Ultrasound Evaluation of the Abdominal Wall and Lumbar Multifidus Muscles in Participants Who Practice Pilates: A 1-year Follow-up Case Series

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Abstract

Objective: The purpose of this study was to describe ultrasound (US) changes in muscle thickness produced during automatic activation of the transversus abdominis (TrAb), internal oblique (IO), external oblique (EO), and rectus abdominis (RA), as well as the cross-sectional area (CSA) of the lumbar multifidus (LM), after 1 year of Pilates practice.
Methods: A 1-year follow-up case series study with a convenience sample of 17 participants was performed. Indeed, TrAb, IO, EO, and RA thickness, as well as LM CSA changes during automatic tests were measured by US scanning before and after 1 year of Pilates practice twice per week. Furthermore, quality of life changes using the 36-Item Short Form Health Survey and US measurement comparisons of participants who practiced exercises other than Pilates were described.
Results: Statistically significant changes were observed for the RA muscle thickness reduction during the active straight leg raise test ($P = .007$). Participants who practiced other exercises presented a larger LM CSA and IO thickness, which was statistically significant ($P < .05$). Statistically significant changes were not observed for the domains of the analyzed 36-Item Short Form Health Survey ($P > .05$). A direct moderate correlation was observed ($r = 0.562$, $P = .019$) between the TrAb thickness before and after a 1-year follow-up.
Conclusions: Long-term Pilates practice may reduce the RA thickness automatic activation during active straight leg raise. Furthermore, LM CSA and IO thickness increases were observed in participants who practice other exercise types in conjunction with Pilates. Despite a moderate positive correlation observed for TrAb thickness, the quality of life did not seem to be modified after long-term Pilates practice. (J Manipulative Physiol Ther 2018;xx:1-xxx)
Key Indexing Terms: *Abdominal Muscles; Exercise Movement Techniques; Paraspinal Muscles; Ultrasonography*

Introduction

The Pilates method, created by Joseph Pilates, is based on the coordination of body, mind, and spirit and promotes the uniform development of the body by restoring good posture and physical activity.[1] It aims to strengthen the core muscles through more than 500 strengthening and stretching exercises. The Pilates method may be divided into 2 modalities: mat and machine. The exercises with machines are carried out with resistance applied by springs and pulleys.[2] There is general agreement about the anatomic delimitation of the core or powerhouse, which runs from the bottom of the pelvic floor to the top of the rib cage. This would be the central point of the Pilates method, and based on a good control of the same, it also includes the participation of the rest of the limbs in the exercises.[3]

It is a very popular training method in the field of rehabilitation and well-being, and its principles are similar to the training of the stability of the spine through motor control. The resistance and activity of the abdominal and lumbar muscles recently have been considered the best option to improve the stability of the spine.[4]

Although there is no universally accepted definition for core stability, and different studies assess the transversus abdominis (TrAb) and lumbar multifidus (LM) muscles as

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primary stabilizers, others point out that no specific core element is more important than another for lumbar stability, all of which contribute to the optimal lumbopelvic stability required for sports practice and functional activities.[3,5] Therefore, more and more studies verify the muscular activation of the stabilizing muscles of the spine, mainly the TrAb and internal oblique (IO) muscles, with ultrasound (US) images through the practice of Pilates exercises.[6-9]

The muscular activity of the LM has not been measured with US in Pilates studies; however, its activity has been shown with surface electromyography (EMG) data in some Pilates exercises.[10-13]

The muscles of the abdominal wall, such as rectus abdominis (RA) in the midline, and laterally the external oblique (EO), IO, and TrAb work in a coordinated way with the diaphragm, LM, and pelvic floor muscles for control of the spine under normal circumstances.[14] In the case of lumbopelvic pain, functional deficits of the muscles of the abdominal wall have been found.[15,16]

Quality of life is another important factor that is present in studies that value the effects of Pilates in participants who practice it. The 36-Item Short Form Health Survey (SF-36) is one of the most widely used and evaluated health-related quality of life instruments. It is a generic scale that provides a profile of health status, includes items of physical function and physical role, and is considered in conjunction with the new versions of an instrument very suitable for use in research and clinical practice.[17] Different Pilates studies have used this questionnaire to assess the effect of training with the Pilates method on quality of life, showing an improvement in almost all subscales in older adults,[18] in all subscales in median adult age,[19] and functional capacity, pain, and vitality subscales in adults with chronic low back pain.[20]

The use of US in the practice of physiotherapy to assess muscle morphology and to guide rehabilitation decision making has increased quickly during the last decade as a reliable and valid option to be used in clinical practice.[21] The use of US imaging in the field of neuromusculoskeletal rehabilitation has been called rehabilitative US imaging (RUSI) and defined as "the procedure used by physiotherapists to assess muscles and soft tissue morphology and their function during physical exercise and is used to assist in the application of therapeutic interventions aimed at improving neuromuscular function."[22] Its purpose is to improve our understanding of the relationship between motor control and function, to determine which patients can benefit from the therapeutic approach of treatment through specific exercises, to increase documentation on the effect, to improve the effectiveness of treatments, and to increase feedback.[21] After the international symposium of RUSI in May 2006, RUSI has been applied in the clinic and in research to study the abdominal wall muscles and the back.[23,24]

In 2009, a systematic review aimed to determine whether RUSI was a valid measure of trunk muscle size and activation and whether such measures were sensitive to change compared US with magnetic resonance imaging and EMG; results suggested that the change in thickness in these muscles was a valid measure of the activity of these muscles at moderate levels of effort and that RUSI was sensitive to both positive and negative changes.[25] Different cross-sectional studies have used RUSI to measure and compare the thickness and recruitment differences of these muscles in healthy participants and in those with low back pain.[26,27]

Indeed, more and more physiotherapy clinics offer Pilates therapeutic classes as a training method that improves the health of the locomotive system, prevents pain, and promotes the general well-being of the people who perform it. Also, the use of therapeutic US by physiotherapists to evaluate muscle morphology and muscular function in people with musculoskeletal problems is growing and is a valid and practical method to assess the evolution of certain pathologies or conditions.[21,22,25] Quantification, within the limits of the study, of the changes in muscle contraction that are observed after a year of performing Pilates is useful information for the patients who practice it, for those who want to do it, and for the physiotherapy therapeutic objectives that arise when using the Pilates method in the long term.

The found studies evaluated the muscular activity of the abdominal wall and the multifidus by Pilates exercises in the short term.[6-13] To the authors' knowledge, no studies with a 1-year follow-up observed the change in muscle contractions at their request through automatic activation tests in people who performed Pilates. The study would be a first approach to assess longitudinally, with a 1-year follow-up, changes in abdominal wall muscle thickness and cross-sectional area (CSA) during contraction of main lumbar-stabilizing muscles. It cannot be determined that the effect is directly due to Pilates because there is no control group or random assignment, but it serves as an approximation for future observational studies and clinical trials.

Therefore, the primary aim of this study was to describe the changes in muscle thickness that occur during the activation of the TrAb, IO, EO, RA, and CSA of the LM, as measured with US, in the sample of participants performing Pilates for 1 year by using automatic activation test. Furthermore, the secondary purposes of this research were to describe (1) the observable differences (or lack thereof) between the effects of Pilates and those of other sports, including changes in muscle thickness; (2) the changes in the quality of life of participants in the sample who performed Pilates during 1 year, as measured by the SF-36; and (3) the correlations among the muscular activity of the different valued muscles.

Methods

Study Design

A 1-year follow-up case series study with a convenience sample of 17 participants was carried out between March 2016 and April 2017. A flow chart of the participants through