

Effects of Pilates Exercise on Age-Related Kyphosis

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Abstract

This report describes a case in which Pilates exercise was used successfully to treat age-related kyphosis. The patient was a 72-year-old woman who presented to us complaining of abnormal posture and being unable to stand for more than 3 min without using a walker or cane. A standing lateral plain radiograph showed kyphotic deformity of the thoracic spine and a C7 sagittal vertical axis to be 185 mm. We recommended thoracic to iliac spinal correction and fusion surgery. However, the patient opted for conservative treatment, so was referred for rehabilitation. Her kyphosis was flexible, with a decrease in the thoracic kyphosis angle from about 50 degrees in the standing position to about 10 degrees in the lying position. The basic concept when using Pilates exercise for rehabilitation in patients with kyphosis is stretching of the ventral aspect of the body and strengthening exercises for the dorsal aspect of the spine. After 4 weeks of rehabilitation, the patient's posture became more upright and she could stand without support for more than 10 min. Even though we have had only one such case, our experience is that Pilates exercise can be a useful rehabilitation tool for patients with age-related kyphosis.

Keywords: Age-Related Kyphosis; Pilates; Rehabilitation

Introduction

Pilates exercise has been found to be an effective rehabilitation tool, particularly in patients with chronic low back pain [1-5]. Pilates involves both flexibility exercises and strength/stability exercises for the deep abdominal muscles, allowing more control of movement [6]. Joseph Pilates developed this exercise technique in the 1920s and called it "contrology". According to a report by Cruz-Diaz, *et al.* [7], Pilates can decrease low back pain even in patients aged over 65 years. Roller, *et al.* [8] investigated the effect of exercises using a Pilates reformer machine on the risk of falls in patients aged 65 years or over and found a significant improvement in motor function after 10 weeks. Furthermore, Fernández-Rodríguez, *et al.* [9] performed a meta-analysis of studies on use of Pilates exercise in people over the age of 60 years and concluded that it had a moderate effect on balance, strength, flexibility, and functionality and a substantial effect on the risk of falls in older adults. Therefore, even for the aged population, Pilates can reduce pain and improve motor function.

Age-related kyphosis (roundback) as a result of sagittal imbalance in the spine is a common degenerative spinal condition in the aged population and affects quality of life. Although there have been reports of successful correction of posture by thoracic to pelvic fusion surgery [10-12], none mention a mobile segment at the fused level. Theoretically, given that the spinal column is the organ of motion, surgery that preserves motion would be the best option for a degenerative spine.

In this report, we describe a case of adult spine deformity (ASD) as a result of sagittal imbalance that we treated successfully using Pilates exercise and discuss the possible indications for Pilates in ASD.

Case Report

A 72-year-old woman presented to us with a complaint of abnormal posture and inability to stand for more than 3 min without a walker or cane for support. A standing lateral plain radiograph showed kyphotic deformity of the thoracic spine and a C7 sagittal vertical axis to be 185 mm (Figure 1A). Therefore, we recommended thoracic to iliac spinal correction surgery. However, her preference was for rehabilitation. Her kyphosis was very flexible, with a decrease in the thoracic kyphosis angle from about 50 degrees in the standing position to about 10 degrees in the lying position (Figure 1B). Therefore, we anticipated that Pilates-based rehabilitation could be effective and referred her to our rehabilitation department.

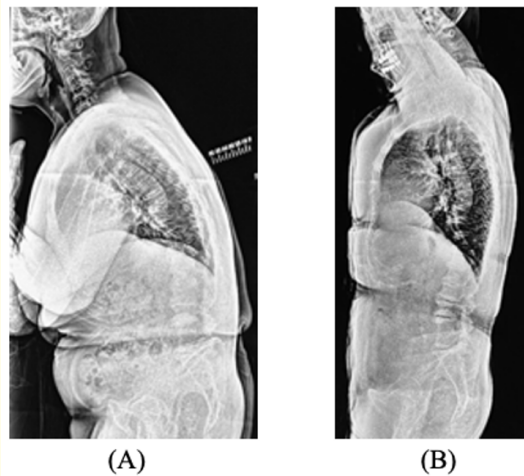


Figure 1: Lateral plain radiographs of the spine. (A) A lateral standing plain radiograph shows kyphotic deformity of the thoracic spine and a sagittal vertical axis of 185 mm at C7. The age-related kyphosis in this patient was flexible, with a decrease in the thoracic kyphosis angle to about 10 degrees in the lying position (B) from about 50 degrees in the standing position (A).

She was treated as an inpatient for the first 2 weeks at our hospital. Treatment during this time consisted of one 40-min Pilates session daily on Monday to Friday with weekends off. Thereafter, she was transferred to a specialist rehabilitation hospital, where she performed Pilates exercise for 40 min in the morning and 40 min in the afternoon for a further 14 days continuously. The Pilates rehabilitation regimen for sagittal imbalance was the same in the two hospitals and based on the concept of stretching of the ventral aspect of the body and strengthening exercises for the dorsal aspect of the spine.

A spine corrector and chair was used in addition to mat exercise for stretching of the thorax. Figure 2 shows the chair exercise performed in the prone position. After the patient pushes down on the chair bar (Figure 2A), she is pushed upward by the power of the springs (Figure 2B), which stretches her thorax backwards. Figure 3 shows the patient exercising with a spine corrector. By lying down on the spine corrector in the supine position (Figure 3A) and lying over the dome, the thorax can be stretched backwards (Figure 3B). In addition, spine twisting and swan prep exercises were performed on a Pilates mat.

Strengthening exercise was performed on a mat with use of a chair and focused on the gluteus maximus muscles (Figure 4). Hand-knee exercises on all fours and chair exercise in the standing position were used to stabilize the functional status of the trunk.

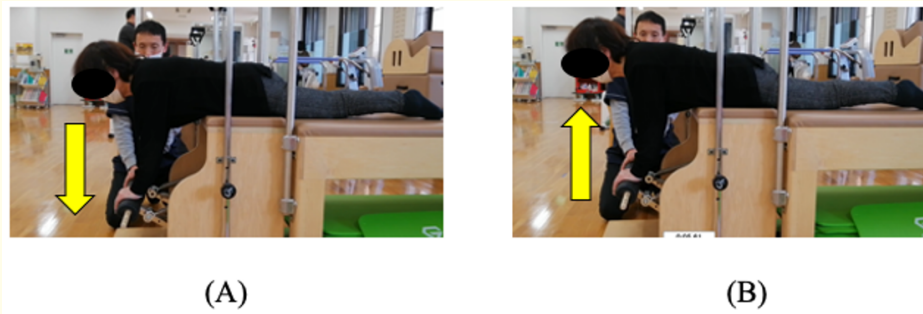


Figure 2: Thoracic spine extension exercise with a chair. The patient pushes a bar (A), that is pushed back by a spring, thereby putting the thoracic spine under extension loading (B).



Figure 3: Extension exercise with a spine corrector. The patient leans into the equipment (A) and leans down further with thoracic extension (B).



Figure 4: Bridge exercise to strengthen the hip extensors. The patient starts the exercise in the supine position with the hip and knee flexed (A). Focusing on muscle contraction in the buttock area, the patient pushes the buttocks upward (B).

Measurements were made before and after the rehabilitation of the flexibility of the hamstrings (evaluated using the straight leg raise test), quadriceps (heel to buttock distance), and thorax (floor to chin distance). Also, posture was evaluated using photographs taken during sitting, standing, and walking.

The angle measured on the straight leg raise test was 80 degrees both before and after rehabilitation. However, the heel-buttock distance decreased from 11 cm to 0 cm on the right side and from 13.5 cm to 0 cm, indicating that the quadriceps muscles had become more flexible. The floor to chin distance during extension of the thoracic spine in the prone position increased from 0 cm to 4.2 cm. Before rehabilitation, the patient could not lift her chin in the prone position; after 4 weeks of Pilates exercise, she could extend the thoracic spine.

The patient’s posture was clearly improved in the sitting (Figure 5A) and standing (Figure 5B) positions. Figure 5A shows that her head could touch the vertical line of the buttock in the sitting position and that the vertical line of the heel is very close to her head in the standing position (Figure 5B) after the rehabilitation. Before rehabilitation, she was walking with a forward bending posture (Figure 6A) but could walk with a straight posture 4 weeks later (Figure 6B). Clinically, she could not stand for more than 3 min at the initial visit but could stand for more than 10 min without any support after 4 weeks of Pilates sessions.

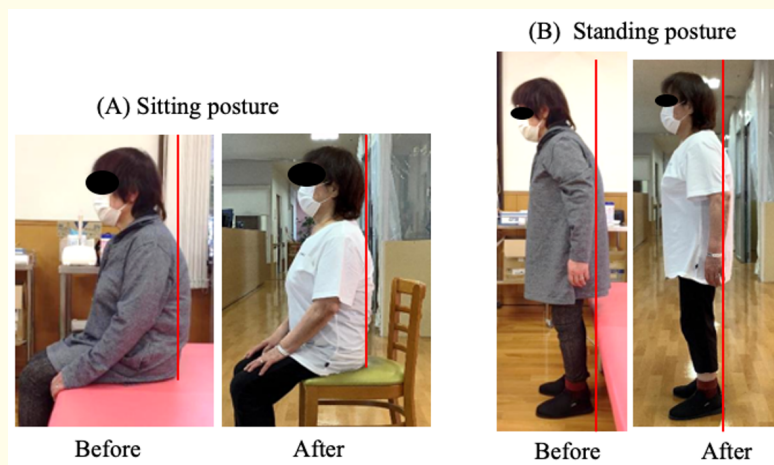


Figure 5: Changes in posture in the sitting (A) and standing (B) positions. (A) In the sitting position, the patient’s head can touch the vertical line of the buttock, and in the standing position (B), the vertical line of the heel is very close to her head after pilates rehabilitation.



Figure 6: Posture during walking. Before rehabilitation, the patient was walking with a forward bending posture (A). Four weeks later, she could walk with a straight posture (B).

Discussion

The concept of Pilates is that the body, mind, and spirit are united by physical fitness. Pilates incorporates six main principles, namely, centering, concentration, control, breathing, precision, and fluidity [13]. Mat and equipment exercises based on this concept and these principles are performed at our institution and its affiliated hospitals.

In the case described here, we opted for Pilates exercise as an alternative to thoracic to pelvic correction and fusion surgery in a woman with age-related kyphotic deformity at the thoracic level. Kyphotic deformity may be flexible or rigid. In our patient, the deformity was flexible, and she could lie down and sleep in the supine position. However, in patients with certain conditions such as diffuse idiopathic skeletal hyperostosis or multilevel vertebral body compression fractures, the kyphotic deformity is rigid and the same in the standing and lying positions. Patients with rigid kyphotic deformity need osteotomy, correction, and long fusion [10-12].

In 1945, contrology was defined as a way to develop the body uniformly and correct posture [13]. Thus, historically speaking, the Pilates method would have been suitable for correcting posture such as in our case. Our basic strategy for treating flexible age-related kyphosis using Pilates exercise involves axial elongation, extending the thoracic spine while maintaining the lumbar spine in a neutral position, and core stabilization.

Axial elongation underpins all Pilates exercises and is performed with appropriate breathing. Patients are always aware of the importance of axial elongation of the spine in terms of normalization of posture, whether exercising on the mat or with equipment.

Articulation of the thoracic spine in isolated extension while keeping the lumbar spine in a neutral position is also a key exercise used to correct kyphotic thoracic posture when standing. Swan prep and spine twisting (especially extension and rotation) on the mat [14] are the basic Pilates exercises used for mobilization of the thoracic spine. Similar exercise is also possible using equipment such as a spine corrector and chair (Figure 2 and 3).

Core stabilization exercises, especially for the back muscles and hip extensors, are performed on the mat and, in our patient, mainly included scoop and all-fours exercises. Scoop is similar to draw-in exercise [15] and all-fours exercise is similar to hand-knee exercise [16]. In this patient, we focused on bridge exercise to strengthen the hip extensors, namely, the gluteus maximus muscles (Figure 4). We also used a chair and reformer to achieve core stabilization. Strengthening exercise of the trunk and hip extensor muscles allowed the thoracic and lumbar spine to be held in a neutral posture, so that the kyphotic posture in the standing position could be corrected.

As shown in figure 5 and 6, our patient's posture changed dramatically after 4 weeks of Pilates rehabilitation. Although Pilates exercises are reported to be effective for maintaining better posture, there is limited information in the literature on using this method to correct sagittal imbalance, as in the present case. We believe that Pilates exercise would be a suitable rehabilitation method for patients with the flexible type of kyphotic deformity in the standing position.

Limitations of the Study

Our patient participated in Pilates sessions for only 4 weeks and was lost to follow-up thereafter, so the long-term results of our Pilates regimen in this patient are unknown. However, such patients should be advised to continue this type of rehabilitation in order to maintain a better standing posture.

Conclusion

We encountered a 72-year-old woman whose age-related kyphotic posture as a result of sagittal imbalance was successfully corrected using Pilates exercise. Pilates could be effective in patients with such sagittal imbalance and avoid the need for long-level fusion surgery.

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