J Korean Soc Phys Med, 2016; 11(3): 59-63
http://dx.doi.org/10.13066/kspm.2016.11.3.59

Online ISSN: 2287-7215
Print ISSN: 1975-311X

Research Article

Open Access

The Effects of Pilates based Breathing on Changes in the Thicknesses of the Abdominal Muscles

Hae-Yeon Kwon, PT · Hyun-Ju Moon[1†], PT · Moon-Jeoung Kim[1], PT

Department of Physical Therapy, Dong-Eui University
[1]Department of Physical Therapy, Catholic University of Pusan

Received: June 15, 2016 / Revised: June 25, 2016 / Accepted: July 26, 2016

| Abstract |

PURPOSE: The purpose of the present study is to examine the effects of sole Pilates based breathing on the thicknesses of the abdominal muscles.

METHODS: Twenty adults aged in their 20-30s were randomly selected. The selection criteria were those who had no medical history of pain due to musculoskeletal system, neurologic, or orthopedic diseases within six months before the selection. The thicknesses of the abdominal muscles (the transversus abdominis muscle, internal oblique abdominal muscle, and external oblique abdominal muscle) of the subjects were measured using ultrasonography before and after Pilates breathing. The study was approved by the research ethics committee of the Catholic University of Pusan.

RESULTS: After Pilates based breathing, the thicknesses of the transversus abdominis muscle, the internal oblique abdominal muscle, and the external oblique abdominal muscle increased significantly. In particular, the thickness increase rate of the transversus abdominis muscle was shown to be the highest.

CONCLUSION: Sole Pilates based breathing is expected to be effective for the improvement of trunk stability through strengthening of abdominal muscles, because it induces the coordinated contraction of the transversus abdominis muscle and other abdominal muscle. It will be need the Longitudinal study for identify to long term effects of Pilates based breathing.

Key Words: Pilates based breathing, Abdominal muscle thickness, Trunk stability

Ⅰ. Introduction

Pilates exercise emphasizes a normal posture through spinal alignment and functional movements. Therefore, Pilates exercise is gaining great popularity not only for the rehabilitation of athletes or patients with low back pain, but also for the enhancement of a healthy quality of life (Muscolino and Cipriani, 2004; Cruz-Ferreira et al., 2011). Pilates exercise has several basic principles and among them, Pilates based breathing is a base for regulating time points for converting movements. In addition, Pilates based

†Corresponding Author : pulhanpogi2@naver.com

breathing is meaningful in that it is a preceding step for all Pilates movements and it becomes the basis of Pilates exercise. A characteristic of Pilates based breathing is the emphasis on deep respiration. The concrete method is as follows. During inspiration, a breath is taken through the nose, the lower ribs are widened upward laterally, the abdomen is expanded forward, and the diaphragm is moved downward, creating a feeling that the organs in the abdominal cavity are pushed down into the pelvic cavity. During expiration, a deep breath is pushed out through the mouth, and the lower ribs, the abdomen, and the diaphragm are returned to their original positions, creating a feeling that the organs in the pelvic cavity are being pulled upward. This breathing method activates all muscles from the diaphragm to the pelvic floor region during expiration by widening the core region to the pelvic floor to connect strongly the ribs with the pelvis, thereby achieving spinal stability (Latey, 2001). A previous study reported that Pilates based breathing relatively increased the activity of the transversus abdominis muscle compared to the internal oblique abdominal muscle (Barbosa et al., 2015). In addition, Critchley et al. (2011) showed that the internal oblique abdominal muscle contracted more during movements in the trunk strengthening group, the transversus abdominis muscle contracted more in the Pilates exercise group. Therefore, functional Pilates exercise seem to induce the contraction of the transversus abdominis muscle relatively more than other abdominal muscles. Repeated applications of these Pilates exercise are thought to increase neuro-muscular accommodation force by promoting the selective activity of the transversus abdominis muscle. Therefore, Pilates exercise is frequently used as a method of reducing spinal instability and treating low back pain through trunk motor control (Rydeard et al., 2006).

Although studies indicate that Pilates exercise reduces low back pain or trunk instability through neuro-motor control (Posadzki et al., 2011; Wells et al., 2012), scientific bases are weak regarding whether Pilates based breathing per se is associated with spinal stability. In addition, as all Pilates exercise are accompanied by breathing, the sole effects of breathing per se cannot be easily known.

Therefore, the purpose of the present study is to examine the sole effects of Pilates based breathing on the thicknesses of the abdominal muscles.

Ⅱ. Methods

1. Subjects

The present study was conducted with 20 healthy adult females aged in their 20-30s. The subjects were randomly selected from among those who voluntarily agreed to participate in the experiment, and all subjects were requested to sign a written agreement. The selection criteria were those who had no medical history of pain due to musculoskeletal system, neurologic, or orthopedic diseases within six months before the selection. The experiment was approved by the research ethics committee of the Catholic University of Pusan.

2. Procedure

Before beginning the present experiment, the experimenter explained the Pilates based breathing method to the subjects. The subjects practiced three times so they could become familiar with the breathing method.

In the present experiment, each subject lay on the bed in a crook-lying position and aligned the anterior superior iliac spine (ASIS), the knee, and the second toe of each leg to form a straight line. Thereafter, the subject conducted Pilates based breathing with an inspiration and an expiration of 5s, respectively. 8repetitions of this breathing were regarded as 1set, and the subject conducted 2sets. When 1set was complete, the subject took a rest for 5 min to prevent hyperventilation and muscle fatigue. While the experiment was in progress, the subject was instructed to

maintain the neutrality of the spine and conduct inspirations and expirations in accordance with the timer of a watch, and a skilled physical therapist feedback the breathing condition of the subject. During inspirations of Pilates based breathing, the subject was instructed to take a breath through the nose, to widen the ribs upward laterally, to push the abdomen forward, and to push the diaphragm downward to create a feeling of pushing the organs in the abdominal cavity down into the pelvic cavity. During expirations, the subject was instructed to push out a breath through the mouth and to return the ribs, the abdomen, and the diaphragm to their original positions to create a feeling of pulling the organs in the pelvic cavity upward in to the abdominal cavity (Latey, 2001). At this time, to maintain the lumbar lordotic curve constant, a pressure biofeedback unit (PBU) was placed at the L3-4 level and the subject was instructed to maintain the reading at 40mmHg. Abdominal muscles thickness were measured by ultra sound at pre and post intervention respectively.

3. Measurement

Ultrasonography (SONOACE X4, MEDISON, Korea) was used to measure the deep abdominal muscle thicknesses and 7.5-MHz linear probes were set to B-Mode during the measurement. The thicknesses were measured at a point 5cm medial from the middle region between the right iliac crest and the inferior margin of the 11th rib when the subject was breathing out (Teyhen et al., 2005). The thicknesses were measured 3 times, and the average value was used in the analysis. To measure abdominal muscle thicknesses using ultrasonic images, a 10 mm horizontal line was drawn at the point of attachment of the posterior rectus sheath, which is connected to the external oblique abdominal muscle and the muscle fascia of the transversus abdominis muscle. In addition, a vertical line was drawn at the point to measure the thicknesses of the transversus abdominis muscle, the internal oblique abdominal muscle, and the external oblique abdominal muscle in order of precedence.

4. Statistics

SPSS 19.0 (Chicago, IL, USA) was used to derive the experimental results, and the general characteristics of the subjects were analyzed using descriptive statistics. The abdominal muscle thicknesses before and after the intervention were analyzed using paired t-tests to compare them with each other, and the significance level was set to α=.05.

Ⅲ. Results

The subjects' general characteristics are shown in Table 1.

Table 1. Characteristics of the subjects

(N=20)

Variables	Value
Age (year)	21.72±3.46
Height (cm)	160.44±5.12
Weight (kg)	51.11±4.49
BMI	19.50±1.58

After the application of Pilates based breathing, the transversus abdominis muscle, the internal oblique abdominal muscle, and the external oblique abdominal muscle became significantly thicker, and in particular, the thickness increase rate of the transversus abdominis muscle was the highest (Table 2).

Table 2. Change of deep abdominal muscle thicknesses after Pilates based breathing

(units: cm)

Muscles		Mean±SD (cm)	Increase rate (%)	p
TrA	pre	.27±.08	33	.00*
	post	.36±.10		
IO	pre	.57±.13	19	.01*
	post	.68±.22		
EO	pre	.42±.10	21	.00*
	post	.51±.12		

TrA: Transvers Abdominis, IO: Internal Oblique, EO: External Oblique, *p<.05

Ⅳ. Discussion

In the present study, the effects of Pilates based breathing on changes in the thicknesses of the abdominal muscles were observed. As a result, it could be seen that the thicknesses of the transversus abdominis muscle, the internal oblique abdominal muscle, and the external oblique abdominal muscle significantly increased after the application of Pilates based breathing. A previous study reported that during deep expirations, the activities of the transversus abdominis muscle and the internal and external oblique abdominal muscles increased (Ishida and Watanabe, 2012; Lee, 2012). In the present study, the thicknesses of the muscles are thought to have increased, because deep breaths are pushed out during expirations due to the characteristics of Pilates based breathing, leading to further increases in muscle activity through the coordination of the transversus abdominis muscle and the internal and external oblique abdominal muscles. Endleman and Critchley (2008) showed significant increases in the thicknesses of the transversus abdominis muscle and the internal oblique abdominal muscle after the application of Pilates exercise, and the researchers reported that the results occurred because Pilates exercise induced coordinated contractions of the transversus abdominis muscle and other abdominal muscles (Endleman and Critchley, 2008; Kim et al., 2016). Moon et al. (2015) identified that among the abdominal resistance training group, the Pilates exercise group, and the control group, the Pilates exercise group showed the largest increase in the thickness of the transversus abdominis muscle, while the Pilates exercise group and the abdominal resistance training group showed larger increases in the thickness of the internal oblique abdominal muscle compared to the control group. The researchers advised that Pilates exercises induced the contraction of the transversus abdominis muscle particularly more, and this was thought to be effective for the improvement of trunk stability through deep and superficial abdominal muscles coordination. In the present study, the increase rate of the thickness of the transversus abdominis muscle (33%) was higher than that of the internal oblique abdominal muscle (19%) or the external oblique abdominal muscle (21%) after applying Pilates based breathing. This can be regarded as attributable to the fact that Pilates based breathing promoted the contraction of the transversus abdominis muscle relatively more than other muscles. Given these study results, Pilates exercise is expected to promote coordination among the deep abdominal muscles, such as the transversus abdominis muscle and the internal oblique abdominal muscle, and an increase in the recruitment of the motor units of these muscles, thereby improving lumbar muscle strength and endurance and leading to lumbo-pelvic stability (Sureeporn et al., 2011). Meanwhile, all Pilates exercise are accompanied by Pilates based breathing, and Pilates based breathing induces breathing muscle activity proactively before and during the occurrence of movements of the extremities and it neutralizes the spine, thereby providing trunk stability so that natural continuous movements can occur (Cruz-Ferreira et al., 2011). In addition, Pilates based breathing induces the coordinated contractions of the diaphragm, the multifidus muscles, the transversus abdominis muscle, and the pelvic floor muscle to achieve core stability. Therefore, repeated training with Pilates breathing is thought to induce core stability simultaneously with functional movements of the extremities and is considered an efficient core exercise method that can be implemented with just breathing, without any time or space restrictions.

Ⅴ. Conclusion

The lateral wall of the abdomen is built of the transversus abdominis (TrA), internal oblique abdominal muscle (IO), and external oblique abdominal muscle (EO). Of these

abdominal muscles, the greatest role is ascribed to the TrA, which, together with the posterior portion of the IO, is part of a deep cylinder providing stability for the lumbar spine. Also this study showed that Pilates breathing increase the thickness of transversus abdominis, internal oblique abdominal muscle (IO), and external oblique abdominal muscle (EO). So Pilates breathing performing regular is be likely to enhance strength of the abdominal muscles and it will lead a stability of trunk.

References

Barbosa AW, Guedes CA, Bonifácio DN, et al. The pilates breathing technique increases the electromyographic amplitude level of the deep abdominal muscles in untrained people. J Bodyw Mov Ther. 2015;19(1): 57-61.

Cruz-Ferreira A, Fernandes J, Laranjo L, et al. A systematic review of the effects of pilates method of exercise in healthy people. Arch Phys Med Rehabil. 2011;92(12):2071-81.

Critchley DJ, Pierson Z, Battersby G. Effect of pilates mat exercises and conventional exercise programmes on transversus abdominis and obliquus internus abdominis activity: pilot randomised trial. Man Ther. 2011;16(2):183-9.

Endleman I, Critchley DJ. Transversus abdominis and obliquus internus activity during Pilates exercises: measurement with ultrasound scanning. Arch Phys Med Rehabil. 2008;89(11):2205-12.

Ishida H, Watanabe S. Influence of inward pressure of the transducer on lateral abdominal muscle thickness during ultrasound imaging. J Orthop Sports Phys Ther. 2012;42(9):815-8.

Kim JS, Kim YH, Kim EN, et al. Which exercise is the most effective to contract the core muscles: abdominal drawing-in maneuver, maximal expiration, or Kegel exercise?. J Korean Soc Phys Med. 2016;11(1):83-91.

Latey P. Modern pilates: the step by step, at home guide to a stronger body. Australia. Allon & Unwin. 2001.

Lee BK. The effect of the forced pulmonary function of young female, by changes in lung function related to postures and by transverse abdominis activation in standing position. J Korean soc phys med. 2012;7(3):267-74.

Muscolino JE, Cipriani S. Pilates and the "powerhouse"-I. J Bodyw Mov Ther. 2004;8(1):15-24.

Moon JH, Hong SM, Kim CW, et al. Comparison of deep and superficial abdominal muscle activity between experienced Pilates and resistance exercise instructors and controls during stabilization exercise. J Exerc Rehabil. 2015;11(3):161-8.

Posadzki, P, Lizis, P, Hagner-Derengowska M. Pilates for low back pain: a systematic review. Compl Ther Clin Pract. 2011;17(2):85-9.

Rydeard R, Leger A, Smith D. Pilates-based therapeutic exercise: effect on subjects with nonspecific chronic Barbosa low back pain and functional disability: a randomized controlled trial. J Orthop Sports Phys Ther. 2006;36(7):472-84.

Sureeporn P, Aatit P, Ubon P, et al. Effects of Pilates Training on Lumbo-Pelvic Stability and Flexibility. Asian J Sports Med. 2011;2(1):16-22.

Teyhen DS, Miltenberger CE, Deiters HM, et al. The use of ultrasound imaging of the abdominal drawing-in maneuver in subjects with low back pain. J Orthop Sports Phys Ther. 2005;35(6):346-55.

Wells C, Kolt, GS, Bialocerkowski A. Defining Pilates exercise: a systematic review. Complement Ther Med. 2012;20(4):253-62.