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Effects of Tailored Stabilization Exercise Regimens on Lumbar Instability

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Abstract

Background: The primary goals of Lumbar Stabilization Exercises (LSE) are to increase the muscles' neuromuscular control, strength, and endurance, essential for dynamic trunk and spinal stability. Even though LSE is a highly successful treatment for lumbar instability and pain reduction, further research is necessary to fully understand its effects and maximize its use for a larger population.

Methods: Patients aged between 40 and 60 years with symptoms of lower back pain were included in the study. The patients were chosen based on the diagnosis, symptoms, and clinical presentation, consistent with a radiologic diagnosis of spondylosis and spondylolisthesis. Exercise sessions gradually increased in duration, with a pressure biofeedback monitor ensuring ten accurate contractions held for 10 seconds each. Low-load leverage through the limbs was introduced to progress the workouts.

Results: The significant decrease in pain levels reflects the positive impact of stability exercises on the functional disability level of patients. The baseline mean disability level of 26.34 exhibited notable improvement, decreasing to 16.23 with a mean difference of 10.11. The statistical significance of this mean difference ($p<0.05$) provides compelling evidence to reject the null hypothesis, affirming the effectiveness of the intervention in positively influencing the disability level among the participants

Conclusion: The study's findings highlight the beneficial effects of customized stabilization exercise programs on lumbar instability and persistent low back pain. The intervention showed substantial improvements in functional impairment and pain reduction across participants, focusing on individualized graded lumbar stabilization exercises.

Keywords

Exercise, Low Back Pain, Lumbar Region, Spondylosis.

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Introduction

Lumbar instability and Chronic Low Back Pain (CLBP) frequently combine and impact a significant percentage of patients—up to 57%, according to estimates[1]. Approximately 85–95% of lower back pain (LBP) cases are classified as Non-Specific LBP (NSLBP) since they do not have a clear etiology or identifiable pathology[2]. According to a previous systematic study, the estimated prevalence of CLBP worldwide is 20.1%, and a steady rise is found starting in the third decade of life. LBP is the most prevalent musculoskeletal condition, affecting over 30% of patients requiring physiotherapy[3-4]. The muscular imbalances and subsequent motor dysfunctions resulting from acute low back pain may progress to chronic pain based on the frequency of recurrences[5]. In people with persistent low back pain, lumbar instability—which is frequently linked to weakening lumbar muscles—contributes to psychological problems, including anxiety and depression, as well as a lower quality of life. Identifying muscular imbalances and lumbar instability as the leading causes of low back pain, keeping good posture, and putting exercise regimens to improve balance becomes essential for pain management[6-7]. Exercise regimens with different modes and intensities are frequently prescribed to patients with low back pain to address muscular strengthening and balance control[8]. Exercise regimens for stabilization, which aim to reduce discomfort and promote functional recovery by increasing muscular activation through trunk muscle contractions, have shown promising results as per available evidence. Stabilizing the deep muscles, such as the quadratus lumborum, erector spine, multifidus, iliopsoas, and abdominals, is essential for maintaining the stability of the spine[9-10]. Exercise is an effective intervention for improving the back's strength, mobility, endurance, and functional impairment. Various exercise modalities have been proposed to address CLBP, emphasizing lumbar stabilization and core strengthening[11-12]. These modalities include "Lumbar Stabilization Exercise (LSE), Motor Control Exercise, Core Exercise, Lumbar Flexion Exercise, Walking Exercise (WE), and Bracing Exercise".

Although various exercises are available, there needs to be more proof to conclude that any one therapy plan is effective[13]. The primary goals of lumbar stabilization exercises are to increase the neuromuscular control, strength, and endurance of the muscles essential for dynamic trunk and spinal stability[14]. Notably, it is considered a multi-stage, affordable, and safe workout. Individualized Graded Lumbar Stabilization Exercise (IGLSE) is a personalized lumbar stabilization exercise program proposed to recognize the heterogeneity in lumbar muscle strengths among individuals[15]. IGLSE uses a range of postures and intensities that may be adjusted to optimize therapeutic advantages for individual patients. Because of its graduated protocol with adjustable intensity, this customized technique increases exercise safety by strengthening the lumbar musculature without flexion or extension and encourages high compliance. Even though LSE is a

highly successful treatment for lumbar instability and pain reduction, further research is necessary to fully understand its effects and maximize its use for a larger population.

Methodology

Study Size

A total of 50 patients with low back pain were included in the study.

Study Setting

The study was conducted at rehabilitation centres in Karachi.

Study Design

This study was a quasi-experimental study design. The patients were recruited via a convenience sampling method. All the patients were briefed about the study protocol, its benefits, and risks.

Selection Criteria

- ***Inclusion Criteria***
  Patients aged 40-60 years with symptoms of lower back were included in the study. The patients were chosen based on the diagnosis, symptoms, and clinical presentation, consistent with a radiologic diagnosis of spondylosis and spondylolisthesis.

- ***Exclusion Criteria***
  Patients with diagnosed psychological illness, inflammatory joint disease, difficulty in comprehending the English language that prevents the participants from responding to the questionnaire, and a history of spine surgery were excluded from the study.

Outcome Measures

- ***Pain Measures***
  For the estimation of pain, a visual analogue pain scale was used[16].

- ***Functional Measures***
  The level of functional disability of each participant was determined by computing a percentage score using the Oswestry Disability Questionnaire. This reliable questionnaire is used broadly to assess and calculate the treatment effects regarding adjustment in how people with persistent low back pain can move around functionally[17].

Intervention

The standardized treatment involved instructing patients in specific activities to engage deep abdominal muscles while preventing substitution by larger torque-producing muscles. Exercise sessions gradually increased in duration, with a pressure biofeedback monitor ensuring ten

accurate contractions held for 10 seconds each. Low-load leverage through the limbs was introduced to progress the workouts. Once correct activation was confirmed, co-contraction patterns were integrated into symptomatic postures and activities. Patients were encouraged to regularly engage these muscles during daily activities to enhance lumbar spine dynamic stability. Sessions lasted approximately 15 minutes, occurring four times a week over 12 weeks.

Blinding was maintained throughout the process, ensuring unbiased evaluation. Therapists provided clear instructions for stimulating deep muscles, with exercises progressing from basic contractions to functional postures. Correct muscle activation was verified through the use of a pressure biofeedback monitor. The session lasted about 15 minutes, with a frequency of 4 times a week for 12 weeks.

Ethical Considerations

The study was conducted in the physical therapy department of Al-Shifa Hospital, IRB#ASC-PT-011/02/2020. Ethical standards in all parameters were fulfilled, including confidentiality of information, autonomy and non-malfeasance as provided in the Helsinki Declaration for studies incorporating human subjects.

Statistical Analysis

Data was analyzed using SPSS software version 21. The demographic data was analyzed using descriptive statistics with mean and standard deviation. A paired sample t-test was performed for inferential statistics to compare the mean differences in pain scores at the pre- and post-level whereas a p-value <0.05 was considered statistically significant results.

Results

A total of 50 patients were recruited in the study with a mean age of 48.22±9.20. The mean and standard deviation of the pre- and post-stages of the VAS pain score are presented in Table 1. The mean pain score at the pre-stage was 7.84±0.95, which reduced up to 3.74±0.83 after 12 weeks of intervention with a p-value of <0.01.

Table-1 Mean comparison of pain scores using VAS scale

VAS	Mean±S.D.	Mean Difference	P-Value
Pre	7.84±0.95	4.1	<0.01*
Post	3.74±0.83		

**Significant*
n=50

Table-2 depicts the effects of stability exercises on the functional disability level of patients after 12 weeks of intervention. The results revealed a positive impact on disability level, with a mean value of 26.34 at baseline reduced to 16.23 with a mean difference of 10.11. The fact that the $p<0.05$ suggests that this mean difference is statistically significant, providing strong evidence to reject the null hypothesis that the intervention has no effect. In practical terms, this means that the observed decrease in disability levels is unlikely to be due to random chance alone.

Table-2 Mean comparison of functional disability using ODI

VAS	Mean±S.D.	Mean Difference	P-Value
Pre	26.34±2.45	10.11	<0.01*
Post	16.23±3.89		

**Significant*
n=50

Discussion

The analyses of the findings revealed that at baseline, the average pain score at the pre-intervention stage was 7.84±0.95, demonstrating a substantial reduction to 3.74±0.83 after 12 weeks of intervention ($p<0.01$). This significant decrease in pain levels reflects the positive impact of stability exercises on the functional disability level of patients. The baseline mean disability level of 26.34 exhibited notable improvement, decreasing to 16.23 with a mean difference of 10.11. The statistical significance of this mean difference ($p<0.05$) provides compelling evidence to reject the null hypothesis, affirming the effectiveness of the intervention in positively influencing the disability level among the participants. In a randomized controlled study design, 48 individuals suffering from persistent LBP were compared for their response to WE against IGLSE[15]. Exercise for flexibility, WE, Stabilization Exercise (SE), and Stabilization with WE (SWE) were the four groups into which participants were split. Following a six-week intervention, all groups significantly decreased LBP during physical exercise. The SE group had a significant increase in activity time, whereas the WE group saw a significant increase in exercise frequency. In both the WE and SWE groups, there was a considerable improvement in the endurance of supine, side-lying, and prone positions.

A study revealed that lumbar SE and WE may result in increased muscular endurance and thus can aid in relieving back pain and preventing its persistency[15]. Another study examined the effects of a progressive stabilization exercise program on respiratory resistance in patients with lumbar instability and randomized 43 volunteers to either the experimental or control group. Whereas the control group just conducted progressive lumbar stabilization exercises, the

experimental group coupled respiratory resistance with progressive lumbar stabilization activities. For both groups, the therapies, which lasted four weeks, three times a week for forty minutes each, significantly reduced pain levels and improved psychosocial stability, balance, and Fear-Avoidance Beliefs Questionnaire (FABQ) scores[16]. On the other hand, the experimental group showed higher improvements in FABQ scores and balancing ability[16]. This study underlines the usefulness of gradual stabilization exercises with respiratory resistance to improve respiratory and motor functioning, lower discomfort, and foster psychosocial well-being[17]. A systematic review identified the effects of core stability exercises in reducing back pain and lumbar lordosis. According to the research, simple, highly efficient workouts that focus on strengthening the muscles and pelvic nucleus may prevent lumbar lordosis and lower back pain. It is emphasized that improving core stability is a crucial way to deal with the underlying issues, lessen functional abnormalities, and reduce discomfort[18]. The study's conclusions are valid by including reliable and generally recognized outcome measures, such as the Oswestry Disability Index and the visual analogue pain scale. The study's robustness is further increased using a standardized intervention regimen and a sample size of 50 individuals. There are, however, a few shortcomings to take into account. A control group is needed to compare the intervention results with those of a non-intervention group, and the study's quasi-experimental design may make it more challenging to establish a definitive cause-and-effect link. Furthermore, the study's single-centre design and convenient sampling technique may impact the results' generalizability to larger populations. Notwithstanding these drawbacks, the research offers insightful information on the beneficial effects of stability exercises on pain relief and improved functional impairment in people with lower back pain.

Conclusion

This study's findings highlight the beneficial effects of customized stabilization exercise programs on lumbar instability and CLBP. The intervention showed substantial improvements in functional impairment and pain reduction across participants, focusing on individualized graded lumbar stabilization exercises. The results are consistent with other research showing the beneficial effects of lumbar stabilization exercises for treating lower back pain and enhancing general well-being.

Acknowledgment
None.

Conflict of Interest
None.

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None.

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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design: Zaveri M

Acquisition, Analysis or Interpretation of Data: Osama M, Afzal M

Manuscript Writing & Approval: Faiz A, Afzal M

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.