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Research Article

Effectiveness of dry needle therapy in patients with chronic nonspecific low back pain

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ABSTRACT

Background: Low back pain is a prevalent symptom worldwide, with various underlying causes, making differential diagnosis essential. This study aims to investigate the efficacy of dry needling treatment added to exercise in patients with chronic Nonspecific Low Back Pain (NLBP). The McKenzie exercise program was applied to all participants.

Materials and Method: The study comprised sixty participants, randomly allocated into two groups: the dry needling (DNG) and the exercise group (EG). The participants in DNG received a total of six sessions of dry needling treatment, two days a week, to the gluteus medius and quadratus lumborum and multifidus muscles. All participants were given a McKenzie exercise program two sets per day for three weeks.

Results: A significant difference was noted in the VAS-night values of the patients within the DNG before treatment (p: 0.004), and the EG also exhibited a significant difference in the VAS-activity (p: 0.017) and VAS-resting (p: 0.024) values following the treatment. A statistically significant decrease was observed in favor of DNG in VAS-rest, VAS-night, VAS-activity values (p>0.001) in the comparions of the groups.

Conclusions: Dry needling treatment added to exercise therapy in chronic NLBP patients is effective on activity and rest pain severity in the shortterm results. However, no additive efficacy of dry needling treatment was found on the number of trigger points, disability, and depression.

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1. Introduction

Low back pain is a symptom that is very common all over the world, can be caused by many reasons and requires differential diagnosis [1]. It is one of the leading non-fatal pains that cause disability worldwide for the last 30 years. In addition, the most common form of low back pain is NLBP with a prevalence of 85%, where the cause of the pain cannot be revealed [2–5]. It is recommended to investigate whether there is a specific anamnesis and physical examination that can explain the cause of pain in patients having non-specific low back pain. NLBP treatment includes physical therapy modalities such as hot pack and transcutaneous electrical nerve stimulation. In addition, drug treatments such as acetaminophen, non-steroidal anti-inflammatory drugs, tramadol, tricyclic antidepressants are applied in medical treatment. Methods such as spinal manipulation, exercise, massage therapy, acupuncture, dry needling and cognitive behavioral therapies are involved in the management of NLBP [6,7].

Trigger points are palpable tight bands or hypersensitive points within the muscle that cause muscle pain, spasm, or referred pain [8]. Studies have shown that the problem in trigger points is not only a localized muscle problem, but also hypersensitivity in the peripheral and

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central systems, somatic-visceral relationship, deterioration in microcirculation and inflammatory mediator proliferation [9–14]. Trigger points in the multifidus muscles, quadratus lumborum and gluteus medius can cause low back pain [8].

Dry needling, which is applied directly to the myofascial trigger point with acupuncture needles, is a method that has been used quite frequently in the treatment of musculoskeletal pain recently [15]. Dry needling reduces the number and sensitivity of trigger points, resulting in a reduction in local and referred pain. Thus, dry needling improves joint range of motion, decreases muscle activation and peripheral and central hypersensitivity [11].

The aim of this study is to assess the effectiveness of dry needling treatment added to exercise in patients with chronic NLBP.

2. Materials and Method

This study was carried out as a prospective, randomized, accessor blinded between 15/08/2020–15/02/2021 in outpatient clinic. The study included patients who presented to the outpatient clinic with complaints of chronic low back pain characterized as mechanical and were diagnosed with chronic non-specific low back pain (NLBP).

Approval for this study was obtained from the University Clinical Research Ethics Committee (Approval Number: 015-KAEK-43-20-09, Date: 27/07/2020), adhering to the principles outlined in the Helsinki Declaration of 2008. The CONSORT checklist for the study is available in Fig. 1.

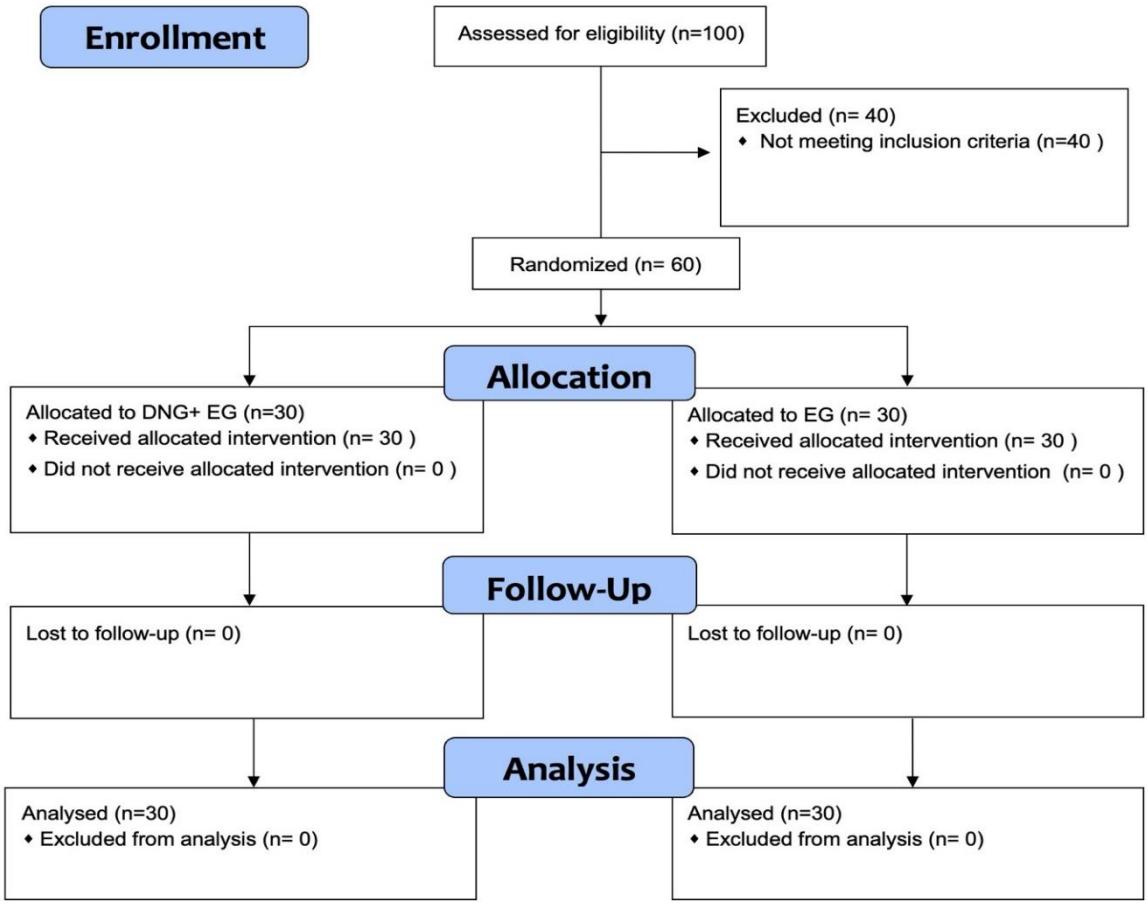

Fig. 1. Consort flow diagram of the study.

The study involved patients aged 20–70 years and diagnosed with NLBP who had not received any treatment in the last three months. Patients with inflammatory low back pain, rheumatological or oncological disease, motor and neurological deficits, spinal fracture or dislocation were excluded. All patients were informed in detail about the study and a voluntary consent form was signed. In all cases with low back pain, physical and neurological examination was performed after a detailed anamnesis. The study incorporated sixty participants, who were randomly allocated into two groups: the dry needling (DNG) and the exercise group (EG). Randomization was done using the closed envelope technique.

2.1. Interventions

After the trigger point was palpated and the skin was cleaned with alcohol, it was applied to the gluteus medius and quadratus lumborum muscles at an angle of 90 degrees to the participants in the dry needling treatment group while the patient was lying on their side.

The multifidus muscle was applied at an angle of 90 degrees with the patient lying face down. In the application, 0.25×0.40 mm and 0.30×0.60 mm thin and stainless steel needles were used (Fig. 2).

The participants underwent a total of six treatment sessions, administered twice a week. Session times were

planned as a minimum of 20 minutes. At the tenth minute of each session, the needle was re-rolled to increase stimulation [8,16].

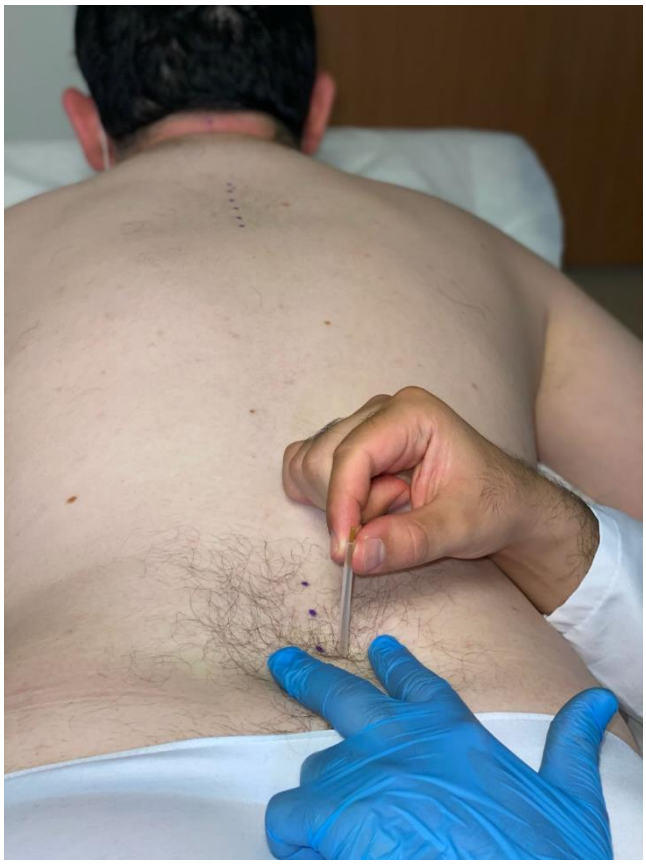

Fig. 2. Dry needling to multifidus muscle.

McKenzie's method was used for the exercise program. This method is defined for patients having low back pain, it is also considered as pain postural syndrome, dysfunction (dysfunction) syndrome and derangement syndrome. The treatment principle in postural syndrome is to correct the posture, in dysfunctional syndrome it is exercise in the direction with dysfunction, and in dysregulation syndrome, exercises depending on the directional preference of the patient are recommended. Thus, it allows the patient to plan individual exercises [17].

The exercise program was applied to all participants. The exercises were given to two sets per day, starting with at least five repetitions of each movement, and ten repetitions after 1 week. The exercises were continued for three weeks.

2.2. Measurements

The primary outcome of this study was to investigate the effectiveness of dry needling in NLBP.

Secondary outcomes included:

- The level of pain relief: Measurement methods.
- Functional improvement: Patient assessment scales.
- Response time to treatment: Initial signs of improvement.
- Complication rates: Side effects and adverse events.

The patients included in the study were evaluated according to age, gender, height, weight, educational status and occupation. In addition, the number of active and latent trigger points on the gluteus medius, quadratus lumborum, and multifidus muscles were determined. [8,18] Patients were evaluated before treatment and at 3 months after treatment [18].

The severity of low back pain was measured through the Visual Analogue Scale (VAS). While evaluating the VAS, patients were prompted to indicate the severity of their pain by marking a point on a 0-10 cm line with: 0, no pain; 10, the most severe pain possible. VAS evaluation was evaluated in three different categories including during physical activity, at night and at rest [19].

The Modified Oswestry Pain Inquiry Form (MOS), which consists of seven questions scored between 0 and 5, was used for functional status assessment. Personal care, lifting, pain severity, walking, sitting, standing, sleeping, pain in travel, social life, and the degree of change in pain were investigated using MOS. According to MOS, 1-10 points are considered as mild functional disability, 11–30 points as moderate functional disability, 31-50 points as severe functional disability [20].

The effect of low back pain on patient psychology was evaluated with the Beck depression scale (BDI). In the BDI, each question has 21 questions with the lowest score being 0 and the highest score being 3. According to the results of the evaluation, depressive symptoms are determined as minimal level between 0 and 9 points, mild level between 10 and 16 points, moderate level between 17 and 29 points, and depressive symptoms between 30 and 63 points [21].

3. Sample Size and Statistical Analyses

The power analysis was conducted using the G.Power–3.1.9.7 program. The calculations were based on an independent t-test, with an effect size of 0.8, alpha of 0.05, power of 0.8, two groups, and one measurement. The total sample size was calculated to be 60. SPSS software package were employed for the statistical analyses. Quantitative variable behaviors were conveyed through variance and central tendency (Mean ± SD). Fisher Exact test was applied in cases of low sample size, and the Chi-square test was utilized to discern differences in categorical variables. The Mann-Whitney U-Test methods were employed to demonstrate behavioral differences in group means when normality and equivalence assumptions were met, and the Student T-Test conditions were not met. Statistical significance was established at $p=0.05$ for all analyses.

4. Results

The mean age of the patients involved in the study was 43.9 ± 13.62 in DNG and 41.23 ± 8.96 in EG. In DNG, 26.7% of the patients were male, 73.3% were female, and in EG, 36.7% were male and 63.3% were male. Regarding gender, age, weight, height, educational status, and occupation, no statistically significant differences were observed between the groups ($p>0.05$) (Table 1).

A significant difference was observed in DNG ($p<0.05$) in VAS-night values before treatment, and in VAS-activity ($p=0.017$), VAS-resting ($p=0.024$) values in EG after treatment (Tables 2 and 3).

A difference was detected in DNG ($p=0.004$) in the VAS-night values of the patients before the treatment. In addition, a significant difference in the VAS-activity values ($p=0.017$), VAS-resting ($p=0.024$) values in the EG was observed after the treatment (Tables 2 and 3). In order to compare the treatment efficacy between the groups, the differences in the 1st month values prior to and following the treatment were compared. A statistically significant decrease favoring the DNG was observed in VAS-rest, VAS-night, and VAS-activity values between the groups ($p>0.001$) (Table 4).

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Table 1. Demographic data.

Parameters	DNG (n:30)	EG (n: 30)	p-value
Height (cm)	165.37 ± 6.7	165.27 ± 6.98	0.845
Weight (kg)	71.67 ± 10.99	70.63 ± 10.34	0.709
Pain duration (month)	11.93 ± 12.92	7.1 ± 5.35	0.099
BMI	26.84 ± 4.53	25.87 ± 3.88	0.377
Age	43.9 ± 13.62	41.23 ± 8.96	0.251
Gender Female/Male	22 / 8	19 /11	0.579
Education status Non-university/University	20/10	18 /12	0.789
Jobs Retired Housewife Employee Officer Student	 2 21 4 2 1	 0 16 9 4 1	0.256

Table 2. Baseline parameters.

Parameters	DNG (n:30)	EG (n:30)	p-value
BDI	29.0 ± 6.87	31.87 ± 10.12	0.204
	28 (13- 43)	30 (10- 50)	
TP-Gluteus Mediıus-Right	16.07 ± 3.08	16.83 ± 4.63	0.952
	16 (12- 25)	16 (12- 32)	
TP-Gluteus Mediıus-Left	15.0 ± 1.6	15.77 ± 2.97	0.729
	15 (11- 20)	15 (12- 26)	
TP-Multifidus-Right	16.13 ± 2.93	16.6 ± 3.17	0.623
	15 (12- 22)	15.5 (12- 22)	
TP- Multifidus-Left	15.2 ± 1.47	14.83 ± 5.01	0.976
	15 (12- 18)	15.5 (0- 26)	
MOS	20.73 ± 7.22	21.7 ± 7.24	0.631
	22 (8- 28)	22 (8- 36)	
TP-Quadratus Lumborum-Right	17.67 ± 7.18	15.23 ± 3.91	0.13
	16 (0- 35)	15 (10- 26)	
TP-Quadratus Lumborum-Left	15.73 ± 2.13	17.07 ± 4.49	0.332
	16 (11- 20)	16 (12- 32)	
VAS-Activity	8 (5- 10)	8 (6- 10)	0.053
VAS-Night	8 (0- 10)	6 (0- 10)	0.004
VAS_Rest	8 (5- 10)	8 (6- 10)	0.121

BDI: Beck Depression Inventory; MOS:Modified Oswestry Pain Inquiry Form;
VAS: Visual Analogue Scale; TP: Trigger Points

Table 3. Comparison of post-treatment values between groups.

Group	DNG (n:30)	EG (n:30)	p-value
BDI	14.37 ± 4.37	16.6 ± 6.99	0.384
	13.5 (5- 24)	14 (5- 32)	
TP-Gluteus Mediıus-Right	23.1 ± 3.01	21.73 ± 2.65	0.272
	22 (20- 32)	22 (16- 26)	
TP-Gluteus Mediıus-Left	21.2 ± 2.01	20.37 ± 2.57	0.402
	21.5 (18- 26)	21.5 (14- 26)	
TP- Multifidus-Right	23.6 ± 3.82	23.3 ± 4.8	0.868
	26 (16- 30)	26 (14- 30)	
TP- Multifidus-Left	21.4 ± 3.11	19.9 ± 6.73	0.441
	22 (16- 30)	21 (0- 33)	
MOS	8.7 ± 4.71	10.8 ± 5.89	0.17
	10 (2- 18)	10 (0- 22)	
TP-Quadratus Lumborum-Right	24.53 ± 7.09	24.23 ± 6.57	0.445
	25.5 (0- 36)	24 (16- 40)	
TP-Quadratus Lumborum-Left	23.87 ± 4.0	23.6 ± 4.42	1
	24 (18- 32)	24 (16- 32)	
VAS-Activity	3 (2- 5)	4 (3- 5)	0.017
VAS-Night	3 (0- 5)	3 (0- 5)	0.377
VAS-Rest	3 (2- 5)	4 (3- 5)	0.024

BDI: Beck Depression Inventory; MOS: Modified Oswestry Pain Inquiry Form;
VAS: Visual Analogue Scale; TP: Trigger Points

Table 4. Comparing the distribution of the difference values of the parameters between the groups.

Group	DNG (n:30)	EG (n:30)	p-value
Diff- BDI	14.63 ± 5.49	15.27 ± 6.64	0.738
	15 (4 - 30)	15 (5 - 40)	
Diff-TP-Gluteus Mediıus-Right	-7.03 ± 2.25	-4.9 ± 6.04	0.127
	-7 (-10 - -4)	-5 (-10 - 16)	
Diff-TP-Gluteus Mediıus-Left	-6.2 ± 1.75	-4.6 ± 4.51	0.357
	-6 (-11 - -4)	-6 (-7 - 12)	
Diff-TP- Multifidus-Right	-7.47 ± 3.25	-6.7 ± 4.69	0.861
	-8 (-12 - -4)	-8 (-12 - 7)	
Diff-TP- Multifidus-Left	-6.2 ± 2.38	-5.07 ± 4.03	0.497
	-7 (-12- -3)	-6.5 (-1 - 6)	
Diff-MOS	12.03 ± 7.43	10.9 ± 6.92	0.543
	12.5 (-2- 26)	10 (-7 - 28)	
Diff-TP-Quadratus Lumborum-Right	-6.87 ± 5.66	-9.0 ± 3.47	0.237
	-7.5 (-16 - 12)	-8 (-14 --5)	
Diff-TP-Quadratus Lumborum-Left	-8.13 ± 2.67	-6.53 ± 6.31	0.597
	-8 (-14- -4)	-8 (-14 -15)	
Diff-VAS-Activity	5 (-7)	4 (3 - 5)	<0.001
Diff-VAS-Night	5 (0-10)	3 (0-5)	<0.001
Diff-VAS-Rest	5 (-7)	4 (3-5)	<0.001

BDI: Beck Depression Inventory; MOS:Modified Oswestry Pain Inquiry Form;
VAS: Visual Analogue; Diff: Difference

5. Discussion

This study evaluates the effectiveness of combining dry needling treatment with the McKenzie exercise program for individuals with chronic NLBP.A notable difference was observed in the VAS-night scores of patients in the dry needling group (DNG) before treatment. Additionally, the exercise group (EG) showed significant differences in VAS-activity and VAS-resting scores after treatment. Comparisons between the groups revealed a statistically significant reduction in VAS-rest, VAS-night, and VAS-activity scores in favor of DNG

According to many studies in the literature, it has been reported that dry needling treatment has a local effect on the taut band with dilatation, and also provides pain inhibition by activating the descending pathways in the central nervous system and plays a role in peripheral segmental inhibition. However, the mechanism of action of dry needling therapy has not yet been fully elucidated [22]. Martín-Corrales et al. [23] evaluated the long-term results of dry needling treatment with an exercise program for low back pain that they applied for 4 weeks in their study where they evaluated the effectiveness of dry needling treatment. In the study of Martín-Corrales et al., forty-six patients were randomly divided into two equal groups and a total of eight sessions of dry needling and sham dry needling were applied twice a week for four weeks. They evaluated the patients before and after treatment. As a result of their study, a decrease in VAS values was observed in both groups, but they could not find a difference between the two groups. In our study, pain measurements decreased in both dry needling and post-exercise evaluations, but when you evaluated the difference before and after treatment, results in favor of dry needling were obtained. Tüzün et al.'s [24] study was conducted with 34 patients having low back pain. In their research, in addition to dry needling, massage therapy and classical physical therapy program (hot pack, TENS, ultrasound and exercise) were compared to the patients for six sessions for three weeks. They found a significant difference in regarding McGill Pain Questionnaire, VAS, Beck Depression Questionnaire and Tampa Kinesiophobia Scale. Another randomized controlled trial in 50 patients with low back pain compared the effectiveness of dry needling and exercise therapy. While no significant results were found in the Oswestry disability index and paraspinal muscle length evaluations performed before and after the treatment, significant results were obtained in the visual analog scale and algometer measurements. A significant difference detected in pre-treatment and post-treatment analyses of the two groups [25]. In a meta-analysis examining the effectiveness of dry needling therapy in low back pain, it was stated that dry needling therapy was superior to laser, physical therapy, trigger point injection and other combined treatments. However, there are uncertainties regarding its efficacy during and after treatment. It was also reported in this meta-analysis that adverse effects may be underreported due to the risk of bias for the safety of dry needling therapy. It has been reported that large-scale and long-term randomized controlled studies with more rigorous methodological data are needed [26]. In a recent study evaluating the effectiveness of electrical dry needling and physical therapy in patients having chronic low back pain, a significant difference was found in both patient groups [27].

Exercise therapy, which is another treatment method, is a series of special movements applied to improve or rehabilitate the body [28]. A meta-analysis of 249 controlled randomized trials reported moderate evidence that exercise is effective in pain and functionality in patients having low back pain compared with no treatment or placebo treatments [22]. Another meta-analysis examining the effects of conservative treatments on low back pain reported high-level evidence for the effectiveness of exercise therapy and stated that exercise programs implemented after low back pain treatment reduced work loss, disability, risk of recurrence of low back pain, and severity of low back pain [29]. Due to differences in the duration, symptoms, causes and origins of low back pain, different results about exercise efficacy emerge in randomized controlled studies. There are opinions that exercise treatments planned by dividing into subgroups are more effective in patients with low back pain [23]. In our study, the McKenzie method, which is a more specific exercise program, was applied [19,20] According to the results of a study examining the efficacy of McKenzie exercises and manual therapy in patients suffering from chronic low back pain, a significant difference was found in patients who underwent the McKenzi method. In addition, in a meta-analysis of 5578 patients and 89 studies in which exercise types were analyzed in patients suffering from chronic low back pain, low-level evidence was reported that the Mc-Kenzie method was more effective than other types of exercise on pain [29]. The most important limitation of this valuable randomized accessor blinded study comparing dry needling with a specific exercise therapy without dry needling in patients having chronic low back pain is the absence of an untreated control group. Another limitation is the lack of long-term evaluation. However, most studies in the literature evaluated short-term (three-month) results. It is undeniable that studies with a longer duration and large population should be added to evaluate the efficacy of treatment.

6. Conclusions

According to the results of this study, dry needling treatment added to exercise therapy in chronic NLBP patients, is effective on activity and rest pain severity in the short term results. However, no additive efficacy of dry needling treatment was found on the number of trigger points, disability, and depression.

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Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this manuscript.

Author Contributions

All of the authors made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; were involved in drafting the manuscript or revising it critically for important intellectual content; and gave final approval of the version to be published.

Data Availability

The datasets created and/or analyzed during the current study are not publicly available, but are available from the corresponding author upon reasonable request.

Ethics Approval and Consent to Participate

This study was approved by the ethics committee of University Clinical Research Ethics Committee (Approval Number: 015-KAEK-43-20-09; Date: 27/07/2020). Written informed consent was obtained from the participants. All methods were performed in accordance with relevant guidelines and regulations.

REFERENCES

1. Bardin LD, King P, Maher CG. Diagnostic triage for low back pain: a practical approach for primary care. *Med J Aust*. **2017**;206(6):268-73.
2. Spencer LC, Abate D, Brady OJ, Cooper C, Davey G, Claro RM, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990-2017: A systematic analysis for the global burden of disease study 2017. *Lancet*. **2018**;392(10159):1789-858.
3. Kim LH, Vail D, Azad TD, Bentley JP, Zhang Y, Ho AL, et al. Expenditures and health care utilization among adults with newly diagnosed low back and lower extremity pain. *JAMA Netw Open*. **2019**;2(5):e193676.
4. Hartvigsen J, Hancock MJ, Kongsted A, Louw Q, Ferreira ML, Genevay S, et al. What low back pain is and why we need to pay attention. *Lancet*. **2018**;391(10137):2356-67.
5. Koch C, Hänsel F. Non-specific low back pain and postural control during quiet standing-A systematic review. *Front Psychol*. **2019**;10:586.
6. Chou R, Deyo R, Friedly J, Skelly A, Hashimoto R, Weimer M, et al. Nonpharmacologic Therapies for Low Back Pain: A Systematic Review for an American College of Physicians Clinical Practice Guideline. *Ann Intern Med*. **2017**;166(7):493-505.
7. Chou R, Deyo R, Friedly J, Skelly A, Weimer M, Fu R, Dana T, et al. Systemic Pharmacologic Therapies for Low Back Pain: A Systematic Review for an American College of Physicians Clinical Practice Guideline. *Ann Intern Med*. **2017**;166(7):480-92.
8. Simons DG, Travell JG, Simons LS. Travell & Simons' Myofascial Pain and Dysfunction: Upper Half of Body. 1st ed. Philadelphia-Tokyo: Lippincott Williams & Wilkins; **1999**.
9. Shah JP, Thaker N, Heimur J, Aredo JV, Sikdar S, Gerber L. Myofascial trigger points then and now: a historical and scientific perspective. *PM&R*. **2015**;7(7):746-61.
10. Fernández-De-Las-Peñas C, Dommerholt J. Myofascial trigger points: peripheral or central phenomenon? *Curr Rheumatol Rep*. **2014**;16:1-6.
11. Dommerholt J. Dry needling-peripheral and central considerations. *J Man Manip Ther*. **2011**;19(4):223-7.
12. Aredo JV, Heyrana KJ, Karp BI, Jay PS, Pamela S, et al. Relating chronic pelvic pain and endometriosis to signs of sensitization and myofascial pain and dysfunction. *Semin Reprod Med*. **2017**;35(1):88-97.
13. Cagnie B, Dhooge F, Van Akeleyen J, Cools A, Cambier D, Danneels L. Changes in microcirculation of the trapezius muscle during a prolonged computer task. *Eur J Appl Physiol*. **2012**;112:3305-12.
14. Flodgren GM, Crenshaw A, Gref M, Fahlström M. Changes in interstitial noradrenaline, trapezius muscle activity and oxygen saturation during low-load work and recovery. *Eur J Appl Physiol*. **2009**;107:31-42.
15. Gunn CC, Wall PD. The Gunn Approach to the Treatment of Chronic Pain: Intramuscular Stimulation for Myofascial Pain of Radiculopathic Origin. 2st ed. London: Churchill Livingstone; **1996**.
16. Dunning J, Butts R, Mourad F, Young I, Flannagan S, Perreault T. Dry needling: a literature review with implications for clinical practice guidelines. *Phys Ther Rev*. **2014**;19(4):252-65.
17. Téllez-García M, de-la-Llave-Rincón AI, Salom-Moreno J, Palacios-Ceña M, Ortega-Santiago R, Fernández-de-Las-Peñas C. Neuroscience education in addition to trigger point dry needling for the management of patients with mechanical chronic low back pain: a preliminary clinical trial. *J Bodyw Mov Ther*. **2015**;19(3):464-72.
18. Hou C-R, Tsai L-C, Cheng K-F, Chung K-C, Hong C-Z. Immediate effects of various physical therapeutic modalities on cervical myofascial pain and trigger-point sensitivity. *Arch Phys Med Rehabil*. **2002**;83(10):1406-14.
19. Melzack R. The short-form McGill Pain Questionnaire. *Pain*. **1987**;30(2):191-7.
20. Yakut E, Düger T, Oksüz C, Yörükan S, Ureten K, Turan D, et al. Validation of the Turkish version of the Oswestry Disability Index for patients with low back pain. *Spine*. **2004**;29(5):581-5.
21. Fernández-Carnero J, Gilarranz-de-Frutos L, León-Hernández JV, Pecos-Martin D, Alguacil-Diego I, Gallego-Izquierdo T,et al. Effectiveness of different deep dry needling dosages in the treatment of patients with cervical myofascial pain: a pilot RCT. *Am J Phys Med Rehabil*. **2017**;96(10):726-33.
22. Lázaro-Navas I, Lorenzo-Sánchez-Aguilera C, Pecos-Martín D, Jiménez-Rejano JJ, Navarro-Santana MJ, Fernández-Carnero J, et al. Immediate effects of dry needling on the autonomic nervous system and mechanical hyperalgesia: A randomized controlled trial. *Int J Environ Res Public Health*. **2021**;18(11):6018.
23. Corrales MC, Bautista IV, Mera JEM, Matías F, Ochoa AA, Izquierdo TG, et al. Benefits of adding gluteal dry needling to a four-week physical exercise program in a chronic low back pain population. a randomized clinical trial. *Pain Med*. **2020**;21(11):2948-57.
24. Tüzün EH, Gildir S, Angın E, Tecer BH, Dana KÖ, Malkoç M. Effectiveness of dry needling versus a classical physiotherapy program in patients with chronic low-back pain: a single-blind, randomized, controlled trial. *J Phys Ther Sci*. **2017**;29(9):1502-9.
25. Zia A, Sajjad AG, Hafeez A, Altaf S, Khan N, Malik RJ. Effectiveness of dry needling on the lumbar paraspinal muscle in patients with mechanical back pain: A randomized controlled trial. *J Med Sci*. **2021**;29(04):277-81.
26. Hu H-T, Gao H, Ma R-J, Zhao X-F, Tian H-F, Li L. Is dry needling effective for low back pain?: A systematic review and PRISMA-compliant meta-analysis. *Medicine*. **2018**;97(26).
27. Palomo LIC, Martínez GE, Soler AE, Sánchez CAM, Sánchez FM, López GH. Electrical dry needling versus conventional physiotherapy in the treatment of active and latent myofascial trigger points in patients with nonspecific chronic low back pain. *Trials*. **2022**;23(1):238.
28. Grubišić F. Is Exercise beneficial in patients with low back pain?-A cochrane review summary with commentary. *J Rehabil Med*. **2022**;54:341-50.
29. Owen PJ, Miller CT, Mundell NL, Verswijveren SJJM, Tagliaferri SD, Brisby H, et al. Which specific modes of exercise training are most effective for treating low back pain? Network meta-analysis. *Br J Sports Med*. **2020**;54(21):1279-87.