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Photobiomodulation in the treatment of chronic non-specific neck pain. A randomized clinical trial

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Abstract

Introduction. Neck pain is defined as the presence of musculoskeletal pain in the posterior region of the neck, above the shoulders, or in the upper dorsal area. Physiotherapy aims to minimize pain, recover mobility, and strengthen muscles. For this, it uses several techniques, such as photobiomodulation, which can be achieved by light emitting diode (LED) therapy and low level laser therapy (LLLT). The objective of this study was to analyse the effect of the association of LED and LLLT in the treatment of chronic non-specific neck pain.

Methods. A quantitative, experimental, randomized study was performed. The sample was composed of 28 individuals, divided into a control group and an intervention group. Pre- and post-treatment visual analogue scale, Leeds Assessment of Neuropathic Symptoms and Signs, and the McGill Pain Questionnaire were used. Both groups were submitted to 6 sessions during 2 weeks, with a cluster apparatus, composed of an arrangement of 3 LEDs (590 nm, 1500 mW) and an LLLT (830 nm, 150 mW); the control group received placebo laser intervention. The application was punctual (1 minute per region), at the point of greatest pain, in the trapezius, scalene, and sternocleidomastoid muscles.

Results. In both cases, the pain reduction was significant ($p < 0.05$) for the 3 assessment instruments; however, the effect sizes for the visual analogue scale and the McGill Pain Questionnaire were higher in the intervention group.

Conclusions. The cluster used was effective in reducing pain in individuals with chronic non-specific neck pain.

Key words: neck pain, low-level light therapy, phototherapy

Introduction

Neck pain is defined as the presence of musculoskeletal pain in the posterior region of the neck, above the shoulders, or in the upper dorsal area. It is estimated that 22–70% of the population will experience at least one episode of cervical pain at some point in their lives [1]. The annual incidence in adults is 14.6%, and women are more vulnerable than men. The main complaints of individuals with neck pain include reduced range of motion and difficulty in completing daily tasks [2]; in addition, it can generate postural changes that even interfere with diaphragmatic excursion [3].

Neck pain can be classified as acute, when there is pain for less than 6 weeks; subacute, below 3 months; and chronic, above 6 months [4]. Factors associated with chronicity are low job satisfaction, sedentariness, headaches, female gender, secondary gain, ergonomic and psychosocial causes [4, 5]. Neck pain can be considered non-specific when there is no primary disease, such as trauma, infection, inflammatory disorder, neurological or systemic disease [6].

Physiotherapy can play an important role in the treatment of patients with chronic cervical pain, as it seeks to minimize pain, recover mobility, and strengthen the muscles, providing an improvement in quality of life [7–11]. For this, resources such as photobiomodulation are applied, with the use of low level laser therapy (LLLT), which is characterized by monochromaticity, collimation, spatial and temporal coherence, producing a non-invasive treatment, painless and capable of providing biomodulatory effects on living organisms [12], with anti-inflammatory, pro-repair and analgesic actions [13, 14]. In turn, a light emitting diode (LED) is a diode that emits monochromatic radiation, but not coherent; however, it apparently also presents anti-inflammatory, healing, and pain mitigation properties, similar to LLLT [15–18]. Since some equipment currently takes the form of a cluster in which there are associated LEDs and LLLTs, the objective of this study was to evaluate the joint use of these tools in the treatment of individuals with chronic non-specific cervicalgia, aiming at reducing the pain.

Subjects and methods

The study is characterized as a quantitative, experimental, randomized trial, blinded for the volunteer and evaluator. It was conducted at the Physical Rehabilitation Centre of the Western Paraná State University (Unioeste), Cascavel, Brazil.

The target population consisted of young individuals. Inclusion criteria were chronic non-specific cervical pain and age of 18–30 years. Exclusion criteria involved shoulder lesions, temporomandibular joint dysfunction, osteoarthritis, tumours, cervical trauma, infectious diseases, degenerative disc disease, pacemaker, pregnancy, hypothyroidism, and heart problems.

Invitations were made in social media and 32 individuals with chronic non-specific neck pain complaint were screened. After selection by inclusion and exclusion criteria, 28 participants were randomized into 2 groups (14 individuals each): a control group (CG), receiving placebo laser application, and an intervention group (IG), receiving active cluster application.

The variables analysed in this study were the scores of the visual analogue scale (VAS) for pain, Leeds Assessment of Neuropathic Symptoms and Signs (LANSS), and the McGill

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Pain Questionnaire, applied prior to the first therapy session and at the end of the last one. VAS was used to quantify pain intensity, and is characterized as a numerical scale, ranging from 0 to 10 (0: without pain, 10: worst pain) [19].

The LANSS scale is an instrument capable of reliably distinguishing a nociceptive, neuropathic, or mixed dominant pain [20]. Validated in Brazil by Schestatsky et al. [21], the scale ranges from 0 to 24 points and consists of 2 sections: one that explores the qualitative aspects and the other one for pain sensitivity.

The McGill Pain Questionnaire [22] is an instrument used to evaluate quantitative measures of pain in the sensory, affective, and evaluative quality of the painful phenomenon. Besides, there is a subcategory of pain miscellaneous. For the final score, the sum of the values for each subclass was considered.

The equipment used for therapies was the Fluence HTM with Amber LED cluster + infrared laser, composed of an arrangement of 3 LEDs and LLLT. The LEDs had a wavelength emission of 590 nm ± 10% (1500 mW), and the LLLT of 830 nm (150 mW); the applicator area was 23.8 cm^2. The equipment had a valid calibration certificate. The volunteer was seated on a chair, with the head in bending supported by a roller placed on a stretcher. The emitter was applied bilaterally for 1 minute to each region at the point of greatest pain, found by palpation in the trapezius, scalene, and sternocleidomastoid muscles. The intervention was applied 3 times a week for 2 weeks. In IG, the emission energy equalled 8.4 J; in CG, the application occurred with the apparatus off, characterizing placebo. The volunteer used eye protection, which prevented them from viewing the equipment, and the therapist wore goggles for the red and near-infrared wavelengths.

The data were presented as mean and standard deviation, with inferential analysis performed by generalized mixed models and with post-test least significant difference. In all cases, the significance level was 5% ($p < 0.05$), comparisons occurred between groups, evaluations, and interaction of factors. Hedges' effect size by *g* was also evaluated, with the following interpretation: ≤ 0.19 – negligible; 0.20–0.49 – small; 0.50–0.79 – medium; 0.80–1.29 – large; ≥ 1.30 – very large.

Ethical approval

The research related to human use has complied with all the relevant national regulations and institutional policies, has followed the tenets of the Declaration of Helsinki, and has been approved by the Ethics and Research Committee of Western Paraná State University (opinion No.: 3,231,455) and registered with the Brazilian Registry of Clinical Trials (RBR-7YDVPF).

Informed consent

Informed consent has been obtained from all individuals included in this study.

Results

The study involved 28 individuals, divided into 2 groups: CG and IG. Among these, 6 individuals in CG did not complete the treatment by abandonment of the sessions, which provides 8 individuals in CG and 14 in IG. In CG (7 females and 1 male), the average age was 20.87 ± 3.31 years, with a height of 1.65 ± 0.09 m. The individuals in IG (13 females and 1 male) had a mean age of 24.64 ± 10.61 years and height of 1.65 ± 0.07 m.

For VAS, no significant results were evidenced for comparison between groups ($p = 0.608$), but for evaluations ($p < 0.001$) and interaction ($p = 0.043$), significant reductions for CG ($p = 0.027$) and IG ($p < 0.001$) were observed, with large and very large effect sizes, respectively (Table 1).

Since the LANSS scale in the 1st evaluation, both for CG and IG, had a mean of less than 8, the pain did not present a neurological but rather a nociceptive characteristic. After treatment, the mean decreased in the comparison between evaluations ($p = 0.033$); however. there were no significant differences when comparing the groups ($p = 0.339$) or interaction ($p = 0.568$), and both groups presented mean effect sizes (Table 2).

The McGill Pain Questionnaire evaluated the sensory, affective, evaluative, miscellaneous, and total scores. There were no differences between groups and interaction ($p > 0.05$), but differences were observed between evaluations (sensory:

Table 1. Evaluation of the visual analogue scale for pain (mean and standard deviation)

Group	EV1	EV2	*ES*
CG	5.9 ± 0.8[a]	4.5 ± 1.4[b]	–1.12
IG	6.9 ± 1.3[a]	4.0 ± 1.8[b]	–1.80

EV1 – 1st evaluation, EV2 – 2nd evaluation, CG – control group, IG – intervention group
Different lower case letters show significant differences.

Table 2. Leeds Assessment of Neuropathic Symptoms and Signs scale evaluation (mean and standard deviation)

Group	EV1[A]	EV2[B]	*ES*
CG	7.4 ± 2.7	5.4 ± 2.1	–0.77
IG	6.8 ± 4.8	3.4 ± 4.2	–0.72

EV1 – 1st evaluation, EV2 – 2nd evaluation, CG – control group, IG – intervention group
Different capital letters show significant differences.

Table 3. The McGill Pain Questionnaire evaluation (mean and standard deviation)

Score	Evaluation	CG	IG
Sensory	EV1[A]	15.5 ± 6.8	18.1 ± 7.7
	EV2[B]	13.1 ± 9.1	12.9 ± 7.4
	ES	–0.28	–0.67
Affective	EV1[A]	3.2 ± 3.7	4.9 ± 3.4
	EV2[B]	1.7 ± 2.2	2.6 ± 2.7
	ES	–0.46	–0.73
Evaluative	EV1[A]	2.5 ± 0.8	3.6 ± 1.2
	EV2[B]	1.6 ± 0.5	2.1 ± 1.3
	ES	–1.31	–1.16
Miscellaneous	EV1[A]	4.4 ± 3.8	6.3 ± 4.8
	EV2[B]	2.6 ± 3.0	3.6 ± 3.7
	ES	–0.48	–0.60
Total	EV1[A]	25.6 ± 13.9	32.9 ± 15.5
	EV2[B]	19.1 ± 13.0	21.2 ± 14.1
	ES	–0.46	–0.76

CG – control group, IG – intervention group, EV1 – 1st evaluation, EV2 – 2nd evaluation
Different capital letters show significant differences.

$p = 0.150$, affective: $p = 0.003$, evaluative: $p < 0.001$, miscellaneous: $p = 0.022$, and total: $p = 0.002$). The effect sizes for sensory, affective, miscellaneous, and total scores were small and medium in CG and IG; for the evaluative score, the effect size was very large in CG and large in IG (Table 3).

Discussion

The present study showed that both the placebo and the photobiostimulation treatment led to a reduction in the pain-related variables studied. In absolute numbers, female volunteers were more numerous, and a sample composed of young people was chosen. This predominance goes against the studies on neck pain mapping [4, 23].

In a review study on the use of LLLT in the cervical region, there is an indication that applying an 830-nm wavelength is more effective, with a variation between 0.8 and 9 J and an irradiation time of 15–180 seconds per point of application; the World Association for Laser Therapy recommends to use at least 4 J per point in the cervical region [24]. In the present study, a form of association of LED with LLLT of 830 nm with 60 seconds at each point was provided, with the associated dose of 8.4 J. It is worth noting that the energy delivered was associated with the red radiation of LED, with much of the photonic energy emitted by this means, which has analgesia as one of its effects [17, 18, 25].

In this study, the volunteers submitted to the cluster exhibited a reduction in the 3 instruments used for evaluation, in absolute numbers and effect size. Only for LANSS, IG did not show effect sizes above those in CG, i.e., clinically, there were advantages of the treatment, especially in terms of pain intensity, in which there was a very large effect size for this therapy. El-Gendy et al. [26] performed a study in which they evaluated different associated electrotherapeutic methods (among them, a low power laser, 905 nm, 25 mW, 1.5 J/cm^2, 1 minute per day, for 12 days) compared with myofascial release and only stretching and strengthening exercises in individuals with chronic cervical pain of mechanical origin. They reported that there were advantages of the former over the conventional therapy group (exercises), with no differences between them for pain or function.

The use of photobiomodulation is based on the fact that the cells present sensitive receptor systems to the photons, and these, once stimulated by radiation, promote changes in the permeability of the cell membrane, in the transmembrane transport systems, besides stimulating mitochondrial enzymes, such as cytochrome c oxidase, which results in increased production of ATP [27, 28]. Also, histological and morphometric analyses demonstrate that treatment with LED induces a qualitative and quantitative increase in fibroblasts, thereby raising the content of tissue collagen [29].

With regard to the effect observed in CG, it can be assigned to the placebo effect. Such effect can be ascribed to an altered psychological state achieved by subjecting the individual to a non-active stimulus, which produces a response of the central nervous system in areas related to pain perception, making them more active [30–32]. It should be noted that in this group, participant loss occurred throughout the therapy, which may suggest that individuals less likely to incur the placebo effect may have given up on care precisely because they did not observe a reduction in pain.

Limitations

The sample loss is a limitation of this study. Thus, it is suggested that future studies may be conducted with larger sample sizes and involve an absolute CG in order to better clarify the effects.

Conclusions

In the present study, photobiostimulation produced a reduction in pain among individuals with chronic non-specific neck pain. Cluster therapy can thus be indicated in such cases.

Disclosure statement

No author has any financial interest or received any financial benefit from this research.

Conflict of interest

The authors state no conflict of interest.

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