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## CASE REPORT

### McKenzie-type Exercises Improve the Functional Abilities of a Patient with Recurrent Herniated Discs: A Case Report

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**Abstract:** This case is unique in which the patient had two previous lumbar spinal surgeries, recurrent herniated discs, and new bulged and herniated discs were developed. We aimed to investigate whether implementing the McKenzie method would reduce the symptoms of a long history of Low Back Pain (LBP) with multiple surgeries. A 2-months of McKenzie-type exercise program was performed at a rate of 5 days/week. Disability index, pain intensity, lumbar Range of Motion (ROM), and lower limb strength were tested before and after the exercise treatment intervention. Disability and pain were also measured at 3-months follow-up. The Oswestry disability index and pain visual analogue scale score reduced immediately after the treatment intervention and remained reduced at 3-months follow-up from 44% to 22%, and from 8 to 4, respectively. Lumbar ROM improved about 1.5 cm during standing flexion and 3 cm during extension. Unilateral leg extension of the affected leg and bilateral leg press increased by 16.5 kg and 70 kg, respectively. The current protocol has shown that McKenzie-type exercise treatment can improve the physical functions and reduce pain in a patient with a history of lumbar spine surgeries and prolonged LBP. In addition, despite no additional exercise, McKenzie method increased the lower limb strength, possibly through nerve root decompression.

**Keywords:** Low back pain, Herniated disc, McKenzie method, Rehabilitation, Lumbar spine, Unilateral leg extension.

#### Article History

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## 1. INTRODUCTION

Low back pain (LBP) is characterized by pain that is localized within the 12<sup>th</sup> rib and the lower gluteal fold region associated with or without a radiating pain to one or both legs [1]. LBP can be acute or chronic, lasting for 12 weeks or longer [2]. LBP is the leading cause of reduced functional activity and the most common reason for work absence worldwide [3]. Moreover, lower cardiovascular function develops as a result of long term inactivity and/or disability [4].

LBP pain is a symptom that may be caused by several pathologies. In most cases, the cause of LBP cannot be determined, and hence it is termed non-specific LBP [5]. Disc degenerative disorders are well-documented epidemiology that can readily cause LBP [6]. A herniated disc is one of the most common specific conditions among all degenerative disc disorders that cause LBP along with radiculopathy [7]. Radicular pain is suggested to arise from nerve inflammation, irritation and/or compression [8]. Radicular pain characterized by leg pain radiating to below the knee is the most prevailing neuropathic pain ranging up to 43% of the population [9].

Clinical tests used to localize disc herniation in the lumbar spine include one-leg stand from a chair, standing on the toes and heel of one foot, raising the thigh from sitting under resistance, and several other tests to evaluate muscular strength [10]. The positive results of those tests suggest a nerve or multiple nerves compression in the lumbar spine that innervates the lower limb muscles. Altogether, disc herniation or protrusion in the lower back results in losing physical functions, including core and leg muscle strength and endurance [11]. In addition, limited lumbar range of motion (ROM) during flexion-extension and lateral bending have been consistently reported in patients with LBP [12, 13]. The decreased muscular function and lumbar ROM have been associated with different pain and disability scores among the patients [1].

Surgical intervention for patients ageing from 18 - 89 years with herniated discs has shown improvements in their disability index and physical functions [14]. Surgical treatment of a lumbar herniated disc achieved greater improvements in primary and secondary outcomes compared to non-operative treatments [15]. However, surgical operations include intraoperative and postoperative complications and an increased rate of recurrent disc herniation [16]. On the other hand, non-operative treatment modalities have been shown to

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result in equivalent outcomes with surgical interventions in the long term [8]. Passive procedures within the non-operative treatment, such as massage, hot and cold therapies, and ultrasound have been ineffective to improve disability, pain, or physical function among patients [17, 18]. In contrast, several modalities of exercise-type treatments were shown to reduce pain, disability, the severity of symptoms, and recurrence probability of LBP additional to the substantial improved physical function [19, 20].

McKenzie-type exercises, in particular, are based on the passive and active extension of the lumbar spine. It is used for the diagnosis and treatment of LBP. The nucleus pulposus of the intervertebral disc can posteriorly, anteriorly, and laterally migrate depending on the spine position. McKenzie-type of lumbar extension position was shown to reduce the posterior migration of the lumbar nucleus pulposus [21]. Several studies have shown improvements in the functional abilities and pain intensity following treatment using the McKenzie method in patients with acute LBP [22 - 24]. Nonetheless, there is limited evidence to support the effectiveness of McKenzie protocols in patients with chronic LBP [24].

The previous studies that investigated the effects of McKenzie-type exercise to decrease the severity of LBP have used patients with acute or chronic nonspecific LBP associated with or without radiculopathy; however, with no history of lumbar surgical interventions [22 - 25]. The efficacy of McKenzie method to treat acute and chronic LBP was shown through ~ 4 - 9 points of pain reduction and ~ 5 points of disability reduction on a 0- to 100- scale compared to standard and passive therapies [24, 26]. The mechanism of McKenzie method for treating LBP is based on the nucleus pulposus migration within the intervertebral disc during different spine positions [23]. In the case of a herniated disc, the fibrous annulus is ruptured and the nucleus pulposus migration during McKenzie exercises is not feasible [27]. In addition, there is an increased incidence rate of short- and long-term recurrent back and leg pain and disc herniation in patients after lumbar surgeries, and hence reduced nucleus pulposus content [28]. Therefore, the efficacy of the McKenzie method in patients with a history of lumbar surgery and recurrent LBP and disk herniation is questionable. Nonetheless, according to the general efficacy of the McKenzie method in patients with nonspecific LBP, it was hypothesized that this intervention would reduce pain and disability in a patient with a history of spinal surgeries. This study has utilized the McKenzie method in the treatment of a case who had two previous surgeries in the lumbar spine and experienced recurrent back and leg pain after both surgeries.

## 2. CASE DESCRIPTION

M.H has provided a signed informed consent that fully described all the procedures of the study and verbally expressed his complete willingness to completely perform the exercise treatment. The local ethical committee at Yarmouk University approved the procedures. M.H is a man who was admitted to the hospital in April 2015 due to severe pain in his lower back associated with radiculopathy. The MRI had revealed the presence of spinal stenosis and herniated disc

compressing the nerve root at the L4-L5 level. In May 2015, a laminectomy surgery was performed to the patient to widen the spinal canal and remove the herniated portion of the disc. The surgery included a dural tear that resulted in Cerebrospinal Fluid (CSF) leak, which was shortly evident after surgery by the appearance of fluid accumulation at the posterior site of the lumbar spine. In addition, a follow up diagnostic MRI showed an incomplete removal of the herniated portion of the disc.

Few months later in 2015, a second surgery was performed for M.H that included dural suture combined with 7 layers of fat and muscle patch for managing the dural tear. Postoperative meningitis developed after the surgery, which was fortunately treated with 21 days of antibiotic therapy. The removal of the remaining herniated disc was not feasible due to the previous surgical complications.

In August 2019, M.H reported to the exercise science and rehabilitation laboratory with increasing lower back and left leg pain for more than 7 months. He was 46 years old, with a bodyweight of 95 kg and a height of 184 cm. He reported mechanical stress at work and only household activities during leisure. M.H. appeared in good health condition, but walking abnormally.

### 2.1. The Magnetic Resonance Imaging (MRI) Report

A lumbar spine MRI was performed for the patient in March 2019. The image showed an enhancing granulation tissue seen around the L4/L5 level, where the laminectomy surgery was performed. The lumbar spine was straightening, reflecting muscle spasm. Diffuse posterior disc bulge was observed at L2/L3, L3/L4, and L4/L5 levels indenting the thecal sac and encroaching and narrowing both neural canals. A broad-based central disc protrusion was observed at L5/S1 level, compressing the thecal sac and narrowing both neural exit canals. An evident type II endplate degeneration was also observed at L5/S1 level.

### 2.2. Physical Examinations

Straight Leg Raise (SLR) and slump tests were performed on both legs [8]. Pain was assessed using the Visual Analogue Scale (VAS) [29]. Disability was measured using the Oswestry low back pain disability questionnaire [30]. The standing range of motion during flexion and extension was performed using the modified Schober's test [31, 32]. Lower body strength was assessed using unilateral 4-repetition maximum (4-RM) leg extension and 10-RM bilateral leg press. The strength testing procedure was according to the American college of sports medicine (ACSM) instructions [33]. Briefly, the patient cycled for 7 min at his own pace and performed 2 sets at about 50% of his perceived capacity of the multiple-RM. The multiple-RM was determined within 5 trials with 3 - 4 min rest periods between trials. After each successful trial, the weight was increased until the patient could complete the selected repetitions with the proper technique. All physical examinations were performed prior and after 2 months of the McKenzie-type exercise intervention.

### 2.3. The Exercise Intervention

The exercise intervention was performed at a frequency of

5 days/week for a total of 10 weeks. The selected exercises were modified from a previous protocol that showed improvements in the lumbar function and pain relief [34]. The intervention initially included lying prone for 5 min, prone on elbows for 5 min, prone press-ups (3 sets of 10 repetitions), prone press-ups with overpressure, and standing back extension (10 sets of 30 sec). Standing back extension was removed from the set of exercises because of the increased pain during the performance as reported by the patient's feedback. Plank exercise (3 sets of 30 sec) was added to the set of exercises in the third week of the protocol to strengthen the abdominal muscles. Deep abdominal muscle strengthening was shown effective to further stabilize the lumbar spine [35].

### 3. RESULTS

SLR test elicited pain in the patient's front thigh above the knee at 45° in the left leg but was negative in the right leg. The pain was similarly generated in the left leg during the SLR test before and after the exercise intervention. The slump test was negative for both legs before and after the exercise intervention. VAS score reduced from 9 to 5 after the exercise intervention. Disability measured by the Oswestry disability index was improved from 44% to 24% after the exercise intervention. The patient has specifically shown improvements in pain intensity, lifting, walking, personal care, standing, sleeping, travelling, and social life abilities in the Oswestry low back pain disability questionnaire. The exercise intervention increased the lumbar ROM from 8.5 to 9.75 cm during flexion and from 1.75 to 5 cm during extension. The exercise intervention increased the bilateral 10-RM leg press from 60 kg to 130 kg and the 4RM unilateral leg extension of the affected leg from 31.5 kg to 48 kg. M.H generally expressed an overall improvement in his quality of life. At 3 months follow-up, Exercise intervention maintained disability at 22% and VAS score at 4.

### 4. DISCUSSION

This case was unique in which the patient had two lumbar spine surgeries associated with surgical and clinical complications. Studies that used the lumbar extension type of non-operative therapy are scarce and included patients who did not receive any surgical intervention [22 - 24]. In addition, the measured lower limb strength outcomes, in this case, are minimally examined after interventions to treat LBP. The current two-months of exercise intervention resulted in improved disability index, pain intensity, lumbar ROM, and unilateral and bilateral lower limb strength. Furthermore, at 3 months follow-up, disability and pain were still at lower values than the basal evaluation.

Previous studies have also shown improvements in the disability and pain indices and the lumbar function with McKenzie-type exercise programs [22, 36 - 38]. McKenzie exercise has shown a greater impact on the disability index than other types of treatment such as back school, electrophysical agents, and standard physiotherapy (massage, laser therapy, transcutaneous electrical nerve stimulation) [23, 36, 38]. Others have shown that other types of exercise interventions, such as stabilization exercises and chiropractic manipulation, were superior to the McKenzi method to reduce

disability and pain intensity [37, 39]. It appears that the superiority of the effects of McKenzie method to other exercises and therapeutic interventions depends on the type of intervention that is being compared with [25]. The patient has shown unwavering improvements in the disability and pain score after 3 months from the end of the exercise intervention. It is not feasible, however, to attribute the lasting reduced disability and pain scores to the period of treatment. Nonetheless, the patient reported neither physical activity nor special treatment during the 3-months of follow-up. McKenzie treatment method was shown to reduce disability and bothersome symptoms for up to 104 weeks of follow-up period after treatment [39].

Our intervention has shown an improvement in the lumbar flexion-extension ROM. Not all studies that used the McKenzie-type exercise have shown this improvement. For example, lumbar extension resistance training for 12 weeks did not improve the lumbar or standing ROM during flexion and extension Schofer's test [13]. In contrast, 1 or 2 sessions of lumbar extension exercise for 12 weeks resulted in improved lumbar ROM during flexion and extension [40]. The contradictory results were attributed to the initial low ROM before treatments who demonstrated improvements after the exercise therapy [13]. In our case, M.H. showed low values of ROM during flexion and extension before the intervention. Nonetheless, this increased ROM may have contributed to the reduction of pain intensity and disability of the patient.

The current exercise intervention has shown remarkable effects on lower limb strength. Although the patient did not perform any resistance training and not even any other type of exercise besides the McKenzie-type exercises, his strength of the unilateral leg extension and bilateral leg press increased by 17 kg and 70 kg, respectively. Previous studies suggest that muscular strength is most likely to improve after resistance and stabilization types of exercise in patients with chronic LBP [1]. Lumbar extension exercise improved the lumbar extension strength; however, the exercise was associated with resistance [13, 40]. The strength outcome is scarce in the studies that investigated the effect of McKenzie-type exercises. Moreover, previous studies measured the strength of the lumbar area, whereas no study has tested for lower limb strength after the McKenzie method treatment [25]. Nerve compression seen with disc herniation is mostly associated with muscle strength loss [41]. More studies are required to assess whether McKenzie-type exercises can improve lower limb strength by decompressing the sciatic nerve.

### CONCLUSION

The current McKenzie-type exercise intervention program appears to improve disability, pain, ROM, and lower limb strength. This case provides optimistic results of the rehabilitation interventions following lumbar spine surgeries, especially in patients with recurrent herniated discs. More research should examine the effects of McKenzie method and other exercise-based treatments in a bigger sample size of patients with a history of lumbar surgeries and recurrent LBP.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

All procedures were approved by the local scientific and ethical committee at Yarmouk University, Jordan.

## HUMAN AND ANIMAL RIGHTS

No Animals were used in this research. All human research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013.

## CONSENT FOR PUBLICATION

A signed written informed consent was provided by the patient.

## AVAILABILITY OF DATA AND MATERIALS

Not applicable.

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## CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

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