Shiryan *et al.*
Bulletin of Faculty of Physical Therapy (2022) 27:33
https://doi.org/10.1186/s43161-022-00085-9

Bulletin of Faculty of Physical Therapy

ORIGINAL RESEARCH ARTICLE Open Access

Effectiveness of polarized polychromatic light therapy on myofascial trigger points in chronic non-specific low back pain: a single blinded randomized controlled trial

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Abstract

Background: Phototherapy has been used for the treatment of chronic low back pain. However, the effect of linear polarized polychromatic light (PL) has not been examined on myofascial trigger points in patients with chronic non-specific low back pain (NSLBP).

Objectives: To investigate the effectiveness of PL on pain intensity, pain sensitivity of active myofascial trigger points (MTrPs) in gluteus medius (GM) and quadratus lamborum (QL) muscles, back disability, and lumbar range of motion in chronic NSLBP.

Methods: Forty-two participants of both genders with chronic NSLBP were randomly allocated into two equal groups: group A (Linear polarized polychromatic light (PL): 21 participants received polarized light therapy in the range of red and near-infrared rays on myofascial trigger points of bilateral GM and QL muscles for 5 min/point followed by stretching and strengthening exercises for 4 weeks. Group B (Sham PL): 21 participants received the same program but with sham linear polarized polychromatic light therapy. Numeric pain rating scale, pressure algometer, and Roland-Morris Disability Questionnaire were used to measure pain intensity, pain sensitivity (as represented by pain pressure threshold (PPT) of MTrPs of the target muscles and back disability respectively. Further, lumbar flexion, extension, and bilateral rotation were examined with a tape measure, while bilateral side bending were examined with a universal goniometer.

Results: After the intervention program, significant improvements ($p < 0.05$) in pain intensity, PPT of MTrPs of left GM (Effect Size (ES): 1.23) and bilateral QL muscles (ES Rt QL: 0.9; Lt QL: 1.56) were found in group A in comparison with group B. Nevertheless, the two groups displayed similar improvements ($p > 0.05$) in lumbar range of motion and back disability.

Conclusion: Linear polarized polychromatic light therapy in the range of red and near-infrared rays improves pain intensity and pain sensitivity of myofascial trigger points in chronic NSLBP.

Trial registration: PACTR, PACTR202111577053926. Registered 22 June 2019-Prospectively registered.

Keywords: Low back pain, Myofascial trigger points, Infrared therapy, Photobiomodulation therapy, Polarized light

Introduction

Low back pain (LBP) is a prevalent global health problem [1] and the leading cause of years lived with disability [2]. It has a negative impact on work efficiency and quality of life [2, 3] and more notably imposes a heavy burden

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to society [4]. Commonly, LBP cannot be attributed to a recognized specific pathology; thus referred to as non-specific low back pain (NSLBP) [5]. Patients with NSLBP are frequently presented with active and latent myofascial trigger points (MTrPs) [6]. MTrP is identified as a hypersensitive spot in a palpable taut band of skeletal muscle fibers, when stimulated with mechanical pressure it induces local pain and twitch response as well as referred pain [7]. MTrPs are further subdivided into two different types: active and latent. Both active and latent MTrPs provoke local and referred pain, but active MTrPs also reproduce patient symptoms, while latent MTrPs do not [7]. MTrPs can be associated with muscle weakness, muscle dysfunction, and movement restriction [8]. Previous studies found that the quadratus lumborum, the iliocostalis lumborum, and the gluteus medius muscles were the most affected by MTrPs in patients with chronic NSLBP [9–11] and were easier in manual palpation [11].

Currently, several non-pharmacological interventions are available for the treatment of LBP [3]. Photobiomodulation therapy (PBMT) is one of these interventions that have been lately advocated by the American College of Physicians clinical practice guidelines for the treatment of LBP [12]. PBMT is a form of phototherapy that uses low-intensity, non-ionizing light therapy to induce therapeutic effects through the interaction with mitochondria [13]. The positive therapeutic outcomes of PBMT include relief of pain or inflammation, immunomodulation, wound healing, and stimulation of tissue regeneration [14]. Light amplification via stimulated emission of radiation (laser), light emitting diodes (LEDs), and broadband irradiation in the visible and infrared spectrums are all examples of how PBMT is applied [15]. A promising and under-investigated type of PBMT is polarized light therapy [14]. In this type of phototherapy, light travels in specific planes in contrary to normal propagation of light waves across all different planes [16]. Polarized light has the advantage of deeper tissue penetration to a depth of up to 5 cm. Polarized light therapy has been shown to accelerate ulcer healing and musculoskeletal injuries [17].

Polarized polychromatic light therapy is a low-power light source as well like laser therapy. However, rather of being monochromatic and coherent light beam, polarized light is polychromatic and non-coherent. Further, compared to laser therapy linear polarized polychromatic light therapy is less expensive and does not necessitate the same safety measures for both the patient and the therapist and allows wider areas to be irradiated as opposed to the small diameter of the laser beam [18].

Polarized polychromatic light in the range of red and near-infrared rays is a non-pharmacological therapeutic modality that is user-friendly, safe, and inexpensive [19]. Polarized red and near infrared light therapy has been shown to promote biological activities when compared to non-polarized light [15]. The energy absorption by photoacceptors (chromophores) during light irradiation determines the photo-biological activities [20]. The physiological effects of infrared radiation are assumed to be caused by two kinds of photoacceptors (i.e., intracellular water and cytochrome c oxidase) [20]. Light is converted into signals through photon absorption, which may then be used to trigger biological activities [21].

The application of far infrared rays for treating myofascial trigger points has been examined [22, 23]. It is theorized that far infrared rays have the potential to improve blood flow and decrease ischaemia in myofascial neck pain [22] and in trapezius myofascial trigger points [23]. However, there is dearth in the controlled studies on the effect of polarized red and near infrared rays on myofascial trigger points in chronic NSLBP. Thus, this study was designed to investigate the effect of linear polarized polychromatic light therapy in the range of red and near infrared rays on pain intensity, pain sensitivity of active MTrPs in gluteus medius and quadratus lamborum muscles, back disability, and lumbar range of motion in patients with chronic NSLBP.

Methods

This study was carried out at the Outpatient Physical Therapy Department, in Atres General Hospital at Mansheyt Alqanatir, Giza, from October to December 2019 and approved by the local ethics committee of the Faculty of Physical Therapy, Cairo University (P.T.REC/012/002341) and was registered in Pan African Clinical Trial Registry (PACTR202111577053926).

Design of the study

A prospective parallel-group single blinded randomized controlled trial.

Participants

Forty-two patients with clinically diagnosed chronic NSLBP participated in this study. Participants of both genders with an age range of 25–45 years and a BMI between 18 and 25 Kg/m^2 were recruited by word of mouth. Chronic NSLBP is described as pain or discomfort between the costal margins and inferior gluteal folds that lasts at least 3 months and may be accompanied by referred pain to the lower limbs [24]. At time of conducting the study, the participants should have had a minimum of one active MTrP in the examined bilateral muscles (gluteus medius and quadratus luborum) and a baseline score of "3" and "4" in numeric pain rating scale (NPRS) and Roland-Morris Questionnaire (RMQ) respectively. Patients with severe skin diseases (for example, skin cancer, severe psoriasis, severe eczema, and severe

dermatitis); patients with LBP associated with nerve root compression; serious spinal pathologies, such as fractures, tumors, inflammatory, and infectious diseases; serious cardiovascular or metabolic disorders; previous spinal surgery; fibromyalgia; and pregnancy were excluded from the study.

Procedures

For MTrPs identification, patients were screened by a licensed clinical physiotherapist with 10 years of clinical experience. MTrPs identification was done according to the criteria of active MTrP diagnosis [25], and then MTrPs were marked with a pen marker.

All participants were instructed about the objectives of the study and agreed to participate before signing a written informed consent form.

Interventions

All participants received 20 min of conventional program which consisted of manual passive stretching exercises for the hamstrings from supine, iliopsoas from side lying, back extensors muscles from cross sitting and lower back muscles from crook lying positions, the stretching position was maintained for 30 s and was repeated 3 times/session. Then, a gradual strengthening exercises for the abdominals and back muscles were conducted from crook lying and prone positions respectively. The intensity of the exercises started with 10 repetitions/set and then was increased gradually to provide safety and adapt to the change of the strength of the patient's muscles in response to exercise [26].

Group A: linear polarized polychromatic light therapy (LP)

A Bioptron Compact (Medolight Zepter, Harrier Inc., USA) device was used to administer the linear polarized red and near-infrared radiation therapy. Medolight consists of 108 light emitting diodes, (LED), built with gallium-arsenic semiconductors which produced linearly polarized, polychromatic, non-coherent light with wavelengths: Near Infrared 880 ± 30 nm and Red 640 ± 30 nm, power density of 40 mW/cm^2, power supply of 100–240 V, 95 % degree of polarization, frequency of 50 HZ and max energy density/5 min: 8 J/cm^2. For the application of linearly polarized, polychromatic light, the patients were asked to assume a prone-lying position and then the MTrPs of the target muscles were exposed directly to the device which was held in contact with skin for 5 min per point (Figs. 1 and 2).

Group B: sham LP

The participants received the same device and procedures but with no light emitted as the device was switched off.

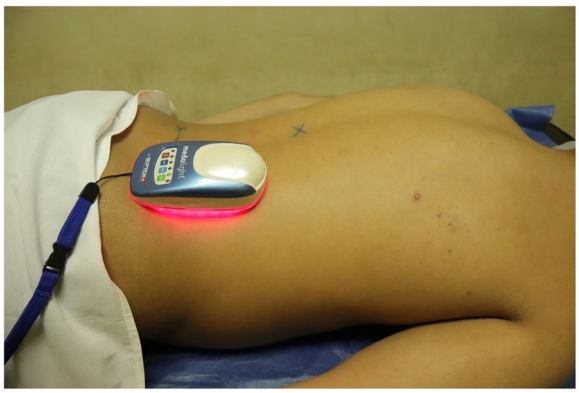

Fig. 1 Irradiation of MTrPs of right quadratus lamborum muscle with LP

All participants received the treatment protocol three times per week for 4 weeks. Each session lasted for approximately 40 min. During the study, participants were instructed not to receive any other treatment to the target area. Further, participants were instructed to perform the exercise program at home. To verify their compliance to the abovementioned instructions, the participants were asked about it each session. All participants were examined in the same conditions at the start and completion of a 4-week treatment program. PPT and lumbar ROM measurements were taken by a licensed clinical physiotherapist with almost 10 years of clinical experience and who was blinded to group allocation.

Outcome measures

1) *Pain intensity*

Numerical pain rating scale (NPRS) was used to measure the level of pain intensity. Each patient of both groups was asked to select (Mark) a whole number (0–10

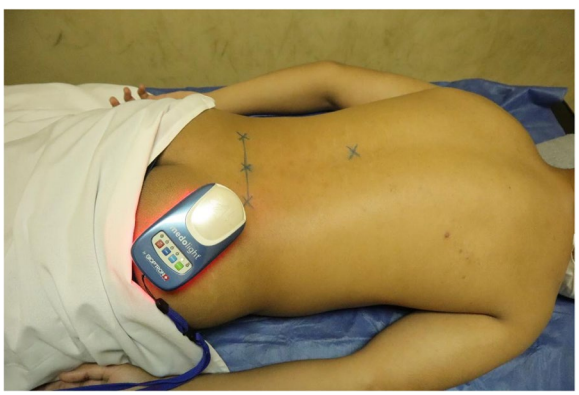

Fig. 2 Irradiation of MTrPs of right gluteus medius muscle with LP

integers) that best reflected the current intensity of his/her pain. NPRS is a one-dimensional, reliable, and valid scale with adequate sensitivity. Compared to other pain scales, NPRS is superior to the visual analogue scale, and verbal rating scale [27].

2) *Pressure pain threshold (PPT)*

FPK (Wagner Pain Test^{TM} Instruments-Model FPK/FPN-Greenwich-USA) model digital algometer was used to measure PPT in MTrPs. Digital pressure algometer is a reliable tool in quantifying mechanical pain sensitivity of deep structures in LBP [28]. Pressure algometers are useful for objectively quantifying muscle pressure pain thresholds. PPT is thought to be a useful parameter for measuring a treatment's effect in low back pain [28].

3) *Back function disability*

It was determined using the Roland-Morris Disability Questionnaire (RMDQ). It is a self-administered assessment in which higher values on a 24-point scale indicate greater levels of functional disability [29]. The use of RMDQ as a reliable and valid tool to assess the effect of chronic LBP on physical performance has been recently recommended [30]. The Arabic version of the RMDQ has high reliability and internal consistency, as well as good agreement with the English version [31].

4) *Lumbar range of motion*

A tape measure was used to measure lumbar flexion, extension, and bilateral rotation. Starting position. *Flexion and extension:* from standing position, the patient stood with feet shoulder width apart. With the patient in the start position, a pen marker was used to mark a point 15 cm above the midpoint of the line linking the posterior superior iliac spines (PSISs) (i.e., the spinous process of S2), and then a tape measure was used to measure the distance between the two points. End position. *Flexion:* the patient was asked to bend forward to the limit of his lumbar flexion motion. The distance between the PSIS and the 15-cm skin mark at the limit of lumbar flexion range of motion (ROM) was measured a second time. The lumbar spinal flexion ROM was the difference between the start and end measurements. This measuring technique is known as the modified-modified Schöber test (MMST) [32]. The MMST was found to have moderate validity ($r = 0.67$), excellent reliability (intraclass correlation coefficient > 0.91) and a minimum metrically detectable change (MMDC) of 1 cm [33]. *Extension*: the patient's hands were placed on the iliac crests for lumbar extension. When conducting the test motions, the patient was asked to maintain his knees straight. *End positions*. The patient was instructed to move the trunk backward to the limit of lumbar extension motion. The distance between the PSIS and the 15-cm skin mark at the limit of lumbar extension ROM was measured a second time. The lumbar spinal extension ROM was the difference between the start and end measurements [32].

Trunk rotation: starting position. The patient sat with his feet on a stool and his arms folded in front of his chest. The patient held the tape measure's end against the lateral aspect of the acromion process. The therapist placed the opposite end of the tape measure on the greater trochanter's upper border. The distance between two points was calculated. End position. The patient rotated the trunk to its maximum range of motion. At the limit of rotation, the distance between the lateral aspect of the acromion process and the upper border of the greater trochanter was measured again. The rotation ROM was the difference between the start and end position measurements [32].

Bilateral lumbar side-bending was measured using a universal goniometer. From standing position, the goniometer axis was set in the midline at the level of the PSIS (over the S2 spinous process). The stationary arm was aligned perpendicular to the floor, while the movable arm was pointed toward the spine of C7. The goniometer was readjusted at the limit of lumbar lateral flexion. The ROM of lumbar lateral flexion to the measured side was the number of degrees the moveable arm travelled away from the 0° position [32]. The universal goniometer has good construct validity and reproducibility for assessing trunk range of motion in LBP patients [34, 35].

Randomization

A randomization list (1:1 allocation ratio) was created using randomly permuted block sizes produced by a random number generator, and the treatment allocation was concealed. It was carried out by an independent researcher who was not engaged in in patients' recruitment and who was blinded to groups' assignment. Participants were randomly allocated into two groups: (A) linear polarized polychromatic light therapy (PL) group and (B) sham PL group.

Sample size calculation

Based on priori sample size calculation with an effect size (Cohen's *d*) [36] of 0.89 and considering a power of 80% and alpha of 0.05, 17 participants would be required in each group. With consideration of the dropout rate, the adequate sample size was determined as 21 participants in each group.

Statistical analysis

For all statistical analyses, IBM-SPSS version 21.0 statistical software was used. Mann-Whitney tests were performed to investigate the differences between study groups for ordinal data (NPRS and RMDQ). Further, Wilcoxon-signed rank tests were applied for within group comparisons. Continuous data (the PPT of the bilateral GM and bilateral QL muscles, lumbar flexion, extension, bilateral side bending, and bilateral rotation) were checked for normality by using Shapiro-Wilk test. As data were normally distributed, independent *t* tests were used. Within group comparisons were assessed using paired *t* tests. Multiple *t* tests were adjusted with Bonferroni correction. The *P* value of 1% was the limit of statistical significance.

Cohen's *d* was calculated to determine the effect size for the continuous variables after pairwise comparisons using the following formula: $d =$ Mean (group1) − Mean (group2)/SD (pooled). The *d* values indicating a "small," "medium," and "large" effect size are .20, .50, and .80 respectively [36].

Results

A total of 57 subjects were evaluated for inclusion: 42 subjects of them met the inclusion criteria and were enrolled then equally randomized to the study groups (Fig. 3): group A: linear polarized polychromatic light therapy ($n = 21$; males: $n = 9$ and females: $n = 12$) and group B: sham linear polarized polychromatic light therapy ($n = 21$; males $n = 7$ and females $n = 14$). The independent *t* tests revealed non-significant differences between both groups in the general characteristics ($P > 0.05$) (Table 1). Wilcoxon-signed ranked tests showed significant decrease ($p < .0001$) in the scores of NPRS and RMDQ within both study groups. On the other hand, between groups comparison showed a significant decrease ($p = .002$) only in the post-scores of NPRS in group A compared to group B (Table 2). The decrease in values of NPRS in group A was lower by 2 points than group B. Paired *t* tests indicated that the mean values for PPT of the bilateral GM and QL, the ROM of lumbar flexion, extension, bilateral side-bending, and rotation increased significantly ($p < .01$) after treatment compared

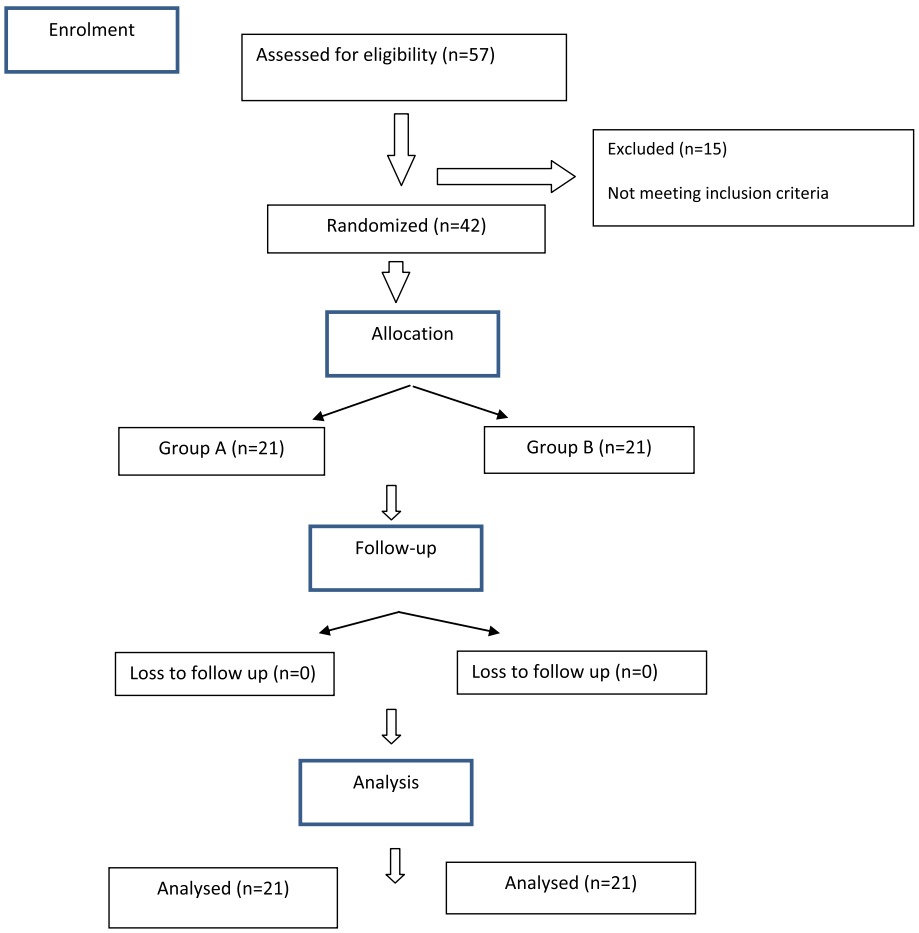

Fig. 3 Participants' flow chart

Table 1 General characteristics of participants in groups A and B

Variable	Group	Mean (SD)	*P*
Age (years)	Group A	31.5 (7.9)	.79
	Group B	32.2 (8.1)	
Height (m)	Group A	1.7 (.1)	.59
	Group B	1.68 (.09)	
Weight (kg)	Group A	66.7 (8.6)	.45
	Group B	64.9 (6.2)	
BMI (Kg/m^2)	Group A	23 (1.3)	.62
	Group B	22.8 (1.3)	

P probability, *BMI* body mass index, *Group A* linear polarized polychromatic light therapy, *Group B* sham linear polarized polychromatic light therapy, *SD* Standard Deviation

Table 2 Comparisons between median (IQR) of Numericpain rating scale and Roland-Morris Disability Questionnaire for groups A and B before and after treatment

Variable	Group	Baseline value median (IQR)	Post-intervention median (IQR)	*p* (inter-group)
NPRS	Group A	7 (5)	2 (2)**	.002*
	Group B	7 (3)	4 (3.5)**	
RMDQ	Group A	18 (14)	5 (7)**	.055
	Group B	14 (11)	8 (8)**	

*Significantly different between group A and group B at $p < 0.01$, **Significantly different between pre- and post-intervention within each group at $p < 0.01$, *IQR* inter quartile range, *Group A* linear polarized polychromatic light therapy, *Group B* sham linear polarized polychromatic light therapy, *NPRS* Numeric Pain Rating Scale, *RMDQ* Roland-Morris Disability Questionnaire

with "before" in both groups. Regarding between groups comparisons, the PPT of the MTrPs of Lt GM and bilateral QL muscles increased significantly ($p < .01$) in group A compared to group B after treatment. The effect sizes for PPT of the Lt GM, Rt, and Lt QL muscles were large (Table 3). On the other hand, there were no significant ($p > .01$) differences between both groups in the PPT of the MTrPs of Rt GM and lumbar ROM in different directions (Table 3). The effect sizes for PPT of the MTrPs of the Rt GM and lumbar ROM in different directions were less than 0.5. Only the effect size of lumbar flexion was 0.7 (Table 3).

Discussion

The findings of the current study showed significant improvements in the pain intensity, pain sensitivity (PPT) of the MTrPs of left GM, and bilateral QL muscles in the linear polarized polychromatic light therapy group compared to the sham light group in patients with chronic NSLBP. On the other hand, similar findings were observed between both study groups in the PPT of the MTrP of the right GM, back disability and lumbar ROM. The minimal clinical important difference (MCID) for NPRS was found to be 1.65 [37]. In the current study, the extent of change in pain intensity in PL group was lower by 2 points than the sham light group indicating a meaningful pain reduction.

Both the visible and infrared regions of the electromagnetic spectrum of polarized light may explain its mechanism of action. Polarized light is likely to provide bio-simulative effects that accelerate cellular functions and increase blood flow. Further, bio-positive effects of polarized light include decreasing plasma levels of pro-inflammatory cytokines, raising anti-inflammatory cytokine levels and fibroblast proliferating factors, and changing lymphocyte proliferation [38].

It is proposed that polarized light in the red and near infrared rays induces warm sensation in the treated area. This locally induced heating effect activates the release of histamine and prostaglandins, increasing vasodilation, modifying enzyme activity and metabolic rate, and elevating pain threshold through a direct mechanism on free nerve endings or nerve trunk that supply the affected region [38]. It is worthwhile to mention that patients in the current study reported mild warm sensation in the treated areas.

In the current study, the increase in PPT in the left GM and bilateral QL trigger points was significant with large effect size following the application of linear polarized red and near-infrared light compared to the sham light therapy group. These findings are in agreement with Huang et al. 2012 [38] who stated that linear polarized near-infrared light (LPNIR) is an effective and safe modality compared with placebo to treat various chronic pains including back myofascial pain syndrome. In their study, the patients received nerve block with active or placebo LPNIR, each painful point was irradiated for 10 min at 80% power output and treated for 3 weeks. At a wavelength of 600 to 1600 nm, the greatest power output was 1800 mW. Further, Shahimoridi et al. 2020 [39] concluded that polarized low-level laser therapy (PLLLT) can effectively reduce the sensitivity of MTrPs in the trapezius muscles. In their study, Shahimoridi et al. 2020 [39] used different light band and treatment procedures than that used in our study. They applied polarized and non-polarized low-level laser therapy for a period of 2 weeks, 5 sessions a week.

Other studies have shown similar results, which point to an improvement in pain intensity in different painful conditions when treated with PNIR. Previous trials assessed the effectiveness of PNIR light in acute and chronic musculoskeletal injuries, such as acute ankle sprain [40], lateral epicondylitis [41–43], carpal tunnel syndrome [44] and temporomandibular disorder [45].

Table 3 Comparisons between Mean (SD) of the PPT of GM and QL muscles and lumbar range of motion for group A and group B before and after treatment

Variable		Group	Baseline values (mean±SD)	Post-intervention (mean±SD)	*P* (inter-group) 95% CI	Cohen' *d*
PPT (kg/cm^2)						
	Rt GM	Group A	1.9 ± .92	3.2 ± .65**	.165 − .141–.802	0.4
		Group B	2.1 ± .91	2.9 ± .84**		
	Lt GM	Group A	2.3 ± .87	3.3 ± .71**	< 0.001* .512–1.43	1.23
		Group B	1.9 ± .82	2.4 ± .76**		
	Rt QL	Group A	2.2 ± .88	3.3 ± .98**	.008* .239–1.53	0.9
		Group B	2.1 ± 1.01	2.4 ± 1.08**		
	Lt QL	Group A	2.3 ± 1.06	3.7 ± .83**	< 0.001* .832–1.95	1.56
		Group B	2.1 ± .93	2.3 ± .95**		
Lumbar Flexion (cm)		Group A	6.6 ± 1.37	7.7 ± .75**	.033 .049–1.09	0.7
		Group B	6.07 ± .93	7.1 ± .91**		
Lumbar Extension (cm)		Group A	3.28 ± .83	4.76 ± .75**	.373 − .266–.695	0.26
		Group B	3.26 ± .73	4.54 ± .78**		
Side bending°	Rt side	Group A	31.9 ± 7.1	36.4 ± 5.2**	.571 − 2.41–4.32	0.16
		Group B	28.5 ± 6.7	35.5 ± 5.5**		
	Lt side	Group A	32.3 ± 6.8	36.7 ± 4.8**	.366 − 1.78–4.73	0.29
		Group B	28.7 ± 7.2	35.2 ± 5.5**		
Rotation (cm)	Rt side	Group A	6.9 ± 2.2	8.4 ± 2.1**	.726 − 1.12–7.86	0.13
		Group B	5.3 ± 2.2	7.9 ± 2**		
	Lt side	Group A	7 ± 2.1	8.5 ± 2**	.809 − .449–2.06	0.41
		Group B	5.9 ± 2.2	7.7 ± 1.9**		

CI confidence interval, *PPT* pressure pain threshold, *GM* gluteus medius, *QL* quadratus lamborum, *Cohen' d* effect size, *Group A* linear polarized polychromatic light therapy, *Group B* sham linear polarized polychromatic light therapy, *SD* Standard Deviation

*Significantly different between the group A and group B at $p < 0.01$

**Significantly different between pre- and post-intervention within each group at $p < 0.01$

Further, Yoo et al. 1993 [46] found that polarized light therapy in the red and near-infrared spectrum (600–1600 nm) was effective in pain attenuation in cases with myofascial pain syndrome.

Contrary to expectations, this study did not find significant differences between the study groups in physical functioning nor lumbar ROM in different directions. These findings are in contrast to earlier findings which found improvements in joints ROM following the application of polarized light in healthy and patients' groups. Demura et al. 2006 [47] suggested that LPNIR was better than placebo in increasing shoulder flexibility in healthy volunteers. Further, Demura et al. 2002 [48] found increased shoulder and ankle ROM in healthy participants compared with placebo. Also, Abd El-Rashid et al. 2019 [49] concluded that orange filtered polarized light was beneficial in improving the metacarpophalangeal range of motion in children with hand burn. These differences may be attributed to variations in the examined samples, the applied light band and doses.

The findings of the current study showed that linear polarized polychromatic light therapy was not superior to sham light therapy in improving physical functioning or lumbar ROM. This could be attributed to the received dose which was not enough to improve lumbar flexibility. It is worthwhile to mention that although lumbar flexion increased by 0.57 cm with a medium effect size (0.7), this improvement did not reach a significant level.

Within group comparisons showed that all outcome measures improved after the treatment program compared with before in both groups. It is sensible to state that the placebo effect of polarized light has been reported before [22, 23]. The mechanism of placebo pain relief, such as the ratings of expected pain levels, the desire for pain relief, or anxiety levels, may influence pain scores [50].

There are some strengths of the current study. The use of low cost tools such as the tape measure and universal goniometer is supported since the described measurement error, reliability, and minimum detectable change support the good reproducibility results [34, 35]. Also, several patient-reported outcome tools were used to assess LBP such as the Numerical Pain Rating Scale (NPRS) and Roland Morris Disability Questionnaire

(RMDQ) [51]. They provide communication channels between patients and clinicians [52, 53] and allows active patient participation which is important in non-pharmacological treatment of LBP [54].

This study is limited to short-term effect and a small sample size. Also, although all patients were instructed to perform exercises at home, but their daily routine could not perfectly have controlled. Future studies should be directed toward the investigation of the effect of polarized polychromatic light therapy on other myofascial trigger points (e.g., erector spinae and gluteus maximus muscles) with different doses and duration of applications.

Conclusion

Linear polarized polychromatic light therapy in the range of red and near-infrared rays improves pain intensity and pain sensitivity of myofascial trigger points in chronic NSLBP.

Acknowledgements
The authors would like to thank Dr. Aya Ahmed Khalil at Atres General Hospital for her help in data collection.

Authors' contributions
GTS and EAE made substantial contributions to the conception, design of the study; the acquisition, analysis, and interpretation of data, further they substantively revised the manuscript. FSA contributed significantly in the conception and design of the study and substantively revised the manuscript. All authors read and approved the final manuscript.

Funding
The authors did not receive funding for this study.

Availability of data and materials
The data collected during the current study are available by the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
The study was approved by the local ethics committee of the Faculty of Physical Therapy, Cairo University (P.T.REC/012/002341). All the participants signed an informed consent form.

Competing interests
The authors declare that they have no competing interests.

Received: 28 February 2022 Accepted: 19 April 2022
Published online: 03 August 2022

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