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EFFECTIVENESS OF DIFFERENT PHYSICAL THERAPY EXERCISE TECHNIQUES IN CHRONIC LOW BACK PAIN: A RANDOMIZED CONTROLLED STUDY

ORIGINAL ARTICLE

ABSTRACT

Purpose: Exercise therapy is the most common conservative treatment for low back pain. Exercise has generally been associated pain and kinesiophobia. In this context, especially paraspinal muscles need to be focused on. For this reason, the aim of our study is to evaluate different types of exercises that will help increase neuromuscular facilitation and core stability in paraspinal muscles by considering patient satisfaction.

Methods: A total of thirty-seven female patients with chronic low back pain were included in the study. The Oswestry Low Back Pain Questionnaire was used to assess functionality. Core stability was evaluated with a stabilizer. Pain intensity and satisfaction were measured with Visual Analog Scale. Patients' kinesiophobia levels were assessed by using Tampa Kinesiophobia Scale. Patients were randomized into three groups according to the interventions as: Proprioceptive Neuromuscular Facilitation exercise group (n = 9), core stability exercise group (n = 14) and control (n = 14) group. The duration of applications was 3 days per week with a total of 6 weeks.

Results: There were group differences for core muscle strength (p = .045), Oswestry scores (p = .001), pain intensity score (p = .003) and Tampa score (p = .001). There were significant gains for Core muscle strength and Oswestry scores for Proprioceptive Neuromuscular Facilitation and Core stability groups (p < .05).

Conclusion. Core stabilization exercises have additional effects to improve rehabilitation outcomes for patients. Besides that, the level of patient satisfaction was importantly different between all groups in favor to Core stability in chronic low back pain.

Keywords: Core Stability, Exercise, Low Back Pain, Patient Satisfaction, Proprioceptive Neuromuscular Facilitation.

KRONİK BEL AĞRISINDA FARKLI FİZYOTERAPİ EGZERSİZ TEKNİKLERİNİN ETKİNLİĞİ: RANDOMİZE KONTROLLÜ BİR ÇALIŞMA

ARAŞTIRMA MAKALESİ

ÖZ

Amaç: Bel ağrısı için en yaygın konservatif tedavi egzersizdir. Egzersiz genellikle ağrı ve kinezyofobi ile ilişkilendirilmiştir. Bu bağlamda özellikle paraspinal kaslara da odaklanılması da gerekmektedir. Bu nedenle çalışmamızın amacı, paraspinal kaslarda nöromüsküler fasilitasyon ve core stabilitesini artırmaya yardımcı olacak farklı egzersiz türlerini hasta memnuniyetini göz önünde bulundurarak değerlendirmek idi.

Yöntem: Kronik bel ağrısı olan otuz yedi kadın hasta çalışmaya dahil edildi. Fonksiyonellik değerlendirilmesi için Oswestry Bel Ağrısı Ölçeği kullanıldı. Core stabilizasyon stabilizatör ile değerlendirildi. Ağrı şiddeti ve memnuniyet Vizüel Analog Skala ile ölçüldü. Hastaların kinezyofobi düzeyleri Tampa Kinezyofobi Ölçeği ile değerlendirildi. Hastalar rastgele üç gruba ayrıldı; Proprioseptif Nöromuskuler Fasilitasyon egzersiz grubu (n=9), Core stabilizasyon grubu (n=14) ve kontrol grubu. Uygulama süresi haftada 3 gün toplam 6 hafta idi.

Sonuçlar: Core kas kuvveti (p = 0,045), Oswestry skoru (p = 0,001), ağrı şiddet skoru (p = .003) ve Tampa skoru (p = 0,001) gruplar arasında farklılık gösterdi. Proprioseptif Nöromuskuler Fasilitasyon ve Core stabilizasyon egzersiz grubunda Core kas kuvveti ve Oswestry skorlarında anlamlı kazanımlar elde edildi (p <0,05).

Sonuçlar: Kronik bel ağrısında Core stabilizasyon egzersizlerinin hastaların rehabilitasyon sonuçlarını geliştirmek için ek etkileri vardır. Bunun yanı sıra Core stabilizasyon lehine hasta memnuniyet düzeyi tüm gruplar arasında önemli ölçüde farklı idi.

Anahtar Kelimeler: Core stabilizasyon, Egzersiz, Bel Ağrısı, Hasta Memnuniyeti, Proprioseptif Nöromuskuler Fasilitasyon.

INTRODUCTION

Low back pain (LBP) is widespread medical situation for those living with a disability; in most countries, it is also the medical situation requiring rehabilitation (1). LBP is constantly, treated as a symptom, not an illness. When the physiology of the pain is not fully known it defined as non-specific low back pain. Pain in people may be due not only to physical factors but also to psychosocial factors, and this limits people's activities of daily living (2). If people could learn to cope with their pain and exercise regularly instead of being afraid, their recovery will be positively affected, but if they engage in fear behavior instead, this can lead to reduced daily activity levels, muscle weakness and increased pain, leading to disability. Kinesiophobia is defined as the fear of physical activity or motion owing to feel pain and the incidence of fear due to low back pain is % 57.3. Physical exercises are the most used way to dealing with kinesiophobia in patients with LBP (3). It is thought that exercises are beneficial in patients with LBP (4).

Unfortunately, the superiority of any of these treatments over the other has not yet been definitively demonstrated in the literature (5). Core stability exercises (CSE) enhance the ability of the neuromuscular and motor control systems by providing improvement lumbopelvic and abdominal control and it helps to prevent spinal injury. It has been stated that core stabilization exercises are effective on pain, quality of life and disability in female (2,6). Proprioceptive Neuromuscular Facilitation (PNF) exercises are also recommended to reduce pain intensity and improve functional disability in patients with LBP (7). PNF exercise has been advised for sensorimotor control training as well as for stimulating lumbar muscle proprioception. Thus, it enhances joint coordination, muscle strength, movement control, stability, and mobility. However very low-to-moderate-quality proof shows that motor control exercises with a focus on muscle strengthening of the deep muscles, coordination exercises, and core stabilization have a significant effect for chronic LBP. Many different modalities are used to treat LBP. The recommendations to treat patients with LBP include the use of nonpharmacological treatment (6). However, the evidence for nonpharmacologic treatments is still limited (8).

The aim of the research was to examine the effectiveness of alternative exercise techniques on core stability, functionality, pain, kinesiophobia and patients' satisfaction in individuals with chronic LBP.

METHODS

A total of thirty-seven female patients (mean age 50.05 ± 13.43 years) who were admitted to the outpatient clinic of a tertiary level hospital, between March 2018 and September 2018 with a complaint of chronic LBP were included in the study.

Patients aged 18-65 years who had LBP for at least 3 months and had no neurological deficit were included in the study. Patients with specific spinal pathology, back or lower extremity surgery were not included in the study.

This study was approved by Baskent University Institutional Review Board and Ethics Committee (Project no: KA18/27) and supported by Baskent University Research Fund. The study was registered with clinical trial number as NCT03493438. Written informed consent was signed by all participants.

Sample Size

The sample size required for the study was calculated by power analysis according to significant differences on mean difference (Δ) and common standard deviation (σ) of Oswestry disability scores of a pilot study as primary outcome. The sample size was determined as 10 but the number of participants were increased in each group in case of dropouts with the alpha level set at 0.05 to achieve 95% power (8).

Randomization procedure was performed using an online random-allocation software program (Figure 1) (9). Patients were randomized into three groups according to the interventions as: PNF exercise group (n = 9), CSE group (n = 14) and control (n = 14) group.

Interventions

All patients regardless of group allocation were commenced with a physical therapy program. It consists of hot pack and conventional transcutaneous electrical nerve stimulation (TENS). TENS was applied 100 Hz frequency and 60 μs pulse duration

with Chattanoga Intelect® stimulator. Treatment duration was 20 minutes. Afterwards the patients in each group received the randomized related exercise therapy under the supervision of a physiotherapist for 20 minutes as described below. Applications were made 3 times a day for 6 weeks

Proprioceptive Neuromuscular Facilitation Group

In order to increase the neuromuscular effect by stimulating the proprioceptors in the trunk muscles, PNF was applied by giving manual resistance (11). Chopping and lifting patterns were used to train the core muscles to activate prior to movement helping to stabilize the spine. Facilitation applied when patients were in sitting position. Each pattern was performed for 30 minutes.

Core Stability Group

Core stabilization exercises were given to the patients with respiratory control. Different visual imaging techniques were used while performing the exercises, and the patients were asked to maintain their spine straightness while doing the exercises (11). After teaching the neutral spine position, posterior pelvic tilt, cat-cow and shoulder bridge exercises were shown, respectively. exercise started with 8 reps and increased up to 20 reps.

Control Group

The control group was treated with physical therapy agents. and were informed about the importance of exercise but no exercise was given.

Outcome Measures

Descriptive characteristics of the patients were recorded at admission. Core stability, functionality, pain and kinesiophobia were evaluated at pre-intervention and at the end of 6 weeks therapy. Functionality and core stability were the primary outcome measures of the study while pain, kinesiophobia and satisfaction were secondary outcome measures.

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Functionality

The Oswestry Low Back Pain Questionnaire was used to evaluate functionality in activities of daily living. The questionnaire composed of 10 questions. There are options between 0 and 5 points for each question. The patient was asked to select the statement that best explain the situation. The maximum score is 50. 1-10 points indicate mild dysfunction, 11-30 show moderate dysfunction, and 31-50 demonstrate severe dysfunction. The Turkish version of the questionnaire is valid (13).

Core Stability

Core stability was evaluated with a pressure device (Stabilizer Pressure Biofeedback Unit, USA, Chattanooga Group, Hixson, TN). While the patients were lying on their back with their knees flexed at 90°, they were allowed to do the exercises by contracting their pelvic floor muscles by slowly pulling their lower abdomen in as if they were holding their urine with respiratory control to strengthened transversus abdominus (TrA) and multifidus (MF) muscle. The last part of the pressure device was placed on the posterior superior iliac spine. The pressure gauge was situated to indicate 40 mmHg before the drawing-in maneuver start. Subjects were asked to increase the pressure by 10 mmHg and maintain the state for 5 seconds (14-16).

Pain Intensity

Pain intensity was measure with visual analog scale (VAS). Patients express their pain by marking on a 100 mm scale according to its degree. “0” represents the absence of pain, and “100” represents the most severe pain. The space between the specified point and the beginning of the line is measured in millimeters and the numerical value recorded (17).

Kinesiophobia

Patients’ kinesiophobia measured by Tampa Kinesiophobia Scale. The survey consists of 17 questions. It measures the people’s fear of movement / re-injury. It also includes the parameters of injury / re-injury and fear-avoidance in work-related activities. A 4-point Likert scale (1=strongly disagree, 4=strongly agree) is used in the scale. Four items

Table 1. Descriptive Clinical Characteristics of Patients.

	PNF (n=9)	Core Stability (n=14)	Control (n=14)	Total (n=37)	p
Age (year, $\bar{x}\pm sd$)	55.55±11.94	45.64±12.89	50.92±14.22	50.05±13.42	0.326 $^{\mu}$
Body Mass Index (kg/cm^2, $\bar{x}\pm sd$)	25.36±2.46	27.46±4.37	30.35±5.06	28.04±4.63	0.256 $^{\mu}$

PNF: Proprioceptive Neuromuscular Facilitation, VAS: Visual Analog Scale, $^{\chi}$: Chi-square test, n: number of patients, %: percentage, X: mean, SD: standard deviation, kg: kilogram, cm^2: centimeters-square.

(4, 8, 12 and 16) were reverse coded. The total score ranges from 17 to 68, with higher values indicating more severe kinesiophobia. The Turkish version of the questionnaire was verified, and its reliability was checked (18).

Patient Satisfaction

We used VAS to evaluated Patient satisfaction. Patient show on diagram his satisfaction or unsatisfaction. The numeric value in the diagram is saved.

Statistical Analysis

SPSS 25 (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp) was used to analysis. Descriptive statistics (mean, standard deviation, median, minimum value, maximum value, and percentile) for discrete and continuous variables were given. The homogeneity of the variances was controlled with Levene's test. We used the Shapiro-Wilk test to assumpted of normality. If parametric test prerequisites were gratified, we used the student's t test to compare the differences between the two groups, when not Mann Whitney–U test was used. To compare the differences between three and more groups, one-way analysis of variance was used when the parametric test prerequisites were gratified, and the Kruskal Wallis test was used when such prerequisites were not. The Bonferroni correction method was used to examine the significant results concerning three and more groups. Repeated measures of analysis of variance were analyzed by Mauchy's sphericity test and Box's Test of Equality of Covariance Matrices. We used Repeated Measures Analysis of Variance for repeated measures. If parametric tests (factorial design for repeated measures analysis) do not provide the preconditions, Greenhouse-Geisser correction or Huynh-Feldt correction was used for corrections to the Degrees of Freedom or Friedman Test. We used Bonferroni test for multiple comparisons.

RESULTS

The descriptive characteristics of patients were given in Table 1. The comparison of 3 groups across time points for outcome measures of TrA and MF muscle strength, Oswestry scores, VAS pain intensity and Tampa scores revealed the exact different responses of group-by-time interaction. There was a group difference for TrA and MF muscle strength ($p = .055$), Oswestry score ($p = .001$), VAS pain intensity score ($p= .001$) and Tampa score ($p = .001$). There were significant gains for TrA and MF muscle strength and Oswestry scores for PNF and core stability groups ($p < .05$). Core group show a time-dependent modify in all parameters. There was a significant reduce in pain and Tampa scores for core stability group ($p < .05$) (Table 2). The level of satisfaction was importantly different between all groups in favor to core stability ($p < .05$) (Table 3).

DISCUSSION

In this study, we investigated the effectiveness of different exercise groups on core stability, functionality, pain, kinesiophobia, and satisfaction in patients with chronic LBP. The results of this study showed that; muscle strength, disability, pain intensity and kinesiophobia scores differed between the groups. Significant gains were seen in muscle strength and disability scores for both the PNF and core stability groups, while a significant decrease was observed in pain and kinesiophobia scores in the core stability group. It was determined that the satisfaction levels of the patients differed in all groups, and the highest satisfaction was observed in the core stability group.

Table 2. Treatment Outcomes of The Patients After Interventions.

		PNF (n=9) $\bar{x}\pm sd$ Min-Max	Core Stability (n=14) $\bar{x}\pm sd$ Min-Max	Control (n=14) $\bar{x}\pm sd$ Min-Max	Total (n=37) $\bar{x}\pm sd$ Min-Max	Group X Time Effect p
TrA and MF Muscle Strength	Pre- intervention	35.00±3.42 30.00-40.00	36.00±2.96 30.00-40.00	38.07±1.89 35.00-41.00	36.54±2.94 30.00-41.00	F=3,166 p =0.055
	Post-intervention	38.55±4.74 34.00-50.00	39.50±1.09 37.00-40.00	38.50±1.69 36.00-41.00	38.89±2.59 34.00-50.00	
	Mean difference	3.556	3.500	0.429		
	p	F=8.651 p=0.006*	F=13.040 p=0.001**	F=0.196 p=0.651		
Oswestry Score	Pre- intervention	53.40±24.95 14.00-86.00	34.42±13.56 14.00-62.00	27.85±7.90 14.00-42.00	36.55±18.15 14.00-86.00	F=21,580 p=0.001*
	Post-intervention	45.11±20.56 10.00-64.00	19.00±11.52 2.00-46.00	27.57±7.31 14.00-38.00	28.59±16.30 2.00-64.00	
	Mean difference	8.289	15.429	0.286		
	p	F=16.613 p<0.001**	F=89.536 p<0.001**	F=0.031 p=0.862		
VAS Pain Intensity Score	Pre- intervention	4.34±2.45 0.00-6.80	4.22±2.39 0.90-8.60	3.55±2.22 0.80-7.30	3.99 ±2.35 0.00-8.60	F=9,180 p =0.001*
	Post-intervention	3.23± 1.96 0.00-5.35	1.55±1.10 0.00-4.60	3.48±2.24 0.75-8.00	2.69±1.98 0.00-8.00	
	Mean difference	1.106	2.664	0.068		
	p	F=4.238 p=0.047	F=38.291 p<0.001**	F=0.025 p=.876		
Tampa Score	Pre- intervention	42.77±2.22 39.00-45.00	44.21±5.82 35.00-56.00	42.00±8.72 27.00-61.00	43.02±6.46 27.00-61.00	F=7,641 p =0.001*
	Post-intervention	40.66± 3.00 37.00-45.00	39.21±3.68 33.00-46.00	41.85±8.70 27.00-62.00	40.56±5.97 27.00-62.00	
	Mean difference	2.111	5.000	0.143		
	p	F=3.680 p=0.064	F=32.110 p<0.001**	F=0.026 p=0.872		

TrA: Transversus Abdominus, MF: Multifidus, PNF: Proprioceptive Neuromuscular Facilitation, VAS: Visual Analog Scale, test, n: number of patients, Min: minimum, Max: maximum, $\bar{x}\pm sd$: mean ±standard deviation, * p<0.05, **p<0.001.

Table 3. Satisfaction Results According to The Groups

	PNF (n=9) $\bar{x}\pm sd$ Min-Max	Core Stability (n=14) $\bar{x}\pm sd$ Min-Max	Control (n=14) $\bar{x}\pm sd$ Min-Max	Total (n=37) $\bar{x}\pm sd$ Min-Max	p $^{\mu}$
Patients' Satisfaction for Functionality	4.56±1.56 2.00-8.00	6.72±1.45 4.50-8.60	6.45±1.49 2.80-8.10	5.19±1.88 1.14-8.60	**0.027***
Patients' Satisfaction for Pain	4.08±1.34 1.14-6.00	6.50±1.42 4.10-8.60	4.60±1.89 1.90-8.00	6.09±1.70 2.0-8.60	**0.017***

n: number of patients, Min: minimum, Max: maximum, $\bar{x}\pm sd$: mean ±standard deviation, $^{\mu}$: Kruskal Wallis test, *: p<.05.

There are various studies about exercise treatment in LBP. There are differences in the literature regarding exercises. In one review it was reported that improvement in pain and disability was better in the PNF group than in the core exercise and conventional physiotherapy group, but the quality of evidence was low to moderate (6). PNF exercises commonly used to reduce pain and enhance the muscle strength on upper and lower extremities (19). Areeudomwong et al. showed that a 4-week PNF training period help to reduce pain intensity and functional disability as well as improve patient satisfaction and quality of life (7). According to our results, PNF exercise beneficial for functionality and muscle strength. On the other hand, we can say that core stabilization exercises are better for muscle strength, disability, pain, kinesiophobia and patient satisfaction in LBP.

The main reason for this result could be the more activation and strengthening of deeper trunk muscles, especially transversus abdominus in both groups. All techniques of PNF training in this study were performed in spiral and diagonal patterns, helps to activate of superficial muscles over their patterns. It may be said that PNF exercises may not strengthen inner abdominal muscles as transversus abdominus as much as core stability exercise program. Areeudomwong et al. showed PNF exercises are more effective on superficial muscles of trunk (7).

In the literature within the pelvis, spine, and kinetic chain, and CSE is an exercise treatment regimen for LBP conditions. Beomryong and Yim compared three different exercise groups and showed that the core stability of the individuals in the exercise group was affected more positively than those in the sham group (22). In our study, an increase in core muscle strength was observed in both PNF and CSE groups. In a review of Core Stability Exercises, it is said that scales such as VAS, Numerical Rating System are reliable and effective measures for rating pain in Patients with Non-Specific Low Back Pain (23). In this study, VAS was also used to evaluate pain, and a significant difference was observed in the pre- and post-treatment pain values of the people in the core stability exercise group. In patients with subacute or chronic low back pain, the minimum clinically significant change (MCIC) indicated for VAS is at least 20 mm (24). Akhtar et al. showed that both general physical therapy (PT) exercises and CSE effective in managing LBP but CSE have more reductions in pain scores compared to general PT. The mean VAS score changes in CSE 3.08 whereas 1.71 in PT group (21). Osteloand et.al. indicate that the MCIC value should be at least 10 in the oswestry index used to measure functional disability (24). The statistical significance values we obtained for pain and disability in our study are also clinically significant for the core stabilization exercise group. In our study, statistically significant results were obtained in the results of kinesiophobia, muscle strength and satisfaction in the core stabilization group. However, since the clinical significance values of these parameters were not found in the literature, no comparison was made with our study results.

The effectiveness of exercise mainly depends on the individuals themselves and the individual desire to be healthy. Exercise selection according to the patient's global health status, talents and skills is very important for the efficacy of exercise treatment. Core stability exercise program is a very popular exercise program since pilates programs started to spread. It is important to remember that generally people are influenced by what is commonly used in popular culture. This culture may have led to the belief that core stability exercises will be more curative than other exercises. Pain is not only related to the physiology of the individual but also the social environment, beliefs, and psychology, which is affected by many factors is a concept that should be considered multiple. Therefore, it may be an advantage to do an exercise that the individuals believe and have an awareness from social environment. This could be another reason for the core stability exercise group to be superior to other exercise interventions as well as high satisfaction scores in the core group also supports these results.

Supervision of exercise and motivation-enhancing behavior therapy may also play a considerable role in increasing the efficacy of exercise therapy. That is why we are planning based on different supervised exercise programs. We could speculate that patients with chronic LBP who core stability exercises benefits more and should be encouraged to

exercise with strength and mindful techniques together.

The limitation of our study was the lack of double-blind long-term follow-up results to determine intervention gains for exercise programs.

CONCLUSION

All interventions with supervision especially core stabilization exercises have favorable effects to improve rehabilitation outcomes for patients with chronic low back pain. Further research is necessary to understand longer term outcomes and to understand how differences among patients and interventions influence outcomes.

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