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Carly Theriault
University of New England

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McKenzie Approach to Treating Lumbar Radiculopathy with a Lateral Shift: A Case Report

Carly Therault, LAT, ATC is a Doctor of Physical Therapy (DPT) student.

Department of Physical Therapy, University of New England, 719 Stevens Ave, Portland, ME

Address all correspondence to Carly Therault at ctherault1@une.edu

The patient signed an informed consent allowing the use of his medical history and photographs for this case report. He received information from the university's Health Insurance Portability and Accountability Act (HIPAA) policies.

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Key Words: McKenzie, lumbar radiculopathy, low back pain, lateral shift, physical therapy

ABSTRACT

Background and Purpose: Pain and dysfunction of the lumbar spine has the highest incidence of any other musculoskeletal condition. LBP is thought to affect 70-85% of people. The purpose of this case report was to implement the McKenzie method, along with manual therapy, strengthening and stretching exercises, modalities, patient education, and an HEP for a patient with lumbar radiculopathy.

Case Description: The patient was a 59-year-old male with an eight-year history of LBP. Following his most recent injury, the patient had LBP with pain radiating to the right LE. The patient received PT treatment twice a week for eight weeks. His POC included McKenzie based treatment, manual therapy, therapeutic exercise, electrical stimulation, and education regarding self-management techniques and an HEP.

Outcomes: Pain levels had decreased from 10/10 at worst to 3/10 at worst on the Numeric Pain Rating Scale. Other improvements included lumbar ROM, strength, sensation, muscle tone, and tenderness.

Discussion: This case report described the management of a patient with lumbar radiculopathy using the McKenzie method, along with manual therapy, therapeutic exercise, modalities and an HEP. The POC appeared to be successful as the patient had decreased pain, increased strength and ROM, and centralization of symptoms. The outcomes of this case were consistent with current research regarding directional preference and repeated motions. Further research is still needed in order to determine the long-term benefits of McKenzie based exercise programs for patients with LBP, specifically lumbar radiculopathy.

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INTRODUCTION/BACKGROUND and PURPOSE

The lumbar spine is a complex chain of joints that can be very vulnerable to injury. Pain and dysfunction of the lumbar spine has the highest incidence of any other musculoskeletal condition.¹ People of any age can suffer from low back pain (LBP) and studies show that 70-85% of people have experienced LBP, either acute or chronic.² Most cases of LBP typically involve the intervertebral discs.¹ Certain postures and positions such as decreased lumbar lordosis, can lead to lumbar flexion which may be responsible for causing discogenic LBP. Individuals with bulging discs or herniated nucleus pulposus (HNP) tend to have increased pain in the low back with radiating pain into the lower extremities (LE) with activities involving lumbar flexion, such as with driving, prolonged sitting, bending and lifting. Radiculopathy is caused by compression of specific nerve roots originating in the lumbar spine. Lumbar extension on the other hand, may help to decrease LBP and centralize radiating symptoms. Centralization refers to the concept that radiating symptoms into the extremities, caused by an issue in the spine, can dissipate or move proximally towards the spine.^{1,3} The concept of centralization is a common finding in patients with LBP, affecting 65%.¹

These directional preferences are the basis for the McKenzie method, otherwise known as Mechanical Diagnosis and Treatment (MDT).^{1,3} The McKenzie method is a reproducible evaluation and treatment technique that focuses on the movement of the nucleus pulposus within the intervertebral disc during trunk movement.² During forward flexion of the lumbar spine in particular, the anterior aspect of the intervertebral disc is being compressed, therefore, pushing the nucleus pulposus posteriorly towards the spinal nerve roots.² The McKenzie method evaluation involves having a patient perform repeated motions at their end range and monitoring their symptoms for centralization or peripheralization.^{4,3} Peripheralization refers to the concept that with more pressure on the nerve, symptoms can radiate to the distal extremities. Once it is revealed which repeated motions increase or decrease a patient's pain, the intervention is to have the patient perform these repeated motions. An important component of the McKenzie method is instructing a patient in a home exercise program (HEP) to teach them self-management strategies.⁴ Patients are also instructed to maintain correct standing and seated postures as

well as avoiding movements of the spine that increase their pain, such as forward bending, twisting and lifting if the issue is disc related.

Most of the time sagittal plane motions such as extension and flexion will be enough to centralize a patient's radicular symptoms and reduce their LBP. However, in some patients, sagittal plane repeated motions may not be enough to reduce their symptoms. Those with a lateral component, referred to as a relevant lateral shift, may respond better to frontal plane motions at the start of intervention.⁵ A lateral shift will present with shoulders shifted either to the right or the left of their hips and pelvis when assessing their posture. It is important to always assess the patient's posture during the initial evaluation (IE) prior to treatment to rule out whether or not they may have a lateral component associated with their discogenic LBP.

Due to the recurrent nature of the patient's LBP and radiculopathy, even with previous physical therapy (PT) treatment, this case report is necessary to reveal which treatment techniques are effective in reducing pain. The purpose of this case report was to implement the McKenzie method^{4,3,6}, along with manual therapy, strengthening^{7,8} and stretching⁷ exercises, modalities, patient education⁷ and an HEP for a patient with lumbar radiculopathy. Due to this patient's history of recurring LBP, directional preference, and relevant lateral shift, he is a good candidate for this case report.

CASE DESCRIPTION

Patient History and Systems Review

The patient was a 59-year-old male with a ten-year history of LBP. He originally injured his low back in 2008 when lifting a heavy box at work and felt immediate pain in his low back. His symptoms resolved over time and he did not seek treatment. The patient reinjured his low back in 2017 after lifting a 75-pound box at work and he filed a claim with Worker's Compensation. After this injury, the patient had LBP with pain radiating to the right LE. He had magnetic resonance imaging (MRI) done in 2017 which revealed a HNP at the L4-L5 level, as well as bulging discs at L3-L4 and L5-S1. The patient received PT treatment in 2017 for 12 visits. He also received cortisone injections and chiropractic care in 2017, which

gave him temporary relief of symptoms. The patient reported that the previous PT treatment helped to reduce the right leg pain, however, his LBP had never fully resolved.

The patient's symptoms returned in May 2018 after heavy lifting at work, and he filed another claim through Worker's Compensation. He went to his primary care provider (PCP) after the exacerbation of symptoms and he was referred again to PT. At the IE, the patient presented with bilateral LBP, with pain presenting worse on the right side. He had radiating symptoms into the right LE, along the posterolateral aspect of his right hip, thigh, calf and foot. He often experienced numbness and tingling into his right foot. His symptoms were made worse by lifting, carrying, bending forward, driving, prolonged walking, and prolonged sitting or standing. The patient reported that he preferred a standing position, but his back would begin to hurt after 10 minutes. The patient often experienced pain at night which woke him up, however, he was able to fall asleep after repositioning. He primarily slept on his left side with a pillow between his knees to maintain proper spine alignment. The patient also reported that he had noticed a change in his posture since the most recent injury in 2018, in which his upper body seemed to be shifted to the left in comparison with his lower body.

The patient was employed at a produce company, where he was required to do heavy lifting and drove a forklift every day. He was out of work due to his inability to perform required duties. He resided near a beach and enjoyed walking in the morning, however, he was unable to walk more than a half mile without pain. His prior level of function was working full duty, no restrictions at his job and walking about two to three miles a day prior to work. Besides his history of LBP, the patient's past medical history was unremarkable. He was taking tramadol for his muscle spasms and using heating pads regularly to modulate his pain. He reported a pain level of 9/10 on the numeric pain rating scale (NPRS). The patient presented with no red flags, answering "no" to any recent accidents, surgeries, bladder/bowel dysfunction, unexplained weight loss, and pain when he coughed or sneezed. The patient's main concerns regarding his diagnosis were that he was unable to work, participate in activities he once enjoyed, and function without pain or discomfort.

A systems review was taken during the IE, which can be found in Table 1. The systems review revealed the patient had unremarkable findings for cardiovascular/pulmonary and integumentary systems. As far as the patient's musculoskeletal findings, he presented with postural abnormalities, decreased range of motion (ROM), strength, spine mobility, tenderness to palpation (TTP) and increased muscle tone. The patient had no impairments with communication and cognition and he reported that he learned best through demonstration.

Examination – Tests and Measures

The patient's IE began with an assessment of his standing and sitting postures (Table 2). He presented with mild decreased lumbar lordosis and a left lateral shift. It was determined that this was a relevant contralateral shift due to it being shifted away from the painful right side and the patient's subjective report that he noticed this postural change after his most recent low back injury.⁹ The patient's trunk ROM was assessed next. The patient presented with limited and painful trunk flexion, extension, lateral flexion and rotation, flexion being the most painful motion. He was then asked to perform repeated motions while monitoring his low back and LE symptoms. The patient first performed repeated flexion of the lumbar spine, in which he began complaining of increased right LE pain, down to the lateral calf and dorsum of the foot. Following this, the patient was asked to perform repeated lumbar extension, in which his LE symptoms resolved, and he experienced a slight increase in LBP. According to the McKenzie method, this assessment of repeated motions revealed that forward flexion caused the patient's symptoms to peripheralize.⁴ This was then corrected with repeated extension as the patient's symptoms began to centralize.

The patient's low back was TTP along the bilateral lumbar paraspinal musculature, bilateral quadratus lumborum, bilateral spinous and transverse processes of the lumbar spine and the right piriformis muscle. His right piriformis and lumbar paraspinals also revealed increased muscle tone during palpation. Special tests were performed on the patient, such as a straight leg raise (SLR) which is a neurodynamic test that is used most frequently in patients with potential disc injury.¹⁰ A SLR was performed bilaterally and revealed a positive SLR on the right for low back and right leg pain, and

positive on the left for LBP only. The Slump test was also positive on the right for LBP and leg pain and was negative on the left. Both the SLR and Slump test were found to have moderate accuracy and ability to detect a herniated disc, according to Ekedahl et al.¹⁰

A neuromuscular screening was then performed on the patient. This screening revealed decreased sensation of the right distal tibia and dorsum of the foot, or L4-S1 involvement. His dermatomes and light touch on the left were intact. The patient presented with myotomal weakness of L4-S1 on the right, demonstrated as the inability to hold against moderate resistance with dorsiflexion, great toe extension and ankle eversion. Deep tendon reflexes (DTRs) were checked as well and were intact. Subjectively, the patient rated his current pain level as a 9/10 on the NPRS. Pain at its best was rated a 4/10 and pain at its worse was rated a 10/10.

Clinical Impression: Evaluation, Diagnosis, Prognosis

The initial impression of the patient was that he presented with LBP and radiculopathy into the right LE. Based on the objective findings during the IE, the patient's symptoms were consistent with lumbar radiculopathy, along with a directional preference, as his symptoms seemed to centralize with repeated lumbar extension.⁴ This patient was chosen for the case study due the high prevalence of LBP seen in the outpatient setting.¹ There are many treatment methods that PTs use to treat LBP, including the McKenzie method. The patient's relevant lateral shift that had occurred following his most recent injury also made him a good candidate for this case study.

The patient was given a medical/physical therapy diagnosis of "Radiculopathy, lumbosacral region" (M54.17). His functional limitations included the inability to maintain static postures, difficulty bending and lifting, and impaired activities of daily living (ADLs) due to pain. The patient's prognosis was considered to be good due to his lack of co-morbidities and previous benefits of PT. The only factor considered to be a barrier to his long-term spine health was the heavy lifting he was required to do at work. The patient was to be treated 2-3 times a week as needed, for 45 minutes to one-hour sessions for 8-12 weeks. If the patient was not responding to treatment, and his myotomal weakness was not improving, his physician would have been consulted. A PT re-evaluation was to be completed every 30 days. During

the re-evaluations the same tests and measures taken at the IE would be used to look for any improvements regarding patient's pain, ROM, spine mobility, and function, and the plan of care (POC) would be modified if needed.

The POC for this patient was to first focus on correcting his lateral shift with therapeutic exercise such as performing side glides at the wall and hips off center techniques such a prone on elbows with hips off to the left. Once the contralateral shift was corrected, the patient would be progressed to a lumbar extension program according to his tolerance. This would include progressing prone on elbows to prone press ups¹¹ and standing lumbar extensions. General spine ROM exercises would be incorporated such as lower trunk rotations (LTR) in supine and strengthening exercises such as supine clams and bridging. The patient would progress to core⁸ and hip strengthening exercises, as tolerated, starting in one plane and progressing to multi-planar motions. The patient was also to receive manual therapy, including soft tissue mobilization (STM) as tolerated to the lumbar, thoracic and sacral spine regions. Modalities such as electrical stimulation and moist hot packs (MHP) would also be used early on to modulate the patient's pain. All interventions would be modified to fit the needs of the patient and to determine his tolerance to each exercise. It was important to monitor for centralization versus peripheralization of the patient's radiating symptoms into the LE, to determine whether or not the treatment method was working for the patient.

Short-term goals for this patient included improving standing and sitting postures, increasing lumbar extension ROM and achieving independence in an HEP. Long-term goals for this patient included improving LE strength, carrying ability, and pain level. Detailed short-term and long-term goals can be found in Table 4.

INTERVENTION and PLAN OF CARE

Coordination, Communication, Documentation

Coordination of care for this patient included communication with his PCP who referred him to PT, including sending copies of his IE and re-evaluations every 30 days. Daily notes were also documented at each patient visit. The patient saw a physical therapy assistant (PTA) on a few occasions,

therefore, the patient's POC was discussed and modified based on his needs. Rehabilitation technicians were also instructed on patient's therapeutic exercises and assisted him on several occasions.

Patient Related Instruction

The patient was educated about his diagnosis and objective findings, his POC and treatment interventions, and the importance of consistent PT visits. He was instructed on an HEP, including shift corrections and McKenzie based exercises. The patient was educated on the importance of monitoring his radicular symptoms for centralization/peripheralization and maintaining proper posture. Before returning to work, the patient was instructed on proper lifting mechanics and how to prevent future injury. The patient reported good understanding and compliance with his HEP.

Towards the end of therapy, the patient's ability to self-manage his symptoms improved as he became more independent with his HEP. The patient was given copies of his HEP and updated copies if any exercises were added.

Procedural Interventions

The patient attended PT two times a week for 8 weeks, totaling 16 visits (Figure 2). These 45-minute to one-hour treatment sessions included McKenzie based exercises, strengthening, stretching, manual therapy, and electrical stimulation (Table 3).

Due to the patient's relevant lateral shift noted upon IE and his decrease in LE symptoms while performing repeated lumbar extension, treatment included McKenzie based exercises (Figure 1). The purpose of including McKenzie based exercises was to correct the patient's lateral shift and utilize his directional preference to reduce pain. According to Laslett⁶, patients should be taught self-correction and management of a lateral shift prior to performing lumbar extension exercises. The patient performed side glides at the wall as well as lumbar extension exercises with hips off center to incorporate frontal plane shift-correction⁵. Once the lateral shift was corrected, the patient performed progressive lumbar extension exercises at his available end-range. Exercise modifications were made based on patient's ability and can be viewed in Table 3.

Strengthening exercises were performed to improve the patient's hip and core strength. Core strengthening exercises were performed in order to activate the transverse abdominus (TA) as well as lumbar spine extensors to improve spine stability and posture.⁸ Similarly, hip strengthening exercises were also performed in order to improve lumbar spine stability.¹² Exercises were progressed by adding resistance such as a TheraBand (TheraBand, Akron, OH) and a First Place Elite Medicine Ball (Perform Better, West Warwick, RI).

Stretching exercises, such as a piriformis stretch, LTR, and cat camel stretch, were performed in order to improve the patient's mobility and relieve pain. According to Nandyala et al⁷, nonsurgical treatment for a HNP should include flexibility exercises to improve function. The patient was instructed to perform stretches as a part of his HEP, along with the strengthening and McKenzie exercises.

Manual therapy such as STM was performed by the PT and student PT in order to reduce the patient's tenderness and increased muscle tone of the lumbar paraspinals and piriformis regions. Changes in the patient's muscle tone in the specified areas were noted throughout the patient's episode of care. Modalities such as electrical stimulation was used in combination with a MHP to reduce pain and muscle spasm. Electrical stimulation was administered to the patient in the form of interferential current (IFC). In a study by Facci et al,¹³ IFC was shown to improve pain and disability in patients with LBP. Using the Chattanooga Intellect Legend Stimulator (Chattanooga Medical Supply, Chattanooga, TN), IFC was administered to the patient at a frequency of 80-150 Hz and an intensity that was strong but comfortable for the patient. The duration of this treatment was 15 minutes and the electrodes were placed in an "X" pattern along the patient's low back.

OUTCOME

Throughout the episode of care, the patient reported steady progress and reduction of symptoms. The most significant finding was the correction of the patient's lateral shift, which resolved completely after the 2nd visit. At discharge, objective measures were gathered and showed improved pain levels, lumbar spine ROM, and muscle tone and tenderness (Table 2). His reported pain levels had decreased from 10/10 at worst to 3/10 at worst, using the NPRS (Table 2). This included abolishment of his R LE

pain and a significant decrease in his LBP. The patient also presented with increased LE strength and sensation, which revealed intact lumbar myotomes and dermatomes. He reported increased ability to maintain good posture and lifting mechanics as well as independence with his HEP. Upon discharge, the patient had returned to work full duty and continued to have relief of symptoms with completion of McKenzie extension exercises. The patient verbalized his intent to continue with his HEP to manage his residual symptoms and agreed to return to PT if symptoms worsened.

DISCUSSION

This case report described the management of a patient with lumbar radiculopathy using the McKenzie method, along with manual therapy, therapeutic exercise, modalities and an HEP. The patient's POC was created based on research evidence and clinical experience from working with patients with lumbar radiculopathy. The POC appeared successful as the patient had centralization of symptoms, decreased pain, increased strength and improved ROM following his episode of care. Factors that may have positively affected the patient's treatment included compliance with HEP, high prior level of function, good overall health and the interventions provided during PT. Potential factors that may have negatively affected patient outcomes included poor posture habits and lifting mechanics. Therefore, it is important to teach self-management techniques⁵ as well as proper posture and lifting mechanics in order to prevent future injury or return of symptoms.

The outcomes of this case were consistent with current research regarding directional preference and repeated motions. The patient responded favorably to McKenzie based treatment, as performing repeated lumbar extension exercises at his available end-range seemed to centralize his symptoms and eventually abolish his LE pain.^{4,3} HEP compliance also seemed to be a contributing factor to the success of treatment for this patient because he was able to self-manage and relieve his symptoms at home.⁴ There is research suggesting that prescribing McKenzie exercises in the frontal plane can correct a patient's lateral shift⁵ and this may help to restore their normal function.¹⁴ In this case, the patient responded quickly to frontal plane repeated motions as his LBP decreased and his lateral shift was corrected after a few sessions. The clinical implications of this case were that the McKenzie approach to treating lumbar

radiculopathy, in the presence of a lateral shift, seemed to be successful for this patient. Further research is still needed in order to determine the long-term benefits of McKenzie based exercise programs for patients with LBP, specifically lumbar radiculopathy. Due to the increased prevalence of LBP, more research is necessary to find the optimal treatment method in order to prevent chronic pain and disability.²

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TABLES and FIGURES

Table 1. Systems Review

Cardiovascular/Pulmonary	Unremarkable
Musculoskeletal	<ul style="list-style-type: none"> • Decreased lordosis of the lumbar spine • Relevant lateral shift with shoulders off to the L in comparison with the hips • Decreased trunk ROM • Decreased trunk and R LE strength • Increased pain with AROM of the lumbar spine • Tenderness to palpation of the lumbar spine region and right glute muscles • Slightly decreased mobility of the lumbar and thoracic spines
Neuromuscular	<ul style="list-style-type: none"> • Slightly increased muscle tone of the lumbar paraspinals and right piriformis muscle • Positive slump test for radicular symptoms on the right side • Decreased sensation of the L4-S1 dermatomes in the R LE
Integumentary	Unremarkable
Communication	Not impaired
Affect, Cognition, Language, Learning Style	Not impaired. Patient reported to learn best through demonstration.

Left (L), Range of motion (ROM), Right (R), Lower extremity (LE), Active range of motion (AROM)

Table 2. Tests & Measures

Tests & Measures	Initial Evaluation Results	Discharge Evaluation Results
Palpation For tenderness	TTP of R piriformis, B lumbar paraspinals, B quadratus lumborum, and spinous and transverse processes of the lumbar spine.	No TTP of R piriformis, B lumbar paraspinals, B quadratus lumborum, and spinous and transverse processes.
For muscle tone	Moderately increased tone of R piriformis and lumbar paraspinals R>L	Mild increased tone of lumbar paraspinals R>L
Posture	Moderately decreased lumbar lordosis Relevant L lateral shift	Mildly decreased lumbar lordosis. No L lateral shift
Lumbar spine ROM Flexion (normal= 80°) Extension (n= 30°) Left lateral flexion (n= 35°) Right lateral flexion (n= 35°) Left rotation (n= 45°) Right rotation (n= 45°)	35° 10° 10° 10° 20° 20°	80° 25° 35° 35° 40° 40°
Lumbar Special Tests SLR Slump test	(+) on R for LBP, (+) on L for LBP (+) on R for radicular symptoms, (-) on L	(-) Bilaterally (-) Bilaterally

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Lumbar Spine Mobility	2 - Slightly decreased mobility	2- Slightly decreased mobility
Mechanical Lumbar Spine Assessment (in standing) Repeated flexion in standing Repeated extension in standing	Increased LBP and R LE pain Increased R LBP and decreased LE pain/symptoms	No provocation of symptoms Decreased LBP
Lumbar Dermatomes (Sensation)	Decreased on R, light touch L4-S1 dermatomes in the R LE distal 2/3 of tibia and R foot, dermatomes intact on the L LE paresthesia on the R, none on the L	Intact bilaterally No paresthesia
Lumbar Myotomes Hip flexion (L2) Knee extension (L3) Ankle dorsiflexion (L4) Great toe extension (L5) Ankle eversion (S1)	4+/5 bilaterally 4/5 on R, 5/5 on L 3/5 on R, 4+/5 on L 3+/5 on R, 4+/5 on L 3+/5 on R, 4/5 on L	4+/5 B 5/5 B 4+/5 B 4+/5 B 4/5 B
Deep Tendon Reflexes Patellar tendon Achilles tendon	2+ 2+	2+ 2+
Numeric Pain Rating Scale (0-10) Current pain level At worst At best	9/10 10/10 4/10	1/10 3/10 0/10

Tenderness to palpation (TTP), Bilateral (B), Right (R), Left (L), Range of motion (ROM), Straight leg raise (SLR), Low back pain (LBP), Lower extremity (LE)

Table 3. Interventions & Parameters

Interventions	Rx Week 1	Rx Week 2	Rx Week 3	Rx Week 4	Rx Week 5	Rx Week 6	Rx Week 7	Rx Week 8
McKenzie Based Exercises	L side glides at wall 2x10, 10 sec holds POE with HOC L 2x10, 10 sec holds	POE 3x10, 10 sec holds Standing lumbar extension (back to table) 3x10, 5 sec holds Quadruped sinking down into PPU x15	POE 3x10, 10 sec holds Standing lumbar extension 3x10, 5 sec holds PPU 2x10, 10 sec holds	POE 3x10, 10 sec holds Standing lumbar extension 3x10, 5 sec holds PPU 2x10, 10 sec holds	Standing lumbar extension 3x10, 5 sec holds PPU 2x10, 10 sec holds	Standing lumbar extension 3x10, 5 sec holds PPU 2x10, 10 sec holds	Standing lumbar extension 3x10, 5 sec holds PPU 2x10, 10 sec holds	Standing lumbar extension 3x10, 5 sec holds PPU 2x10, 10 sec holds
Strengthening		Prone hip extension 2x10 bilat Supine marching with TA activation 3x30 sec	Prone hip extension 2x10 bilat Supine clams with green TheraBand 2x10 Bridging 2x10	Prone hip extension 2x10 bilat Supine clams with green TheraBand 2x10 Bridging 2x10	Prone hip extension 2x10 bilat Supine clams with blue TheraBand 2x10 Bridging 2x10 Bird dogs x15 bilat (with TA activation)	Bird dogs x15 bilat (with TA activation) High kneeling shoulder flexion with 2# med ball 2x10 Paloﬀ press with blue TheraBand Prone superman holds 2x10 sec	Bird dogs x15 bilat (with TA activation) High kneeling shoulder flexion with 2# med ball 2x10 Paloﬀ press with blue TheraBand Prone superman holds 2x10 sec	Bird dogs x15 bilat (with TA activation) High kneeling shoulder flexion with 4# med ball 2x10 Paloﬀ press with blue TheraBand Prone superman holds 2x15 sec

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							Plank holds 2x15 sec	Plank holds 2x20 sec
Stretching	Supine piriformis stretch on R x3, 30 sec holds	Supine piriformis stretch on R x3, 30 sec holds Active hamstring stretch/sciatic nerve glides x15 on R LTR x10 bilat	Supine piriformis stretch on R x3, 30 sec holds Active hamstring stretch/sciatic nerve glides) x15 on R LTR x15 bilat	Supine piriformis stretch on R x3, 30 sec holds LTR x15 bilat Cat camel stretch (focus on camel) x15	Supine piriformis stretch on R x3, 30 sec holds LTR x15 bilat Cat camel stretch (focus on camel) x15	Supine piriformis stretch on R x3, 30 sec holds LTR x15 bilat Cat camel stretch (focus on camel) x15	Supine piriformis stretch on R x3, 30 sec holds LTR x15 bilat Cat camel stretch (focus on camel) x15	Supine piriformis stretch on R x3, 30 sec holds LTR x15 bilat Cat camel stretch (focus on camel) x15
Manual Therapy	STM to lumbar paraspinals and R piriformis x15 min	STM to lumbar paraspinals and R piriformis x15 min	STM to lumbar paraspinals and R piriformis region x15 min	STM to lumbar paraspinals and R piriformis region x15 min	STM to lumbar paraspinals and R piriformis region x15 min	STM to lumbar paraspinals and R piriformis region x15 min		
Electrical Stimulation	IFC with MHP x15 min	IFC with MHP x15 min	IFC with MHP x15 min	IFC with MHP x10 min				

Left (L), Prone on elbows (POE), Hips ff center (HOC), Prone press ups (PPU), Transverse abdominus (TA), Medicine ball (med ball), Right (R), Lower trunk rotations (LTR)

Table 4. Short & Long-Term Goals

Short Term Goals	Long Term Goals
The patient will achieve proper standing and sitting postures, with no lateral shift, within 2 weeks in order to reduce low back pain and improve function.	The patient will increase his gross LE strength to 4+/5 within 8-12 weeks in order to achieve proper lifting mechanics.
The patient will become independent in his HEP within 4 weeks, including self-management techniques, in order to reduce his pain at home and improve his ability to perform ADLs.	The patient will report a pain level of less than 1/10 during forward bending, within 8-12 weeks, in order to perform ADLs with minimal difficulty.
The patient will achieve greater lumbar extension range within 4 weeks, in order to peripheralize LE symptoms.	The patient will be able to carry a 40lb box with pain level less than 2/10, within 6-8 weeks, in order to return to work modified duty.
	The patient will be able to carry a 75lb box without pain in 8-12 weeks, in order to return to work full duty.

Home exercise program (HEP), Activities of daily living (ADLs), Lower extremity (LE)

Figure 1. Therapeutic Exercises

Exercise #1: Side Glides (for left lateral shift correction)

The patient was instructed to stand with L arm against the wall, keeping it close to his body. Feet out far enough from the wall to allow for hips to glide to the L towards wall. The patient performed 2 sets of 10 repetitions, holding each time for 10 seconds. The patient was monitored for centralization or peripheralization of symptoms.



Exercise #2: Prone on elbows (*Hips off center left*)

The patient was instructed to assume a prone position, with hips positioned toward the left in relation to his upper body and lower legs. He then came up onto his elbows, achieving lumbar extension. The patient held this position for 10 seconds and completed 2 sets of 10 repetitions. His symptoms were monitored by the PT. Below shows a posterior view, as well as a side view of the exercise being performed.



Exercise #3: Lower Trunk Rotations

The patient was instructed to lay in a hooklying^a position and allow his knees to fall slowly to each side, while his back remained on the mat table. He completed 10-15 repetitions to each side, pausing for a second or two with each repetition.



Exercise #4: Prone on elbows (*Hips center*)

The patient was instructed to assume a prone position on the mat table and come up onto his elbows for 10 seconds. He repeated this exercise for 3 sets of 10 repetitions.



Exercise #5: Prone Press Up

The patient was instructed to lay in a prone position with his elbows bent and hands placed next to his shoulders. He then straightened his elbows to assume a prone press up position, gaining even more lumbar extension. The patient performed this exercise for 2 sets of 10 repetitions, holding each for 10 seconds.



Exercise #6: Bridges

The patient was instructed to lay in hooklying^a with his feet on the mat table. He was cued to activate his transverse abdominus as he lifted his hips in the air, putting weight through his heels. He was cued to contract his glute muscles during the bridge. The patient performed this exercise for 2 sets of 10 repetitions.



^aHooklying describes a position where the patient is lying supine with knees bent and feet flat on the floor

Figure 2. Timeline

