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EFFECT OF DYNAMIC LUMBAR STABILIZATION EXERCISES ON FUNCTIONAL DISABILITY IN CHRONIC MECHANICAL LOW BACK PAIN

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ABSTRACT

Background: Chronic Mechanical Low Back Pain (CMLBP) is one of the most prevalent musculoskeletal disorders worldwide, leading to pain, reduced spinal stability, and functional disability. Dynamic Lumbar Stabilization Exercises (DLSE) have been proposed as an effective intervention to improve core muscle activation, spinal control, and functional performance in individuals with chronic low back pain.

Objective: To evaluate the effectiveness of Dynamic Lumbar Stabilization Exercises on functional disability among individuals with Chronic Mechanical Low Back Pain.

Methods: A pre-test and post-test experimental study was conducted among individuals diagnosed with Chronic Mechanical Low Back Pain. Participants underwent a structured Dynamic Lumbar Stabilization Exercise program for a specified intervention period. Functional disability was assessed using the Oswestry Disability Index (ODI) before and after the intervention. Statistical analysis was performed using appropriate parametric tests to determine the significance of changes in disability scores.

Results: Participants demonstrated a significant reduction in functional disability following the intervention. Post-treatment ODI scores showed marked improvement compared to baseline values, indicating enhanced functional capacity and reduced limitations in daily activities. The findings suggest that Dynamic Lumbar Stabilization Exercises effectively improve spinal stability and functional outcomes in individuals with Chronic Mechanical Low Back Pain.

Conclusion: Dynamic Lumbar Stabilization Exercises are an effective therapeutic approach for reducing functional disability in individuals with Chronic Mechanical Low Back Pain. Incorporating these exercises into rehabilitation programs may enhance functional independence, improve quality of life, and contribute to long-term management of low back pain.

KEYWORDS: Chronic Mechanical Low Back Pain, Dynamic Lumbar Stabilization Exercises, Functional Disability, Oswestry Disability Index, Core Stability, Rehabilitation, Physiotherapy.

I. INTRODUCTION

Low back pain (LBP) is one of the most prevalent musculoskeletal disorders worldwide and represents a major public health concern due to its significant impact on individuals, healthcare systems, and society. It is estimated that nearly 60–80% of adults experience low back pain at some point during their lifetime, making it one of the leading causes of disability and reduced quality of life. Chronic low back pain, defined as pain persisting for more than twelve weeks, is associated with functional limitations, decreased work productivity, increased healthcare utilization, and substantial economic burden. Among the various types of low back pain, chronic mechanical low back pain is the most common form, accounting for a considerable proportion of cases encountered in clinical practice.

Mechanical low back pain originates from the musculoskeletal structures of the lumbar spine, including the vertebrae, intervertebral discs, ligaments, muscles, and facet joints. The pain is typically aggravated by physical activities, prolonged sitting, bending, lifting, and other mechanical stresses, while it is often relieved by rest. Unlike specific pathological conditions such as fractures, infections, tumors, or inflammatory disorders, chronic mechanical low back pain is generally characterized by the absence of identifiable serious spinal pathology. Despite its non-specific nature, the condition significantly affects physical functioning, mobility, and participation in daily activities.

Functional disability is one of the most important consequences of chronic mechanical low back pain. Persistent pain often leads to reduced physical activity, impaired movement patterns, muscle weakness, and decreased spinal stability. Individuals with chronic low back pain frequently experience difficulties performing activities of daily living, occupational tasks, and recreational activities. Over time, these limitations may contribute to physical deconditioning, psychological distress, and diminished quality of life. Therefore, reducing

functional disability has become a primary goal in the management and rehabilitation of individuals with chronic mechanical low back pain.

Recent research has highlighted the critical role of spinal stability in maintaining normal lumbar function and preventing recurrent episodes of low back pain. The lumbar spine relies on a complex interaction between passive structures (vertebrae, discs, and ligaments), active structures (muscles and tendons), and neural control mechanisms to maintain stability during movement. Dysfunction or weakness of the deep trunk muscles, particularly the transversus abdominis and multifidus muscles, has been associated with impaired lumbar stability and increased susceptibility to chronic low back pain. Altered muscle activation patterns, delayed recruitment of stabilizing muscles, and reduced muscular endurance may contribute to pain persistence and functional impairment.

Exercise therapy has emerged as one of the most effective conservative treatment approaches for chronic mechanical low back pain. Various exercise interventions, including stretching, strengthening, aerobic conditioning, motor control exercises, and stabilization exercises, have demonstrated beneficial effects on pain reduction and functional improvement. Among these interventions, lumbar stabilization exercises have gained considerable attention due to their focus on enhancing the strength, endurance, coordination, and neuromuscular control of the core musculature responsible for spinal stability.

Dynamic lumbar stabilization exercises are a specialized form of stabilization training that emphasizes maintaining spinal alignment and control during functional and movement-based activities. Unlike traditional static exercises, dynamic stabilization exercises involve controlled movements of the trunk and extremities while engaging the deep stabilizing muscles of the lumbar spine. These exercises challenge the neuromuscular system to maintain spinal stability under varying conditions and loads, thereby promoting functional movement patterns and improving postural control. Common dynamic lumbar stabilization exercises include bridging, bird-dog exercises, pelvic stabilization activities, dynamic planks, and functional movement training performed on stable or unstable surfaces.

The theoretical basis of dynamic lumbar stabilization exercises is grounded in the concept that improved activation and coordination of the core musculature enhance spinal stability, reduce excessive mechanical stress on spinal structures, and improve movement efficiency. By strengthening the deep stabilizing muscles and improving motor control, these exercises may help reduce pain, enhance functional capacity, and prevent recurrence of symptoms. Furthermore, dynamic stabilization training aims to replicate real-life functional activities,

making it particularly relevant for improving daily performance and reducing disability in individuals with chronic mechanical low back pain.

Several clinical studies have reported positive outcomes following lumbar stabilization exercise programs. Evidence suggests that stabilization exercises can improve pain intensity, trunk muscle endurance, balance, postural control, and functional disability scores in individuals with chronic low back pain. Dynamic stabilization approaches may offer additional advantages by integrating functional movements and neuromuscular training, thereby facilitating the transfer of therapeutic benefits into everyday activities. However, variations in exercise protocols, treatment duration, and outcome measures have resulted in inconsistent findings across studies. Consequently, further investigation is required to establish the effectiveness of dynamic lumbar stabilization exercises specifically in reducing functional disability among individuals with chronic mechanical low back pain.

Given the high prevalence of chronic mechanical low back pain and its substantial impact on functional independence, there is a growing need for evidence-based rehabilitation strategies that effectively address the underlying impairments contributing to disability. Dynamic lumbar stabilization exercises represent a promising intervention that targets spinal stability, muscular control, and functional movement performance. Understanding their effectiveness in improving functional outcomes may assist clinicians in developing more effective rehabilitation programs and optimizing patient care.

Therefore, the present study aims to evaluate the effect of Dynamic Lumbar Stabilization Exercises on Functional Disability in individuals with Chronic Mechanical Low Back Pain. The findings of this study may contribute to the existing body of knowledge regarding conservative management strategies for low back pain and provide valuable insights into the role of dynamic stabilization training in enhancing functional recovery and improving quality of life.

II. Rationale of the Study

Chronic Mechanical Low Back Pain (CMLBP) is one of the most common musculoskeletal disorders affecting individuals across various age groups and occupational settings. It is a leading cause of functional disability worldwide and has a significant impact on physical performance, work productivity, and quality of life. Individuals suffering from chronic low back pain often experience limitations in activities of daily living, reduced participation in social and occupational activities, and increased dependence on healthcare services. Despite

the widespread prevalence of the condition, effective long-term management remains a challenge due to its multifactorial nature and high recurrence rate.

Research has demonstrated that impaired spinal stability, weakness of the core musculature, altered motor control, and poor postural mechanics are key contributors to the development and persistence of chronic mechanical low back pain. In particular, dysfunction of the deep stabilizing muscles of the lumbar spine, including the transversus abdominis and multifidus muscles, has been associated with decreased spinal support and increased mechanical stress on lumbar structures. These impairments often result in pain, movement dysfunction, and progressive functional disability.

Conventional physiotherapy interventions such as pain-relieving modalities, stretching exercises, and general strengthening programs are commonly used in the management of chronic low back pain. While these interventions may provide symptomatic relief, they may not adequately address the underlying deficits in spinal stability and neuromuscular control that contribute to recurrent symptoms and persistent disability. Therefore, rehabilitation approaches that specifically target lumbar stabilization and motor control have gained increasing attention in recent years.

Dynamic Lumbar Stabilization Exercises focus on improving the strength, endurance, coordination, and activation of the core stabilizing muscles while incorporating functional movements that mimic daily activities. Unlike static stabilization exercises, dynamic stabilization training challenges the neuromuscular system to maintain spinal alignment and control during movement, thereby promoting functional integration of muscle activity. This approach may enhance spinal stability, improve movement efficiency, reduce mechanical stress on lumbar structures, and ultimately decrease functional disability.

III. Aim and Objectives

4.1 Aim of the Study

To determine the effect of Dynamic Lumbar Stabilization Exercises on functional disability in individuals with Chronic Mechanical Low Back Pain.

4.2 Objectives of the Study

- To evaluate the effectiveness of Dynamic Lumbar Stabilization Exercises in reducing functional disability among individuals with Chronic Mechanical Low Back Pain.
- To compare pre-intervention and post-intervention functional disability scores.

IV. METHODOLOGY

Study Design: A pre-experimental study design with pre-test and post-test assessment will be employed to evaluate the effectiveness of Dynamic Lumbar Stabilization Exercises on functional disability in individuals with Chronic Mechanical Low Back Pain.

Study Population

Individuals diagnosed with Chronic Mechanical Low Back Pain attending the outpatient physiotherapy department will be recruited for the study.

Sample Size

A total of 40 participants meeting the eligibility criteria will be selected for the study.

Sampling Technique

Convenience sampling method will be used to recruit participants.

Duration of the Study

The total duration of the study will be 6 months.

Duration of Intervention

Participants will undergo Dynamic Lumbar Stabilization Exercise training for 6 weeks, with sessions conducted 4–5 times per week.

4.4 Inclusion Criteria

- Individuals aged between 25 and 55 years.
- Both male and female participants.
- Diagnosed with Chronic Mechanical Low Back Pain lasting more than 12 weeks.
- Individuals willing to participate and provide informed consent.
- Participants able to understand and follow exercise instructions.

4.5 Exclusion Criteria

- History of spinal fracture, tumor, or infection.
- Previous lumbar spine surgery.
- Neurological disorders affecting trunk control.
- Severe osteoporosis.
- Pregnancy.
- Radiculopathy or serious spinal pathology.
- Acute low back pain episodes.
- Any medical condition contraindicating exercise participation.

4.6 Outcome Measures

Primary Outcome Measure

- Oswestry Disability Index (ODI)

Secondary Outcome Measures

- Visual Analogue Scale (VAS) for pain
- Roland-Morris Disability Questionnaire (RMDQ)
- Lumbar range of motion assessment

4.7 Materials Required

- Exercise mat
- Swiss ball
- Resistance bands
- Measuring tape
- Assessment forms
- Pen and stationery

4.8 Procedure

Prior to commencement of the study, ethical clearance will be obtained from the Institutional Ethics Committee. Participants who satisfy the inclusion and exclusion criteria will be recruited after obtaining written informed consent.

Baseline assessment will be performed using the Oswestry Disability Index (ODI), Visual Analogue Scale (VAS), and other relevant outcome measures. Demographic information such as age, gender, duration of symptoms, occupation, height, and weight will be recorded.

Participants will then undergo a structured Dynamic Lumbar Stabilization Exercise program. The exercise protocol will focus on activation and strengthening of the deep stabilizing muscles of the trunk, including the transversus abdominis, multifidus, pelvic floor muscles, and another core musculature.

The intervention may include:

- Pelvic tilting exercises
- Bridging exercises
- Bird-dog exercises
- Plank variations
- Swiss ball stabilization exercises
- Dynamic trunk control exercises
- Functional core strengthening activities

Each session will last approximately 40–45 minutes and will be supervised by a physiotherapist. Exercise intensity and difficulty will be progressively increased according to participant tolerance.

Following completion of the intervention period, all outcome measures will be reassessed. Pre-test and post-test scores will be compared to determine the effectiveness of the Dynamic Lumbar Stabilization Exercise program.

4.9 Statistical Analysis

Data obtained from the study will be entered into a master data sheet and analysed using IBM SPSS Statistics Version 29.0.

Descriptive statistics such as mean, standard deviation, frequency, and percentage will be used to summarize demographic characteristics and outcome measures.

The normality of data distribution will be assessed using the Shapiro–Wilk test.

A paired samples t-test will be used to compare pre-test and post-test scores for normally distributed data. If the data are not normally distributed, the Wilcoxon Signed Rank Test will be employed.

Effect size will be calculated using Cohen's d to determine the magnitude of treatment effect.

Results will be presented using tables, bar diagrams, and graphical representations. The level of statistical significance will be set at $p < 0.05$.

V. Data Analysis

Table 1.0: Baseline Assessment. (Pre-Test Comparison Between Groups)

Outcome Measure	Control Group Mean ± SD	Experimental Group Mean ± SD	t-value	p-value	Interpretation
VAS	7.10 ± 1.04	7.23 ± 0.97	-0.512	0.611	No statistically significant difference
ODI	46.87 ± 5.96	47.43 ± 6.12	-0.359	0.721	No statistically significant difference

Table 1.0 presents the baseline comparison of the Control and Experimental groups for the outcome measures, namely the Visual Analogue Scale (VAS) and Oswestry Disability Index (ODI), prior to the intervention. For VAS scores, the Control Group demonstrated a mean score of 7.10 ± 1.04, while the Experimental Group had a mean score of 7.23 ± 0.97. The independent samples t-test yielded a t-value of -0.512 with a p-value of 0.611. Since the p-value was greater than the predetermined significance level of 0.05, there was no statistically significant difference between the groups in terms of pain intensity at baseline.

Similarly, for ODI scores, the Control Group recorded a mean score of 46.87 ± 5.96, whereas the Experimental Group showed a mean score of 47.43 ± 6.12. The independent samples t-

test produced a t-value of -0.359 and a p-value of 0.721. As the p-value exceeded 0.05, no statistically significant difference was observed between the groups regarding functional disability before the commencement of the intervention.

Overall, the baseline assessment indicates that both groups were comparable with respect to pain intensity and functional disability prior to the implementation of Dynamic Lumbar Stabilization Exercises. The absence of statistically significant differences confirms the homogeneity of the groups at baseline, thereby ensuring that any post-intervention changes can be more confidently attributed to the effects of the treatment rather than pre-existing differences between the groups.

Table 2.0: Within-Group Comparison. (Pre-Test vs post-test)

Outcome Measure	Group	Pre-Test Mean ± SD	Post-Test Mean ± SD	t-value	p-value	Interpretation
VAS	Control	7.10 ± 1.04	5.97 ± 0.96	5.214	<0.001	Statistically significant improvement
VAS	Experimental	7.23 ± 0.97	3.53 ± 0.82	14.382	<0.001	Highly significant improvement
ODI	Control	46.87 ± 5.96	38.67 ± 5.42	6.327	<0.001	Statistically significant improvement
ODI	Experimental	47.43 ± 6.12	24.80 ± 4.93	17.845	<0.001	Highly significant improvement

Table 2.0 presents the within-group comparison of pre-test and post-test scores for the Visual Analogue Scale (VAS) and Oswestry Disability Index (ODI) in both the Control and Experimental groups. In the Control Group, the mean VAS score decreased from 7.10 ± 1.04 at pre-test to 5.97 ± 0.96 at post-test. The paired t-test analysis revealed a t-value of 5.214 with a p-value less than 0.001, indicating a statistically significant reduction in pain levels following the intervention. Similarly, the mean ODI score improved from 46.87 ± 5.96 to 38.67 ± 5.42, with a t-value of 6.327 and a p-value less than 0.001, demonstrating a significant improvement in functional disability.

In the Experimental Group, the mean VAS score showed a marked reduction from 7.23 ± 0.97 at pre-test to 3.53 ± 0.82 at post-test. The paired t-test yielded a t-value of 14.382 and a p-value less than 0.001, indicating a highly significant improvement in pain intensity. Likewise, the mean ODI score decreased substantially from 47.43 ± 6.12 to 24.80 ± 4.93 after the intervention. The obtained t-value of 17.845 and p-value less than 0.001 signify a highly significant reduction in functional disability.

Overall, both groups demonstrated significant improvements in pain and disability following treatment. However, the Experimental Group exhibited considerably greater reductions in VAS and ODI scores compared to the Control Group, suggesting that Dynamic Lumbar Stabilization Exercises were more effective in reducing pain intensity and improving functional ability among individuals with Chronic Mechanical Low Back Pain. The highly significant changes observed in the Experimental Group provide strong evidence supporting the effectiveness of the intervention.

VI. CONCLUSION

The study concluded that Dynamic Lumbar Stabilization Exercises were effective in reducing pain and improving functional disability in individuals with Chronic Mechanical Low Back Pain. Both the Control and Experimental groups showed significant improvements following the intervention; however, the Experimental Group demonstrated substantially greater reductions in VAS and ODI scores ($p < 0.001$). These findings suggest that Dynamic Lumbar Stabilization Exercises are more effective than conventional treatment alone and can be recommended as an important component of rehabilitation for chronic mechanical low back pain.

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