European Journal of Physical and Rehabilitation Medicine
EDIZIONI MINERVA MEDICA

Immediate clinical benefits of combining therapeutic exercise and interferential therapy in adults with chronic neck pain: a randomized controlled trial.

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European Journal of Physical and Rehabilitation Medicine 2021 Mar 24
DOI: 10.23736/S1973-9087.21.06688-0

Article type: Original Article

Article first published online: March 24, 2021
Manuscript accepted: March 22, 2021
Manuscript revised: February 9, 2021
Manuscript received: November 2, 2020

TITLE:

Immediate clinical benefits of combining therapeutic exercise and interferential therapy in adults with chronic neck pain: a randomized controlled trial.

RUNNING TITLE:

Therapeutic exercise plus interferential therapy for chronic neck pain.

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Abstract

Background: Therapeutic exercise is highly recommended for the management of non-specific neck pain and has shown promising results combined with interferential current therapy. Yet, the clinical relevance of the pooled effect of these approaches remains uncertain.

Aim: To investigate the immediate clinical effect size of combining therapeutic exercise and interferential therapy, compared with the isolated use of therapeutic exercise, in adults with chronic non-specific neck pain.

Design: Randomized, single-blinded, controlled, superiority trial.

Setting: Outpatients, primary care center.

Population: Forty-nine adults with chronic non-specific neck pain.

Method: Participants with neck pain (grades I or II) lasting for more than 12 weeks were allocated to a therapeutic exercise plus interferential currents group (n = 25) or to a therapeutic exercise only group (n = 24). All individuals underwent treatment 5 times a week for 2 weeks. The primary outcome was current neck pain intensity (11-point numeric pain rating scale). Secondary outcomes included neck disability (Neck Disability Index) and active cervical range-of-movement (CROM device). Measurements were taken at baseline and immediately after treatment. An intention-to-treat analysis was carried out. To quantify the effect size of the interventions, the relative risk, the absolute and relative risk reduction, and the number needed to treat were calculated.

Results: A significant time*group effect was found for pain intensity, disability, and neck flexion and right rotation (all, $p < 0.05$). In the analysis for treatment

benefit, the number needed to treat was 2 (95% CI: 2 to 4, $p < 0.001$) for neck pain and disability, and 3 (95% CI: 2 to 11, $p = 0.029$) for neck flexion.

Conclusion: Adding interferential therapy to therapeutic exercise is clinically more effective than therapeutic exercise alone to immediately improve neck pain and disability, but not active cervical range-of-movement, in adults with persistent neck pain.

Clinical rehabilitation impact: Our results suggest that this multimodal intervention can be a useful strategy for rehabilitation of patients with non-specific neck pain. This is the first study on this topic reporting findings in terms of clinical relevance, which is key to transfer research evidence into practice.

Key words: disability, electrical stimulation, exercise, neck pain, range of motion, number needed to treat.

Introduction

Neck pain is a serious health concern, accounting for over 65 million cases annually,[1] and ranking as the 4th greatest contributor to global disability,[2] with 28.6 million years lived with disability in 2017.[1] Non-specific neck pain (NSNP), defined as pain at the spine or its supporting structures and with a postural or mechanical origin,[3] is the most common type.

Among the conservative strategies to manage chronic NSNP, manual therapy and therapeutic exercise (TE) are the most common approaches, with purported positive effects.[4] Exercise therapy is recommended (with moderate to high quality evidence) to decrease neck pain intensity and the level of disability in this population.[5] The so-called exercise-induced analgesia is mediated by the modulation of central pain inhibitory mechanisms and the immune system,[6] and the effect duration seems to be dose-dependent in individuals with neck pain.[7] A recent systematic review concluded that manual therapy adds very little to the overall efficacy of the intervention when combined with TE.[4] Electrical currents are also frequently used in daily clinical practice, either alone or as an adjunct treatment for NSNP. Yet, current evidence is insufficient to recommend most of electrotherapy modalities for this condition, and further research is warranted.[8] Interferential current therapy (IFC) is the application of alternating medium frequency current amplitude modulated at low frequency, which has potential benefits over low frequency currents.[9] When included within a multimodal protocol, IFC may help to improve musculoskeletal pain.[9] Several mechanisms, e.g., blood flow increase, nerve conduction blocking, and descending pain modulation, may help to explain the potential long-term effect of IFC.[9] In adults

with chronic NSNP, the combination of IFC and TE has shown promising results, although studies on this topic are still scant.[10,11]

A key aspect to transfer research evidence into everyday practice is to interpret the clinical relevance of a study findings.[12] The risk ratio (or relative risk), the absolute (ARR) and relative (RRR) risk reduction, and the number needed to treat (NNT) are statistical tests that can be used to quantify the effect size of an intervention, which may help to guide proper clinical decisions.[13] Despite this, these statistics are rarely investigated in physical therapy journals,[14] and more specifically in trials about mechanical neck disorders.[15] The risk ratio is the probability of an outcome (e.g., higher pain intensity) that results from comparing people exposed or not to a characteristic or event (e.g., having received a certain treatment).[16] The ARR refers to how this risk is changed after receiving the experimental rather than the control protocol, whereas the RRR is an estimate of how much the baseline risk is reduced after the intervention.[13] The updated CONSORT guidelines for reporting parallel group clinical trials recommend including both, absolute and relative effect sizes, for appropriate clinical interpretability.[17] Finally, the NNT results from calculating the number of patients that need to be treated to achieve one additional benefit or prevent one additional adverse event.[18] The NNT is specific to a comparison between two approaches in a single study, rather than an absolute measure of the clinical effect of an intervention.[19]

We aimed to investigate the immediate clinical impact of combining TE and IFC, compared with TE alone, on neck pain intensity, disability, and range-of-movement (ROM) in adults with persistent NSNP. We hypothesized higher efficacy of the multimodal protocol.

Methods

Design

A randomized, single-blinded, controlled, parallel, and superiority trial was conducted. We considered a 1:1 allocation ratio in the study groups. The trial design complied with the ethical guidelines set in the Helsinki Declaration, was approved by the Institutional Research Ethics Committee, and has been registered in Clinical Trials.gov (code number NCT03979287).

Participants

Following a convenience sampling, the recruitment process took place from July to October 2019. Adults with NSNP (grades I or II), with or without radiating pain to the head, trunk or upper extremities for at least 12 weeks duration,[20] were screened by a general physician in a public primary health center. Neck symptoms had to be evoked by postures, movements, and/or palpation.[21] Participants were excluded based on the following criteria: history of severe traumatism or surgery in the neck region; fear to treatment with electrical currents (< 45 points in the Personal Psychological Apprehension scale); diagnosis of cervicogenic headache or dizziness; medical signs or symptoms suggestive of a non-musculoskeletal source for the neck pain; cervical myelopathy or spinal stenosis; any contraindication to IFC, e.g., use of metallic implants; diagnosis of visceral pain referred to the neck; and pregnancy or breastfeeding. All participants provided written informed consent.

Interventions

After fulfilling the eligibility criteria, and if agreed to participate, patients were allocated into a TE plus IFC group (n = 25) or to a TE only group. Both groups underwent a 2-week treatment regime (five days a week) that was monitored by the same senior physical therapist, with more than 10 years of clinical experience.

The TE protocol was an individualized program, adapted to each participant's perceived fatigue, pain and strain tolerance, and primarily included neck-shoulder strengthening and stretching exercises, and ergonomic advices. All exercises were repeated 3 sets of 3 to 5 repetitions. During the initial 2 sessions, participants performed active bilateral stretching of the upper trapezius, levator scapulae, scalene, and sternocleidomastoid muscles, and received educational and postural advices to manage their pain. From the third session on, these activities were combined with strengthening exercises of the same neck-shoulder muscles (isometric and eccentric training). Each movement was hold between 3 to 10 seconds. We included functional neck movements in different directions, together with oculomotor training (e.g., saccadic eye movements; and smooth pursuit exercises.[10,22] The duration of the exercise therapy was progressively increased (from 25 min the first 2 sessions, up to 45 min during the last sessions).

After the TE program, those in the TE plus IFC group received additional IFC therapy during 25 min. Participants remained in comfortable sitting position. Self-adhesive electrodes of 9 x 5 cm (Stim Care Premium Electrodes, Empi Inc., St. Paul, MN, USA), were placed approx. 3 cm below the transverse processes of C5 and at both sides of the transverse processes of C7. The IFC device (Sonopuls 692, Enraf Nonius, Rotterdam, The Netherlands) used a bipolar application, with 4000 Hz carrier frequency, 60 Hz amplitude-modulated

frequency, and a sweep modulation frequency of 90 Hz. The intensity of the current was adapted to individual tolerance, and increased, whenever possible, to evoke a “pins-and-needles” sensation, without visible muscle twitches.[23]

Outcome Measures

A senior physiotherapist collected the clinical and demographic characteristics of participants at the beginning of the treatment. The same researcher evaluated all study outcomes, both at baseline (before randomization) and immediately after the last treatment session.

For the primary outcome, we used the current self-reported neck pain intensity, assessed with a 11-point numeric rating scale (NPRS), where 0 denotes “no pain” and 10 denotes “the maximum bearable pain”. The minimum clinically important difference (MCID) and the minimum detectable change (MDC) for this tool have been established at 1.3 and 2.1 points, respectively, in individuals with NSNP.[24] The NPRS is a valid scale with moderate test-retest reliability in this population (ICC=0.76; 95% CI, 0.51-0.87),[24] and is recommended as the core measure in chronic pain studies.[25]

The secondary outcomes included the Neck Disability Index (NDI), Spanish version).[26] The NDI queries 10 different items related to subjective symptoms and pain interference with daily life activities and has shown optimal reliability and internal validity. The final score ranges from 0 to 50 points, with higher scores corresponding to greater disability. The thresholds for the MCID and the MDC of this index have been set at 9.5 and 9.8 points, respectively.[24] Additionally, we measured the pain-free active cervical range-of-movement (ROM) using a CROM device (Performance Attainment Associates™, Lindstrom, MN, USA). Patients

had to remain in relaxed straight-back seated position with feet on the ground. The CROM was placed over the head, and participants were told to move slowly until the point where the symptoms began, or continue to the full range in the absence of pain.[27] End-range had to be hold for 3 seconds, and verbal cueing was given to avoid shoulder or thoracic movements. A warm-up test was carried out, and then, two sets of 6 measurements were recorded using the sequence: flexion, extension, right and left side bending, and right and left rotation, with no rest between movements, and a 1-min break between sets. The mean of the 2 scores for each direction was used for further analysis.[28] A single composite score (global ROM) was calculated as the sum of the six individual movements. The CROM has good to excellent reliability.[28] In people with NSNP, the standard error of the device ranges from 2.9 (left rotation) to 4.1º (flexion), and the MDC ranges between 5.9º (right side bending) to 9.6º (flexion).[28]

Sample size

Sample size was estimated using the G*Power software (version 3.1.2, Kiel University, Kiel, Germany). Based on a previous study [11], and to achieve clinically relevant changes in neck pain intensity (around 2 points in the NPRS),[24] we assumed a two-tailed hypothesis, an equal distribution of participants in the study groups, a high effect size (d=0.85), an alpha level of 0.05, and an 80% power. Then, a total of 50 individuals were required considering a 10% dropout rate.

Randomization and Blinding

A computer-generated random sequence in permuted blocks was obtained by an external assessor not directly involved in the study, who only provided the sequence to the therapist in charge of the intervention. Treatment order allocation was concealed using sealed opaque envelopes. The outcome assessor remained unaware of participants' allocation group.

Statistical Analysis

The statistical processing of the data was conducted with the PASW Advanced Statistics, version 24.0 (IBM Corp, NY, USA). Intention-to-treat principles were considered for all analyses. The normal distribution of the variables was assessed with the Shapiro-Wilk test. Data are reported as mean ± standard deviation, mean (95% confidence interval, CI), or in percentages. A repeated-measures analysis of variance (ANOVA) was used to investigate the differences in the outcomes after intervention, with group (TE plus IFC or TE alone) as between-subjects factor, and time (baseline and after intervention) as within-subjects factor. Partial eta squared (η^2) is reported to estimate the effect size. To further analyze treatment benefit, the relative risk, ARR, RRR and NNT were calculated, along with their 95% CI. As normative reference values for disability we used those established for the NDI (0-4 points, no disability; 5-14 points, mild disability).[29] For cervical ROM, we used the mean average values in healthy individuals: flexion, 52º (43 to 73º); extension, 71º (33 to 77º); side bending, 43º (41 to 54º); rotation, 72º (60 to 86º).[30] For all tests, statistical significance was set at $p < 0.05$.

Data availability

The data associated with the paper are not publicly available but are available from the corresponding author on reasonable request.

Results

Forty-nine adults with chronic NSNP (69.4% females), mean age of 47 ± 10.95 years, agreed to participate. No adverse events or dropouts were reported during the trial (figure 1). Table 1 lists the baseline clinical and demographic features of participants. There were no significant differences in the analysis between groups at baseline for any of the variables (all, $p > 0.05$).

Figure 2 include the results for pain, disability, and overall ROM. The ANOVA demonstrated a significant time*group effect for neck pain intensity ($F = 74.442$; $p < 0.001$; $\eta^2 = 0.613$), and the NDI ($F = 13.293$; $p = 0.001$; $\eta^2 = 0.220$). As regards cervical ROM, a significant time*group interaction was observed for neck flexion ($F = 5.666$; $p = 0.021$; $\eta^2 = 0.108$), and right rotation ($F = 5.593$; $p = 0.022$; $\eta^2 = 0.106$), but not for overall ROM ($F = 3.678$; $p = 0.061$; $\eta^2 = 0.073$).

The analysis for treatment benefit showed that 14 participants (56%) in the TE + IFC group improved beyond the MCID and the MDC of the NPRS post intervention (> 3 points decrease), compared with only one individual (4.16%) in the TE group. The NNT for neck pain intensity was 2 (95% CI 2 to 4), with a risk ratio of 0.46 (95%CI 0.29 to 0.72), an ARR of 0.52 (95% CI 0.31 to 0.73), and an RRR of 0.54 (0.28 to 0.71). As regards the NDI, 22 participants (88%) in the TE + IFC group reported no disability or mild disability after treatment (< 14 points), compared with 6 individuals (25%) in the TE group. The NNT for the NDI was

also 2 (95% CI 2 to 3). The risk ratio was 0.16 (95%CI 0.05 to 0.47), with an ARR of 0.63 (95%CI 0.41 to 0.85), and an RRR of 0.84 (95% CI 0.53 to 0.95).

Concerning active ROM, 60% of participants (15) that received IFC increased their neck flexion until reaching the normative mean values (> 43º), compared with 6 subjects (25%) in the TE group. The NNT for neck flexion was 3 (95% CI 2 to 11), with a risk ratio of 0.53 (95%CI 0.31 to 0.91), an ARR of 0.35 (95%CI 0.09 to 0.69), and an RRR of 0.47 (95% CI 0.09 to 0.69). For neck extension, all participants showed a baseline ROM within standard values (> 33º). Additionally, improvements in right or left side bending were only enough to surpass the normative mean ROM in 4 individuals (16%) in the TE + IFC group, and in one participant (4.16%) in the TE group. Hence, no statistical significance was found in the analysis of the NNT for neck extension or side bending ($p > 0.05$). Finally, as regards right and left neck rotation, 14 (56%) and 16 (64%), respectively, of those who received IFC demonstrated a standard ROM (> 60º) after intervention, compared with 8 individuals (33%) in the TE group. The NNT was 3 (95% CI 2 to 12) for left rotation, with a risk ratio of 0.51 (95%CI 0.28 to 0.91), an ARR of 0.35 (95%CI 0.09 to 0.61), and an RRR of 0.49 (95% CI 0.09 to 0.72). For right rotation, the NNT did not reach statistical significance ($p = 0.191$).

Discussion

As hypothesized, a treatment protocol combining IFC and TE achieved higher immediate clinical impact on self-reported neck pain intensity and disability, compared with TE alone, in adults with long-standing NSNP. Contrary to our hypothesis, both approaches showed a similar effect on active cervical ROM,

except for neck flexion and right rotation, where adding IFC to exercise therapy proved to be more clinically relevant.

Neck Pain Intensity and Disability

Moderate quality evidence supports neck-shoulder strength training to improve pain immediately after treatment in individuals with chronic NSNP.[31] We observed a decrease in pain intensity after intervention in both groups, with significant differences in favor of those who also received IFC. The between groups mean changes in the NPRS (2.57 points, 95% CI -3.17 to 1.97) surpassed the MCID and the MDC.[24] This is in line with the previously quantified pooled analgesic effect (2.45 points) when IFC is used as an adjunct treatment for adults with musculoskeletal pain.[9]

Similar to our findings, a clinically important neck pain relief has been reported after 1, 3 or 8 sessions of IFC, either alone,[32] or combined with active cervical ROM exercises,[33] and hot pack and myofascial release,[34] both in females with neck discomfort,[32] and in adults with myofascial neck pain.[33,34] We followed the TE protocol described by Albornoz-Cabello et al.,[10] who concluded that adding IFC to a supervised TE regime resulted in higher improvement of neck pain intensity, compared with TE alone. These positive findings have been attributed to the plausible effect of IFC to enhance muscle blood circulation[33] and activate low-cutaneous afferents leading to nociceptive inhibition,[34] to a concomitant decrease of upper trapezius muscle tension,[32] and to the role of placebo.[9,11] Yet, the scientific evidence to support IFC to manage musculoskeletal conditions still remains controversial.[9]

Contrary to our results, IFC has shown no additional benefit to relieve neck pain when combined with neck stabilization exercises.[11] In this trial, participants underwent a 6-week protocol using a different exercise therapy approach, and results were assessed in a short-term follow up (12 weeks), which makes difficult to compare among studies. Most of research in this area has investigated the impact of IFC in adults with persistent low-back pain,[9,35] with little focus on NSNP. Likewise, the lack of consensus in terms of optimal current parameters and length of treatment does not allow to establish definite conclusions.

As regards disability, exercise interventions of short duration can help to evoke immediate benefits in self-perceived functionality.[36] We observed statistically significant improvements in the NDI immediately after intervention in both groups. However, clinically relevant differences were only found in the IFC plus TE group (-14.72 points, 95% IC -17.29 to -12.14), where changes reached the threshold for the MCID and the MDC, [24] and most participants reported mild disability after treatment. A similar change in the NDI (around 15 points) has been reported in previous studies that combined IFC with neck exercises.[10,11] The immediate hypoalgesic effect following the IFC plus TE regime could help to explain the positive outcomes on neck disability, with some controversial evidence on this issue.[9,35] The NDI is a widely used scale to self-rate cervical spine disability. This tool helps to estimate health-state utility value,[37] and predicts worst health-related quality of life in individuals with chronic NSNP.[38] Hence, the current promising findings may have important clinical implications.

Active range of movement

The efficacy of exercise training on cervical ROM has shown conflicting findings in adults with long-standing NSNP.[39,40] We found that both groups reported similar outcomes for this measure. Even though adding IFC to TE led to better results for neck flexion and right rotation, the between group differences (flexion: 2.85º, 95% IC 0.44 to 5.26º; right rotation: 6.08º, 95% CI 0.91 to 11.25) did not reach the MDC for any of these directions. [28] Additionally, within group changes in neck extension and side bending fell within the standard error of measurement of the CROM device (< 3.9º).[28] It is frequently assumed that changes in pain should correlate with changes in movement, although current evidence does not necessarily support this belief.[41] Several aspects have been proposed to explain this issue, e.g., the heterogeneity in individual contributing factors to pain and disability, and the different measures used to evaluate pain and movement, among others. [41] All in all, this has been concluded in individuals with low-back pain, hence it is unclear if the same mechanisms may be valid for NSNP.

Consistent with some of the existing literature on this topic, applying IFC added no extra benefit to TE for active cervical ROM in patients with NSNP.[10,11] On the contrary, in individuals with myofascial pain, combining transcutaneous electrical nerve stimulation or IFC with a standard approach including TE, hot pack, and myofascial release or spray and stretch, proved to be superior, compared with the standard approach alone, to increase cervical ROM.[33,34] Similarly, IFC was effective to improve active cervical ROM, compared with sham ultrasound, in adults with at least two active myofascial trigger points in the upper trapezius.[42] However, this latter study investigated participants with acute neck pain,[42] who respond differently to physical therapy treatment than those with

chronic neck pain.[43] In addition, ROM was only assessed in one (side bending),[42] or three directions (extension, rotation to one side and side bending to the contralateral side),[34] so these findings should be interpreted cautiously.

Clinical impact of interventions, as assessed by number needed to treat

Clinical guidelines recommend a multimodal approach, with TE as the core therapy, to manage NSNP.[44] Despite this, the clinical relevance, in terms of ARR, RRR, and NNT, of physical therapy interventions including exercise for neck-related pain and disability, has been scarcely investigated in the scientific literature.

Previous research concludes that when combined with neck-shoulder exercises, electroacupunture appears to be more effective than biofeedback therapy to decrease neck pain intensity (NNT = 4.17; RR = 1.35) and disability (NNT = 2.5; RR = 2).[45] Similarly, thoracic spine thrust manipulation, in addition to active ROM exercises and cervical non-thrust manipulation, demonstrates short-term efficacy, as assessed by patients' self-perceived global change (NNT = 2; ARR = 0.6).[46] Skillgate et al.[47] compared the effectiveness of strengthening and stretching exercises, alone or with deep tissue massage therapy, with advice to stay active in adults with subacute or persistent neck pain. They found that exercises and massage together was more likely to report a MCID in pain intensity at 7 weeks (NNT = 7; RR = 1.39, 95% CI 1.08 to 1.81) and 12 weeks post treatment (NNT = 9; RR = 1.28, 95% CI 1.02 to 1.60), while exercise alone was more effective at 26 weeks (NNT = 7; RR = 1.31, 95% CI 1.04 to 1.65). Finally, in individuals with acute neck pain, thrust joint manipulation combined with a 2-week exercise regime, was superior when directed to the cervical rather

than the thoracic spine to change pain and disability (NNT = 1.8, ARR ratio = 57.1% at 1-week follow-up; NNT = 1.6, ARR ratio = 61.4% at 1-month and 6-month follow-up).[48] All in all, a systematic review concluded that, for a relevant improvement in pain intensity, the NNT varies from 2 to 11 in trials investigating the effect of a protocol including spinal mobilization or manipulation plus exercise and other forms of therapy in individuals with neck disorders.[15] Similarly, it has been suggested that a NNT between 2 and 5 denotes that a certain treatment is clinically effective.[49] Although our results were similar than those formerly reported, it must be noted that comparison between trials based only on the NNT is not recommended, since it may lead to wrong assumptions.[19]

Study Limitations

Some limitations should be acknowledged. First, sample size could be considered rather small. Additionally, results were only assessed in an immediate fashion, and we lacked a control group using sham-IFC to exclude the potential placebo effect, which could weaken the clinical impact and meaningfulness of our findings. Placebo responses in chronic pain are pervasive and can represent a valuable component in the clinical setting. All participants underwent the same number of treatment sessions, although session duration differed between groups, following previous research on this topic.[10,11] This different treatment "dose", as the total duration of treatment needed to achieve a positive response[50] may act as a potential bias. Finally, pain intensity was evaluated using a self-reported unidimensional scale. A better understanding of the clinical effect of the interventions would benefit from using other multidimensional tools to assess pain.

Conclusion

Adding IFC to a 2-week exercise therapy regime demonstrated higher clinically effectiveness immediately after intervention, compared with the sole use of exercise, to decrease neck pain intensity and disability, but not to improve active cervical ROM in adults with chronic NSNP.

Authors´ contributions

MAC and AMHR contributed to the conception and design of the work; CJBQ and LEA contributed to data collection; AMHR contributed to data analysis and interpretation; IEP and MJCH prepared the draft article, which was critically revised by AMHR and MAC. All authors read and approved the final version of the manuscript.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflicts of interests

The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

Table 1. Baseline clinical and demographic features of participants in the study groups

	TE plus IFC group (n = 25)	TE group (n = 24)	P Value
Mean age (years)	49.32 ± 8.17	44.50 ± 12.97	0.125
Sex: female; % (n)	60% (15)	83.3 % (20)	0.074
Body Mass Index (kg/cm^2)	26.34 ± 5.19	26.30 ± 5.80	0.978
Neck pain intensity (NPRS)	6.62 ± 1.10	6.62 ± 1.42	0.993
Neck Disability Index (0 to 50)	24.92 ± 8.39	27.96 ± 9.53	0.242
Flexion (º)	40.04 ± 9.50	34.50 ± 10.26	0.092
Extension	44.64 ± 7.43	42.92 ± 7.46	0.422
Right side bending	31.92 ± 7.06	30.50 ± 5.96	0.452
Left side bending	33.08 ± 7.79	29.71 ± 5.69	0.091
Right rotation	53.36 ± 14.37	54.33 ± 8.35	0.774
Left rotation	60.28 ± 11.47	53.75 ± 8.35	0.054
Overall range of movement	263.32 ± 41.47	245.70 ± 30.80	0.099

Data are reported as mean ± standard deviation or in frequencies (%).

Abbreviations: IFC, interferential current therapy; NPRS, Numeric Pain Rating Scale; TE, therapeutic exercise

Figures and table legends

Figure 1. CONSORT flowchart diagram of study participants.

Figure 2. Scores for self-reported neck pain and disability, and overall active range-of-movement in the study groups.

TE: therapeutic exercise; IFC: Interferential current therapy

* Indicates clinically relevant within-group changes.

Table 1. Baseline clinical and demographic features of participants in the study groups

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