

Case Study

Impact of post-manipulation corrective core exercises on the spinal deformation and lumbar strength in golfers: a case study

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Abstract. [Purpose] This study examined spinal shape in professional golfers with chronic back pain, and analyzed the effects of a 4-week regimen of semi-weekly manipulation and corrective core exercises on spinal shape. [Subjects] Two golfers with chronic back pain. [Methods] The pelvis and spinal vertebrae were corrected using the Thompson “drop” technique. Angle and force were adjusted to place the pelvis, lumbar spine, and thoracic vertebrae in neutral position. The technique was applied twice weekly after muscle massage in the back and pelvic areas. The golfers performed corrective, warmup stretching exercises, followed by squats on an unstable surface using the Togu ball. They then used a gym ball for repetitions of hip rotation, upper trunk extension, sit-ups, and pelvic anterior-posterior, pelvic left-right, and trunk flexion-extension exercises. The session ended with cycling as a cool-down exercise. Each session lasted 60 minutes. [Results] The difference in height was measured on the left and right sides of the pelvic bone. The pelvic tilt changed significantly in both participants after the 4-week program. [Conclusion] In golfers, core muscles are critical and are closely related to spinal deformation. Core strengthening and spinal correction play a pivotal role in the correction of spinal deformation.

Key words: Chronic back pain, Manipulation, Core exercise

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INTRODUCTION

Gosheger et al.¹⁾, in their study of 703 golfers, reported muscle damage due to overtraining in 82.5%, and external injury in 17.4%. In elite golfers, the most frequently affected areas were, in descending order, the back, wrist, and shoulder. In amateur golfers, the order was the elbow, back, and shoulder. McHardy et al.²⁾ demonstrated that the back is the most frequently affected area in golfers due to the impact experienced when hitting a ball, and due to an incorrect swing form. The subsequent disruption in balance alters body shape, and has a significant effect on performance. According to data on injuries experienced by amateur golfers³⁾, the most commonly involved area was the back. In a survey conducted by Pink and Jobe⁴⁾, 59% of the injuries reported during the 1990 US Professional Golfers' Association (PGA) tour were related to the back. This high back injury rate is attributed to intensive training with an incorrect swing form. It is also associated with excessive rotation of the body to

increase the shot distance, and the number of repeated swings⁵⁾. All sport activities require performance of specific techniques, and players incur various types of injuries. In particular, golfers use muscles that are not commonly used in daily living activities, which leads to frequent injuries⁶⁾. With the game of golf increasing in popularity over the past 20 years, the risk of associated injuries has risen as well. Playing golf can cause injury primarily in the back, shoulder, elbow, hand, and wrist⁷⁾. Kohn⁸⁾ reported that the causes of injuries experienced during golf include weakened muscles, lack of flexibility, excessive exercise, insufficient warmup, and an incorrect swing form. All measures requiring use of therapists' hands for diagnosis and therapy are referred to as “manipulation”, and the various types of orthopedic manipulation include the Cyriax, Kaltborn, Maitland, Mennell, Paris, and Grimsby methods⁹⁾.

Chiropractic spine correction technique applies stimulation to joints at high speeds and small amplitudes. This technique corrects the spine by applying force to joints so that they exceed their normal range of motion and reach the parapsysiologic space, which is the limit of elasticity¹⁰⁾. Chiropractic corrects abnormal spinal segments to change the mobility of the spine, enabling delivery of the commands issued by the central nervous system to effector organs through the efferent nervous system, which is the functional subsystem of the peripheral nerves¹¹⁾.

Positive effects of manipulation therapy are evident im-

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mediately, or within 4–6 weeks of the first treatment^{12, 13}). The therapy is deemed effective if 50% improvement in acute lumbago is made in one therapy session. Fisk¹⁴) and Potter¹⁵) set the threshold rate at 93%. Dynamic trunk stabilization exercises effectively mitigate spinal dysfunction; these exercises strengthen the core muscle groups around the lumbar spine, which play an important role in dynamic stability of the spinal segments¹⁶). Without sufficient muscle stability, body movements cause incorrect movements of the muscles¹⁷). Various terms are used to describe muscle-adjusting activities for trunk stability: lumbar stabilization, dynamic stabilization, exercise control training, neutral lumbar adjustment, muscle integration, and trunk stabilization¹⁸). All stability-related muscles are attached to the spinal cord. The multifidus, transversus abdominis, and internal oblique provide stability between spinal segments; the larger-sized erector spinae and rectus abdominis facilitate overall movement of the body¹⁷). Gym ball exercises were introduced in the 1900s in physical rehabilitation programs for the treatment and prevention of stroke, myelosis, and back and neck pain, as well as for postural correction. Recently, these exercises have been used as a core strengthening tool by professional athletes, as they improve muscle strength, joint movement, and balance, and thus improve spinal flexibility and stability¹⁹). Gym ball exercises improve muscle strength, endurance, flexibility, and coordination; these benefits are a result of efforts to maintain balance on an unstable ball, which leads to improved reflexes and cognition, and thereby improved balance^{20, 21}). As noted previously, only a few exercise programs can help correct spinal vertebral distortion and strengthen surrounding muscles in golfers. Several theory-oriented and formalized rehabilitation programs have been applied in both athletes and non-athletes. Against this background, this study examined spinal shape in two professional golfers with chronic back pain, and analyzed the effects of a 4-week regimen of semi-weekly manipulation therapy and corrective core exercises on spinal shape.

SUBJECTS AND METHODS

Two golfers were selected as study subjects. Subject A was 43 years old, 174 cm tall, weighed 78.30 kg, had a body mass index (BMI) of 25.9 (kg/m²), and a 24 year career. Subject B was 46 years old, 171.40 cm tall, weighed 73.40 kg, had a BMI of 25.0 (kg/m²), and a 28 year career. The first subject is a golfer who visited this rehabilitation center. He complained of chronic pain at the right waist region and right lower extremity for at least six months, and showed hamstring shortening, at less than 60° during straight leg raising (SLR) tests. A three-dimensional (3D) spinal imaging device, Formetric III (Germany), was used for examination (Fig. 1), and the Togu and gym ball (Swiss ball, USA) were used for the exercises. The Thompson bed was used for manual therapy. The Formetric III was used to identify the relationship between the spinal shape and the pelvic state by analyzing the back surface. To ensure data reliability, the measurement was repeated three times, and the average value was used.

Thompson Terminal Point technique effectively corrects the pelvis using drop points on a drop bed after conducting

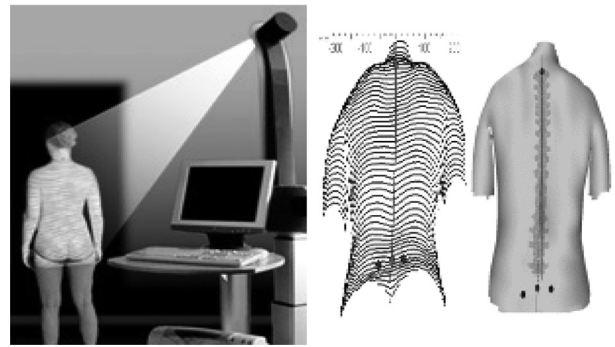


Fig. 1. 3D Spine Analysis and Data of Formetric III Measurements

Derifield leg checks. Based on the Thompson technique, the pelvis and spinal vertebrae were corrected using the Thompson bed. This technique uses a “drop.” The angle and force were adjusted so that the pelvis, lumbar spine, and thoracic vertebrae were in a neutral position. The technique was applied twice a week, after 20 minutes of muscle massage in the pelvic and back areas. Using isokinetic lumbar muscle strength measurement equipment (IsoMed 2000 Back system, Germany), peak torque/body weight of flexion and extension of the lumbar region were measured. Isokinetic back muscle strength was measured before and after 4 weeks of treatment. For corrective exercises, the golfers performed warmup stretching for 10 minutes, followed by three sets of 20 squats on an unstable surface using the Togu ball. The participants then used a gym ball for 30 repetitions of hip rotation, upper trunk extension, and sit-ups, and pelvic anterior-posterior, pelvic left-right, and trunk flexion-extension exercises, with 30 seconds of rest between the exercises. At the end of the session, they cycled for 5 minutes as a cool-down exercise. Each session of correction and exercises lasted for a total of 60 minutes. Both subjects understood the purpose of this study and provided written informed consent prior to participation, in accordance with the ethical standards of the Declaration of Helsinki.

RESULTS

This study applied a 4-week manipulation therapy and spinal exercise program in two professional golfers with chronic back pain due to deformation of spinal vertebrae; the effects of this program are shown in Table 1. The difference in height was measured on the left and right sides of the pelvic bone using the posterior superior iliac spine (PSIS) as a reference point for a comparison of the pelvic tilt. The pelvic tilt changed significantly in both participants after the 4-week exercise program. In Subject A, an 8 mm deformity on the right side decreased by 6 mm after four weeks. In Subject B, a 3 mm deformity on the right side returned to the normal position in 3 weeks. Pelvic torsion was also evaluated by measuring a line perpendicular to the line that connected the two PSISs. In Subject A, a tilt of 5.4° in the anterior direction decreased by 2.6° after 4 weeks. In Subject B, a tilt of 5.5° in the anterior direction returned to a normal position after 4

Table 1. Changes in the spinal condition of two golfers after a 4-week core strengthening exercise program

		Pre-test	1 week	2 weeks	3 weeks	4 weeks
Pelvic tilt (mm)	A	8 (R)	7 (R)	4 (R)	4 (R)	2 (R)
	B	3 (R)	1 (R)	1 (R)	0 (R)	0 (R)
Pelvic torsion (°)	A	5.4 (A)	3.8 (A)	3.0 (A)	3.2 (A)	2.6 (A)
	B	5.5 (A)	4.2 (A)	3.0 (A)	1.5 (A)	0.2 (A)
Trunk length (mm)	A	594	600	624	624	629
	B	468	471	471	471	478
Lordotic angle (°)	A	18	22	28	33	35
	B	16	25	30	32	36

A, B: Golf players
R: right, A: anterior

weeks. The trunk length increased by 35 mm, from 594 mm to 629 mm in Subject A, and by 10 mm, from 468 mm to 478 mm in Subject B. In both participants, the hypo-lordotic curve changed to a normal lordotic curve after 4 weeks.

Table 2 shows the isokinetic back muscle strength of the golfers after the 4-week treatment. Both A and B showed improvement in peak torque flexion at 30°/sec after 4 weeks, with increases from 2.06 to 2.51 Nm/kg and 2.08 to 2.56 Nm/kg for A and B, respectively. A and B also showed increases in peak torque extension at 30°/sec, from 2.13 to 2.91 Nm/kg and 2.28 to 3.12 Nm/kg, respectively.

DISCUSSION

Weak lumbar muscles cause back pain and are at a higher risk for injury. For this reason, a customized exercise program is needed to strengthen lumbar muscles. Akuthota et al.²²⁾ and McKenzie²³⁾ reported that strengthening lumbar extensors reduces back fatigue and can prevent injury, with a stronger resistance to vertical pressure on the spine. Kim et al.²⁴⁾ applied a 10-week core rehabilitation exercise program in golfers, and reported increases in lumbar extensor strength. Lee et al.²⁵⁾ used small tools for lumbar stabilization exercises in middle-aged women and reported that the exercise improved lumbar extensor muscles, mitigated back pain, and prevented damage, by improving the stability of the trunk muscles. Other studies by Park and Ham²⁶⁾, Kim and Lee²⁷⁾, and Lee et al.²⁸⁾ showed that stabilization exercises were effective in changing surface muscles of the trunk, cross-sectional areas of the muscles, and thickness of the deep muscles. It was reported that the cross-sectional area and thickness of the deep muscles increased significantly after stabilization exercises²⁹⁾.

The relationship between pelvic displacement and back pain has a neuromuscular origin and involves biomechanical elements. The pelvis can have a considerable impact on the sacroiliac joint and biomechanics of leg length inequality. It is known to be an early cause of both acute and chronic damage to the sacroiliac joint, and the joint dysfunction can lead to leg length inequality³⁰⁾.

Athletes develop an asymmetrical body posture due to long-term training of particular movements. This deformation makes maintenance of the normal curve of the spine difficult, and causes reduced range of motion and weakened abdominal muscles, as well as back pain³¹⁾. Bradford and

Table 2. Changes in the 30°/sec Isokinetic lumbar strength of two golfers after a 4-week core strengthening exercise program (Nm/kg)

		Pre-test	4 weeks
Peak torque flexion	A	2.06	2.51
	B	2.08	2.56
Peak torque extension	A	2.13	2.91
	B	2.28	3.12

A, B: Golf players

Winter³²⁾, and the study by Marica and Susan³³⁾, demonstrated that gym ball exercises and a corrective stretching program can be effective when they consist of exercises that extend the body trunk and improve flexibility of the rigid areas, as well as exercises that strengthen the trunk muscles for better posture and stability. This study produced similar results compared to previous studies, as it showed that core strengthening exercises lead to a better right-left balance and increased length of the trunk in professional golfers.

A study by Gong et al.³⁴⁾ showed that pelvic adjustment has a positive impact on functional leg length inequality and foot pressure. Park et al.³⁵⁾ reported greater stability after pelvic adjustment in an elderly population. These findings are consistent with the findings of the present study, which showed improvement in spine deformation after thoracic, lumbar, and pelvic manual therapy. This study showed that manual therapy and gym ball exercises can be effective in improving spinal deformation in professional golfers, which is consistent with the results of previous studies. Seo and Park also reported significant effects of lumbar stabilization exercise, using a Togu ball for 8 weeks, on back muscle strength in middle-aged women.

In our opinion, golfers, fencers, and baseball players who present with a distorted posture due to unilateral body movement can improve performance by improving balance, with manual therapy and gym ball exercises. The core strengthening exercises were effective in treating back pain in both participants, and such programs are important for effective rehabilitation of patients. In golfers, core muscles are critical, as they are closely related to spinal deformation. Core strengthening and spinal correction play a pivotal role in the correction of spinal deformation.

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