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REHABILITATION  
FOLLOWING LUMBAR  
SURGERY

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In diseases that cause lower back pain, like disc hernia, degenerative disc disease, different surgical procedures ranging from fusion to discectomy, microdiscectomy and even lumbar disc replacement are performed in appropriate indications. In this chapter we will discuss discectomy surgeries, which constitute the majority of lower back surgeries. Following lumbar disc surgery, the success rate is 60-90%.<sup>1, 2</sup> This rate differs according to study inclusion criteria, surgical indication and the definition of success. In 10-30% of the subjects operated, problems like continued lower back-leg pain, motor deficits, worsening in the functional state, not being able to return to work were observed. The primary criteria for success are the correct indication and the appropriate technique. Moreover, long term nerve root compression; being functionally inactive, long-term bed rest in the pre-operative or post-operative period, neuropathic pain and depression resulting from chronic pain can cause complaints to continue following surgical procedure.

Patients with lumbar disc hernia, who have been operated or not, have weakness in the lower back, back and abdominal muscles. This weakness may be the result of pre- or post-operative inactivity, reflex inhibition relating to pain and long term retraction of muscles following surgery. After a discectomy surgery, a 30% reduction in the strength of body muscles has been reported.<sup>3</sup> The most important part in the functional restoration of patients with disc hernia, who have been operated or not, is the exercise schedule.

The purpose of the post-operative rehabilitation schedule is to preserve the damaged tissue and to

control the pain. Whereas in the sub-acute period, the purpose is to enable the patient to return to normal daily life and work activities as soon and painless as possible. To achieve these objectives, a rehabilitation schedule should be planned that ensures the optimal strength, durability and coordination of the neuromuscular system affecting the spine. There are different types of exercise schedules applied in the rehabilitation of patients with lower back pain. Whereas Mc Kenzie emphasizes that extension exercises are more suitable, there are others who advocate that spinal flexion exercises are more effective on lower back pain, compared to spinal extension exercises. The lumbar spine is damaged by excessive flexion and repeating excessive lateral torsion. In recent years, another exercise type that has gained more recognition is the dynamic lumbar stabilization exercises. Prior to discussing these exercises, we need to review the structures that stabilize the spine.

Spine stability is achieved with bone architecture, disc mechanics, ligament support and muscular strength, durability and coordination. According to the model developed by Panjabi, three sub-systems, i.e., spinal colon (passive), spinal muscles (active) and neural effect (control) work in connection with each other to ensure the stability of the spine. Body, abdominal and pelvis muscles connecting to the thoracolumbar fascia are categorized as stabilizing muscles and mobility muscles. Stabilizing muscles are monoarticular or segmental muscles that are located deeper and keep the spine stable by controlling the movement during activity; these muscles have the capacity to carry static load. Mobility

muscles are muscles defined as bi-articular or multi-segmental, that is more superficial and contract concentrically to generate strength and accelerate movement during activities. Functionally can muscles be grouped as locally stabilizing muscles (transversus abdominis, deep segmental lumbar multifidus, psoas major), globally stabilizing muscles (oblique abdominal muscles, spinalis, gluteus medius) and globally mobilizing muscles (rectus abdominis, iliocostalis, piriformis).<sup>4</sup> These muscles that attach to the thoracolumbar fascia act as an abdominal corset and at the same time enable flexion, extension and rotation of the spine. In recent years, the term “core” has emerged. Core consists of abdominal muscles at the front, paraspinal muscles at the back, the diaphragm at the top and the pelvic floor and hip muscles at the bottom.<sup>5</sup> The thoracolumbar fascia is a broad soft tissue structure. Its superficial and deep layers attach to the spinous projections at the middle line, the rib cage at the top, the pelvis (including the gluteus maximus fascia) at the bottom and the free border at the lateral to the internal oblique, transversus abdominis and the latissimus dorsi. When contracted together with the muscle groups, the thoracolumbar fascia acts at the same time as a proprioceptor, providing information about the position of the body. When responses of the body muscles of individuals with and without lower back pain during upper extremity movements are evaluated, it has been reported that the transversus abdominis contraction occurs definitely immediately before the upper extremity movement and that in individuals with lower back pain this contraction is delayed. In healthy individuals, the transversus abdominis and multifidus contracts 30 ms prior to shoulder movements and 110 ms prior to leg movements to stabilize the spine. The attachment of the thoracolumbar fascia to the latissimus, which is the internal shoulder rotator, can explain this interaction during upper extremity movement.<sup>6,7</sup> Similarly, on the MRI images of individuals with lower back pain, atrophy was determined in the lumbar multifidus muscle. Therefore, as part of the conservative therapy of patients with lower back pain and during the post-operative period, exercises called “**core stabilization exercises**” and “**dynamic lumbar stabilization exercises**” are recommended. In this exercise schedule, the primary objective is to strengthen the stabilizing muscles, then the mobilizing muscles. (Table 1) The more durable the stabilizing

muscles are, the more it can protect from repetitive micro-traumas by enveloping the spine like a natural corset both during the movement of the spine itself and the activities performed using the extremities. Due to their attachment to the pelvis, gluteal muscles and hamstring muscles have great importance in lumbar spinal movements too. The rigidity of these muscles causes too much stress to be transmitted to the lumbar movement segments and the sacroiliac joints. Thus, to allow normal lumbar movement, exercises that increase the flexibility of the gluteal and the hamstring muscles together with the mobilizing muscles are performed.

To study whether active rehabilitation after lumbar disc surgery is more effective compared to no treatment and which rehabilitation schedule is more effective, a meta-analysis has been conducted and presented in 2009 as a Cochrane review.<sup>8</sup> For this purpose, 14 randomized controlled studies conducted in patients aged 18-65 years, who had lumbar disc surgery for the first time using all techniques, including standard discectomy, microdiscectomy, laser discectomy and chemonucleolysis, met the inclusion criteria. The groups were formed: those starting active rehabilitation directly following surgery, those starting active rehabilitation 4-6 weeks after surgery and those starting active rehabilitation 12 months after surgery. For each group, active rehabilitation with the no-treatment group (placebo or the waiting list control group), active rehabilitation with the other type rehabilitation method and only active rehabilitation with specific intervention in addition to active rehabilitation was compared. To summarize the results of this compilation:

- In any study (14 RCT), there are no reports that active rehabilitation schedules increase the re-operation rate.

- Since there was no increase in complications with the shortening of the post-operative rest period after discectomy, it has been concluded that early return to activity following lumbar disc surgery is not harmful.

- Exercise schedules result in more significant improvement in functionality, compared to the no-treatment group. This improvement is greater in high-intensity exercise schedules than in the low-intensity ones (**moderate evidence**).

- In the group starting exercise schedule 4-6 weeks after surgery, the pain was observed to decrease more

**Table 1.** Dynamic lumbar stabilization exercises<sup>4</sup>

<b>DYNAMIC LUMBAR STABILIZATION EXERCISES<sup>4,10</sup></b>
<b>Exercises performed in supine position</b>
Determining the neutral position: Neutral position is the position that causes no pain during flexion and extension of the lumbar region and needs to be defined individually. The isometric co-contraction of the multifidus and transversus abdominis muscles is the most important muscles that keeps the spine in neutral position. The main position that enables balance and strength. Functional activities and exercises should be done after the neutral position is determined.
In supine position, while being in neutral position, i.e., while the abdominal muscles are contracted, extend one leg 90 degrees in flexion, keeping at the same time the other leg fixed to the ground in flexion from the hip and knee downwards (figure 1)
Lie in the position shown in Figure 1, the opposite arm is placed under the head.
Forming a bridge: While keeping the abdominal and hip muscles contracted, raise and lower the hips a few cm from the floor.
Abdominal crunch (figure 2)
Hamstring stretching while laying in supine position and raising the extended leg
<b>Exercises performed in facedown position</b>
Lifting one arm facedown: Lay down facedown, with arms and legs stretched out and lower part of the abdomen supported with a pillow. Raise and lower only one arm, while taking care not to disturb the stabilization of the spine.
Lifting one leg facedown: Lay down in the same position as above. Contracting the hip muscles, lift and lower one leg, taking care not to disturb the stabilization of the spine.
Lifting opposite arms and legs in facedown position: Lay down in the same position as above. Contract the hips muscles, raise one opposite arm and one leg (this combines the first two movements above), taking care not to disturb the stabilization of the spine, in another words, not to move the body.
Lifting two arms in facedown position
Lifting two legs in facedown position
Simultaneously raising both arms and legs in facedown position: Lay down facedown, with a cushion under the abdomen. Prevent movement of the spine by contracting the abdominal and hip muscles. Raise both legs and arms simultaneously, wait for 5 seconds and lower them again.
<b>Exercises performed in crawling position</b>
Standing in crawling position (figure 3)
Stretching one arm in crawling position
<b>Contracting hip muscles and stretching one leg in crawling position</b>
In crawling position, the first two movements are combined: the spine is not moved, hip muscles are contracted and one arm on one side and one leg on the other side of the body is raised (figure 4)
<b>Exercises performed in standing position</b>
Move forwards in standing position: While you stand, without bending down from the lower back, get down by flexing one knee and get up again
Gliding on the wall: Lean on the wall. Glide across the wall with knees flexed. Flexion of the knees should not be more than 90 degrees. return to the original position.
Bending forward in upright posture: While you stand, bend forward completely from the hips, without bending from the lower back



c. Lumbar stabilization exercise

**Figure 1:** In supine position, while in neutral position, i.e., while you lay down with abdominal muscles contracted, extend one leg 90 degrees in flexion and keeping at the same time the other leg fixed to the ground in flexion from the hip and knee downwards (4)



d. Abdominal crunch lumbar core strength

**Figure 2:** Abdominal crunch (4)



e. Lumbar stabilization exercise, starting position

**Figure 3:** Staying in crawling position (with contracted abdominal muscles) (4).



f. Lumbar stabilization exercise, extended position

**Figure 4:** In crawling position, contract the hip muscles without moving the spine, extend the opposite leg and arm (4)

rapidly than in the no-treatment group and similarly, the decrease in pain is more rapid in high-intensity schedules, compared to low-intensity schedules (**low-quality evidence**).

- In short-term, training performed under supervision was not found to be more effective than exercised performed at home (**low-quality evidence**). However, in a study conducted by Hakkinen *et al.* to evaluate the compliance in home exercise schedules, it has been reported that the compliance rate decreased to 50-60% after 2 months and to 30% after 6 months. In view of this, to sustain patient motivation for long-term rehabilitation, a more intensive observation is recommended.

- In this compilation, studies in patients with standard discectomy and microdiscectomy were included. In another Cochrane review, it has been shown that there is no significant difference in terms of efficacy between standard discectomy and microdiscectomy.<sup>9</sup> The results of this compilation does not show the superiority of a surgical technique. The subject of this compilation is not to investigate the superiority of surgical techniques, but rather to study the surgical indications that may change the rehabilitation results. Unfortunately, indications were defined in very few of the studies included.

- Behavioral therapy (Behavioral graded activity (BGA) is a schedule that involves bio-psychosocial approach. Ostelo *et al.* investigated the effectiveness of this schedule; however, no difference was observed to standard physiotherapy.

- There is no study evaluating which type of intervention is more cost-effective. High-intensity schedules seem to be more effective, but are at the same more expensive. Because high-intensity schedules, if started early after surgery, enable the individual to start work earlier, it can be assumed that they are indirectly more cost-effective, but an analysis of this needs to be performed.

- There are no sufficient studies on returning to work or sick leave periods due to illness. In the majority of studies, there are no reports about how many patients were working prior to surgery. In the future, returning to work needs to be investigated with an appropriate measure in randomized controlled studies.

In our country there are two randomized controlled studies that meet the inclusion criteria of this Cochrane review. If we are to review these in detail; Filiz *et al.* evaluated 60 patients between 20-50 years who had a single level discectomy performed, by designating them into three groups to compare the effectiveness of exercise schedules following lumbar disc surgery. The first group was given a lower back training and a dynamic lumbar stabilization schedule (3 times a week, each set 1.5 hours, movements are first repeated 5 times, in time 15 times), while the second group was given a lower back training and a home exercise schedule consisting of Williams-McKenzie exercises. The third group, which is the control group, was not given any lower back training or exercise. All exercise schedules started postoperatively on day 30. Lower back training was performed as a training consisting of a total of 4 courses 2 times a week, where the structure of the spine and its function, causes of lower back pain, the importance of exercise and relaxation, images showing the right sitting, standing, lying down, standing up, sleeping, lifting weight positions are explained in a language easily understood by patients. The return to work period in this patient population, consisting mainly of housewives, was in each group 56, 75 and 86 days respectively. Since the high-intensity schedule (dynamic lumbar stabilization exercises) were performed 3 days a week under the supervision of a physician, it contributed to the patients overcoming their fear and to the improvement of their psychological state.<sup>10</sup>

The other study conducted in our country and taken from the Cochrane review is a prospective

randomized and controlled study to determine the effectiveness of dynamic lumbar stabilization exercises following lumbar discectomy surgery.<sup>11</sup> 42 patients between 20-60 years of age, who had undergone a disc hernia operation for the first time using the single level microdiscectomy method and who have no stability problems like spondylolysis/spondylolisthesis, were divided into three groups, namely the exercise group, home schedule group and the control group. Dynamic lumbar stabilization exercises started 5 weeks postoperatively and continued 8 weeks, 3 days a week, 3 sets, with each movement starting with 5 repetitions and increased to 15 repetitions, if tolerated by patients. During the control made at week 12, the dynamic lumbar stabilization exercise group was determined to be in a better state in terms of pain, function and mobility.

Focusing on the question what the rehabilitation schedule should be in daily practice, in literature only lumbar degenerative disc disease is mentioned and a rehabilitation protocol is provided for patients who underwent lumbar total disc replacement.<sup>12</sup> In this study, 20 patients under 50 years with single level disc degeneration, who were unresponsive to conservative treatment and minimal invasive procedures and underwent lumbar disc prosthesis surgery, were included in the schedule. A pre-operative assessment was performed by a multidisciplinary team (consisting of a neurosurgeon, pain specialist and a physiotherapist) and the rehabilitation schedule was combined into five phases. (Table 2)

After lumbar surgery, patients tend to avoid physical activities that they think will cause them to get injured again; this is called "fear of movement," the extreme form is also called "kinesiophobia." When 97 patients who had lumbar disc surgery are evaluated 10-34 months after surgery, in almost half of the patients (36 of 80 patients completing the study) kinesiophobia was observed. Those with kinesiophobia were determined to be functionally in a worse state, had more pain, catastrophic thoughts and depression symptoms and had lower quality of life.<sup>13</sup> Kinesiophobia is a factor negatively affecting the rehabilitation of patients with lower back pain. Patients who return to normal life with a schedule of a rehabilitation physician will feel more secure and overcome this fear.

As a result, new surgical techniques are continually improving and therefore there is no single

**Table 2.**  
Rehabilitation protocol for patients with lumbar degenerative disc disease,  
who had lumbar total disc replacement

REHABILITATION PROTOCOL FOR PATIENTS WITH LUMBAR DEGENERATIVE DISC DISEASE, WHO HAD LUMBAR TOTAL DISC REPLACEMENT <sup>12</sup>
<p><b>Phase I. Pre-operative assessment</b></p> <ul style="list-style-type: none"> <li>- Information provided on the surgery and the post-operative period.</li> <li>- Description of patient training (principles of protecting the lower back; correct lying down, sitting, standing up and standing positions).</li> </ul>
<p><b>Phase II. Active resting phase (week 0-3)</b></p> <ul style="list-style-type: none"> <li>- Mobilization with the help of a physiotherapist, day 1 post-operatively. If the patient experiences pain, analgesic measures are taken by applying TENS.</li> <li>- Classical principles of lower back protection (changing position frequently, not sitting in the same position for more than 30 min) are explained. Patient is instructed on what to do and what not to do.</li> </ul> <p><b>What needs to be done and what should not be done:</b></p> <ul style="list-style-type: none"> <li>● The lumbar region should not be rotated in the first 3 weeks</li> <li>● Bending should not be done from the lumbar region in the first 6 weeks</li> <li>● High-intensity abdominal exercises should not be done in the first 6 weeks</li> <li>● Competitive sport should not be done in the first 6 months</li> <li>● In the first 6 weeks, heavy lifting, turning from the waist and hyperextension should be avoided</li> <li>● The patient should try to hold the lower back straight</li> <li>● After 6 weeks, swimming is allowed</li> <li>● After 6 weeks, jogging is allowed</li> <li>● After 2 weeks, driving is allowed</li> <li>- On day 3 post-op, the correct posture is taught.</li> <li>- Patient is discharged from hospital</li> </ul>
<p><b>Phase III - Early protection phase (week 4-6)</b></p> <ul style="list-style-type: none"> <li>- Pelvic tilting exercises are started in limits that do not cause pain</li> <li>- The lower back protection principles and the importance of maintaining the correct posture are reminded</li> <li>- With weekly follow-ups to the rehabilitation center, an evaluation of exercise compliance and pain is performed</li> </ul>
<p><b>Phase IV. Dynamic phase (week 7 - month 6)</b></p> <ul style="list-style-type: none"> <li>- Dynamic lumbar stabilization exercises</li> <li>- Proprioceptive exercises</li> <li>- Kinetic chain strengthening exercises</li> <li>- Until week 12, weekly follow-up visits to the rehabilitation center</li> <li>- Swimming</li> <li>- Jogging</li> </ul> <p>At week 6 post-operatively, dynamic lumbar stabilization exercises are made under supervision, with the pelvic tilting exercises repeated within limits where the patient has no pain. Any exercise that increases pain is excluded from the schedule. The patient is evaluated by a physiotherapist once every 3 weeks. A kinetic chain exercise schedule is started that includes proprioception exercises individually tailored to the patient.</p>
<p><b>Phase V. Return to sport phase (after 6 months)</b></p> <ul style="list-style-type: none"> <li>- In the beginning, low resistance, highly repetitive activities are suitable.</li> <li>- A sport activity appropriate for and preferred by the patient is chosen. Sport that would cause the patient to bump into something should be avoided, the risks of falling down or bumping must be explained.</li> </ul>

rehabilitation protocol. A multidisciplinary training should be given; if possible directly after lumbar discectomy operation, the most frequently done surgery, and the lower back protection principles (training of the patient for correct lying down, sitting and getting up) should be taught to the patient in the pre-operative period. During the post-operative period, physical treatment agents like TENS can help relieve pain. During the post-operative period, long bed rests should not be recommended, the patients should be mobilized quickly and should start daily life activities gradually, they should be explained

about what to take care (avoiding extreme flexion and lateral torsion movements, not staying in the same position for a long time, not sitting more than 30 minutes). Approximately at the fourth week post-operatively, the painless neutral position should be determined and dynamic lumbar stabilization exercises should be started at a level tolerated by the patient. At the last stage, an aerobic exercise schedule suitable for the patient like walking should be added to increase the capacity of the patient even more.<sup>14</sup> Patients should be instructed to follow lower back protection principles their whole life. (Table 3)

**Table 3.** Examples of Lower Back Protection Principles

EXAMPLES OF LOWER BACK PROTECTION PRINCIPLES
During resting by lying down, the patient himself needs to find the most comfortable and painless position. When lying down, arms should not be extended above the head and should be held straight at both sides. While lying down, a cushion needs to be placed under the knees, when lying on the side, the foetal position should be taken and the cushion has to be placed between the legs. Patients should not lie facedown.
Since turning in bed may be painful, knees are flexed, feet are pressed down on the bed, legs and the shoulders are moved as one part and rolling on the side turns the body.
When getting out of bed, the lower back should not be raised in a flexed state, first the body should be turned on the side, afterwards sit down and stand up.
The bed should not be either too hard or too soft. Wool beds taking the form of the body should not be used. Orthopedic or semi-orthopedic bed should be used.
Patients should not sit in too low and soft couches.
While sitting, a small step should be placed under the feet. The knees should be kept 5-7 cm above the hips.
During sitting, lower backspace should be supported with a cushion and the patient should sit straight.
Sitting and particularly bending forward while sitting are positions that cause the heaviest load on the lower back. Therefore, patients should not sit for too long in the same position, but rather walk for a few minutes then sit down again.
While standing up after sitting, movement should not be bending forward from the lower back. Instead, the curve of the lower back should be maintained, leg should be straightened and the body should get up.
Patients should not stand for too long.
Correct standing posture is the positions where the shoulders are straight, abdominal muscles are contracted, and the knees are straight.
Due to the risk of falling down, slippery floor surfaces should be avoided.
When bending forward to lift an object or even to tie a shoe, your back should be completely straight. By flexing the knees, it should be ensured that the bending movement is not done by the lower back, but by the legs.
If objects need to be carried, these objects should not be pulled toward the body, but pushed.
Housewives should complete their chores by resting their back and dividing their chores throughout the day.

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