International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Effectiveness of Flexion based Core Strengthening Exercises on Patients with Lumbar Canal Stenosis: A Series of Case Report

Dr. Shivani Sharma[1], Dr. Rashmikant Shah[2], Dr. Heli Shah[3]

[1]MPT Ortho [Healthy Future]

[2]MPT Neuro [Healthy Future]

[3]MD, DM (Neuro)

Email: *healthyfuturephysio[at]gmail.com*

Abstract: ***Background: Research has shown that a form of core stability is an effective intervention in the reduction of nonspecific lower back pain. However, there is limited exploration examining the effects of the core strengthening- specifically on cases lumbar canal stenosis. The purpose of this study was to estimate the effect of core strengthening exercises on pain, core strength and quality of life in a patient with lumbar canal stenosis. Methodology: We performed flexion-based exercises on patients with lumbar canal stenosis,and collected data pre and post treatment. Pre and post treatment outcome measures were taken using NPRS, Treadmill Test, Modified oswerthey index and Zurich claudication scale. Results: There is significant improvement in reduction of pain, core strength and quality of life in a patient with lumbar canal stenosis. Conclusion: flexion-based core strengthening exercises brings pain levels down and improves patients' quality of life and symptoms.***

Keywords: Back pain, Core stability, Core strengthening, Lumbar canal stenosis

1. Introduction

Roughly 80% of people will experience lower back pain at some point in their lives. Lower back pain has been anextensively used term encompassing a wide spectrum of lumbar spine injuries and pathologies. Lumbar canal stenosis is a condition in which narrowing of the central spinal canal, lateral recess, or foramen leads to compression of the neural and vascular structures, resulting in back and leg pain, disability particularly like decreased walking capacity, and mainly lowered health related quality of life[1].Stenosis is characterized by narrowing of the spinal canal, nerve root canal and/or intervertebral foramina which may cause neural tissue compression. Symptoms of lumbar stenosis may include pain in the lower back, groin and leg (unilaterally or bilaterally), weakness or numbness. Neurogenic claudication is a symptom that is not reported by all patients. When present, it is endured as pain, paraesthesia or cramping of one or both legs. Standing and walking aggravates symptoms, while sitting relieves symptoms[2]. The impact of symptoms is variable depending on the individual, and may potentially guide treatment to operative or non-operative intervention. Although the prevalence of LCS is unknown, study which states that rise in spine surgery rates over recent decades, with spinal canal stenosis being the most common diagnosis associated with spinal surgery[3].Non-operative treatment is generally accepted to be the first step for the treatment of lumbar canal stenosis. Still, recommendations in non-operative treatment are based on expert opinion rather than primary research[4].Given the prevalence and cost associated with LCS, and the lack of strong evidence for non-surgical care for these patients, developing optimal non-operative management strategies is a high priority. Therefore, the purpose of this study was to provide an evidence based designed protocol for lumbar canal stenosis[5].

2. Aim

The purpose of this case report study is to critically appraise randomized, controlled trials with a clear outline of the non-operative treatment rehabilitation approach, and to promote the formation of evidence-based strategy. In addition, the available studies do not describe adequately the employed protocols. So, with our observation we conducted this series of case report providing detailed protocol for lumbar canal stenosis.

3. Introduction of Core

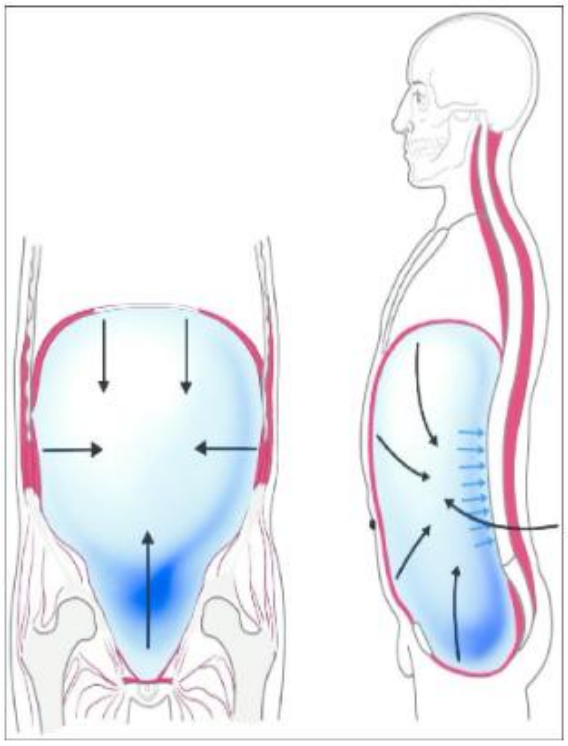
The anatomical core is "the axial shell which is made up of the pelvic and shoulder girdles, and all soft tissues i.e., articular and fibro-cartilage, ligaments, tendons, muscle, and fascia with proximal attachment originating on the axial skeleton,regardless of whether the soft tissues terminates on the axialor appendicular skeleton (upper and lower extremities)."Some of the major muscles of the core with proximal and distal attachments in the lumbosacral region of the axial skeleton include the lumbar multifidus, erector spinae, quadratus lumborum,external oblique abdominis, internal obliqueabdominis, rectus abdominis, transverse abdominis, psoasmajor, pelvic floor muscles, and diaphragm. Of thevarious core muscles, the lumbar multifidus, transverseabdominis, and quadratus lumborum appear to be the most meaningful muscles for fitness professionals and clinicians who prescribe exercises to improve physical performance or manage musculoskeletal injuries. The function and morphology of these 3 muscles

has been associated with lower-back pain in the general population and athletes. The lumbar multifidus is the most medial spine muscle and does extend, laterally flex, and rotate the spine. The transverse abdominis is the deepest of the abdominal muscles andstabilize the spine and increase intra-abdominal pressure. The quadratus lumborum is the most lateral spine muscle and acts to laterally flex and stabilize the spine.

Thus, physical fitness exercises that elicit activity in muscle may represent greater challenges to the neuromuscular system, and consequently, may be most effective for improving core muscle strength and stability if included in an exercise training program. Decisions about which core exercises to perform are often based on opinion, personal experience, and narrative review articles that may or may not be based on the existing scientific evidence. Decision making in such a manner has led to the implementation of a wide variety of core training techniques with little to no consistency among the strength and conditioning specialists about what core exercises are best in specific circumstances. Consequently, which exercises are best suited for activating the core muscles and improving core strength and stability is still being debated, and an evidence-based consensus has not been reached[6]. Therefore, an evidence-based and systematic summary about core muscle activity during physical exercises is needed for the strength and conditioning specialist to make informed recommendations to their athletes and clients[7].

4. Importance of Core

The role of anticipatory trunk muscle activity in adults has been widely studied and discussed in an attempt to describe the determinants of spinal stability for movement and musculoskeletal function. The stabilizing postural activation of the diaphragm has been studied in lifting tasks and activation of the extremities[8]. A study by Kolar et al demonstrated that abnormal postural activation of the diaphragm when isometric resistance was applied to the extremities might serve as an underlying mechanism of chronic low back pain due to a greater strain on the ventral region of the spinal column[9]. According to Kolar IAP regulation & ISSS can be disrupted by insufficient postural function of the diaphragm, often resulting in increased compressive forces on the spine due to compensatory activity of the superficial spinal extensors, and abnormal position of the chest or ribcage due to an imbalance between upper and lower chest musculature. The ISSS provides the “punctum fixum” (fixed stable base) from which muscles can generate movement.



IAP Regulation by diaphragm, pelvic floor and transverses Abdominis.

5. Literature Review

Pain and disturbance in quality of life is very common, in patients with lumbar canal stenosis. For individuals with lumbar canal stenosis, altered muscle activity and pain are common during functional tasks. Clinicians often seek intervention to improve muscle activity and reduce impairments. However, the Aim of this literature review is to summarize evidence regarding the underlying pathology of lumbar canal stenosis and the best way to treat this condition by giving a designed protocol for the same.

6. Case Presentation

Patient No. 1:
The patient A is a 60-year-old female who started ffeeling pain and tingling sensation in both leg, pain in toes and back pain about three years ago. She also had a complain of pain and tingling sensations after a walk of 50-100 meters and she needs to sit after every activity in standing due to tingling and pain. She has a history of diabetes since a year.

Patient No.2:
The patient B is a 78-year-old Male who started feeling back pain and pain in legs 8 months ago. Then he consulted to neuro physician who diagnosed him with stenosis and suggested for taking physiotherapy.

Patient No.3:
The patient C is an88-year-old male who started feeling pain and tingling in his leg in 2021.He was unable to walk about even 200 meters. He has no any history of BP and Diabetes.

Patient No.4:
The patient D is a 60-year-old female. She fell down 25 years ago and she was having compliant of pain and tingling in her right leg and back since25 yrs. She wass not able to walk long.

Patient No.5:
The patient E is a 60-year-old male. He has history of pain and numbness in right leg since past 10 years. He is not able to walk long distance. No history of diabetes. He has limb length discrepancy.

7. Methodology

Treatment Regime:

NO.	Name of Exercise
1	Static Abs
2	Static Abs with SLR
3	Static Abs with 90-90
4	Static Abs with Knee Drop
5	Static Abs with Dissociation
6	Clamshells
7	Hip Abduction with Extension
8	Anticore Exercises
9	Glutes and Abs Met
10	Calf, Hamstring and Piriformis Stretch
11	Body Blade Exercise

Treatment Parameters:
1) Duration of treatment: 45 minutes / session
2) Total number of sessions: 1 sessions /day
3) Total treatment period: 6 days/week

Outcome Measures
1) NPRS
2) Modified Oswestry Disability Index (ODI)
3) Zurich Claudication Questinner
4) Trademill Test.

8. Results

NPRS:

Sr. No.	Patients Name	Pre-Treatment Score	Post Treatment Score
1.	A	9/10	0/10
2.	B	8/10	0/10
3.	C	6/10	0/10
4.	D	7/10	0/10
5.	E	10/10	4/10

Modified Oswestry Disability Index (ODI)

S. No.	Patients Name	Pre-Treatment Score	Post Treatment Score
1.	A	/100	/100
2.	B	27/100	9/100
3.	C	17/100	5/100
4.	D	33/100	3/100
5.	E	34/100	21/100

Zurich Claudication Questionnaire

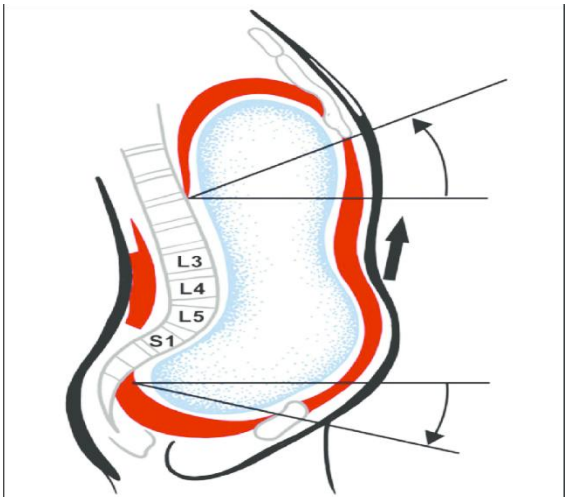
Sr. No.	Patients Name	Pre-Treatment Score	Post Treatment Score
1.	A	/55	/55
2.	B	31/55	17/55
3.	C	36/55	13/55
4.	D	30/55	12/55
5.	E	41/55	29/55

Treadmill Test

S. No.	Patients Name	Pre-Treatment Score		Post Treatment Score	
		Speed (mph)	Time (minute)	Speed (mph)	Time (minute)
1.	A	1.7	3	4.2	12
2.	B	1.7	3	2.5	5
3.	C	2.5	5	3.4	9
4.	D	2.5	4	4.2	12
5.	E	Unable to perform		Unable to perform	

9. Discussion

The study was aimed to compare the effectiveness of flexion-based core strengthening exercises on pain, and quality of life in patients with lumbar canal stenosis. And to provide a detailed assessment with treatment protocol. A kinematic study by Arjman & Shirazi-Ad demonstrated that the unloading effect of IAP is more effective in forward lifting tasks whereas the capability of IAP to unload the spine in upright standing posture holds true only for cases with very low abdominal co-activation[11]. This study depicts that the unloading and stabilizing actions of IAP seem to be posture and task specific. The **integrated spinal stabilizing system (ISSS)** as described by Kolar is comprised of balanced co-activation between the deep cervical flexors and spinal extensors in the cervical and upper thoracic region, as well as the diaphragm, pelvic floor, all sections of the abdominals and spinal extensors in the lower thoracic and lumbar region. The diaphragm, pelvic floor and transversus abdominis regulate IAP and provide anterior lumbo-pelvic postural stability[12].Kolar et al demonstrated that abnormal postural activation of the diaphragm when isometric resistance was applied to the limbs might serve as an underlying mechanism of chronic lower back pain due to a greater strain on the ventral region of the spinal column[13]. According to Kolar IAP regulation & ISSS can be disintegrated by inadequate postural function of the diaphragm, often resulting in more compressive forces on the spine due to compensatory activity of the superficial spinal extensors, and abnormal position of the chest or ribcage due to an imbalance between upper and lower chest musculature[14].



Impaired ISSS resulting in anterior shear stresses onlumbar segments.

Panjabi described the stabilizing system of the spine as a 3-way interaction between the neural (CNS), active (musculature) and passive (bones, joints) systems. Clinicians who have primarily focused treatment on muscles and joints are increasingly recognizing the importance of "training the brain" by addressing motor control mechanisms at the CNS level. DK and DNS "bridge the gap" to understanding this 3-way interaction. It is the opinion of the authors that the majority of the dysfunctions commonly seen may be more related to CNS or "motor control dysfunction" than local joint or muscle dysfunction[15].

The basis for the theories that are included in DK is that development of human motor function in early childhood is genetically pre-determined and follows a predictable pattern. These motor patterns or programs are formed as the central nervous system (CNS) matures, enabling the infant to control posture, achieve erect posture against gravity, and to move purposefully via muscular activity. The existence of central movement patterns that are inborn and "hard-wired". For example, an infant does not need to be taught /when and how to lift its head up, grasp a toy, roll over, creep, or crawl. All these movement patterns or muscular synergies occur automatically in a specific developmental sequence throughout the course of CNS maturation. There is also a strong synchrony between CNS maturation and structural or anatomical development of bones, muscles, and other soft tissues. In short, maturation of the brain influences development of motor patterns, which in turn, influences structural development[16].This relationship is very apparent in the presence of a CNS lesion, where this developmental synchrony and muscle coordination are adversely affected. The disturbed muscle coordination, soft tissue, and joint development subsequently alters joint position, morphological development, and ultimately, the entire posture[17].

From A Neuro Physician's Note:
Lumbar spinal stenosis (LSS) refers to an anatomic condition that includes narrowing of the intraspinal (central) canal, lateral recess, and/or neural foramen. Spondylosis or degenerative arthritis affecting the spine is the most common cause of LSS and typically affects individuals over the age of 60 years. Lumbar spinal stenosis affects approximately 103 million people worldwide.

The diagnosis can generally be made based on a clinical history of back and lower extremity pain that is provoked by lumbar extension, relieved by lumbar flexion, and confirmed with cross-sectional imaging, such as computed tomography or magnetic resonance[18] imaging (MRI).

Management of lumbar stenosis resorts on a trial of conservative, nonsurgical treatment precedes surgical treatment generally. Those who have progressive neurologic deficits, especially the cauda equina syndrome which indicates more urgent surgical decompression, carefully selected patients with back, buttock, lower extremity pain who do not improve with conservative management.

Nonsurgical treatments used for LSS have included physical therapy, analgesic and anti-inflammatory medications, epidural steroid injections, lifestyle modification & multidisciplinary rehabilitation

Given their analgesic and anti-inflammatory properties, non-steroidal anti-inflammatory drugs (NSAIDs) ought to be effective in LSS, but the evidence suggests they are no more effective than acetaminophen. Opioids and muscle relaxants are also prescribed for pain control in LSS. Several trials suggest that some drugs, including prostaglandins, gabapentin, pregabalin, duloxetine, tricyclic antidepressants (TCA-amitriptyline, nortriptyline etc) improve pain and walking distance & also help in improving radicular pain.

A review of injections for central LSS concluded that epidural injections with local anaesthetic alone, or local anaesthetic with steroids, offer some relief of low back pain and lower extremity pain for central LSS.

The primary goal of surgical intervention in LSS is to decompress the neural structures that are being encroached upon, theoretically relieving symptoms and improving function. Decompression of the neural structures generally focuses on relieving the leg symptoms (claudication or radiculopathy) associated with LSS and less on improving any accompanying back pain[19]. Spinal arthrodesis with the goal of achieving spinal fusion has generally been recommended for spinal stenosis associated with degenerative spondylolisthesis, recurrent stenosis after previous decompression, instability or scoliosis[2].

The minimally invasive lumbar decompression (MILD) procedure is an image guided minimally invasive procedure for treatment of degenerative central canal LSS with ligamentum flavum hypertrophy through percutaneous decompression of the hypertrophic ligamentum flavum[20]. However, evidence for the relative safety and comparative effectiveness of MILD compared with standard decompression is lacking.

Interspinous spacer devices are an alternative intervention in spinal stenosis designed to separate the spinous processes at the stenotic levels, thereby preventing the narrowing associated with loading and lumbar extension[2]. They are inserted between the spinous processes using a minimally invasive technique and are designed to limit extension and decompress the nerves.

Physiotherapists most often advocate back flexibility exercise, back stabilization exercises and strengthening exercises, heat or ice, acupuncture, and joint mobilization for improving symptoms of LSS. Given the dynamic aspects of posture relative to spinal canal diameter, flexion exercise may improve the underlying pathophysiology of LSS; alternatively, the main role of physiotherapy may be to improve patients' function with LSS rather than improve the LSS itself.

In conclusion, first-line therapy is activity modification, oral anti-inflammatory agents & drugs alleviating symptoms of radicular pain, and physical therapy. Long-term benefits from epidural steroid injections have not been established.

Selected patients with continued pain and activity limitation may be candidates for decompressive surgery.

10. Conclusion

Flexion-based core strengthening exercises brings pain levels down and improves patients' quality of life and symptoms. And delays the need of the decompressive surgery. Our purpose of the study is to help early stages of lumbar canal Stenosis where the patients have very limited mobility restricted. Poor posture and lesser muscle strength might aid the symptoms and limits the mobility which in turn leads to decrease in walking ability and poor quality of life. Our aim was to correct that poor posture by strengthening the muscles which reduces the pressure on the disc which reduces the symptoms of claudication

References

[1] Haig AJ, Tong HC, Yamakawa KSJ, et al.Spinal stenosis, back pain, or no symptoms at all? A masked study comparing radiologic and electrodiagnostic diagnosis to the clinical impression. Arch Phys Med Rehabil. 2006;87:897–903.
[2] Jansson KA, Nemeth G, Granath F, et al. Health-related quality of life (EQ-5D) before and one year after surgery for lumbar spinal stenosis. J Bone Joint Surg Br. 2009;91:210–216.
[3] Atlas SJ, Keller RB, Wu YA, et al. Long-term outcomes of surgical and nonsurgical management of lumbar spinal stenosis:8-to-10-year results from the Maine Lumbar Spine Study. Spine (Phila Pa 1976). 2005; 30:936–943.
[4] Fritz JM, Erhard RE, Delitto A, et al. Preliminary results of the use of a two-stage treadmill test as a clinical diagnostic tool in the differential diagnosis of lumbar spinal stenosis. J Spinal Disord. 1997; 10:410–416.
[5] Kapural L, Mekhail N, Bena J, et al. Value of the magnetic resonance imaging in patients with painful lumbar spinal stenosis(LSS) undergoing lumbar epidural steroid injections. Clin J Pain. 2007; 23:571–575.
[6] Penning L,Wilmink JT. Posture-dependent bilateral compression of L4 or L5 nerve roots in facet hypertrophy: a dynamic CT-myelography study. Spine (PhilaPa1976). 1987; 12:488–500.
[7] Battie´ MC, Jones A, Schopflocher DP, Hu RW. Health-related quality of life and comorbidities associated with lumbar spinalstenosis. Spine J. 2012;12:189–195.
[8] Ciol MA, Deyo RA, Howell E, Kreif S. Assessment of surgery for spinal stenosis: time trends, geographic variations, complications, and reoperations. J Am Geriatr Soc. 1996;44:285–290.
[9] Kolar P: Facilitation of Agonist-Antagonist Coactivation by Refl ex Stimulation Methods In: Craig Liebenson: Rehabilitation of the Spine – A Practitioner's Manual. Lippincott Williams & Wilkins, 2nd edition 2006, 531-565.
[10] Kolar P, Sulc J, Kyncl M, Sanda J, Cakrt O, Andel R, Kumagai K, Kobesova A. Postural function of the diaphragm in persons with and without chronic low back pain. J Orthop Sports Phys Ther. 2012;42(4):352-62.
[11] Arjmand N & Shirazi Adl A. Role of intra-abdominal pressure in the unloading and stabilization of the human spine during static lifting tasks. Eur Spine J, 2006;15:1265–1275.
[12] Kolar P, Sulc J, Kyncl M, et al. Stabilizing function of the diaphragm: dynamic MRI and synchronized spirometric assessment. J Appl Physiol. 2010;109:1064-1071.
[13] Kolar P, Neuwirth J, Sanda J, Suchanek V, SvataZ,Vojejnik J, Pivec M. Analysis of diaphragm movement, during tidal breathing and during its activation while breath holding, using MRI The International Journal of Sports Physical Therapy | Volume 8,Number 1 | February 2013 | Page 73 synchronized with spirometry. Physiol Res. 2009;58: 383-92.
[14] Kolar P, Sulc J, Kyncl M, Sanda J, Cakrt O, Andel R, Kumagai K, Kobesova A. Postural function of the diaphragm in persons with and without chronic low back pain. J Orthop Sports Phys Ther. 2012;42(4):352-62.
[15] Panjabi MM. The stabilizing function of the spine. Part I. Function, dysfunction, adaptation, and enhancement. J Spinal Disorders. 1992;5(4):383-9; discussion 397.
[16] Panjabi MM. The stabilizing function of the spine. Part II. Neutral zone and instability hypothesis. J Spinal Disorders. 1992; 5(4):390-6; discussion 397.
[17] Clare Frank, Alena Kobesova, Pavel Kolar, Clinical commentary dynamic neuromuscular stabilization & sports rehabilitation The international journal of sports physical therapy, volume 8, number 1, february 2013, page 62
[18] Katz JN, Zimmerman ZE, Mass H, Makhni MC. Diagnosis and Management of Lumbar Spinal Stenosis: A Review. JAMA. 2022 May 3;327(17):1688-1699. doi: 10.1001/jama.2022.5921. PMID: 35503342.
[19] Lurie J, Tomkins-Lane C. Management of lumbar spinal stenosis. BMJ. 2016 Jan 4;352:h6234. doi: 10.1136/bmj.h6234. PMID: 26727925; PMCID: PMC6887476.
[20] Deer TR, Kapural L. New image-guided ultra-minimally invasive lumbar decompression method: the mild procedure. Pain Physician 2010;13:35-41

Author Profile

Dr. Shivani Y Sharma, Master of Physiotherapy in Ortho and Sports, Senior Physiotherapist at Healthy Future, Ahmedabad, since 1.5 year.

Dr. Rashmikant Shah, Master in Neuro Rehabilitation (London, UK), Owner of Healthy Future, Advance Physiotherapy & Neuro Rehabilitation Centre, Ahmedabad, since 2010.

Dr. Heli S Shah, MD, DM (NEURO)Has worked with Dr. Sudhir Shah for 3 years. Currently doing fellowship in Movement disorders.