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Research Article

Effectiveness of Core Stability Exercises in Preventing Recurrence of Lumbar Disc Herniation: A Prospective Controlled Trial

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ABSTRACT

Background: Lumbar disc herniation is a prevalent spinal condition leading to chronic pain and disability. Despite various interventions, recurrence rates remain significant. Core stability exercises have been proposed as a potential preventive strategy due to their role in enhancing spinal stability. **Objective:** To evaluate the effectiveness of core stability exercises in reducing pain, improving functional outcomes, and preventing recurrence of lumbar disc herniation over a two-year follow-up period. **Methods:** A prospective controlled trial with 90 participants was conducted. Participants were randomly allocated into two groups: core stability exercises (n=45) and conventional physiotherapy (n=45). Baseline assessments included Visual Analog Scale (VAS) for pain, Oswestry Disability Index (ODI), and MRI imaging. Interventions were supervised, and adherence was monitored. Follow-up assessments were conducted at regular intervals, with recurrence rates analyzed using Kaplan-Meier survival analysis. Statistical analyses were performed using SPSS 25.0, with $p < 0.05$ considered significant. **Results:** The intervention group showed a significant reduction in VAS scores (baseline: 6.2 ± 1.3 ; 24 months: 1.8 ± 0.9 , $p < 0.001$) and ODI scores (baseline: 38.4 ± 5.6 ; 24 months: 15.2 ± 3.9 , $p < 0.001$). Recurrence rates were lower in the intervention group (8.9% vs. 26.7%, $p = 0.03$), with a hazard ratio of 0.31 (95% CI: 0.11–0.89). **Conclusion:** Core stability exercises significantly reduced pain improved functional outcomes, and lowered recurrence rates of lumbar disc herniation. These findings highlight the value of incorporating core stability exercises into rehabilitation programs.

Keywords: Lumbar Disc Herniation, Core Stability Exercises, Low Back Pain, Spinal Rehabilitation, Chronic Pain, Recurrence Prevention, Physiotherapy.

INTRODUCTION

Core stability exercises have emerged as a cornerstone in management and prevention of lumbar disc herniation and chronic low back pain, conditions that significantly impair functional abilities and quality of life. Lumbar disc herniation, a prevalent spinal disorder, often results from repetitive strain, poor postural control, or inadequate core muscle support, leading to neural impingement and debilitating pain.

The integration of core stability exercises into rehabilitation programs has gained attention due to their potential to address the underlying biomechanical dysfunctions associated with these conditions. Studies have demonstrated that these exercises not only enhance the activation and endurance of abdominal and lumbar muscles but also reduce pain intensity and functional disability, thereby improving patients' overall quality of life (1, 2, 3).

The effectiveness of core stability exercises lies in their ability to restore muscular balance and optimize neuromuscular control of the

lumbar-pelvic region. This is particularly important as weakened or underactive core muscles can exacerbate mechanical stress on the lumbar spine, increasing the risk of disc degeneration and herniation. Interventions involving core stability exercises have shown promising outcomes, such as reductions in pain severity, improvements in lumbar flexibility, and enhanced muscle activation, particularly in the transversus abdominis, multifidus, and oblique muscles (4, 5). Notably, advanced variations, including suspension-based exercises, have been identified as superior in certain parameters, such as muscle activation and proprioception, compared to conventional approaches (6, 7). In addition to managing symptoms, core stability exercises play a pivotal role in the prevention of recurrent lumbar disc herniation by mitigating risk factors such as reduced lumbar lordosis, poor spinal alignment, and inadequate muscle support.

Preventive strategies are crucial, as recurrence rates in lumbar disc herniation remain significant, leading to persistent disability and socioeconomic burden (8, 9). Research highlights the synergistic benefits of combining core stability exercises with other modalities, such as spinal decompression therapy, which further amplifies therapeutic outcomes by addressing both structural and functional impairments (10).

Despite the evidence supporting their efficacy, successful implementation of core stability exercises requires careful

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consideration of individualized patient needs, adherence to exercise protocols, and appropriate supervision to ensure optimal outcomes. This underscores the importance of refining exercise programs to maximize their benefits and minimize risks. Given their non-invasive nature, cost-effectiveness, and broad applicability, core stability exercises represent a valuable intervention for both the management and prevention of lumbar disc herniation and associated chronic low back pain, warranting continued exploration in clinical and research settings (11, 12).

MATERIAL AND METHODS

This prospective controlled trial was conducted to evaluate the effectiveness of core stability exercises in the prevention of recurrence of lumbar disc herniation. The study included a total sample size of 90 participants, recruited through purposive sampling. Eligible participants were screened based on predefined inclusion and exclusion criteria, ensuring they had a history of lumbar disc herniation confirmed by magnetic resonance imaging (MRI) and met the requirements for participation in a supervised rehabilitation program. Participants with significant comorbidities or contraindications to physical therapy were excluded from the study. The trial adhered to a 2-year follow-up protocol to monitor recurrence rates and assess the long-term effects of the intervention.

Ethical approval for the study was obtained from the institutional ethics committee, and the research followed the principles outlined in the Declaration of Helsinki (1964) and its subsequent amendments. Written informed consent was obtained from all participants prior to enrollment, ensuring their voluntary participation and understanding of the study's purpose and procedures. Data collection was performed by trained researchers using standardized tools and methodologies. Baseline assessments included detailed clinical evaluations, MRI imaging to document the extent of lumbar disc herniation, and patient-reported outcome measures such as the Oswestry Disability Index (ODI) and Visual Analog Scale (VAS) for pain. Functional ability and muscle endurance were assessed using validated physical performance tests, ensuring consistent and reliable data collection. Follow-up assessments were conducted at regular intervals during the 2-year

study period to monitor changes in pain, functional ability, and recurrence rates of lumbar disc herniation.

Participants were randomly assigned to either an intervention group or a control group. The intervention group underwent a structured core stability exercise program supervised by experienced physiotherapists, focusing on the activation and strengthening of core muscles, including the transversus abdominis, multifidus, and obliques. The control group received conventional physiotherapy treatment without targeted core stability exercises. Both groups were encouraged to maintain compliance with their respective rehabilitation protocols throughout the study period.

Statistical analysis was conducted using SPSS software, version 25.0, with an alpha level set at 0.05. Descriptive statistics were used to summarize baseline characteristics, while inferential tests such as paired t-tests and chi-square tests were employed to compare outcomes between groups. Recurrence rates were analyzed using Kaplan-Meier survival analysis to evaluate time-to-event data, and Cox proportional hazards models were used to identify predictors of recurrence. Missing data were handled using multiple imputation methods to ensure the robustness of the results.

The study adhered to strict quality control measures to ensure accuracy and validity of data. Regular training sessions for research personnel and periodic audits of data collection procedures were conducted. The findings from this study aim to provide evidence-based insights into the role of core stability exercises in the prevention of lumbar disc herniation recurrence.

RESULTS

This study evaluated the effectiveness of core stability exercises compared to conventional physiotherapy in preventing the recurrence of lumbar disc herniation over a 2-year follow-up period. A total of 90 participants were enrolled and evenly randomized into two groups: the intervention group (core stability exercises, n=45) and the control group (conventional physiotherapy, n=45). Baseline demographic and clinical characteristics, as shown in Table 1, were similar between the two groups, ensuring comparability ($p > 0.05$).

Table 1: Baseline Characteristics of Participants

Characteristic	Intervention Group (n=45)	Control Group (n=45)	p-value
Mean Age (years)	42.3 ± 6.8	41.7 ± 7.1	0.68
Male (%)	62	58	0.74
Baseline ODI Score (%)	38.4 ± 5.6	39.1 ± 6.1	0.59
Baseline VAS Score (cm)	6.2 ± 1.3	6.5 ± 1.4	0.31

The intervention group demonstrated significant improvements in pain reduction and functional ability compared to the control group. Pain levels, measured using the Visual Analog Scale (VAS), decreased substantially from baseline to 24 months in both groups; however,

the reduction was more pronounced in the intervention group. Similarly, functional disability, assessed using the Oswestry Disability Index (ODI), showed greater improvement in the intervention group. These findings are summarized in Table 2.

Table 2: Clinical Outcomes

Outcome	Intervention Group (Mean ± SD)	Control Group (Mean ± SD)	p-value
VAS Score (Baseline)	6.2 ± 1.3	6.5 ± 1.4	0.31
VAS Score (24 months)	1.8 ± 0.9	3.9 ± 1.2	<0.001
ODI Score (Baseline)	38.4 ± 5.6	39.1 ± 6.1	0.59
ODI Score (24 months)	15.2 ± 3.9	25.7 ± 5.1	<0.001

Recurrence rates of lumbar disc herniation were significantly lower in the intervention group, with only 4 participants (8.9%) experiencing recurrence, compared to 12 participants (26.7%) in the control group ($p = 0.03$). Kaplan-Meier survival analysis revealed a statistically significant advantage for the intervention group in preventing recurrence, with a log-rank test showing $p = 0.02$. The hazard ratio for recurrence in the intervention group was 0.31 (95% CI: 0.11–0.89, $p = 0.03$). These results are presented in Table 3.

Further analysis using Cox proportional hazards regression identified adherence to the exercise protocol and baseline muscle endurance as significant predictors of reduced recurrence. Participants who

adhered to the prescribed exercise regimen had a hazard ratio of 0.28 (95% CI: 0.09–0.87, $p = 0.03$), while higher baseline muscle endurance was associated with a hazard ratio of 0.34 (95% CI: 0.12–0.96, $p = 0.04$).

The results indicate that core stability exercises were more effective than conventional physiotherapy in reducing pain, improving functional outcomes, and lowering recurrence rates of lumbar disc herniation over the 2-year follow-up. These findings underscore the importance of targeted core muscle rehabilitation in preventing recurrence and enhancing recovery in patients with lumbar disc herniation.

Table 3: Recurrence Rates and Hazard Ratios

Group	Recurrence (%)	Hazard Ratio (95% CI)	p-value
Intervention Group	8.9	0.31 (0.11–0.89)	0.03
Control Group	26.7	Reference	-

DISCUSSION

The findings of this study demonstrated that core stability exercises were significantly more effective than conventional physiotherapy in reducing pain, improving functional outcomes, and preventing the recurrence of lumbar disc herniation over a two-year follow-up period. These results align with previous studies that emphasized the importance of core muscle strengthening in mitigating biomechanical stress on the lumbar spine and enhancing neuromuscular control (1, 2). The intervention group experienced notable improvements in Visual Analog Scale and Oswestry Disability Index scores, corroborating earlier research that highlighted the role of core stabilization in alleviating pain and restoring functional ability in patients with lumbar spine disorders (3, 4).

The reduction in recurrence rates observed in this study further underscored the preventive potential of core stability exercises. Only 8.9% of participants in the intervention group experienced a recurrence compared to 26.7% in the control group, a difference supported by Kaplan-Meier survival analysis. This finding was consistent with literature suggesting that targeted core rehabilitation strengthens key stabilizing muscles, including the transversus abdominis and multifidus, which are critical for spinal stability and resilience against recurrent herniation (5, 6). The enhanced adherence to the exercise protocol in the intervention group also contributed to these outcomes, as adherence has been previously identified as a key factor in the success of rehabilitation programs (7).

Despite these strengths, the study had certain limitations. The sample size, though sufficient to detect significant differences, may not fully capture the variability in outcomes across diverse populations. Additionally, while efforts were made to standardize the exercise protocols, individual variations in exercise execution and compliance may have influenced the results. Another limitation was the reliance on patient-reported outcomes for pain and function, which, although validated, could be subject to reporting bias. The study did not include imaging follow-ups, which might have provided more detailed insights into structural changes associated with the interventions. Future research could address these gaps by incorporating larger, more diverse cohorts and advanced imaging modalities to explore the long-term impact of core stability exercises on lumbar spine health.

The study's strengths included its prospective controlled design and a robust two-year follow-up period, allowing for a comprehensive evaluation of both immediate and long-term effects. The use of validated outcome measures and rigorous statistical analysis further reinforced the reliability of the findings. The inclusion of Kaplan-Meier survival analysis and Cox proportional hazards modeling provided a nuanced understanding of recurrence risks and their predictors. The results underscored the importance of individualized rehabilitation programs tailored to patients' specific needs and baseline functional status. Incorporating core stability exercises into routine physiotherapy regimens could enhance clinical outcomes, particularly in patients at high risk of recurrence. However, achieving sustained adherence to exercise protocols remains a challenge, highlighting the need for innovative strategies such as digital interventions, patient education, and structured follow-up support to improve compliance.

CONCLUSION

In conclusion, the study provided compelling evidence supporting the efficacy of core stability exercises in reducing pain, improving functional outcomes, and preventing recurrence in patients with lumbar disc herniation. These findings have important implications for clinical practice, emphasizing the value of incorporating targeted core muscle rehabilitation into standard care for lumbar spine

disorders. Future studies should aim to refine these interventions further and explore their integration with other modalities to optimize patient outcomes.

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