Effect of Global Postural Reeducation Exercise on Pain and Hip Muscle Flexibility in Patients with Chronic Low Back Pain and Movement Control Dysfunction

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Abstract

Introduction: Patients with non-specific low back pain (NSLBP) and movement control dysfunction demonstrate alternation in hip muscles flexibility and spinal movement patterns. Therapeutic modalities that augment hip muscles flexibility could help these patients. The aim of this study was to investigate the effect of global postural reeducation (GPR) on pain and hip muscle flexibility in patients with NSLBP and movement control dysfunction.

Materials and Methods: A total of 27 men with a mean age of 31.21 ± 2.5147 years, height of 166.44 ± 6.11 cm, and weight of 64.21 ± 5.25 kg participated in this study. The visual analogue scale (VAS) was used to evaluate pain. The flexibility of hip muscles (rectus femoris, tensor fasciae latae, external rotators and hamstring) was measured using universal goniometer. All data were assessed at baseline and after the intervention. The Shapiro-Wilk test and paired t test were used for statistical analysis at significance level of P = 0.05.

Results: Our results revealed a decline in pain (P<0.004) and an increase in the flexibility of the hamstring muscles in the right (P<0.003) and left (P<0.003) legs. There were no statistically significant differences in the flexibility of rectus femoris muscle, external rotators, and tensor fasciae latae.

Conclusion: The results suggest that GPR had a significant effect on the level of pain. Further, it affected the flexibility of hamstring muscles in legs. Using GPR is recommended for pain relief and improving the flexibility of hamstring muscles in patients with NSLBP.

Keywords: Chronic non-specific low back pain, Motor control, Global postural reeducation, Flexibility

Introduction

Low back pain (LBP) is a common multifactor musculoskeletal disorder in today’s societies,1,2 which is experienced by over 70 to 80% of people at least once in their life.3 Non-specific low back pain (NSLBP) refers to muscle tension or local stiffness in the region below the ribs and above the gluteal sulcus, which can be defined with or without leg pain.4 Although most of the time, NSLBP improves spontaneously, half of the patients with this disease have a long history of back pain or several episodes of back pain. According to the current reports, this group of patients alone account for 80% of the costs associated with back pain treatment.5

According to Luomajoki et al, one possible underlying mechanism of NSLBP is movement control impairment (MVCI)6 which can be due to pain, abnormal tissue loading, lack of proprioceptive awareness and, possibly, the lack of a withdrawal reflex motor response.6 The consensus is increased muscle activity in these individuals as a stabilization mechanism.7,8

Research has shown that around 70% of patients with nonspecific back pain suffer...
from various mechanical disorders including changes in
the strength and length of the spinal muscles, diminished
strength of spinal muscles, asymmetry of internal and
external rotation of the hip, and pes planus. In previous
studies on these patients, the relationship between
these mechanical disorders and intensity of NSLBP has
been measured. In a study conducted to investigate the
relationship between mechanical factors and intensity of
back pain, the strength and stamina of the back muscles
and those surrounding the hip had a close relationship
with the intensity of back pain. Furthermore, NSLBP causes the patient to experience a vicious cycle, where the patients with chronic back
pain (more than three months), experience movement
constriction, whereby their physical activity becomes
severely restricted, further increasing muscle weakness.
Although the effect of interventions on movement
defects in patients with NSLBP has not been evaluated
systematically so far, most studies have reported a
relationship between pain and mobility constriction as
well as altered movements and postural patterns with the
intensity of back pain. In a study by Stevenson et al on
factory workers, it was found that the flexibility of body
muscles generally affects the incidence of NSLBP.
Exercise can play a significant role in treating NSLBP.
The effectiveness of exercise therapy has been reported
as a non-invasive and non-pharmacological method for
treating NSLBP across various studies.
Studies have suggested that exercise significantly
reduces the relapse of NSLBP. In addition, researchers
have mentioned various therapeutic exercises for each
individual factor (flexibility as well as strength and
stamina of muscles), where each of them is specific
only to one factor. If the therapist applies the special
therapeutic exercises to the patient to improve each
factor, it necessitates a long time for treatment. Further,
the patient does not have the ability to do all the exercises
simultaneously. For being completely recovered, most
of the factors mentioned should be improved among
patients with NSLBP; therefore, a kind of exercise is
required which is able to treat most disordered muscles
simultaneously.

In the research by van der Velde and Mierau, it was
found that a 6-week exercise program improved the
flexibility of muscles in patients with chronic non-
specific NSLBP. Gordon and Bloxham systematically
investigated the effects of exercise and physical activity on
NSLBP. They observed that these exercises can improve
the flexibility and range of motion of muscles. The
results of a study by Leo Rathinaraj et al on the effect of
segmental stability of the spine with an existing program
in patients with mechanical LBP indicated that exercise
plays a vital role in mitigating NSLBP. Nezhad Roomezi
et al studied the effect of core stability exercises on the
pain and performance of female patients with NSLBP and
observed a significant improvement in the extent of pain
and performance of the women with NSLBP.
One of the therapeutic methods that have recently
attracted attention is global postural reeducation (GPR)
method which was developed in France by Souchard et
al. This therapeutic method has been developed based
on an integrated idea of the system of muscular chains,
which can face shortening resulting from situational,
behavioral, and psychological factors. This method
has been developed based on identifying posterior and
anterior muscular chain and the general stretching of
antigravity muscles. Although this method is widely used across different
countries, only a few studies support its clinical and
theoretical effects. The studies that have been conducted
with regards to GPR training indicated that this method
might be effective in treating some musculoskeletal
diseases and disorders including NSLBP, disc herniation,
and ankylosing spondylitis. The results indicated that
GPR intervention in people with back pain resulted in
further improvement of pain and disability compared
with stability training. Some studies have been developed
on functional exercises over the past recent years, the
majority of which have mainly dealt with investigating
balance disorders and have less addressed disorders of
motion and movement control.
Therefore, based on what has been mentioned and
suggestions of previous researches, the present study
aims to investigate the effect of a six-week period of GPR
exercises on the pain and flexibility of some hip muscles
of men with NSLBP suffering from lumbar MVCI.

Materials and Methods
The present study was a quasi-experimental study with
pre- and post-intervention design.

Inclusion and Exclusion Criteria
Inclusion criteria were the diagnosis of NSLBP and
lumbar MVCI, being 30-35 years of age, being classified
as medium-risk subgroup (patients with an unfavorable
prognosis with high levels of physical prognostic
indicators appropriate for physiotherapy were excluded)
using the STarT Back Screening Tool, having no history
of macro trauma and acute lesions, having no history
of surgery in the back region and lower extremities,
not having functional or congenital kyphosis (using
kyphometer) and scoliosis (using scolimeter), having
no history of receiving physical therapy over the past
three months, and not receiving pharmacotherapy. The
exclusion criteria included unwillingness of the patient
to continue the therapeutic program, not attending the
therapeutic sessions, and having diseases that disrupted
participation in the study.

Sample Population and Study Design
Using G-Power software, 27 men with NSLBP and
deficit in performing Luomajoki and colleagues’
movement control tests\textsuperscript{27} were chosen for this research. In this study, purposive sampling method was used and after baseline testing, the patients were allocated to the experimental groups. After recording the demographic characteristics of the patients, those who had the initial inclusion criteria with NSLBP (Quebec questionnaire)\textsuperscript{28} and movement control deficit were included in the research. All of the applicants were tested in terms of movement control so that the statistical population of the research would consist of patients with NSLBP suffering from movement control deficit.\textsuperscript{21,27} In the pre-and post-test stages, the evaluation of flexibility and pain was performed on all the subjects under the same conditions using the following method. The pain intensity was measured using visual analog scale (VAS), while the flexibility of rectus femoris, hamstring, external rotators, and tensor fasciae latae muscles was measured by a goniometer, which was performed by the researcher before and after the intervention. After pre-test evaluation, the experimental group performed GPR exercises for six weeks. Two days after the completion of the exercises, post-test was done under pretest conditions, and the data were analyzed further.

**Quebec Questionnaire**

At the beginning of the study, the Québec Back Pain Disability Scale (QBPDS) which included 20 items, with each having a predetermined score, was used for sampling. For this purpose, the subjects filled this questionnaire. Then, they were examined by specialists for clinical assessment. Those who did not meet the conditions of running the training protocol and intended tests, according to the specialists, and had a QBPDS score of lower than 15 were excluded from the research.\textsuperscript{28}

**Movement Control Test**

In this research, movement control tests were performed after verification by the specialists and filling the questionnaire by the subjects. The subjects performed movement control tests which included six tests (Table 1). When implementing these tests, if the subject had an incorrect performance, the proper method was explained, and if he learned the proper movement but was still unable to do it, the person was considered to have a movement control deficit. In addition, those who had at least two deficits in these tests were included in the present study.\textsuperscript{29}

**Assessing the Intensity of Back Pain**

The intensity of back pain was measured by VAS. This scale has been plotted and graded as a 10-cm line, which was used for measuring the intensity of perceived pain in this study. In this scale, zero represents the absence of pain, 1-3 shows mild pain, 4-6 denotes moderate pain, and 7-10 indicates severe pain. In this study, the patients specified their perceived pain (which they sensed most of the time) by indicating a position on the continuum as the method of measuring pain.\textsuperscript{31}

**Evaluating Muscle Flexibility**

Flexibility of hip muscles was measured using a universal goniometer (Patterson Medical) (Table 2).

**The GPR Protocol**

In the present study, for the GPR method, positions which involved mainly the posterior chain length were chosen as this chain is shortened in patients with NSLBP. This method involves lying, sitting, and standing positions. In the present study, five methods were used which included: 1) supine lying, abduction of hand, and opening thighs, 2) supine lying, abduction of hands, and closing the angle of thighs, 3) sitting, abducting the hands, and closing the angle of thighs, 4) standing and bending the trunk forward, and 5) standing against the wall and opening the angle of thighs. The duration of each method varied between 5 and 15 minutes. These movements were performed for 6 weeks and three sessions per each week. Furthermore, in the present study, oral instructions and the manual booklet were used to keep the proper alignment and prevent compensatory movements of the patients.\textsuperscript{17}

**Statistical Methods**

Normality and variance homogeneity of data were tested using the Shapiro-Wilk and Levene tests, respectively.

### Table 1. Movement Control Test

<table>
<thead>
<tr>
<th>Movement Control Test</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Waiters bow: Flexion of the hips in upright standing without movement of the low back.\textsuperscript{30}</td>
</tr>
<tr>
<td>2</td>
<td>Pelvic tilt: Dorsal tilt of pelvis actively in upright standing.\textsuperscript{30}</td>
</tr>
<tr>
<td>3</td>
<td>One leg stance: From normal standing to one leg stance: measurement of lateral movement of the belly button. (Position: feet one third of trochanter distance apart).\textsuperscript{30}</td>
</tr>
<tr>
<td>4</td>
<td>Sitting knee extension: Upright sitting with neutral lumbar lordosis; extension of the knee without movement (flexion) of the low back.\textsuperscript{30}</td>
</tr>
<tr>
<td>5</td>
<td>Quadruped position: Transfer of the pelvis backwards and forwards (rocking) keeping low back in neutral. Starting position 90° hip flexion.\textsuperscript{30}</td>
</tr>
<tr>
<td>6</td>
<td>Prone lying active knee flexion.\textsuperscript{30}</td>
</tr>
</tbody>
</table>
Table 2. Evaluating Muscle Flexibility

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean ± SD Pre-test</th>
<th>Mean ± SD Post-test</th>
<th>Percentage Changes</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back pain</td>
<td>6.32±1.54</td>
<td>4.24±1.04</td>
<td>32.91</td>
<td>0.004*</td>
</tr>
</tbody>
</table>

Significant difference (P ≤ 0.05).

Descriptive and inferential statistics were used for data analysis. To investigate intra-group differences, paired t-test was used in SPSS software version 21.0. A P value of less than 0.05 was considered statistically significant.

Results

A total of 27 men with NSLBP participated in this study. They had a mean age of 31.21 ± 2.51 years, height of 166.44 ± 6.11 cm, and weight of 64.21 ± 5.25 kg. After initial evaluations and initiation of treatment, 3 patients were excluded from the study due to missing 3 consecutive training sessions. The results of paired t-test indicated a significant difference in the pre- and post-test pain score (P = 0.004) (Table 3).

The results of paired t test indicated that there were not any statistically significant differences in the flexibility of rectus femoris, tensor fasciae latae, and external rotators hip muscles. On the other hand, a significant difference was noted in the flexibility of hamstring muscle (Table 4).

Discussion

The aim of this study was to investigate the effect of the GPR method on the pain and flexibility of some hip muscles in men with NSLBP suffering from back movement control deficit. The results suggested that these exercises have had a significant effect on the level of pain. Further, the GPR method affected the extent of flexibility of some hip muscles (rectus femoris, tensor fasciae latae, and external rotators), though it was not statistically significant. On the other hand, GPR significantly affected the flexibility of the hamstring muscle.

One of the important factors studied in this study is the flexibility of hip muscles (rectus femoris, Tensor fasciae latae, external rotators, and hamstring). One of the muscles of interest in this study was hamstring muscle. It is connected to ischial tuberosity, and shortening of this muscle causes posterior pelvic tilt, diminished back curve, and thus straight back, which results in NSLBP. According to the findings obtained by Zahednezhad et al, the pain intensity level in people with NSLBP has a correlation with the flexibility of the hip muscles. On the other hand, shortened hamstring muscles alongside this weakness can result in posterior pelvic tilt and diminished spinal curvature. The studies have also shown that any change in the normal pattern of the movements of the spine and hip can increase the incidence of NSLBP due to the muscular attachments to them. The results obtained from this study indicated that the GPR method was effective in improving the flexibility of hamstring muscle. Accordingly, since shortened hamstring muscle has the greatest relationship with the pain intensity, it can be stated that the enhanced flexibility of this muscle possibly contributes to pain mitigation.

Furthermore, considering the shortened muscle chain which was observed in the subjects suffering from NSLBP, we applied the GPR method (global active stretching along with isometric contractions) to the subjects. This method prevents the activity of agonist muscles and stimulates antagonist muscles, causing the muscle spindle to stretch. The tonic muscles represent two-thirds of the total of our musculature, they are quite fibrous and of slow contraction and have a high tone. These characteristics reinforce their resistance and make it possible for part...
of their fibers to remain in permanent contraction and in constant interaction with gravity. Its characteristics guarantee us the possibility of being erect and achieving stability, hence the reason why they are commonly known as postural muscles.35,36 This group tends to stiffen and shorten, and its injury is commonly the result of overuse or misuse. Additionally, due to their arrangement in the joints, when they become more hypertoncic and shorten, they add a compression and shearing component to joints that could evolve in a morphological change and therefore an imbalance of tensions and possibly pain. The GPR method has been designed considering the physiology of each muscle group and focuses on the elongation of the tonic muscles conditioned at the same time by an eccentric contraction of the dynamic muscles while achieving decompression and correct alignment of the joint segments.35,36

In patients with NSLBP, this can result in improved mobility of the spine and reduced bodily pain.37 Among the possible reasons for the effectiveness of these exercises in improving the flexibility of hamstring muscles, one can mention that the reeducation exercises induce posterior and anterior muscle chain to stretch and affect the flexibility of hip muscles, which could possibly be effective in mitigating pain intensity. Although we cannot definitely say that GPR exercises alone are effective for patients with NSLBP, these exercises can be considered as an important part of the therapeutic method for patients with NSLBP.

In our research, the reason for the insignificant effect of GPR on the improvement of the flexibility of tensor fasciae, latae, rectus femoris, and external rotator muscles could be attributed to the short duration of the exercise program (6 weeks). On the other hand, GPR significantly improved pain and flexibility of hamstring muscles in patients with NSLBP. Evidently, this type of exercises prevents the activity of agonist muscles and stimulates antagonist muscles, causing the muscle spindle to stretch. In people with chronic NSLBP, this can result in improved mobility of the spine, flexibility, and diminished pain. The findings of our study on the improvement of pain were similar to those obtained by Bonetti et al, who evaluated the effects of GPR method on pain and functional disability. In this study, GPR method improved the pain and functional disability in the patients with NSLBP.37

### Conclusion

Overall, the results of this study suggest the positive role of GPR method in improving pain in patients with NSLBP suffering from back movement control deficit. In addition, no dissatisfaction or side effect was reported by the patients in this study. This finding alongside the results of previous studies can be considered a great contribution to exercise therapy in these patients. One of the limitations of this study was the absence of a control group.

### Ethical Approval

This study was approved by the Ethics Committee of Sports Sciences Research Institute (Code: IR.SSRI.REC.1397.267).

### Conflict of Interest Disclosure

The authors declare that they have no competing interests.

### Informed Consent

All participants were informed about procedures, and they signed an informed consent form prior to participation in study procedures, in accordance with the declaration of Helsinki.

### References


