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Does Dry Needling Contribute to Conventional Treatment on Nocturnal Calf Cramps? A Randomized Controlled Study

Nokturnal Bacak Kramplarının Tedavisinde Kuru İğnelemenin Etkisi: Randomize Kontrollü Bir Çalışma

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Abstract

Objective: Nocturnal calf cramps (NCC) are painful contractions of the lower limbs at night, most commonly in the calf muscles. Many trials demonstrated that dry needling (DN) effectively treats various musculoskeletal conditions. This study aimed to examine the effectiveness of DN in treating NCC.

Materials and Methods: Forty-two patients were randomized into two groups. The first group received stretching exercises, and the second group received stretching exercises and DN to trigger points in the gastrocnemius muscle. The cramp duration (CD), the number of cramps (NOC), cramp intensity (CI), algometric measurements of pressure pain threshold (PPT), and Pittsburgh sleep quality index (PSQI) values were recorded before, after, and three months after treatment.

Results: There was no difference between the groups regarding the parameters investigated before intervention. Investigated before intervention. Both groups had a significant decrease in NOC, CI, and PSQI scores and an increase in PPT values after treatment and the third month (p<0.001). At post-treatment measures, between the groups, there was a significant decrease in CI (p<0.001) and PSQI (p=0.002), and increase in PPT (p=0.001) in the DN group, and no difference in NOC (p=0.545) and CD (p=0.140). At the 3-month follow-up, between the groups, there was a significant decrease in NOC (p=0.016), CI (p<0.001), and increase in PPT (p=0.003) in the DN group and no difference in PSQI (p=0.229) and CD (p=0.175).

Conclusion: DN in the treatment of NCC in the short and medium term is an effective method of reducing pain, decreasing the duration and intensity of cramps, and improving sleep quality.

Keywords: Nocturnal calf cramps, dry needling, trigger points, gastrocnemius, sleep quality

Öz

Amaç: Nokturnal bacak krampları (NBK), geceleri alt ekstremitelerde, en sık baldır kaslarında görülen ağrılı kasılmalardır. Literatürde kuru iğneleme (Kİ) tedavisinin çeşitli kas-iskelet sistemi ağrılarında etkinliğini gösteren çalışmalar mevcuttur. Bu çalışma, Kİ'nin NBK tedavisindeki etkinliğini incelemeyi amaçlamıştır.

Gereç ve Yöntem: Kırk iki hasta iki gruba randomize edildi. Birinci gruba germe egzersizleri verilirken, ikinci gruba ise germe egzersizleri ile birlikte gastroknemius kasındaki tetik noktalara Kİ uygulandı. Kramp süresi (KS), kramp sayısı (KSa), kramp şiddeti (KŞ), algometrik ağrı eşiği ölçümleri (AAÖ) ve Pittsburgh uyku kalitesi indeksi (PSQI) değerleri tedaviden önce, sonra ve üç ay sonra kaydedildi.

Bulgular: Çalışma öncesi parametreler açısından gruplar arasında fark yoktu. İki grupta da tedavi sonrasında ve üçüncü ayda KS, KŞ ve PSQI skorlarında anlamlı bir düşüş ve AAÖ değerlerinde artış görüldü (p<0,001). Tedavi sonrası ölçümlerde, gruplar arasında, Kİ grubunda KŞ (p<0,001) ve PSQI (p=0,002) değerlerinde anlamlı düşüş ve AAÖ (p=0,001) değerinde artış görülürken, KSa (p=0,545) ve KS (p=0,140) değerlerinde fark bulunmadı. Üç aylık takipte, gruplar arasında, Kİ grubunda KS (p=0,016), KŞ (p<0,001) ve AAÖ'de (p=0,003) anlamlı bir düşüş görülürken, PSQI (p=0,229) ve KS'de (p=0,175) fark görülmedi.

Sonuç: Kİ, NBK tedavisinde kısa ve orta vadede ağrıyı, krampların süresini ve şiddetini azaltmada ve uyku kalitesini iyileştirmede etkili bir yöntem olarak karşımıza çıkmaktadır.

Anahtar kelimeler: Nokturnal bacak krampları, kuru iğneleme, tetik nokta, gastroknemius, uyku kalitesi

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Introduction

Nocturnal calf cramps (NCC) are painful contractions of the lower limbs at night, most commonly in the calf muscles. Cramps can last anywhere between a few seconds and several minutes. Although cramps are usually brief, pain and tenderness can last for hours (1). Fifty to sixty percent of adults report experiencing NCC. They are slightly more prevalent among women, and their incidence rises with age (2). The condition has a negative impact on patients' sleep quality in particular, as well as their overall quality of life (3). Although most cases are idiopathic, secondary NCC can occur due to various neurologic, endocrine, metabolic, vascular, drug-induced, and toxic causes. Although treatment of secondary causes, pharmacologic and nonpharmacologic therapies, and minimally invasive procedures such as botulinum toxin and lidocaine injection have been used, a treatment method with a consistent efficacy and safety profile is not yet established (4).

Myofascial trigger points (MTrP) are palpable nodules in muscle tissue that are hyperirritable and hypersensitive (5). MTrPs can cause muscle cramps in young and older adults without any other underlying cause (6). According to the literature, MTrPs, particularly those of the gastrocnemius muscle, are one of the causes of NCC (7). Injection therapy for MTrPs was described by Travell and Simons, who were the first to identify this entity. Injections of the gastrocnemius muscle's MTrPs have been shown to improve pain and sleep quality (1).

Based on the scientific principles of western medicine, dry needling (DN) therapy, which uses acupuncture needles to treat MTrPs, is simple to learn, cost-effective, minimally invasive, and low-risk treatment. Even though DN for treating musculoskeletal pain has been empirically developed, studies have shown no difference between DN and the injection of pharmacological agents in treating MTrPs (8). Randomized controlled trials and meta-analyses have demonstrated that DN effectively treats various musculoskeletal conditions (9-12).

Regarding all of this information, this study aimed to examine the effectiveness of DN in the treatment of NCC.

Materials and Methods

In this prospective, randomized, single-blinded, and controlled study, patients aged between 20-50 who described experiencing NCC at least once a week were included after Biruni University's Clinical Research Ethics Committee approval with the decision number 2015-KAEK-42-20-11 (date: 27.07.2020). The study took place between December 2019 and April 2020. All participants were informed about the study and signed an informed consent form. Eligible participants were required to have experienced cramps for at least six months, have no history of physical activity before cramps, and have MTrP in the gastrocnemius muscle. Gastrocnemius muscle MTrPs were diagnosed as criteria described by Travell and Simons, witch as follows; hypersensitive nodules within a taut band in the gastrocnemius muscle, typical reflected pain pattern, and twitch response with snapping palpation of the trigger point. The MTrP assessment was conducted by a researcher (F.B.) with at least five years of experience in this field. Patients with electrolyte or hormonal imbalance due to any known disease, congenital musculoskeletal disease, inability to communicate, or cognitive dysfunction due to any psychiatric or central nervous system disease were excluded from the study. Patients with a primary diagnosis of insomnia, bleeding diathesis or cancer, recent vertebral compression fracture, a history of sleeping pills, anticoagulants or sedative medication use for one month or longer, history of invasive therapy for MTrPs or to gastrocnemius muscle in past six months and patients who refused to give consent were also excluded.

The demographic data of the patients participating in the study were recorded, and the patients were randomized into two groups by drawing a random assignment from sealed envelopes. Flowchart of the study is presented in Figure 1. The first group received stretching exercises, and the second group received stretching exercises and DN to MTrPs in the gastrocnemius muscle. The cramp duration (CD), the number of cramps (NOC) experienced during one week, cramp intensity (CI) according to visual analog scale values, algometric measurements of pressure pain threshold (PPT), and Pittsburg sleep quality index (PSQI) values were recorded before, after and three months after treatment by a blinded researcher.

To evaluate patients' PPT levels, algometric measurements were performed before, after, and three months after treatment. The evaluation was repeated thrice from the most sensitive point on the taut bands determined by palpation. The mean of three applications was taken, and the assessment was completed.

The sleep quality of the patients was evaluated with the PSQI before, after, and three months after treatment. This scale, which assesses sleep quality and sleep disturbances in the past month, consists of seven components. Each component is evaluated between 0 and 3 points. The maximum score is 21; anything above 5 on the full scale indicates poor sleep quality (13).

Patients in both groups were given a standardized stretching exercise program for the gastrocnemius muscle. The exercises were described to the patients by a physiotherapist with 10 years of experience in the field. The patients are told to start by standing straight up with their backs to a wall that is at least an arm's length away. Then they are instructed to advance on one leg and place their hands on the wall. The patients are instructed to straighten their knees while keeping their heels flat on the floor after placing their hands on the wall. In order to feel a stretch down the back of their calves, the patients then leaned their bodies toward the wall (14). Patients were asked to perform the exercise at least twice daily, 3 stretches per leg, with each stretch lasting at least 60 seconds (15). Patients were given an exercise sheet explaining the exercise and including visuals. Patients were informed that the exercise should be performed for three weeks.

DN was performed by a researcher (F.B.) with at least five years of experience in the field. The patient was placed in the prone

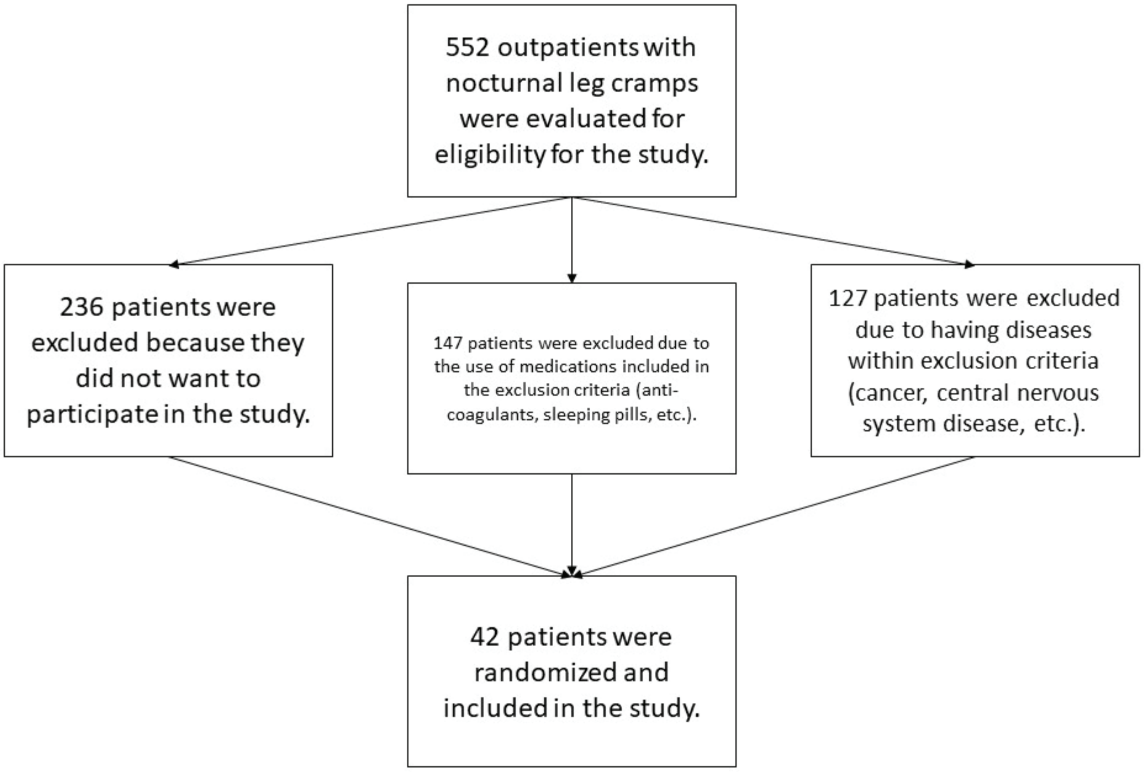

Figure 1. Flowchart of the study

position to apply DN to the medial head of the gastrocnemius muscle, and the patient's knee was slightly flexed. Pincer palpation technique was used. Needling was performed with the penetration angle of the needle slightly medialized, and care was taken to avoid needle penetration to the midline (Figure 2a). For needling of the lateral head of the gastrocnemius muscle, the patient was placed in a prone position, and the knee was slightly flexed. Care was taken to avoid needle penetration to the midline. Needling was performed with the penetration angle of the needle slightly lateralized (Figure 2b) (16). 0.30x50 mm acupuncture needles were used. The treatment was applied for six sessions, two sessions per week (17). There were no major adverse events after the procedures except minor side effects such as bleeding, tenderness and pain during needling.

Statistical Analysis

Mean, standard deviation, median, minimum, maximum value frequency, and percentage were used for descriptive statistics. The distribution of variables was checked with the Kolmogorov-Smirnov test. Independent samples t-test and Mann-Whitney U test were used to compare quantitative data. The Wilcoxon test was used for the repeated measurement analysis. The chi-square test was used for the correlation analysis. SPSS 27.0 (IBM Corp., Armonk, NY) was used for statistical analyses.

Results

In both groups, there was no significant difference between the patient's age, gender, body mass index, and occupational data.

Figure 2. Application of dry needling therapy to the gastrocnemius muscle; **a**) medial head, **b**) lateral head

Demographic data of the patients are given in Table 1.

There was no difference between the groups regarding CD before treatment (p=0.939). In the exercise therapy group, a statistically significant decrease was found in CDs after treatment compared to pretreatment (p<0.001) and at three-month follow-up (p<0.001). In the DN group, a statistically significant decrease in CD was found after treatment compared to the pretreatment period (p<0.001) at the three-month follow-up (p<0.001). No significant difference was found between the two groups in post-treatment measurements (p=0.140) and at the three-month follow-up (p=0.175) (Figure 3).

Before treatment, there was no statistically significant difference between the groups in the NOC (p=0.680). In the exercise therapy group, there was a statistically significant decrease in the

Table 1. Demographic data of the patients

		Exercise			Exercise + dry needling			
		Mean ± SD /n-%		Median	Mean ± SD /n-%		Median	p-value
Age		37.0	±8.2	36.0	37.6	±8.1	39.0	0.822^{t}
Gender	Male	13	61.9%		15	71.4%		0.513$^{x^2}$
	Female	8	38.1%		6	28.6%		
BMI		23.4	±1.1	23.7	23.7	±0.8	24.0	0.330^{m}
Occupation	Housewife	5	23.8%		4	19.0%		0.707$^{x^2}$
	Student	7	33.3%		11	52.4%		0.212$^{x^2}$
	Officer	8	38.1%		6	28.6%		0.513$^{x^2}$
	Retired	1	4.8%		0	0.0%		1.000$^{x^2}$

^{t}Independent samples t-test, ^{m}Mann-Whitney U test, $^{x^2}$Chi-square (Fisher test)
SD: Standard deviation, BMI: Body mass index

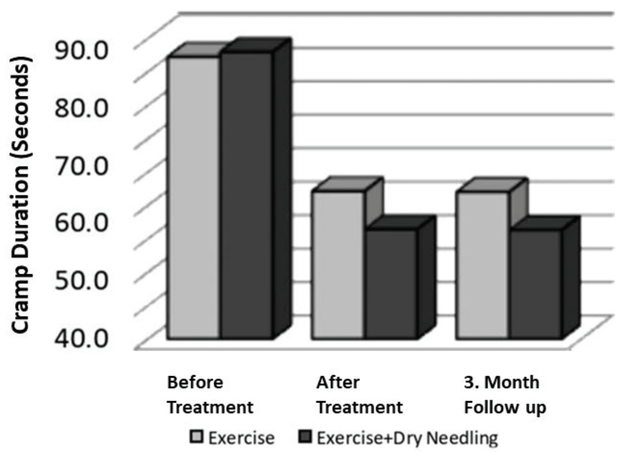

Figure 3. Change in cramp duration between groups after treatment and at the three-month follow-up

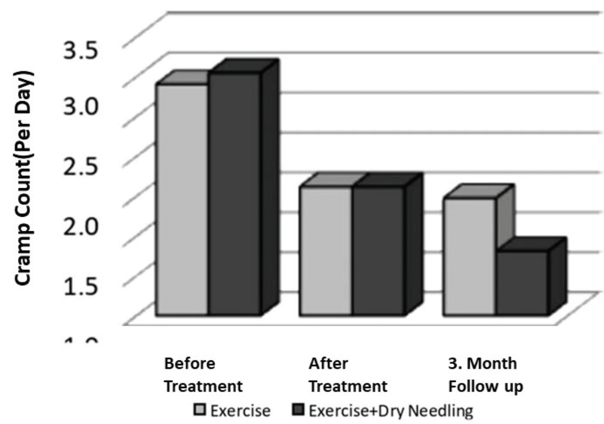

Figure 4. Change in number of cramps between groups after treatment and at the three-month follow-up

NOC after treatment (p<0.001) and at the three-month follow-up (p<0.001). In the DN group, a statistically significant decrease was found in the NOC after treatment (p<0.001) and at three-month follow-up (p<0.001). A comparison between groups revealed no significant difference between post-treatment measurements (p=0.545). At the three-month follow-up, there was a statistically significant decrease in the NOC in the DN group (p=0.016) (Figure 4).

There was no significant difference in CI between the groups before treatment (p=0.07). In the exercise group, a statistically significant decrease in CI was found after treatment compared to pretreatment (p<0.001) and at three-month follow-up (p<0.001). In the DN group, a statistically significant decrease in CI was found after treatment compared to the pretreatment period (p<0.001) and at the three-month follow-up (p<0.001). In the comparison between groups, there was a significant decrease in CI in the DN group after treatment (p<0.001) and at the three-month follow-up (p<0.001) (Figure 5).

PPT values prior to treatment did not significantly differ between the groups (p=1.00). In the exercise group, a statistically significant increase was found in PPT values after treatment compared to pretreatment (p<0.001) and at three-month follow-up (p<0.001). In the DN group, a statistically significant increase was found in PPT values after treatment compared to before treatment (p<0.001) and at the three-month follow-up (p<0.001). In comparison between groups, there was a significant increase in PPT values in the DN group after treatment (p=0.001) and at the three-month follow-up (p=0.003) (Figure 6).

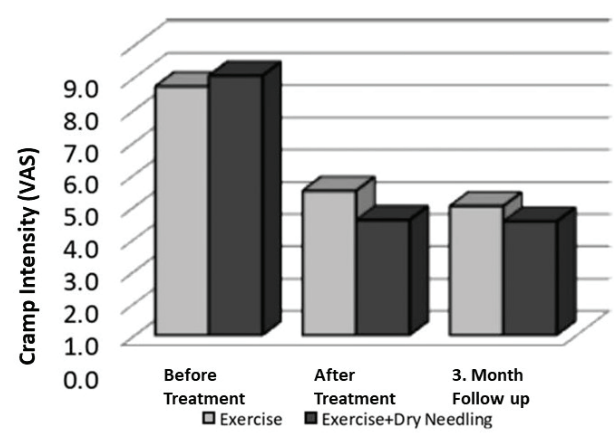

Figure 5. Change in cramp intensity between groups after treatment and at the three-month follow-up
VAS: Visual analogue scale

Prior to treatment, there was no statistically significant difference between the groups in the PSQI scores (p=0.07). In the exercise therapy group, there was a significant decrease in the PSQI scores after treatment compared to pretreatment (p<0.001) and at the three-month follow-up (p<0.001). In the DN group, there was a significant decrease in the PSQI scores after treatment compared to pretreatment (p<0.001) and at the three-month follow-up (p<0.001). In the comparison between groups, there was a significant decrease in the PSQI scores in the group receiving DN treatment (p=0.002). At the three-month follow-up, there was no significant difference between groups (p=0.229). The decrease in PSQI scores after treatment and at the three-month follow-up was significantly greater than exercise alone (p=0.003) (Figure 7).

Discussion

NCC is a common, distressing problem that occurs at night, particularly in the elderly, and have a significant deleterious

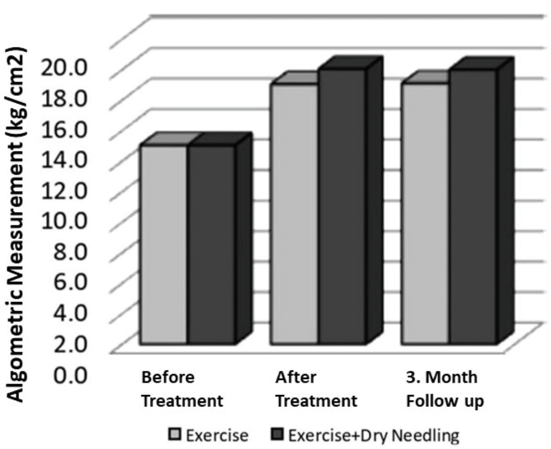

Figure 6. Change in algometric measurements (PPT) between groups after treatment and at the three-month follow-up
PPT: Pain pressure threshold

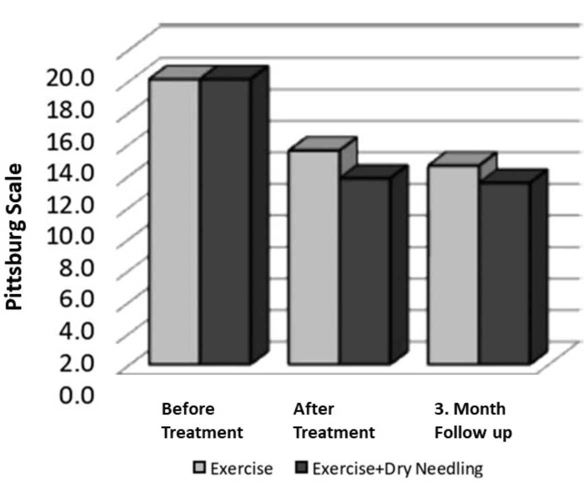

Figure 7. Change in the Pittsburg scale between groups after treatment and at the three-month follow-up

effect on sleep and quality of life (4). Numerous therapies have been used despite their subpar performance and the prevalence of side effects, such as the usage of magnesium and quinine. The Food and Drug Administration has strongly cautioned against using quinine to treat NCC owing to the possibility of adverse effects (18). Despite the promise of muscle stretching and exercise as first-line therapy for NCC, poor compliance with this approach is a persistent problem, especially in treating older patients afflicted with the syndrome (19). DN is a practical, inexpensive, and medication-free treatment for NCC. Even though the relationship between MTrP and NCC has been demonstrated in the literature, there are limited studies concerning the use of DN as a treatment for NCC (17). This study aimed to investigate the efficacy of DN in the treatment of NCC. The results of this study showed that DN added to exercise therapy was superior to exercise therapy alone in terms of the NOC, CI, raising PPT, and sleep quality.

There are various views in the literature regarding the therapeutic effects of DN. According to an article by Abbaszadeh-Amirdehi et al. (20), DN reduces the irritability of the motor terminal plate and the sympathetic nervous system's hyperactivity in active MTrPs. An article that Dommerholt (21) published ascribed the mechanical, neurophysiologic, and chemical actions of DN to its therapeutic benefits. Similar to this article, Ziaeifar et al. (22) reported that DN treatment had a better impact on pain threshold levels than the MTrP compression approach. According to Ziaeifar et al. (22), the application of DN generated this result via increasing blood flow and oxygen levels in the area of MTrP as well as higher chemical and mechanical change. Tesch et al. (23) reported that the pressure pain threshold is closely related to electrical activity levels in the MTrP. Animal experiments have shown that DN treatment inhibits spontaneous electrical activity in MTrPs. Similar to the above, the decrease in algogenic and pro-inflammatory compounds (neuropeptides, catecholamines, and pro-inflammatory cytokines) in active MTrPs after twitch responses during DN can contribute to alleviating pain and raising PPT. It has been demonstrated that the inactivation of active MTrPs by DN also involves supraspinal pain control mechanisms in both antinociception and pain alleviation, independent of peripheral processes. Therefore, the therapeutic effects of DN on active MTrPs may include both peripheral and central processes (23).

Various views have been put forward in the literature about the origin of muscle cramps. Although some researchers report that the source of cramps are motor nerve discharges that occur spontaneously, hyperactivity of the motor unit brought on by disinhibition at the level of the spine, and aberrant excitability of the terminal branches of the motor axons (24,25); a study by Roeleveld et al. (26), which investigated the temporal and spatial surface electromyography characteristics of cramps, indicated that cramps originate at levels close to the muscle fibers or from the muscle fiber itself. Ge et al. (6) investigated the connection between latent MTrPs and nociceptive stimulation that causes muscle cramps. They concluded that the relationship between

MTrPs and muscle cramps might be caused by increased nociceptive sensitivity in MTrPs; the researchers advised that MTrPs should be considered when treating muscle cramps (6). According to the research findings by Prateepavanich et al. (7), injection therapy to MTrPs of the gastrocnemius muscle was beneficial in reducing the symptoms of NCC. Furthermore, parallel to this study's findings, Kim et al. (1) reported that in patients with NCC, MTrP injection into the gastrocnemius muscle relieves pain and minimizes the degree of sleeplessness.

The phrase "sleep quality" includes factors such as total sleep time, sleep onset delay, fragmentation level, total waking time, sleep efficiency, and sporadical sleep-disrupting events such as spontaneous arousals or apnea. The highly regarded PSQI is an indicator of overall sleep quality, relying on respondents' backdated evaluations (past month) of several sleep measures, including sleep latency, length, habitual sleep quality, sleep disruption, use of prescription sleeping medications, and daytime dysfunction (27). Generally, painful conditions and sleep disruption may interact, and nocturnal pain episodes, in particular, have been shown to alter the sleep cycle, bring on stages of arousal, and even bring on awakenings (1). Lautenbacher et al. (28) found that improved pain alleviation may encourage more restorative sleep, which in turn helps to reduce long-term pain, in their study on the link between sleep deprivation and pain perception. Hawke et al. (3) reported that NCC is significantly linked to worse sleep quality and lower physical components of health-related quality of life. They also stated that the harmful influence of NCC on sleep quality might be a significant factor in explaining how they affect health-related quality of life (3). DN's advantage over exercise alone in terms of sleep quality and algometric measures may be explained by its superiority in treating MTrPs compared to exercise therapy alone, thereby improving sleep quality.

Study Limitations

The study has several limitations. First, the study investigated and treated only MTrPs in the gastrocnemius muscle. More accurate and universal results could be obtained with more extensive and comprehensive studies, including MTrPs in other lower extremity muscles. Again, although the efficacy of DN has been observed, better results might be achieved with more extensive populations. Long-term follow-up of the effectiveness should be investigated. Studies with larger populations are needed, including other drug treatments such as gabapentin and other injection methods such as botulinum toxin therapy.

Conclusion

In conclusion, this study's results suggest that using DN in the treatment of NCC in the short and medium term is an effective method of reducing pain, decreasing the duration and intensity of cramps, and improving sleep quality.

Ethics

Ethics Committee Approval: Ethical approval to report this case was obtained from Biruni University Clinical Research Ethics Committee (decision number: 2015-KAEK-42-20-11, date: 27.07.2020).

Informed Consent: Written informed consent was obtained from the patient(s) for their anonymized information to be published in this article.

Peer-review: Internally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: M.H.T., F.B., Concept: F.B., Design: M.H.T., Data Collection or Processing: M.B., Analysis or Interpretation: Y.Ç., Literature Search: F.B., Writing: M.H.T.

Conflict of Interest: No conflict of interest was declared by the authors.

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