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Effect of Backward Walking on Isokinetic Muscular Function, Low Back Pain Index and Lumbosacral Angle in Unilateral Exercise Athletes

Sun-Ho Kim[1]* and Young-Bok Yoon[2]

[1]Department of Sports Leisure, Nambu University, Korea; sunho100@hanmail.net
[2]Department of Golf Industry, Chonnam Techno University, Korea; youngbok7800@hanmail.net

Abstract

Background/Objectives: Backward walking can be used as an exercise therapy program for prevention of low back pain. Accordingly, the purpose of this study was to investigate the effect of backward walking on isokinetic muscular function, low back pain index and lumbosacral angle in unilateral exercise athletes. **Methods/Statistical Analysis:** The subjects are 25 (age 21.37 ± 2.06 years, height 171.85 ± 4.12 cm, weight 71.97 ± 5.74 kg, exercise career 7.03 ± 1.95 years, pain duration was 6.05 ± 0.75 months) unilateral exercise athletes (golf, bowling and shooting player). Backward walking was performed with a frequency of three times a week (Tuesday, Thursday, Saturday), by 60 minutes at a time for 10 weeks. Comparison of related variables before and after backward walking was verified by paired t-test. **Findings**: The present study shows that extensor and flexor of lumbar were significantly increased after backward walking. Lumbosacral angle was significantly decreased after walking back. In addition, low back pain index such as VAS and VRS were each showed a significant decrease. **Application/Improvements:** In conclusion, backward walking represents that it improves muscle strength of the lumbar vertebra and reduces the lumbosacral angle and appeared to reduce the pain of the lumbar vertebra showing that the exercise program can be used in the prevention of low back pain.

Keywords: Back Pain, Backward Walking, Isokinetic Muscular, Lumbosacral, Unilateral Exercise Athletes

1. Introduction

Almost 50 to 80 % of the world population experiences the pain in the lumbar vertebra part at least once a lifetime which affects daily life or a lot of influence to certain actions[1,2]. It progresses to chronic low back pain for about 20%, due to low back pain, especially 11~12 % is disturbed in the daily life, it can be regarded as a serious problem in modern society[3].

For low back pain it is known that abnormal posture, disk of degenerative changes, degenerative spondylosis, sprains, excessive muscle contraction, constant movement and irritation in one direction play an important role. Change of the lumbosacral angle also causes the low back pain while changing secondarily the curvature of lumbar vertebra, thoracic, cervical in order to maintain the center of gravity[4–6].

Unlike the general public for the purpose of health promotion, athlete will acquire the specialized functions and technologies for the purpose of performance enhancement primarily. In particular, with sustainable impact and stimulating one direction for a particular area, athletes have often complained of low back pain, which causes the soft tissue weakness and muscle imbalance of lumbar vertebra part[7].

Low back pain is often developed to chronic back pain. For the general public, 90% of the improvement within two weeks[8], but for athlete because of the unilateral

*Author for correspondence

repetitive motion and overuse, etc., it continues long-lasting pain that does not improve[9]. Such chronic pain drops exercise performance by lowering the strength, flexibility, endurance, balance, etc[10,11]. It is reported that of all the American college athletes less than 30% as much as 1% have received a severe pain experiencing the low back pain[12]. When low back pain is exacerbated, the majority of players requires to decreases the intensity of the training and should concentrate on rehabilitation. But, some players endure their pain and without any treatment or rehabilitation continue to participate in sports result in serious side effects also. In this situation, it is required for elite athletes to reduce the pain with various methods and to prevent low back pain.

For low back pain relief and therapy, conservative therapy and surgical therapy are utilized in combination including exercise therapy, drug therapy, physical therapy, non-surgical therapy. Among these therapies, exercise therapy of nonsurgical method has been widely used to correct the structure of the wrong spine while improving the function of the muscles and ligaments as a way to nourish the intervertebral disk[3,13]. Recently as one of exercise therapy for low back pain prevention and mitigation for general public, as well as the rehabilitation or athletes, the backward walking is used[14–17].

The motion of backward walking requires a feedback process of various information of the sensor. That is, the central pattern generators play an important role for the person working. Because backward walking is not a simple activity of muscles expanding backwards, but a very sophisticated operation, it requires several separated neuromodulator which improves the ability for mobilization of motor unit and the effect of exercising is greater[16–18].

It have been reported for improvement of posture stability, low back pain reduction and improvement in exercise function, enhancement of anaerobic capacity, improve flexibility of the hamstring area, improved aerobic endurance, improve muscle strength and balance after backward walking[14,17,19–21]. Although the diverse effects on backward walking is proven like above mentioned, the research for the athletes appealing low back pains by using unilateral direction about the effects on backward walking is insufficient. Therefore, in this study, we want to know how does it impacts on the isokinetic muscular function of the lumbar vertebra, low back pain index and lumbosacral angle.

2. Materials and Methods

2.1 Subjects

The examinee of this study is appealing the pain of lumbar spine number 4 ~ 5 muscle pains for more than 3 months, but we selected 28 peoples of N University male athletes who voluntarily wish to participate and understand the research objects registered in the association of G-city who has no irritation or symptoms of neuromuscular clinically in particular. These examinees are golf, bowling or shooting athletes mainly using right hand or right foot with over 5 years of experience and do not have medical problems in the lumbar region by passing the basis of medical examination as blood pressure, heart rate and electrocardiogram in stable state. The final subjects were 25 excluding 3 from the test who did not fulfill faithfully in the program of the 10 weeks of the test period (Age 21.37 ± 2.06 years, Height 171.85 ± 4.12 cm, Weight 71.97 ± 5.74 kg, Exercise career 7.03 ± 1.95 years, pain duration was 6.05 ± 0.75 months). An experimental agreement was submitted by all examinees and educated to understand enough about the behavior which may affect the test during experimental period.

2.2 Methods (Exercise Program and Measurement Method)

In order to adapt to motion of the backward walking, the exercise was performed for 10 weeks after conducting one week of a preliminary exercise comfortable enough to walk back. It was performed with a frequency of three times a week (Tuesday, Thursday, Saturday), by 60 minutes at a time for 10 weeks as warming up (10 min.), The movement (40 minutes), the movement arrangement (10 minutes). Exercise intensity was set with a Rating of Perceived Exertion (RPE) based on previous studies[14,22] so as for the person to feel comfortable. In other words, the intensity of RPE 11~12 until 1~5 weeks and PRE 13~14 until 6-10 weeks for not feeling uncomfortable and with pain. Every time the backward walking was performed at a given time in the 400 m track with straight-line exercise. Walking back is by spreading the chest all along while the shoulder is back to fully retract and gazing at about 5 to 10 degrees lower. The shapes of the hands are like holding an egg and bend the knees walking naturally. Next, the forefoot puts down the back way before the heel. At this

time, the toe touches the ground first and the heel should fall late in the ground.

Measurement for the isokinetic muscular function was performed by a dedicated skilled exercise prescriptor to minimize an error in the measurement and avoid errors. Isokinetic strength of the lumbar muscle was aligned beforehand with the axis of rotation of the rehabilitation program to the metadata of the input arm dynamo of Kin-Com using spine rehabilitation equipment rehabilitation system and after connection with the securing screws to the body of the lower end of the Kin-Com fixing lower end of the tibia and femoral part with safe pad and especially, it was determined an anatomic measurement posture and the extension exercise 3 times repeatedly at the angular velocity 60˚/sec, centered with the lumbar to be muscle strength values of the extension and flexion, after fixing pelvis and after matching with back safe pad and fixing under the joint and measuring the maximum bending from 0˚~ 90˚.

Index of pain felt in the lumbar vertebra part is to be marked by "V" at a related position according to the level of pain and disability using Huskisson[23] is reported and the Verbal Rating Scale (VRS) and Visual Analogue Scale (VAS). The VAS method was measured by scoring with counting the distance, after direct marking on the bar the scale is not visible.

X-ray photograph of lumbosacral angle was measured by medical assistant of radiation at N University in a diagnostic radiology laboratory. When shooting in upright state, it is a shooting in standing lateral view. To assess the stability of the lumbosacral joint, it was measured at an angle for measuring the sacrum base angle using Ferguson's angle with L5 (fifth when lumbar) line connecting the lower edge and S1 upper edge (first upper surface of the upper edge) for the connection line[24].

2.3 Statistics

Measurements obtained in this study were the average and standard deviation was calculated for the metrics using SPSS Ver. using 20.0. Comparison of related variables before and after of backward walking was verified by paired t-test by statistical significance level was set at $\alpha = .05$.

3. Results

It showed (Figure 1) a significant respective increase in extensor ($p<.05$) and flexor ($p<.05$), after 10 weeks of

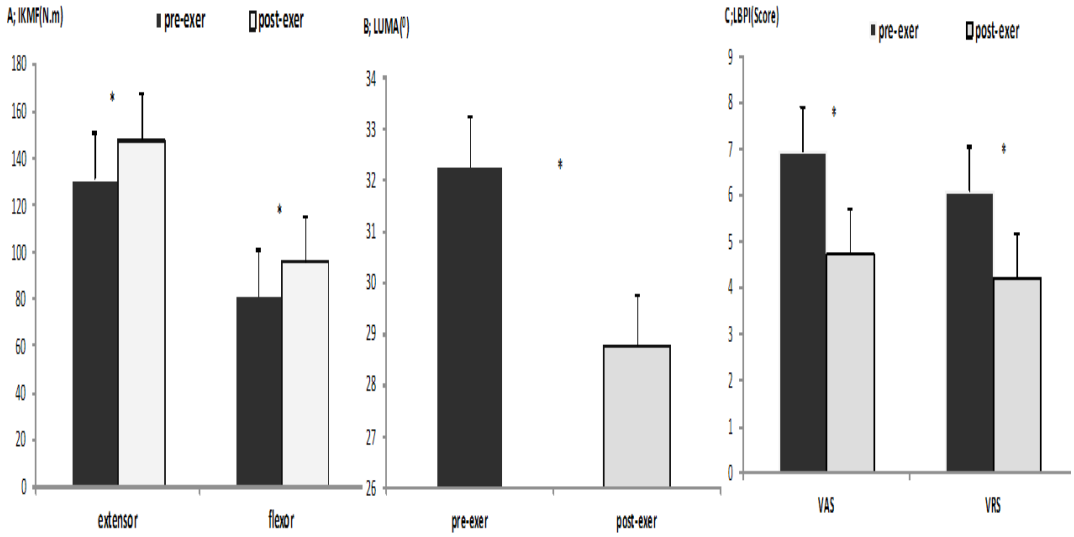

Figure 1. Isokinetic muscular function, lumbosacral angle and low back pain index.

Values are means ± SEM. *Significant different after backward walking exercise ($p<0.05$), 1. Isokinetic muscular function, 2. Lumbosacral angle, 3. Low back pain index, VAS; Visual Analogue Scale, VRS; Verbal Rating Scale, pre-exer; pre exercise, post-exer; post exercise.

backward walking for targeted unilateral athletes suffering from low back pain and lumbosacral angle showed a significant decrease ($p<.05$). In addition, low back pain index and measures of Visual Analogue Scale (VAS) and Verbal Rating Scale (VRS) each showed a significant decrease.

4. Discussion and Conclusion

As the most basic human exercise, walking has been used for decades for health promotion, it has been reported a variety of effects for walking exercise[16,25,26]. It is recommended for the elderly or infirm or those people who did not work for a long time or people suffering from chronic pain, because it is safe exercise and easy to carry out without special equipment or financial burdens in particular, without the limitations of time and place in everyday life[27]. Walking can be distinguished as the forward direction walking and the rear direction. Forward walking and backward walking show biomechanical structural differences and walking back is only different in the direction of movement kinematics such as moving by the heel as the forefoot landing on the ground and the heel grounded, it shows the same path of movement as walking forward[28,29].

When walking backwards direction, use muscle as opposed to when you walk forward, when walking back postural stability and balance skills can be improved because postural stability and balance skills are increased. Also, it reduces the risk of injury by strengthening the muscles around the knee and balanced development of the quadriceps and hamstring muscle and mitigated pain of the knee or low back while strengthening the lower body[30–32]. Especially, it has been reported that backward walking is an exercise therapy compared to the forward walking motion as a large number of exercise units have been mobilization and because it increases the energy utilization and promote the activation of the motor cortex and skeletal muscle[33], it is effective in improving exercise capacity which can be used for rehabilitation clinically[17,26,34].

In this study, aimed at unilateral athlete each showed a significant increase in the extensor and flexor of isokinetic muscular strength of the lumbar after performing backward walking. Lumbar extensor muscle fixes the spine and plays an important role in stabilizing the position and can prevent injuries and injury while taking a fixed position for athletes taking an action on one side in one direction must be backed by a strong muscle function for as much as can afford the movements of muscles[35]. The results of this studies are considered to be consistent with the muscle strength of a major part of previous research[14,36,37] that improves after backward walking and these results is because of the improvement of the muscle function due to strengthening muscles and ligaments and range of motion in lumbar vertebra part after backward walking.

Lumbosacral angle is formed by the line connecting the superior plateaus of the lumbar and sacrum and the horizontal plane, and its optimal lumbosacral angle is about 30°. Decreased muscle strength and functional imbalance of the lumbar vertebrae increase the tension of the muscles and make the normal angle of the lumbosacral angle locate outside of it. Low back pain is triggered if the lumbosacral angle is increased by increasing shearing force applied to the lumbar vertebra and exerted pressure on the spinal ligaments and facet joint at the rear side. As proper strength of the lumbosacral angle is 30° [38,39], the front angle of lordosis is getting to be a growing form and becomes smaller than the rear angle of lordosis of 30°[40,41]. In this study the backward walking show is effective for mitigating tension exerted on the lumbar vertebrae because lumbosacral angle is reduced after walking backwards showing a significant level. These results are understood as the lordosis and anterior rotation of pelvis is decreased by providing positive mechanical advantages functionally and efficiently to the lumbar vertebra by walking back operation[42].

The measurement of pain including the lumbar vertebra is difficult because it can be evaluated in the subjective aspect of a person[43]. Because the pain of lumbar vertebra can be expressed depending on the subjective feeling, living environment, emotional, mental status of the patients variously, measuring the subjective level of pain of the patients correctly can be important criteria to determine the result of the low back pain treatment. In this context, the degree of pain was measured by using Visual Analogue Scale (VSA) and Verbal Rating Scale (VRS) of the subjective pain level that is objectified and quantified[23]. This scaling method of the visual supervisor is used in the measurements of depression, psychological symptoms such as anxiety neurosis or symptoms such as difficulty breathing, nausea, tiredness and for measuring

the quality of life[44,45].

Visual Analogue Scale score and Verbal Rating Scale score measured in this study, each score are showing to reduce and it shows a tendency to be consistent with the previous study[14,37,39] significantly after backward walking. These results is understood that the walking back operation increased neuromuscular control and improvement of the pelvic alignment and increase the core strength of the lumbar vertebra and mitigated the pressure exerted on the lumbar vertebra part around while opening the facet joint of the spine[12,31].

It could be confirmed that backward walking represents that it improves muscle strength of the lumbar vertebra part and reduces the lumbosacral angle and appeared to reduce the pain of the lumbar vertebra showing that the exercise program can be used in the prevention of low back pain. However, we did not fully control the daily lives of the subjects and sample too small. And because we limited unilateral athletes appealing the low back pains who can work, it is somewhat excessive to generalize the results.

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