International Journal of ChemTech Research
CODEN (USA): IJCRGG, ISSN: 0974-4290, ISSN(Online):2455-9555
Vol.10 No.5, pp 391-401, 2017

Effect of Pilates mat Exercises versus Motor Control Exercises on nonspecific acute low back pain patients

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Abstract : This study was to investigate the effectiveness of Pilates mat exercises as compared with Motor Control exercises in treatment of nonspecific acute low back pain. Sixty male and female patients referred from an orthopedic surgeon. Patients were randomly assigned into two equal experimental groups. The first experimental group (A) consisted of 30 patients with a mean age of 25.33 (± 3.72) years old, body mass of 70.43 (±3.43) Kg, and height of 166.53 (±1.61) cm; received Pilates mat exercises. The second experimental group (B) consisted of 30 patients with mean age of 25.26 (± 3.4) years old, body mass of 69.52 (±2.82) Kg, and height of 166.73 (±1.77) cm; received Motor Control exercises. Treatment was given 3 times per week, each other day, for one month. Patients were evaluated pretreatment and post treatment for back pain severity, back function, lumbar flexion, extension and side bending range of motions. Patients in both groups showed significant improvement in all measured variables. In between groups difference the first group showed a significant improvement than the second group in lumbar flexion range of motion, and no statistical difference in increasing lumbar extension, however there is clinical difference and high percent of improvement in the favor of the first group. There was no significant difference between both groups in reduction of pain and functional disability. Pilates mat exercises and Motor Control exercises are effective in relieving pain and functional disability. Pilates mat exercises is more effective in increasing the lumbar flexion range of motion. There was no difference between Pilates mat exercises and Motor Control exercises groups in increasing the lumbar extension range of motion; however there was clinical difference and high percent improvement in favor of Pilates mat exercises group.
Keywords : Nonspecific acute low back pain, Pilates mat exercises, Motor Control exercises.

Introduction

Low back pain is strongly associated with disability, absence from work, and mood changes such as depression and anxiety[1].It was reports that 70-85% of all people have back pain at some time in life that back pain is the most common cause of limitation in activity in those younger than 45 years of age, and that prevalence rates are shown to be from 12% to 35 %[2].

Low back pain can arise from a wide variety of causes, such as unaccustomed activity, trauma, stress or injury to the structural elements of the spine. Acute LBP occurs suddenly, either as a completely new presentation (first time ever) or, after a period of at least 6 months without LBP. Acute LBP is usually defined as pain that is present for less than 6 weeks after onset[3].

Approximately 90% of LBP (both acute and chronic) is considered non-specific. Non-specific LBP, also known as ordinary or "simple backache", and "common" or "garden variety low back pain", is mechanical low back pain of musculoskeletal origin in which symptoms vary with physical activities[4].Non-specific LBP may be related to mechanical strain or dysfunction, although it often develops spontaneously, and can be painful and disabling, however the severity or intensity of the pain tells the clinician very little about the source of pain[5]. Nonspecific Low Back Pain is often further subdivided based on duration of symptoms to acute LBP if it lasts up to 6 weeks; or sub-acute pain is identified as lasting 6 weeks to 3 months; or chronic low back pain if it lasts for longer than 12 weeks[6].

Pilatesis an exercise method that was first taught as "Contrology" by Joseph Pilates at his studio in New York during the late 1920s. The exercise system that Joseph Pilates developed merged the theories and movement styles of gymnastics, martial arts, yoga and dance. Modern Pilates focuses on maintaining a 'neutral spine', pelvic and spinal stability, along with activation of transversus abdominis and pelvic floor muscles in combination with controlled breathing[2].

The primary goal of the Pilates exercises is alignment as well as core control. This is taught by incorporating five principles of alignment to be addressed for each exercise performed. This includes breathing patterns to more deeply engage the deep local musculature, rib placement, scapular girdle placement and engagement, and cervical spine and pelvic alignment**.** An important element of the Pilates method is being able to expand the ribs laterally, which helps you to draw in your abdomen, at the same time relaxing the upper body. While accentuating the axial arrangement of the body, the method ensures the optimum conditions for the respiratory system and helps to stabilize the backbone. Unlike other exercises based on passive breathing, the Pilates breathing method involves active respiration. It activates outer intercostal muscles and abdominal muscles. The most efficient muscle participating in breathing out, and thus in increasing the pressure in the abdominal cavity is the transverse abdominal muscle[7].

Pilates exercises mainly involve isometric contractions (i.e. contraction without joint movement) of the core muscles, which make up the muscular center responsible for the stabilization of the body, both while it is moving or at rest. Pilates became popular as a treatment for low back pain long after Joseph Pilates died. Traditional Pilates exercises follow six basic principles: centering (i.e. tightening the 'powerhouse' (trunk muscles)),concentration (i.e. cognitive attention while performing the exercises),control (i.e. postural management while performing the exercises), precision (i.e. accuracy of exercise technique), flow (i.e.smooth transition of movements within the exercise sequence)and breathing in co-ordination with the exercises[8].

The reported benefits of Pilates exercises include improvements in strength, range of motion, co-ordination, balance, muscle symmetry, flexibility, proprioception (awareness of posture),body definition and general health The exercises are adapted to the condition of the patient and difficulty is gradually increased while respecting individual abilities and characteristics[9].

Motor Control exercise program (also known as stabilization exercise) has become the most popular treatment method in spinalrehabilitation since it has shown its effectiveness in some aspects related to pain anddisability. However, some studies have reported that specific exercise program reduces painand disability in chronic but not in acute low back pain, although it can be helpful in thetreatment of acute low back pain by reducing recurrence rate[10].

The biological rationale for motor control exercise is fundamentally based on the idea that the stability and control of the spine are altered in people with low back pain. Physiological studies have demonstrated that patients with low back pain may exhibit a delayed onset of activity of the deep trunk muscles(e.g., transversus abdominis, multifidus)when the stability of the spine is challenged in dynamic tasks. Morphologically, a lower cross-sectionalarea and a larger percentage of intramuscular fat in the multifidus muscle were found inpatients with low back pain compared with asymptomatic controls. Moreover, it was found that patients with low back pain tend to increase the spinal stiffness to compensate forthe lack of stability from the deep muscles by increasing the activity of the superficial muscles. Finally, it was demonstrated that patients who recovered from an episode of acute low back pain are more susceptible to recurrence and chronicity if these changes were not treated with motorcontrol exercise[11].

Motor Control exercise program involved 2 stages: Stage 1; Train coordinated activity of the trunk muscles, including independent activation of the deeper muscles (including transversus abdominis and multifidus) and reduce over activity of specific superficial muscles in an individualized manner and stage 2; Implement precision of the desired coordination and train these skills in static tasks and incorporate them into dynamic tasks and functional position[11]. In NALBP Motor Control exercises aimed at restoring the stabilizing protective function of the multifidus. The exercises were designed specifically to activate and train the isometric holding function of the multifidus muscle at the affected vertebral segment (in cocontraction with the transversus abdominis muscle) [12].

The goals of treatment for nonspecific acute low back pain are to relieve pain, improve function, reduce time away from work, and develop coping strategies through education. Exercise plays a role in the management of LBP with recent systematic reviews showing that exercise is effective in improving pain and function and is more beneficial than passive therapies. However, the most effective type of exercise remains to be clarified. Optimizing treatment may minimize the development of chronic pain, which accounts for most of the health care costs related to low back pain[13].

In addition,Yamato et al.did not find any studies that investigated the effectiveness of Pilates for acute and sub-acute LBP. That why our study has to be done, to try to investigate the effective exercises in treatment of nonspecific acute low back pain[9].

Methods and Subjects

Design and randomization:

Experimental design; in this randomized controlled trial, participants were divided randomly into Pilates and Motor Control groups using conceal envelop.

Subjects:

Sixty patients (male and female) referred from an orthopedic surgeon after assessment of their backs, their ages range from 20-30 years. All participants received 12 sessions each other day (3 days per week), and each session will be 45 minutes.

Intervention:

Each participant signed an informed consent prior to entry into the study, and the ethical clearance was approved by the Institutional Human Research Ethics Committee (ethical approved number: P.T.REC/012/001019).

Pilates mat group. Patients in Pilates mat group attended 45-minute sessions, three times per week, for 6 weeks. The exercises consisted of: breathing, pelvic placement, rib cage placement, scapular movement and stabilization, head and cervical placement, hamstring stretch with resistance band, quadriceps stretch, dead bug and circle squeeze.

*Motor Control group.*Patients in Motor Control group attended 45-minute sessions, three times per week, for 6 weeks. The exercisesconsisted of: abdominal brace (Static abdominal contraction), multifudus muscle isometric activation, bridge, quadruped position exercise and wall slide.

Outcome measures:

Pain.Evaluationwas done according to the visual analogue scale.The patients were presented with a 10cm line and asked to mark an X on the line indicating the intensity of their pain over the past week. The line was labeled "no pain" at point zero at one end and "the worst pain you can imagine" at point 10 at the other end[14].

Roland- Morris Disability Questionnaire (RMQ). The RMQ is a self-administered questionnaire listing activities that can be compromised by LBP. The RMQ is a self-administered questionnaire consisting of 24 items to measure functional disability secondary to LBP. The patient is instructed to put a mark next to each appropriate statement and the total number of marked statements is added by the investigator.The scores range from 0 to 24, with 0 representing no disability and a score of 24 indicating severe disability[15].

Trunk flexion and extension range of motion (ROM). The digital inclinometer (Baseline evaluation instrument, model no. 12-1057)was used to measure the trunk flexion and extension range of motion is placed over the lumbo-sacral angle while the patient is standing in an erect posture. Angular reading is taken while holding in place. The patient is then instructed to maximally flex forward while the new angular reading is taken in the fully flexed position. Then subtract the first reading (erect) from the second one (fully flexed). The final reading is the trunk forward flexion range of motion, then repeat the same procedure to measure the backward trunk extension range of motion[16].

Statistical Analysis:

Statistical analysis was conducted using SPSS for windows, version 18 (SPSS, Inc., Chicago, IL). The current test involved two independent variables. The first one was the (tested groups); between subjects factor which had two levels (group A received Pilates mat exercises and group B receivedMotor Control exercises). The second one was the (measuring periods); within subject factor which had two levels (pretreatment, post treatment).The 2×2 mixed design MANOVA was used to compare the tested variables of interest at different tested groups and measuring periods. Shapiro-Wilk test and descriptive analysis using histograms with the normal distribution curve showed revealed the data was not normally distributed for ordinal variable (pain severity, and RMQ questionnaire). Therefore, nonparametric statistical tests in the form of Wilcoxon Signed Rank tests was used to compare between pre and post treatment for each group and Mann-Whitney U test was used to compare between both groups. The alpha level was set at 0.05.

Results

All subjects completed the 6-week trail according to the study protocol.The characteristics of participants are indicated in table1.

Table (2): Demographic characteristics of subjects in both groups

Items	**Group A (Pilates group)**	**Group B (Motor Control group)**	**Comparison**		**S**
	Mean ± SD	**Mean ± SD**	**t-value**	**P-value**	
Age (yrs.)	25.33±3.72	25.26±3.4	0.072	0.943	**NS**
Body mass (Kg)	70.43±3.43	69.52±2.82	1.117	0.269	**NS**
Height (cm)	166.53±1.61	166.73±1.77	-0.456	0.65	**NS**

***SD: standard deviation, P: probability, S: significance, NS: non-significant.**

Pain:

In group A, the median score of pain level in the "pre" and "post" tests were 8 and 1.65 respectively. There was significant reduction in pain level at post treatment in compare to pretreatment (Z = -4.785, P = 0.0001*). While in group B, the median score of the pain level in the "pre" and "post" tests were 8 and 1.75 respectively. There was significant reduction in pain level at post treatment in compare to pretreatment (Z = -4.784, P = 0.0001*). In addition, there was no significant difference between the both groups pretest (U = 413, Z = -0.548, and P = 0.584), andthere was no significant difference of the median values of the "post" treatment between both groups with (U = 445.5, Z = -0.067, and P= 0.947), (see table 2 and figure1).

Table (2): Median, U, Z, and p values of pain level pre and post test at both groups.

Pain level	Pre test	Post test	Z-value	p- value
	Median	Median		
Group A	8	1.65	-4.785	0.0001*
Group B	8	1.75	-4.784	0.0001*
U-value	413	445.5		
Z-value	-0.548	-0.067		
p- value	0.584	0.947		

***Significant level is set at alpha level <0.05 p-value probability value**

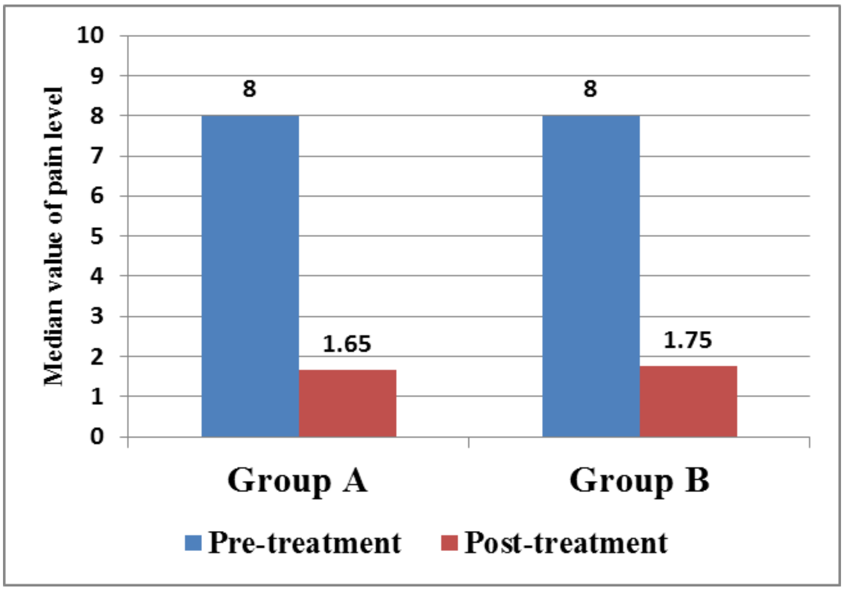

Fig. (1): Median values of pain level between both groups at different measuring periods.

Roland and Morris Questionnaire (RMQ):

In group A, the median score of RMQ scale in the "pre" and "post" tests were 13 and 1 respectively. There was significant reduction in RMQ scale at post treatment in compare to pretreatment (Z = -4.789, P = 0.0001*). While in group B, the median score of the RMQ scale in the "pre" and "post" tests were 14 and 1 respectively. There was significant reduction in RMQ scale at post treatment in compare to pretreatment (Z = -4.788, P = 0.0001*).In addition,there was no significant difference between the both groups pretest (U = 434, Z = -0.238, and P = 0.812), and there was no significant difference of the median values of the "post" treatment between both groups with (U = 397.5, Z = -1.001, and P= 0.317), (see table 3 and figure 2).

Table (3): Median, U, Z, and p values of RMQ scale pre and post test at both groups.

RMQ scale	Pre test	Post test	Z-value	p- value
	Median	Median		
Group A	**13**	**1**	**-4.789**	**0.0001***
Group B	**14**	**1**	**-4.788**	**0.0001***
U-value	**434**	**397.5**		
Z-value	**-0.238**	**-1.001**		
p- value	**0.812**	**0.317**		

***Significant level is set at alpha level <0.05 p-value probability value**

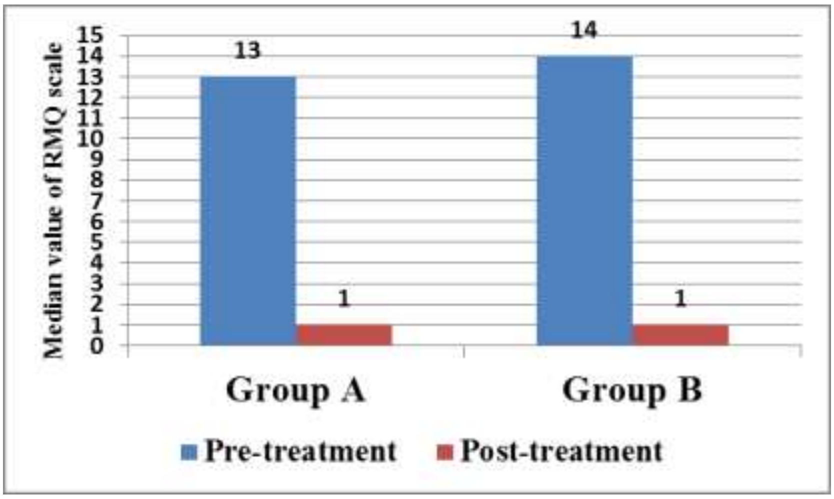

Fig. (2): Median values of RMQ scale between both groups at different measuring periods.

Trunk flexion and extension range of motion (ROM):

*Trunk flexion range of motion.*In the group (A)comparison the mean ± SD values ofROM of lumbar flexionin the "pre" and "post" tests were28.86±7.86 and 57.33 ±1.94respectively. There was significant increase of ROM of lumbar flexion at post treatment in compare to pretreatment (P-value =0.0001*). As well, the mean ± SD values of ROM of lumbar flexionin the "pre" and "post" tests were 29.1 ±8.01 and 53.06±4.84respectivelythe group (B).There was significant increase of ROM of lumbar flexion at post treatment in compare to pretreatment (P-value =0.0001*). In addition, the mean values of the "pre" test between both groups showed no significant differences with (P=0.91), and there was significant difference of the mean values of the "post" test betweenboth groups with (p=0.0001*)and this significant increase in favor of group (A) than group (B), (see table 4 and figure 3).

Table (4): Mean ±SD and p values of ROM of lumbar flexion pre and posttest at both groups.

ROM of lumbar flexion	**Pre test**	**Post test**	**MD**	**% of change**	**p- value**
	Mean± SD	**Mean± SD**			
Group A	28.86±7.86	57.33 ±1.94	-28.47	98.6	0.0001*
Group B	29.1 ±8.01	53.06±4.84	-23.967	82.36	0.00001*
MD	-0.233	4.27			
p- value	0.91	0.0001*			

***Significant level is set at alpha level <0.05** **SD: standard deviation**
MD: Mean difference **p-value: probability value**

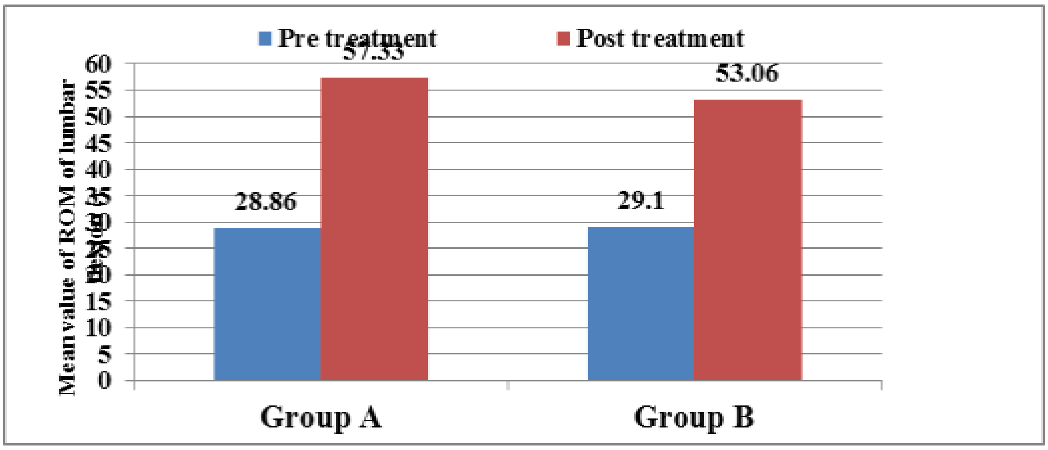

Figure (3): Mean values of ROM of lumbarflexion pre and posttests in both groups.

*Trunk extension range of motion.*In group (A)the mean ± SD values ofROM of lumbar extensionin the "pre" and "post" tests were10.17 ±1.59 and 27.54±3.28 respectively. Multiple pairwise comparison tests (Post hoc tests) revealed that there was significant increase of ROM of lumbar extension at post treatment in compare to pretreatment (P-value =0.0001*).However, the mean ± SD values of ROM of lumbar extensionin the "pre" and "post" tests were 10.13 ±1.57 and 28.12 ±3.38respectivelythe group (B).There was significant increase of ROM of lumbar extension at post treatment in compare to pretreatment (P-value =0.0001*).In addition, the mean values of the "pre" test between both groups showed no significant differences with (P=0.935), and there was no significant difference of the mean values of the "post" test betweenboth groups with (P=0.506)**.**However, there was no statistical difference between both groups; there was clinical difference and high percent of improvement in favor to group A, (see table 5 and figure 4).

Table (5): Mean ±SD and p values of ROM of lumbarextension pre and posttest at both groups.

ROM of lumbarextension	Pre test	Post test	MD	% of change	p- value
	Mean± SD	**Mean± SD**			
Group A	10.13 ±1.57	28.12 ±3.38	-17.98	177	0.0001*
Group B	10.17 ±1.59	27.54±3.28	-17.37	170	0.0001*
MD	0.04	-0.577			
p- value	0.935	0.506			

***Significant level is set at alpha level <0.05** **SD: standard deviation**
MD: Mean difference **p-value: probability value**

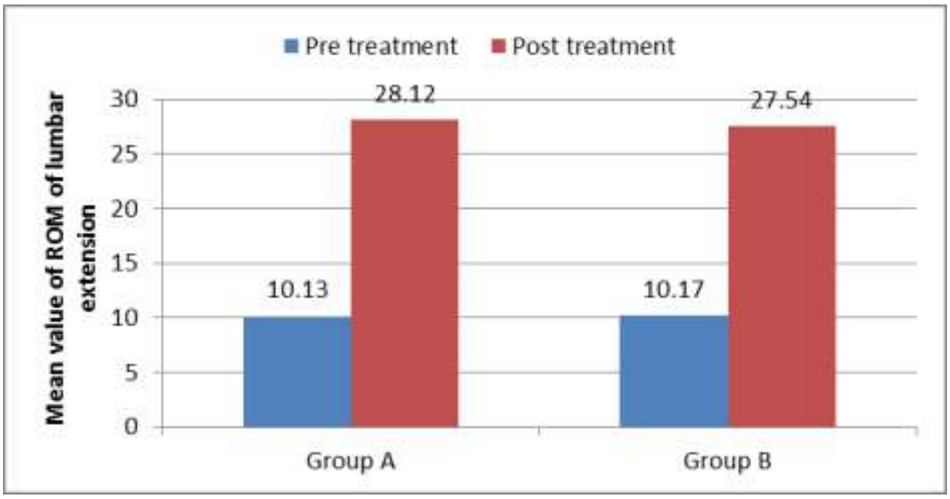

Figure (4): Mean values of ROM of lumbarextension pre and posttests in both groups.

Discussion

In current study, the comparison of findings with other studies will be based on the term of nonspecific low back pain but not on the duration of illness or trauma, because there were no studies investigated the effectiveness of Pilates for acute low back pain. All of the studies investigatedonly the effectiveness of Pilates for chronic non-specific low back pain.

The results of the current study demonstrated that there was significant decrease in pain severity in Pilates mat exercises group. This was supported by the findings ofMiyamoto et al., [1]; Rajpal et al.[17], Miyamoto et al., [1]compared between Pilates group and educational booklet group on 86participants with chronic low back pain. They measured pain severity byPain Numeric Rating Scale (NRS). Regarding pain severity they reported significant decrease in favor of Pilates group[1]. Rajpal et al., compared between Pilates group and McKenzie group on 40 female with low back pain. They measured pain using VAS and they found significant decrease in favor of Pilates group[17]. Considering functional disability, in the Pilates exercises group there was significant decrease in functional disability. Miyamato et al., assessed disability using the Roland and Morris disability index. They reported decrease in functional disability in Pilates exercises group. Regarding the range of motion in Pilates exercises group there was significant increase in lumbar flexion range of motion and significant increase in lumbar extension range of motion[1]. These findings were contradictory with the study of Pereira et al.; who compared between Pilates method and stabilization programs in chronic low back pain, Pilates method did not improve functionality and pain in patients who have chronic low back pain when compared with control and lumbar stabilization exercises groups[18]. This difference may be due to that Pereira et al. study carried out on chronic low back pain while our study was conducted on acute low back pain.

Logical explanations for reduction in pain and disability are relevant to specific concepts of Pialtes exercisein terms of the role and neural control mechanism of local muscles, motor learning and physiological response to specific volume of Pilatesprogram. The concept of Pilates exercise focuses oncore or powerhouse and breath control that activates local muscles, especially transversus abdominis, internal oblique, diaphragm, lumbar multifidus and pelvic floor muscles. Currently, scientific data show that these muscles have primary role in stabilizing thelumbo-pelvic system[19].

The volume of Pilates exercise in this study was specific to cause physiological effects. Prolonged exercise (approximately 45 minutes) with low to moderate intensity is specific to promote strength,endurance, and neuromuscular control of the local muscles (i.e., transversus abdominis, pelvic floor and multifidus muscles). The local muscle largely consists of type I or slow-twist skeletal muscles. TypeI fibers contain plentiful mitochondria, high amount of oxidative enzymes and high density of capillaries. These characteristics make them well adapted fore ndurance activities over 30 minutes such as Pilates exercise prescription in this trial. Size or cross-sectional area of type I muscles increase as a result ofincreasing mitochondria, membranous and muscle filaments within the fibers[20]. Thereby, the strength and endurance of type I fibers occur showing improvement of lumbo-pelvic stability. Improved recruitment and synchronous stimulation of thesemotor units also account for increased muscle strength. Therefore, as a significant result of proper muscles recruitment to stabilize the lumbar system, it will prevent pain and disability[21].

Considering interpretation of increasing in trunk flexion and extension range of motion post treatment. The Pilates exercise prescription in this study was successful to enhance flexibility component in agreement with flexibility exercise prescription byACSM[22]. This effect can be explained by specific concept of Pilates approach, mechanical response ofboth contractile and non-contractile tissues and neurophysiological response to specific volumes of Pilates exercise prescription in current study.

The concepts of Pilates exercise focus on flowing movement throughout the whole body. The intensity of movement is the final range of motion at a tightness point without discomfort. The frequency of practice is three sessions per week with 5 repetitions per position. These dosages of exercise are appropriated to promoteflexibility according to many researches that suggest that 2-10 repetitions of stretching exercise for 10-15seconds during a 4-10-week period of trainingcontributes to developing flexibility[12,21].

Neurophysiological properties of contractile tissues response to stretching exercise. When Pilates stretching position is applied, slow stretch to soft tissues (i.e., skin, tendon, joint capsule) and muscles activates Golgi tendon organ. This sensory receptor detects differences in the tension generated by either passive stretch or active muscle contraction. Golgitendon organ inhibits alpha motor neuron activity as are sult of decreased tension in muscles, permitting sarcomeres to lengthen[20].

Besides the change of mechanical characteristics of contractile and non-contractile tissues during slow stretch, the effect can be explained by stress-strain curve, when gentle force is applied perpendicular tothe cross-sectional area of the tissues. Initially, the wave collagen fibers are straightened. With addition altension stress, recoverable deformation occurs in the elastic range. Reaching the elastic limits results in heat release (hysteresis) and new length. Additionally, the creep phenomenon can occur with low-magnitude and repetition of Pilates exercise in 45-minute sessions, three sessions per week, for 4 weeks. Repetitive stress will increase the plastic deformation of tissues usually in the elastic range, allowing a gradual rearrangement of collagen fibers and ground substance. The stretching positions applied after warm-up phase to raise the soft tissues temperature emphasize the creep effect and lengthen the soft tissues. Another explanation of these changes is associated with viscoelastic properties, that the effects of stretching exercise increased range of motion owning to either a decrease in viscoelasticity or an increase in stretch tolerance[21].

In Motor Control exercises group, there was significant decrease in pain severity and functional disability. This was supported by the findings of Franca et al.; they compared between Motor Control and strengthening of abdominal and trunk muscles, on pain, functional disability, and activation of the transversus abdominis(TrA) muscle. Both techniques lessened pain and reduced disability. Motor Control is superior to strengthening for all variables. Strengthening does not improve TrA activation capacity[23]. Several studies had highlighted the presence of dysfunction in multifidus muscle and in the deep abdominal muscles especially the transversus abdominis muscle. It had been shown that there is a clear link between altered slow motor unit recruitment and development of chronic low back pain status, therefore using this type of exercises would help in normal motor unit recruitment pattern and thus reducing pain and functional disability[24, 25, 26].Regarding the range of motion of lumbar flexion, in the Motor Control exercises group there was significant increase in lumbar flexion range of motion. This finding is supported by the study of Hides et al., where the range of motion was assessed by a two inclinometer method. They reported increase in range of motion of lumbar flexion in the Motor Control group.Regarding the range of motion of lumbar extension, in the Motor Control exercises group there was significant increase in lumbar extension range of motion. This finding is supported by the study of Hides et al., where the range of motion was assessed by a two inclinometer method. They reported increase in range of motion of lumbar extension in the Motor Control group[12].

Regarding explanation of reduction of pain and disability and improvement in trunk flexion and extension range of motions in Motor Control group.There is internal structural changes are present in type I multifidus fibers in patients who have experienced pain for only 3 weeks, Results of multifidus muscles biopsies of the patients with poor outcome showed muscle atrophy and an increase infrequency of pathologic changes in the multifidus, especially for moth-eaten type I fibers. and It was revealed in the biomechanical studies that the lumbarmultifidus is an important muscle for lumbar segmental stability. It is able to provide segmental stiffness and control motion in the neutral zone,and it contributed two thirds of the increased stiffness imparted by contraction of the muscles[17]. For these reasons, any injury to the multifidus muscle could be expected to have direct effects on lumbar segmental stability[27].

Hides et al. showed that specific, localized, holding contractions of the lumbar multifidus helped to restore symmetry of muscle size. The technique stimulated early, localized, segmental activation and isometric holding (endurance) of the multifidus muscle within theco-contraction pattern with the deep abdominal muscles. Itwas proposed that this localized physical training, which can restore muscle size at the segmental level,may be a necessary first stage of rehabilitation, before more generalized stabilization training, so that muscle control at the segmental level might be better assured[12].In addition, Motor Control exercises can cause changes in muscle mass and increase strength and endurance and as a consequence improve trunk range of motion and reduce pain and instability by decreasing the pathological changes in type I muscle fiber in the multifudus muscle[28].

Conclusion

The results of this study revealed that both Pilates mat exercises program and Motor Control exercises program were effective in reducing pain severity and functional disability in nonspecific acute low back pain patients. Pilates mat exercises program was more effective than Motor Control exercises program in increasing lumbar flexion range of motion. There was no statistical difference between groups regarding lumbar extension range of motion but there was clinical difference with high percent of improvement in favor to Pilates mat exercises group. There were no difference between groups regarding pain and functional disability.

References

1. Miyamoto GC, Costa LOP, Galvanin T, Cabral CMN. Efficacy of the addition of modified Pilates exercise to a minimal intervention in patients with chronic low back pain: a randomized controlled trial. Physical Therapy 2013; 93:310–20.
2. O'Brien C. Pilates can decrease chronic low back pain and related functional disability. A research project submitted in partial fulfillment of the requirements for the degree of Master of Osteopathy, Unitec Institute of Technology 2010.

3. Krismer, M, Van Tulder M and Low Back Pain Group of the Bone and Joint Health Strategies for Europe Project. Strategies for prevention and management of musculoskeletal conditions. Low back pain (non-specific).Best Practice & Research. Clinical Rheumatology 2007; 21(1), 77-91.
4. Henchoz Y and Kai-Lik SA. Exercise and nonspecific low back pain: A literature review. Joint, Bone, Spine: Revue Du Rhumatisme 2008; 75(5), 533-9.
5. Bogduk N. On the definitions and physiology of back pain, referred pain, and radicular pain. Pain2009; 147, 17-19.
6. Weiner SS and Nordin M. Prevention and management of chronic back pain. Best Practice & Research. Clinical Rheumatology 2010; 24(2), 267-79.
7. Metel S, Milert A, and Szczygiel E. Pilates Based Exercise in Muscle Disbalances Prevention and Treatment of Sports Injuries. An International Perspective on Topics in Sports Medicine and Sports Injury 2012; pp 382-399.
8. Wells 2012 Wells C, Kolt GS, Bialocerkowski A. Defining Pilates exercise: a systematic review. Complementary Therapy Medicine 2012; 20(4):253–62.
9. Yamato TP,Maher CG, Saragiotto BT, Hancock MJ, Ostelo RWJG, Cabral CMN, MenezesCosta LC, Costa LOP. Pilates for low back pain. Cochrane Database of Systematic Reviews 2017.
10. Luque-Suárez A, Díaz-Mohedo E, Medina-Porqueres I, and Ponce-García T. Low Back Pain: Stabilization Exercise for the Management of Low Back Pain, Dr. Ali Asghar Norasteh (Ed.)2012; pp 265-292.
11. Leonardo OP, Costa, Christopher G. Maher, Jane Latimer, Paul W. Hodges, Robert D. Herbert, Kathryn M. Refshauge, James H. McAuley and Matthew D. Jennings. Motor Control exercise for chronic low back pain: A randomized placebo- controlled trial. PHYS THER 2009; 89:1275-1286.
12. Hides JA, Jull GA, Richardson CA. Longterm effects of specific stabilizing exercises for first-episode low back pain. Spine 2001; 26:E243-E248.
13. Becker A, Held H, Redaelli M, et al. Low back pain in primary care: costs of care and prediction of future health care utilization. Spine 2010; 35(18):1714-1720.
14. Altan L, Korkmaz N, Bingol U ,and Gunay B. Effect of Pilates training on people with fibromyalgia syngrome : A pilot study. Arch Phys Med Rehabil 2009. 90; 1983-1988.
15. Roland M, and Morris R. A study of the natural history of back pain. Part I: development of a reliable and sensitive measure of disability in low back pain spine 1983; 8:141-144.
16. MacDermid, et al. Range of Motion Measurements. Journal of Hand Therapy 1999; 12:187-192.
17. Rajpal N, Arora M, Chauhan V. A study on efficacy of Pilates & Pilates & McKenzie exercise in postural low back pain - a rehabilitative protocol. Physiotherapy and Occupational Therapy Journal 2008; 1(1):33–56.
18. Pereira LM, Obara K, Dias JM, Menacho MO, Guariglia DA, Schiavoni D, Pereira HM, Cardoso JR. Comparing the Pilates method with no exercise or lumbar stabilization for pain and functionality in patients with chronic low back pain: Systematic review and meta-analysis. Clin Rehabil 2011.
19. Vasseljen O, Fladmark AM. Abdominal muscle contraction thickness and function after specific and general exercises: A randomized controlled trial in chronic low back pain patients. Man Ther 2010; 15:482-9.
20. McArdle WD, Katch FI, Katch VL. Exercise Physiology: Energy, Nutrition, and Human Performance. 6 ed. Philadephia: Lippincott Williams & Wilkins 2007.
21. Phrompaet S, Paungmali A, Pirunsan U, Sitilertpisan P. Effects of Pilates Training on Lumbo-Pelvic Stability and Flexibility. Asian Journal of Sports and Medicine 2011; 2(1): 16-22.
22. ACSM. ACSM's Health-Related Physical Fitness Assessment Manual. 3 ed. Philadelphia: Lippincott Williams & Wilkins 2010.
23. Franca FR, Burke TN, Hanada ES, Marques AP. Segmental stabilization and muscular strengthening in chronic low back pain: a comparative study. J Manipulative Physio Ther 2011; 34(2):98-106.
24. Inani, S.B.; Selkar, S.P. Effect of core stabilization exercises versus conventional exercises on pain and functional status in patients with non-specific low back pain: A randomized clinical trial. J. Back Musculoskelet. Rehabil. 2013; 26, 37–43.
25. Šarabon N. Effects of trunk functional stability training in subjects suffering from chronic low back pain: A pilot study. Kinesiol. Slov. 2011: 17: 25–37.
26. You, J.H.; Kim, S.Y.; Oh, D.W.; Chon, S.C. The effect of a novel core stabilization technique on managing patients with chronic low back pain: A randomized, controlled, experimenter-blinded study. Clin. Rehabil. 2014; 28: 460–469.

27. Hauggaard A, and Persson AL. Specific stabilization exercises in patients with low back pain: A systematic review. Physical Therapy reviews 2007; 12:233-248.
28. Uddin S, and Ahmed F.Effect of lumbar stabilization exercises versus pressure feedback training in low back ache patients. AIIC 2013; 1:687-695.

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