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# The Effect of Physical Therapy on Pain and Quality of Life in Patients with Chronic Neck Pain: A Prospective Randomized Controlled Study

Kronik Boyun Ağrılı Hastalarda Fizik Tedavinin Klinik Durum ve Yaşam Kalitesi Üzerine Etkisi: Prospektif Randomize Kontrollü Bir Çalışma

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***ABSTRACT***

*OBJECTIVE: This study aimed to evaluate the effectiveness of physical therapy (PT) on pain, functional status, depressive symptoms, and quality of life in patients with chronic neck pain (CNP).*

*MATERIAL AND METHODS: The study was designed as a randomized controlled trial involving outpatient clinic patients at a tertiary care hospital and included 80 patients with CNP. The patients were randomly assigned to two groups. The treatment group (TG) received ten sessions of conventional PT (hot pack, ultrasound, and Transcutaneous Electrical Nerve Stimulation) and home-based exercises. The control group (CG) was only given a home-based exercise program. Both groups were informed about correct posture and daily life activities. Patients were assessed pre-treatment, at the end of treatment (2 weeks), and 12 weeks after the treatment using the Visual Analogue Scale (VAS pain), cervical range of motion (ROM), Beck Depression Index (BDI), and short form-36 (SF-36).*

*RESULTS: Both groups showed significant improvements in VAS pain scores, ROM, SF-36, and BDI scores post-treatment ($p<0.01$ for all). At the three-month follow-up, the improvements in the TG continued, while the CG showed a regression compared to the levels observed two weeks after the treatment. The degree of improvement in VAS pain and BDI scores in the TG was significantly greater than in the CG ($p<0.01$).*

*CONCLUSION: In the treatment of CNP, adding PT modalities to the home exercise resulted in greater reductions in pain, disability, and depressive symptoms, as well as improvements in quality of life compared to home exercise alone. It's appropriate to recommend PT modalities as a beneficial treatment for CNP.*

*Keywords: Chronic neck pain, quality of life, exercise, physical therapy modalities*

***ÖZ***

*AMAÇ: Bu çalışmanın amacı, kronik boyun ağrısı (KBA) olan hastalarda fizik tedavinin (FT) ağrı, fonksiyonel durum, depresif semptomlar ve yaşam kalitesi üzerindeki etkinliğini değerlendirmektir.*

*GEREÇ ve YÖNTEM: Çalışma, 3. basamak hastane tabanlı, randomize kontrollü olarak tasarlanmıştır. KBA olan 80 hasta iki gruba randomize edilmiştir. Tedavi grubuna (TG), on seans konvansiyonel FT (sıcak paket, ultrason ve Transkutanöz Elektriksel Sinir Stimülasyonu) ve ev egzersiz programı verilmiştir. Kontrol grubuna (KG) ise yalnızca ev egzersiz programı verilmiştir. Her iki gruba da doğru duruş, günlük yaşam eğitimi verilmiştir. Hastalar, tedavi öncesi, tedavi sonunda (2 hafta) ve tedaviden 12 hafta sonra Vizüel Analog Skoru (VAS ağrı), servikal eklem hareket açıklığı (EHA), Beck Depresyon Ölçeği (BDÖ) ve yaşam kalitesi kısa form-36 (SF-36) kullanılarak değerlendirilmiştir.*

*BULGULAR: Her iki grup da tedavi sonrası VAS ağrı skorları, servikal EHA, SF-36 ve BDÖ skorlarında anlamlı iyileşmeler göstermiştir (tüm parametrelerde, $p<0,01$). Üç aylık takipte, TG'deki iyileşmeler devam ederken; KG'de tedavi sonrası ikinci haftada gözlemlenen düzeylerde gerileme izlenmiştir. TG'deki VAS ağrı ve BDÖ skorlarındaki iyileşme derecesi, KG'ye göre anlamlı derecede daha fazladır (her biri için, $p<0,01$).*

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*SONUÇ: Kronik boyun ağrısı tedavisinde, ev egzersiz programına FT modalitelerinin eklenmesi, yalnızca ev egzersiz programına göre ağrı, engellilik ve depresif semptomlarda daha büyük azalmalar ile yaşam kalitesinde daha fazla iyileşmeler sağlamıştır. Kronik boyun ağrısında FT modalitelerinin faydalı bir tedavi olarak önerilmesi uygun gözükmektedir.*

*Anahtar Kelimeler: Kronik boyun ağrısı, yaşam kalitesi, egzersiz, fizik tedavi modaliteleri*

**INTRODUCTION**

Chronic neck pain (CNP) is a prevalent and debilitating musculoskeletal condition that affects 15-20% of the adult population and it is more commonly observed in women than in men (1,2). It is characterized by persistent pain and discomfort in the posterior and lateral aspect of the neck region, often resulting in functional limitations and decreased quality of life. CNP can have various etiologies, including mechanical, degenerative, and postural factors, and it is associated with significant healthcare costs and socioeconomic burdens (3). The management of CNP typically involves a multidisciplinary approach, aiming to alleviate pain, improve function, and enhance patients' overall well-being. Common conservative treatment options include patient education, medical interventions (paracetamol, non-steroidal anti-inflammatory drugs (NSAIDs), opioids, muscle relaxants, etc), exercise therapy, injections, and physical therapy (PT) modalities (3-5). While patient education and medical interventions, such as analgesics and muscle relaxants, have been extensively studied and are widely implemented, the efficacy of PT modalities in CNP management remains an area of ongoing research.

Physical therapy modalities encompass a range of therapeutic interventions, including manual therapy techniques, therapeutic exercises, electrotherapy modalities, and heat/cold applications (4-6). Superficial heat agents, such as hotpack (HP), and deep-heating agents, such as therapeutic ultrasound (US), are commonly used conservative treatment methods for CNP (7,8). US and HP contribute to pain reduction through various mechanisms. They can increase endorphin levels, raise the pain threshold, alter the viscoelastic properties of tissues, reduce pressure and tension in nerve endings, and facilitate the removal of harmful metabolic waste from the affected area through vasodilation, among others (9). Additionally, therapeutic US can effectively reduce pain through its micro-massage effect (10). Transcutaneous nerve stimulation (TENS) is another electrotherapy method commonly used in the conservative treatment of chronic musculoskeletal pain due to its analgesic effect, although its effectiveness is not strongly supported by robust evidence (11). Similar to other agents, TENS positively contributes to pain modulation through the gate control theory and by triggering the release of natural opioids (beta-endorphins and enkephalins) in the body (9,12).

These interventions address the underlying musculoskeletal dysfunctions, promote tissue healing, reduce pain, and improve physical function. There is no clear evidence on the effectiveness of PT modalities for CNP, as studies report inconsistent results and lack comprehensive data, with some showing positive effects on pain reduction and functional improvement. In contrast, others find minimal or no significant benefits (4,6,13,14). The heterogeneity in study designs, treatment protocols, outcome measures, and patient populations contributes to the variability in the reported results.

There is a lack of Level 1a evidence regarding the effectiveness of PT modalities in managing CNP. Therefore, well-designed prospective randomized controlled trials (RCTs) are needed to provide high-quality evidence. This study aims to address this gap and evaluate the effectiveness of PT modalities (electrophysical therapy), widely used in conservative CNP management, including in Türkiye.

**MATERIAL & METHODS**

**Study Design**

The research was designed as a hospital-based, single-center, randomized controlled study. The study protocol was approved by the Ethics Committee of Konya University, Meram Medicine Faculty (approval number: 2012/083). This study was conducted according to the Declaration of Helsinki, and written informed consent for participation in the study was obtained from all patients.

**Participants**

Patients who applied to the University of Konya, Medicine Faculty, Physical Medicine and Rehabilitation Clinics, and

were diagnosed with non-specific CNP clinically between June 2012 and July 2014 were assessed for the study. The diagnosis of CNP is defined, in line with the literature, as non-specific, mechanical, degenerative, discogenic musculoskeletal pain occurring in the neck region, based on anamnesis, detailed physical examination, and necessary imaging (X-ray and/or magnetic resonance imaging) (3-5).

The inclusion criteria were subjects between the ages of 18 and 65 years old with a pain severity of ≥3 according to the Visual Analog Scale (VAS pain) and previous neck pain of at least 12 weeks. The exclusion criteria included the presence of acute protruded or extruded cervical disc herniation (CDH), CDH or cervical stenosis leading to a neurological deficit, the presence of red flags, including cancer, infection, fracture, and rheumatological diseases (e.g., ankylosing spondylitis or rheumatoid arthritis), chronic widespread pain, including fibromyalgia, individuals with significant headaches, patients with a history of major depression or those who had started antidepressant medication within the last 3 months, thoracic outlet syndrome, history of cervical region surgery, individuals with cardiac pacemakers, those who are pregnant, or those with decompensated systemic diseases (respiratory failure, heart failure, liver cirrhosis, etc.).

**Interventions**

All patients were initially provided with education, including the resting position of the neck and points to consider in daily life activities. Additionally, all patients were given a home exercise program for three months, including range of motion (ROM) exercises and isometric strengthening exercises. These strengthening exercises were applied to the cervical flexor, extensor, and rotator muscles due to their ease of use and practicality in daily practice (6). The program consisted of two sets of 10 repetitions, performed twice a day. The same physician demonstrated the exercises to the patients multiple times and provided written materials with visual representations of the exercises to all participants. Patients whose exercise compliance, assessed based on self-reported adherence, was below 70% at the follow-up assessment were excluded from the study. The patients were not prescribed any analgesics for regular use. However, they were advised that they could take 500 mg of paracetamol or an NSAID if necessary, provided that they did not use it within 24 hours before the follow-up appointments.

In the active treatment group (TG), in addition to the treatments received by the control group (CG), conventional PT modalities, including HP, therapeutic US (ITO US-100®), and TENS (Intelect®), were applied for two weeks. The patients received a total of 10 sessions of conventional PT, with one session per day for five days a week, for two weeks, in alignment with the routine practice of our hospital. The treatment included the application of an HP to the neck area for 20 minutes, continuous US at a dose of 1.5 watts/cm$^2$ for 10 minutes, and conventional TENS for 30 minutes. The TENS parameters were set with a pulse duration of 100 microseconds, a frequency of 100 Hz, and an amplitude adjusted to a level where the patient felt paresthesia.

The patients were randomly allocated into two groups using simple randomization using the coin flip method by an independent hospital staff member. The evaluation of patients' parameters and questionnaires was conducted by the same physician.

**Evaluation Parameters**

Patient evaluations were performed by the same physician at baseline, 2 weeks post-treatment, and 3 months post-treatment. The VAS pain, ranging from 0 to 100 mm, was used to measure pain intensity. The active ROM of the cervical spine in all directions (flexion, extension, right and left lateral flexion, and rotation) was assessed. In this study, the active cervical ROM levels were evaluated using a grading method based on the percentage of limitation. Based on this classification, the degrees of limitation are as follows: no limitation (0%), 1$^{st}$-degree limitation (0-25%), 2$^{nd}$-degree limitation (25-50%), 3$^{rd}$-degree limitation (50-75%), and 4$^{th}$-degree limitation (75-100%).

The SF-36 Health Survey, which is the most commonly used generic measure of quality of life, was utilized to assess the quality of life. The SF-36 quality of life scores have been validated and tested for reliability in Turkis (15). It consists of eight subscales, including physical functioning, physical role limitations, emotional role limitations, pain, general health, vitality (energy or fatigue), social functioning, and mental health. Scores on each subscale range from 0 to 100, with higher scores indicating better health status.

The Beck Depression Inventory (BDI) is used to assess depressive symptoms. It has been validated and tested for reliability in Turkish (16). The inventory consists of 21 items, and each item utilizes a four-point self-rating scale ranging from 0 to 3 to evaluate specific behaviors associated with depression. The total maximum score on the inventory is 63, with a score of 17 or higher indicating the presence of a depressive mood.

**Statistical Analysis**

The statistical analysis of the data was conducted using IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp. software in a computerized environment. The chi-square test was used for categorical variables to determine whether there were differences in demographic variables between groups. Independent t-tests were applied to assess differences for continuous variables. The changes in VAS, SF-36, and BDI scores of patients at baseline, post-treatment, and 3-month follow-up were evaluated for time effects, group effects, and group-time interactions using repeated measures analysis of variance (ANOVA). The assumption of sphericity was assessed using the Mauchly test statistic. Multiple comparisons were adjusted using the Sidak method based on corrected p-values. Furthermore, the analysis of ordinal values of cervical ROM limitations in patients at baseline, post-treatment, and 3-month follow-up was performed using the nparLD package in the R program. Multiple comparisons were adjusted using the Bonferroni method based on corrected p-values. A significance level of $p<0.05$ was considered statistically significant.

The G Power 3.1.9.4 program was used for the study sample size. Considering the VAS-pain value, which is the main outcome of this study, it was calculated that (ANOVA: Repeated measures, between factors) at least 40 patients per group should be taken in when the effect size (medium) is 0.3, the alpha value is 0.05, and the power value is 0.90.

**RESULTS**

A total of 85 patients were randomized at baseline, of whom 80 completed the study, resulting in a total of 40 participants in both groups. No treatment-related side effects (wound development, blood pressure fluctuations, discomfort, allergies, etc.) were reported by the participants or observed on medical follow-ups. Figure 1 shows the study's flow chart.

Both groups consisted of 38 females and 2 males. The mean duration of symptoms in the TG and CG were 4.1±4.2 and 2.7±2.4 years respectively (p=0.06). The demographic characteristics of the patients are presented in Table 1, and there were no statistically significant differences between the groups in terms of age, gender, BMI, marital status, education level, smoking status, and occupation (p>0.05).

The change in VAS pain scores between the TG and the CG during the treatment period is shown in Figure 2 and Table 2. According to these results, a significant reduction in pain was observed in both groups. In the CG, the decreased pain level observed 2 weeks after treatment increased at the 12-week follow-up. However, in the TG, the reduction in pain continued throughout the follow-up period. Significant improvement in cervical ROM was observed in both groups after treatment, but the ROM gains at 12 weeks decreased in the CG while they continued in the TG, and the improvement in the TG was found to be superior to the CG ($p<0.01$). Similarly, the changes in BDI and SF-36 quality of life scores are summarized in Tables 2 and 3 below.

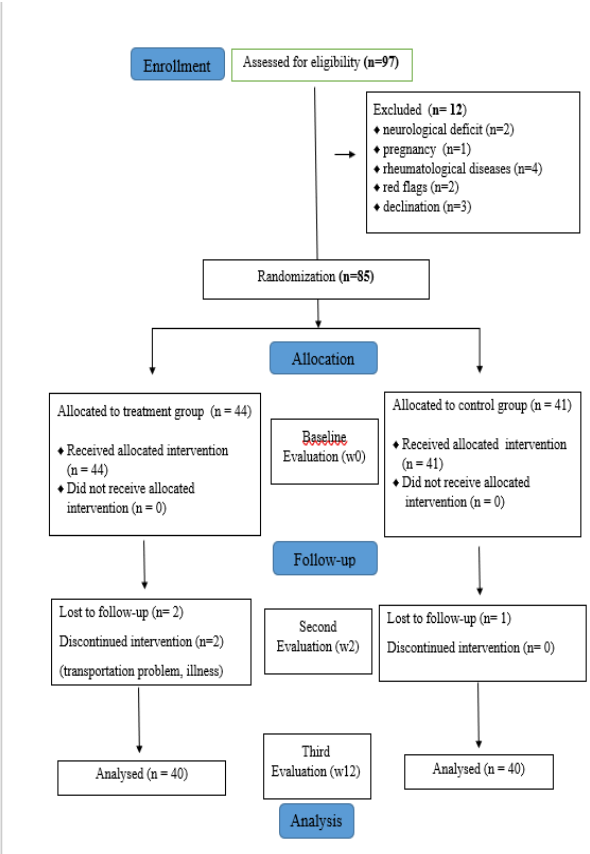


*Figure 1. Flowchart of the enrollment process of the study*

*Table 1. Demographic characteristics of study participants*

| | | Treatment Group (n=40) | Control Group (n=40) | p |
|---|---|---|---|---|
| | | **Mean ± SD** | **Mean ± SD** | |
| **Age (Years ± SD)** | | 49.9±9.9 | 48.8±9.1 | 0.609[a] |
| **BMI (kg/m² ± SD)** | | 31.5±6.2 | 31.0±4.7 | 0.698[a] |
| **Symptom Duration (Years)** | | 4.1±4.2 | 2.7±2.4 | 0.06[c] |
| | | **n (%)** | **n (%)** | |
| **Sex** | Female | 38 (95) | 38 (95) | 1.00[b] |
| | Male | 2 (5) | 2 (5) | |
| **Marriage** | Single | 4 (10) | 0 (0) | 0.116[b] |
| | Married | 36 (90) | 40 (100) | |
| **Education** | Illiterate | 5 (12,5) | 5 (12,5) | 0.334[b] |
| | Primary School | 26 (65) | 31 (77,5) | |
| | High School or College | 9 (22,5) | 4 (10) | |
| **Smoking** | Non-smoker | 35 (87,5) | 36 (90) | 0.950[b] |
| | Smoker | 5 (12,5) | 4 (10) | |
| **Employment** | Employed | 35 (87,5) | 38 (95) | 0.55[b] |
| | Housewife | 4 (10) | 2 (5) | |
| | Student | 1 (2,5) | 0 (0) | |

BMI: Body mass index, SD: Standard deviation, [a]Independent Samples t-test, [b]Pearson chi-square test, [c]Mann-Whitney U test

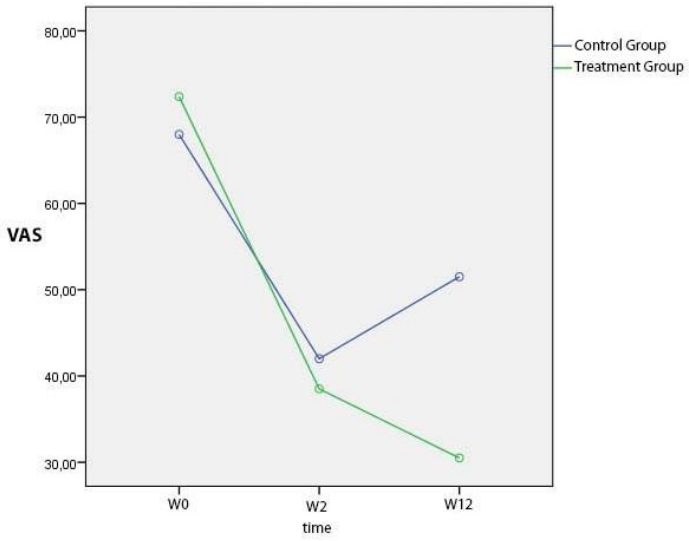


*Figure 2. The change in VAS pain scores over time was examined in the treatment and control groups*

*VAS: Visual Analogue Scale*

*Table 2. Evaluation of patients' VAS-pain and Beck Depression Inventory scores*

| | | TG Group | Control Group | p |
|---|---|---|---|---|
| | | **Mean ± SD** | **Mean ± SD** | |
| **VAS** (mm) | W0 | 72.37±9.47 | 68.00±11.59 | 0.068[a] |
| | W2 | 38.50±12.51 | 42.00±13.99 | 0.242[a] |
| | W12 | 30.50±11.75 | 51.50±12.51 | <0.001[a] |
| | W0-W2 (p[b]) | <0.001 | <0.001 | 0.006[c] |
| | W0-W12 (p[b]) | <0.001 | <0.001 | |
| | W2-W12 (p[b]) | <0.001 | <0.001 | |
| **BDI** | W0 | 16.62±7.85 | 14.35±6.55 | 0.164[a] |
| | W2 | 5.70±4.26 | 6.25±4.14 | 0.560[a] |
| | W12 | 4.45±4.51 | 8.97±4.21 | < 0.001[a] |
| | W0-W2 (p[b]) | <0.001 | <0.001 | 0.387[c] |
| | W0-W12 (p[b]) | <0.001 | <0.001 | |
| | W2-W12 (p[b]) | 0.056 | <0.001 | |

VAS: Visual Analog Scale, BDI: Beck Depression Inventory, W0: Before treatment, W2: 2 weeks after treatment, W12: 12 weeks after treatment, [a] Independent Samples t-test, [b]paired t-test, [c]Two-Way Repeated Measures Analysis of Variance (ANOVA)

*Table 3. Evaluation of patients' SF-36 Quality of Life scores*

| | | **TG Group** | **Control Group** | **p** |
|---|---|---|---|---|
| | | **Mean ± SD** | **Mean ± SD** | |
| Physical Functioning | W0 | 67.8±16.1 | 62.7±16.1 | 0.016[a] |
| | W2 | 36.7±15.4 | 33.6±15.2 | 0.365[a] |
| | W12 | 33.1±19.6 | 44.2±15.1 | <0.001[a] |
| | W0-W2 (p[b]) | <0.001 | < 0.001 | 0.765[c] |
| | W0-W12 (p[b]) | <0.001 | < 0.001 | |
| | W2-W12 (p[b]) | 0.189 | < 0.001 | |
| Social Functioning | W0 | 33.7±22.3 | 39.6±19.7 | 0.212[a] |
| | W2 | 72.5±16.7 | 74.0±16.5 | 0.677[a] |
| | W12 | 70.6±20.9 | 57.5±17.6 | <0.001[a] |
| | W0-W2 (p[b]) | <0.001 | <0.001 | 0.592 |
| | W0-W12 (p[b]) | <0.001 | <0.001 | |
| | W2-W12 (p[b]) | 0.884 | <0.001 | |
| Physical Role Limitations | W0 | 3.7±12.0 | 3.7±14.4 | 1.000[a] |
| | W2 | 54.3±34.8 | 50.0±30.4 | 0.552[a] |
| | W12 | 63.1±33.0 | 30.6±26.8 | <0.001[a] |

| | | | | |
|---|---|---|---|---|
| | W12 | 63.1±33.0 | 30.6±26.8 | <0.001[a] |
| | W0-W2 (p[b]) | <0.001 | <0.001 | |
| | W0-W12 (p[b]) | <0.001 | <0.001 | 0.011[c] |
| | W2-W12 (p[b]) | 0.188 | <0.001 | |
| | W0 | 7.5±17.6 | 6.6±18.7 | 0.839[a] |
| Emotional Role Limitations | W2 | 67.5±28.7 | 67.5±32.4 | 1.000[a] |
| | W12 | 69.1±31.4 | 43.3±33.0 | < 0.001[a] |
| | W0-W2 (p[b]) | <0.001 | <0.001 | 0.055[c] |
| | W0-W12 (p[b]) | <0.001 | <0.001 | |
| | W2-W12 (p[b]) | 0.983 | <0.001 | |
| | W0 | 29.5±11.1 | 34.6±11.0 | 0.043[a] |
| Pain | W2 | 65.0±11.9 | 66.5±15.4 | 0.629[a] |
| | W12 | 68.1±15.4 | 52.7±12.4 | <0.001[a] |
| | W0-W2 (p[b]) | <0.001 | <0.001 | |
| | W0-W12 (p[b]) | <0.001 | <0.001 | 0.203[c] |
| | W2-W12 (p[b]) | 0.389 | < 0.001 | |
| | W0 | 21.5±13.6 | 23.6±14.3 | 0.500[a] |
| Vitality (Energy) | W2 | 58.0±16.3 | 58.2±17.1 | 0.954[a] |
| | W12 | 61.1±19.0 | 42.1±16.3 | <0.001[a] |
| | W0-W2 (p[b]) | <0.001 | <0.001 | |
| | W0-W12 (p[b]) | <0.001 | <0.001 | 0.068[c] |
| | W2-W12 (p[b]) | 0.535 | <0.001 | |
| | W0 | 31.0±14.0 | 35.5±12.4 | 0.133 |
| Mental Health | W2 | 68.8±12.9 | 67.5±16.9 | 0.701 |
| | W12 | 71.3±16.7 | 54.1±14.0 | < 0.001 |
| | W0-W2 (p[b]) | <0.001 | <0.001 | 0.082[c] |
| | W0-W12 (p[b]) | <0.001 | <0.001 | |
| | W2-W12 (p[b]) | 0.678 | <0.001 | |
| | W0 | 33.5±15.7 | 38.7±16.8 | 0.154[a] |
| General Health | W2 | 57.6±14.0 | 57.7±14.1 | 0.968[a] |
| | W12 | 60.6±16.2 | 47.3±15.3 | <0.001[a] |
| | W0-W2 (p[b]) | <0.001 | <0.001 | |
| | W0-W12 (p[b]) | <0.001 | <0.001 | 0.387[c] |

| | | | |
|---|---|---|---|
| | W2-W12 ($p^b$) | 0.212 | <0.001 |

SD: Standard deviation, W0: Before treatment, W2: 2 weeks after treatment, W12: 12 weeks after treatment, [a] Independent Samples t-test, [b]Paired t-test, [c]Two-Way Repeated Measures Analysis of Variance (ANOVA)

**DISCUSSION**

In the present study, aimed at investigating the effectiveness of PT modalities, which are among the conservative treatment methods for CNP, on clinical findings and quality of life, a significant improvement compared to baseline was observed in both groups during the follow-up period after treatment. While the improvement in the CG decreased at the 3-month follow-up after the treatment received at CG, a continuation of improvement was observed in the TG.

In an RCT, it has been reported that a combination of US and TENS is as effective as high-intensity laser therapy (HILT) in treating neck pain associated with cervical disc herniation (17). In an RCT conducted by Venosa et al. (18) the effects of HILT and a combination of US treatment and TENS on pain, ROM, and functional activity in patients with cervical spondylosis were evaluated. After 12 treatment sessions, improvement was observed in cervical ROM, VAS pain scores, and neck disability index (NDI) in both groups, but the HILT group was found to be superior. However, studies are available that demonstrate these treatments' ineffectiveness (19,20). There are numerous studies in the literature regarding the efficacy of US and TENS in the treatment of CNP, and it is evident that there are promising results (21). In our study, physical therapy modalities were compared to a CG that received a highly potent treatment including exercises (22,23), contrary to some previous studies. It was found that 10 sessions of US, TENS, and HP therapy were effective. We believe that the results we obtained will contribute to the conflicting findings in the literature.

In a systematic review (24), which included 83 studies, to demonstrate the effectiveness of physical therapy modalities in the treatment of acute or CNP, acupuncture, laser therapy, and intermittent traction were reported to have moderate levels of evidence in short-term follow-up. For acute whiplash syndrome, subacute, or CNP, pulse US therapy, infrared light therapy, and continuous traction were reported to have no significant effect on pain reduction with moderate evidence. Furthermore, it was stated that the addition of superficial HP therapy to mobilization, manipulation, or electrical stimulation did not provide additional benefits in the 6-month follow-up. The authors emphasized the need for determining standard treatment doses and conducting well-designed studies in this regard.

A meta-analysis published in 2018 revealed insufficient evidence regarding the use of TENS for cervical spine pain (25). Only one RCT related to neck pain and six RCTs related to lower back pain were included in this meta-analysis. It was reported that TENS had very short-term effectiveness and did not show significant efficacy after 1-3 months of treatment. In our study, patients were assessed 3 months after the treatment, and it was observed that the clinical effectiveness in the TG continued without diminishing. Therefore, our study, being an RCT with a moderate follow-up period, can contribute to the need for strong-quality studies in this area.

In the present study, the combined application of physical therapy modalities prevented us from isolating the effectiveness of each modality individually. Therefore, this study would be insufficient in contributing to the clarification emphasized in systematic reviews and meta-analyses, which state that US therapy may be effective for neck pain but that the extent of its additional benefit when combined with other treatments is not clear (26). However, considering that in many physical therapy and rehabilitation clinics these treatments are commonly combined and are cost-effective and safe, the results we obtained are valuable from a clinical practice perspective.

Exercise therapy is believed to reduce inflammation, decrease muscle activity and spasms, improve muscle coordination, and support tissue regeneration, thereby restoring musculoskeletal pain and disability (27). Indeed, many exercise programs are designed to correct muscle coordination, relax tense muscles, increase ROM, and enhance muscle strength. There is limited research evaluating the effectiveness of exercise programs specifically for CNPs. Lluch et al. (28) found that low-load training involving deep cervical flexor muscle exercises for

six weeks resulted in reduced pain and disability in patients but did not observe changes in pressure pain sensitivity in the regional neck muscles. Schomacher et al. observed structural changes such as increased fat concentration and type 2 fibril proliferation in the deep cervical extensor muscle group in patients with neck pain (29). They recommended exercises targeting the deep cervical extensor muscles. Studies on the effectiveness of exercise in the treatment of CNP have generally focused on specific muscle groups and demonstrated the efficacy of these targeted exercises (23,30).

In studies investigating the effectiveness of medical treatments or PT modalities, the comparison is often made with a CG receiving either a placebo effect or exercise interventions (4,6,8,13,14). In a recent study, Haklıgil et al. (8) compared Pilates alone to Pilates combined with conventional physiotherapy in CNP. Similar to our study, this RCT included physiotherapy modalities such as hot packs, TENS, and US, and reported that the addition of physiotherapy modalities was beneficial. Moreover, as in our study, sham physiotherapy modalities were not used in this RCT. In our study, both groups were engaged in home exercise therapy from the beginning of the study until the 3-month follow-up, in addition to patient education and points to consider in daily life activities. Therefore, it would not be appropriate to make definitive conclusions solely regarding the effectiveness of the exercise program due to the methodology of the present study. However, the observed improvements in both groups support the potential positive effects of exercise when combined with other treatments on clinical symptoms and quality of life. The addition of PT modalities, especially HP and TENS, to exercise in a patient experiencing pain will likely decrease pain in the short term and increase patient compliance with exercises.[30] In our study, in the group receiving physical therapy in addition to exercise and medical treatment, the continued decrease in pain and improvement in physical functions for up to 3 months may also be attributed to the indirect impact of exercise on adherence to daily life activities.

In the evaluation of the quality of life and satisfaction in patients with neck pain, more rational tools such as the NDI or the Neck Pain and Disability Index are commonly used, rather than the SF-36 test (31). Due to the majority of our study participants having low educational levels, not driving cars, and leading sedentary lifestyles, the SF-36 scale, which primarily assesses general activities, was utilized to measure their quality of life. CNP often coexists with mood disorders such as depression and anxiety (21,32). Considering this association, we used the BDI as a general screening test for assessing the emotional status of the patients. The results obtained in our study are consistent with the literature, as we observed a reduction in BDI scores and an improvement in quality of life parallel to the decrease in pain following treatment.

**Study Limitations**

The main limitations of the present study were the unequal treatment of the groups and the lack of single-blinding. The intervention group received more intensive treatment, while the CG did not receive the same dose of sham therapy. As a result, this may significantly impact the findings. However, these treatments are inherent practices in PT, and patients undergoing these therapies would naturally receive more treatment compared to those not receiving PT. Hence, this aspect does not invalidate the main objective of our study, and the obtained results remain meaningful. Although a true sham application for HP could not be conducted, sham applications could have been performed for TENS and US; however, this was not the primary aim of our study. Other important limitations include the single-center nature of the study, the lack of a long-term follow-up period, and the absence of structured psychiatric evaluations for assessing mood levels. Additionally, cervical ROM was assessed using a subjective classification method rather than goniometry or digital measurement techniques, which could have provided more reliable data. Despite these limitations, we believe that the strengths of our study, such as being an RCT and the thorough evaluation of patients at two different time points, are noteworthy. In a field where strong evidence is lacking, we hope that our study will contribute significantly to the literature.

**CONCLUSION**

In the treatment of CNP, adding PT modalities (HP, US, and TENS) to the home-based exercise program resulted in greater reductions in pain, disability, and depressive symptoms, as well as improvements in quality of life compared to home-based exercise alone in the short and

medium term. Considering that PT modalities are safe, easy to apply, relatively inexpensive, and effective treatment options, they may be considered an important component of conservative treatment for CNP.

Ethic: This study was approved by the Ethical Committee of the Konya University Medicine Faculty (approval number: 2012/083). Its procedure complied with the Declaration of Helsinki guidelines.
Etik: Bu çalışma Konya Üniversitesi Tıp Fakültesi Etik Kurulu tarafından onaylandı (onay numarası: 2012/083). Prosedürü Helsinki Bildirgesi Yönerge'lerine uygundur.
Author contribution status; The concept of the study; MŞ, NŞ, RY, design; MŞ, NŞ, RY, literature review; MŞ, NŞ, RY, collecting and processing data; MŞ, NŞ, RY, statistics; MŞ, NŞ, RY, writing phase; MŞ, NŞ, RY
Yazar katkı durumu; Çalışmanın konsepti; MŞ, NŞ, RY, dizaynı; MŞ, NŞ, RY, Literatür taraması; MŞ, NŞ, RY, verilerin toplanması ve işlenmesi; MŞ, NŞ, RY, istatistik; MŞ, NŞ, RY, yazım aşaması; MŞ, NŞ, RY
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