Original

Efficacy of Open Kinetic Control on Pain and Disability in Low Back Patient: A Randomized Controlled Trial

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Abstract

AIM: To find out how an open kinetic control program affects people with low back pain in terms of both pain and functional impairment. **DESIGN:** Single masking, pre-post randomized controlled trial. **SETTING:** LBP patients from the Outpatient Clinic at Faculty of Physical Therapy, Giza, Egypt. **METHODS:** 30 patients with LBP were randomized into two groups utilizing an opaque sealed envelope. **Group "A"** (open kinetic) and **Group "B"** (control): Two groups were given standard treatment. Treatment was given three times a week for four weeks. The patient was evaluated before and after therapy using a visual analogue scale (VAS) as well as the Oswestry impairment Index for pain severity and functional impairment. **RESULTS:** All variables in the open kinetic and control groups revealed significant variations between pre and post-treatment (p-value < 0.05). Between groups analysis revealed that there were no statistical significant differences open kinetic and control group while after treatment, there were statistically significant changes (p-value < 0.05) between open kinetic and control groups. **CONCLUSION:** Both open kinetic and conventional workouts reduced pain and functional impairment in individuals with low back pain.

Key words: Segmental stabilization; open kinetic; low back pain.

INTRODUCTION

Low back pain (LBP) is the leading cause of disability in western civilization. (1) LBP imposes a major economic burden, resulting in high direct healthcare expenditures as well as high indirect costs owing to time away from work. (2) Although some pathologies or traumas can induce LBP, an underlying condition is missing in over 90% of patients. (3) The most common musculoskeletal disorder is low back pain (LBP), which is now becoming a major public health problem because to its high economic consequences and severe disability in high-income countries. (4) Between 2005 and 2015, the number of years lived with a handicap due to LBP increased by 17.2%, totaling 815 years lived with a disability per 100,000 people worldwide. (5)

A major contributor to years spent disabled is low back pain (LBP). (6) Non-specific LBP, in which the symptoms cannot be consistently linked to a particular disease or pathology, affects the majority of patients (> 90%) in primary care. (3) According to clinical guidelines, the management of chronic LBP should not involve the use of pharmaceutical interventions, such as cognitive behavioral therapy, exercise therapy, or education in addition to general activity. (8)

Targeting certain muscle groups requires the use of open kinetic chain exercises (OKC). Concentric muscular contractions are commonly used in conjunction with it, and it frequently results in enhanced distraction and rotational pressures. Because of the immobilization of the distal portion, when one joint in the kinetic chain moves, other joints in the chain move as well. This allows the proximal and distal regions to get resistance training at the same time. (9)

Exercise with an open kinetic chain OKC exercises are excellent in treating particular muscles and increasing muscle strength in LBP sufferers. Studies on OKC therapies for LBP were limited due to the threshold. The purpose of this study was to compare the efficacy of open kinetic control exercises for pain and disability in patients with LBP.

MATERIAL AND METHOD

- ### Study design

This clinical trial used a randomized controlled study design. The subjects were chosen from the outpatient clinic at Cairo University's Faculty of Physical Therapy in Egypt. Clinically, both traditional treatment and an open kinetic control program were used, and participants were evaluated in the Physical Therapy lab and outpatient clinic at Cairo's Faculty of Physical Therapy. After being informed about the study's procedures and goals, each participant signed a consent document.

- **Participants and randomization**

Thirty subjects were drawn from the outpatient clinic of the Faculty of Physical Therapy in Giza, Egypt. In this study, male and female participants aged 20 to 45 years old, suffering from LBP for over 4 weeks without a particular diagnosis of a disease or spinal pathology, and having mild to moderate disability based on the Oswestry Disability Index (ODI), Patients with spinal difficulties, aberrant conditions, prior spine surgeries, or recent participation in stabilizing exercise programs within the last three months were excluded from the study. A computer-generated randomization block was used to divide the patients evenly into two groups (A and B), each of which had 15 subjects. The block sizes of three and nine were chosen to reduce bias and assure equitable representation among the groups.

To keep the allocation secret, randomization codes were maintained in sealed envelopes that were opaque and sequentially numbered. The first author, who was not involved in data collection, used random assignment; the second author opened the sealed envelope and administered treatment; the third and fourth authors collected data without knowing the group assignments; and the fifth author performed data analysis and interpretation.

- ## Interventions

On the day of the first evaluation, all patients received the intervention based on their group: Group A (Open kinetic control group) received "open kinetic chain exercise" in addition to traditional physiotherapy, whereas Group B (Control group) received only traditional physiotherapy. Each group underwent the specified program three times each week for four weeks.

Exercise description for all groups:

The physiotherapist provided personalized care to each patient. Exercise sessions lasted four weeks and consisted of three sets of 10 reps each. The workout intensity gradually increased, and open chain movements were performed at high velocity and load.

Group A (Open kinetic chain group): Traditional treatment and open kinetic chain.
Patients in the research received the same standard treatment as group B, followed by open kinetic chain exercises including lower limb abduction and knee extension while resting on a roller in a supine position.
Traditional therapy; the patients were received exercise program as in control group. (10)
Group B Active Comparator "Control group": traditional therapy
Assigned Interventions: The patients were received conventional therapy three sessions a week for four week.
Traditional therapy: The program was described as follows: Patients performed exercises such as sitting knee raises on a gym ball to help them maintain their balance when moving their hips on a smaller base of support, abdominal slides to help them regulate the activity of their rectus abdominis muscles while moving, and a lying trunk curl while lifting their legs to strengthen both upper and lower abdominal muscles. Simple superman exercises to strengthen the back muscles and hip flexors. **(10)**

Outcome measures

All outcome measures were evaluated at baseline and after the four-week trial period that followed the first session. The study's key metric was peak hamstring torque, which was measured with an isokinetic dynamometer. The VAS was used to assess pain, and the ODI was utilized to assess lumbar function as secondary outcomes.

- **Pain**

The visual analog scale is a dependable and exact method for evaluating pain. The line is 10 centimeters in length. The participants were asked to identify the position using a scale of 0 to 10, separated into 1 cm pieces. The point at which 0 cm signified no discomfort and 10 cm represented the worst conceivable pain was to be determined. **(11)**

- **Back function (disability)**

The Oswestry Disability Index is a reliable and accurate way to assess back function. It consists of 10-item questionnaires. To identify which sentence best describes them, each patient had to select one box from each area. The overall score, which varied from 0 (no pain or disability) to 50 (severe pain and disability), was computed by dividing the scores by 50, or 45 if a portion was missing. To compute the percentage, divide the score by 50 and multiply by 100 to get the percentage in points. Minimal disability is defined as 0% to 20%, moderate disability as 21%-40%, severe disability as 41%-60%, crippled at 61%-80%, and total disability as 81%-100%. **(12)**

Statistical analysis

Shapiro-Wilk and Levene's tests for homogeneity of variances were used to confirm the normality of the data and assess group homogeneity. The distribution of the data was normal, and the variance was homogeneous. When comparing groups based on all demographic characteristics, the unpaired t-test was used. The effects of treatment on pain and disability were investigated using mixed MANOVA. When the MANOVA showed significant results, additional univariate ANOVAs were conducted. For multiple comparisons, post-hoc testing using the Bonferroni correction was carried out. For all statistical tests, p-value= 0.05 was chosen as the significance level. SPSS version 23 was used.

RESULTS:

Demographic Characteristics:

Table (1) showed the patients' characteristics of the experimental and control groups. There were no statistical significant differences regarding patient's general characteristics between both groups (p-value ≥ 0.05).

Mixed design multivariate analysis was conducted to investigate the effect of treatment on the measured variables. There was Statistical Significant difference between groups as Wilk's Λ = 0.39, F = 13.1, P-value < 0.0001, Partial Eta Squared ($\eta^{2)}$ = 0.61. Also there was statistical significant effect on time (pre-post treatment) as Wilk's Λ = 0.05, F = 172.39, p-value < 0.0001, η^2 = 0.95, as well as for the interaction between groups and time as Wilk's Λ= 0.23, F = 29.11, p-value < 0.0001, η^2 = 0.77

Between-groups comparison: Baseline and after four weeks of intervention

At baseline, there was no statistically significant differences between experimental and control group in all measured variables (P-value ≥ 0.05) as shown in table (2). After four weeks of intervention, there was statistically significant differences between experimental and control group at all measured variables with more favor to experimental group (P-value < 0.05) as shown in tables (2).

Within-groups comparison

There were statistically significant differences in all outcome measures when comparing the pre and post intervention results (p-value<0.0001) in experimental group only as shown in table (2).

Table (1): General characteristics of patients (N=30)*

	Study group	Control group	t- value	p-value
	$\bar{X}$ ±SD	$\bar{X}$ ±SD		
Age (years)	32±6.75	32.9 ±6.51	-0.3	0.77 [a]
Weight (kg)	68.7±4.83	72.1±7	-1.26	0.22[a]
Height (cm)	165.1±9.47	166±7.71	-0.23	082 [a]
BMI (kg/m²)	25.4±3.19	26.3±3.42	-0.61	0.55 [a]

*: Data were expressed as mean ±Standard deviation; N: number; P: probability; BMI: body mass index; [a]: non-significance difference

Table (2): Within and between group analysis for pain intensity and function disability

Variables	Experimental Group	Control Group	MD(95% CI)	p-value (between groups)	η²
VAS (cm)					
Pre-treatment	6.1±1.52	6.6±1.51	-0.5 (-1.92 to 0.92)	0.47 [a]	
Post-treatment	2.7±0.95	4.4±1.07	-1.7 (-2.65 to -0.75)	0.0001 [b]	**0.44**
p-value (within-group)	0.0001 [b]	0.12 [a]			
Function disability					
Pre-treatment	32.7±3.68	31.5±2.88	1.2(-1.91 to 4.3)	0.43 [a]	
Post-treatment	11.8±3.49	24±2.83	-12.2 (-15.18 to -9.22)	0.0001 [b]	**0.8**
p-value (within-group)	0.0001 [b]	0.0001 [b]			

VAS: visual analogue scale; *p*-value: probability; [a]: non-significance difference; [b]: significance difference; CI: confidence interval.MD: mean difference.

DISCUSSION

This study looked into how open kinetic control affects pain intensity and functional impairment in people with LBP. Our statistical analysis found substantial differences across groups in pain severity and functional impairment following a 4-week treatment, with the open kinetic control group showing higher improvement.

The study's key finding is that after four weeks of segmental control exercises, there is a greater reduction in pain and impairment, with mean differences in pain between and among groups following therapy. -1.7 (Experimental & Control) and mean differences after treatment within and between groups for disability: -12.2 (Experimental/Control).

Trunk stabilization exercise using open kinetic control resulted in a significant decrease in both LBP and disability. **(14)** The exercise is thought to reduce pain in individuals with LBP by controlling trunk muscle movement, strengthening muscles, and stabilizing posture, as well as enhancing proprioception and neuromuscular control. **(15)**

Another study found that lateral leg lifts (SLA) target hip abductors. Maintaining the strength of these muscles is critical because they help to support the pelvis, relieve pressure on the back, and ensure balance and movement for a person. (13)

This study's findings support past research recommending the addition of stabilization exercises in musculoskeletal rehabilitation for lower back pain. These include activating the transversus abdominis as well as lumbar multifidus muscles, increasing local muscle activity, and increasing lumbar segmental motor control. (13)

The key limitation of this study was the short 4-week length of the therapies and extrapolating the findings to a larger population; all participants were young people. Therefore, the results may not be generalizable to senior patients with LBP.

Based on the data, OKC combined with other exercises may be recommended as a potential LBP therapy approach. This combination may result in a greater decrease in LBP severity and disability than standard treatment alone.

Conclusion

Open Kinetic Control Exercises significantly reduce pain intensity and functional impairment in patients with LBP.

Clinical massage: Open kinetic control exercises (OKC) are a key component of the rehabilitation strategy for LBP patients.

Conflict of interest:

No conflict of interests has been declared by authors.

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REFERENCES

1. **James SL, Abate D, Abate KH, et al.** Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the global burden of disease study 2017.Lancet. **(2018)** 392(10159):1789–858.

2. **Hartvigsen J, Hancock MJ, Kongsted A, et al.** What low back pain is and why we need to pay attention. Lancet. **(2018);** 391(10137):2356–67.

3. **Maher C, Underwood M, Buchbinder R.** Non-specific low back pain. Lancet (London, England), **(2017)** 389(10070), 736–747.

4. **Cezarino RS, Cardoso JR, Rodrigues KN, et al.** Chronic low back pain in patients with systemic lupus erythematosus: prevalence and predictors of back muscle strength and its correlation with disability. Rev Bras Reumatol Engl Ed **(2017);** 57:438–44.

5. **Doualla M, Aminde J, Aminde LN, et al.** Factors influencing disability in patients with chronic low back pain attending a tertiary hospital in sub-Saharan Africa. BMC Musculoskelet Disord, **(2019).**20:25.

6. **Buchbinder R, van Tulder M, Öberg B, (4) et al.:** Low back pain: a call for action. Lancet (London, England). **(2018);** 391(10137): 2384–8.

7. **Foster NE, Anema JR, Cherkin D, et al.** Prevention and treatment of low back pain: evidence, challenges, and promising directions. Lancet (London, England). **(2018);** 391(10137):2368– 83.

8. **Qaseem A, Wilt TJ, McLean RM, et al.** Clinical guidelines Committee of the American College of P. noninvasive treatments for acute, subacute, and chronic low Back pain: a clinical practice guideline from the American College of Physicians. Ann Intern Med. **(2017)**166(7):514–30.

9. **Stochkendahl, Mette Jensen, Per Kjaer, Jan Hartvigsen, Alice Kongsted, Jens Aaboe, Margrethe Andersen, Mikkel Andersen, et al**. “National Clinical Guidelines for

Non-Surgical Treatment of Patients with Recent Onset Low Back Pain or Lumbar Radiculopathy." European Spine Journal 2018. 27 (1): 60–75.

10. Koppenhaver SL, Fritz JM, Hebert JJ, Kawchuk GN, Childs JD, Parent EC, Gill NW, Teyhen DS. Association between changes in abdominal and lumbar multifidus muscle thickness and clinical improvement after spinal manipulation. J Orthop Sports Phys Ther 2011; 41(6): 389-99.

11. Fairbank JCT, Pynsent PB. The Oswestry Disability Index. Spine.2000. 25: 2940–53.

12. A. Luque-Suarez, E. Diaz-Mohedo,I. Medina-Porqueres and T. Ponce-Garcia. Stabilization Exercise for the Management of Low Back Pain. Physiotherapy Department, Malaga University,Spain May 2012: 10.5772/34602.

13. Gregory M,Brthany C ; How to strengthen the lower back (medical news today.com) January 24, 2020

14. Yue YS, Wang XD, Xie B et al. Sling exercise for chronic low back pain: a systematic review and meta-analysis. PLos One. 2014; 9(6): e99307.

15. Ferreira ML, Ferreira PH, Latimer J, Herbert RD, Hodges PW, Jennings MD, Maher CG, Refshuage KM. Comparison of General Exercise, Motor Control Exercise and Spinal Manipulative Therapy for Chronic Low Back Pain: A Randomized Trial. Pain. 2007; 131: 31-37.