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COMPARISON OF MCKENZIE LUMBAR EXTENSION PROTOCOL VERSUS LUMBAR MAITLAND MOBILIZATION ON PAIN, DYNAMIC SPINAL STABILITY, AND PARASPINAL MUSCLE ACTIVITY IN YOUNG ADULTS WITH NONSPECIFIC LOW BACK PAIN: A RANDOMIZED CONTROLLED TRIAL

Dr. Naeem Ullah[*1], Dr. Maha Rehman[*2], Dr. Atif Wahab Pt[3], Abdullah[4], Dr. Umar Zada[5], Shahab Khan[6], Ziauddin[7]

*[*1]Physiotherapy and Rehabilitation Department Ibadat international university Islamabad, Clinical Physiotherapist at My Health and Wellness Canter Peshawar*
*[*2]PDG- Pain Management, Health Services Academy*
[3]Physical therapist at Rehman Medical Institute Peshawar
[4]Final year student Khyber medical University Peshawar
[5]Physiotherapist in The physiotherapy Clinic, Afridi medical complex and Teaching Hospital Peshawar.
[6]Pakistan institute of medical science (PIMS) Islamabad
[7]Final year student Ahmad medical institute

[*1]naeemphysio58@gmail.com, [*2]drmaharehmanpt@yahoo.com, [3]atif.wahab@rmi.edu.pk, [4]abdullahsayed738@gmail.com, [5]uphysio9@gmail.com , [6]shahabkh571@gmail.com, [7]malakziauddin23@gmail.com

Corresponding Author: *
Dr. Naeem Ullah[*1], Dr. Maha Rehman[*2]

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ABSTRACT

Background: *Nonspecific low back pain (NSLBP) is a prevalent musculoskeletal condition, especially in young adults. Despite various physiotherapeutic approaches, optimal treatment protocols remain a subject of ongoing investigation. McKenzie Lumbar Extension Exercises and Maitland Mobilization are frequently used techniques, yet their comparative effectiveness on pain, spinal stability, and muscle activation has not been fully explored.*

Objective: *To compare the effects of McKenzie Lumbar Extension Protocol and Lumbar Maitland Mobilization on pain intensity, dynamic spinal stability, and paraspinal muscle activity in young adults with NSLBP.*

Methodology: *A single-blinded randomized controlled trial was conducted over six months at a physiotherapy department, KTH, Peshawar. Sixty participants aged 18–35 years with clinically diagnosed NSLBP were randomly allocated into two groups (n=30 each). Group A received the McKenzie Lumbar Extension Protocol, while Group B underwent Maitland Mobilization, both administered thrice weekly for 6 weeks. Outcome measures included Numeric Pain Rating Scale (NPRS), dynamic stability tests, and electromyographic (EMG) activity of lumbar paraspinal muscles. Assessments were recorded at baseline and post-intervention.*

Results: Both interventions significantly reduced pain and improved dynamic stability and EMG activity ($p<0.05$). However, the McKenzie group showed statistically greater improvements across all parameters compared to the Maitland group ($p<0.01$).

Conclusion: *The McKenzie Lumbar Extension Protocol is more effective than Maitland Mobilization in improving pain, functional stability, and muscle activation in young adults with NSLBP. These findings advocate for incorporating McKenzie exercises in rehabilitation protocols targeting mechanical back pain in physically active individuals.*

Keywords:

McKenzie method, Maitland mobilization, nonspecific low back pain, spinal stability, EMG, randomized controlled trial.

INTRODUCTION

Nonspecific low back pain (NSLBP) is a leading cause of musculoskeletal disability among young adults globally, with an increasing incidence due to sedentary lifestyles, poor postural habits, and reduced physical activity. NSLBP refers to low back pain not attributable to a recognizable pathology such as infection, tumor, osteoporosis, fracture, structural deformity, inflammatory disorder, or radiculopathy. Approximately 80% of the global population experiences at least one episode of low back pain (LBP) during their lifetime, with young adults increasingly reporting persistent symptoms (1,2). The socioeconomic burden of LBP is substantial, with lost productivity and healthcare expenditures placing significant pressure on health systems worldwide (3). The clinical presentation of NSLBP often includes pain, functional limitations, muscle imbalance, altered proprioception, and impaired neuromuscular control. Consequently, rehabilitation approaches must address not only pain but also biomechanical and neuromuscular dysfunctions. Among the conservative interventions employed, the McKenzie method, also known as Mechanical Diagnosis and Therapy (MDT), and Maitland mobilization techniques have been widely used (4,5). However, literature comparing their effects on functional biomechanical outcomes such as dynamic spinal stability and paraspinal muscle activity in young adults is scarce.

The McKenzie lumbar extension protocol emphasizes repeated movements and postural correction based on directional preference and mechanical loading to centralize symptoms (6). It is known for reducing pain and disability while promoting self-treatment and independence. Evidence suggests that McKenzie exercises influence the lumbar intervertebral disc dynamics and spinal kinematics, potentially improving neuromuscular control and spinal stability (7,8). Despite its clinical popularity, more objective, muscle-based outcome studies are required to support its efficacy beyond pain and ROM assessments. On the other hand, Maitland mobilization, a type of passive joint mobilization, involves graded oscillatory movements intended to decrease pain and restore accessory motion at spinal segments (9). The technique is rooted in neurophysiological and mechanical mechanisms, with studies suggesting that mobilization can influence proprioceptive feedback, spinal segmental motion, and muscle tone modulation (10,11). Maitland grades III and IV mobilizations are commonly employed for chronic or subacute LBP with stiffness or hypomobility. While both interventions target LBP symptomatology, their comparative effects on dynamic spinal stability—defined as the ability of the spine to maintain or return to equilibrium during movement—and paraspinal muscle activity, remain under-explored. The paraspinal muscles, including multifidus and erector spinae, play a crucial role in active spinal control. Dysfunction in these muscles has been associated with delayed activation, asymmetry, and reduced endurance in NSLBP patients (12,13).

Furthermore, altered neuromuscular patterns such as poor trunk coordination and reduced anticipatory muscle firing compromise postural control and load distribution across the lumbar spine (14). Emerging evidence supports electromyographic (EMG) and pressure biofeedback training to objectively assess paraspinal recruitment patterns and spinal control (15). However, limited RCTs have incorporated these as outcome measures when comparing McKenzie and mobilization protocols. Young adults represent a unique subset of LBP patients due to their active lifestyle, engagement in sports, or prolonged academic demands, all of which impose dynamic challenges on spinal biomechanics (16). Functional assessments targeting spinal control and endurance in this population are essential to prevent chronicity and improve quality of life. Thus, there is a clear research gap in evaluating how McKenzie and Maitland techniques affect functional and neuromuscular outcomes, especially in younger cohorts. The current randomized controlled trial

aims to compare the effects of the McKenzie lumbar extension protocol versus lumbar Maitland mobilization on pain intensity, dynamic spinal stability, and paraspinal muscle activation in young adults diagnosed with nonspecific low back pain.

Methodology

This randomized controlled trial was conducted over six months (from June to November 2024) at the outpatient physiotherapy department of Khyber Teaching Hospital, Peshawar. following approval from the Institutional Research Ethics Board (Approval No. PT-2025/032). A total of 40 participants, aged between 18 and 35 years, were recruited through purposive sampling. Inclusion criteria required a clinical diagnosis of NSLBP persisting for more than four weeks and less than three months, with pain rated between 3 and 7 on the Numerical Pain Rating Scale (NPRS). Participants were excluded if they had a history of spinal surgery, disc herniation confirmed via imaging, neurological deficits, systemic disorders, red flag symptoms (such as weight loss, night pain, or fever), or were currently undergoing other forms of physical therapy or using pain medications. After screening, informed written consent was obtained from all eligible participants. Participants were randomly assigned to two groups (n=20 per group) using a computer-generated randomization list, and allocation concealment was ensured using sealed opaque envelopes.

Group A received the McKenzie Lumbar Extension Protocol, which included prone and standing extension exercises such as prone lying, prone on elbows, prone press-ups, and standing lumbar extensions. These exercises were prescribed and supervised by a trained and expert physiotherapist three times per week for four weeks, with additional instructions for home-based repetitions. Group B received Lumbar Maitland Mobilization, which included Grade III and IV posterior-to-anterior central and unilateral oscillatory mobilizations targeted at hypo-mobile lumbar segments (identified during initial manual examination). Mobilizations were applied with the patient in a side-lying position, consisting of three to four bouts per segment, each lasting 60 seconds with a one-minute rest interval. Both interventions were standardized and delivered by experienced manual therapists trained in their respective techniques. Participants were instructed to avoid any other interventions or medications during the trial period. Outcome measures were collected at baseline and at the end of the four-week intervention period by a blinded outcome assessor. The primary outcome was pain intensity, measured using the Numerical Pain Rating Scale (NPRS), a reliable and valid 11-point scale ranging from 0 (no pain) to 10 (worst pain). Secondary outcomes included dynamic spinal stability assessed through the Functional Reach Test and the Dynamic Sitting Balance Test. Additionally, paraspinal muscle activity (erector spinae and lumbar multifidus) was measured using surface electromyography (EMG) during controlled trunk flexion and extension tasks. Raw EMG signals were band-pass filtered and normalized to maximal voluntary isometric contraction (MVIC) for comparison. Statistical analysis was performed using SPSS version 25. Descriptive statistics (means, standard deviations) were computed for demographic and baseline characteristics. The Shapiro–Wilk test was used to test data normality. Between-group comparisons were analyzed using independent sample t-tests for parametric data and Mann–Whitney U tests for non-parametric variables. Within-group pre- and post-intervention comparisons were performed using paired t-tests or Wilcoxon signed-rank tests, as appropriate. A p-value <0.05 was considered statistically significant. The study followed the ethical principles outlined in the Declaration of Helsinki. All data were handled confidentially, and participants were assured of voluntary participation with the right to withdraw at any time without any impact on their treatment. No adverse events were reported during the intervention period.

Results

A total of 40 participants completed the study—20 in each intervention group. No dropouts were reported. Baseline demographic and clinical characteristics, including age, gender, BMI, pain duration, and initial outcome scores, were statistically comparable between the McKenzie and Maitland groups, ensuring homogeneity of groups at the start of the study.

Table 1: Baseline Characteristics of Participants

Variable	McKenzie Group (n=20)	Maitland Group (n=20)	p-value
Age (years)	25.4 ± 4.1	24.9 ± 3.8	0.62
Gender (M/F)	11 / 9	10 / 10	0.76
BMI (kg/m²)	23.6 ± 2.8	23.9 ± 3.0	0.68
Pain Duration (weeks)	6.2 ± 1.5	6.0 ± 1.7	0.74
Baseline NPRS	6.3 ± 1.1	6.5 ± 1.2	0.55

Table one shows no statistically significant difference was observed in any baseline variable, confirming group comparability before intervention.

Table 2: Within-Group and Between-Group Comparison of Pain Scores (NPRS)

Time Point	McKenzie Group	Maitland Group	p-value (between)
Pre-treatment	6.3 ± 1.1	6.5 ± 1.2	0.55
Post-treatment	2.8 ± 1.0	3.7 ± 1.1	0.02*
Δ Change	-3.5	-2.8	

Table 2 shows that both groups demonstrated significant pain reduction ($p<0.001$); however, the McKenzie group showed significantly greater improvement in NPRS scores compared to the Maitland group ($p=0.02$).

Table 3: Functional Reach Test (FRT) – Measure of Dynamic Stability

Time Point	McKenzie Group (cm)	Maitland Group (cm)	p-value
Pre	25.1 ± 4.6	24.8 ± 4.3	0.82
Post	32.4 ± 3.9	29.1 ± 4.2	0.03*
Δ Change	+7.3	+4.3	

Table 3 shows that Both groups improved significantly in dynamic stability post-treatment. However, the McKenzie group showed a significantly greater improvement in Functional Reach ($p=0.03$).

Table 4: EMG Activation – Erector Spinae (%MVIC)

Time Point	McKenzie Group	Maitland Group	p-value
Pre	38.2 ± 5.5	37.9 ± 4.9	0.87
Post	49.5 ± 6.2	45.3 ± 5.7	0.04*
Δ Change	+11.3	+7.4	

Post-intervention EMG analysis showed statistically significant increases in erector spinae activation in both groups, with the McKenzie group achieving a greater gain ($p=0.04$).

Table 5: EMG Activation – Lumbar Multifidus (%MVIC)

Time Point	McKenzie Group	Maitland Group	p-value
Pre	31.4 ± 4.7	30.8 ± 5.1	0.71
Post	42.9 ± 5.3	39.1 ± 4.8	0.05*
Δ Change	+11.5	+8.3	

A significant improvement was observed in lumbar multifidus activation in both groups ($p<0.001$), with slightly superior results in the McKenzie group ($p=0.05$).

Discussion

This randomized controlled trial aimed to evaluate and compare the efficacy of the McKenzie Lumbar Extension Protocol and Lumbar Maitland Mobilization in young adults with nonspecific low back pain (NSLBP). The results demonstrated significant within-group improvements in pain intensity, dynamic spinal stability, and paraspinal muscle activity in both groups. However, the McKenzie group showed greater gains across all outcome measures, indicating that the McKenzie protocol may be more effective than segmental mobilization alone. The significant pain reduction observed in both groups is consistent with previous literature showing the short-term benefits of both manual therapy and directional preference exercises for NSLBP (1,2). However, the superior outcomes in the McKenzie group reinforce the theoretical basis of this approach—emphasizing symptom centralization, directional preference, and patient self-management. A study by Garcia et al. (2021) highlighted the long-term pain-relieving benefits of McKenzie therapy in mechanically induced low back pain, attributing them to disc unloading and neuromechanical reprogramming (3).

Dynamic spinal stability, assessed using the Functional Reach Test (FRT), improved significantly post-intervention, particularly in the McKenzie group. This improvement may be linked to repeated lumbar extension movements improving proprioceptive input and central motor control (14). Previous trials have reported that active, task-specific exercises result in better postural correction and core control compared to passive mobilizations (16). The results of this study align with those findings, suggesting that the McKenzie protocol enhances segmental stability through neuromuscular re-education. Increased paraspinal muscle activation (measured via surface electromyography) in both groups indicates improved neuromuscular function; however, the McKenzie group demonstrated greater post-treatment EMG amplitude. This supports existing literature suggesting that active interventions—particularly those involving trunk extension—are more effective at targeting the deep spinal stabilizers, such as the multifidus and erector spinae (6,7). According to Hides et al. (2019), restoring function in these muscles is crucial for long-term recovery and recurrence prevention in NSLBP patients (18).

The Maitland Mobilization technique, while effective in reducing segmental stiffness and modulating pain through neurophysiological pathways, may not sufficiently activate the deep stabilizing musculature (19). It appears that its benefits are limited primarily to the short-term restoration of joint mobility and pain inhibition through the gate control mechanism (20). Conversely, the McKenzie method incorporates active loading, encouraging muscle co-contraction and motor pattern retraining (21). The findings also highlight the role of lumbar lordosis restoration through directional exercises. Maintaining lumbar curvature is essential for spine mechanics, shock absorption, and load distribution. A study by Moustafa et al. (2020) emphasized the effectiveness of lumbar extension protocols in correcting sagittal imbalance and restoring physiological lordosis, which contributes to pain reduction and better trunk stability (22).

Importantly, this study targeted young, physically active adults—a population that generally responds more favorably to exercise-based protocols due to enhanced neuromuscular adaptability and tissue plasticity (23). Active engagement in treatment, such as that facilitated by the McKenzie protocol, also enhances patient autonomy, compliance, and satisfaction (24). However, it is essential to recognize the limitations of this trial. The study duration was relatively short (4 weeks), and no long-term follow-up was performed to assess sustainability of results. Furthermore, surface EMG has inherent limitations in detecting deep muscle activation, and future studies may benefit from using ultrasound imaging or intramuscular EMG for more precise measurements (25).

Despite these limitations, the current findings support existing recommendations for using active, patient-directed protocols in NSLBP management (26,27). Incorporating McKenzie principles not only improves clinical outcomes but also empowers patients with self-treatment strategies, potentially reducing recurrence and healthcare dependency (28). In conclusion, while both intervention strategies demonstrated clinical effectiveness, the McKenzie Lumbar Extension Protocol produced superior outcomes in pain relief, functional stability, and paraspinal muscle activation. These findings support the inclusion of McKenzie-based

interventions as a primary approach in managing NSLBP among physically active young adults.

Conclusion

This randomized controlled trial compared the effects of the McKenzie Lumbar Extension Protocol and Lumbar Maitland Mobilization on pain intensity, dynamic spinal stability, and paraspinal muscle activity in young adults with nonspecific low back pain. The results demonstrated that both interventions were effective in alleviating symptoms and improving functional outcomes. However, the McKenzie protocol produced significantly greater improvements across all variables, including pain reduction, functional postural control, and paraspinal muscle activation. The superiority of the McKenzie approach may be attributed to its active, movement-based nature, which not only addresses mechanical dysfunctions but also enhances neuromuscular re-education and postural stability. In contrast, Maitland mobilization, while effective in segmental pain relief and mobility, lacked the same impact on muscular endurance and dynamic spinal function.

Given the increasing emphasis on active rehabilitation and patient-driven care, McKenzie exercises appear to offer a more comprehensive and sustainable solution for managing nonspecific low back pain in young, physically active individuals. These findings support incorporating McKenzie protocols as a frontline intervention in clinical practice, particularly for patients seeking self-management strategies and long-term relief. Future studies should explore the long-term benefits and recurrence rates following both interventions to further inform clinical decision-making

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