Effect Of Hip Hinge Exercise on Pain, Endurance and Function in Individuals with Chronic Non-Specific Low Back Pain

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***Abstract*—Background: Chronic non-specific low back pain is a prevalent musculoskeletal condition associated with persistent pain, impaired trunk muscle endurance, and functional limitations. Chronic nonspecific low back pain (CNSLBP) is characterized by persistent pain lasting more than 12 weeks without an identifiable specific structural pathology. Hip hinge exercises involve repeated hip flexion and extension while maintaining a neutral lumbar spine. During this movement, the lumbar multifidus contracts isometrically to stabilize the spine and resist unwanted spinal motion. In individuals with CNSLBP, multifidus dysfunction characterized by delayed activation, reduced endurance, and muscle atrophy. An improved understanding of which stabilization exercises largely activate the deep multifidus in persons with CNSLBP.Objective: To evaluate the effect of hip hinge exercise combined with conventional exercise on pain, lumbar extensor endurance, and function in individuals with chronic non-specific low back pain. Methods: An experimental study was conducted on 30 individuals with chronic non-specific low back pain. Participants were randomly allocated into two groups of 15 participants each. Group A received hip hinge exercise along with conventional exercise, whereas Group B received conventional exercise alone. The intervention was provided three times per week for four weeks. Pain was assessed using the Visual Analogue Scale, Multifidus muscle endurance using the Biering-Sorensen test, and functional disability using the Modified Oswestry Disability Index. Pre- and post-intervention outcomes were analyzed statistically. Results: Both groups demonstrated statistically significant improvements in pain, multifidus muscle endurance, and functional disability after four weeks of intervention ($p<0.05$). VAS, Sorensen test, and Modified ODI scores in both Group A and Group B following the intervention ($p < 0.001$). In Group A, VAS decreased from 5.29 ± 1.02 to 2.95 ± 1.01, Sorensen test scores increased from 29.72 ± 7.45 to 46.80 ± 5.98, and Modified ODI decreased from 36.60 ± 5.35 to 23.47 ± 5.50. Similarly, in Group B, VAS decreased from 4.99 ± 0.92 to 4.31 ± 0.88, Sorensen test scores increased from 30.83 ± 7.80 to 40.41 ± 8.42, and Modified ODI decreased from 35.06 ± 4.86 to 30.25 ± 4.82. Conclusion: Addition of hip hinge exercise to conventional exercise produced improvements in pain, Multifidus muscle endurance, and functional ability in individuals with chronic non-specific low back pain. Hip hinge exercise may be considered as a functional movement-control exercise within a rehabilitation program for chronic non-specific low back pain.**

***Index Terms*—chronic nonspecific low back pain, hip hinge exercise, Multifidus muscle endurance, pain, function**

I. INTRODUCTION

Low back pain is one of the most prevalent musculoskeletal conditions worldwide and is a major contributor to disability. Recent estimates from the Global Burden of Disease Study 2021 indicate that approximately 628.8 million individuals worldwide were living with low back pain in 2021, with approximately 266.9 million new cases during the same year. Low back pain was associated with approximately 70.2 million years lived with disability, demonstrating its substantial global health burden. Although age-standardized rates have decreased compared with 1990, the absolute number of affected individuals has increased considerably. [1]

Low back pain is commonly classified according to duration as acute, subacute, or chronic. When symptoms persist for more than 12 weeks, the condition is generally considered chronic. In many individuals, no specific pathological condition can be identified to explain the symptoms, and these cases are

commonly described as chronic non-specific low back pain Chronic nonspecific low back pain (CNSLBP) is characterized by persistent pain lasting more than 12 weeks without an identifiable specific structural pathology. [2]

Chronic low back pain can substantially affect physical functioning, participation in daily activities, work, and quality of life. Persistent pain may also be associated with altered movement strategies and reduced physical capacity. Consequently, rehabilitation should address not only pain but also physical impairments and functional limitations. Exercise therapy is an important component of conservative management for chronic low back pain. A systematic review conducted to inform a World Health Organization clinical guideline reported that structured exercise programs probably reduce pain and functional limitations in adults with chronic primary low back pain. [3]

Muscle performance is an important consideration in individuals with chronic low back pain. The lumbar multifidus is a deep paraspinal muscle involved in segmental control and stabilization of the lumbar spine. Alterations in multifidus morphology and motor control have been described in people with low back pain. Motor-control exercise aims to improve the coordination and control of the trunk musculature and has been investigated extensively in individuals with chronic non-specific low back pain. [4]

Multifidus performance is particularly relevant in chronic low back pain because sustained and repetitive activities require adequate endurance of the lumbar stabilizing musculature. Reduced endurance may result in early muscle fatigue and compensatory movement strategies, potentially increasing mechanical stress on other spinal structures. Therefore, improving the endurance capacity of the lumbar stabilizing musculature is an important component of rehabilitation for individuals with chronic non-specific low back pain. systematic review and meta-analysis provide evidence supporting exercise as an approach for improving the performance of the lumbar extensor musculature. [6]

Motor-control exercise is another commonly used intervention for chronic non-specific low back pain. A systematic review and meta-analysis by Capel-Alcaraz et al. reported significant effects of motor-control exercise on pain and disability in individuals with chronic non-specific low back pain. These findings support the importance of exercises that emphasize controlled trunk and lumbopelvic movement. [7]

The coordination between the hip and lumbar spine is particularly relevant during functional movements such as bending and lifting. The hip hinge is a movement strategy in which the individual moves primarily through the hip while maintaining controlled lumbar positioning. It promotes hip-dominant movement and lumbopelvic dissociation and is frequently used to teach appropriate movement mechanics during bending and lifting.

Michaud et al. investigated hip hinge movement with a neutral spine using wearable sensors during lifting exercises. Their findings demonstrated the feasibility of assessing hip-hinge performance and highlighted the importance of maintaining appropriate lumbar positioning during lifting. The authors described the hip hinge and lumbopelvic dissociation as important components of maintaining a neutral spine during lifting tasks. [8]

The biomechanical rationale for hip hinge exercise is that controlled hip flexion and extension allow the individual to perform bending movements while limiting excessive lumbar motion. Repeated practice may improve awareness of spinal position, coordination between the hip and trunk, and functional movement control. However, existing literature has primarily investigated hip hinge biomechanics and lifting technique rather than its direct clinical effects on pain, lumbar extensor endurance, and disability in individuals with chronic non-specific low back pain. [8]

Recent evidence continues to support exercise-based management of chronic low back pain. A network meta-analysis involving 75 randomized controlled trials and 5,254 participants found that several exercise interventions improved pain and physical function in individuals with chronic low back pain, although the authors noted limitations in the quality and quantity of evidence for individual exercise approaches. [9]

Therefore, although general exercise and motor-control exercise are supported for chronic low back pain, limited research has specifically investigated the addition of hip hinge exercise to conventional exercise. In particular, evidence regarding its effect on multifidus muscle endurance and functional disability remains limited.

Hence, the present study was undertaken to evaluate the effect of hip hinge exercise combined with

conventional exercise on pain, lumbar extensor endurance, and function in individuals with chronic non-specific low back pain.

II. AIM

To evaluate the effect of hip hinge exercise along with conventional exercise on pain, lumbar extensor endurance, and function in individuals with chronic non-specific low back pain.

III. OBJECTIVES

1. To evaluate the effect of hip hinge exercise on multifidus muscle endurance using the Biering-Sorensen test.
2. To evaluate the effect of hip hinge exercise on pain using the Visual Analogue Scale.
3. To evaluate the effect of hip hinge exercise on functional disability using the Modified Oswestry Disability Index.

IV. MATERIALS AND METHODS

The present experimental study was conducted to determine the effect of hip hinge exercise on endurance, pain, and functional status in individuals with chronic non-specific low back pain. A total of 30 participants with chronic non-specific low back pain were included in the study. Participants were selected using a simple random sampling method and were randomly allocated into two equal groups. Group A consisted of 15 participants who received hip hinge exercise along with conventional exercises, whereas Group B consisted of 15 participants who received conventional exercises alone. The intervention was carried out for a period of four weeks, with treatment administered three times per week. Baseline assessment was performed before commencement of the intervention.

IV.1 Selection Criteria:

Inclusion Criteria

- Patient having low back pain more than 3 months
- Age: 24-34 year
- Male & female both
- Visual Analogue scale: 3-7 cm
- Prone instability test positive
- Subject willing to participate.

Exclusion Criteria

- Spondylosis of spine, prolapsed intervertebral disc, spondylolisthesis with or without radiating pain.
- History of spine surgery & fracture within 6-12 months.
- Any severe musculoskeletal, neurological, cardiovascular condition.

IV.2 Outcome Measures

Pain intensity was assessed using the Visual Analogue Scale, multifidus muscle endurance was assessed using the Biering-Sorensen test, and functional disability was assessed using the Modified Oswestry Disability Index. The same outcome measures were reassessed after completion of the four-week intervention.

IV.3 Procedure

Institutional ethical approval was obtained before commencement of the study. Eligible participants were informed about the procedure and their willingness to participate was obtained.

Thirty participants were randomly allocated into two groups. Baseline measurements of VAS, Biering-Sorensen test duration, and Modified ODI were obtained before intervention.

Group A received hip hinge exercise along with conventional exercise, while Group B received conventional exercise alone.

The intervention was administered three times per week for four weeks.

A. Hip Hinge Exercise

- The participant stood with a stick positioned behind the body.
- The stick was maintained in contact with the sacrum and the middle region of the upper back. The knees were slightly flexed while the participant maintained controlled lumbar and pelvic positioning.
- The participant was instructed to push the hips backward and bend forward predominantly through the hip joints. The participant then returned to the upright position through controlled hip extension.
- The exercise was performed with emphasis on maintaining the controlled lumbar position throughout the movement.

B. Conventional Exercise

During the first and second weeks, conventional exercise consisted of:

- Ankle and toe movements: 10 repetitions.
- Static back exercises: 10 repetitions.
- Pelvic bridging: 10 repetitions.
- Hot pack: 10 minutes
- Hamstring stretching: 20-second hold × 3 repetitions.
- Quadriceps stretching: 20-second hold × 3 repetitions.

During the third and fourth weeks:

- Lumbar rotation exercises: 10 repetitions.
- Knee-to-chest exercises: 10 repetitions.
- Cat-camel exercises: 10 repetitions.

V. STATISTICAL ANALYSIS

Statistical analysis was performed using SPSS version 26 and Microsoft Excel. The Shapiro-Wilk test was used to assess normality of the data.

Within-group pre- and post-intervention changes were analyzed using appropriate statistical tests. Between-group differences were analyzed using the independent t test. Statistical significance was considered at $p<0.05$.

Within Group Analysis

VARIABLES	GROUPS	MEAN±SD	MEAN±SD	Mean difference	T-value	P-value
		PRE	POST			
VAS	GROUP A	5.29±1.02	3.35±1.01	-2.34	9.62	<0.001
	GROUP B	2.95±0.92	4.31±0.88	-0.68	8.83	<0.001
SORENSEN TEST	GROUP A	29.71±7.45	46.79±5.98	17.08	-14.94	<0.001
	GROUP B	30.82±7.80	40.41±8.42	9.38	-5.50	<0.001
MODIFIED ODI	GROUP A	36.66±5.35	23.43±5.50	-13.13	20.09	<0.001
	GROUP B	35.06±4.86	30.25±4.82	-4.80	10.94	<0.001

Table 1. Within Group Analysis

Within-group analysis demonstrated a statistically significant improvement in VAS, Sorensen test, and Modified ODI scores in both Group A and Group B following the intervention ($p < 0.001$). In Group A, VAS decreased from 5.29 ± 1.02 to 2.95 ± 1.01, Sorensen test scores increased from 29.72 ± 7.45 to 46.80 ± 5.98, and Modified ODI decreased from 36.60 ± 5.35 to 23.47 ± 5.50. Similarly, in Group B, VAS decreased from 4.99 ± 0.92 to 4.31 ± 0.88, Sorensen test scores increased from 30.83 ± 7.80 to 40.41 ± 8.42, and Modified ODI decreased from 35.06 ± 4.86 to 30.25 ± 4.82.

Between Group Analysis

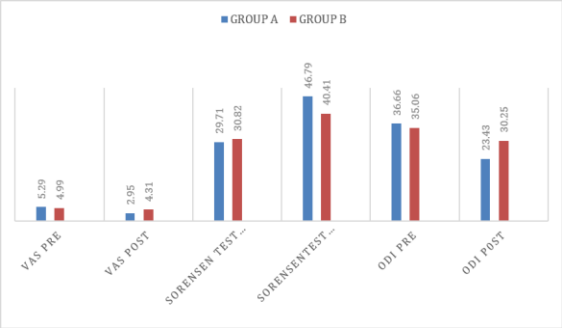

Fig.1. Between Group Analysis

Between-group analysis showed a statistically significant difference in post-treatment scores between Group A and Group B for VAS ($t = -4.298$, $p < 0.001$), Sorensen test ($t = 2.518$, $p = 0.018$), and Modified ODI ($t = -3.731$, $p < 0.001$). Furthermore, comparison of change scores demonstrated significantly greater improvement in Group A than Group B for VAS ($t = -6.509$, $p < 0.001$), Sorensen test ($t = 3.754$, $p < 0.001$), and Modified ODI ($t = -10.586$, $p < 0.001$). These findings indicate that hip hinge exercise combined with conventional exercise was more effective than conventional exercise alone in improving pain, multifidus endurance, and functional disability in individuals with chronic non-specific low back pain.

VI. DISCUSSION

The present study investigated the effect of adding hip hinge exercise to conventional exercise in individuals with chronic non-specific low back pain. The results demonstrated improvements in pain, multifidus muscle endurance, and functional disability in both groups, with greater improvement reported in the hip hinge plus conventional exercise group.

The reduction in pain observed in both groups may be attributed to the beneficial effects of active exercise. Exercise therapy has demonstrated beneficial effects on pain and functional limitations in individuals with chronic primary low back pain. Verville et al. reported moderate-certainty evidence that structured exercise programs probably reduce pain and functional limitations compared with no intervention. [3]

The reduction in pain following hip hinge exercise may be attributed to improved hip-dominant movement, better lumbopelvic control, and reduced excessive lumbar loading. Hip hinge training promotes activation of the gluteal, hamstring, and lumbar stabilizing muscles, including the multifidus, thereby improving spinal stability and reducing mechanical stress on lumbar structures. These changes may contribute to decreased pain and improved functional movement. Studies incorporating hip-hinge exercise have reported improvements in pain and disability in individuals with low back pain.

The present study also demonstrated improvement in multifidus muscle endurance. Group A showed an increase in Sorensen test duration from 35.34 seconds to 67.46 seconds. Group B also demonstrated improvement, although the post-intervention value was lower than that observed in Group A.

The improvement in Sorensen test performance may be attribute to repeated isometric activation of the lumbar stabilizing musculature during hip hinge exercise. Maintaining a neutral lumbar spine while performing hip-dominant movement places sustained demand on the multifidus, thereby improving its neuromuscular control and resistance to fatigue. Previous studies have demonstrated that stabilization and hip-strengthening exercises can improve multifidus activation and muscle morphology in individuals with chronic low back pain.

The improvement in functional disability may be related to reduced pain and improved physical capacity. Group A demonstrated a reduction in Modified ODI from 39.07 to 27.04, while Group B improved from 39.87 to 32.87. Exercise interventions have previously been associated with improvements in functional limitations in chronic low back pain. [3], [9]

The hip hinge may have an additional functional advantage because the exercise reproduces a movement pattern used during daily activities such as bending, lifting, and returning to standing. Michaud et al. demonstrated the importance of hip hinge and lumbopelvic dissociation during lifting exercises and showed that hip-hinge performance could be assessed using wearable sensors. [8]

The improvement in Group A may therefore be explained by the combination of conventional exercise with specific practice of hip-dominant movement and controlled lumbar positioning. Repeated practice may improve movement awareness and lumbopelvic coordination, potentially contributing to better performance during functional activities.

The findings are also consistent with evidence supporting motor-control exercise for chronic non-specific low back pain. Capel-Alcaraz et al. found that motor-control exercise can improve pain and disability in individuals with chronic nonspecific low back pain. [7]

VII. LIMITATIONS

1. The sample size was limited to 30 participants.
2. The intervention duration was only four weeks.
3. Long-term follow-up was not performed.
4. The Biering-Sorensen test assessed general lumbar/trunk extensor endurance rather than isolated multifidus endurance.
5. Multifidus activation was not directly assessed using electromyography or ultrasound.
6. The independent effect of hip hinge exercise cannot be completely separated from the effects of conventional exercise.
7. The study population was restricted to individuals aged 24 to 34 years, limiting generalizability to other age groups.

VIII. CONCLUSION

The present study demonstrated that both conventional exercise and hip hinge exercise combined with conventional exercise improved pain, lumbar extensor endurance, and functional disability in individuals with chronic non-specific low back pain.

The addition of hip hinge exercise demonstrated greater improvement in the reported outcomes compared with conventional exercise alone. Hip hinge exercise may therefore be considered a useful functional movement-control exercise as part of physiotherapy rehabilitation for chronic non-specific low back pain.

IX. LIMITATION

However, the findings do not establish a direct effect on isolated multifidus endurance because the multifidus was not independently measured. Future studies using electromyography or ultrasound imaging are recommended to investigate the specific effect of hip hinge exercise on multifidus activation and morphology.

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