The Effects on the Pain Index and Lumbar Flexibility of Obese Patients with Low Back Pain after PNF Scapular and PNF Pelvic Patterns

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Abstract. [Purpose] The purpose of this study was to determine whether exercises using proprioceptive neuro-muscular facilitation (PNF) scapular and pelvic patterns might decrease the pain index and increase the lumbar flexibility of obese patients with low back pain. [Subjects and Methods] Thirty obese patients with low back pain were randomly assigned to an experimental group (n=15) and a control group (n=15). The exercise program of the experimental group consisted of scapular patterns (anterior depression – posterior elevation) and pelvic patterns (anterior elevation – posterior depression). The control group performed neutral back muscle strengthening exercises. Over the course of four weeks, the groups participated in PNF or performed strengthening exercises for 30 minutes, three times per week. Subjects were assessed a pre-test and post-test using measurements of pain and lumbar flexibility. [Results] The results show that lumbar flexion and lumbar extension significantly improved in the experimental group, had significant improvement and that the Oswestry Disability index (ODI) significantly decreased. However, there were no significant changes in the control group. The experimental group also showed significant differences in the pain index and lumbar flexibility from the control group. [Conclusion] This study showed that PNF can be used to improve pain index rating and lumbar flexibility. The findings indicate that the experimental group experienced greater improvement than the control group by participating in the PNF lumbar stabilization program.

Key words: Obesity, Low back pain, Proprioceptive neuromuscular facilitation

INTRODUCTION

As society has become highly industrialized and automated, physical activity has decreased, triggering an overall lack of exercise and which resulted in chronic diseases accompanied by diverse activity disorders1). Among these, low back pain is a clinical, social, and economic problem affecting everybody, and it is a very important and common condition among humans3).

There are diverse causes of low back pain. Physical conditions, such as obesity may lead to secondary occurrence of low back pain3). In particular, abdominal obesity causes an imbalance in the muscles around the pelvis, and this unbalanced muscle pattern triggers excessive activity of the hip joint flexors, to compensate for the weakened abdominal muscles, hip joint contracture, and anterior pelvic tilt, which results in lordosis and, therefore, low back pain3). Generally, the etiology of obesity with low back pain has been clarified by focusing on structural parts, such as vertebral joints and intervertebral discs, and muscular injuries5, 6). In particular, a lot of research has been conducted on improving the muscle strength of abnormally obese patients through muscle strengthening exercise programs5, 8); decreasing pain and enhancing dynamic balance through the use of directional tilt and rotation exercises9); strengthening of the lumbar region using a ball10); engaging in endurance and flexibility training11); and implementing core muscle stabilizing exercises12); and pain control13). However, those previous studies solved structural problems through simple lumbar strengthening exercises and they focused on strengthening large muscle groups, such as the abdominal muscles. They were lacking in co-contraction and flexibility training and, therefore, they failed to contribute much to the stabilization of the lumbar region14). A previous study recommended proprioceptive neuromuscular facilitation (PNF), which may stimulate the proprioceptive senses of the lumbar region muscles, and is useful for training sensory-motor regulation and balance15). Therefore, this study examined the effects of PNF intervention on lumbar flexibility and the pain index of obese patients with low back pain using interventions for low back pain patients described in previous studies.

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SUBJECTS AND METHODS

Subjects
The subjects of this study were 30 obese males in their 20s to 40s who visited S Hospital located in Daegu Metropolitan City complaining of low back pain from April 15, 2014 to May 15, 2014. The subjects were randomly and equally assigned to an experimental group and a control group. The criteria for inclusion in this study were: people who had visited the hospital and received treatment for low back pain; people whose body mass index (BMI) was higher than 25 kg/m$^2$; people who had not undergone vertebral fixation or other surgical treatments, and people who had no cardiovascular diseases related to abdominal obesity and/or metabolic diseases such as diabetes mellitus. The subjects understood the purpose of this study and consented to participation in it. This study was approved by the IRB of the Korea Nazarene University and was conducted in accordance with the ethical principles of the Declaration of Helsinki. The general characteristics of both groups are shown in Table 1.

Methods
The experimental group participated in a 30-minute PNF-pattern exercise session three times per week, for four weeks, after receiving basic physical therapy (hot pack, ICT, US) and resting for five minutes. Four physical therapists with three years of experience, and who had completed PNF levels 1 and 2 trained the experimental group.

The subjects lay on a bed and began the exercise. In order to exercise the upper extremities first, a therapist positioned himself at the head of each of the subjects, one by one, and manipulated each of the subject’s shoulder joints in a scapular pattern (anterior depression – posterior elevation pattern) using the basic principles of PNF. The therapist held the acromion areas of the subject’s shoulders with both hands and instructed the subject to “move the shoulder bone toward the pelvis of the opposite side”. The therapist provided adequate resistance after successful trajectory contraction of the abdominal muscles while the subject’s shoulders were moving. Then, the therapist conducted a pelvic pattern exercise (anterior elevation – posterior depression pattern). He held the anterior ridge of the subject’s pelvis and instructed the subject to “move the pelvic bone toward the shoulder of the opposite side”, triggering movement of the pelvis and resulting in trajectory contraction of the abdominal muscles. The therapist then provided adequate resistance. At that time, for irradiation effect against the resistance, each of the subjects alternately conducted muscle contractions on both sides of their bodies\(^7\). The subjects were allowed to rest whenever they felt fatigue during the exercise.

The control group performed strengthening exercises three times per week for four weeks after basic physical therapy (HP, ICT, US) and resting for five minutes. For an ordinary lumbar muscle strengthening exercise, the control group conducted a warm-up exercise (stretching) for five minutes, a flexion exercise (raising the upper abdominal region in a lying position, stretching the knees and raising

| Table 1. General characteristics of the subjects |
|-----------------------------------------------|
| EG (n=15) | CG (n=15) |
|-----------------|-----------------|
| Age (years) | 34.5 ± 9.1 | 33.5 ± 8.2 |
| Height (cm)  | 174.1 ± 6.1 | 176.8 ± 3.3 |
| Weight (kg)  | 76.1 ± 3.2 | 77.8 ± 6.2 |
| BMI (kg/m$^2$) | 29.1 ± 2.8 | 28.4 ± 1.3 |

Values are means ± SD, EG: experimental group; CG: control group

the legs, and flexing the trunk by stretching the arms and raising the legs in a side-lying position) for 10 minutes, an extension exercise (pulling the chin and lifting the head and raising the trunk in a prone position, raising one leg while laying the arms comfortably in a prone position) for 10 minutes, and a cool-down exercise (stretching, breathing exercise) for five minutes\(^8\). When the subjects felt fatigue during the exercise, they rested.

The flexibility of the lumbar region through measured with trunk flexion and trunk extension. In order to measure trunk flexion, the subjects drew their heels together and stretched their fingers; then they slowly bent their body forward. Measurements were taken while rebound of the body and bending of the knees were prevented. In order to measure trunk extension, the subjects lay prone on a mat with both hands behind their waist, and the assistant fixed the ankles of the subjects and raised their upper body high, maintaining that position for more than one second. Measurements were taken from the ground to the subjects’ chins. Measurements of trunk flexion and extension were taken three times and the average values were recorded in cm\(^9\). Measurements were taken prior to and after the experiment of both the experimental group and the control group subjects.

To analyze low back pain the Oswestry Disability Index (ODI) was used. ODI is a scale that measures the response that patients with low back pain have to activities of daily living and disorders. ODI consists of 10 items (the degree of pain, self-management, raising objects, walking, sitting, standing, sleeping, hobbies, movement, and sexual activity). According to the degree of the patients’ performance, each of the 10 items is assigned a point ranging from zero to five. The condition of no pain is given zero points and the condition of the worst degree of pain is given five points. The total score was 50 points\(^10\). This study converted the total score into percentages. The ODI of the experimental group and the control group were measured prior to and after the experiment.

For analysis, this study used SPSS ver. 12.0, and each group’s mean and standard deviation were calculated. In order to compare differences in the lumbar flexibility between each group prior to and after the exercise, two-way ANOVA was conducted, and in order to compare differences between the groups after the experiment, the independent t-test was carried out. The significance level (α) was chosen as 0.05.
RESULTS

Lumbar flexion and lumbar extension significantly increased (p<0.05) and ODI significantly decreased after the intervention in the experimental group (p<0.05). There were no significant differences in the control group between prior to and after the intervention (p>0.05). In the comparison of the groups after the intervention, only lumbar extension and ODI were significantly different between the two groups (p<0.05); there was no significant difference in lumbar flexion between the groups (p>0.05) (Table 2).

DISCUSSION

Low back pain is associated with body mass index, and the intensity of low back pain gradually increases as the degree of obesity becomes higher\textsuperscript{21}. In the treatment of gradually increasing low back pain in obese people, the effect of treating low back pain with exercise therapy rather than surgical therapy was recently clarified, and exercise therapy has developed as an area that has drawn a great deal of attention\textsuperscript{22}. Stretching and physical exercise programs are effective for low back pain patients, and in particular, exercises combined with muscle resistance and aerobic exercises have the best effects\textsuperscript{23}. Because a lot of research has already proven the usefulness of manual exercise therapy directly provided by therapists in a variety of exercise treatment methods\textsuperscript{24, 25}, this study examined the effects of combination patterns of the PNF on lumbar flexibility and pain index of 30 patients. In order to reduce subject muscle fatigue and efficiently increase their muscle strength, the exercises combined with muscle resistance and aerobic exercises have the best effects\textsuperscript{23}. For the effect of PNF combination patterns on lumbar flexibility and pain, the results of previous studies that have examined the effects of back pain, the results of this study are consistent with the results of previous studies that have examined the effects of PNF combination patterns on lumbar flexibility and pain.

| Table 2. The comparison of lumbar flexion and lumbar extension and ODI between the experimental group and the control group |
|---------------------------------|------------------|------------------|
|                                 | EG               | CG               |
|                                 | Pre-test         | Post-test        | Pre-test         | Post-test        |
| Lumbar flexion (cm)             | 0.3 ± 0.1        | 1.3 ± 1.7\textsuperscript{a} | 0.3 ± 0.1        | 0.6 ± 0.2        |
| Lumbar extension (cm)           | 15.3 ± 2.4       | 27.3 ± 3.4\textsuperscript{a} | 17.6 ± 2.9       | 21.1 ± 2.8\textsuperscript{a} |
| ODI (%)                         | 32.0 ± 3.2       | 23.4 ± 4.7\textsuperscript{a} | 31.8 ± 3.5       | 28.1 ± 2.4\textsuperscript{a} |

Mean±SE, ODI: Oswestry Disability Index, *Significant difference from before the intervention, p <0.05. \textsuperscript{a} Significant difference in changes between the two groups, p<0.05.
strengthening the ability of the muscles to generate tensile force through spiral movement of the abdominal muscles. We consider that the PNF treatment method, which has been routinely applied to stroke patients, has further treatment opportunities in physical therapy for treating musculoskeletal system conditions like low back pain.

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