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Research Article

Effects of Core Stability and Mckenzie Exercises in Low Back Pain with Extension Preference

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ABSTRACT

Introduction: Low back pain is a leading cause of disability worldwide. Various treatments have been recommended to address this prevalent issue, with core stability and McKenzie exercises being among the most evidence-based options. However, recent comparative studies lack mechanical assessment and functional tests. This study compares the effects of core stability and McKenzie exercises on the range of motion, pain, disability, and function in patients with mechanical low back pain.

Materials and Methods: In this clinical trial, 22 patients received core stability exercises, and 22 received McKenzie exercises based on individual mechanical assessments. Before treatment, each patient underwent mechanical assessment via the McKenzie mechanical assessment form, pain assessment using the visual analog scale, disability evaluation with the Oswestry disability index questionnaire, muscle control, as well as function assessment with unilateral single limb stance, and range of motion evaluation using fingertip-to-floor distance measurements. All variables were measured again after 8 sessions over two weeks of intervention.

Results: Both groups showed significant improvements in trunk flexion range of motion, disability, functional status, and pain (P>0.05). However, the two groups had no significant differences (P<0.05).

Conclusion: Both core stabilization and McKenzie exercises are effective in reducing pain disability, increasing range of motion, and enhancing functional status in patients with mechanical low back pain.

Keywords:

Low back pain; Exercise therapy; Core stability; Range of motion

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Introduction

Low back pain is a prevalent musculoskeletal disorder that affects a large portion of the global population and is recognized by the World Health Organization (WHO) as one of the leading causes of disability in humans. Most cases are classified as mechanical nonspecific low back pain, characterized by an unknown injury to the vertebral column [1]. In approximately 90% of chronic low back pain cases, clinicians are unable to pinpoint a specific diagnosis or pathological cause, leading to the classification of chronic nonspecific low back pain.

Recent reviews have demonstrated that passive interventions such as ultrasound, thermal agents, and massage, without incorporating exercise therapy, are not as effective as exercise-based treatment regimens in reducing pain in adults with chronic nonspecific low back pain [2]. Core stability, which involves maintaining a neutral spinal position to improve core stability, helps in effectively transmitting force from muscle contractions to the vertebral column, ultimately reducing the risk of premature fatigue and injury [3].

The abdominal muscles, specifically the transverse abdominis and multifidus, play a crucial role in the local stability of the lumbar spine. These muscles provide stability and proprioceptive inputs to the lumbar spine [4]. Proprioception, a key component of the somatosensory system, provides sensory inputs to the central nervous system and aids postural control.

Studies indicate that patients with low back pain often exhibit decreased proprioception compared to individuals without back pain, leading to difficulties in maintaining a neutral spinal position and contributing to ongoing pain [5]. Reduced anticipatory capacity of the transverse abdominis muscle in patients with low back pain can result in diminished local protective function in the lumbar spine, indicating poor motor control and weakness in this muscle and the multifidus. These muscles are critical stabilizers that help reduce pressure on the lumbar spine and are important risk factors associated with chronic low back pain [6].

Various methods are available for treating low back pain, with exercise therapy being highlighted as one of the most beneficial interventions, especially for managing subacute and chronic low back pain, according to the American Physical Therapy Association (APTA) guidelines [7]. Core stability exercises focus on co-contracting the abdominal muscles through motor learning, connecting them to the thoracolumbar fascia to enhance stiffness and local stability by increasing intra-abdominal pressure [8]. Additionally, these exercises can induce changes in the brain's motor cortex, improving muscle behavior and supporting the essential functions of core stabilizer muscles [9]. They also can reduce pain and disability and improve proprioception in patients with low back pain [10-12].

McKenzie exercises represent another type of exercise therapy offering a comprehensive system for assessing, classifying, and treating musculoskeletal disorders, focusing on patient self-management [13]. Studies have indicated that when performed by a skilled therapist, the McKenzie method exhibits appropriate reliability [13-16] and can lead to reductions in pain, drug consumption, and improvements in activities of daily living for patients with low back pain [17-20] by centralization phenomenon [17] and also is applicable in managing chronic nonspecific low back pain as mentioned in previous guidelines [7].

In alignment with the APTA guidelines for managing low back pain, motor control and directional preference exercises, such as McKenzie exercises, are among the most evidence-based approaches for managing low back pain. Although it can be prescribed in any phase of low back pain, it is more evident in the chronic stage [7].

Despite exercise therapy being a crucial element in treating chronic low back pain, there is a lack of conclusive evidence regarding the more effective type of exercise. Therefore, further research is essential to compare the effects of these exercise modalities [2]. No studies have compared the effects of McKenzie and core stability exercises on balance with functional tests. A study compared pain, disability, and the thickness of the transverse abdominis and multifidus muscles after the intervention with McKenzie and core stability exercises [19].

In summarizing the existing research with similar titles, we found a lack of mechanical assessment and the use of the Oswestry disability index (ODI), which is considered the gold standard questionnaire for low back pain due to its highest reliability and repeatability among all indexes. None of these studies incorporated functional tests to assess patients [19-23].

Experts typically utilize clinical tests to evaluate muscle coordination and lumbar spine stability, emphasizing the need for reliability in these assessments. Among the few standardized and validated functional tests for assessing lumbar muscle coordination clinically, the functional single-limb stance stands out for its appropriate reliability, with kappa coefficient ranges between 0.88 and 1 [24].

Several studies have been conducted to compare the effects of McKenzie and core stability exercises, each using different outcome measures, leading to contradictory results [23, 25-27]. While some studies point out that McKenzie exercises are more effective than manual therapy and core stability exercises, others report the opposite. Limited evidence exists comparing the two methods regarding the lumbar spine range of motion. Most studies indicate that core stability exercises are more effective in reducing disability and increasing the thickness of core stabilizer muscles. However, Hlaing et al. pointed out that the relationship between reduced pain and disability and increased thickness of core stabilizer muscles might not be significant [28].

In another study in India on 30 patients, core stability exercises were found to be more effective in reducing pain and disability in low back pain patients than McKenzie exercises [25]. Conversely, a study in Pakistan on 120 patients reports that McKenzie exercises are more effective in reducing pain and disability compared to routine physiotherapy that includes simple back extensor strengthening, pelvic tilt, cat-lion stretch, lion, static abdominal crunch, and reverse crunch exercises [29].

Given the high prevalence of low back pain, the limited evidence on the most effective exercise modalities, and the conflicting results from previous studies, further research in this field is imperative. Mechanical assessments are missing in most studies, and the sole study conducted in Iran failed to incorporate the ODI questionnaire and range of motion assessments alongside mechanical assessments using McKenzie forms and functional tests. Moreover, there is a lack of attention to tailoring exercises based on directional preferences (McKenzie exercises) (Figures 1, 2, 3 and 4). Addressing these gaps could streamline treatment, reduce costs, and enhance patient satisfaction.

Materials and Methods

Study design

This study was a randomized clinical trial in which participants were selected using simple, purposive sampling. The research was conducted in the Faculty of Rehabilitation, Shahid Beheshti University of Medical Sciences.

Study participants

This study was conducted on 44 patients suffering from chronic low back pain. The sample size was obtained based on a similar study's Mean±SD [25].

Inclusion criteria

The participants should be 30-65 with a body mass index (BMI) below 30 kg/m^2. They should experience mechanical low back pain with extension directional preference, a subcategory of nonspecific low back pain, first confirmed by mechanical assessment form before intervention for both groups, with or without radiculopathy. They were referred and diagnosed by medical doctors and had a minimum pain intensity of 3 on the visual analog scale (VAS). They should have no history of abdominal or lumbar surgeries within the past month and a baseline to identify their painful positions.

Exclusion criteria

The exclusion criteria included structural problems such as spondylosis, disk herniation, excessive lordosis, kyphosis, and scoliosis, as indicated in a clinician's magnetic resonance imaging (MRI) reports. Patients with a history of tumors, recent trauma or fractures, infections within the past month, incontinence, pregnancy, short hamstrings, brain injuries, vestibular disorders, alcohol or drug addiction, or those unwilling to continue in the study were also excluded.

Study procedure

Therapists matched the inclusion and exclusion criteria and assigned a number to each participant using a random method involving a dice, where even numbers were allocated to the McKenzie exercises group and odd numbers to the core stability exercises group. Patients were unaware of their assigned group to maintain blinding throughout the study.

Assessments were conducted using the mechanical diagnosis and treatment (MDT) form, and patients were divided into two groups: Group 1 received McKenzie exercises, and group 2 received core stability exercises. Both groups were assessed using the ODI, which evaluates patient disability through 10 questions covering various life situations, as well as pain intensity using the VAS, muscle control, and balance via the functional single limb stance, and the fingertip-to-floor (FTF) distance measurement in centimeters. At the end of the first session, patients were instructed not to utilize any other interventions [30].

Study measurements

The FTF distance measurement involves the distance between fingertips and the floor with extended knees in

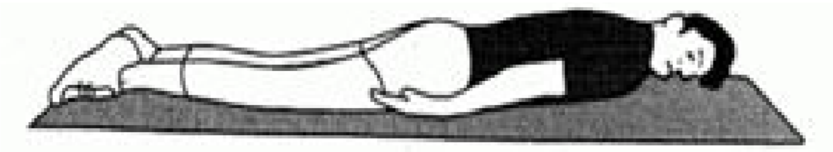

Figure 1. Prone lying

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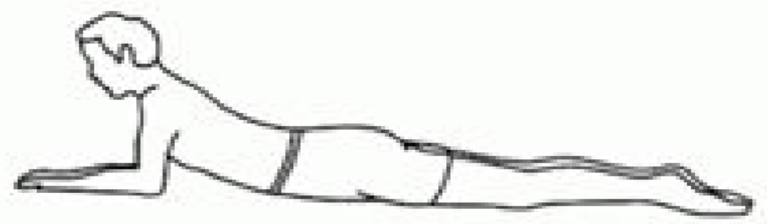

Figure 2. Prone on elbow

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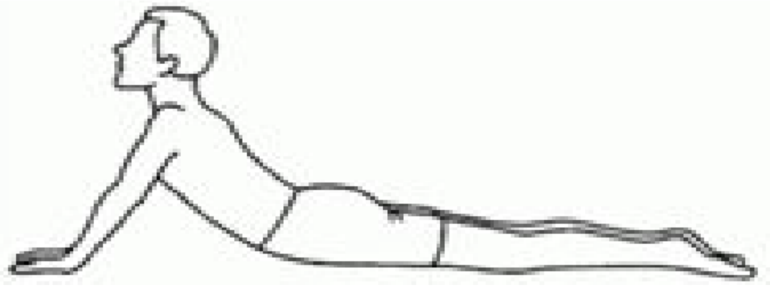

Figure 3. Extension on elbow

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a standing position. The single-limb stance test assesses muscle control, with the patient standing one meter away from a striped wall and flexing each hip and knee to approximately 60° for 20 s on each side. The therapist observes for deviations from the vertical and horizontal lines to determine test results [24].

Study interventions

The McKenzie exercises were divided into three stages based on extension directional preference and gradual progress of exercises:

1. Patients initially lay prone for 5 minutes, and if symptoms did not worsen or peripheralize (indicating poor prognosis), they progressed to stage 2.

2. Stage 2 involved lying prone with elbow extension for 5 minutes.

3. In the final stage, patients performed 10 repetitions of full extension in a lying position with 2 second pauses between repetitions.

Core stability exercises consisted

1) Abdominal drawing was performed for 2 sets with a 5-second pause between sets; 2) Bridge exercises and unilateral prone leg extensions were performed with extended knees following a similar protocol.

The intervention for both groups lasted 2 weeks, 4 sessions per week [31]. At the end of the intervention period, pain, disability, range of motion, and functional tests were reassessed. The sample size for each group was determined based on similar studies [23], resulting in a total of 44 participants evenly split between the two groups. Data were collected from patient files and statistical analysis was conducted using IBM SPSS software, version 22. Ethical considerations for the study were in accordance with the guidelines of the Shahid Beheshti University of Medical Sciences Ethics Committee.

Statistical analysis

This study involved 44 patients with low back pain who were divided into the McKenzie and the core stability groups. The McKenzie group had 22 patients, comprising 10 men and 12 women. The core stability group also had 22 patients, with an equal split of 11 men and 11

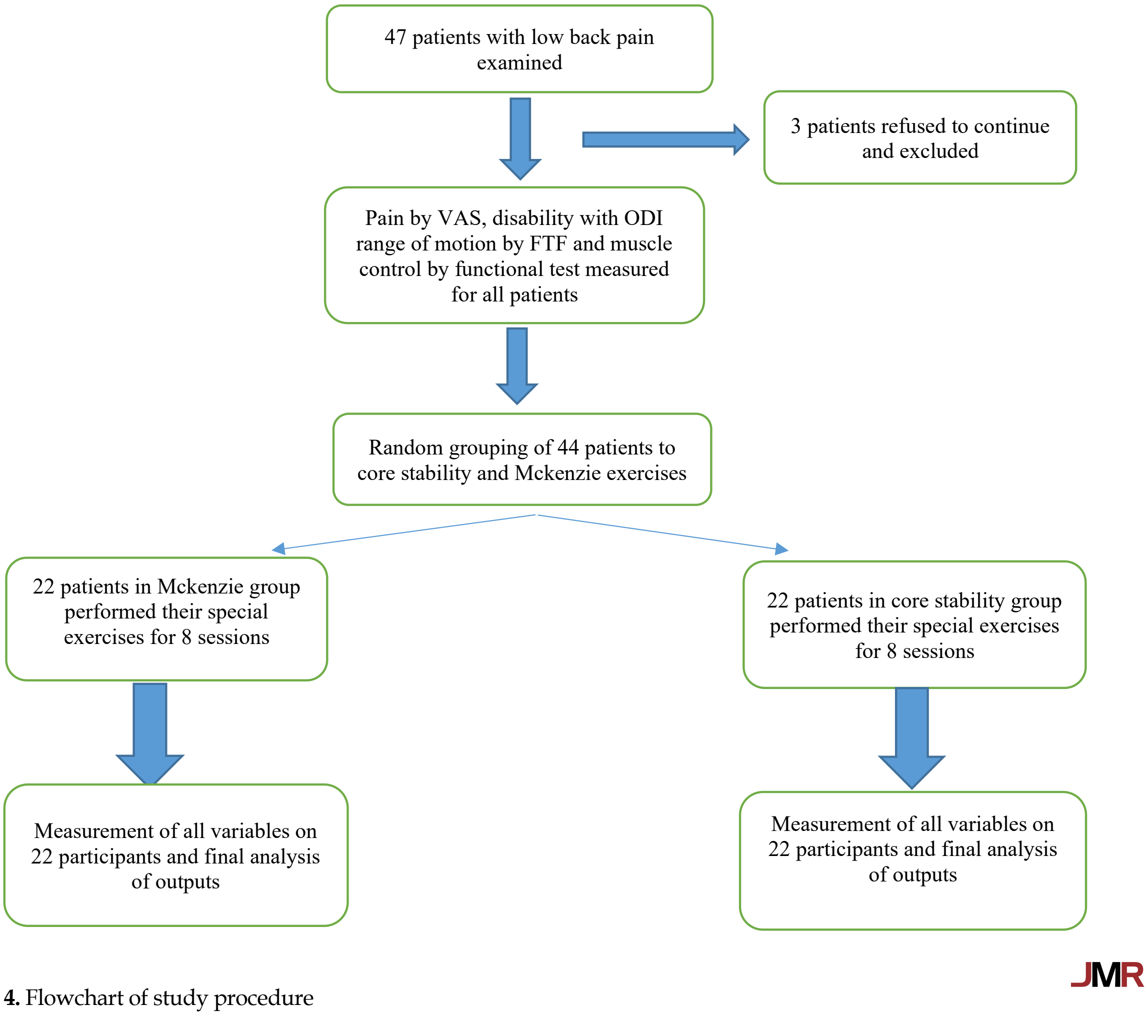

Figure 4. Flowchart of study procedure

women. A chi-square test for the gender variable yielded a P of 0.763, indicating a homogeneous gender distribution in both groups, signifying no significant differences between the groups in this regard (Table 1).

Regarding the normality of demographic variables, an independent t-test was conducted, revealing statistically insignificant differences between the groups in these variables, indicating homogeneity in demographic characteristics across both groups. For quantitative variables, except for VAS2, which exhibited a P>0.05 in the Shapiro-Wilk test and displayed a normal distribution in both groups, all other quantitative variables had at least one P<0.05 in the Shapiro-Wilk test, indicating an abnormal distribution that required non-parametric tests to compare differences. The statistical indices of quantitative variables before the intervention are presented in Table 2.

The results from Table 2 demonstrated that all quantitative variables showed P>0.05 before the intervention, indicating insignificant differences between the groups. The qualitative variable also exhibited a P>0.05 in the Pearson chi-square test, suggesting a homogeneous variable distribution between the groups before the intervention. The differences in the distribution of quantitative variables after the intervention were insignificant (P>0.05 for VAS2 in both groups based on an independent t test and P>0.05 for FTF2 and ODI2 in the Mann-Whitney non-parametric test). The functional test variable after the intervention between the groups also yielded a P>0.05 in the Pearson chi-square test, indicating no significant statistical differences in its distribution. Table 3 compares differences between quantitative variables before and after intervention.

The P for the range of motion were 0.001 for the McKenzie group and 0.034 for the core stability group. As per the results in Table 4, quantitative variables, including VAS, disability score, and range of motion, exhibited significant statistical differences before and after the intervention (P<0.05 in the Wilcoxon test), but no differences between the groups were observed. Table 4 compares differences between functional test variables

Table 1. Demographic variables of the participants (n=22)

Variables	Group	Mean±SD	t	P
Age (y)	Mckenzie	43.909±10.97	-0.113	0.911
	Core stability	44.273±10.31		
Height (cm)	Mckenzie	169.32±10.869	0.518	0.607
	Core stability	167.73±9.442		
Weight (kg)	Mckenzie	68.32±10.714	1.04	0.304
	Core stability	65.23±8.923		
BMI (kg/m²)	Mckenzie	23.64±1.957	0.367	0.716
	Core stability	23.44±1.764		

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before and after the intervention. According to the results in Table 4, the functional test variable showed significant differences (P<0.05) before and after the intervention in both groups.

Discussion

This study aimed to compare the effectiveness of McKenzie and core stability exercises in improving pain, disability, range of motion, and muscle control in patients with nonspecific low back pain. Participants were selected based on predetermined inclusion and exclusion criteria and randomly assigned to the McKenzie or core stability exercise group following a mechanical assessment. Each group engaged in the prescribed exercises for 8 sessions, with variables reassessed at the conclusion of the intervention.

The mechanism behind McKenzie's exercises has remained a topic of debate, with previous notions suggesting that repetitive movements may realign protruded disks now being debunked [32]. Current understandings point towards mechanisms such as endorphin release, a phenomenon observed in various forms of exercise, which may help reduce pain perception and anxiety, thus facilitating the treatment of mechanical low back pain [2]. Additionally, the centralization phenomenon resulting from McKenzie's exercises may aid in reducing pain and enhancing treatment outcomes [33]. As the MDT institute explains, responses in this method are reported in two forms: symptomatic responses include centralization or reducing pain intensity based on VAS score or questionnaires such as ODI and mechanical responses include the range of motion. So, patients with radiculopathy could report any of these forms, but patients without radiculopathy could not report centralization for their complaints. Hence, differentiating patients with or without radiculopathy is not clinically important in this study. Furthermore, repetitive movements prescribed in this method may have a corrective effect on the patient's posture, which could worsen the pain. However, the postural correction theory is still under debate as previous studies have shown that lumbar lordosis and lumbosacral angle are not associated with low back pain [34]. These types of exercises are easily educated, are dependent on the patient,

Table 2. Quantitative variables before and the intervention (n=22)

Groups	Mean±SD					
	ODI1	ODI2	FTF1	FTF2	VAS1	VAS2
Mckenzie exercises	15.273±6.4474	8.727±6.0642	5.318±5.9533	3.75±4.5139	5.72±2.027	3.045±1.5577
Core stability exercises	13.955±6.4474	8.5±5.4138	10.705±13.5178	9.273±11.6586	5.773±1.631	3.136±1.9098
P	0.371†	0.981†	0.299†	0.191†	0.868†	0.863*

Abbreviations: ODI: Oswestry disability index; FTF: Fingertip to floor distance; VAS: Visual analogous scale.

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*Based on the independent t-test; †Based on the Mann-Whitney test.

Table 3. Comparing quantitative variables before and after the intervention

Groups			Mean±SD	P*
Mckenzie Exercises	First pair	VAS1	5.727±2.0279	0
		VAS2	3.045±1.5577	
	Second pair	ODI1	15.273±6.4747	0
		ODI2	8.727±6.0646	
Core stability Exercises	First pair	VAS1	5.773±1.6310	0
		VAS2	3.136±1.9098	
	Second pair	ODI1	13.955±6.4474	0
		ODI2	8.5±5.4138	

Abbreviations: ODI: Oswestry disability index; FTF: Fingertip to floor distance; VAS: Visual analogous scale.

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*Based on the Wilcoxon test.

and have immediate effect after performing, reduce treatment costs and improve patients' trust. Core stability exercises are speculated to improve pain and disability through neuromuscular adaptations, targeting the recruitment patterns of trunk muscles rather than focusing on hypertrophy. Specifically, muscles such as the transverse abdominus and multifidus are believed to have delayed reaction times and altered recruitment patterns in patients with low back pain, leading to compromised proprioception and motor function. By restoring normal recruitment frequencies, core stability exercises aim to establish pain-free and stable postures for daily activities, consequently improving movement quality, balance, and postural control [5, 23, 26].

While there are conflicting findings in the literature regarding the efficacy of McKenzie versus core stability exercises, with some studies suggesting one approach may be more beneficial than the other [23, 25, 28, 34], the results of this study indicate no significant differences between the two groups in terms of pain reduction, disability improvement, range of motion, and muscle control. These findings align with previous research by Halliday et al. (2019), which also reported similar outcomes in terms of pain intensity [28].

Conclusion

In conclusion, this study focused on male and female individuals experiencing low back pain with or without radiculopathy. After stringent participant selection and randomization, the efficacy of McKenzie versus core stability exercises was evaluated using standardized assessments such as the MDT assessment form. While both types of exercises demonstrated benefits in reducing pain intensity, improving disability, increasing range of motion, and enhancing muscle control, no significant differences between the two intervention groups were observed in this study.

Table 4. Differences between functional tests before and after the intervention

Group			Functional Test 2 (After the Intervention)		Total	P*
Mckenzie exercises	Functional test 1 (before the intervention)	+	6	10	16	0.001
		-	2	4	6	
	Total			22		
Core stability exercises	Functional test 1 (before the intervention)	+	4	9	13	0.031
		-	3	6	9	
	Total			22		

*Based on the McNemar test.

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Study limitations

In this study, myofascial pain and patterns were not considered, which in most cases are present along with other sources of pain and disability. Also, a follow-up may add validity to these findings.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Ethics Committee of Shahid Beheshti university of medical sciences (Code: IR.SBMU.RETECH.REC.1402.093) and the Iranian Registry of Clinical Trials (IRCT) (Code: IRCT20230806059059N1). All participants provided informed consent before participating in the study.

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Authors' contributions

Study design: Hamidreza Nemati; Hoda Niknam and Khosro Khademi Kalantari; Data collection: Hamidreza Nemati; Writing–original draft: Hamidreza Nemati; Data analysis: All authors.

Conflict of interest

The authors declared no conflict of interest.

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