to control lumbar flexion because they cannot produce enough force to truly extend the spine. Their most important function has been hypothesized to be that of a sensory organ to provide proprioception for the spine, given the predominance of muscle spindles seen histologically in these muscles. The anterior muscles of the lumbar spine include the psoas and quadratus lumborum. Because of the direct attachment of the psoas on the lumbar spine, tightening this muscle accentuates the normal lumbar lordosis. (60)

The back muscles are exposed to pathophysiologic condition by a retractor during posterior lumbar spine surgery. External compression by a retractor increases intramuscular pressure to levels that impede local muscle blood flow. The muscle degeneration after surgery could be explained by direct mechanical damage and by the increased intramuscular pressure of muscle tissue by the retractor. (71)

- Fatty degeneration of posterior muscles

From a biomechanical perspective, the lumbar multifidus muscles (LMM) are important stabilizers of the lumbar spine, and dysfunction in the LMM has been found to play a role in chronic and recurrent low back pain. The LMM become neurologically inhibited following a low back injury and prolonged inhibition can lead to atrophy with fatty replacement, in which healthy muscle is replaced with fat (79).

A comparison of conventional open surgery with MI-TLIF upon degeneration of the paraspinal muscle with a 1 year follow-up evaluation revealed that both single and multi segment fusion showed less change in fat infiltration percentage and cross-sectional area in the MI-TLIF but there was no significant difference between the two groups. This suggests that as time passes after surgery, there is no significant difference in the level of degeneration of the paraspinal muscle between surgical techniques. (72)

- Vertebral plateau oedema (Modic 1 MRI signal)

The prevalence of Modic changes among patients with degenerative disk disease (DDD) of the lumbar spine varies between 19% and 59%, with type 1 and 2 changes being the most common. (63)

According to Modic, (64) the altered signal intensity detected by MR imaging is not, in and of itself, the causal pathologic process but rather a reflection of the causal process, which is some type of biomechanical stress or instability. Karchevsky et al (65) concluded that these changes likely represent a response of the bone marrow to the degenerative process involving the disk. In fact, type 1 changes have been shown to develop in 8% of patients following diskectomy and 40% following chemonucleolysis, which may be viewed as models of accelerated disk degeneration. (64) Kokkonen et al (66) observed a strong positive correlation between Modic changes and disk degeneration and proposed that endplate degeneration is more likely to be a sequel in the process of disk degeneration than a factor contributing to disk damage.

Modic changes and low back pain

Kjaer et al (67) suggested that Modic changes constitute the crucial element in the degenerative process around the disk in relation to LBP and clinical findings. They demonstrated that DDD on its own was a fairly quiet disorder, whereas DDD with Modic changes was much more frequently associated with clinical symptoms. Most authors agree that, among Modic changes, type 1 changes are the ones most strongly associated with LBP. (68-70)

According to the literature, most Modic 1 lesions change to become Stage 2 lesions in 18 to 24 months. In this study, 17 patients with Modic Type 1 signal had changes after 6 months. It appears that posterior osteosynthesis combined with posterolateral arthrodesis accelerates the course of Modic 1 lesions, probably by correcting mechanical instability. (78)

- Muscle denervation after surgery

One of the most important functions of the trunk muscle is to support the vertebral body. In particular, the back muscle, which is the extensor muscle of the lower lumber part, plays a pivotal role in the stability of the lumbar segment, and is essential in the dynamic control of segmentation movement. A direct injury to the back muscle during surgery for posterior fusion or an indirect injury from ischemia and denervation during the process of retracting the back muscle with long hours of excessive pressure are inevitable and might cause muscular atrophy and pain. This has become a major issue in failed back surgery syndrome. (73)

Different studies have shown that atrophy of paraspinal muscles arises after open dorsal lumbar fusion, and the reasons for this atrophy are still not yet fully clarified. Atrophy of paraspinal muscles after open, posterior lumbar interbody fusion seems to be associated with denervation, as well as direct muscle trauma during surgery. While muscle atrophy is also correlated with a worse clinical outcome, it seems to be a determining factor for successful lumbar spine surgery.

There was a significant increase of electromyographic denervation activity ($p = 0.024$) and reduced recruitment of motor units ($p = 0.001$) after 1 year. Laboratory studies showed a significant increase of CK ($p < 0.001$) and myoglobin ($p < 0.001$) serum levels at day 2 after surgery. The paraspinal muscle volume decreased from 67.8 to 60.4 % ($p < 0.001$) after 1 year. Correlation analyses revealed a significant negative correlation between denervation and muscle volume ($K = -0.219$, $p = 0.002$). Paraspinal muscle volume is significantly correlated with physical outcome ($K = 0.169$, $p = 0.020$), mental outcome ($K = 0.214$, $p = 0.003$), and pain ($K = 0.382$, $p < 0.001$) after 1 year. (62)

Disturbed back muscle innervation and loss of muscular support leads to the disability and increased biomechanical strain and might be one important cause to the failed back syndrome. (74)

Both inactivity and axonal injury (mainly of neurapraxia type) contribute to the selective type 2 atrophy and inner structure changes in disc patients' multifidus muscle. (75)

Atrophy may be the consequence of LBP: after the onset of pain and possible long-loop inhibition of the multifidus a combination of reflex inhibition and substitution patterns of the trunk muscles may work together and could cause a selective atrophy of the multifidus. Since this muscle is considered important for lumbar segmental stability, the phenomenon of atrophy may be a reason for the high recurrence rate of LBP. (76)

Indications for surgery:

- Ineffective conservative therapy
- "Red flag" findings associated with cauda equina syndrome (surgical emergency): progressive motor or sensory deficit, saddle anesthesia, bilateral sciatica or leg weakness, difficulty urinating, including retention, fecal incontinence.(4)
- Additional indicators of nerve root problems: unilateral leg pain > LBP, pain radiates to foot or toes, numbness and paresthesia in same distribution, straight leg raising test induces more leg pain, localized neurologic findings (limited to 1 nerve root).(5)

2. Natural history and relationship to impairment

As with any pain history, features of back pain that should be explored include location; character; severity; timing, including onset, duration, and frequency; alleviating and aggravating factors; and associated signs and symptoms. The causes of back pain are often very difficult to determine. For as many as 85% of patients, no specific cause for back pain is found.(6)

Associated impairment for low back pain may include:

Neurological deficits

Radicular symptoms can be the result of overt mechanical compression of a nerve root or a chemically mediated inflammatory process. The most common compressing lesion by far is a disk protrusion. Fewer than 1% of patients who present with radicular symptoms have other causes, including infection, malignancy, or fracture.(7) The most common levels of disk herniation are L4–L5 and L5–S1, with L5 and S1 being the most common nerve roots involved in radiculopathy. Multiple nerve roots can be affected by a single disk herniation, given the organization

of the cauda equina. Cauda equina syndrome occurs when the lowest sacral rootlets are affected, resulting in bowel, bladder, and sexual dysfunction.(8) Up to 1% of all disk herniations present as cauda equina syndrome.(9)

Dysfunction of pelvic organs:

Neurogenic bladder - urinary bladder and bladder outlet dysfunction attributable to any disturbance in the nervous system. (10) Definition: detrusor sphincter dyssynergia (DSD) - urodynamic finding of detrusor contraction concurrent with involuntary contraction of the sphincter (urethra and/or periurethral striated musculature).(11)

Types:

- flaccid bladder (areflexic) - acontractile detrusor - related to injury below T12(12)

- automatic bladder (hyperreflexic) - detrusor overactivity - related to injury at or above T12(13)
- acontractile urethral sphincter. (14)
- detrusor-sphincter dyssynergia (DSD), also called neurogenic detrusor sphincter dysfunction (NDSD). (15)

Incidence/Prevalence:

- neuro-urologic symptoms reported to be common in patients with neurologic conditions. (16)
  - 57%-83% 1month post stroke, but 80% recover by 6 months
  - 90%-97% with myelomeningocele
  - 70% with Parkinson disease after 5 years
  - 80% with multiple sclerosis after 10 years
  - 26% with degenerative disk disease
  - 27% with lumbar canal stenosis
  - 83% with cauda equina syndrome

Bowel incontinence - unintentional passage of solid or liquid stool. (17) Definitions: anal incontinence includes fecal incontinence and flatus incontinence(18) Passive fecal incontinence is passage of stool without awareness.(19) Urge fecal incontinence is inability to postpone defecation.(20)

Strongest risk factors are bowel disturbances, especially diarrhea, rectal urgency, chronic illness and increased disease burden. Few of the likely risk factors are spinal cord injury, back surgery, diabetes mellitus, multiple sclerosis, cauda equina injury, central nervous system tumor and others. (21)

Myelopathy

Myelopathy describes any neurologic deficit related to the spinal cord. Myelopathy is usually due to compression of the spinal cord by osteophyte or extruded disk material in the cervical spine. Many primary neoplastic, infectious, inflammatory, neurodegenerative, vascular, nutritional, and idiopathic disorders result in myelopathy, though these are very much less common than discogenic disease, metastases, and trauma. (22)

Examples of myelopathy include:carcinomatous myelopathy (spinal cord degeneration associated with cancer); compressive myelopathy (spinal cord changes from the pressure of hematomas, stenosis [narrowing], or masses); radiation myelopathy (spinal cord destruction from radiation sources such as x-ray therapy). When spinal cord destruction is caused by a complication of disease, the specific myelopathy signifies that origin. (e.g.,diabetic myelopathy). Since the spinal cord ends in the middle back at L1 or at the L1-L2 vertebrae (varies), only herniations of L1-L2 discs can cause spinal cord compression or myelopathy. Disc disorders with myelopathy occurring between lumbar vertebrae L3 to L5 are rare. Herniations of L2-L3 through L5-S1 can cause radiculopathy (compression of one spinal nerve root) or cauda equina syndrome (many spinal nerve roots compressed). (23)

Paresis - a general term referring to a mild to moderate degree of muscular weakness, occasionally used as a synonym for PARALYSIS (severe or complete loss of motor function).(24)

Paralysis is defined as complete loss and paresis as diminution of muscle power from abnormalities of the UMN, LMN, peripheral nerve, or muscle fibers. *Palsy* is a nonspecific descriptive term that indicates varying degrees of paralysis and/or paresis. (25)

Deep sensation impairment

Peripheral neuropathy is a disorder characterized by damage to nerves after they exit central nervous system with clinical manifestations including weakness, pain, numbness, and/or autonomic dysfunction depending on the type of peripheral nerve involved. (26)

Neuropathies are classified as axonal if the nerve cell axon is primarily involved, or demyelinating if the lesion is in the myelin coating of the nerve. Single nerve trunk lesions may be traumatic, ischemic, or inflammatory. Peripheral nerve dysfunction in the absence of CNS

disease is common. Patients present with complaints of numbness, burning, unsteadiness (often described as dizziness), falling, or weakness. Physical examination may show sensory impairment (pressure, vibration, position, pain, and temperature or simple touch depending on the size of nerves involved), muscle weakness and wasting with fasciculations, and/or diminished reflexes. (27)

Proprioceptive sensation (also termed deep sensation): receptors are located in muscles, tendons, ligaments and joints (28)

- *Joint position sense* (arthresthesia): To test the lower extremity, the patient's foot can be moved and the patient asked to point to the great toes with eyes closed. The Rosenberg test is also a test of joint position sense. This test is performed by having the patient stand with heels together and close his or her eyes. Stand close to the patient to prevent a fall. If position sense is diminished, the patient will sway severely or fall.

- *Vibratory sense* (pallesthesia): The timed vibratory test is the most sensitive simple method of detecting mild to moderate impairments in vibratory sensation. Apply the fork to the most distal joint of both upper and lower extremities as illustrated, and ask the patient to describe what is felt. Instruct the patient to indicate instantly when the sensation stops and note the total elapsed time since the fork was struck.

- *Kinesthesia:* perception of muscular motion. Usually not measured in routine clinical evaluation.

3. Diagnosis approach and prognosis

Imaging of the lumbar spine should be used in the evaluation of low back pain if specific pathology needs to be confirmed after a thorough history and physical examination.(29)

X-ray is often the first imaging technique used to look for broken bones or an injured vertebra. X-rays show the bony structures and any vertebral misalignment or fractures. Soft tissues such as muscles, ligaments, or bulging discs are not visible on conventional x-rays.

Computerized tomography (CT) is used to see spinal structures that cannot be seen on conventional x-rays, such as disc rupture, spinal stenosis, or tumors. Using a computer, the CT scan creates a three-dimensional image from a series of 2 dimensional pictures.

Myelograms enhance the diagnostic imaging of x-rays and CT scans. In this procedure, a contrast dye is injected into the spinal canal, allowing spinal cord and nerve compression caused by herniated discs or fractures to be seen on an x-ray or CT scans.

Discography may be used when other diagnostic procedures fail to identify the cause of pain. This procedure involves the injection of a contrast dye into a spinal disc thought to be causing low back pain. The fluid’s pressure in the disc will reproduce the person’s symptoms if the disc is the cause. The dye helps to show the damaged areas on CT scans taken following the injection. Discography may provide useful information in cases where people are considering lumbar surgery or when their pain has not responded to conventional treatments.

Magnetic resonance imaging (MRI) uses a magnetic force instead of radiation to create a computer-generated image. Unlike x-ray, which shows only bony structures, MRI scans also produce images of soft tissues such as muscles, ligaments, tendons, and blood vessels. An MRI may be ordered if a problem such as infection, tumor, inflammation, disc herniation or rupture, or pressure on a nerve is suspected. MRI is a noninvasive way to identify a condition requiring prompt surgical treatment. However, in most instances, unless there are “red flags” in

the history or physical exam, an MRI scan is not necessary during the early phases of low back pain.

Electrodiagnostics are procedures that, in the setting of low back pain, are primarily used to confirm whether a person has lumbar radiculopathy. The procedures include electromyography (EMG), nerve conduction studies (NCS), and evoked potential (EP) studies. EMG assesses the electrical activity in a muscle and can detect if muscle weakness results from a problem with the nerves that control the muscles. (2).

Scintigraphy

Radionuclear bone scanning is a fairly sensitive but not specific imaging modality that can be used to detect

occult fractures, bony metastases, and infections. To increase anatomic specificity, **single-photon emission computed tomography (SPECT)** bone scanning is used to obtain bone scans with axial slices. This allows the diagnostician to differentiate uptake in the posterior elements from more anterior structures of the spine.(30)

Prognosis:

Functional outcomes may vary with individuals. After a spine fusion surgery, it takes 3 to 12 months to return to most normal daily activities, and the success rate in terms of pain relief is probably between 70% and 90%, depending on the condition the spine surgery is treating.

About 35% of patients with chronic low back pain may be pain-free at 9-12 months.(31) Predictors of poor recovery are psychosocial “yellow flag” findings: anxiety, depression, feelings of uselessness, irritability, poor coping strategies, pain-interrupted sleep, passivity regarding treatment, withdrawal from activities, demoralizing beliefs about pain, history of sexual or physical abuse, history of substance abuse, inadequate social support, older age, overprotective environment, occupational factors, expectation that pain will increase with work, pending litigation, problems with worker's compensation claims, poor job satisfaction, unsupportive work environment.(32)

4. Impairment treatment principles

After lumbar surgery Initial rehabilitation phase: 0 – 4 weeks

Goals:

1. Mobilise independently and safely
2. Understand good posture and spinal mechanics
3. Independent home exercise programme (HEP)
4. Understand self-management and pacing concept particularly with ADL and PDL
5. Return to driving at 4-6 weeks

A sensible approach is advised and a gradual

increase in activities recommended. Current evidence supports a steady paced up increase in activity whilst respecting postoperative soreness, healing times, neural sensitivity and patient’s previous level of fitness.

Recovery/rehabilitation phase: 4 – 20 weeks

Goals:

1. Increase normal activity and function
2. Optimise normal movement
3. Increase lifting

Avoid heavy lifting [>10 kg] until 12 weeks post-operation or until the surgeon advises.

Contact sports should be avoided until about 3-4 months or at the surgical team's

Discretion

Recovery can continue up until 18 months so expectations must be individual and realistic:

1. Achieve realistic goals set by patient
2. Return to normal activities
3. Minimal leg pain
4. Continuing with paced exercise programme and good posture

APPROACH FOCUSED ON LOW BACK PAIN.

1. EFFORT TRAINING, SAGITAL BALANCE ACTIVE RESTORATION

Physical therapist can help treat balance problems by identifying causes, and designing an individual treatment program, including exercises can do at home. Physical therapist can help you:

Improve Mobility.

Physical therapist will help regain the ability to move around with more ease, coordination, and confidence. Physical therapist will develop an individualized treatment and exercise program to gradually build strength and movement skills.

Improve Balance.

Physical therapist will teach exercises for both static balance (sitting or standing still) and dynamic balance (keeping balance while moving). Physical therapist will progressively increase these exercises as skills improve.

Improve Strength.

Physical therapist will teach exercises to address muscle weakness, or to improve overall muscle strength. Strengthening muscles in the trunk, hip, and stomach (ie, "core") can be especially helpful in improving balance. Various forms of weight training can be performed with exercise bands, which help avoid joint stress.

Improve Movement.

Physical therapist will choose specific activities and treatments to help restore normal movement in any of joints that are stiff. These might begin with "passive" motions that the physical therapist performs for you, and progress to active exercises that do yourself.

Improve Flexibility and Posture.

Physical therapist will determine if any of major muscles are tight, and teach how to gently stretch them. The physical therapist will also assess posture, and teach exercises to improve ability to maintain proper posture. Good posture can improve balance.

Increase Activity Levels.

Physical therapist will discuss activity goals with you, and design an exercise program to address your individual needs and goals. Physical therapist will help reach those goals in the safest, fastest, and most effective way possible. [81] [Exercise: Exercises to Try: Balance Exercises]

---

5 exercises that are shown below are aimed at improving balance and lower body strength. They include

standing on one foot

1. Stand on one foot behind a sturdy chair, holding on for balance.
2. Hold position for up to 10 seconds.
3. Repeat 10 to 15 times.
4. Repeat 10 to 15 times with other leg.
5. Repeat 10 to 15 more times with each leg.

- walking heel to toe

1. Position the heel of one foot just in front of the toes of the other foot. Your heel and toes should touch or almost touch.
2. Choose a spot ahead of you and focus on it to keep you steady as you walk.
3. Take a step. Put your heel just in front of the toe of your other foot.
4. Repeat for 20 steps.

- balance walk

1. Raise arms to sides, shoulder height.
2. Choose a spot ahead of you and focus on it to keep you steady as you walk.
3. Walk in a straight line with one foot in front of the other.
4. As you walk, lift your back leg. Pause for 1 second before stepping forward.
5. Repeat for 20 steps, alternating legs.

- back leg raises

1. Stand behind a sturdy chair, holding on for balance. Breathe in slowly.
2. Breathe out and slowly lift one leg straight back without bending your knee or pointing your toes. Try not to lean forward. The leg you are standing on should be slightly bent.
3. Hold position for 1 second.
4. Breathe in as you slowly lower your leg.
5. Repeat 10 to 15 times.
6. Repeat 10 to 15 times with other leg.
7. Repeat 10 to 15 more times with each leg.

- side leg raises

1. Stand behind a sturdy chair with feet slightly apart, holding on for balance. Breathe in slowly.
2. Breathe out and slowly lift one leg out to the side. Keep your back straight and your toes facing forward. The leg you are standing on should be slightly bent.
3. Hold position for 1 second.
4. Breathe in as you slowly lower your leg.
5. Repeat 10 to 15 times.
6. Repeat 10 to 15 times with other leg.
7. Repeat 10 to 15 more times with each leg.

You can do balance exercises almost anytime, anywhere, and as often as you like, as long as you have something sturdy nearby to hold on to if you become unsteady. In the beginning, using a chair or the wall for support will help you work on your balance safely.

III. Balance exercises overlap with the lower body strength exercises, which also can improve your balance. Do the strength exercises -- back leg raises, side leg raises, and hip extensions -- two or more days per week, but not on any two days in a row. [82] [Physical Therapist's Guide to Balance Problems]

The results suggest that a simple, widely accepted physical exercise program for community-dwelling elderly persons is effective in improving the dynamic standing balance in relation to falls and might delay the onset of the retardation of motor function. These findings can contribute to the future planning of community-based exercise programs; in particular, the length of the program and the timing of changes to the exercise load. **[83]**

2. IF SUBACUTE PAIN, PERSISTENT INSTABILITY, OEDEMA OF VERTEBRAL PLATES: BRACING SHOULD BE CONSIDERED.

Clinical instability is an important cause of low back pain. Although there is some controversy concerning its definition, it is most widely believed that the loss of normal pattern of spinal motion causes pain and/or neurologic dysfunction. The stabilizing system of the spine may be divided into three subsystems:

- spinal column (providing intrinsic stability);
- spinal muscles (surrounding the spinal column, providing dynamic stability);
- neural control (unit evaluating and determining the requirements for stability and coordinating the muscle response).

Under normal conditions, the three subsystems work in harmony and provide the needed mechanical stability [84]. [Manohar M. Panjabi]

Biomechanical studies under controlled laboratory conditions have provided some insight into the role of spinal column components (disk, ligaments and facets) in providing spinal stability. All components of the spinal column: intervertebral disc, spinal ligaments and facet joints, contribute to spinal stability, in varying degree. The stabilizing role of the various components of the spinal column has been studied by simulating injuries in the biomechanical laboratories and determining the effects on the neutral zone and range of motion of the spinal specimen. Greater importance of the spinal column in LBP problems, but more likely, due to the difficulties in studying the other two components of the spinal stabilizing system, namely the spinal muscles and neural control unit [84].

The first paradigm states that a pain-spasm-pain cycle is likely responsible for dysfunction and disability related to musculoskeletal conditions. This theory proposes that when an injury occurs there is a reflexive response from the surrounding musculature to become hypertonic to essentially brace the injured structure preventing further injury. However, if the contracture of the musculature is maintained for an extended period of time a deleterious effect occurs in which the muscles themselves become a source of pain, therefore propagating the pain spasm-pain effect. This pain model appears to have a significant relationship to Panjabi's (1992a) theory of spinal stability, thus when the passive structures sustain damage, the active structures adjust through altered neuromuscular firing patterns [85].

The second paradigm proposed by Lund, Donga, Widmer, and Stohler (1991) came about when their comprehensive review of literature demonstrated inconsistent evidence to support the idea of hyperactivity in muscles with different musculoskeletal conditions. In respect to low back pain they identified only one study that demonstrated higher muscle activity in the paraspinals of patients compared to control subjects. They did, however, find a relationship that suggests decreased force output of flexor and extensor muscles of the spine when acting as agonists during movement. Conversely studies have shown increased hyperactivity of the erector spinae when acting as an antagonist to movement patterns (86)

It may be hypothesized that a certain percentage of these patients may have suboptimal neuro-muscular control, especially under dynamic conditions.

IV.

V. Physical therapy and rehabilitation techniques

1. Approach of neuropathic pain: drugs, electric stimulation, implanted cordonal stimulation.

Neuropathic pain (NeP) is defined by the International Association for the Study of Pain (IASP) as pain arising as a direct consequence of a lesion or disease affecting the somatosensory system. (Loeser and Treede) (87)
Physical therapy is important for neuropathic pain management because active people heal and adapt faster. Training tight muscles or muscles that are in spasm (a common cause of trigger points) to relax can substantially improve a patient's level of function.

Evidence-based pharmacological strategies for the management of NeP suggest that first line treatments may be: antidepressants (tricyclics or dual re-uptake inhibitors of serotonin or noradrenaline), calcium channel A2-D ligands (gabapentin and pregabalin), local anaesthetic type drugs (lidocaine), and opioids . (87)

*TENS (transcutaneous electrical nerve stimulation) [1] (Pittler and Ernst, 2008). (87)

A review of systematic reviews on TENS and chronic pain (osteoarthritis, rheumatoid arthritis, low-back pain) found that two out of six reviews that high intensity (strong but tolerable) intensities of TENS were more effective compared to placebo than low intensity (strong but comfortable) applications (Claydon and Chesterton, 2008). These results were based on a total of eight high quality (adequate randomization and blinding) trials which used validated pain intensity or relief visual analogue (VAS) or numeric rating scales (NRS) as the outcome measure.(87)

The principle by which TENS is thought to work is that stimulation of the Abnerve fibres causes interference with and temporary interruption to pain transmission in the c-fibres and Adfibres at the dorsal horn and spinal levels. [88]
*Trigger points
Muscle pain matters: it's an important problem. Aches and pains are an extremely common medical complaint, and trigger points seem to be a factor in many of them. They are a key factor in headaches (possibly including migraine and cluster headaches as well, neck pain and low back pain, and (much) more. What makes trigger points clinically important — and fascinating — is their triple threat. They can:

1. *cause* pain problems,
2. *complicate* pain problems, and
3. *mimic* other pain problems [89]

*Muscle stretching

Neuropathy pain can be released when the problematic muscles are released. Neuropathy pain occurs in the extremities: leg, ankle, foot, hand, or arm. Regardless of the area where neuropathy occurs, **neuropathy can be solved without surgery** by using a rehabilitation method called Active Isolated Stretching and Strengthening. Tight muscles in the low back region can exert pressure onto the sciatic nerve that then causes pain, numbness, or itching in the leg, foot, or ankle. If you have numbness in your hand or arm, then this will be caused by muscular tightness in your upper body region – the shoulders, chest, arms, and neck area**. Removing the muscular tightness will remove the neuropathy!**

*Physiotherapy exercises

The symptoms that typify peripheral neuropathy are numbness, reduced proprioception, weakness, poor balance and, in particular, allodynia and hyperalgesia,; the mechanisms that underlie those symptoms may include: hyperglycemia and AGEs (diabetic neuropathy), GSK-3 and glial activation, and elevated levels of the pro-inflammatory cytokines TNFα, IL-1β and IL-6. (90) .

routine exercise can be a beneficial addition to medical and pharmaceutical treatments for people with peripheral neuropathy. According to the U.S. Surgeon General (U.S. Department of Health and Human Services, 1996) and the American College of Sports Medicine (American College Sport Medicine, 2010), the myriad relevant preventative benefits of routine exercise include: enhanced macro- and micro-vascular health (e.g., better endothelial function, reduced vasoconstriction and enhanced blood flow); reduced risk of hypertension, atherosclerosis and numerous cardiovascular diseases; decreased production of ROS and increased anti-oxidant defenses; reduced risks of certain types of cancer; increased muscle strength and cardiorespiratory endurance. With specific regard to the most common cause of peripheral neuropathy (i.e., diabetes), exercise is also well-known to reduce: blood glucose levels, the formation of Amadori products (Balducci et al., 2010; Ahn and Song, 2012; Kluding et al., 2012), the accumulation of AGEs (Boor et al., 2009; Yoshikawa et al., 2009; Kotani et al., 2011) and the risk of developing type II diabetes and metabolic syndrome (American College Sport Medicine, 2010; Li and Hondzinski, 2012). (90)

Physiotherapists are an essential part of the multidisciplinary team, and invaluable aid to patients with neuropathic pain. They can challenge beliefs about pain and damage, pain and movement and promote normal movement and discourage pain behaviours such as fear-avoidance of movement. They can encourage behavioural strategies such as pacing; and reinforce progress by helping patients set achievable goals. (91)

Approach of neuroligic deficit

Treatment include:

- Exercises to improve muscle strength ;
- Facilitation of normal movement patterns
- Exercises to improve functional ability in day to day tasks such as transfers
- Gait re-education to improve the quality of your mobility
- Provision of walking aids or orthotics to improve independence and safety
- Exercises to improve balance and coordination
- Home assessment if necessary to identify suitable equipment to make life easier at home and improve safety
- Referral to Occupational Therapy or Speech Therapy for assessment if necessary
- Liaison with family or carers to advise on the best ways for them to assist you with day to day activities e.g. helping you in and out of bed
- Hydrotherapy treatment if appropriate to work on improving strength, balance, range of movement and mobility (91)

We are helping our clients to:

- develop core stability
- manage their long term condition
- build muscle activity
- extend the range of movement in the joints.

We offer full range of interventions, including

- balance training
- stretching /strengthening exercises
- exercise class
- functional electrical stimulation (as an adjunct to physiotherapy)
- gait re-education
- exercise prescription
- muscle activation
- movement re-education
- upper limb rehabilitation (92)

A. ACTIVITY LIMITATIONS AND PARTICIPATION RESTRICTIONS

See chapter E, ICF codes d4-d9

C. SOCIAL AND ECONOMIC CONSEQUENCES

1. Epidemiological data

About 40% of people say that they have had low back pain within the past 6 months.(33) Estimated lifetime prevalence of low back pain is between 49% and 84%.(34;35) It is the most common cause of job-related disability and a leading contributor to missed work days. The median time off work for a back injury is 7 days, and many people with low back pain never alter their activity. A small percentage of low back pain becomes chronic, however, and causes significant disability. In most studies about half of the sick days used for back pain are accounted for by the 15% of people who are home from work for more than 1 month. Between 80% and 90% of the health care and social costs of back pain are for the 10% who develop chronic low back pain and disability. Just over 1% of adults in the United States are permanently disabled by back pain, and another 1% are temporarily disabled.(36) In a large survey, more than a quarter of adults reported experiencing low back pain during the past 3 months.

There is no epidemilogic data about how many pacients after low back surgery recive rehabilitation. But in Unversity and regional hospital there are PRM specialsits who consult the patients with functional disorders.

In year of 2015 NRC Vaivari after low back surgery in patient rehabilitation received 680 persons.

2. Social data

Besides determining a diagnosis, a purpose of the history is to explore the patient's perspective and illness experience. Certain psychosocial factors are valuable in determining prognosis. Factors such as poor job satisfaction, catastrophic thinking patterns about pain, the presence of depression, and excessive rest or downtime are much more common in patients in whom back pain becomes disabling. These are called yellow flags because the clinician should proceed with caution, and further psychologic evaluation or treatment should be considered if they are present.(37)

The percentage of patients disabled by back pain, as well as the cost of low back pain, has steadily increased during the past 30 years. This appears to be more from social causes than from a change in the conditions that cause low back pain. The two most commonly cited factors are the increasing societal acceptance of back pain as a reason to become disabled, and changes in the social system that pay benefits to patients with back pain.

3. Economic data

Health care financing per one resident in Latvia in 2012 was 227, 89 LVL (324.26 EUR) or 44 3.21% from gross domestic product (GDP).

The direct financial costs of patients post-surgery are health care costs, and indirect are related to working absenteeism, i.e. production losses and impact on insurance costs (38)(6).

Whether a person returns to work with low back pain and after low back surgery depends on pain severity, persons functional status, work specifications.

D. LEGAL FRAMEWORK IN YOUR COUNTRY

After approving diagnosis by MR, CT patients are consulted by neurology, neurosyrgery specialists. Rehabilitation starts at acute settings, if impairment of functions pesrsists patient continues rehabilitation out-patient, day-stay rehabilitation programme or in the dedicated general rehabilitation programme.

VI. Description of the Programme

A. ENVIRONMENT OF THE PROGRAMME

1. Clinical setting

Individual practice or part of a doctor's group practice	Yes/No
Individual practice in a private hospital	Yes/No
Part of a local (public) hospital	Yes/No
Part of a regional hospital (or rehabilitation centre)	Yes/No
Part of a university or national hospital	**Yes**

Comment: ……

2. Clinical programme

Inpatients in beds under PRM responsibility	Yes
Inpatient beds belonging to other departments	Yes/No
Day programme (most of the day in outpatient setting, not home)	Yes/No
Outpatient clinic (assessment and/or treatment, for up to 3 hours/day)	Yes/No
Community based (in the patient's home or workplace or other relevant community location, eg sports centre)	Yes/No

Comment: in general rehabilitation programme there are 42 inpatient beds, for patients with low back pain 12 beds are for primary rehabilitation course, 6 beds are for follow up programme patients.

3. Clinical approach

Uniprofessional	Yes/No
Multiprofessional	Yes

Comment: with involvement of necessary specialists-consultants form other center's programs and University clinics.

4. Facilities

Does your programme have a designated space for:	
For assessments and consultations?	Yes
For an ambulatory or day care programme?	Yes
For inpatient beds?	Yes

For therapeutic exercises?	Yes
For therapeutic exercises?	Yes
For training in independence and daily living?	Yes
For vocational and/or recreational activities?	Yes

Comment: there are accessibility to equipped intensive therapy unit with anaesthesiology on 24 hour duty, X-ray, ultrasonography, EKG.

Equipped video gait analysis.

There is swimming pool, hydrotherapy complex, horse riding therapy arena, Mechanotherapy complex, physical modalities complex.

B. TARGET POPULATION

1. Inclusion criteria

Indication for in-patient rehabilitation programme after lumbar surgery :

a) Patient 6-8 weeks post lumbar surgery with neurological deficit (dysfunction of pelvic organs, myelopathy, paresis and deep sensation impairment), lasting pain which are causing person's moving or self-care impairment, functional disability;
b) Patient post lumbar surgery with functional disability (SFK codes) and is not able to undergo rehabilitation out-patient or day rehabilitation programs.

Patients are motivated and have the capacity to undergo rehabilitation program.

2. Criteria for refusal

The patient is not motivated or is not interested in going through the rehabilitation process.

Patient's metal condition is not appropriate to participate in the rehabilitation.

Severe and/or decompensated comorbidities of complications.

General contraindications for rehabilitation:

- uncorrected metabolic diseases (diabetes mellitus, myxoedema, thyrotoxicosis);
- hepatic or pancreatic insufficiency;
- heavy or repeated haemorrhages of any reason or anaemia Hb<80g/l;
- parasitoses;
- acute infectious disease;
- active stage of any form of tuberculosis;
- patients with transmissible sexual diseases;
- mental illness with personality desocialisation;
- complicate ventricular rhythm disturbances.

3. Patients referrals

Direct access to the PRM programme	Yes
Referral from general practitioners	Yes
Referral from other specialists	Yes
Referral from specialists in PRM	Yes

Comment: in exceptional cases, the patient can be directly referred by a general practitioner (GP) if it has not been done during a previous (hospital) stage. Then GP forwards to PRM physician for consultation, and he/she takes a decision on the selection of a rehabilitation setting.

4. Stage of recovery before admission

Within two weeks of onset	Yes
2 weeks to 3 months after onset	Yes
3 months or longer after onset	Yes

5. Early management before admission

A) How are patients selected?

The patients are selected in the hospital by the attending surgeon or neurologist together with the PRM doctor who performs the assessment of patient's functioning disorders, rehabilitation potential and indications, who designs the rehabilitation plans in the hospital and for further rehabilitation, and who manages the transfer of the patient to the rehabilitation centre.

General practitioner can send a patient to the PRM doctor who then completes the assessment of the functioning disorders, potential, indications and admits the patient to the rehabilitation programme.

b) Do they benefit from PRM advice in acute settings?

At the University Clinics, specialized and regional hospitals the PRM services are accessible where patients are consulted and the rehabilitation course has been started in the acute stage and then the patient is sent for further rehabilitation within a specialized programme.

c) What alternate solutions are proposed to refused patients?

The refused patients may receive medical treatment in the hospital. They take treatment of comorbidities and complications in the hospital settings.

C. GOALS

Main goals of the programme are:

to reduce impairment;

to reduce pain;

to provide improvement of functional abilities in activity and participation domains;

to help the patient to return to productive life;

to adapt physiotherapy program for persons with low back pain.

1. In terms of body structure and body function (impairment)

ICF code	ICF label
s120	Structure of spinal cord
b7	All codes from chapter 7 Neuromuscular and movement-related functions
b280	Sensation of pain

2. In terms of activity

ICF code	ICF label
d4	All codes from Chapter 4-Mobility
d5	All codes from Chapter 5-Self Care
d620	Acquisition of goods and services
d630	Preparing meals
d640	Doing housework
d650	Caring for household objects

3. In terms of participation

ICF code	ICF label
d770	Intimate relationships
d845	Acquiring, keeping, terminating a job
d920	Recreation and leisure

D. CONTENT OF THE PROGRAMME

1. General scheme and time frame

PRM doctor consults the patients on the 2nd day after lumbar surgery. Physiotherapist starts to work with patients on the 2nd day after surgery. At first, there are exercises while lying in bed, after that the patients are verticalized. All of the patients are seen by ergo therapist and are educated about principles of ergonomics. Before the patients are discharged from hospital, physiotherapist gives them exercises for the next 2-6 weeks.

Patients with neurological deficit and functional disability receive recommendations for in-patient rehabilitation. Patients with no neurological deficit continue rehabilitation in day centres or as outpatients.

In-patient rehabilitation starts 6-8 weeks after lumbar surgery. PRM doctor sees the patients, evaluates their state of health (evaluation by ICF codes), gives them Visual Analog Scale for Pain and draws up a further rehabilitation goals and plan. Patients work with multidisciplinary rehabilitation team. On the first day of in-patient rehabilitation patients are seen by physiotherapist who also evaluates the patient and starts appropriate therapeutic exercises. If the need arises, patients are offered hydro complex procedures and physical modalities.

Average in-patient rehabilitation time is 10-14 days. Short-term goals are achieved while patients are in rehabilitation centre. Patient continues to exercise at home or ambulatory. After 6-8 months patients are re-evaluated by PRM doctor to determine if there is any need for further rehabilitation.

2. Role of PRM specialist

The PRM specialist evaluates the patient's condition: sets the short and long term goals, works out the rehabilitation plan, performs the treatment of pain, consults about technical aids, orthosis and prevention of fall risks. PRM specialist uses Visual Analog Scale of Pain, Berthel index of Activities of Daily Living, Berg Balance scale, evaluation of muscle strength. PRM specialist performs medication therapy and leads the whole multidisciplinary specialists' team.

The PRM physician invites necessary consultants and organizes medical joint meetings for complicated cases.

The PRM physician consults and selects complicated patients in University hospitals.

PRM specialist writes patient epicrisis with summary of rehabilitation course, evaluation, and recommendations after rehabilitation program

3. Specific role of each team member in this programme

The rehabilitation team, leads by a **PRM doctor**.

Physiotherapists will develop mostly gross motor skills and mobility, adapt individual exercise program. Walking ability, gait training. Physiotherapists are responsible for evaluation of motor function of all muscle groups, training for range of motion, walking and standing, balance, with body weight support, with adapted technical aids, reduces fall risks. Performs pain reduction with physical modalities, activities in swimming pool, mechanotherapy,

Rehabilitation tehniques:

1. Passive movements;
2. Passive muscle stretch;
3. Active muscle stretch;
4. PIR (Post-isometric relaxation);

5. Muscle-strengthening exercises;
6. Coordination exercises;
7. Balance exercises;
8. Active joint mobilization;
9. Passive joint mobilization;
10. Active joint stabilization;
11. Basic movement exercises;
12. Breathing exercises;
13. Ambulation (walking) exercises;
14. Posture correction;
15. TENS (Transcutaneous electrical nerve stimulation);
16. Relaxation exercises;
17. Massage

TESTS:

1. Romberg maneuver;
2. VAS (Visual Analogue Scale);
3. Lasegue test;
4. Heel-to-shin test;
5. Finger-to-nose test;
6. Kendall rank.

Occupational therapists

1. Educate about ergonomics and the basic principles of joint protection. Addresses factors that influence the participation in/and performance of actual job tasks, including the (a) worker's abilities, skills, neurobehavioral factors, physical health and fitness, cognition, and psychological and emotional well – being (b) the environment in which the job exists (39)[1]. Train to comply ergonomic working environment and respect the principles of joints protection during daily life activities. (40) [2]
2. Active or functional therapy approaches (This therapeutic approach involves actively practicing real-life tasks, typically in real-life environments. (41) [3]
3. Pain management:
    - Respect for pain;
    - Balance activity and rest;
    - Position change and movement (42)[4];
    - Relaxation exercises (43; 44) [5; 6].
4. Adapting the environment to promote the performance of activities (grooming, productivity, leisure time). Increased activity level and improved ability to cope with the demands of home and job(45) [7]:
    - Adapting environment / Adaptive devices - facilitates daily activities performance (mobility aids, support handles, shower/bath chairs, adapted worktable, adapted computer s.o.)(46) [8];
    - Braces - braces offer a safe, non-invasive way to help heal from a current condition and/or prevent future problems from occurring (Soft collar; trochanteric, sacroiliac and lumbosacral belts; corsets s.o.) (46)[8].
5. Designe recommendations and implementation of transitional return-to-work programs

Psychologists: assessment of personal factors, support, adaptation to new abilities (disability), rebuilding self- esteem.

Social workers: advice and help in social security fields, cooperation with the family and local municipalities about financial support, house adaptation, returning to school or to work and founding solutions about the discharge place.

Nutritionists: consult about energy needs, protein needs, ideal body weight, fluid needs, and fibre needs. Adapts diet plan for weight loss, if required.

The nursing staffs: Nurses work with data collection, patient registration, administering treatment and medication prescribed by a physician. (43) (5)

Physical modalities nurses- perform physical therapy prescribed by PRM specialist.

Orthosist – provides orthosis for patients.

4. Diagnostic and assessment tools

Diagnostic equipment: X-ray, clinical and biochemical laboratory, ultrasound, electrocardiography.

Tools for clinical assessment (7, 8, 9):

Barthel Index

Comparative Pain Scale

Falls Risk Assessment Tool (FRAT)

E. DISCHARGE PLANNING AND LONG TERM FOLLOW UP

1. Discharge criteria

The patient is discharged after rehabilitation program on day 10-14.

2. How patients are managed after the programme?

Before discharge from first rehabilitation course, the rehabilitation team make further plan and follow up program together with the patient.

If necessary patient may continue rehabilitation out-patient, day rehabilitation program.

VII. Additional information about PRM organization

A. SAFETY AND PATIENT RIGHTS

1. Safety

The safety concerns of people in the unit where the programme takes place, relate to:	
Emergencies (fire, assault, escape)	Yes
Medical emergencies	Yes
Equipment	Yes
Handling of materials	Yes
Transports	Yes
The safety of people in the programmes of your unit is provided by:	
Written standards from National Safety Bodies	Yes
Written standards from National Medical Bodies	Yes
Unit-specific written rules	Yes
Periodic inspection	
Internal	Yes
External	Yes

2. Patient rights

Has your programme adopted a formal policy or statement of patients' rights?	Yes
Does this statement specify the influence that the patient should have in the formulation and implementation of the programme?	Yes
Is the statement known to all personnel involved in delivering the programme?	Yes
Is this checked periodically?	Yes
Is the statement made known to and is available to all persons visiting your unit?	Yes

3. Advocacy

Give at least one example of how your organization advocates for people your programme deals with:
Confereces.

Off site visits to other hospitals on demand/ Consiliums.

Comment: our centre organizes interdisciplinary conferences every month, where other medical specialists are also invited, in order to share information on rehabilitation issues and promote good health behaviour.

B. PRM SPECIALISTS AND TEAM MANAGEMENT

1. PRM Specialists in the Programme

Does your PRM physician have overall responsibility and direction of the multiprofessionnal team?	Yes
Does your PRM physician have overall responsibility and direction of the rehabilitation programme, not medical responsibility only?	Yes
Does he/she have a European Board Certification in PRM?	Yes
Does he/she meet National or European CME/CPD Requirements?	Yes
Number of CME or EACCME points earned in the last 3 years:	270
The two primary functions for the PRM specialist in your Programme are to:	
Treat comorbidity	Yes/No
Assess the rehabilitation potential of the patient	Yes
Analyse & treat impairments	Yes/No
Coordinate interprofessional teams	Yes

Beside the two primary functions of PRM physicians, a lot of work must be done in the treatment of comorbidity and secondary complications.

The leader of the Low back pain program has to attract attention of other professionals and officials in order to promote quality of patients care.

The National recertification procedure on PRM specialists takes place every 5 years and requires a minimum of 250 credit points.

2. Staff devoted to this programme

Please, don't mention staff members who do NOT participate in this specific programme!

Which rehabilitation professionals work on a regular basis (minimum of once every week) in your programme? (give the number)	
Physiotherapists	6
Neurologist	1
Occupational therapists	2
Psychologists	1
Massage specialist	3
Social workers	1
Nutritionist	1
Nurses	5
Nurse assistant	5
Physioterapist of swimming pool and fitness gym	1

Secretary	1

Consultants from other departments and University clinics are also involved on demand. The rehabilitation team is often complemented with assistive technicians.

3. Team management

How often does your staff receive formal continuing education (mark as is)?	
In team rehabilitation:	Every year Every second year Other period **Not regularly**
In their own profession:	**Every year** Every second year Other period Not regularly
Do team activities in your rehabilitation programme include the following?	
Is the patient at the centre of a multiprofessional approach?	Yes
Do you always give informed choices of treatment?	Yes
Do you regularly promote family involvement?	Yes
Does your organisation of multi professional team working include:	
Holding regular team meetings with patient's records only (more than 2 members)	Yes
Holding regular team meetings (more than 2 members) with the presence of the patients	Yes
Joint assessment of the patient or joint intervention	Yes
Regular exchanges of information between team members	Yes

Meetings of the multidisciplinary rehabilitation team in patient's absence take place every week.

C. INFORMATION MANAGEMENT

1. Patient records

Do the rehabilitation records have a designated space within the medical files?	Yes
Do you have written criteria for:	
Admission	Yes
Discharge	No
Do your rehabilitation plans include written information about aims and goals, time frames and identification of responsible team members?	Yes
Do you produce a formal discharge report (summary) about each patient?	Yes

Each patient has his or her own medical file, which contains information on all rehabilitation courses (first and follow up).

2. Data about general organization

How many new patients (registered for the first time) are treated in your programme each year:	**…**
In your day care or inpatient programme:	
What is the mean duration spent in therapy by patients on this programme	10 Days
How many hours a day do the patients spend in therapy.	4-6 Hours
Give the mean duration of stay spent in the programme:	14 Days

Monday till Saturday patients have 4-6 therapies per day, on Sunday patients receive 2 therapies a day.

3. Programme monitoring and outcomes

Does your programme have an overall monitoring system in addition to patient's records?	No
Are the long term outcomes of patients who have completed your programme regularly monitored?	
Impairment (medical) outcomes:	Yes/No
Activity/Participation (ICF) outcomes:	Yes/No
Duration of follow up of the outcomes:	3-6 months 12 months longer
Do you use your outcome data to bring about regular improvements in the quality of your programme's performance?	Yes
Do you make the long term overall outcomes of your programme available to your patients or to the public?	No

4. Sustainability of the programme

Does your programme show evidence of sustainability?	
Established as part of public service:	Yes/No
Has existed for more than 3 years:	Yes/No
Has received national accreditation (where available):	Yes/No
Has been accepted for oral presentation in a National or International congress (mandatory criterion for accreditation)	Yes/No
Has been the subject for papers in PRM journals	No

VIII.Quality improvement

A. WHAT ARE THE MOST POSITIVE POINTS OF YOUR PROGRAMME?

There are effective planning and selection of patients in cooperation with University Clinics.

Close professional contacts with neurosurgeons, orthopaedic surgeons, neurologists.

There is availability of intensive therapy unit with anaesthesiologist on 24 hour duty.

After discharge patient can continue rehabilitation out-patient, day rehabilitation programs, follow up programs.

B. WHAT ARE THE POINTS TO IMPROVE IN YOUR PROGRAMME?

To promote the scientific activities and research works in the field of low back pain

Rehabilitation.

To collect and statistically process data about low back pain patient rehabilitation and after lumbar surgery rehabilitation.

C. WHAT ACTION PLAN DO YOU INTEND TO IMPLEMENT IN ORDER TO IMPROVE YOUR PROGRAMME?

1. Extrinsic conditions that you wish to obtain

More variations of fitness equipment, larger fitness rooms.

More single rooms for patients

2. Intrinsic improvement of the programme

Learning workshop about using specific assessment tools for all team members.

Digital medical records.

Regular training and education program of the staff.

Prevention of Burn-out syndrome.

International cooperation and research work.

Regular update of the program.

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