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RESEARCH ARTICLE

EFFECT OF LUMBAR STABILIZATION VERSUS MCKENZIE EXERCISES ON PAIN AND FUNCTIONAL DISABILITY IN PATIENTS WITH POST LAMINECTOMY SYNDROME: A RANDOMIZED CONTROLLED TRIAL

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ABSTRACT

Background: Although not well known, post-laminectomy syndrome (PLS) is an important cause of chronic back pain, which may lead to decreased quality of life, disability and psychological disorders. **The purpose:** This study was conducted to determine and compare between the effectiveness of lumbar stabilization and McKenzie exercises on intensity of pain and disability in patients with PLS. **Methods:** Forty five patients with PLS were enrolled in this study and equally divided into three groups: Group (A) received conventional physical therapy program (Ultrasound, TENS and Moist Heat), group (B) received lumbar (core) stabilization exercises and group (C) received McKenzie exercise. Training program was three sessions per week for four weeks. Intensity of pain was assessed using Visual Analogue Scale (VAS) and disability was assessed using the Oswestry disability Questionnaire. **Results:** There was a statistically significant reduction in the mean values of score of pain and Oswestry disability Questionnaire in three groups ($p<0.05$) post treatment. In the comparison among groups, core stabilization exercise group showed significantly greater reduction of pain and functional disability compared with McKenzie group and conventional therapy group ($p<0.05$) post treatment. **Conclusion:** Core stabilization exercise is more effective than McKenzie in reducing pain and disability in patients with PLS.

INTRODUCTION

Post-laminectomy syndrome is defined by the International Association for the Study of Pain (IASP) as back pain, with or without referred or radiating pain, that is located mainly in the lower limbs. It is of unknown origin and persists or begins after surgical procedures which are performed to treat lumbar disc (Merskey and Bogduk, 2004). Although not well known, PLS is an important cause of chronic back pain. Low back pain is a common complaint, with a reported peak prevalence in the adult population of 37 % and a lifetime prevalence between 60 and 85 %. In addition to the suffering and disability associated with PLS, it has a considerable impact on society. Compared with other models of chronic pain, PLS patients with neuropathic pain experience intense levels of pain, lower quality of life, greater disability and higher rates of unemployment (Chan and Peng, 2011). To solve such problems concerning pain and disability related to PLS, various treatment methods have been used in several previous studies (Ferreira *et al.,* 2007; Wang *et al.,* 2012). Recently, it has been reported that both stabilization exercises and McKenzie exercises can improve chronic low back pain (Franca *et al.,* 2010; Hosseinifar *et al.,* 2013). It is proposed that specific stabilization exercises program might lead to change in central motor program and automatically feed forward recruitment of deep core muscles (Millisdotter and Strömqvist, 2007). Such as the multifidus (MF) and transversus abdominis (TrA) muscles, the diaphragm, and the pelvic floor. These exercises also improve flexibility, strength deficits of the superficial muscles of the spine, and retain precise neural control of these muscles (Ye *et al.,* 2015). McKenzie back extension exercises have been ordered by physicians and prescribed by physical therapists. The goal of McKenzie exercises is to centralized pain. Backward bending can reduce such stress peaks in many discs, which explain pain relief in some back pain patients undergoing extension exercises. Backward bending may also correct any posteriorly displaced intradiscal mass (Adams *et al.,* 2002). The McKenzie method utilizes an approach involving postural awareness and repetitive movements with the underlying idea that a reverse force can decrease pain and return function (www.Mckenzie institute USA, 2013). Despite numerous studies addressing the prevention and treatment of PLS, to the best of our knowledge, there is no study to assess effect of lumbar stabilization exercises versus McKenzie on patients with PLS .So, the current study is the first randomized controlled study to determine and compare the effect of core stabilization exercises versus McKenzie on pain and disability in patients with PLS.

MATERIALS AND METHODS

Participants: Forty-five patients with PLS from both genders, were selected from the outpatient clinic of Faculty of Physical Therapy and Kasr Al-Aini Hospital, Department of Neurosurgery. This randomized controlled study was conducted in the period from November 2016 to August 2017. Patients were eligible to participate in the study if they had PLS which has been previously diagnosed by a neurosurgeon and, age ranged from 30to 45, BMI less than 30 kg/m2, Patient has no history of previous lumbar spine surgery and Being after the first post-operative month. While patients were excluded from the study if they had history of previous back surgery, more than two levels laminectomy, pathological or congenital deformities of trunk, hip, knee, ankle joints, psychological disorders, spinal tumors ,systemic disease (cardiovascular, infectious and/ or metabolic disease that could interrupt exercises) and pregnancy.

Design: A single trained investigator evaluated all patients and collected all data to eliminate inter- investigator error. Patients were randomly allocated into study group (core stabilization group and McKenzie group) or a control group (Conventional physical therapy group) with 15 patients in each group. Study group (Group A) received core stabilization exercises and study group (Group B) received McKenzie exercises the while control group (Group C) received conventional physical therapy.

Data collection: At baseline and after last treatment session, Visual Analogue Scale (VAS) and The Oswestry disability Questionnaire (ODQ) were used for outcome measures, based on following procedures.

Pain assessment: The Visual analogue scale was used for pain assessment. In this scale, pain is rated from 0 to 100 mm, in which the 0 represented no pain and100 represented maximum pain tolerance. Subjects were indicated the best number described their pain (Skikic and Suad, 2003).

Disability assessment: The oswestry disability index was used to assess percentage of functional disability. This questionnaire is a golden standard tool to indicate ability of patients with LBP (Kinkade, 2007). This questionnaire consists of 10 sections and each of sections include 6 rates, from zero to five. The first section of this questionnaire rates pain and the other sections assess activities of daily living. Total score of questionnaire is recorded as percentage (McKenzie, 1994).

Intervention

Intervention: For warming up, patients performed bicycle exercises for five minutes at moderate pace then did stretching exercises for 10 minutes (Koumantakis *et al.,* 2005). The training program was scheduled 12 sessions in 4 weeks for three groups.

Control group (Group A): They received conventional physical therapy program (Ultrasound, TENS and Moist Heat).

Lumbar stabilization exercises group (Group B): The stabilization exercises were performed in 6 steps: 1) Segmental Control Exercises (SCE) with emphasis on training the of isolated contraction of the TrA, MF, and pelvic floor muscles; 2) Segmental Control Exercises with emphasis on co-contractions of the TrA, MF, and pelvic poor muscles in the prone, supine, and four-point kneeling positions; 3) Segmental Control Exercises in closed kinematic chain; 4) Segmental Control Exercises in open chain exercise applied by adding leverage of the limbs; 5) development of SCE in functional situations; and 6) co-contraction of the TrA and MF muscles during application of an external load (O'Sullivan *et al.,* 1997 and McCarthy *et al.,* 2004).

McKenzie exercises group (Group C)

stage one: McKenzie program begin by testing the patient's pain tolerance. The patient was positioned in a prone lying. If the patient could stay in this position for at least five minutes, or if the symptoms were reduced the researcher gradually increased the time until he reached ten minutes before progressing to the next level

Stage two: Patient was asked to rest on both elbows from prone lying position for seconds and gradually increase the time until he reach five minutes. This position was repeated every hour until the symptoms regress.

Stage three: Each patient was asked to gently push up to increase the arch of lower back (according to tolerance of each patient) Patient stop treatment if pain or any leg symptoms "pain, numbness, weakness" extended further as a result of this exercise. Each patient was asked to increase the repetitions of each exercise gradually until reach fifteen repetitions with thirty seconds rest intervals.

Stage four: Each patient was asked to do full extensions in the back (according to the tolerance of each patient) and hold for eight seconds, then slowly lower upper body. Repetitions of exercise gradually increased up to ten times with thirty seconds rest intervals.

Stage five: The patient was asked to have his feet shoulder width apart, place his hands on his back to support it, try to keep legs straight even when he hinges backwards as far as he can go, ask the patient to hold that standing lumbar extension position for 20seconds then come right back up and gradually increase repetitions up to fifteen times with thirty seconds rest intervals (www.backtrainer.com,2011).

Data analysis

- Descriptive statistics and One Way Analysis of Variance (ANOVA) were conducted for comparison of the mean age, weight, height and BMI among groups.
- Chi square test was conducted to compare the effect of sex among three groups.
- 3×2 mixed design MANOVA test was conducted to determine effect of treatment on pain intensity score and disability score pre and post treatment among three groups.
- Post hoc tests was conducted for comparison of mean values of pain and disability score between each pair of groups.
- The level of significance for all statistical tests was set at $p < 0.05$.
- All statistical tests were performed through the statistical package for social studies (SPSS) version 22 for windows. (IBM SPSS, Chicago, IL, USA.

RESULTS

General characteristics: There was no significant difference among three groups in the mean values of age (p=0.217), weight (p=0.976), height (p=0.951) and BMI (p=0.919) (Table 1).

Sex distribution: Chi square revealed there was no significant differences between both groups in sex distribution (p>0.05) (Table 2).

-3× 2 mixed design MANOVA

Overall effect: The results indicated that there were no significant effects of the tested group (the first independent variable) on the all tested dependent variables (F=1.375, P=0.208). In addition, there were significant effects of the measuring periods (the second independent variable) on the tested dependent variables (F=88.431, P=0.0001*). Also, the interaction between the two independent variables was significant, which indicates that the effect of the tested group (first independent variable) on the dependent variables was influenced by the measuring periods (second independent variable) (F=10.781, P=0.0001*) (Table 3).

A-Effect of treatment on pain intensity:

1-Comparison between pre and post treatment within each group: There was a statistically significant decrease in the mean value of pain intensity score post treatment compared with pretreatment in three group (p = 0.0001 in three groups). (Table 4).

2-Comparison between groups: Post Hoc Tukey Test revealed that there was a statistically significant difference in the mean value of pain intensity score between Group A and B (P= 0.001) and between group B and C (P=0.042) post treatment while there was a statistically non significant difference between group A and C (P=0.091) post treatment (Table 4).

B- Effect of treatment on functional disability:

1-Comparison between pre and post treatment within each group: There was a statistically significant decrease in the mean value of oswestry disability index score post treatment compared with pretreatment in three group (p = 0.026 in group A and p=0.0001 in both group B and C) (Table 5).

2-Comparison between groups: Post Hoc Tukey Test revealed that there was a statistically significant difference in the mean value of Oswestry disability index score between group A and B (P= 0.04) and between group B and C (P= 0.019) while there was a statistically non significant difference between group A and C (P=0.999) post treatment (Table 5).

DISCUSSION

The results of the current study showed that, the lumbar stabilization group has a significant reduction in pain and disability than McKenzie group. This results comes in agreement with the findings of **Hosseinifar et al. (2013)** who found stabilization exercises are more effective than McKenzie exercises in improving the intensity of pain and function score in patients with chronic pain.

Table 1. Descriptive statistics and One Way Analysis of Variance (ANOVA) for the mean age, weight, height and BMI values of the patients for the three tested groups

	Group A (N=15)	Group B (N=15)	Group C (N=15)	F-value	P-value
Age (years)	36.73±4.8	35.8±4.73	38.66±3.88	1.587	0.217
Weight (kg)	70.66±10.12	70.4±8.16	71.06±6.11	0.025	0.976
Height (cm)	167±5.95	167.66±6.41	167.06±6.58	0.05	0.951
BMI (kg/m²)	25.22±2.87	25.03±2.9	25.41±1.58	0.085	0.919

*Significant at alpha level <0.05 BMI: body mass index

Table 2. Distribution of sex in both groups

	Group A		Group B		Group C		Chi -Square	
	Females	Males	Females	Males	Females	Males	X^2	P -value
No.	7 (46.7%	8 (53.3%)	8 (53.3%)	7 (46.7%)	8 (53.3%)	7 (46.7%)	0.178	0.915
Total	15 (100%)		15 (100%)		15 (100%)			

Table 3. The 3x2 mixed design Multivariate Analysis of Variance (MANOVA) for all dependent variables at different measuring periods between both groups

Source of Variation	F-value	P-value
Groups	1.375	0.208
Measuring periods	88.431	0.0001*
Interaction	10.781	0.0001*

*Significant at alpha level <0.05

Table 4. Descriptive statistics and 3×2 mixed design MANOVA for Pain intensity score at different measuring periods among different groups

Pain level	Group A (Mean ±SD)	Group B (Mean ±SD)	Group C (Mean ±SD)
Pre	8 ±1.64	8.53 ±1.35	8.6±1.03
Post	6.4 ±1.99	3.8 ±1.74	5.6 ±1.62
% of change	↓20%	↓55.45%	↓34.88 %
Multiple pairwise comparisons between pre and post treatment values for Pain intensity score at different groups			
Pre Vs. post	Group A	Group B	Group C
p-value	0.0001*	0.0001*	0.0001*
Multiple pairwise comparison tests (Post hoc tests) for the Pain intensity score among different groups at different measuring periods			
	Group A Vs. group B	Group A Vs. group C	Group B Vs. group C
Pre	0.876	0.449	0.999
Post	0.001*	0.091	0.042

*Si,.gnificant at alpha level <0.05

Table 5. Descriptive statistics and 3×2 mixed design MANOVA for disability score at different measuring periods among different groups

Functional scale	Group A (Mean ±SD)	Group B (Mean ±SD)	Group C (Mean ±SD)
Pre	59.66 ±10.65	62.77±8.37	64.25±6.89
Post	57.58 ±11.03	48.24±10.54	58.62 ±7.78
% of change	↓3.48%	↓23.14%	↓8.76%
Multiple pairwise comparisons between pre and post treatment values for disability scoreat different groups			
Pre Vs. post	Group A	Group B	Group C
p-value	0.026*	0.0001*	0.0001*
Multiple pairwise comparison tests (Post hoc tests) for the disability score among different groups at different measuring periods			
	Group A Vs. group B	Group A Vs. group C	Group B Vs. group C
Pre	0.999	0.478	0.999
Post	0.04*	0.999	0.019*

*Significant at alpha level <0.05

The results of the current study regarding the significant reduction of the pain and disability in lumbar stabilization group than McKenzie group might be explained by several mechanisms. This is because, patients with PLS may suffer from back pain and or leg pain. This pain resulted from denervation atrophy of back muscles resulted from injury to the dorsal rami (Sihvonen *et al.,* 1993). Also, pain itself produces an extra cause for further back muscle weakness as the pain reduces activities of back muscles and gluteal muscles (Leinonen *et al.,* 2000). Core stability is usually used to strengthen the muscles around the abdominal, lumbar, and pelvic regions, because the muscles of these regions play an important role in stability as well as in controlling the lumbar posture by using tonic or postural muscles during whole-body exercises (Marshall and Murphy, 2005) So, the first explanation might be attributed to role of core stabilization exercises in improving back muscle strength.. This explanation was confirmed by Ye et al. (2015) who mentioned that core stabilization exercises improve strength deficits of the superficial muscles of the spine. Hides et al. (1996) identified selective atrophy of the lumbar MF after the first episode of back pain; the atrophy was unlikely to revert without specific training, and the lower muscular stability predisposed an individual to further episodes of low back pain.

In patients with low back pain, the TrA has decreased anticipatory capacity, meaning that it has reduced segmental protective function (Hodges and Richardson. 1996). So, the weakness and lack of motor control of both muscles which are primary stabilizers of the lumbar segment, minimizing compressive forces on spinal structures is independent risk factor for chronic low back pain (Richardson *et al.,* 2004). So, the second explanation might be explained by the fact that core stabilization exercises addressed two muscles primarily affected by low back pain (TrA and lumbar MF). This explanation was supported by the findings of Franca et al. (2010) who found that stabilization exercise led to significant gain in TrA muscle activation capacity.

Conclusion

Lumbar stabilization exercises were more effective than the McKenzie exercises in reducing pain and disability in the treatment of patients with PLS.

Limitation of this study

Limitations of the study were that there were no long-term follow up examinations. Moreover, biopsychosocial factors were not observed in this study.

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