Medical Hypotheses 126 (2019) 46–50

Contents lists available at ScienceDirect

Medical Hypotheses

journal homepage: www.elsevier.com/locate/mehy

A single preoperative pain neuroscience education: Is it an effective strategy for patients with carpal tunnel syndrome?

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ARTICLE INFO

Keywords:
Multimodal pain management
Physical therapy
Disability
Kinesiophobia
Carpal tunnel release

ABSTRACT

Patients undergoing carpal tunnel release surgery may continue to experience pain despite the intervention. This symptom may be modulated by psychosocial factors including depression, catastrophic thinking, and kinesiophobia. Pain neuroscience education (PNE) has been found to be effective when combined with therapeutic exercise in patients with chronic pain, but this strategy has not been evaluated in patients with persistent hand pain. The findings of this study indicate that a single preoperative PNE session in combination with therapeutic exercise does not provide added benefits in comparison to standard preoperative care plus therapeutic exercise. Future studies should evaluate if patients with carpal tunnel release are additionally benefited by the incorporation and consequent behavioural changes of more PNE sessions to multimodal treatment.

Introduction

Carpal tunnel syndrome (CTS) is a neurological condition caused by compression of the median nerve at the wrist, due to increased pressure within the carpal tunnel [1]. Surgical intervention is indicated in patients with persistent symptoms who have not responded to conservative management, patients with severe symptoms, or patients with serious electrophysiological disorders [2,3]. Surgery involves freeing the transverse carpal ligament to reduce pressure on the median nerve [4]. Unfortunately, symptoms persist after surgery in some patients [5–8].

Therapeutic exercise during the postoperative stage has been shown to provide more benefits than surgery alone [9]. Interestingly, a home exercise program, complemented by a standard pre-surgical protocol to provide education on the diagnosis and recovery process, produces similar results to postoperative sessions with a hand therapist [10]. However, this type of treatment does not incorporate psychosocial factors such as depression, kinesiophobia, and catastrophic thinking, which are considered to be important predictors of postoperative pain and disability [11–14]. Pain neuroscience education (PNE) is another simple, low-cost, and easily-implemented treatment option [15] that has been used to modulate these psychosocial factors [16–18].

The objective of PNE is to prevent, decrease, and treat symptoms, approaching pain as a natural and necessary process [19]. This strategy can be used to help patients better understand the biological and physiological elements of the experience of pain, with the goal of altering and reconceptualising the perception of pain [20]. PNE has been shown to reduce catastrophic thinking, kinesiophobia and anxiety in patients with chronic pain [16–18]. Recent studies have also shown that, in patients with neuropathic pain due to lumbar radiculopathy, a single preoperative pain education session was associated with a more favourable surgical experience and reduced healthcare utilisation compared to a control group [21], significantly decreasing healthcare costs during the three years following surgery [22]. However, Traeger et al. [23] showed that adding two hours of PNE to the recommended first-line care for patients with acute lower back pain did not improve pain outcomes. Therefore, it is necessary to prove if education can benefit other conditions of chronic pain.

Given that pain persists in some CTS patients after surgery [5–8], the role of psychosocial factors in modulating symptoms [11,14], and the apparently limited efficacy of unimodal postoperative rehabilitation [24] in this population, it is important to evaluate the clinical effects of multimodal interventions for pain management, including the use of new strategies to improve patient care, such as PNE.

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https://doi.org/10.1016/j.mehy.2019.03.013
Received 6 December 2018; Accepted 21 March 2019
0306-9877/

The hypothesis

While PNE has been found to be effective when combined with therapeutic exercise in patients with chronic pain [16,25], this strategy has not been evaluated in patients with persistent hand pain. PNE is a promising approach for this population as it addresses the psychosocial variables that may modulate pain-symptom factors [16–18]. The objective of this study, therefore, was to evaluate the efficacy of a multimodal intervention combining preoperative PNE with postoperative therapeutic exercise in surgical CTS patients. It was hypothesised that a single PNE session combined with preoperative exercise could have better results in perceived pain, catastrophic thinking, kinesiophobia, and the function of the upper limbs compared to standard preoperative care combined with preoperative exercise.

Methods

Participants and design

The study was a double-blind, randomized, controlled trial carried out by two physiotherapists. The investigator responsible for performing the study assessments was blind to the group assignment. The second investigator was responsible for generating the random allocation sequence, enrolling participants, assigning participants to interventions, and study treatment. The patients were blind to group assignment. There were no important changes to methods after trial commencement.

Potential study subjects were consecutive patients admitted for open carpal tunnel release surgery to treat CTS at the La Florida Clinical Hospital from June to November 2017. The inclusion criteria were: aged 18 years or older; awaiting surgery for physician-diagnosed CTS; and willingness to participate in the study. The exclusion criteria were: inability to understand test instructions; illiteracy; prior participation in a pain education program; uncontrolled mental health problem; cognitive disorder; or prior surgery on the extremity requiring operation. Participants provided informed consent following an explanation of the study aims and procedures. The Ethics Review Board of our institution approved all procedures (Hospital Clínico La Florida, RN0032017), which were performed in accordance with the principles of the Declaration of Helsinki of the World Medical Association and its revision in 2013. This trial was registered at www.clinicaltrials.gov (registration number: NCT03576196). The sample size was calculated using the software G*Power 3.1. Based on data from a prior study on the impact of pain education [19], perceived pain was predicted to decrease by 30.9 points on average, with a standard deviation of ± 18.7. Given a significance level of 0.05; a statistical power of 80%; and a predicted attrition rate of 20%, the minimum sample size required was 12 patients per group.

Intervention

Patients were randomly assigned to the intervention or control group using the software Randomization (www.randomization.com). Patients in the control group (CG) received standard care [21], which consisted of a single education session one week prior to surgery that provided information about the medical, anatomical, and pathological aspects of CTS. Patients in the experimental group (EG) received a single one-on-one session of PNE one week prior to surgery [21]. The 30-minute PNE session [21,22] was imparted by a trained Physical Therapist with two years of experience in PNE. The key contents of the session (Fig. 1) included the neurophysiological and biopsychosocial aspects of pain and the concept of peripheral and central sensitization. An audio-visual approach to instruction was used, with examples and metaphors to improve the patient's comprehension of the materials, as recommended by prior studies [15]. Both the EG and CG patients also received a session of hand therapy 7 days after surgery, with verbal and written instructions for a home exercise program that included active digital flexor tendon gliding; active thumb opposition; and active wrist range of motion (flexion and extension). Patients were instructed to perform 1 set of 5–10 repetitions, 4–6 times per day for 4 weeks [26].

Outcome measures

Both groups were measured prior to surgery and at weeks 4 and 12 after surgery. Perceived pain intensity was assessed using the Visual Analogue Scale (VAS). This tool has been validated and is reliable for evaluating postoperative pain [27]. Upper-extremity function was evaluated using the short form of the Disabilities of the Arm, Shoulder, and Hand Questionnaire (QuickDASH). This measure has been validated for disabilities specific to upper extremities [28,29]. To assess catastrophic thinking as a response to pain, the Pain Catastrophizing Scale (PCS) [30] was administered. This measure has been standardized and validated. To measure fear-of-movement due to pain, the Tampa Scale of Kinesiophobia (TSK-11) was used [31]. This measure has also been standardized and validated. Finally, emotional status prior to surgery was assessed using the Hospital Anxiety and Depression Scale (HADS) [32]. There were no changes to trial procedures after the trial commenced. All the questionnaires used in this study have been previously validated in Spanish.

Statistical analyses

Data normality was verified using a Shapiro-Wilk test; all data were normally distributed. The mean and standard deviation were calculated for quantitative variables, and percentages were calculated for qualitative variables. A general linear mixed model with two time points (4 and 12 weeks after surgery) was used to evaluate the effects of PNE on pain, upper-extremity disability, catastrophic thinking, and kinesiophobia, considering the following effects: treatment group (CG or EG), time-point (4 and 12 weeks after surgery), baseline score (covariate), and inter-group x time-point interaction. If a significant interaction was found between factors, post-hoc t-tests with Bonferroni correction for multiple comparisons were applied. Statistical significance was established at $p < 0.05$. All statistical analyses were conducted in SPSS version 22.0 (IBM Corporation, Armonk, NY). Small, moderate, or large effect sizes were established by calculating the partial eta squared ($\eta_p^2 \geq 0.01$, $\eta_p^2 \geq 0.06$, or $\eta_p^2 \geq 0.14$, respectively).

Results

Of the 41 patients subjected to surgery, 8 did not meet inclusion criteria, 2 refused to participate, and 1 was lost during follow-up (Fig. 2). The period of recruitment was 6 months, and the trial ended when the estimated sample size was reached. The demographic and reference data for the 30 patients included in this study are shown in Table 1. The two groups appeared numerically similar regarding a range of characteristics.

General linear mixed model analysis showed non-significant differences between treatments for VAS ($p = 0.553$; $\eta_p^2 = 0.006$), significant differences for time-point ($p = 0.040$; $\eta_p^2 = 0.063$) and baseline score ($p = 0.011$, $\eta_p^2 = 0.111$), and a non-significant inter-group x time-point interaction ($p = 0.816$; $\eta_p^2 = 0.001$). QuickDASH results revealed non-significant differences between treatments ($p = 0.651$, $\eta_p^2 = 0.004$), significant differences for time-point ($p = 0.024$; $\eta_p^2 = 0.089$) and baseline score ($p = 0.020$; $\eta_p^2 = 0.095$), and a non-significant inter-group x time-point interaction ($p = 0.506$; $\eta_p^2 = 0.008$). Regarding psychosocial variables, the PCS showed non-significant differences between treatments ($p = 0.594$; $\eta_p^2 = 0.005$) and time-point ($p = 0.510$; $\eta_p^2 = 0.008$), significant differences for baseline score ($p < 0.001$; $\eta_p^2 = 0.296$), and a non-significant inter-group x time-point interaction ($p = 0.510$; $\eta_p^2 = 0.008$). Finally, TSK-11 responses showed non-significant differences between treatments

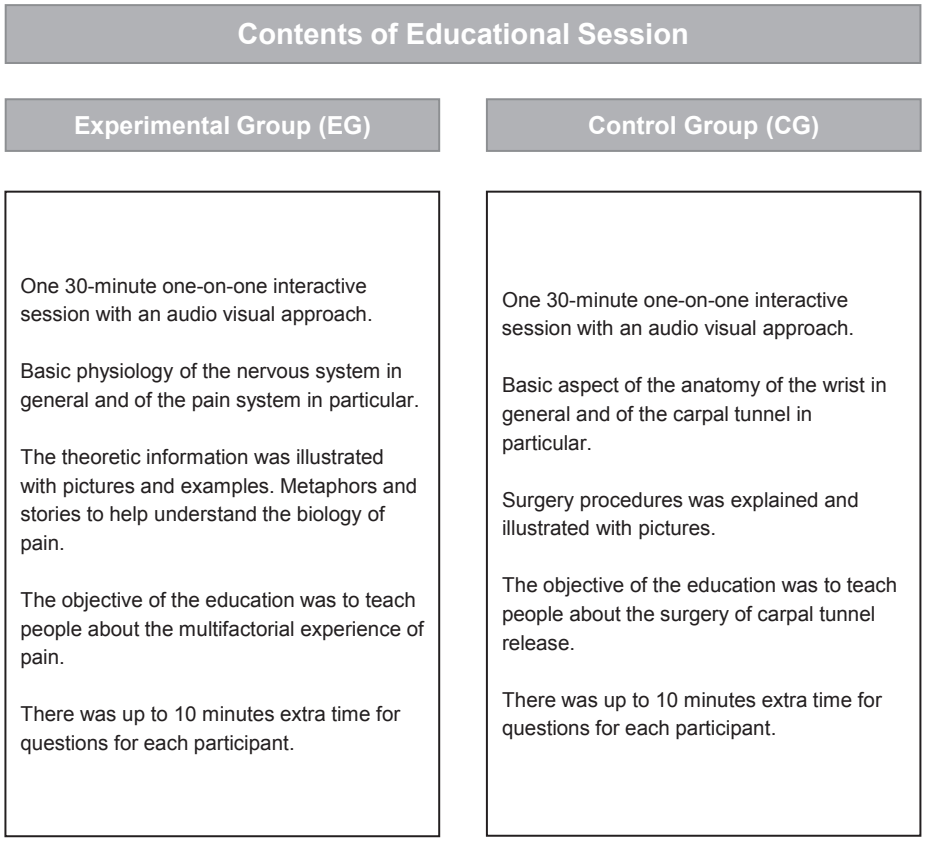

Fig. 1. Contents of Educational Session.

($p = 0.628$; $\eta_p^2 = 0.004$) and time-point ($p = 0.278$, $\eta_p^2 = 0.021$), significant differences for baseline score ($p = 0.015$, $\eta_p^2 = 0.103$) and a non-significant inter-group x time-point interaction ($p = 0.717$; $\eta_p^2 = 0.002$).

Taken together, the obtained results indicate that both treatments have similar effects over time on pain and upper-extremity function, but not on psychosocial variables. All result data are shown in Table 2. All patients reported having completed their home exercise program at

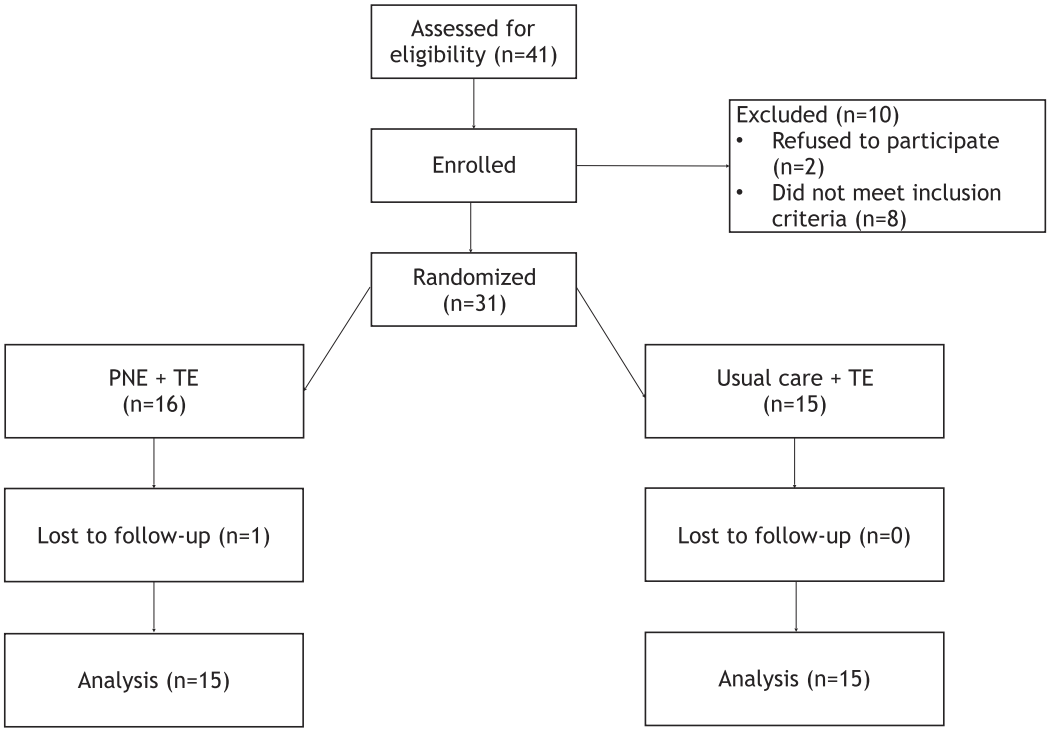

Fig. 2. Patient flow diagram. Abbreviations: PNE, Pain Neuroscience Education; TE, Therapeutic Exercise.

Table 1
Intervention groups at baseline.

	Experimental (n = 15)	Control (n = 15)	Total sample (n = 30)
Gender (%)			
Female	15 (100%)	15 (100%)	30 (100%)
Male	0 (0%)	0 (0%)	0 (0%)
Age (years)	56.8 ± 8.4	50.8 ± 17.7	53.8 ± 13.9
BMI (kg/m^2)	30.1 ± 4.7	31.9 ± 6.2	31.0 ± 5.5
Comorbidities (%)			
Diabetes mellitus	6 (40%)	8 (53.3%)	14 (46.6%)
Depression	4 (26.7%)	2 (13.3%)	6 (20%)
Other	8 (53.3%)	5 (33.3%)	13 (43.3%)
No history	3 (20%)	5 (33.3%)	8 (26.7%)
Educational level (%)			
Primary	7 (46.7%)	6 (40%)	13 (43.3%)
Secondary	3 (20%)	5 (33.3%)	8 (26.7%)
Higher	5 (33.3%)	4 (26.7%)	9 (30%)
Duration of CTS (years)	3.5 ± 2.8	2.6 ± 2.9	3.1 ± 2.9
Type of work activity (%)			
Desk-based	2 (13.3%)	4 (26.7%)	6 (20%)
Non-desk-based	13 (86.7%)	11 (73.3%)	24 (80%)
Employment status (%)			
Part-time	3 (20%)	3 (20%)	6 (20%)
Full-time	12 (80%)	12 (80%)	24 (80%)
Patient-reported outcomes			
VAS	72.6 ± 22.1	61.7 ± 21.6	67.5 ± 21.8
QuickDASH	69.2 ± 15.9	57.5 ± 15.8	63.8 ± 16.5
PCS	37.4 ± 11.6	28.8 ± 10.2	33.4 ± 11.6
TSK-11	32.5 ± 8.1	31.6 ± 7.3	32.1 ± 7.6
HADS	16.9 ± 7.6	13.0 ± 8.1	14.9 ± 7.9

Abbreviations: PNE, Pain Neuroscience Education; BMI, Body Mass Index; CTS, Carpal Tunnel Syndrome; VAS, Visual Analogue Scale; DASH, Disabilities of the Arm, Shoulder, and Hand Questionnaire; PCS, Pain Catastrophizing Scale; TSK-11, Tampa Scale of Kinesiophobia; HADS, Hospital Anxiety and Depression Scale.

the 4 and 12-week study visits. No important harm or unintended effects were reported for either group.

Discussion

These results disproved our hypothesis that a single PNE session combined with postoperative exercise could have better results on perceived pain, catastrophic thinking, kinesiophobia, and function of the upper limbs compared to standard preoperative care combined with postoperative exercise. This despite the role of psychosocial variables in modulating pain in this population [11,14]. The results of this study suggest that a single session prior to surgery is insufficient to produce such improvements in our target population. In any case, a multimodal approach to intervention remains prudent as there is limited evidence for the efficacy of unimodal therapies in the postsurgical rehabilitation of patients with CTS [24].

In this study, both the experimental and control groups showed significant improvements over time, including decreased pain intensity and improved upper-extremity function. Therefore, it is important to note that patients undergoing surgical intervention for CTS benefitted from multimodal treatment combining therapeutic exercise and preoperative education, regardless of whether the education addressed the neurophysiological aspects of pain or the medical, anatomical, and pathological aspects of the syndrome.

Our findings are consistent with prior studies in patients undergoing lumbar spinal surgery [21,22], who did not experience additional benefit in terms of pain intensity after receiving preoperative PNE. Louw [22] reported that PNE is associated with a more favourable surgical experience, decreased healthcare utilisation, and decreased healthcare spending. However, Traeger et al. [23] showed that intensive patient education is not effective when compared with placebo for patients with acute lower back pain. Furthermore, Lluch et al. [18] did not obtain additional benefits for pain and disability when incorporating preoperative PNE in patients with knee osteoarthritis; however, they did report improvements in the psychosocial variables related to pain catastrophism and kinesiophobia. We believe that the results obtained by Lluch et al. [18] in the psychosocial variables could be attributed to reinforcement sessions (4 treatment sessions) and repeated reminders to participants (email and phone calls), which were not considered in our study.

Both groups in the present study did not show significant improvements over time in psychosocial variables (i.e. TSK-11 and PCS). This would indicate that a single education session is not enough to generate changes in patient beliefs. Recent studies have suggested that PNE combined with therapeutic exercise may reduce perceived pain intensity if follow-up sessions are provided to reinforce the content [16,25]. Therefore, we believe that PNE could have greater benefits in patients with carpal tunnel release depending on educational reinforcement and patient retention of key contents over time.

To the best of our knowledge, this is the first study to concomitantly evaluate the effects of PNE on patients undergoing CTS surgery and the critical role of multimodal treatment in this population, with emphasis on the cognitive elements that modulate pain. A limitation of this study is that we did not have direct control of at-home exercises; while patients reported compliance, some level of uncertainty remains. Furthermore, we did not evaluate the patients' capacity to retain the information presented during the preoperative PNE session and the relationship thereof with behavioural changes. A lack of comprehension and incorporation may have limited the efficacy of the intervention, especially given the low educational level of the study sample. It would be helpful to conduct future studies that include follow-up sessions for PNE-contents reinforcement and that optimise retention by adapting PNE instruction to the patients' educational level.

Table 2
Comparison between groups.

		4 weeks after surgery	12 weeks after surgery
VAS (0–100 mm)	CG	39.5 ± 21.2 [27.9–50.9]	26.9 ± 25.8 [12.9–40.9]
	EG	42.8 ± 21.1 [31.7–53.8]	33.6 ± 20.1 [23.1–44.1]
Quick DASH (points)	CG	38.2 ± 19.8 [27.4–48.9]	24.4 ± 22.2 [12.3–36.4]
	EG	40.3 ± 21.4 [29.1–51.4]	32.3 ± 16.9 [23.4–41.2]
PCS (points)	CG	14.4 ± 13.3 [7.1–21.6]	10.5 ± 12.8 [3.6–17.5]
	EG	16.0 ± 13.6 [8.9–23.1]	16.1 ± 12.4 [9.6–22.7]
TSK-11 (points)	CG	28.0 ± 6.3 [24.6–31.4]	25.4 ± 9.4 [20.3–30.5]
	EG	26.4 ± 8.6 [21.8–30.9]	24.9 ± 7.1 [21.2–28.6]

Data are expressed as mean ± standard deviation [95% confidence interval]. VAS, Visual Analogue Scale; DASH, Disabilities of the Arm, Shoulder, and Hand Questionnaire; PCS, Pain Catastrophizing Scale; TSK-11, Tampa Scale of Kinesiophobia; CG, Group; EG, Experimental Group. N = 15 for both groups.

Conclusion

The findings of this study indicate that a single preoperative PNE session in combination with therapeutic exercise did not provide additional benefits in comparison to standard preoperative care plus therapeutic exercise. Future studies should evaluate whether incorporating a greater number of sessions of PNE to the multimodal treatment and its relation to behavioural changes generates additional benefits in patients with carpal tunnel release.

Conflicts of interest

The authors have no conflict of interest to declare. No financial support was provided for this research.

Funding

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

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.mehy.2019.03.013.

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