

## Pilates Exercises in Low Back Pain Syndrome

Saurabh Sharma

### Abstract

Neuromuscular system of body acts to maintain postural stability and reduce the impact of various loads on the spine. Exercises for abdominal muscles are commonly used to enhance spinal stability which further reduces the incidence of low back pain. Different exercise methods have been used to enhance spinal stability. Pilates exercises are the other form of exercises which is widely used for core stability. It is believed that Pilates exercises are effective in maintaining core stability, increasing flexibility, core strength and muscle endurance. The aim of the review is to check the effects of Pilates exercises on core muscles and its role in improving core stability.

**Keywords:** Pilates Exercises; Core Muscles; Low Back Pain.

### Introduction

The Pilates Method is a technique widely used by therapists that was created by Joseph Pilates. Joseph Pilates (1880–1967) developed an exercise method based on a combination of movement techniques such as yoga and Western methods of body conditioning. The Pilates method uses stretching and strengthening exercises to provide strength and flexibility to the core muscles, exercises can be divided into 2 broad categories: mat and apparatus exercises (Bergmark et al., 1989).

Pilates method is based on six principles which include concentration, control, flowing, precision, breathing and the centering principle, and called as differential technique of method. Currently, the Pilates Method is widely used in physiotherapy for flexibility training, improvement of postural alignment and body awareness (Musculino et al. 2004). The Pilates exercises increase stability of the trunk and activate the deep muscles of the lumbopelvic region requiring endurance of trunk muscles. (Endleman and Critchley, 2008). Core stability relates

to the body region bounded by the abdominal wall, the pelvis, the lower back and the diaphragm, spinal extensor muscle and its ability to stabilize the body during movement. However, trunk muscles are classified into 2 groups; superficial muscles which are part of the global muscle system and these include the rectus abdominis muscle (RA) and the external oblique muscle (EO), and deep muscles which are part of the local muscle system and include the transversus abdominis (TrA), the multifidus and the internal oblique (IO) (Bergmark 1989). The main muscles involved in core stability are the transversus abdominis, the internal and external obliques, the quadratus lumborum and the diaphragm, erector spinae and lumbar multifidus muscle. Core is primarily responsible for posture and static as well as dynamic stability and provide the strength in normal individuals and in athletes.

Low back pain is considered as a common musculoskeletal symptom. Low back pain (LBP) affects almost everyone (about 80%) at some time during their life (da Fonseca et al.). Studies indicate that there is an annual prevalence of symptoms in 50% of working age adults (van Tulder et al., 1997). It is estimated that about 90% of cases of low back pain have a nonspecific origin and is of a multifactorial and complex etiology. Core stability is essential for healthy and strong body. Impaired core stability can lead to low back pain and frequent and prolonged back pain inhibits physical activity, can lead to decrease in flexibility, range of motion, endurance and muscle strength (Adams & Roughley 2006). Sertpoyraz et al., stated there are various rehabilitation

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**Author Affiliation:** Assistant Professor, CPRS, Jamia Millia Islamia, New Delhi 110025.

**Reprint Request:** Saurabh Sharma, Assistant Professor, Centre for Physiotherapy and Rehab Sciences, Jamia Millia Islamia, New Delhi -110025.

E-mail: saurabh14332003@yahoo.com

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and exercise programs which have been developed to increase lower back muscle strength and correct imbalanced muscle strength in patients with back pain. Ebenbichler et al., in 2001 reported Muscle dysfunctions, changes in motor control and inadequate recruitment of trunk muscles are the possible causes of non specific low back pain which further lead to reduced stability of the segments of the spine and altered distribution of loads. It has been reported that abdominal strength is important not only for the prevention and treatment of back pain, but also for improving trunk movement and stability.

It is demonstrated that coactivation of trunk muscles is the most widely used mechanism for the maintenance of spinal stability. Pilates method is known to promote protection of spinal structures during the performance of functional activities. In order to study the function of the neuromuscular system of the low back by quantifying the activation and co activation of trunk muscle groups, electromyography has proven to be an important tool (Granata et al., 2005). In clinical practice, the largest recruitment of global muscles is reported which can be associated with an increase in spinal load that has can cause injury or may worsen pain in patients having low back pain. While focusing on the activation of local muscles, the Skilled Modern Pilates exercises are performed in a neutral position that leads to greater local muscle recruitment than global recruitment (O'Sullivan et al., 2006). These exercises can be considered functional since they require the recruitment and sensorimotor control of the trunk muscles while performing limb movements.

### Literature Review

Herrington et al. in 2003 conducted a comparative study on 36 female subjects taken from an asymptomatic population in which they compared the effect of Pilates exercise between 3 different groups. The subjects were divided into 3 groups. One was Pilates group who attended Pilates classes for 45 minutes per week for 6 months, second was abdominal curl group who attended resistance classes for 15 minutes, once or twice per week for 6 months and the last one was the control group who did not attend any classes. Outcome measures were TrA isolation formal test and lumbo-pelvic stability. Data was analyzed using SPSS software. It was identified that 83% subjects from the Pilates group, 33% from the abdominal curl group, and 25%

from the control group passed TrA isolation formal test.

Study showed that only 14% percent of subjects out of 36 has passed the TrA isolation formal test and lumbopelvic stability test using PBU (Pressure Biofeedback Unit). PBU demonstrated that subjects who were Pilates trained were able to contract the TrA more correctly, and maintained better lumbopelvic control than others who performed regular abdominal curl exercises.

D.M. Rossi et al., in 2014 conducted a cross sectional study on 12 young active female subjects. In this study they compared the percentage coactivation between local antagonist muscles (OI/MU) and global antagonist muscles (RA/IL). EMG activity of muscles was analyzed before and during the exercises. Study demonstrated the mat-based Skilled Modern Pilates exercises showed differences in coactivation of the trunk muscles during five Pilates exercises. The antagonist coactivation of global muscles was found to be much more than local muscles in all the Pilates exercises which were performed.

Ji-Hyun Moon et al., in 2015 conducted a study on 30 females in which they compared the effect of Pilates exercises and resistance exercises on activation of deep and superficial abdominal muscles. One control group was also taken. They used Ultrasound machine to measure thickness of muscles and EMG for recording muscle activity. Post test analysis demonstrated that MVIC of the EO (External Oblique) was higher in the Pilates group than the controls. Study demonstrated that the recruitment of surface muscles was not affected by pilates and resistance exercises. But, the thickness of the deep muscles of core was significantly different. Pilates group showed marked changes in the thickness of TrA and IO muscle. EO muscle thickness was higher in Pilates group. The IO muscle thickness was similar between the Pilates and resistance groups. Overall, findings of the study show that Pilates and resistance exercise have a similar effect on spinal stabilization because of the activation and recruitment of deep muscles.

Queiroz et al., in 2010 conducted a comparative study on 19 ballet dancers and pilates instructors who were practicing Pilates from last 6 months and joined a minimum of 1 class of Pilates per week. He studied the activation of core muscles during four Pilates exercises. Outcome measure was surface EMG (SEMG). The exercises were performed in the reformer apparatus. Surface EMG of the four core muscles before the exercises were measured. Then subjects performed exercises and SEMG is measured during exercise. The maximum activity of multifidus muscle

is found in the anteverted pelvis and extended trunk exercise and also during the neutral pelvis and trunk inclined position.

While Gluteus maximus and Rectus abdominis activity was found higher retroverted pelvis and flexed trunk exercise. The study suggests that pelvic stability is maintained in the 4 exercise positions. The neutral pelvis position with the trunk parallel to the ground was found to be increasing Multifidus, gluteus maximus, and oblique muscle activity from 8% to 28% of the MVIC. Multifidus muscle activity was also promoted in the anteverted pelvic position with extended trunk.

Tony English, et al., in 2007 conducted a single subject design study which was done on 3 young and healthy base ball pitchers. Recruitment of subjects were done during off season to avoid threat to internal validity. Pilates exercise methods are taught to the subjects and exercises are performed on mats and tables. Outcome measures were Double leg lowering (DLL) test, Star excursion balance test (SEBT) test and throwing speed. For each subject Double leg lowering (DLL) test, Star excursion balance test (SEBT) test and throwing speed is measured prior to intervention and intervention was continued for 10 weeks and was introduced to one subject at a time. The baseline measurements were compared with after intervention measurements. (DLL) test showed the percent change of 24.43-32.6% and (SEBT) showed change of 4.63-17.84% and throwing speed measurements ranged from 2.29-5.3% with Pilates exercises. The Pilates method of exercise implicated into an off-season baseball conditioning program have a positive effect on performance in trunk strength and stability test and on single leg balance test in all subjects who were studied. Throwing velocity was also positively improved.

## Discussion

The prone lying TrA isolation test can classify subjects accurately into LBP and painless group in about 80% of subjects (Hodges et al.). Lumbo-pelvic instability can occur due to TrA dysfunction and there is increased incidence of low back pain (Richardson et al., 1992; Jull et al., 1993) Herrington et al. demonstrated that subjects trained with pilates have higher TrA activity than abdominal curl trained and untrained people. The onset of limb load is predictable in pilates exercises which can lead to pre setting of TrA because of anticipation of load by the body.

Study by D. M. Rossi et al., demonstrated that trunk stability during pilates exercises on mats showed high coactivation of trunk muscles especially on right side muscles. Asymmetry of load application from lower limbs during performing unilateral exercises may have generated disturbance and trunk rotation which has led to higher coactivation of right sided muscles. Overall pilates exercises has shown to increase coactivation of global muscles of both sides.

In the study conducted by Moon, J. H. et al., comparison of surface EMG and deep muscle thickness in experienced pilates instructors and resistance instructors relative to control subjects was done. Study demonstrated that muscle activation does not depend on experience. However activity of deep muscles was similar in both groups, but TrA is most activated in pilates group. Also the thickness of TrA and IO muscle is increased both in pilates and resistance exercise group. The increase in thickness can be because pilates and resistance exercise groups may be familiar with exercises. The increase in thickness of IO muscle with resistance exercise can be a result of hypertrophy as resistance exercises stabilize the lumbar spine as they work with global muscles against external load (Siti lertpisan et al., 2011).

The purpose of study by Queiroz et al., was to compare activation of trunk flexors, extensors and hip muscles during pilates exercises. Activation of trunk muscles found to be increased with pilates training. Exercises with trunk flexion increased external oblique and gluteus medius activity but reduced multifidus activity. Activity of rectus abdominis was much higher in trunk flexed and pelvis retroversion exercise. While multifidus activity is found to be higher during trunk extensor exercises.

In a study by Tony English, et al., 2007, there is improvement in the subjects performance after the Pilates exercises. Positive changes are seen very early in DLL test. Positive changes are also seen in subjects and throwing velocity is also found to be increased in all subjects. Although limitations are there in study because a single subject design can have a threat over external validity.

## Conclusion

Various methods of exercises has been used such as, strengthening exercises, flexibility training, abdominal drawing-in maneuver for core stabilization but there is evidence which shows that Pilates exercises can also be used for core

stabilization and has positive effects on core stability. Pilates training also enhance postural stability and performance in athletes.

But there were lot of limitations in the studies which were conducted. One study was single subject design which imposed the threat on external validity. In some studies they performed the protocol in single attempt with the limitation that the results can be different on other days. Some studies were performed on people who are trained in that particular exercise programme which can make them familiar with and can lead to different results. Therefore , further studies are required on these factors.

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