Journal of Bodywork & Movement Therapies (2017) 21, 124–132

Available online at www.sciencedirect.com

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journal homepage: www.elsevier.com/jbmt

ORIGINAL RESEARCH STUDY

Effects of a 16-week Pilates exercises training program for isometric trunk extension and flexion strength

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Received 14 March 2016; received in revised form 3 May 2016; accepted 25 May 2016

KEYWORDS
Pilates exercise program;
Chronic low back pain;
Isometric trunk flexion and extension

Summary *Objective:* To evaluate the effects of Pilates exercises designed to improve isometric trunk extension and flexion strength of muscles in women with chronic low back pain (cLBP).
Participants: Female volunteers with cLBP were divided into an experimental group (EG; $n = 27$) and a control group (CG; $n = 27$).
Intervention: Pilates exercises were performed twice per week by the EG; the duration of each session was 60 min. The program lasted for 16 weeks; thus patients underwent a total of 32 exercise sessions.
Results: The maximum isometric waist bending strength of the EG had improved significantly ($p = 0.001$) after 16 weeks of the Pilates program. The results of trunk flexion muscle endurance tests significantly depended on the trunk extension muscle endurance before the intervention, and at 1 month ($r = 0.723$, $p < 0.001$) and 2 months ($r = 0.779$, $p < 0.001$) after the Pilates exercise program. At the end of the 16-week exercise program, cLBP intensity decreased by 2.01 ± 0.8 ($p < 0.05$) in the EG, and this reduction persisted for 1 month after completion of the program.

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http://dx.doi.org/10.1016/j.jbmt.2016.06.005

Conclusions: At 1 and 2 months after cessation of the Pilates exercise program the pain intensified and the functional state deteriorated much faster than the maximum trunk muscle strength. Therefore, it can be concluded that, to decrease pain and improve functional condition, regular exercise (and not only improved strength and endurance) is required. We established that, although the 16-week lumbar stabilization exercise program increased isometric trunk extension and flexion strength and this increase in strength persisted for 2 months, decreased LBP and improved functional condition endured for only 1 month.

Introduction

Chronic low back pain (cLBP) is one of the most common causes of disability, and the Pilates method has been associated with improvements in symptoms (Mostagi et al., 2015). Sixty to eighty percent of the adult population suffer LBP at some point during life (http://www.sciencedirect.com/science/article/pii/S1356689X15000223Airaksinen et al., 2006). Pilates can be used as an adjunctive exercise program to improve flexibility and enhance control/mobility of trunk and pelvic segments and core stability. It may also prevent and attenuate the predisposition to axial musculoskeletal injury (Phrompaet et al., 2011). Exercise is an effective treatment for patients with cLBP. Among the European population, Picavet and Hazes (2003) reported that 27% suffer from cLBP. People with cLBP have more muscle atrophy, especially of the lumbar deep muscles (Tertti et al., 1991; Hides et al., 1994). Limitation of movement due to cLBP causes morphological changes in the lumbar muscles that induce decreased muscle strength and endurance. Decreased muscle strength and endurance negatively affect lumbar stability and eventually cause functional limitations (Stokes et al., 1992). Over the past decade, a number of studies have reported dysfunction in the voluntary activation of the deep-lying trunk muscles in connection with recurrent or chronic LBP (Critchley and Coutts, 2002; Mannion et al., 2012; Pulkovski et al., 2012). Stuge et al. (2004) established that, after intervention and at 1 year post-partum, a patient group that had undertaken specific stabilizing exercises was associated with statistically and clinically significant lower pain intensity, lower levels of disability, and better quality of life compared with the control group. The difference between groups in median values for evening pain after treatment was 30 mm on the visual analogue scale. Disability was reduced by more than 50% for the exercise group; changes were negligible in the control group. Significant differences were also observed for physical tests, in favour of the specific exercise group. Patients with cLBP often experience increased symptoms due to sustained low-load activities such as prolonged sitting and standing (Lafond et al., 2009).

A complex network of almost 70 muscles of varying sizes makes up the lumbar-spine musculature. Each muscle is capable of several possible tasks and exerts various forces and actions on the spinal motion segments (Bogduk, 2005). Collectively, they provide a pool of possible motor actions during load distribution, load transfer, and control of spinal movement. Reasonably strong evidence exists for altered neuromuscular function and stiffened movement patterns in cLBP patients during walking, trunk flexion, and unstable sitting (Geisser et al., 2004; Lamoth et al., 2006). Recent studies on and treatments for cLBP have been focused on improving trunk stability to minimize recurrent episodes and maximize prevention. Trunk muscles are co-activated to stabilize the trunk. Therefore, co-activation of the trunk muscles is necessary to achieve trunk stability and to prevent and treat back pain (Lehman et al., 2005). There has been much discussion about which is the most effective technique for improving spine stability (Vera-Garcia et al., 2007). It has been claimed that there is a link between local muscle dysfunction and cLBP, with the development of clinical instability in which there is an excessive range of abnormal segmental movement without muscular control (Richardson et al., 1999). Thus, stabilization exercises have been designed in order to enhance the neuromuscular control system and correct the dysfunction (McGill, 2002).

It is therefore important to assess the lasting impact of Pilates exercise programs on the treatment of cLBP.

The research questions for this study are:

1. What are the long-term effects of a Pilates exercise program of 16 weeks involving 32 sessions on women suffering from cLBP?
2. What are the effects of a 16-week Pilates exercise program focussing on isometric trunk extension and flexion strength?

Research methods

Design

Before starting the lumbar stabilization exercise program, at the end of the program, and 1 and 2 months after the intervention the following control tests were carried out: isometric force at an angular velocity of 60 deg/s was measured using a Biodex System 3 Pro isokinetic dynamometer (certified ISO 9001 EN 46001; Shirley, NY, USA); a survey was conducted using the Oswestry Disability Index; participants were assessed according to numerical and verbal pain rating scales. Lumbar stabilization exercises were performed two times per week; the duration of each session was 60 min. The program lasted for 16 weeks, so that a total of 32 sessions were executed.