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Original Article

Effectiveness of dry needling versus a classical physiotherapy program in patients with chronic low-back pain: a single-blind, randomized, controlled trial

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Abstract. [Purpose] We compared the effectiveness of dry needling with a classical physiotherapy program in patients with chronic low-back pain caused by lumbar disc hernia (LHNP). [Subjects and Methods] In total, 34 subjects were allocated randomly to the study (n=18) and control groups (n=16). In the study group, dry needling was applied using acupuncture needles. The control group performed a home exercise program in addition to hot pack, TENS, and ultrasound applications. Pain was assessed with the short form of the McGill Pain Questionnaire. The number of trigger points and their pressure sensitivity were evaluated with a physical examination (palpation). The Beck Depression Inventory was used to assess depression. The Tampa Kinesiophobia Scale was used to assess fear of movement. [Results] In the study group, the calculated Cohen's effect sizes were bigger than those in the control group in terms of pain, trigger point-related variables, and fear of movement. Effect sizes for reducing depressive symptoms were similar in both groups. [Conclusion] These results suggest that dry needling can be an effective treatment for reducing pain, number of trigger points, sensitivity, and kinesiophobia in patients with chronic low-back pain caused by lumbar disc hernia.
Key words: Dry needling, Physiotherapy, Low-back pain

INTRODUCTION

Low-back pain is a common health problem worldwide and a major cause of job-related disability, affecting employee job performance and healthcare costs. About 60–80% of adults experience low-back pain at some point in their lifetimes[1–3]. The vast majority of patients experience low-back pain for mechanical reasons. A herniated lumbar disc is one of the most common causes of chronic low-back pain.

When the pain lasts for more than 3 months, it is considered chronic. Lumbar disc hernia (LHNP), a common reason for chronic low-back pain, is characterized by particular findings, such as pain, paravertebral muscle spasm, losses of strength, and hypoesthesia, during the course of the disease. It causes social and financial problems as well as health problems. Many psychosocial elements play a role in making the problem chronic. Cognitive, behavioral, and emotional aspects of the condition gain importance as the disease becomes chronic[4, 5]. Depression and other mental symptoms are involved, and the continuous nature of the pain creates a vicious cycle by increasing the risk for mental disorders such as depression[6]. Fear avoidance is an important psychosocial variable among the patients that have this disability. It is accepted that individual and

psychological factors as well as beliefs and behaviors related to pain play important roles in low-back pain[7].

Trigger points (TPs) are defined as hyperirritable points in a taut band of skeletal muscles that create pain and cause reflected pain when they are palpated[8]. TPs are clinically classified as active and latent. Active TPs are spontaneously painful, and they cause reflected pain that produces symptoms when they are palpated. In contrast, latent TPs do not create pain spontaneously, but they are a source of reflected pain when palpated. When active TPs are compared with latent TPs, chemical pain mediators are more in active TPs[9].

The dry needling (DN) technique developed by Gunn is a treatment method that is used frequently for chronic pain[10]. The DN technique, applied to TPs, reduces the number and the sensitivity of TPs related to the pain. According to Dommerholt[11], DN has effects such as acute decreases in local, reflected, and widespread pain, restoration of joint range of motion and muscle activation, and rapid normalization of active myofascial TP chemistry. DN can reduce peripheral and central sensitization. A Cochrane review concluded, "DN appears to be a useful adjunct to other therapies for chronic low-back pain"[12]. Thus, DN performed on TPs in patients suffering from chronic low-back pain may be effective in reducing TP sensitivity. However, a meta-review concluded that there was insufficient evidence to support DN[13]. The aim of this study was to compare the effectiveness of DN versus a classical physiotherapy program (CPT) on pain, TPs, TP sensitivity, depression, and kinesiophobia in patients with chronic low-back pain caused by LHNP.

SUBJECTS AND METHODS

This single-blind, randomized controlled trial was carried out between November 2015 and January 2016 at the Eastern Mediterranean University Faculty of Health Sciences Department of Physiotherapy and Rehabilitation. An *a priori* power analysis was conducted using the G*Power software (ver. 3.1.9.2). Assuming a two-tailed Wilcoxon signed rank test at the 0.05 significance level with a statistical power of 80%, this analysis showed that 15 subjects would be required for each group. Considering the risk of dropouts, this sample size was increased by 20% in each group, and the final sample size was determined to be 18 subjects in each group.

Subjects between the ages of 35 and 70 year who reported low-back pain lasting at least 3 months, had been diagnosed with LHNP, and had at least one active TP that could produce symptoms were included in the trial (Fig. 1). Those with LHNP who showed neurological symptoms, had any orthopedic problem in the lower extremities or low-back region, had sacroiliac joint problems, were diagnosed with lumbar spondylolisthesis, had any neurological, rheumatic, or oncological problem, had received any physiotherapy less than 6 months earlier, had received any corticosteroid treatment or taken oral medication, and those with a needle phobia were excluded.

Approval was obtained from the Eastern Mediterranean University Ethics Committee. Written informed consent was obtained from all participants.

In total, 34 subjects agreed to participate and were separated in two groups using Random Allocation Software in one block (p<0.05 was accepted)[14]. Randomization was conducted by a person not involved in the study. DN and classic massage (DN + M) was applied to the first group, and the second group was treated with hot-pack, transcutaneous electrical nerve stimulation (TENS), ultrasound, and an at-home exercise program.

All assessments were made before treatment and on the last day of treatment by the same evaluator/physiotherapist (BHT), who was blinded to the treatment groups. Participants' sociodemographic characteristics such as age, weight, height, body mass index (BMI), marital status, and term of education were recorded.

The Short Form McGill Pain Questionnaire (SF-MPQ) visual analog scale (VAS) was used to determine the pain level, the primary outcome measure[15]. Subjects were asked to place an X to indicate the level of pain they were experiencing on a 10-cm scale, where 0 indicates no pain and 10, the worst level of pain. The distance between the marked point and the beginning of the line was recorded as the level of the pain felt.

The sensory and affective characteristics of pain in the lower back and of total pain point were assessed using SF-MPQ, whose validity and reliability in Turkish has been
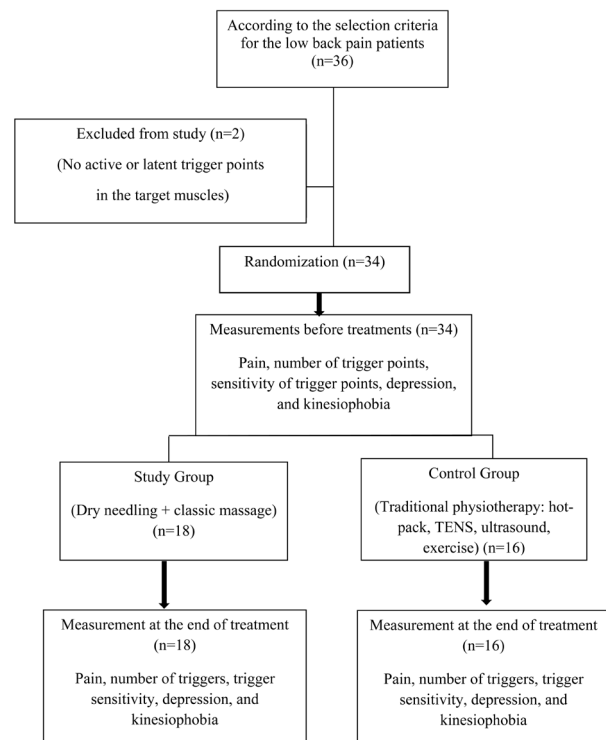

Fig. 1. Flow diagram of the study

shown[16]. The questionnaire contains a total of 15 descriptors (4 affective and 11 sensory) which are rated on an intensity scale: "0"=none, "1"=mild, "2"=moderate, "3"=severe. Additionally, the level of the pain felt was measured using the VAS.

Numbers of active and latent TPs on the gluteus medius, quadratus lumborum, multifidus, and lumbar erector spinae muscles were determined in both groups according to Simons et al.; the reliability of this approach was shown by Gerwin et al[8, 17]. Three separate methods, direct finger pressure, flat palpation, and pinch palpation, were used in the examination. The first two methods were chosen for TPs in the superficial muscles, and the third was used for TPs in deep muscles[18]. To determine TP sensitivity in the stated muscles, perpendicular pressure was applied on the TP at the taut band with the thumb. The sensitivity levels were recorded using a ranking from 0 to 2[19], where "0" indicates that thumb palpation results in increased intensity in the TP area, but there is no pain; "1" indicates that the intensity is increased, and the patient reports pain when asked; and "2" indicates that pain intensity is increased, and the patient spontaneously notes the pain when pressure is applied. The TP sensitivity scores in each muscle were summed, and the total was recorded as the TP sensitivity.

The Beck Depression Inventory (BDI) was used to determine depression levels[20] The BDI is composed of 21 items, each of which includes four choices that are used to distinguish depression from other psychopathological conditions and to determine the level of depression. Each item is scored from 0 to 3. Thus, the highest BDI score is 63, and the lowest is 0. Higher scores indicate higher levels of depression. The validity and reliability of the BDI in Turkish have been reported[21].

Fear of movement was assessed using the Tampa Scale of Kinesiophobia (TSK). The scale is composed of 17 questions that assess fear related to movement. Scores on this scale range from 17 to 68 based on a four-point Likert scale ("1" means strongly disagree and "4" means strongly agree). Higher scores indicate kinesiophobia[22]. The reliability of the scale in Turkish has been shown[23].

DN was performed on active and/or latent TPs in the gluteus medius, quadratus lumborum, multifidus, and erector spinae muscles of the subjects in the study groups without local anesthetic. These muscles were chosen for different reasons. Active TPs occur frequently in the gluteus medius and quadratus lumborum muscles, and although the multifidus muscle, located deeper, is one of the fundamental stabilizers, it has been insufficiently assessed as an important cause of pain[24]. Gluteus medius and quadratus lumborum testing occurred with patients in a side-lying position, whereas patients were positioned lying face down for the multifidus and erector spinae muscles. The needles were applied at a 90° angle for the multifidus, quadratus lumborum, and gluteus medius muscles, and at 45° for the erector spinae muscles. After the TP was located, the skin was cleaned with alcohol, and needling was performed. Thin, stainless steel needles of 0.25 × 0.40 mm and 0.30 × 0.60 mm were used to the TP using the injection technique described by Travel and Simons[8]. The needles were kept in place for 20 min; at the 10th minute, the needle was rolled to enable re-stimulation. The treatment was applied twice per week for six sessions in total. The treatment was applied by a physiotherapist (SG) with a certificate in dry needling at TPs and 2 years of clinical experience.

To reduce pain and relieve muscle spasm, classic (Swedish) massage was applied to the low-back region in the study group. With the patient lying prone, massage was administered to the erector spinae, latissimus dorsi, and gluteal regional muscles in the low back. Stroking and kneading methods were used. Each method was repeated three times. The massage lasted up to 10 min.

In the control group, we applied a hot-pack for 20 min to increase the local circulation, enhance relaxation of muscles with TPs, and decrease the tension at TPs[25].

Control group subjects received burst TENS to the lumbar region paravertebrally using reusable silicone rubber electrodes. The electrode dimensions were 5 × 5 cm. The Chattanooga Intelect TENS (E) 77720 machine was used. The pulse width was set at 100 μsn, pulse frequency was 2 Hz, cycle time was 0.5 s, and the strength of the flow was increased until visible muscle contraction was achieved. If muscle contraction was lost during the session, the amplitude was increased again. The period of treatment was six sessions of 25 min each.

Constant ultrasound was applied paravertebrally to the low back region in subjects in the control group using an Enraf-Nonius Sonopuls 492 ultrasound device. The skin was cleaned before applying the coupling gel. The treatment was applied at 1 MHz frequency and 1.5 W/cm² power for 6 min per day (3 min each on the right and left sides) over 10 sessions, using a complete direct contact method. A 5-cm ultrasound head was used.

The following exercises were assigned to the control group as an at-home exercise program. The patients were asked to exercise twice per day, completing three sets of each exercise, each with 10 repeats. Exercises are shown below.
- Posterior pelvic tilt
- Stretching lumbar extensors
- Stretching hip flexors
- Anterior and posterior pelvic tilt exercises combined with head movements in a crawling position to strengthen the back and abdominal muscles

Statistical analyses were carried out using the SPSS software (ver. 20.0). Whether the data were normally distributed was assessed with the Kolmogorov-Smirnov test. The results are given as mean ($\bar{x}$) ± standard deviation (SD), with numbers and 95% confidence intervals (CIs) for continuous data. The Wilcoxon signed rank test was used in intra-group comparisons, the Mann-Whitney U-test in comparisons between groups and independent samples, and comparisons of percentages were made using the χ^2 test and/or Fisher' Exact Test. The marginal homogeneity test was used to test differences in intervals in dependent variables. For the output of the primary and secondary results, Cohen d effect sizes were calculated using the

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following formulae:

$$d=(\bar{x}1 - \bar{x}2) / S_{pooled},$$

$$S_{pooled} = \sqrt{\frac{S1^2 + S2^2}{2}}.$$

The size of the effect was interpreted as d=0.2, small; d=0.5, medium; and d=0.8, large[26]. Values of p<0.05 were considered to indicate statistical significance.

RESULTS

In total, 18 individuals each participated in the study and control groups. However, two individuals in the control group were excluded because they had no active and/or latent TP. The average ages of individuals were similar in the study (average age: 50.1 ± 11.8 years) and control groups (average age: 50.9 ± 12.5 years) (p=0.863). Socio-demographic characteristics are shown in Table 1. There was no statistically significant difference between the groups in terms of these socio-demographic characteristics (all p>0.05). The groups were similar in terms of all of the variables analyzed before treatment (all p>0.05; Table 2).

A comparison of pre- and post-treatment values showed statistically significant differences (all p<0.05) in both the study and the control groups in pain (VAS), the primary outcome measure. In after-treatment comparisons, significant differences were found between the groups in favor of the study group (p<0.001). The pain level was slightly higher in the control group. The 95% CI for pain in the study group was 0.2–1.1, whereas it was 2.1–4.5 in the control group (Table 3). The effect size of this variable was 1.9 in the study group, whereas it was −0.5 in the control group.

Statistically significant differences were found in both groups in terms of sensory, affective, and total pain points, as measured with the SF-MPQ (all p<0.05). There were significant differences in favor of the study group in the comparisons made after treatment (all p<0.05; Table 3). The effect sizes were high for all of the assessed parameters in the study group. In contrast, the effect sizes for the control group in terms of sensory, affective, and total pain points were 1.3, 0.5, and 1.2 respectively (Table 4).

Statistically significant improvements were seen in both groups after treatment in terms of TP number and sensitivity (all p<0.05). The groups showed statistically significant differences in favor of the study group in the decreases in TP number and in TP sensitivity (both p<0.001). The post-treatment TP number and sensitivity for the study group were lower, with 95% CI values of 3.5–5.1 and 2.4–4.0, respectively, and they were 6.6–8.9 and 7.0–10.6, respectively, in the control group (Table 3). The effect sizes for these variables were high in both groups (Table 4).

The comparisons of pre- and post-treatment scores revealed significant changes in the study group for the depression (p=0.005), whereas the change in the control group was not significant (p=0.079). However, there was no significant difference in depression scores when the groups were compared after treatment (p=0.678). The clinical effect obtained for depression in both groups was small (Cohen's d=0.1; Table 4).

Although the TSK score in the study group was significantly decreased after compared with before treatment (p=0.008), no significant change was found in the control group (p=0.953). When the groups are compared after the treatment, a statistically significant difference was seen in favor of the study group (p=0.018; Table 3). Nevertheless, the effect sizes were small to medium (Table 4).

DISCUSSION

The results of this study showed that a program composed of DN + M was superior to a CPT program for treatment of low-back pain as measured by pain level, which was analyzed as the primary outcome measure. The application of DN + M was more effective in decreasing scores on SF-MPQ, the number of TPs, total sensitivity of TPs, depression, and kinesiophobia, which

Table 1. Socio-demographic and clinical characteristics of the participants

Variables	Groups	
	Study group (n=18)	Control group (n=16)
Age, years, Mean ± SD	50.1 ± 11.8	50.9 ± 12.5
(95% CI)	(44.2–56.0)	(44.2–57.6)
Gender, male, n (%)	10 (55.6)	4 (25.0)
Education stage, n (%)		
No literacy	1 (5.6)	1 (6.3)
Primary school	7 (38.9)	7 (43.8)
Middle school	1 (5.6)	4 (25.0)
High school	6 (33.3)	4 (25.0)
University	3 (16.7)	-
Smokers, n (%)	3 (16.7)	7 (43.8)
Exercise habits, n (%)	7 (38.9)	7 (43.8)
BMI, kg/m², Mean ± SD	29.6 ± 6.1	27.9 ± 4.4
(95% CI)	(26.6–32.6)	(25.6–30.2)
LHNP levels, n (%)		
L3–L4	2 (11.1)	-
L4–L5	9 (50)	10 (62.5)
L5–S1	5 (27.8)	5 (31.3)
L4–5 and L5–S1	2 (11.1)	1 (6.3)

BMI: body mass index; LHNP: Lumbar disc hernia

Table 2. Comparison of pre-treatment measurements

Variables Mean ± SD, (95% CI)		Groups	
		Study group (n=18)	Control group (n=16)
McGill Pain Questionnaire score	VAS	2.5 ± 1.1 (1.9–3.0)	2.4 ± 1.2 (1.8–3.0)
	Sensory pain	6.1 ± 2.6 (4.8–7.4)	6.3 ± 2.7 (4.9–7.7)
	Affective pain	1.0 ± 1.3 (0.4–1.6)	1.5 ± 1.9 (0.5–2.5)
	Total pain	7.1 ± 3.4 (5.4–8.8)	7.8 ± 4.0 (5.7–9.9)
Total number of trigger points		9.6 ± 2.5 (8.4–10.8)	11.1 ± 2.6 (9.7–12.5)
The trigger point sensitivity		14.2 ± 4.9 (11.8–16.6)	12.3 ± 3.8 (10.3–14.3)
Beck Depression Inventory score		13.7 ± 9.9 (8.8–18.6)	13.8 ± 10.6 (8.2–19.4)
Tampa Kinesiophobia Scale score		40.9 ± 11.4 (35.2–46.6)	44.2 ± 8.6 (39.6–48.8)

VAS: visual analog scale

Table 3. Comparison of measured results after treatment

Variables, Mean ± SD, (95% CI)		Groups	
		Study group (n=18)	Control group (n=16)
McGill Pain Questionnaire score	VAS	0.6 ± 0.9 (0.2–1.1)	3.3 ± 2.2* (2.1–4.5)
	Sensory pain	0.6 ± 0.9 (0.1–1.0)	3.2 ± 1.9* (2.2–4.2)
	Affective pain	0 (NA)	0.7 ± 1.0* (0.2–1.2)
	Total pain	0.6 ± 0.9 (0.1–1.0)	3.8 ± 2.3* (2.6–5.0)
Total number of trigger points		4.3 ± 1.6 (3.5–5.1)	7.8 ± 2.2* (6.6–8.9)
The trigger point sensitivity		3.2 ± 1.6 (2.4–4.0)	8.8 ± 3.3* (7.0–10.6)
Beck Depression Inventory score		12.3 ± 9.7 (7.5–17.1)	13.0 ± 10.3* (7.5–18.5)
Tampa Kinesiophobia Scale score		37.8 ± 9.8 (32.9–42.7)	45.4 ± 5.9* (42.3–48.5)

VAS: visual analog scale; NA: not applicable; *p<0.05

Table 4. Cohen's d effect sizes based on results after treatment

Variables		Groups	
		Study group (n=18)	Control group (n=16)
McGill Pain Questionnaire score	VAS	1.9	−0.5
	Sensory pain	2.8	1.3
	Affective pain	1.9	0.5
	Total pain	2.6	1.2
Total number of trigger points		2.5	1.4
Trigger point sensitivity		3.0	1.0
Beck Depression Inventory score		0.1	0.1
Tampa Kinesiophobia Scale score		0.3	−0.2

VAS: visual analog scale

were secondary outcome measures.

CPT is one of the conservative methods used in the treatment of low-back pain[27–29]. There have been studies on the effects of various exercise methods and manual treatments for the treatment of low-back pain, and a program consisting of hot-pack, TENS, ultrasound, and at-home exercises is used frequently in our country under the CPT program. There are conflicting publications on the effectiveness of modalities such as hot and cold pack applications and ultrasound[30–32]. Although no studies have strongly supported the use of TENS for chronic low-back pain, it is included in some treatment guidelines[33]. Moreover, in some clinical guidelines, it is noted that multimodal treatment approaches are required for the treatment of chronic low-back pain[34].

In this study, we found that pain, depression, and the fear of movement in the patients having chronic low-back pain due to LHNP could not be decreased with the CPT program. However, the qualities of pain and the number and sensitivity of TPs were improved.

Mechanical problems cause increased muscle activity by creating tissue damage and inflammation, and they may eventually cause muscle spasms. All of the muscles located in the lumbar region function in ensuring lumbar vertebral stability. The most important muscle for lumbar segmental stability is the multifidus. Cornwall et al. stated that spasm or atrophy in the multifidus muscle can cause local and reflected pain[35]. The erector spinae muscles, where spasm is frequently seen, and the multifidus muscles, which can cause reflected pain and which plays an important role in lumbar stabilization, were chosen for DN treatment as well as gluteus medius and quadratus lumborum muscles, in which active TPs are seen in chronic low-back pain according to Tèllez-Garcìa et al[24].

TPs can be deactivated through many methods, such as ischemic compression, stretching[36], and cold spray with stretching[8]. TENS and needling have also been reported[8, 36]. However, needling was stated to be the best method for the treatment of chronic TPs[37]. DN performed on TPs is recommended as a significant treatment choice for patients with chronic low-back pain, according to the Cochrane Collaboration[12].

The DN technique acts to mechanically disrupt sensory or motor components of nerve endings that contribute to abnormal elements of muscle contractions, which in turn affect activity in the area of TPs. Taut bands of muscle fibers that can be palpated and overstimulation of sensory nerves are reduced by this disruption. Overstimulation of sensory nerves is responsible for the reflected pain and local sensitivity. The temporary damage to the muscle fibers created by the needle causes the release of local intracellular potassium. This prevents depolarization of nerve fibers where extracellular potassium reaches a sufficient amount[37]. Although it is considered that therapeutic effect is created with pain-modulation mechanisms, such as local endorphin release and the gate control theory, it is mainly related with counter irritation mechanisms of irritation that cause inhibition of neuroplastic changes that develop with central sensitization at the dorsal horn cells in spinal cord[24].

Previous studies have shown that TP injection reduces pain and increases the normal range of joint motion, exercise tolerance, and circulation in patients with radiculopathy-origin chronic myofascial pain and patients suffering from chronic pain due to other etiologies[5, 10, 38]. Kalichman and Vulfsons[39] recommended DN because it is an inexpensive, easy to learn, low risk, and minimally invasive treatment method. DN shows an effect after the first session. Recovery in symptoms is usually seen with a program of five or six sessions applied once per 2 days[25]. In the present study, such recovery was seen in the DN + M group following a program composed of six sessions, which resulted in reductions in the pain level, qualities of pain, number of TPs, TP sensitivity, depression, kinesiophobia, and clinical effects, with the exception of depression, As there was no overlap in the confidence intervals in terms of the pain level, qualities of pain, number of TPs, or TP sensitivity, these findings support our conclusions.

Garvey et al.[40], studying 63 patients with low-back pain due to TPs, found no significant differences among the DN, lidocaine, lidocaine + steroid injection, and vapoolant spreys + acupuncture groups. However, DN was preferable. DN therapy was superior to sham DN therapy in chronic low-back pain; however, its effect was found to be temporary in the randomized cross-over study carried by Itoh et al[41]. TENS was compared with DN and laser treatments, and the results showed that DN was more efficient, with benefits lasting for 4 weeks[42].

Although measurements were made after treatment in the present study, it was impossible to assess long-term effectiveness because follow-up visits were not carried out. This is an important limitation of our study.

Chronic low-back pain due to LHNP causes stress and may cause psychological disorders by affecting personal abilities[43]. Some reports have suggested that psychological disorders such as depression and fear of movement are common in patients with chronic low-back pain and that identifying and beginning treatment at an early stage can prevent the problem from becoming chronic and prevent a poor prognosis[43, 44].

Pre- and post-treatment results of this study indicate that DN + M can be considered more effective than CPT for reducing depression and kinesiophobia, although, no statistically significant difference in depression was found between the groups after treatment, and the 95% CIs overlapped.

In Ay et al.[45], local anesthetic injection methods were compared clinically with DN. Improvement in depression scale scores was seen in both groups after treatment, but the difference between the groups was not statistical significant. In another study, Altindağ et al.[46] compared the efficacy of DN and local anesthetic injection and found that both treatment methods were effective in improving pain and quality of life, but neither showed any effect on depression.

Although the reduction in kinesiophobia was significantly greater in the DN + M than in the CPT group after treatment, the 95% CIs overlapped and the clinical effectiveness was small. Thus, the DN + M program has limited clinical efficacy. Kine-

siophobia is the most important predictor of pain-related disability in patients with chronic pain[47]. Thus, when it considering that chronic pain may have cognitive and behavioral implications, such as fear of movement, and this may make the situation more difficult and may cause disability, even a modest clinical effect due to DN may be important.

A study by Téllez-Garcìa et al.[24] compared DN with DN plus neuroscience education. The authors performed DN only on active TPs in the quadratus lumborum and multifidus gluteus medius muscles in their study. Although this study differs from ours in terms of application methods, the effects of DN on pain and kinesiophobia were similar. The reduction in kinesiophobia, or fear of movement due to pain, may be attributable to reductions in pain and in the number and sensitivity of TPs with the DN + M program.

One limitation of our study is that it had no control group that was subjected to no treatment. Although the improvements seen with the DN + M program were superior to those with the CPT program, it is impossible to know whether the improvements in both groups were caused by the nature of each intervention. Hence, the results should be interpreted cautiously. Second, exercises to be given on disc pathologies should be specific to the patient. If the same exercises are given the standard forms, this may have affected the inhibition of pain. However, for the control group, we used a conventional treatment program routinely used in our country. For this reason, we did not use specific exercises for the control group.

Third, as there was no follow-up period, it is impossible to estimate how long the improvements lasted. Thus, studies using short- and long-term effects of treatment programs including DN + M are required in the future.

Results of this single-blind, randomized controlled study showed significant differences in the effects of DN + M compared with CPT program in terms of pain and the number and sensitivity of TPs in patients with chronic low-back pain due to LHNP. Both treatment programs had similar, modest effects on depression. Although the DN + M treatment program was more effective in reducing pain-related fear of movement, its clinical effect was small to medium. DN technique is useful in the management of the low back pain patients with disc herniation because of all these results. Although the total number of subject participated was small, the minimal statistical requirement was satisfied with significance between the study group and control group. Further studies are needed to find the long lasting effect and indication, limitation of the DN to the low back pain after disc herniation. To increase confidence in the conclusions, double-blind, randomized controlled studies are needed.

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