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Immediate Effect of Spinal Mobilization on Lower Limb Strength in Healthy Individuals: A Pilot Study

Background: Spinal Mobilization is one of the manual therapy technique that clinicians have used to treat pain, however, there is still a lack of research on changes in strength in healthy people.
Objectives: To investigate the effect of posterior-anterior lumbar mobilization on lower limb strength in healthy individuals.
Design: Two-group pretest-posttest design.
Methods: In this study, 23 healthy subjects aged 20 years were assigned to 12 lumbar mobilization group (LMG) and 12 sham group (SG) to perform intervention and measurement through pre- and post-design. Intervention was performed in LMG with grade Ⅲ~Ⅳ on L3-5 of the lumbar spine, and lumbar mobilization was performed for each segment. After intervention, knee flexion and extension strength were measured. To measure the main effect on muscle strength, a comparative analysis was conducted using paired t-test and independent t-test.
Results: In LMG, knee flexor and extensor strength were increased significantly at 60°/s ($P<.05$). In addition, the extensors of LMG and SG were significantly different only at 60°/s, and the flexors were significantly different between groups at both 60°/s and 180°/s ($P<.05$).
Conclusion: In healthy individuals, lumbar mobilization results in improvement of strength of knee flexor and extensor, and additional experiments on the effect of mobilization on the lumbar spine on functional changes in the lower limbs will be needed.

Keywords: *Posterior-anterior lumbar mobilization, Knee muscle strength, Healthy individuals*

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INTRODUCTION

Joint mobilization has been frequently used for reducing pain and increasing joint range of motions. This method can improve passive extension and gliding through approaches such as distraction, sliding, compression, rolling, and spinning; restore joint movement; and protect the joint.[1] In addition, joint mobilization increases joint range of motion in stiff tissues, induces normal movement of injured joints, and prevents the aggravation of symptoms during joint movement.[1]

Joint mobilization is one of manual therapeutic method for diagnosis and intervention. By using joint mobilization, physical therapists could perform diagnosis by correlating the examination results with the characteristics and distribution of symptoms and, accordingly, choose proper treatment.[2] Although the mechanism of intervention of joint mobilization still remains unclear, several relevant studies exist. Bialosky et al.[3] reported that joint mobilization results in pain reduction, improvement of joint movement, hyperalgesia, and change in muscle activity. These effects can stimulate the mechanoreceptors in joints and muscles along with the midbrain periaqueductal gray and, consequently, activate α-motor neurons, which leads to changes in muscle activity.[3]

Joint mobilization has been reported to investigate the activity of the erector spinae (ES) and lumbar multifidus (LM) muscles in healthy people. A significant difference was found in LM contraction between the placebo and mobilization intervention.[4,5] Krekoukias et al.[6] reported that grade IV joint mobilization applied on the lumbar spine reduced the activity of the erector spinae. On the other hand, Soon et al.[7] demonstrated that grade III joint mobilization performed on the cervical spine did not lead to a significant difference in the activity of the neck flexors. Suter et al.[8] reported that joint mobilization in patients with lumbar pain resulted in the improvement of knee extensor strength. Thus, further studies are needed to clarify that joint mobilization can alter muscle activity. This study aimed to investigate the effects of lumbar mobilization on knee muscle activity in healthy individuals.

SUBJECTS AND METHODS

Research design

A two-group pretest and posttest design were accepted. According to treatment modality, the subjects were divided into two groups, a lumbar mobilization group (LMG) and a sham group (SG), by using simple random sampling. Intervention was performed through the pretest and posttest design (Figure 1). Groups were assigned using random numbers generated by a Microsoft EXCEL program. The assigned sequence was sealed and opened, not by investigators, but by research assistants, at the beginning of the study. Intervention was performed by therapists with 〉 10 years of experience with manual therapy, and both intervention and assessment were conducted by independent therapists for each group. All the participants were informed about the objective and contents of this study and voluntarily signed an informed consent form. This study was approved by the institutional review board of Namseoul University (NSUIRB-101479-HR-202003).

Subjects

The participants of this study were students at N University in Cheonan, Chungcheongnam-do, all of whom did not have lumbar pain or limited range of motion due to pain. Those who received surgery on the cervical spine in the last 6 months, were currently receiving lumbar treatment, or exercised more than three times a week, history of underlying disease or damage to the musculoskeletal system within the last year or less, such as knee or hip joint, lower extremity were excluded from the study. Although 12 participants were allocated to each group at the beginning of the study, one participant in the LMG and two paricipant in the SG dropped out for personal reasons. Finally, the data of 21 participants were used in the analysis (Table 1).

Intervention Procedures

Lumbar mobilization group

Each participant was instructed to be in a prone position and place their arms on both sides comfortably. The therapist performed grade III to IV joint mobilization on each segment of L3 to L5. At a visual analog scale score of 2 for pain, posteroanterior mobilization was applied on the spinous processes of each segment. A recording of a metronome playing at 80 beats per minute was used to standardize the speed and 2-minute mobilization.[2]

Sham group

In the same posture of the participants as in the LMG, the therapist performed grade I joint mobilization on the spinous processes of the L3-L5 segments. The treatment time and number of treatments applied were equal to those in the LMG.[2]

Outcome Measures

Isokinetic strength assessments

Finding out muscle strength assessment, the therapists investigated extensor and flexor muscles of the

Table 1. Characteristics of the Participants

Variables	LMG (n=11)	SG(n=12)	*P*
Age (yr)	22.47 ± 2.27	23.08 ± 3.51	.23
Height (cm)	165.26 ± 10.19	166.28 ± 9.20	.19
Weight (kg)	69.39 ± 13.08	71.20 ± 12.45	.59

Mean ± Standard Deviation
LMG: Lumbar mobilization group, SG: Sham group

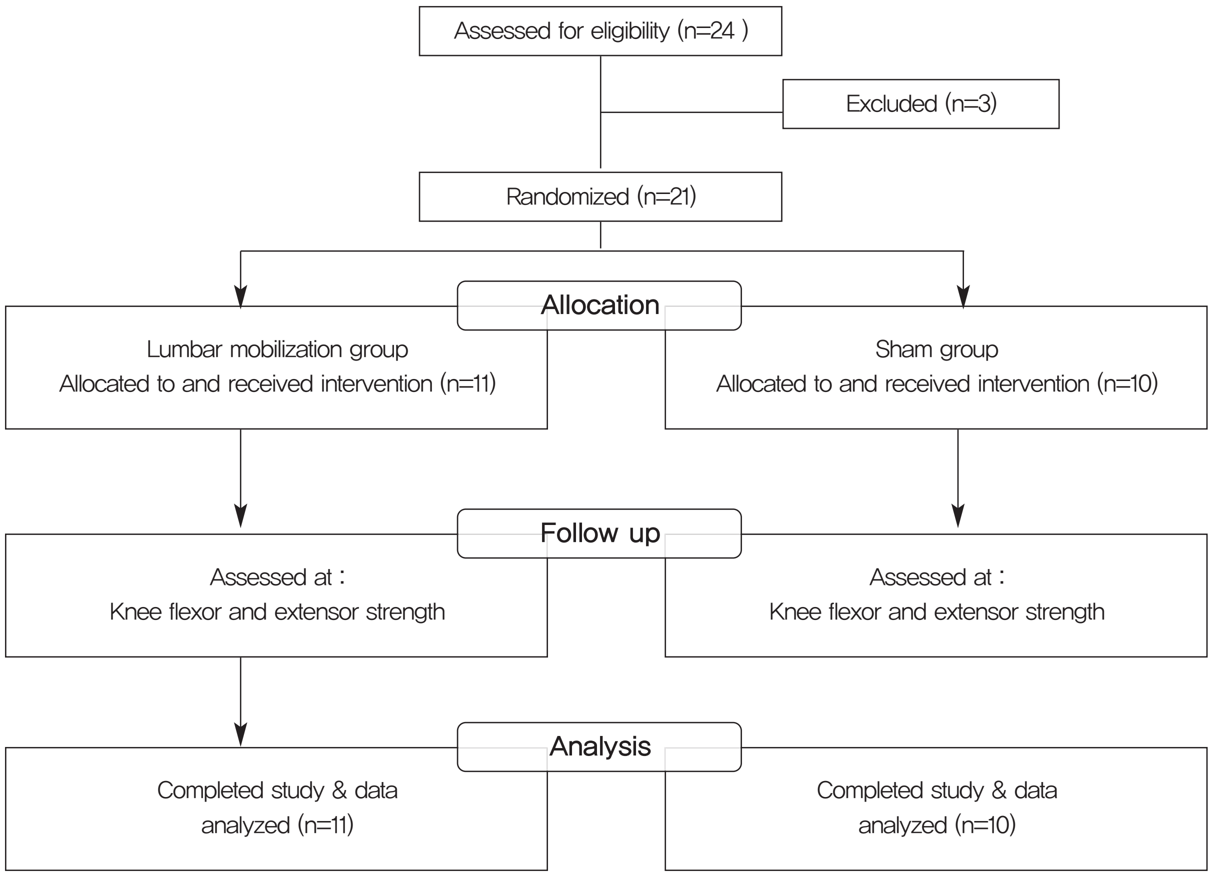

Figure 1. Flow of the participants throughout the study

predominant knee joint using an isokinetic machine, Primus-RS (BTE, USA). Each isokinetic strength was measured repeatedly five times at 60°/s and 10 times at 180°/s, and the mean values were used. Four hours before the measurement, each participant was instructed to practice three times for improved adaptation to the test. In all the measurements, flexion strength was measured subsequently to extension strength, and a 1-minute break was provided between the measurements at each velocity. The participants were asked by the therapist to lean against the back of their chair at a constant force for the measurement of the maximum muscle strength in a natural way.

Statistics and Analyses

All the statistical analyses were performed using SPSS version 22.0. The general characteristics of the participants are presented using descriptive statistics. Data normality was determined using the Kolmogorov-Smirnov test. A paired t-test was applied to identify the difference in strength between before and after the intervention in both groups. The change in strength was compared between the two groups through an independent t-test. The significance level was set at $P<.05$.

RESULTS

In the LMG, the knee flexor and extensor strengths measured at 60°/s increased statistically significantly. In addition, the LMG and SG showed statistically significant differences in extensor strength at 60°/s and 180°/s and in flexor strength at 180°/s (Table 2).

Table 2. Isokinetic strengthening unit (mean±SD)

		LMG		SG		*P*
		Pre	Post	Pre	Post	
Knee strength (Nm)	Extension 60°/s	120.4 ± 20.8	124.4 ± 17.6*	119.1 ±21.5	120.2 ±21.7	.00†
	Extension 180°/s	92.1 ± 18.8	94.3 ± 21.1	91.5 ±20.3	92.9 ±22.8	.12
	Flexion 60°/s	84.9 ± 21.3	88.9 ± 20.9*	86.2 ± 19.4	87.9 ± 21.3	.00†
	Flexion 180°/s	69.1 ± 17.2	72.7 ± 19.0	68.3 ±19.6	69.7 ±20.5	.02†

†Statistically significant difference in the change in knee strength between the groups
*Statistically significant intra-group difference in the change in knee strength
LMG: Lumbar mobilization group, SG: Sham group

DISCUSSION

Joint mobilization is a manual therapeutic method for diagnosis and intervention. Accordingly, by using joint mobilization, physical therapists can perform diagnosis by correlating the examination results with the characteristics and distribution of symptoms and choose the proper treatment based on the diagnosis. In this study, the effects of joint mobilization at the L3-L5 segments on the changes in the knee joint were investigated in healthy adults, the results of which can be used for future diagnosis and intervention.

High velocity low amplitude spinal manipulation (HVLA-SM) of the spine segment continues to excite the proprioceptor associated with the segment. Therefore, the muscle activity could be increased by activating the sensory and motor nervous systems that are dominated by the segment.[9,10]

As a result of this study, significant increases in the strengths of the knee extensor and flexor muscles at 60°/s were observed in the LMG. In addition, statistically significant differences in the extensor strengths at 60°/s and 180°/s and flexor strength at 180°/s were found between the LMG and SG.

Spinal mobilization can control pain by mechanical stimulation, induce long-term inhibition of function of the CNS synapses, and improve lumbar spine movement. Lumbar joint mobilization enhances the posterior chain neurodynamics. The neurophysiological reactions induced by joint mobilization include centrally mediated processes.[11-15] Taylor et al.[16] and Sterling et al.[17] reported a decrease in the activity of the lumbar paraspinal muscles by applying lumbar joint mobilization. Witvrouw et al. and Askling et al. demonstrated a significant increase in the muscle strength and flexibility of the lower extremities after lumbar joint mobilization.[18,19] Perry and Green[20] reported that unilateral lumbar joint mobilization alters the side-specific peripheral sympathetic nervous system. Taken together, the results of previous studies indicate that the neurophysiology and anatomical structures of the lumbar spine can be regulated by lumbar joint mobilization.[21]

L2-L3 joint mobilization has an effect on the hip joint flexors directly connected to the efferent pathways.[22,23] These physiological mechanisms are induced by lumbar joint mobilization that stimulates the arthrokinetic reflex by alerting tonic or phasic receptors. This reflex can increase muscle strength.[24] The increase in muscle strength in the LMG in this study seems to result from the effects of the peripheral sympathetic nervous system and arthrokinetic reflex.

However, the effect of joint mobilization that increased muscle strength remains controversial. Previous studies reported that the effect can vary depending on rhythmic oscillation or high velocity and low amplitude thrust.[2,25-29] As the effects of joint mobilization on the peripheral nervous system and muscles are not consistent, rhythmic, velocity, and amplitude should be considered in studies in the future.

CONCLUSION

This study investigated the effect of postero-anterior lumbar mobilization on knee flexor and extensor strengths in healthy individuals. Knee flexor and extensor strength were statistically significantly improved according to the application of lumbar mobilization. Further studies to establish a corresponding functional outcome for knee flexor and extensor strengths are recommended.

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