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AN INTEGRATED EXERCISE APPROACH FOR SECONDARY LUMBAR SPINAL STENOSIS- A CASE REPORT

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ABSTRACT

Background: Lumbar spinal stenosis (LSS) is a narrowing of the spinal canal that can produce low back pain, leg pain, and weakness. Many treatment approaches are used for its treatment. An integrated exercise approach has been employed in this case, and its effects pre and post treatment has been compared.

Case Summary: A 48-year-old female presenting with a complaint of pain in the lower back region which was radiating to both lower limbs. She also had difficulty to perform household work like bending, sitting and standing. After taking medicine for two months, the patient didn't get any relief and then she comes in Physiotherapy OPD. After the complete physical examination and assessment, secondary lumbar spinal stenosis was diagnosed. The benefits of integrated exercise protocol on LSS were reported, and treatment protocol was planned according to the identified problem areas of the patient. An intervention of 21 days (20-40 minutes per day, five days per week for three weeks) was given to the patient and improvement was taken on baseline evaluation and 11th day and 22nd day of post-intervention.

Outcome measures: The Oswestry Disability Questionnaire observed the recovery of the patient, Modified Schober Test, Numeric Pain Rating Scale, SLR and Slump test.

Conclusion: Considerable improvement was seen in Pain intensity, neural flexibility, ROM and Quality of life after the rehabilitation. It was observed that the integrated exercise protocol has helped in improving the patient with LSS.

Keywords: Lumbar spinal stenosis, Integrated Exercise Protocol, QOL, neural flexibility, Lumbar ROM.

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INTRODUCTION

The term Spinal stenosis is defined as the 'narrowing of the spinal canal with encroachment on the neural structures by surrounding bone and soft tissue [1]. Spinal stenosis is described as one of the end processes in the pathogenesis of low back pain [2]. According to clinical medicine lumbar spinal stenosis is defined as "buttock or lower extremity pain which may occur with or without the low back pain associated with diminished space available for the neural and vascular elements in the lumbar spine." This definition includes two aspects of the morphological abnormalities and clinical manifestations[3]. Multiple factors can cause the narrowing of the spinal canal; it can be degenerative changes of the spine which typically involved facet joint hypertrophy, disc bulging, protrusion and ligamentum flavum is thickening. All these factors may be alone or in combination. The most common another frequent factor in compromising the diameter of the spinal canal is degenerative spondylolisthesis which is characterized by forwarding displacement of a vertebra due to disc and facet degeneration [4]. Patients with significant lumbar spinal canal stenosis report pain, weakness, paresthesias, numbness in the legs while walking, or a combination thereof. The onset of symptoms during ambulation is believed to be caused by increased metabolic demands of compressed nerve roots that have become ischemic due to stenosis. The symptoms that help to distinguish lumbar stenosis from other causes of caudal radiculopathy are the neurogenic claudication, postural aggravation, and cauda equina syndromes [5].

The types of lumbar spinal stenosis are often categorized by the region/ anatomical location of the spine in which the condition has manifested and other on the etiology. According to an anatomical location, it is classified into two types lateral and central. Lateral spinal stenosis is occurring around the spinal nerve in the nerve root canal specifically in the region in the lateral portion of the spinal canal (the lateral recess) or the intervertebral foramen. It occurs due to hypertrophy of the facet joint, posterior lateral bulging of the intervertebral disc and loss of the disc height. Central stenosis is defined as narrowing of the central canal in the spine around the nerve roots of the cauda equine. It occurs due to thickening or bulging of the ligamentum flavum, hypertrophy, outward going bulging of the intervertebral disc and spondylolisthesis. By etiology LSS is classified into two types primary and secondary lumbar canal stenosis. Primary stenosis is defined as narrowing of the spinal canal due to postnatal defects or congenital malformation. Secondary stenosis occurs due to acquiring conditions like spondylolisthesis, after surgery scarring, lumbar IVD herniation, degenerative changes infections, fractures, tumors and combination of these conditions [6].

MRI and Computed Tomography (CT) scan are widely used diagnostic mode for LSS which confirms the presence of spinal stenosis, but MRI is preferred [7]. When the diameter is less than or equal to 12 mm in lumbar spine it is found to be central canal stenosis [8].

There are two different modes of treatment with LSS i.e.

conservative and surgical treatment. Conservative, non-operative therapy includes NSAIDS and exercise programs to strengthen abdominal musculature[9]. Physiotherapy is accepted and effective treatment for spinal disorders in general which includes flexion exercise, pain relieving modalities and orthosis [10]. For the patient having moderate and severe symptoms of lumbar canal stenosis, different conservative and surgical treatment modalities are recommended [8].

Exercises are the core of the physiotherapy treatment, so in the present study, more emphasis is given on the exercise protocol. For the patient with low back pain secondary to spinal stenosis, a treatment regime is made by reviewing the various published articles and books which determined the efficacy of manual interventions, exercises, and electrotherapeutic modalities. The approach is described in Table 1- given in the section of physiotherapy treatment which is made on day by day basis by the researchers.

The aim of the present case study is to analyze the effect of Integrated Exercise Protocol on a patient with secondary lumbar spinal stenosis in improving pain intensity, neural flexibility, lumbar ROM and QOL.

PATIENT INFORMATION

A 48 year old female presenting with a complaint of Pain in the lower back region which was radiating to both lower limbs (right > left) since three months. She had difficulty to perform household work like bending, sitting and standing in the kitchen due to pain. The pain was sudden in onset when a patient attempt to come outside from the car three months ago after a long traveling. She also felt difficulty in walking, sitting and need an assistance of another person for walking since one month. After the onset of pain, no treatment was taken by her in the 1st month from the beginning, but the pain was gradually increasing then she consults the local orthopedician doctor who prescribes some medication and advise her for rest. The patient was taking medication regularly from the 2nd month of the onset but didn't get any relieved. So she discontinued the medication as prescribed by the doctor and not taking any treatment in another 3rd month of the onset. Then patient came to OPD I Punjabi University Patiala for physiotherapy services where she was advised to for an MRI of a low back region for diagnosis purpose. The Magnetic Resonance Imaging (MRI) report reviles Grade I anteriolisthesis of L4-5, associated with canal stenosis of L5-S1 (spinal diameter = 11mm). The L4-5 disc with posterior-inferior osseous of L4 body is together causing anterior thecal sac compression. Mild disc bulge at L2-L3 and L3-L4 level causing mild narrowing of neural foramen, Lumbar facet joints show hypertrophic degenerative changes with the silver of effusion at the L4-L5 level and irregular outline of ligamentum flavum. There was no previous history of pain in the low back region and trauma (The source of information was patient herself, and signed consent for the presentation of this case report was obtained from the patient concerned).

PHYSICAL EXAMINATION

The patient is a Housewife and belongs to an educated family, and her family members are very cooperative for the treatment. The characteristic of pain was constant and dull in nature and aggravated by prolonged sitting and standing and relieved only by rest. The pain was more in the morning hours associated with stiffness in the low back region. The severity of pain was assessed on Numeric Pain Rating Scale which was eight during any functional activity and five at rest.

On observation, the patient body built was mesomorphic, and in a postural evaluation, her lumbar lordosis was increased with anterior pelvic tilt. The patient respiratory pattern was thoracoabdominal and using accessory muscle in normal breathing. The patient has come in the OPD with the help of two family members supporting her from both sides. On palpation, localized tenderness was seen and graded as 2 (Tenderness with a grimace) at L3, L4, L5 and S1 level of the spine.

On sensory examination, all superficial and deep sensations were checked at the dermatomal level and found to be intact. The patient also experiences numbness and paresthesia in both lower limbs (Rt > Lt) which was on and off in nature. On motor examination, the ROM of the lumbar spine was assessed by Modified Schober Test (MST) which was found to be 19 cm. The flexibility of nerve tension was evaluated by SLR and slump test of right and left the side. The SLR right side and the left side was 60° and 65° respectively and Slump test on both sides was 25° for both sides.

The deep tendon reflex for knee and ankle jerk was found to be normal on both side and graded as 2+ (normal response).

According to ICF model (international classification of functioning), the effect of low back pain on functional activity / Quality of life (QOL) and social participation was assessed by Oswestry Disability Questionnaire (ODQ) scale. The total percentage obtained by the patient was 71% which signifies disability level as Crippled on ODQ interpretation.

DIAGNOSIS AND ASSESSMENT

From history, investigation reports and examination a Provisional Clinical diagnosis of L4-5 and L5-S1 secondary lumbar spinal stenosis due to thecal compression was made. After assessing the main problem areas, the physiotherapy treatment goal was formulated as follows:

1. To reduce pain and tenderness.
2. To reduce muscle tightness and improve range of motion and neural flexibility.
3. To promote relaxation
4. To improve mobility of spine
5. To modify/prevent the activity that provokes the symptom
6. To regain functional independence.

INTERVENTION

Physiotherapy treatment protocol-

The therapist gave the treatment protocol of 21 days (20 to 40 minutes per day for five days a week for three weeks) under his observation which was described as follows.

		STAGE I	STAGE II	STAGE III	STAGE IV	
		Flexibility Exercises	Specific Experimental Canal enlargement Ex.	Stabilization/ Strengthening Exercises	Functional /Regain- ing Activities	
Week 1	Day 1	Heel sliding in supine, spinal rotation 10 Rep each side	-no-	-no-	-no-	-no-
	Day 2	Heel sliding in supine, spinal rotation 10 Rep each side	-no-	-no-	-no-	-no-
	Day 3	Heel sliding in supine, spinal rotation 10 Rep each side	Knee to chest (single leg, double leg), 3 -5 rep with 10 sec hold	-no-	-no-	-no-
	Day 4	Heel sliding in supine, spinal rotation 10 Rep each side	Knee to the chest (single leg, double leg), kneel sitting with a forward bend along with arms stretch position from quadruped.(3-5 Rep. 10 sec hold).	-no-	-no-	-no-
	Day 5	Heel sliding in supine, spinal rotation 10 Rep each side	Knee to the chest (single leg, double leg), kneel sitting with a forward bend along with arms stretch position from quadruped.(3-5 Rep. 10 sec hold).	Pelvic bridging (3 to 5 rep with 10 sec hold)	-no-	-no-

Week 2	Day 1	Spinal rotation(10 Rep each side), Hamstring flexibility, Piriformis flexibility (3-5 Rep. 30 sec hold),	Knee to the chest (single leg, double leg), kneel sitting with a forward bend along with arms stretch position from quadruped.(3-5 Rep. 10 sec hold).	Pelvic bridging Strengthening of gluteus medius inside lying (3 to 5 rep with 10 sec hold),	-no-	-no-
	Day 2	Spinal rotation(10 Rep each side), Hamstring flexibility, Piriformis flexibility (3-5 Rep. 30 sec hold),	Knee to the chest (single leg, double leg), kneel sitting with a forward bend along with arms stretch position from quadruped, LIONS position. (5-7 Rep. 10 sec hold).	Pelvic bridging Strengthening of gluteus medius inside lying (3 to 5 rep with 10 sec hold),	Walk inside room for 1or 2 min increase up to 5 to 10 min as per the pain severity.	-no-
	Day 3	Spinal rotation(10 Rep each side), Hamstring flexibility, Piriformis flexibility (3-5 Rep. 30 sec hold),	Knee to the chest (single leg, double leg), kneel sitting with a forward bend along with arms stretch position from quadruped, LIONS position. (5-7 Rep. 10 sec hold).	Pelvic bridging Strengthening of gluteus medius inside lying (3 to 5 rep with 10 sec hold),	Walk inside room for 1or 2 min increase up to 5 to 15 min as per the pain severity.	-no-
	Day 4	Spinal rotation(10 Rep each side), Hamstring flexibility, Piriformis flexibility (5-7 Rep. 30 sec hold),	Knee to the chest (single leg, double leg), kneel sitting with a forward bend along with arms stretch position from quadruped, LIONS position. (5-7 Rep. 10 sec hold).	Pelvic bridging Strengthening of gluteus medius inside lying,), Sacrum counter nutation (5 to 7 rep with 10 sec hold),	Walk 100- 300 meters (2 times/day) Start ADLs light to moderate	-no-
	Day 5	Spinal rotation(10 Rep each side), Hamstring flexibility, Piriformis flexibility (5-7 Rep. 30 sec hold),	Knee to the chest (single leg, double leg), kneel sitting with a forward bend along with arms stretch position from quadruped, LIONS position. (5-7 Rep. 10 sec hold).	Pelvic bridging Strengthening of gluteus medius inside lying,), Sacrum counter nutation (5 to 7 rep with 10 sec hold),	Walk 200- 500 meters (2 times/day) Start ADLs light to moderate	-no-
Week 3	Day 1	Spinal rotation(10 Rep each side), Hamstring flexibility, Piriformis flexibility, IT band flexibility, Quadratus lumborum (5-7 Rep. 30 sec hold),). Iliopsoas release	Knee to the chest (single leg, double leg), kneel sitting with a forward bend along with arms stretch position from quadruped. Cat and camel, LIONS position. (5-7 Rep. 10 sec hold).	Pelvic bridging Strengthening of gluteus medius inside lying, Sacrum counternutation, Posterior pelvic tilting (5 to 7 rep with 10 sec hold), Abdominal prep, Quadruped arm and leg lifts (3-5 rep 10sec hold)	Walk 200- 500 meters (2 times/day) Start ADLs light to moderate	Dual task activity focus on core muscle and functional activity
	Day 2	Spinal rotation(10 Rep each side), Hamstring flexibility, Piriformis flexibility, IT band flexibility, Quadratus lumborum (5-7 Rep. 30 sec hold),). Iliopsoas release	Knee to the chest (single leg, double leg), kneel sitting with a forward bend along with arms stretch position from quadruped. Cat and camel, LIONS position. (5-7 Rep. 10 sec hold).	Pelvic bridging Strengthening of gluteus medius inside lying, Sacrum counternutation, Posterior pelvic tilting (5 to 7 rep with 10 sec hold), Abdominal prep, Quadruped arm and leg lifts (3-5 rep 10sec hold)	Walk 500-700 meters (2 times/day) Start ADLs light to moderate	Dual task activity focus on core and functional activity
	Day 3	Spinal rotation(10 Rep each side), Hamstring flexibility, Piriformis flexibility, IT band flexibility, Quadratus lumborum (5-10 Rep. 30 sec hold),). Iliopsoas release	Knee to the chest (single leg, double leg), kneel sitting with a forward bend along with arms stretch position from quadruped. Cat and camel, LIONS position. (5-10 Rep. 10 sec hold).	Pelvic bridging Strengthening of gluteus medius inside lying, Sacrum counternutation, Posterior pelvic tilting (5 to 10 Rep with 10 sec hold), Abdominal prep, Quadruped arm and leg lifts (3-5 rep 10sec hold)	Walk 500-700 meters (2 times/day) Start ADLs light to moderate	Dual task activity focus on core and functional activity
	Day 4	Spinal rotation(10 Rep each side), Hamstring flexibility, Piriformis flexibility, IT band flexibility, Quadratus lumborum (5-10 Rep. 30 sec hold),). Iliopsoas release	Knee to the chest (single leg, double leg), kneel sitting with a forward bend along with arms stretch position from quadruped. Cat and camel, LIONS position. (5-10 Rep. 10 sec hold).	Pelvic bridging Strengthening of gluteus medius inside lying, Sacrum counternutation, Posterior pelvic tilting (5 to 10 Rep with 10 sec hold), Abdominal prep, Quadruped arm and leg lifts (5-10 rep 10sec hold)	Walk 1 km (2 times/day) Start ADLs light to moderate	Play badminton for 10-20 mins
	Day 5	Spinal rotation(10 Rep each side), Hamstring flexibility, Piriformis flexibility, IT band flexibility, Quadratus lumborum (5-10 Rep. 30 sec hold),). Iliopsoas release	Knee to the chest (single leg, double leg), kneel sitting with a forward bend along with arms stretch position from quadruped. Cat and camel, LIONS position. (5-10 Rep. 10 sec hold).	Pelvic bridging Strengthening of gluteus medius inside lying, Sacrum counternutation, Posterior pelvic tilting (5 to 10 Rep with 10 sec hold), Abdominal prep, Quadruped arm and leg lifts (5-10 rep 10sec hold)	Walk 1 km (2 times/day) Start ADLs light to moderate	Play badminton for 10-20 mins

Table 1: Physiotherapy treatment protocol for the patient with secondary lumbar spinal stenosis.

NOTE :

- Depend on the pain status the repetition may reduce or stop by the therapist.
- All the exercises have to be done with normal breathing.
- In strengthening exercises, core muscle should be engaged.
- If the patient can't perform the exercise, the exercises will shift to another day.

FOLLOW-UP AND OUTCOMES

The recovery of the patient was evaluated on the following outcome measures on NPRS, Modified Schober Test, SLR, Slump test and ODQ scores. The prognosis was observed by comparing baseline score on the outcome measures with the data was taken on the 11th day and 22nd day of the post intervention scores.

S.no.	Outcome measures	11 th day of post-intervention	22 nd day of Post-Intervention
	Oswestry Disability Questionnaire (ODQ)	42%	20%
	Numeric Pain Rating Scale (NPRS)	4	2
	Modified Schober Test	21cm	21cm
	Straight Leg Raise (goniometer)	Right: 70° Left: 75°	Right: 80° Left: 80°
	Slump test (goniometer)	Right: 20° Left: 20°	Right: 15° Left: 15°

Table 2: Comparison of baseline and post-intervention scores on various outcome measures.

DISCUSSION

In the present case study, the pain and tenderness symptoms of the patient have been controlled by using Cryotherapy for 10 min given on low back region. Dehghan and Farahbod (2014) also used cryotherapy as a pain relieving modality and concluded that it was helpful in reducing in decreasing intensity of pain among Low back pain [11].

Creighton *et al.*, (2006) finds that lumbar flexion exercises and manipulation help in increasing the thoracolumbar flexion mobility on Schober test [12]. So, in the present study, the range of motion (ROM) of the Lumbar spine was assessed by using MST and significant improvement was seen in the Baseline and Post-intervention scores.

The neural flexibility was an important component in determining the neural tension among Low back pain associated with radiating pain has been improved and SLR and Slump test noted it. Slump and the SLR test were used to determine the neural flexibility as both elicit pain in the presence of lumbar disc herniation due to the traction of the involved nerve root. The SLR applies traction primarily to L5 and S1 root, and in contrast, Slump test may further apply traction to all the lumbar roots [13]. By the Reiman *et al.* in 2009 the significant improvement was seen on the SLR and Slump test after the administration of intervention. They suggest that the neural flexibility and the manual interventions show significant improvement in the ROM

of SLR [14]. The Range of motion of SLR has affected by many factors like Age, sex, and activity level, so knowing the inter-limb differences as evaluated in the present study was helpful in providing normative values that was not influenced by these factors [15].

The back pain leads to significant disability among the individuals, so to determine the independence in the functional activities (Quality of life) and social participation, ODQ scale was used. Creighton *et al.*, (2006) and Fritz *et al.*, (1997) shows significant physiotherapy intervention has effect in improvement of Quality of life among LSS patient [12,16]. In the present study, it was found that the significant improvement was seen in the Baseline and post intervention scores which were similarly attained by the Whitman *et al.*, (2003). They concluded that the lumbar flexion exercise has been helpful in improving Quality of life of LSS patient [17].

CONCLUSION

The present study has found that the effect of an integrated exercise protocol has a significant effect in improving pain, lumbar ROM, neural flexibility and Quality of life and can be used as a treatment protocol for lumbar spinal stenosis. In the future, the efficacy of the integrated approach to large sample size and in comparison with standardized protocol can be determined.

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