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A Comparison between Two Physical Therapy Treatment Programs for Patients with Lumbar Spinal Stenosis: A Randomized Controlled Trial

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Abstract: ***Aim of Study: The aim of the study was to conduct a randomized control trial to compare the effects of Flexion Group of exercises and mobilizations in Lumbar Spinal stenosis. Methodology: 30 subjects were included in the study as per inclusion and exclusion criteria. A written informed consent was signed by the subjects in their own language. The subjects were divided into three groups by random number table Group (A) Experimental Group (N=15) received Flexion Group of Exercises along with Ultrasonic therapy and Group (B) Experimental Group (N=15) received Spinal mobilizations along with Ultrasonic therapy program. The treatment lasted for six weeks. Patients were assessed by NPRS, MODI and SSS. Result: The statistical analysis showed significant improvement in score of NPRS in both the groups. The data showed significant improvement in score of MODI and SSS in Group A (p<0.001) as compare to Group B (p>0.001) after six weeks of the treatment. Conclusion: The study concluded that patients with LSS can benefit from a course of physical therapy, which includes lumbar flexion exercises and ultrasonic therapy.***

Keywords: Lumbar Spinal Stenosis, Flexion Group of Exercises, Ultrasonic therapy, Spinal Mobilizations

1. Introduction

Lumbar spinal stenosis (LSS) is a degenerative condition causing narrowing of the spinal canal or neural foramina, typically due to aging. [1] It results in symptoms like buttock or lower extremity pain, and neurogenic claudication, which includes radicular pain, numbness, and weakness that worsen with walking and improve with rest. [2] CT scans reveal narrowing with a sagittal diameter <11 mm, lateral recess depth <3 mm, and spinal canal area <1.45 cm². [3]

The condition is more common in older adults, with prevalence increasing from 1.7 - 2.2% in those aged 40 - 49 to 10.3 - 11.2% in those aged 70 - 79. Most often, it occurs at the L4 - 5 level. [1]

Spinal stenosis often occurs at L4 - 5, affecting up to 91% of patients. It results from disc degeneration, reducing disc height and causing bulging of the annulus fibrosus. This shifts stress to the posterior spine, leading to facet joint hypertrophy, osteophytes, and thickening of the ligamentum flavum, which narrows the spinal canal and compresses neural structures. [4]

The pathophysiology of lumbar stenosis involves two main theories: Ischemic Theory**:** Compression of small blood vessels during lumbar extension reduces blood flow to nerve roots, causing pain, tingling, and weakness. Venous Stasis Theory**:** Compression leads to blood pooling in the veins of the cauda equina, resulting in poor oxygenation and accumulation of waste products, which also causes pain and other symptoms. [5]

Schonstrom et al. used computerized tomography (CT) scans to study changes in the dimensions of the lumbar spinal canal with both flexion–extension and axial compression–distraction in human cadaver lumbar spine specimens. It was found that extension and axial compression reduced the cross - sectional area of the spinal canal by 16% (around 40 mm^2). An analogous 2 mm decrease was noted in the mid - sagittal diameter of the spinal canal. [6]

Lumbar spinal stenosis (LSS) is classified as: Anatomical: Central Canal Stenosis: Diameter ≤ 12 mm and Lateral Recess Stenosis: Height ≤ 3 mm or depth ≤ 5 mm. Etiologically it may be Primary: Due to congenital malformations and Secondary: Caused by acquired conditions like degenerative changes or disc herniation. [4]

The main symptom of central lumbar spinal stenosis (LSS) is neurogenic claudication, which includes pain, numbness, weakness, and tingling in the lower back, buttocks, thighs, and legs. Symptoms worsen with standing, walking, or lumbar extension, and relief is often found by bending forward (the "shopping cart sign"). [3] The most common features in LSS are 1. Spinal Extension: Often decreased.2. Ankle Reflexes: Decreased or absent in 50% of patients.3. Weakness: Present in 23% - 51%.4. Sensory Deficits: Seen in 51%; positive straight leg raise in ~50%.5. Kyphotic Posture: Can cause shortened hip flexors and increased lordosis.6. Motor Deficits: Subtle weakness, possible calf atrophy.7. Tenderness: Around paraspinals, glutes, or greater trochanters. [7]

Pain can be diagnosed using a set of tests applied together. One such set includes (Straight Leg Raise (SLR), Romberg Test and Thomas Test). These tests help assess nerve irritation, balance, and hip flexor tightness. SLR: Patient in supine position raises the straight leg to check for sciatica - like pain, indicating nerve root compression. Pain at 30 - 40 degrees suggests a positive test. [1] Romberg Test: Assesses balance by having the patient stand with feet together and eyes closed. Imbalance may indicate sensory issues. Specificity is high; sensitivity is lower.7 Thomas Test: Evaluates hip flexor flexibility. A positive result shows difficulty in hip extension or knee flexion, indicating tight hip flexors. [8]

A variety of conservative and non - conservative treatments are used for the treatment of LSS. In some cases surgical techniques are preferred to treat patients with LSS in which persistent symptoms are not adequately controlled conservative/therapeutic modalities. The Conservative management includes NSAIDS and exercise programs to strengthen musculature surrounding the low back region. The treatment options for lumbar spinal stenosis (LSS): Pharmacologic Management, Epidural Steroid Injections (ESIs): Offer short - term relief for symptoms like neurogenic claudication or radiculopathy. [9] Physiotherapy: Involves active therapies such as exercise and passive modalities like manual therapy and electrotherapy to improve mobility and reduce pain. These treatments aim to alleviate symptoms and improve quality of life based on individual patient needs and severity of LSS. [10]

According to Kim et al flexion exercises (knee to chest, double knee to chest, bridging, pelvic tilts) are shown to increase the central canal space that results in increased spinal mobility and increased abdominal strength. [11]

The ultrasound therapy could aid in reducing the pain intensity and disability of patients with low back pain in lumbar spinal stenosis. [12] Ultrasonic energy heats soft tissues by causing molecular vibration, which can Increase collagen flexibility, enhance nerve conduction, improve blood flow, boost enzymatic activity, muscle contractility and raise pain threshold. [13]

Joint mobilization improves muscle performance in patients with lumbar spinal stenosis by relieving pain, increasing range of motion, and enhancing muscle activation during movement, thereby improving overall quality of life. [14]

The purpose of this study is to compare the effectiveness of a flexion exercise group combined with ultrasonic therapy and spinal mobilization including ultrasonic therapy. This comparison aims to address the current lack of evidence and explain which interventions are most effective for managing patients with lumbar spinal stenosis (LSS).

2. Methodology

Study was approved by Research and Ethical committee of University College of Physiotherapy (UCOP), Faridkot.50 patients were screened, (9 patients did not meet the inclusion criteria & 11 declined to participate).

Inclusion Criteria

1) Patients with age of 50 or above.
2) Patients of both genders - males and females.
3) Patients with low back ache with or without leg pain.
4) Patients having signs and symptoms of lumbar spinal stenosis >3 months.
5) MRI scan showing AP lumbar canal diameter 8 - 12 mm.
6) Loss of sensation in lower limb.

Exclusion criteria

1) Patients having previous spinal surgeries.
2) Patients having infection like tuberculosis**,** osteomyelitis, meningitis etc.
3) Patients having hip or knee osteoarthritis.
4) Patients having history of spinal fractures.
5) Patients having ankolysing spondylitis.
6) Patients having neoplasm.
7) Patients having metabolic diseases like coronary heart disease, stroke etc.
8) Patients having psychiatric disorders.
9) Patients with ongoing Pregnancy.

The Patients were divided into two groups Group A (n=15) and Group B (n=15) based on randomization. Informed consent was signed by the patients. Randomization was done by random table number table. They were evaluated for pain, Quality of life and complement generic measures of lumbar spine disability and health status in patients with lumbar spinal stenosis by using Numeric Pain Rating scale (NPRS), Modified Oswestry Low Back Pain Disability Index (MODI) and Swiss Spinal Stenosis Scale (SSS) respectively.

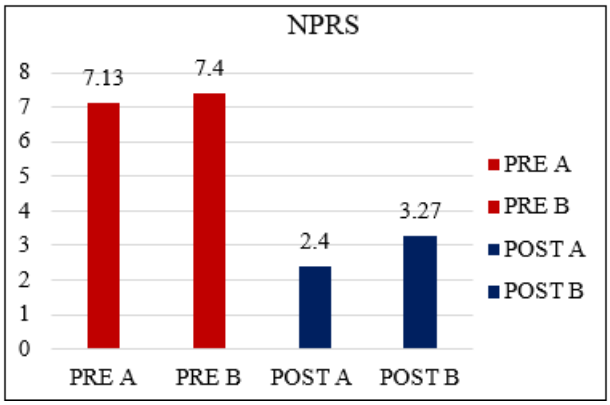
3. Procedure

The study was conducted for 6 weeks with 3 sessions per week. Patients in both Groups recieved10 minutes of pulsed ultrasound at 3 MHz frequency and 0.1 W/cm² intensity, applied with an acoustic gel on the lumbar paravertebral region. The ultrasound was administered with slow circular movements using the transducer head over the painful lumbar region. Treatment duration for each patient was determined using Grey's formula, where the planned local exposure time averaged one minute. For a painful lumbar region area of 40 cm² and a transducer head effective radiating area of 5 cm², the required total treatment time was calculated as 1 minute × (40 cm² / 5 cm²) = 8 minutes. [15] Patient in Group A underwent a regimen that included the Flexion Group exercises that includes knee to chest, double knee to chest, bridging, pelvic tilts, trunk raising and other conditioning exercises and stretching that aims on hip flexors stretching, hamstrings stretching and lumbar paraspinal muscles stretching and therapeutic ultrasound therapy. [8] Patients in Group B received Maitland Grade III Central Posterior - Anterior spinal mobilization along with ultrasonic therapy. The technique involved passive intervertebral movements at the affected lumbar segments for 8 - 10 minutes per session, with three sets of 40 - second oscillations and one - minute rest periods between each set including ultrasonic therapy. [16]

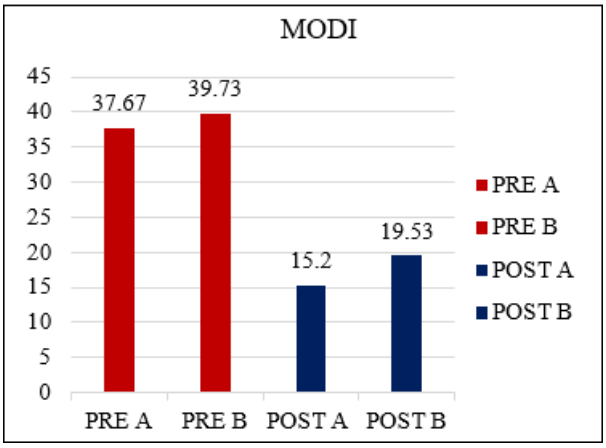
Data Analysis: For data analysis, Dependent and Independent tests were conducted using SPSS to analyze subject characteristics. The NPRS, MODI, and SSS scores of each group were compared between baseline (0th day) and after 6 weeks. A significance level of 0.0001 was set for all analyses to determine statistical significance

4. Results

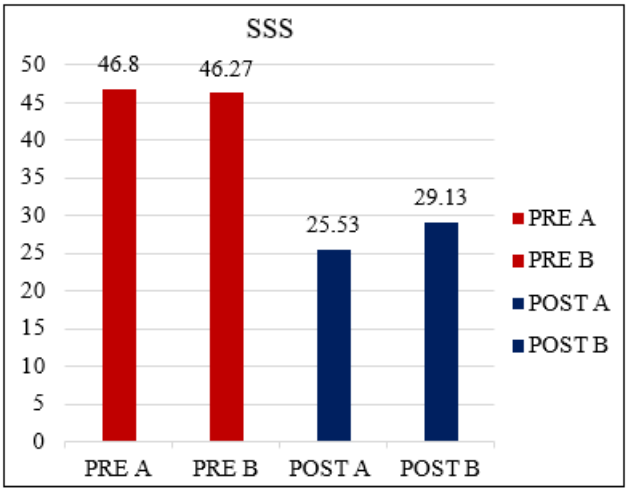
The mean difference NPRS scores between Pre - test and Post – test of Group A and Group B at 0^{th} day and at the end of 6^{th} week are - 0.27 and – 0.87 including t - values are 0.66 and 2.077 respectively.



The mean difference MODI scores between Pre - test and Post – test of Group A and Group B at 0th day and at the end of 6th week are - 2.06 and - 4.33 including t values are 0.4380 and 2.376 respectively.



The mean difference SSS scores between Pre - test and Post – test of Group A and Group B at 0th day and at the end of 6th week are 0.53 and - 3.6 including t values are 0.3459 and 2.34 respectively.



Based on the statistical analysis, it appears that Group A demonstrated a highly significant difference compared to Group B in terms of reducing pain, decreasing disability, and improving quality of life. This conclusion is drawn because the mean differences in NPRS, MODI, and SSS scores between the two groups were statistically significant, with p - values less than 0.005.

5. Discussion

Results of present study concluded that there is statistically significant improvement in the mean values of both the two groups. Results were analyzed using dependent t test for patients with in the group and with independent t test for patients between the group. On comparing Group A and Group B the results demonstrates that flexion group of exercises including ultrasonic therapy was more effective in improving pain, disability and quality of life (NPRS, MODI and SSS scores) in lumbar spinal stenosis at end of 6th week than spinal mobilizations and ultrasonic therapy.

The result of the present study is comparable with the study conducted by Whitman et al (2016) [15] The purpose of this study was to compare between the two physical therapy treatment programs for the patients with Lumber spinal stenosis. The results suggest that patients treated with nonsurgical physical therapy programs such as flexion group of exercises and stretching' s may achieve clinically important improvements at 6 weeks and 1 year. The results of this trial are encouraging and lend support to the premise that patients with LSS can achieve clinically important improvements with a physical therapy management program. Moreover the study conducted by Kumar S, Narkeesh et al (2017) [2] aimed to assess the Effect of Integrated Exercise Protocol in Lumbar Spinal Stenosis as Compare with Conventional Physiotherapy. This present study was done to find out that an integrated exercise protocol that includes the exercises like knee to chest, pelvic rotation and pelvic bridging were better as compared to conventional physiotherapy. It causes the stretching of para - spinal musculature and helps in improving lumbar ROM. there was a significant difference between the base line and post intervention score on Modified Schober test i. e. there was improvement in ROM of lumbar flexion.

6. Conclusion

This study concluded that patients with LSS can benefit from a course of physical therapy, which includes lumbar flexion exercises and ultrasonic therapy. These help in improving pain, lumbar ROM, neural flexibility and disability by increasing lumbar spinal canal diameter to reduce pressure on the soft tissues structures Furthermore, additional gains may be realized with the inclusion of progressive exercises, and stretching's.

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