

Original Article

Comparison of physical function according to the lumbar movement method of stabilizing a patient with chronic low back pain

BYOUNG-HWAN OH, MS¹⁾, HONG-HYUN KIM, MS²⁾, CHEOL-YONG KIM, PhD³⁾,
CHAN-WOO NAM, MS¹⁾*

¹⁾ Department of Physical Therapy, College of Rehabilitation Science, Daegu University: 201 Daegudae-ro, Gyeongsan-si, Gyeongsangbuk-do, Republic of Korea

²⁾ Hyundai Motor Company Occupation Health Center, Republic of Korea

³⁾ Department of Physical Therapy, Ulsan College, Republic of Korea

Abstract. [Purpose] The purpose of this study was to examine the changes caused by lumbar stabilization exercises in chronic low back pain patients. [Subjects and Methods] Swiss ball exercise regimen group and sling exercise regimen group exercised for 30 minutes a day, 5 days a week, for 12 weeks. The control group was to continue performing their usual daily living activities. [Results] We obtained significant results in both the Swiss ball and sling exercise groups, but not in the control group. The best effect was obtained in the sling exercise group. [Conclusion] The Oswestry Low Back Pain Disability Index and visual pain scale scores of the patients with low back pain decreased in both the Swiss ball exercise group and the sling exercise group, and these patients experienced an increase in waist isometric muscular strength after 12 weeks of exercise compared with those doing no exercise (the control group).

Key words: Lumbar stabilizing, Sling exercise, Chronic back pain

(This article was submitted Jul. 22, 2015, and was accepted Sep. 1, 2015)

INTRODUCTION

As society is highly industrialized and automated, reduced activity and lack of physical activity has brought an increase in chronic diseases that are accompanied by various symptoms and disorders; back pain is one such disorder experienced by many people. More than 60–90% of the entire population have back pain at least once in their life time. Excessive force applied to the spine can cause a change in the intervertebral discs. Back pain is also produced by the vertebral ligament that supports a vertebral body, muscle contractions, and rupture phenomena, and unlike diseases, it frequently occurs in people in all types of occupations, at any age, and at all levels¹⁾.

If the back pain persists repeatedly, the muscles around the spine can weaken, and this can cause a decrease in muscle size and momentum compared with patients who do not experience persistent back pain. There are various types of exercise treatments for low back pain; for example, pain relieving pelvic tilt exercise therapy, muscle strengthening exercises, flexibility exercises, endurance exercise,

and physical adaptation exercises²⁾. The most widely used exercise therapies for reducing pain are Williams flexion exercise and McKenzie expansion exercise. Lumbar stability exercises and core stability exercises, which are known to play an important role in spinal segment control and to provide stability where there is spinal segmental instability, complement the two widely used exercise treatments used in treatment of back pain^{3, 4)}.

Lumbar stabilization exercise is performed within the painless range of motion. It is progressed as isometric exercises, which control an unstable posture, and as lumbopelvic posture-controlling exercises when undergoing functional activities. This lumbar stabilization exercises leads to reduction of stress, as much as possible, when mechanically applied to the human spinal structure while performing the functions of daily life and in professional activities⁵⁾.

In addition to helping to maintain appropriate neuromuscular control and coordination, this lumbar stabilization exercise is capable of expanding the shorter parts of muscles by developing and strengthening the spine standing muscles that are involved in the stabilization of the lumbopelvic and abdominal muscles⁶⁾.

Among these lumbar stabilization exercises, Swiss ball exercises and sling movements are best suited if patients are self-motivated to participate in the exercise program, have less burden of an anti-gravity condition, and require treatment that includes a variety of applications^{7, 8)}.

In this study, after the Swiss ball exercise and sling exercise, it was considered to help the rehabilitation treatment

*Corresponding author. Chan-Woo Nam (E-mail: somamir99@naver.com)

by comparing the effects on Oswestry Lumbar Disability Index, a visual measure and Isometric lumbar muscles, and it was also conducted because more systematic rehabilitation therapy could be possible by identifying each feature.

SUBJECTS AND METHODS

This study was conducted using 30 male patients with back pain who had no particular injury, had agreed to participate in this study, and were visiting the “S” center of “H” industry, the “SM” training center, or “S” orthopedics in Ulsan. The participants were provided a written informed consent form in accordance with the ethical standards of the Declaration of Helsinki. The 30 subjects were divided into three groups of 10 and allocated to a Swiss ball exercise group, sling exercise group, or control group. We asked the patients to stop performing other exercises as much as possible within the prescribed period of time so that we could monitor the effect of each exercise regimen.

The Oswestry Low Back Pain Disability Index questionnaire, which was developed to measure clinical remission and relapse in patients with back pain, was used. It showed that a degree of functional disability appeared because of pain, and a self-questionnaire based on interest and response on daily life under physical disability due to chronic low back pain. The questionnaire consists of 10 questions regarding pain management, personal care, walking, sitting, standing, sleeping, and social life. A score of 0–5 is assigned for each question, and the maximum total score is 50. After summing the scores for the questions, the percentage is calculated relative to the total score of 50, and this is referred to as the interference level⁹⁾.

In this study, a clinical visual pain scale was presented to evaluate the degree of pain. After displaying the pain levels the patient felt on a straight line of a 10 cm ruler without gradations, we made points by measuring the distance from the starting point (the range of points was from 0 to 10). We defined 0 points as indicating no pain and 10 points as indicating unbearable pain. After this, each patient was asked to sit on a table for an ISO check (Dr. August Wolff GmbH & Co. KG Arzneimittel, Bielefeld, Germany) to consider the length of his legs. His pelvis was then tightened with lumbar belt, and adjustments were made to the shoulder width of proband and the height (the top surface of the cushion was adjusted to match the height of the acromion of the proband). It was then fixed tightly after winding it up around the thorax of the proband. Both feet remained in contact with the floor and the patient kept both hands on the thorax cushion by using the proband and attach the power sensor to the equipment. At the start of the measurement, the patient maintained maximum muscular strength for 6 seconds in the direction indicated.

We asked the Swiss ball exercise group and the sling exercise group to exercise for 30 minutes a day, 5 days a week, for 12 week. The control group was to continue performing their normal daily living activities. It was carried out in an active way and Swiss ball exercise and Sling exercise were progressed in the same way.

Supine position pelvic lift ball exercise: Lift up both pelvic limb proximal on the Swiss ball (or sling) in the

Table 1. General characteristics of the subjects

| Group | Age (years) | Height (cm) | Weight (kg) |
|-------|-------------|-------------|-------------|
| SBEG | 46.0±3.37 | 172.0±3.20 | 69.3±9.18 |
| SEG | 46.2±3.22 | 170.1±4.48 | 71.0±10.47 |
| CG | 44.2±2.70 | 169.9±4.88 | 69.2±7.79 |

SBEG: Swiss ball exercise group, SEG: Sling exercise group, CG: Control group

supine position. After contracting the deep muscles, lift up the pelvis to make the body a straight line. Kneeling position lumbar stability ball exercise: Put each hand on the Swiss ball (or sling) making a kneeling position and move the trunk forward. Side lying position pelvic lift Swiss ball exercise: After lying on either side, put the distal of the pelvic limb on a Swiss ball. Side lying position pelvic sling exercise: After contracting the deep muscles, lift up the pelvis to make the body a straight line. Pilates of Swiss ball exercise: After making an all-fours posture, put the top of each foot on the Swiss ball. Pilates of sling exercise: After contracting the deep muscles, fully extend both the hips and the knees.

IBM SPSS Statistics for Windows (version 20.0) was used for statistical analysis in this study. We described and analyzed the pre- and post-intervention results of the Oswestry Low Back Pain Disability Index, the visual pain scale, and isometric muscular strength in the all groups. The paired t-test was used to evaluate the changes between before and after the intervention in the two experimental groups and the control group, and statistical significance was accepted for values of <0.05.

RESULTS

A significant difference was found between all three groups (Table 1). There was also a significant difference between the Swiss ball exercise group and the sling exercise group. We obtained significant results in the Swiss ball and sling exercise group, but not in the control group, and better were obtained in the sling exercise group than in the other two groups (Tables 2, 3).

DISCUSSION

The purpose of this study was to discover the changes in physical function by comparing the Oswestry Low Back Pain Disability Index, the visual pain scale, and isometric muscular strength when conducting an experiment using lumbar stabilization exercises for low back pain patients assigned to a Swiss ball exercise group, sling exercise group, and control group.

Low back pain is not a specific term for one disease but is a term that is broadly expressed as a pain syndrome. It is also a term that refers to the pain syndrome that can occur from below the end of the lumbar spinal cord of 2 which sacroiliac is finished to the range of sacroiliac. It is defined as a symptom that appears as a result of musculoskeletal and neurologic status problems¹⁰⁾.

Low back pain can be divided into acute, subacute, and chronic. It is defined as acute if it lasts less than 6 weeks,

Table 2. Comparison of Oswestry and VAS among groups

| | Oswestry (score) | | | VAS (score) | |
|------|------------------|-----------------|------|------------------|-----------------|
| | Before (M±SD) | After (M±SD) | | Before (M±SD) | After (M±SD) |
| SBEG | 28.0±6.3 | 13.8±6.3* | SBEG | 7.0±0.9 | 5.2±1.0* |
| SEG | 32.4±6.7 | 10.4±4.2* | SEG | 7.1±1.6 | 4.5±1.3* |
| CG | 18.9±7.0 | 14.5±4.7 | CG | 6.0±0.9 | 5.4±0.9 |

*p<0.05. SBEG: Swiss ball exercise group, SEG: sling exercise group, CG: control group

Table 3. Comparison of flexor and extensor muscular strengths among groups

| | Flexor muscular strength (Nm) | | | Extensor muscular strength (Nm) | |
|------|-------------------------------|-----------------|------|---------------------------------|-----------------|
| | Before (M±SD) | After (M±SD) | | Before (M±SD) | After (M±SD) |
| SBEG | 84.1±27.1 | 96.4±24.0* | SBEG | 80.6±35.6 | 99.8±31.9* |
| SEG | 66.4±23.5 | 92.1±22.4* | SEG | 67.1±36.9 | 96.0±28.9* |
| CG | 89.8±22.1 | 90.5±20.1 | CG | 102.6±27.2 | 103.7±27.4 |

*p<0.05. SBEG: Swiss ball exercise group, SEG: sling exercise group, CG: control group

subacute if it lasts 6–12 weeks, and chronic if it lasts more than 12 weeks. However, recently, pain has been classified as acute if it lasts 7 days or less, subacute if it lasts from 7 to 17 weeks, and chronic if it lasts for more than 8 weeks in terms of the period of active treatment. Because the causes of low back pain vary and are complex, low back pain should be treated from different angles. The pain can be classified as a disease that requires accurate diagnosis, since it is highly dependent on the individual's psychological state¹¹). Restriction of movement due to low back pain can lead to changes in the morphological characteristics of the back muscles¹²). Back pain also affects the strength and endurance of the back muscles, eventually has an adverse effect on lumbar spine stability, and can be a cause of functional disability¹³).

If we strengthen the lumbar area by applying Swiss ball exercises and sling exercises selectively to prevent changes in muscles that limit movement, boost the stability of the lumbar area, and prevent a malfunction of the back, we can obtain a positive effect. Back stabilization exercise is one of the most popular methods of exercise treatment in recent years, and it has been applied to a variety of patients: those with musculoskeletal problems, those with low back pain, athletes, etc. Also, various types of lumbar stabilization exercises have been implemented in order to prevent damage occurring in everyday life, such as falling, and to target the general public to prevent back pain^{14, 15}).

In an experiment with results similar to those obtained in this study, trunk stabilization exercise was reported to be effective in preventing pain and recurrence of pelvic¹⁶). Furthermore, to determine the effect of a trunk stabilization program on postural balance, speed, and functional muscular strength of elite female handball players, we carried out the sling exercise training and focused on the throwing action targeting 24 people for 6 weeks¹⁷). We concluded that functional muscular strength of the pelvis and trunk significantly improved; therefore, functional muscular strength exercise using a sling was effective in improving neuromuscular

adjustment¹⁸). In another experiment, we found that spinal stability was greater due to the increase of contractility of the lumbar bending and extending force and because the intra-abdominal pressure was increased by the abdominal power. We need to reduce the low back pain of patients through a lot of movement development and utilization using the sling, as it has been shown to be effective for improvement of stability¹⁹).

In conclusion, both the Swiss ball exercise and sling exercise resulted in a reduction in the Oswestry Low Back Pain Disability Index and the visual pain scale in patients with low back pain, and these patients experienced an increase in lumbar isometric muscular strength after 12 weeks exercise compared with patients who performed no exercise (i.e., the control group). However, in comparing the Swiss ball and sling exercise groups, it was found that the sling exercise group was more effective in decreasing the Oswestry Low Back Pain Disability Index and the visual pain scale and increasing lumbar muscular strength.

We performed the sling exercise treatment by applying a variety of strengthening movements to the patient by using easily the cause for changes such as the movement of the contact point and adjustable straps with a line when we perform a certain task using different muscles of the human body, certain muscular strength of muscle is considered to be more useful to find the weakened muscles enough not to perform this function and enhance them.

REFERENCES

- 1) Leigh J: Introduction to occupational epidemiology. *Asia Pac J Public Health*, 1991, 5: 368–368. [CrossRef]
- 2) Pollock ML, Leggett SH, Graves JE, et al.: Effect of resistance training on lumbar extension strength. *Am J Sports Med*, 1989, 17: 624–629. [Medline] [CrossRef]
- 3) Allen BL: The lumbosacral spine: emphasizing conservative management. *JAMA*, 1966, 195: 1160–1160. [CrossRef]
- 4) McKenzie RA: Prophylaxis in recurrent low back pain. *N Z Med J*, 1979, 89: 22–23. [Medline]

- 5) Elia DS, Bohannon RW, Cameron D, et al.: Dynamic pelvic stabilization during hip flexion: a comparison study. *J Orthop Sports Phys Ther*, 1996, 24: 30–36. [[Medline](#)] [[CrossRef](#)]
- 6) McGill SM: Low back stability: from formal description to issues for performance and rehabilitation. *Exerc Sport Sci Rev*, 2001, 29: 26–31. [[Medline](#)] [[CrossRef](#)]
- 7) Lee JS, Yang SH, Koog YH, et al.: Effectiveness of sling exercise for chronic low back pain: a systematic review. *J Phys Ther Sci*, 2014, 26: 1301–1306. [[Medline](#)] [[CrossRef](#)]
- 8) Yoo YD, Lee YS: The effect of core stabilization exercises using a sling on pain and muscle strength of patients with chronic low back pain. *J Phys Ther Sci*, 2012, 24: 671–674. [[CrossRef](#)]
- 9) Davidson M, Keating JL: A comparison of five low back disability questionnaires: reliability and responsiveness. *Phys Ther*, 2002, 82: 8–24. [[Medline](#)]
- 10) Barker KL, Shamley DR, Jackson D: Changes in the cross-sectional area of multifidus and psoas in patients with unilateral back pain: the relationship to pain and disability. *Spine*, 2004, 29: E515–E519. [[Medline](#)] [[CrossRef](#)]
- 11) Grabois M: Management of chronic low back pain. *Am J Phys Med Rehabil*, 2005, 84: S29–S41. [[Medline](#)]
- 12) Stuge B, Laerum E, Kirkesola G, et al.: The efficacy of a treatment program focusing on specific stabilizing exercises for pelvic girdle pain after pregnancy: a randomized controlled trial. *Spine*, 2004, 29: 351–359. [[Medline](#)] [[CrossRef](#)]
- 13) Johannsen F, Remvig L, Kryger P, et al.: Exercises for chronic low back pain: a clinical trial. *J Orthop Sports Phys Ther*, 1995, 22: 52–59. [[Medline](#)] [[CrossRef](#)]
- 14) Barr KP, Griggs M, Cadby T: Lumbar stabilization: core concepts and current literature, Part 1. *Am J Phys Med Rehabil*, 2005, 84: 473–480. [[Medline](#)] [[CrossRef](#)]
- 15) Bennell K, Khan K, McKay H: The role of physiotherapy in the prevention and treatment of osteoporosis. *Man Ther*, 2000, 5: 198–213. [[Medline](#)] [[CrossRef](#)]
- 16) Park JH, Hwangbo G: The effect of trunk stabilization exercises using a sling on the balance of patients with hemiplegia. *J Phys Ther Sci*, 2014, 26: 219–221. [[Medline](#)] [[CrossRef](#)]
- 17) Ferreira PH, Ferreira ML, Maher CG, et al.: Specific stabilisation exercise for spinal and pelvic pain: a systematic review. *Aust J Physiother*, 2006, 52: 79–88. [[Medline](#)] [[CrossRef](#)]
- 18) Saeterbakken AH, van den Tillaar R, Seiler S: Effect of core stability training on throwing velocity in female handball players. *J Strength Cond Res*, 2011, 25: 712–718. [[Medline](#)] [[CrossRef](#)]
- 19) Arokoski JP, Valta T, Airaksinen O, et al.: Back and abdominal muscle function during stabilization exercises. *Arch Phys Med Rehabil*, 2001, 82: 1089–1098. [[Medline](#)] [[CrossRef](#)]