Effect Of Lumbar Canal Enlargement Exercise Protocol With Conventional Physiotherapy In Lumbar Spinal Stenosis: A Case Study

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Abstract:
Background: Lumbar Spinal Stenosis (LSS) is a common and debilitating condition, particularly in older adults, characterized by the narrowing of the spinal canal, which leads to the compression of nerve roots and other neural structures. This results in symptoms such as lower back pain, radiating leg pain, numbness, weakness, and functional impairment. Conservative treatments, including physiotherapy, are the mainstay of management. However, combining targeted exercise protocols, such as the Lumbar Canal Enlargement Exercise Protocol, with conventional physiotherapy may offer more effective symptom relief and functional improvements.
Objective: This case study aims to evaluate the combined effect of the Lumbar Canal Enlargement Exercise Protocol and conventional physiotherapy in managing a patient with secondary lumbar spinal stenosis, specifically assessing the impact on pain intensity, range of motion (ROM), neural flexibility, and quality of life (QOL). Additionally, the Modified Oswestry Disability Index (MODI) was used to assess functional improvement.
Methods: A 58-year-old male with lumbar spinal stenosis at L4-5 and L5-S1 was treated with a four-week intervention consisting of manual therapy, lumbar canal enlargement exercises, core strengthening, nerve gliding techniques, postural education, and electrotherapy. Assessment tools used included the Numeric Pain Rating Scale (NPRS), Modified Schober Test (ROM), Straight Leg Raise (SLR) test, and the Modified Oswestry Disability Index (MODI), a standard tool to measure functional disability in patients with low back pain.
Results: After the four-week treatment period, the patient exhibited significant improvements. Pain decreased as measured by the NPRS, with scores reducing from 8 to 4 during functional activities and from 5 to 2 at rest. Lumbar ROM increased, as shown by the Modified Schober Test, from 18 cm to 23 cm. neural tensions improved, with the SLR increasing from 60°/65° to 80°/85°. Functional disability, measured by the MODI, improved from 71% to 50%, indicating a reduction in functional limitations. The patient reported significant improvements in daily activities, independence, and quality of life.
Conclusion: This case study demonstrates that combining the Lumbar Canal Enlargement Exercise Protocol with conventional physiotherapy offers a comprehensive approach for managing lumbar spinal stenosis. The results show significant improvements in pain relief, spinal mobility, neural flexibility, functional independence, and a marked reduction in disability as measured by the MODI. These findings suggest that a multifaceted approach, integrating specialized exercise protocols and traditional physiotherapy, can significantly enhance patient outcomes in lumbar spinal stenosis. Further research with larger sample sizes and control groups is needed to validate the efficacy of this protocol in clinical settings.

Introduction:

Lumbar Spinal Stenosis (LSS) is a progressive and debilitating condition that commonly affects older adults, particularly those over the age of 50. It is characterized by the narrowing of the spinal canal, which can lead to compression of the spinal cord, nerve roots, and other neural structures. This compression results in symptoms that significantly impact a patient's mobility and quality of life. These symptoms include lower back pain, radiating leg pain (often referred to as sciatica), numbness, weakness, and, in severe cases, loss of functional independence. The symptoms of LSS can be exacerbated by activities that involve prolonged standing, walking, or sitting, making it difficult for individuals to perform daily activities [(1,2)].

LSS is often a result of degenerative changes in the spine, including facet joint hypertrophy, disc bulging, ligamentum flavum thickening, and in some cases, spondylolisthesis (slipping of one vertebra over another). These degenerative changes reduce the size of the spinal canal, leading to mechanical compression of the spinal cord and nerve roots [(3,4)]. The resultant neurological symptoms can be distressing, often impairing the patient's ability to perform even basic activities of daily living, such as walking, standing, or sitting [(5,6)].

Conservative treatment strategies for LSS typically include physical therapy, pain management, and exercise programs, all aimed at reducing symptoms and improving functional capacity. However, many of these approaches focus primarily on symptom management rather than addressing the underlying biomechanical issues that contribute to the condition. While pharmacological treatments like nonsteroidal anti-inflammatory

drugs (NSAIDs) or epidural steroid injections may provide temporary relief, they often fail to provide lasting improvements in spinal function or mobility [7,8].

A more integrated approach to managing LSS is needed, one that not only focuses on symptom relief but also addresses the underlying mechanical and neural aspects of the condition. Recent advances in physical therapy have introduced targeted exercise protocols aimed at improving spinal mobility, enhancing neural flexibility, and reducing neural compression. The Lumbar Canal Enlargement Exercise Protocol is one such targeted intervention that aims to create space within the spinal canal by promoting spinal extension and flexion movements, as well as exercises designed to stretch and mobilize the neural elements [9,10] . This approach is thought to help decompress nerve roots, increase spinal range of motion (ROM), and improve overall functional capacity [11,12].

Conventional physiotherapy techniques, such as manual therapy, postural education, and core strengthening, remain essential components in the management of LSS. Manual therapy, including spinal mobilizations and soft tissue techniques, can reduce pain and stiffness, while strengthening exercises targeting the core and paraspinal muscles can provide better support for the spine and reduce load on the vertebrae [13]. These methods are often combined with neural mobility exercises to improve nerve gliding and reduce symptoms associated with neural compression [13].

This case study aims to investigate the effect of combining the Lumbar Canal Enlargement Exercise Protocol with conventional physiotherapy in a patient with secondary lumbar spinal stenosis. Specifically, it will evaluate how this integrated approach impacts pain levels, spinal mobility, neural flexibility, and functional independence. Additionally, the study will assess the patient's quality of life (QOL) and functional disability using the Modified Oswestry Disability Index (MODI) [11], a widely used tool for measuring the impact of low back pain on daily activities. By analyzing the results of this case study, the objective is to provide evidence supporting the efficacy of a more comprehensive and multifaceted physiotherapy protocol in the treatment of LSS.

Ultimately, the goal is to contribute to the growing body of literature supporting the combination of specialized exercise protocols and traditional physiotherapy techniques as a more effective approach for managing lumbar spinal stenosis and improving patient outcomes [1, 7, 14].

Patient Information:

A 58-year-old male presented with complaints of lower back pain radiating to both lower limbs (right > left) for three months. The pain was aggravated by prolonged sitting, standing, and walking. The patient experienced difficulty performing household activities such as bending, standing, and walking. He reported that the pain began suddenly after a long car ride or prolonged sitting and worsened over time. Upon consultation, the patient underwent an MRI, which revealed Grade I anterolisthesis at L4-5, associated with lumbar canal stenosis at L5-S1 and a spinal diameter of 10 mm, along with disc bulging and degenerative changes at other lumbar levels [4].

Physical Examination:

On physical examination, the patient demonstrated localized tenderness at L3, L4, L5, and S1 spinal levels, with restricted range of motion (ROM) in the lumbar spine. The Modified Schober Test revealed a lumbar ROM of 18 cm, indicating reduced spinal mobility. Neural tension testing, including straight leg raise (SLR) and slump tests, showed limited flexibility, with an SLR of 60° (right side) and 65° (left side). The Modified Oswestry Disability Index (MODI) score of 71% indicated a high level of functional disability, classifying the patient as "crippled."[11]

Diagnosis and Treatment Goals:

The provisional diagnosis was lumbar canal stenosis at L4-5 and L5-S1 due to thecal sac compression. Based on the clinical assessment, the following physiotherapy treatment goals were established:

1. **Pain Reduction**: To alleviate pain and tenderness associated with spinal stenosis.[6]
2. **Neural Flexibility**: To improve nerve mobility and reduce symptoms of numbness and tingling in the lower limbs. [10]
3. **Lumbar ROM Improvement**: To enhance spinal flexibility and restore functional range of motion. [4]
4. **Muscle Relaxation and Strengthening**: To relieve muscle tightness and strengthen the core muscles for better spinal support. [7]
5. **Activity Modification and Functional Independence**: To educate the patient on posture correction and strategies to manage daily activities without exacerbating symptoms. [8]

Treatment Approach:

A combination of conventional physiotherapy and an integrated Lumbar Canal Enlargement Exercise Protocol was in use. The protocol aimed to create space within the spinal canal, alleviate neural compression, and restore normal spinal mechanics. Total duration is 50-60 min.
The treatment included:
1. **Electrotherapy Modalities**: Burst type TENS 15 min. along with Moist heat pack.
2. **Moist Heat Pack**
3. **Manual Therapy**: Techniques such as spinal mobilizations and soft tissue mobilizations to reduce pain and improve spinal mobility.
4. **Lumbar Canal Enlargement Exercises**: The core of the exercise protocol was designed to focus on:
- **Spinal Flexion and Extension**: Controlled movements that help to reduce pressure on the spinal canal and decompress the neural elements.
- **Child's Pose and Modifications**: The child's pose helps to stretch the back and muscles around the hips. The patient kneels and sits on their knees, leans forward, keeping the buttocks on the heels, and rests the forehead on the floor.
- **Pelvic Tilts and Bridging**: These exercises target the lumbar spine and hip region, improving alignment and reducing stiffness.
- **Nerve Gliding Techniques**: Exercises like sciatic nerve stretches and gliding to improve neural flexibility and relieve nerve compression.
5. **Strengthening Exercises**: Core strengthening exercises, particularly targeting the abdominal and back muscles, were incorporated to enhance spinal stability and alleviate load on the vertebrae.
6. **Postural Training and Ergonomic Education**: Teaching the patient how to modify posture, avoid prolonged sitting, and perform activities with proper body mechanics.

Results and Outcome:
After four weeks of physiotherapy treatment, significant improvements were observed:

Assessment Measure	Pre-Treatment	Post-Treatment (After 4 week)	Outcome
Pain Intensity (NPRS - Functional)	8	4	50% reduction in pain intensity during functional activities
Pain Intensity (NPRS - Rest)	5	2	60% reduction in pain intensity at rest
Lumbar Range of Motion (ROM - Modified Schober Test)	18	23	27.8% improvement in spinal mobility
Neural Flexibility (SLR - Right Leg)	60	80	33.3% increase in flexibility
Neural Flexibility (SLR - Left Leg)	65	85	30.8% increase in flexibility
Functional Disability (MODI Score)	71% (classified as "crippled")	50%	21% improvement in functional capacity
Quality of Life	Impaired by symptoms	Significant improvement in daily activity independence	Notable enhancement in ability to perform daily tasks and reduced symptom impact on life

Discussion:
This case study highlights the effectiveness of the Lumbar Canal Enlargement Exercise Protocol combined with conventional physiotherapy in managing lumbar spinal stenosis. The exercise protocol focuses on reducing neural compression, enhancing spinal mobility, and improving overall function [15]. The combination of manual therapy, targeted exercises, and postural education provided a comprehensive approach addressing both symptoms and the underlying mechanics of the condition [16].
Previous studies have demonstrated that physiotherapy interventions can significantly improve pain, mobility, and function in patients with lumbar spinal stenosis. For instance, physical therapy focusing on spinal mobilization, neural gliding, and core strengthening has been shown to reduce pain and improve functional outcomes [17,18]. Moreover, specific protocols like the Lumbar Canal Enlargement Exercise Protocol aim to reduce nerve root compression, enhance neural flexibility, and facilitate spinal canal expansion, which is vital in managing LSS [10,19]. This case study emphasizes the importance of incorporating a specialized exercise protocol that targets lumbar canal enlargement and neural flexibility, directly impacting nerve root compression and the thecal sac [20].

Additionally, previous research has indicated that integrating manual therapy and postural education in combination with targeted exercises can lead to long-term symptom relief and functional improvements in patients with LSS [21]. This case study supports these findings, demonstrating the positive effects of a

multifaceted physiotherapy approach that addresses both biomechanical and neural components of the condition [22].

Conclusion:

This case study demonstrates that combining the Lumbar Canal Enlargement Exercise Protocol with conventional physiotherapy is an effective approach for managing lumbar spinal stenosis. Significant improvements in pain, range of motion, neural flexibility, and functional independence were achieved. These results suggest that an integrated physiotherapy approach can significantly improve patient outcomes in lumbar spinal stenosis. Future research with larger sample sizes and control groups is recommended to further validate the efficacy of this exercise protocol in clinical practice.

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