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Original Article

The immediate effects of neuromuscular joint facilitation on chronic low back pain in young and elderly people

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Abstract. [Purpose] This study aimed to investigate the changes in the pain severity and muscle hardness of the multifidus and longissimus muscles of young and elderly patients with low back pain after neuromuscular joint facilitation treatment. [Participants and Methods] The participants were 13 young patients and 11 elderly patients with chronic low back pain. The neuromuscular joint facilitation lumbar approach was used in all participants. The muscle hardness of the multifidus and longissimus muscles was assessed at the L4 and L5 levels of the lumbar spine. The changes in pain severity of low back pain were assessed using a visual analogue scale before and after treatment. [Results] Visual analogue scale scores significantly decreased in both groups after treatment. The young group showed significant differences in muscle hardness pre- and post-intervention. In addition, except for the muscle hardness of the multifidus muscle before intervention, on the side with pain at the L5 level, longissimus muscle hardness was higher in the elderly, as compared to the young patient group. [Conclusion] Interventions with neuromuscular joint facilitation have an immediate effect on pain relief in young and elderly people with chronic low back pain and on muscle spasms in young people with chronic low back pain.

Key words: Chronic low back pain, Neuromuscular joint facilitation, Muscle hardness

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INTRODUCTION

Low back pain (LBP) is the leading cause of years lived with disability globally, ranking first in both developed and developing countries[1].

The mean lifetime prevalence of LBP is estimated to be 39%, with a mean point prevalence of 18%[2]. The costs of LBP constitute a major burden on the health care systems, as well as on society[3, 4].

Exercise therapy is effective in treating chronic low back pain. Neuromuscular joint facilitation (NJF) is an emerging exercise therapy[5]. The long-term intervention of NJF's lumbar approach improves pain and increases inner muscle thickness in chronic LBP[6].

In clinical treatment, the immediate effect of NJF approach to chronic low back pain was often seen, but there is no research report. The purpose of this study was to investigate the changes in pain severity and muscle hardness of the multifidus and longissimus muscles in the young and elderly patients having low back pain (LBP), after treatment with neuromuscular joint facilitation (NJF).

Our hypothesis is that the NJF approach has immediate effects on pain relief and improvement of muscle spasm on chronic low back pain.

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PARTICIPANTS AND METHODS

The required number of samples was calculated using G*Power software, the effect size was set to 0.8 and power (1-β=0.8), the required number of samples was six. The participants were 13 young patients with chronic LBP (6 men and 7 women; age, 20.0 ± 0.97 years; height, 165.9 ± 10.2 cm; weight, 62.5 ± 17.0 kg), and 11 elderly patients with chronic LBP (6 men and 5 women; age, 73.7 ± 3.2 years; height, 158.6 ± 8.0 cm; weight, 58.1 ± 8.3 kg). All participants had chronic LBP for more than 6 months on one side of their bodies. Chronic low back pain was examined by age group. In addition, lumbar muscle spasms were also considered.

All participants provided informed consent to participate in the study. All experimental procedures in this study were reviewed and approved by the Ethical Review Committee of Jilin Dianli Hospital (JLDL2019-012). The study design is a clinical intervention study.

A physical therapist conducted the clinical examination, which included a questionnaire survey on low back pain, and an assessment of pain severity using the visual analog scale (VAS). The muscle hardness of the multifidus and longissimus muscles at the L4 and L5 levels of the lumbar, the functional reach test (FRT), and the finger floor distance (FFD) were measured before and after the intervention, using the NJF lumbar approach.

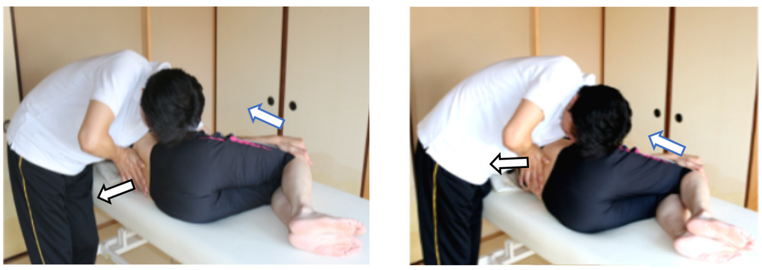
LBP was determined using the VAS. A 10-cm line was drawn, and the left end was labeled "no pain", and the right end was labeled "the worst pain experienced". Each participant was asked to mark the level of pain before and after treatment, and the distance from the left end to the mark was measured.

Muscle hardness was measured using the NEUTON TDM-NA1 (TRY-ALL, Chiba, Japan). The measurement was done in the prone position in a relaxed state. Both right and left sides of the back were examined and the measurement sites were the multifidus muscle at the L4 level (2.5 cm, laterally, from the L4 spinous process), the longissimus muscle at the L4 level (2.5 cm, laterally, from the L4 spinous process), and the multifidus muscle at the L5 level (2.5 cm, laterally, from the L5 spinous process).

FRT was performed using the "yardstick" method, as reported by Duncan et al[7]. FFD was performed using the modified version of Gauvin et al[8]. All measurements were performed twice, and the mean value was used in the analysis.

In the NJF groups, the front inferior pelvic pattern of the NJF was used. One hand of the examiner was placed against the knee, and traction and resistance were applied. The other hand of the examiner was placed on the spinous process to prevent upward curvature. The NJF intervention was performed once from L1 to L5, and a total of five resistance exercises were performed (Fig. 1)[6]. Isometric contraction was performed for 5 seconds in the intermediate position of the NJF pattern. The resistance force in the resistance exercise was tested using a hand-held dynamometer (HHD, ANIMA MT-1, Tokyo, Japan). The device was held by the physical therapist to measure the distal resistance; then, the maximal resistance force was measured using the tester function of the HHD. The maximum force of distal resistance placed on the knee was controlled using HHD. The maximum resistance of the young group was 11.2 ± 2.3 kg, and that of the elder group was 10.9 ± 1.9 kg. There were no significant differences between the two groups. The NJF intervention was carried out by a senior NJF instructor. In the control group, 5 minutes of rest on a relaxed lateral position were provided. The interventions were performed one after the other, separated by a 1-week interval. The order of interventions was randomized.

Two-way repeated-measures analysis of variance (ANOVA) was used to test for statistically significant differences between the intervention and groups. If any significant interaction was found, a paired t-test was performed to compare the outcome indicators, before and after the intervention. Data were analyzed using SPSS ver. 17.0 for Windows (SPSS, Chicago, IL, USA). The level of statistical significance was set at $p<0.05$.



Start position　　End position

⇦ Direction of proximal resistance　　⇦ Direction of distal resistance

Fig. 1. The front inferior pelvic pattern of NJF.
Left hand of the physical therapist was placed against the knee, and traction and resistance were applied. Right hand of the physical therapist was placed on the right side of the spinous process to prevent upward curvature.

RESULTS

The results of the questionnaire reflected the subjective impression of LBP, which was seen as a 92.3% improvement in LBP in the young NJF group, and 90% improvement in the elderly NJF group. The VAS results showed significant differences before and after the intervention in both age groups ($p<0.01$). The FRT results also showed a significant difference between the young and elderly NJF groups ($p<0.01$) (Table 1).

As for muscle hardness, there was a significant improvement in hardness of the multifidus muscles at the L4 and L5 levels before and after the intervention in the young NJF group, and between the young NJF group and the elderly NJF group. The muscle hardness of the longissimus muscle at the L4 level also improved. The young NJF group showed a significant decrease at all levels of muscle hardness after the intervention, but there was no difference before and after the intervention in the elderly NJF group. Excluding the L5 level pain side intervention, the hardness of the other muscle regions was higher in the elderly NJF group as compared to the young NJF group ($p<0.01$) (Table 2). There were no significant differences in the control group results.

DISCUSSION

Based on the results of the VAS and questionnaire, the NJF lumbar approach relieved back pain in both groups. Furthermore, the hardness of the multifidus and longissimus muscles was reduced after the intervention, and muscle spasms showed improvement in the young NJF group.

Patients with low back pain often have abnormalities in the paraspinal muscles, and measurement of the changes in muscle activity, muscle fatigue, muscle size, and muscle density are often used clinically[9)]. In particular, the examination of the multifidus muscle has been emphasized, and the action of the multifidus muscle on lumbar stabilization was observed[10)]. Low back pain is associated with poor posture and includes excessive lumbar lordosis and pelvic tilt. Instability of the lumbar spine due to weakness of the abdominal muscles and gluteal muscles is also involved in the development of low back pain[11)]. In our previous study, long-term intervention by NJF in patients with chronic low back pain increased the cross-sectional area of the multifidus muscle and reduced pain[6)].

In clinical practice, multifidus spasm is common on the affected side of patients with LBP. The multifidus muscle is in a state of defensive hypertonia against LBP. Pain relief and simultaneous relief of multifidus tenderness and spasm are commonly seen after NJF intervention. In this study, pain relief was consistent with the decrease in multifidus muscle hardness after NJF intervention, in the young group. However, while pain relief was evident in the elderly group, no change in muscle hardness was observed. In addition, the muscle hardness was higher than that seen in the young patients. I think it is because the elasticity and extensibility of soft tissue decrease with aging.

These results suggest that intervention with neuromuscular joint facilitation has an immediate effect on pain relief in young and elderly people with chronic low back pain. Neuromuscular joint facilitation has an immediate effect on muscle spasms in young people with chronic low back pain.

The limitation of this study is that there is no change in muscle hardness in the elderly group, so we would like to examine the measurement items in future studies.

Table 1. Comparison of each measurement item before and after intervention

			VAS[a] (cm)	FRT[b] (cm)	FFD[c] (cm)
Young group (n=13)	NJF group	Before	4.5 ± 1.3	39.9 ± 4.5	0.3 ± 11.1
		After	2.7 ± 1.7**	41.6 ± 5.8	2.1 ± 10.7
	Control group	Before	4.6 ± 1.8	40.8 ± 3.5	0.1 ± 10.5
		After	4.4 ± 1.3	42.0 ± 5.2	1.5 ± 12.6
Elderly group (n=11)	NJF group	Before	4.8 ± 1.8	26.9 ± 5.6‡	4.9 ± 8.1
		After	2.5 ± 1.6**	28.7 ± 4.6‡	5.0 ± 7.7
	Control group	Before	4.0 ± 1.5	27.6 ± 4.9	5.9 ± 7.5
		After	3.8 ± 1.1	28.5 ± 3.8	5.4 ± 6.2

Values are mean ± standard deviation.
Comparison before and after intervention: **$p<0.01$.
Comparison between groups: ‡$p<0.01$.
[a]: VAS: Visual analogue scale to evaluate the pain level of the knee joint.
[b]: FRT: Functional reach test.
[c]: FFD: Finger floor distance.

Table 2. Before and after intervention comparison of the muscle hardness (unit: N)

				MMH[a] at L4 level	LMH[b] at L4 level	MMH[c] at L5 level
Young group (n=13)	NJF group	Pain side	Before	0.70 ± 0.11	0.67 ± 0.12	0.71 ± 0.12
			After	0.67 ± 0.11*	0.63 ± 0.10*	0.66 ± 0.07*
		Non-pain side	Before	0.67 ± 0.12	0.67 ± 0.12	0.71 ± 0.11
			After	0.65 ± 0.09	0.64 ± 0.08	0.67 ± 0.08
	Control group	Pain side	Before	0.71 ± 0.50	0.67 ± 0.47	0.71 ± 0.52
			After	0.71 ± 0.47	0.65 ± 0.46	0.70 ± 0.46
		Non-pain side	Before	0.66 ± 0.47	0.66 ± 0.47	0.68 ± 0.47
			After	0.67 ± 0.44	0.67 ± 0.44	0.70 ± 0.45
Elder group (n=11)	NJF group	Pain side	Before	0.84 ± 0.12‡	0.84 ± 0.10‡	0.82 ± 0.17
			After	0.81 ± 0.14‡	0.81 ± 0.11‡	0.87 ± 0.18‡
		Non-pain side	Before	0.82 ± 0.12‡	0.84 ± 0.12‡	0.88 ± 0.13‡
			After	0.84 ± 0.11‡	0.82 ± 0.11‡	0.87 ± 0.16‡
	Control group	Pain side	Before	0.87 ± 0.51‡	0.84 ± 0.51‡	0.89 ± 0.59‡
			After	0.89 ± 0.54‡	0.84 ± 0.55‡	0.91 ± 0.78‡
		Non-pain side	Before	0.80 ± 0.54‡	0.82 ± 0.51‡	0.86 ± 0.59‡
			After	0.83 ± 0.53‡	0.81 ± 0.54‡	0.86 ± 0.58‡

Values are mean ± standard deviation.
Comparison before and after intervention: *$p<0.05$.
Comparison between groups: ‡$p<0.01$.
a: MMH at L4 level: Multifidus muscle hardness at L4 level.
b: LMH at L4 level: Longissimus muscle hardness at L4 level.
c: MMH at L5 level: Multifidus muscle hardness at L5 level.

Conflict of interest

The authors declare no conflict of interest.

REFERENCES

1) GBD 2015 Disease and Injury Incidence and Prevalence Collaborators: Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet, 2016, 388: 1545–1602. [Medline] [CrossRef]
2) Hoy D, Bain C, Williams G, et al.: A systematic review of the global prevalence of low back pain. Arthritis Rheum, 2012, 64: 2028–2037. [Medline] [CrossRef]
3) Dieleman JL, Baral R, Birger M, et al.: US spending on personal health care and public health, 1996–2013. JAMA, 2016, 316: 2627–2646. [Medline] [CrossRef]
4) Lambeek LC, van Tulder MW, Swinkels IC, et al.: The trend in total cost of back pain in The Netherlands in the period 2002 to 2007. Spine, 2011, 36: 1050–1058. [Medline] [CrossRef]
5) Huo M: Neuromuscular joint facilitation. Tokyo: IPEC Press, 2010, p 1.
6) Huang Q, Li D, Zhang J, et al.: Comparison of the efficacy of different long-term interventions on chronic low back pain using the cross-sectional area of the multifidus muscle and the thickness of the transversus abdominis muscle as evaluation indicators. J Phys Ther Sci, 2014, 26: 1851–1854. [Medline] [CrossRef]
7) Duncan PW, Weiner DK, Chandler J, et al.: Functional reach: a new clinical measure of balance. J Gerontol, 1990, 45: M192–M197. [Medline] [CrossRef]
8) Gauvin MG, Riddle DL, Rothstein JM: Reliability of clinical measurements of forward bending using the modified fingertip-to-floor method. Phys Ther, 1990, 70: 443–447. [Medline] [CrossRef]
9) Laasonen EM: Atrophy of sacrospinal muscle groups in patients with chronic, diffusely radiating lumbar back pain. Neuroradiology, 1984, 26: 9–13. [Medline] [CrossRef]
10) Richardson C: Therapeutic exercise for spinal segmental stabilization in low back pain: scientific basis and clinical approach. London: Churchill Livingstone, 1999, p 15.
11) Isida K: About lumbar stabilization function- comparison between the normal subjects and low back pain. Hokkaido Phys Ther, 2000, 19: 15–18.