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The Pilates® Method in the treatment of lower back pain

Método Pilates® no tratamento da dor lombar

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Abstract

Introduction: The Pilates® method incorporates a number of the guidelines recommended for therapeutic exercises considered to be effective in the treatment of chronic lower back pain, such as the contraction of the transversus abdominis and multifidus muscles, associated with breathing, while taking into account the individual characteristics of patients. **Objective**: To assess the effects of the Pilates® method on the treatment of lower back pain. **Method**: This systematic review includes papers published from 2000 to 2010 in the BIREME, LILACS, MEDLINE and SciELO databases. The keywords used were spinal stabilization, Pilates®, and back pain and their equivalents in Portuguese. **Results**: Imbalance among the trunk's agonist-antagonist muscles and the ineffective activation of the transversus abdominis are risk factors for the onset of lower back pain that can be mitigated with the practice of Pilates®-based exercises. **Conclusion**: The method has clinical effects similar to those obtained with traditional stabilization exercises and Back School exercises in the treatment of chronic lower back pain and are considered more satisfactory than conservative treatments.

Keywords: Lower back pain. Spinal stabilization. Pilates.

Resumo

Introdução*: O método Pilates® incorpora várias das diretrizes dos exercícios terapêuticos apontados como eficazes para o tratamento da dor lombar crônica, como a contração dos músculos multífidos e transverso*

abdominal associado à respiração, além da progressão de acordo com as características do paciente. ***Objetivo****: Averiguar os efeitos do método Pilates® no tratamento da lombalgia.* ***Método****: O artigo constitui uma revisão sistemática de artigos publicados entre 2000 a 2010 nas bases de dados do BIREME, LILACS, MEDLINE e SciELO, utilizando as palavras-chave: estabilização vertebral, método Pilates e lombalgia, e seus correlatos em inglês.* ***Resultados****: O desequilíbrio entre a musculatura agonista-antagonista do tronco e a ativação inefetiva do transverso abdominal são fatores de risco para o desencadeamento da dor lombar e que podem ser atenuados mediante a realização dos exercícios do Pilates®.* ***Considerações finais****: O Método tem efeitos clínicos semelhantes aos dos exercícios de estabilização tradicionais e da Escola de Coluna no tratamento da dor lombar crônica e mais satisfatórios que os do tratamento conservador.*

Palavras-chave*: Lombalgia. Estabilização vertebral. Pilates.*

Introduction

Lower back pain is the most common pain disorder in modern society, affecting about 80% of the population, with prevalence among women aged between 22 and 45 years old (1, 2). In the United States, lower back pain is the leading cause of physical disability in the context of work. Yearly expenditures in terms of medical costs and indemnity was estimated around 20 billion dollars in the 1990s, with an increase of 150% for the next decade (3).

As for any pain condition, back pain can be defined as pain with or without stiffness, located in the lower regions of the back between the last coastal arc and the gluteal fold (4). It is classified as acute pain when symptoms last less than 12 weeks, chronic when they last more than 12 weeks, and specific when there is a well-defined etiology, or nonspecific or mechanical/postural, which indicates musculoskeletal disorders (5). Lower back pain is triggered by various etiological factors, such as: inflammatory, degenerative or neoplastic disorders; congenital malformations; muscle weakness; rheumatic predisposition; and signs of degeneration in the spine or intervertebral discs (6).

The spine forms the axial skeleton of the human body and is frequently subject to postural changes and the support of different loads, requiring the proper functioning of the elements that compose it (6). The spinal framework is inherently unstable and interaction among three subsystems is necessary to provide it stability: the passive subsystem consisting of vertebral bodies, joints, spinal ligaments and intervertebral discs; the active subsystem that is composed of spinal muscles and tendons; and the neural subsystem that receives information from the other two subsystems through receptors, capturing changes of balance and promoting specific adjustments through the muscles (7, 8). The importance of good muscular function is highlighted because it is the component that contributes the most to joint stability, as it operates through the entire range of motion (ROM). Unlike the ligaments that perform their roles only at the end of the ROM, the active system may even compensate for weakness in ligament function (9).

Many resources have been used to treat lower back pain, such as laser, massage, spinal manipulation, TENS (transcutaneous electrical nerve stimulation), hydrotherapy, acupuncture, and ultrasound, however few of these show significant improvement and/or have sound scientific evidence at their basis. An exception is therapeutic exercise, which has shown good results (10). Therapeutic exercise is one of the most efficient resources to treat chronic lower back pain, with significant statistical evidence and very relevant clinical repercussions, though the most appropriate configuration of such a program of exercises is yet unknown (10, 11). The model of exercises considered efficient in enabling vertebral stability involves the contraction of the transversus abdominis and multifidus muscles (10, 12).

The treatment of lower back pain using the Pilates® method has been of special interest for study (13). Joseph Humbertos Pilates created the technique in the 1920s during World War I when he initiated the use of springs in hospital beds, developing a system that inspired the creation of his equipment and methods (14). It was only in the 1980s that the Pilates technique was internationally acknowledged and in the 1990s it became popular in the rehabilitation

field. This technique requires the performance of movements in the most deliberate manner based on six basic principles: balance, concentration, control, precision, breathing, and flow (15).

The Pilates method® incorporates various therapeutic exercise guidelines considered efficient for the treatment of chronic lower back pain, such as the contraction of the multifidus and transversus abdominis associated with breathing, while its development takes into account the patient's individual characteristics (13). The general goal of this study was to investigate the effects of the Pilates® method on the treatment of chronic lower back pain through a bibliographic review.

Method

This systematic review was conducted using the following databases: LILACS (Latin American and Caribbean Literature on Health Sciences), BIREME (Latin American and Caribbean Center on Health Sciences Information), SciELO (Scientific Electronic Library Online), and MEDLINE (Medical Literature Analysis and Retrieval System Online). The following keywords were used in the search for papers: spinal stabilization, Pilates®, and lower back pain and their equivalents in Portuguese. Inclusion criteria were: papers written either in Portuguese or English published from 2000 to 2010, addressing the mechanisms of spinal stabilization, chronic lower back pain, the Pilates® method, or treatment of chronic lower back pain. Older papers referred to multiple times and having undeniable historical value were included. Papers addressing disorders different from those under study, reporting only the treatment of acute lower back pain, or mentioning surgical or pharmacological treatments, were excluded.

Results

A total of 68 papers were found, 21 of which were excluded for not meeting the inclusion criteria. Of the 47 papers selected, 10 are special papers, 12 are literature reviews, and 25 are original papers. Thirty-one papers address lower back pain and most indicate joint instability as the pathological-mechanical factor that leads to lower back disorders; 32 discuss the segmental stabilization process; 20 are field papers; four address muscle activities in individuals with lower back pain (Table 1); six address traditional stabilization exercises (Table 2); and 10 discuss stabilization exercises based on the Pilates® method (Table 3).

Table 1 - Muscle activity in individuals with back pain

Authors, journal and year of publication	Objectives
Hides et al., Spine, 1994	To verify the effects of back pain on tropism of the multifidus muscles.
Hides, Richardson and Jull, Spine, 1996	To record the natural history of multifidus recovery after an episode of acute lower back pain.
Hodges, Richardson and Jull, Phys. Research International, 1996	To investigate the role of the transversus abdominis in the segmental stabilization process.
Hodges and Richardson, Physical Therapy, 1997	To investigate the activation of the abdominal muscles during movements of the lower limbs.

Source: Research data.

Table 2 - Traditional stabilization exercises

(To be continued)

Authors, journal and year of publication	Objectives
O'Sullivan, Twomey and Allison, J Orthop Sports Phys Ther, 1998	To investigate the effectiveness of interventions using specific exercises that advocate the co-contraction of deep abdominal muscles with the lumbar multifidus muscle to treat chronic lower back pain.

Table 2 - Traditional stabilization exercises

(Conclusion)

Authors, journal and year of publication	Objectives
Goldby et al., Spine, 2006	To determine the effectiveness of two components of the musculoskeletal physical therapy, i.e., manual therapy and segmental stabilization, on chronic lower back disorders.
Koumantakis, Watson and Oldham, Physical Therapy, 2005	To analyze the inclusion of spinal stabilization exercises in general exercises for the abdominal muscles among patients with sub-acute or nonspecific chronic lower back pain compared to a group performing general exercises only.
Norris and Matthews, Complementary Therapies in Clinical Practice, 2008	To assess the effects of an integrated spinal stabilization program on chronic back pain.
Pereira, Ferreira and Pereira, Physical Therapy in Movement, 2010	To assess the effectiveness of segmental stabilization exercises on the pain and functional ability of individuals with chronic back pain.
Sakamoto et al., Conscientiae Saúde, 2009	To assess the effects of a four-week program of lumbar stabilization exercises on the intensity of pain and level of functionally among 13 individuals with nonspecific chronic back pain.

Source: Research data.

Table 3 - Stabilization exercises based on the Pilates® method

(To be continued)

	Authors, journal and year of publication	Objectives
Muscle activity after intervention using the method in individuals without back pain	Kolyniak, Cavalcanti and Aoki, Rev Bras Med Esporte, 2004	To assess the effect of the Pilates® method on the function of the trunk's extensor and flexor muscles.
	Herrington and Davies, Journal of Bodywork and Movement Therapies, 2005	To compare the effects of the Pilates® method and conventional abdominal exercises on the transversus abdominis.
	Sekendiz et al., J of Bodywork and Movement Therapies, 2007	To examine the effects of Pilates exercises on abdominal and back strength, abdominal muscle resistance and posterior trunk flexibility in the case of sedentary adult women.
	Endleman and Critcheley, Arch Phys Med Rehabil, 2008	To assess the activity of the tranversus abdominis and abdominal internal oblique muscles during classical Pilates' exercises correctly and incorrectly performed with and without equipment.
Effects in individuals with back pain	Critchley, Pierson and Battersby, Manual Therapy, 2010	To assess the effects of Pilates exercises and a program of conventional exercises on the tranversus abdominis and internal oblique muscles.
	Gagnon, Knoxville: The University of Tennessee, 2005	To investigate the effectiveness of Pilates exercises as a therapeutic intervention for the treatment of back pain.
	Gladewel et al., J Sort Rehabil, 2006	To assess the effect of a Pilates program on individuals with chronic back pain.
	Donzelli et al., Europa Medicophysica, 2006	To compare the effects of the Pilates method with those of the Back School on the treatment of chronic back pain.

Table 3 - Stabilization exercises based on the Pilates® method

(Conclusion)

	Authors, journal and year of publication	Objectives
Effects in individuals with back pain	Rydeard, Leger and Smith, J Orthop Sports Phys Ther, 2006	To compare the effects achieved with the Pilates method to those obtained with a conservative treatment for chronic back pain.
	Fonseca, Magni and Freitas, Journal of Sport Rehabilitation, 2009	To assess the influence of pain on the vertical ground-reaction force in patients with back problems and the effect of the Pilates method on the gait of these patients.

Source: Research data.

Discussion

Strong evidence indicates that joint instability triggers lower back pain (9, 16, 17). Joint stability can be defined as a joint's ability to recover its original state after being disturbed (18). Spine stability mainly depends on the contraction of specific groups of muscles, among which the multifidus, transversus abdominis, internal oblique muscles and quadratus lumborum stand out (16, 17, 19, 20).

The coordinated contraction of these muscles promotes increased joint rigidity making it less susceptible to disturbance, preventing the occurrence of joint stress and lesions (16, 17, 19, 20). Electromyographic studies show that individuals with chronic lower back pain experience little activation of the transversus abdominis and that after an episode of acute lower back pain, the multifidus are inhibited and weakened, unable to return to their physiological standards without therapeutic interventions (21, 22, 12).

Sensorial experiences of the proprioceptive system go to the Central Nervous System (CNS) that promotes muscle contraction responses to control stability. When an individual goes through already experienced situations, the CNS performs an anticipatory muscle adjustment, i.e. feed-forward, even before the movement occurs. In the case of new situations, the CNS responds afterwards, i.e., feedback, based on sensorial afferents captured by muscle spindles, Golgi tendon organ (GTO) and intra-articular receptors (18, 23). Activation of the transversus abdominis is a clear example of anticipatory adjustment: it is recruited before any movement of the limbs (24).

The muscles operating in the trunk can be classified as local or global. The multifidus, transversus abdominis and internal oblique muscles are local because they operate directly on the vertebrae, controlling rigidity and intervertebral relationships. The latissimus dorsi and rectus abdominal muscles are global muscles that generate the torque necessary to move the spine and do not directly operate on the vertebrae; they are mobilizer muscles (25). The transversus abdominis and the multifidus muscles are primary stabilizers because they do not have important functions regarding the orientation of the vertebrae. They are specifically configured to control intersegmental motion, while internal oblique muscles and the quadratus lumborum are secondary stabilizers. They have excellent stabilizing ability but can also generate movement (26). Segmental stabilization exercises are for the maintenance and restoration of physiological patterns of local muscle groups (19, 27).

Exercises for lumbopelvic stabilization are widely used to treat chronic lower back pain (28, 29, 30, 31, 32). Research shows that individuals who take part in segmental stabilization programs experience significant improvement in pain and functional performance, even more expressive than improvement and performance obtained with manual therapy, lasting over the long run (20, 30, 31, 32).

The Pilates® method is also applied therapeutically to achieve lumbopelvic stabilization (33, 34, 35). The powerhouse or core strength is the method's focus of intervention. The powerhouse comprises a region that extends from the pelvic floor to the chest, formed by local and global muscles closely related to the stabilization of the spine and internal organs (36, 37, 38, 39). In general, Pilates® promotes three effects on the powerhouse. First, it affects pelvic posture, which results in postural

changes in the spine. Secondly, it promotes stretching and strengthening of the axial muscles, and finally, optimization of the abdominopelvic tone of the rib cage (15).

Pelvic posture largely determines spinal posture due to the sacroiliac joint. In the sagittal plane, the pelvis performs anteversion and retroversion movements so that lumbar lordosis increases when there is anteversion motion and when retroversion occurs lordosis is corrected (15, 40). Therefore, Pilates® works to ensure the pelvis is properly positioned, i.e., a neutral pelvis, due to its implications for the spine. A well-positioned pelvis depends on balance among four large muscle groups, namely: the anterior abdominal wall and hip extensor muscles, responsible for retroversion; the spine extensors and hip flexors, responsible for anteversion (15).

Kolyniak, Cavalcanti and Aoki (3) investigated the effects of the Pilates method on the trunk's extensor and flexor muscles. Twenty people were selected for 25 sessions of Pilates-based exercises distributed over 12 weeks. An isokinetic assessment was performed on these individuals' flexor and extensor muscles of the trunk before and after the 25 sessions. The variables concerning the extensor muscles significantly improved when compared to those of the flexor muscles. Additionally, the agonist-antagonist relationship also improved in regard to all the parameters investigated. The authors assert that extensor muscles are more susceptible to sedentariness and emphasize a need for exercises intended to strengthen these muscles in order to prevent back pain, since imbalance between the trunk's agonistic and antagonistic muscles is a risk factor for the development of spinal disorders.

Sekendiz et al. (37) used an isokinetic dynamometer to investigate the effects of Pilates® mat exercises on sedentary women's core strength. The women who trained with the method experienced significant increases in strength compared to the control group, which performed no physical exercise. Muscle strength in pre-training was 133.0 and 95.28 for the flexor and extensor muscles, respectively, and 168.8 and 142.1 in the post-training. These results reinforce the views of Kolyniak, Cavalcanti and Aoki (3), insofar as the flexor muscles achieved higher levels of strength in the pre-training phase compared to the extensor muscles, though the improvement achieved by the extensor muscles after the interventions was relatively higher.

The abdominopelvic region is bounded by abdominal, back and pelvic muscles. The stronger they are, the more stable the body is. Increased intra-abdominal pressure resulting from strengthening these muscles makes the trunk more stable and optimizes movement motor control (15).

Herrington and Davies' findings (41) show the effectiveness of Pilates® in recruiting the transversus abdominis and the stabilization process in comparison with conventional abdominal exercises. Healthy individuals were distributed into three groups: 12 individuals exercised with the Pilates® method; 12 exercised with traditional abdominal exercises; and 12 individuals did not exercise. A total of 83% individuals who exercised with Pilates®, 33% of those who exercised with conventional abdominal exercises, and 25% of those who did not exercise presented effective ability to contract the transversus abdominis after the period of interventions. Lumbopelvic stability was also assessed in the Pilates group, in which 42% of the individuals were successful, while all the individuals in the other groups failed.

This greater effectiveness in contracting the transversus abdominis is explained by the Endleman and Critcheley study (42). They showed that, statistically, there is significant recruiting of the transversus abdominis and internal oblique muscles during the performance of Pilates-based exercises. This was observed using ultrasound. Muscle activation only happened when the exercise was correctly performed and the studied muscles did not contract in isolation, but activated simultaneously.

Critchley, Pierson and Battersby (43) also observed greater activity of the transversus abdominis and the internal oblique muscles during certain Pilates-based exercises. There were, however, no changes in muscle thickness during rest or functional activities. The population under study was composed of individuals without a history of back pain, among whom, theoretically, the activation of muscle groups were within physiological standards. A group of individuals with back pain would be projected to be more favored because these standards would be restored during rest and functional activities.

Gagnon (44) conducted a study to investigate the effectiveness of Pilates-based exercises as a therapeutic intervention for back pain. Twelve individuals with back pain were randomly assigned to two groups. Six performed conventional stabilization exercises and six performed Pilates-based exercises. Indexes for

pain, functionality and lumbopelvic stability were collected, respectively using the Visual Analog Scale (VAS), the Oswestry Disability Index (ODI) and a Stability Platform (Lafayette Instrument Co) before and after the interventions. Both groups presented significant improvement and in the same proportion.

In the study by Gladwel et al. (45), individuals with chronic back pain participated in a Pilates-based exercises program for six weeks. A one-hour training session was linked with two 30-minute sessions of individual activity performed at home per week. Post-treatment analysis showed positive responses ($P < 0.05$) in general health, performance in sports, flexibility, proprioception and in pain symptoms. Functionality, assessed before and after the treatment using the Oswestry Lower-Back Pain Disability Questionnaire – OSWDQ did not show a significant decrease that would indicate positive progress, probably because few sessions were supervised by a qualified professional and also because the participants were already active individuals.

Donzelli et al. (34) investigated the effects of the Pilates method on the treatment of chronic back pain. Forty-three individuals with chronic back pain were randomly assigned to two groups: 21 individuals in a Pilates group and 22 in a group receiving the Back School treatment. The interventions were implemented in the respective groups for a period of seven consecutive days in groups of up to seven individuals. Questionnaires were applied to measure pain (Visual Analog Scale) and dysfunction (Oswestry Lower Back Pain Disability Scale) before the interventions and one, three and six months after the interventions. Both groups experienced similar clinical improvement. The Pilates method was as effective as the Back School treatment, however, the group treated with Pilates reported greater satisfaction with their treatment.

Another study compared the effects of the Pilates method with those of traditional treatment. A total of 39 individuals with chronic back pain participated in the trial. The participants were randomly assigned to two groups: 21 in the Pilates group and 18 in the traditional treatment group. Functionality and pain scores were measured using scales applied before the interventions and three, six and 12 months after the Pilates treatment. Three one-hour sessions of Pilates-based exercises were implemented weekly for four weeks. The results show that the individuals receiving traditional interventions experienced less relevant improvement in functionality and minimization of pain compared to the Pilates group (35). It is important to note that, in addition to being significant, the results obtained by the Pilates group remained similar in the long run to what was observed in the study by Donzelli et al. (34).

Fonseca, Magni and Freitas (46) investigated the deleterious effects of pain on the gait of individuals with back pain and the influence of 15 sessions of Pilates-based exercises on their gait. The group affected by back pain experienced changes in aspects of gait and satisfactory reduction of these disorders was observed after the Pilates-based interventions.

Final considerations

The Pilates method improves the relationship between the trunk's agonistic-antagonistic muscles, increases activity of the transversus abdominis and internal oblique muscles during the performance of exercises and makes contractions of the transversus abdominis more effective, effects that may minimize the incidence of back pain of a mechanical/postural nature. Statistically significant results are found in the treatment of chronic back pain: even better than results obtained with conservative therapies and similar to those obtained with conventional stabilization exercises or with the Back School treatment.

Therefore, there is evidence that the Pilates method promotes positive effects in the treatment of chronic back pain. There are, however, questions concerning the mechanisms that lead to such responses because studies do not demonstrate changes in the electromyographic activity of the stabilizing muscles nor changes that concern the relationship of the agonistic-antagonistic muscles of individuals with back pain after being part of interventions with the different methods.

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