What Is the Evidence-Based Physiotherapy Level for Polarized Polychromatic Non-Coherent Light Applications? A Narrative Review

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Abstract

Despite many reports from basic research (in vitro, in vivo, and animal experiments), practitioners still have some doubts about the effectiveness and usefulness of polarized light in treating musculoskeletal disorders. It has even been widely accepted that the commercial use of these treatments is supported by a satisfactory level of scientific evidence based on reliable clinical articles. The main purpose of this paper is to present an original review of the literature on the subject in relation to the principles of evidence-based physiotherapy (EBP). This article comprises a critical review of relevant studies available in scientific databases, such as the Cochrane Library, Physiotherapy Evidence Database (PEDro), MEDLINE, and PubMed, along with an attempt to assess the methodological quality of these publications.

Key words

evidence-based physiotherapy,
polarized light,
musculoskeletal disorders

Background

Despite the numerous controversies surrounding the clinical use of polarized light, it is becoming more and more widely utilized in the treatment of musculoskeletal disorders and soft tissue damage. Based on the results of in vitro, in vivo, and animal experiments, many authors report beneficial effects at the cellular and tissue levels [1, 2, 3, 4]. Some potential benefits of irradiation treatment include the improvement of local blood circulation and the stimulation of regenerative processes. These phenomena occur due to the biostimulatory effect of microcirculation in the form of restoration of the vascular network, increased local blood supply, improvement of blood rheological properties, and an increase in collagen production by stimulation of fibroblast proliferation [5, 6]. Some researchers have also pointed to the analgesic and anti-inflammatory effects associated with the application of polarized light [7, 8].

Despite existing basic research reports on this physical agent, practitioners have a number of doubts about its effectiveness during therapeutic management. It has even been widely accepted that the commercial use of these treatments is supported by a satisfactory level of scientific evidence based on reliable clinical articles. Therefore, the main purpose of this paper is to present the author's original review of the relevant literature through the lens of evidence-based physiotherapy (EBP).

Critical literature review

So far, it has been impossible to find scientific reports on the clinical use of polarized light under the auspices of the Cochrane Collaboration. No such report has been published in the MEDLINE, PubMed, Physiotherapy Evidence Database (PEDro), or other professional databases either. In addition, a search for meta-analyses and systematic reviews also did not yield any results. The lack of level-1 (the highest level) publications according to evidence-based medicine (EBM) within the scope of the discussed subject significantly hinders an unambiguous and fully reliable assessment of the usefulness of polarized light for broadly defined physiotherapy. In addition, the PEDro search engine only lists four randomized clinical trials (RCTs), among which only one from 2019 [9] is relatively up-to-date.

Zlatkovic-Svenda et al. [9] used polarized light in a case of Sudeck atrophy (complex regional pain syndrome) due to a distal radius fracture. The study included 52 women who had previously used a hand orthosis. After the limb immobilization was discontinued, the patients were assigned to one of two comparison groups. In group A (n=26), local cryotherapy and hand exercises were performed, and oral analgesics were administered occasionally. In group B (n=26), in addition to the conventional treatment received by group A, the patients underwent irradiation of the dorsal wrist and hand region (a 10-cm diameter area) using a biostimulative lamp (480–3400 nm wavelength, 95% polarization, 40 mW/cm2 power density, and 2.4 J/cm2/min energy flux density). Non-contact irradiation was conducted from a distance of 10 cm from the skin at 5 points within the treatment area for 10 min (2 min per location) once a day, every day for 15 consecutive days. A visual analogue scale (VAS) for subjective pain sensation and a goniometer for forearm pronation and supination range of motion were used. Immediately after the treatment, a more significant reduction in pain (p=0.046) and an increase in the range of hand supination (p=0.001) were observed in group B compared to group A. There was no significant statistical difference in hand pronation (p=0.284). During the follow-up observations (6 months after the end of the research project), four patients in group A had a relapse of the disease, while no patients in group B had a relapse. Unfortunately, the study has many limitations. First of all, there is a lack of accurate and objective measurement tools (the goniometer is considered a tool with large measurement errors and low repeatability of measurements). Second, the use of analgesic drugs among the study participants significantly affected the correctness of the conclusions. This is because, in

the absence of standardized medication doses and a unified algorithm of drug administration, it is difficult to reliably determine whether the analgesic effect was due to physical treatment or pharmacotherapy. The publication received only a 4/10 score for the methodological quality on the PEDro scale.

In addition, authors from Beijing University [10] convincingly showed the significant usefulness of polarized light in musculoskeletal disorders. In 2006, an RCT was conducted involving 77 patients with low back pain syndrome (n=40 in the study group, n=32 in the control group). All participants received Diclofenac (75 mg a day), while the patients in the study group were also subjected to acupuncture and polarized light irradiation. At the end of the project, there was a statistically significant higher pain reduction according to the VAS score among the patients in the study group compared to those in the control group ($p \leq 0.01$), who only received pharmacological treatment. The article scored 5/10 points on the PEDro scale, with the main methodological shortcomings being the lack of objective outcome assessment and the fact that—as in [9]—pharmacotherapy was used, which could affect the clinical picture and the correctness of conclusions. Unfortunately, even the combined use of acupuncture and exposure to polarized light was a methodological error. It seems that phototherapy cannot be unequivocally assessed as useful since it did not constitute the only difference in treatment between the study and the control groups.

In turn, the Greek authors of an article published in the journal *Clinical Rehabilitation* in 2006 (5/10 PEDro score) [11] reported that polarized light is less effective in supporting conventional physiotherapy for musculoskeletal disorders. Seventy-five patients with lateral epicondylitis were randomly assigned into three groups (n=25 in each group). In the first group, the patients underwent a 10-min session of manual therapy (a deep friction massage according to Cyriax and Mill's manipulation). The patients in the second group received individual physiotherapeutic training, consisting of stretching, eccentric exercises, and post-isometric muscle relaxation. In the third group, irradiation sessions using a biostimulation lamp were performed at three points (6 min per point). Standard treatment parameters—wavelength 480–3400 nm, polarization 95%, and power density 40 mW/cm2—were used. The treatment was conducted for four weeks in all groups, and no pharmacological agents were used. Functional tests (the Mill and Thomson tests), a dynamometer test (which measures handgrip strength), and a pain sensation threshold (VAS) test were performed to evaluate the therapeutic progress. The measurements were conducted before and immediately after treatment and after 1, 3, and 6 months as follow-up observations. It was found that the individual physiotherapy program based on exercise therapy (kinesiotherapy) was the most effective in the treatment of tennis elbow and with respect to long-term results. In the researchers' opinion, this algorithm should be the primary therapeutic program. Slightly less effective were manual therapy and phototherapy, which were only recommended as complementary management strategies. Despite the similarity of its PEDro score to those of the above-mentioned papers [9, 10], this article seems to be more methodologically well designed. Both subjective and objective measurement tools were used for the diagnostic evaluation, and the comparison groups were representative as well.

Polarized light has also been used for other geriatric conditions, such as pressure ulcers. In 2008, Durovic et al. [12] conducted an RCT on a sample of 40 patients with chronic pressure ulcers (grades I–III). In the experimental group, polarized light irradiation and standard wound care (debridement and hydrocolloid dressings) were used. In the control group, only standard wound care was provided. The exposures to electromagnetic radiation occurred for 6 min and were performed once a day, five days a week, for one month. The Pressure Ulcer Scale for Healing (PUSH) tool, which is dedicated to analyzing wound areas and quality of life indicators, was used to evaluate the healing process. After the treatment, the authors concluded that biostimulation with polarized li-

ght benefited the patients in the experimental group significantly (p=0.0003) compared to the control group. The study was scored 6/10 on the PEDro scale.

Summarizing the above resources from the PEDro database, it should be noted that the methodological quality of the discussed reports is "average" (level 2) because the scores range from 4 to 7 points. Unfortunately, the small number of studies and the lack of unified conclusions are also a concern, since not all of them support the high efficacy of this therapeutic modality and their results are contradictory.

In turn, when reviewing the PubMed and MEDLINE engines, after excluding duplicated publications, four more RCTs (levels 2 and 3) could be identified.

In 2017, Dimitrios and Stasinopoulos [13] published the results of a study on the effectiveness of polarized light in the treatment of carpal tunnel syndrome in pregnant women. The project involved 46 female patients treated for 2 weeks with a series of irradiations at 5–10 cm from the skin surface (2 treatments per day, 5 times per week). The treatment efficiency was evaluated using the VAS, with a follow-up observation one month after therapy. The researchers concluded that this physical agent was highly effective, but unfortunately, a major disadvantage was the lack of a comparison group (there was only one group treated with polarized light) as a reference for standard management and the estimation of the placebo effect, as well as a lack of objective measurement tools (only the VAS was used).

Another study performed at the same research center [14], also published in 2017 but in the journal *Disability and Rehabilitation*, demonstrated the positive effects of polarized light on patients after an acute ankle sprain. Fifty participants were randomly allocated into two comparison groups (n=25 in each group). In the first group, local cryotherapy was applied to the ankle joint area (20 min of cold packs, every 2 h for 5 days). In the second group, in addition to cryotherapy, phototherapy (480–3400 nm wavelength, 95% polarization, 40 mW/cm2 power density, and 2.4 J/cm^2 dose/energy density) was applied for 10 min once a day for 5 days. After the project was completed, significantly better (p<0.0005) therapeutic results in reducing ankle pain and edema and improving ankle range of motion were found in the patients additionally treated with polarized light. Unfortunately, the weaknesses of this study are the use of imperfect measurement tools (subjective tests, goniometer, and tailor's tape measure) and a short-term follow-up period (only 5 days). Furthermore, physical exercise, which seems to be the primary ankle sprain management strategy (e.g., joint stabilization, stretching, post-isometric relaxation, or cross friction massage), was not performed.

On the other hand, a paper published in 2009 [15] in the journal *Photomedicine and Laser Surgery* supported the usefulness of both polarized light and laser biostimulation (904 nm wavelength and 130 mW/cm2 energy density) as an adjuvant to primary treatment through monthly physical rehabilitation in patients with tennis elbow. The authors concluded in favor of such a claim because they obtained a significantly statistical pain reduction and functional improvement (p<0.0005) in both groups according to pre- and post-treatment comparisons. However, there is some uncertainty about the lack of intergroup differences; thus, this claim cannot be considered entirely justified.

Medenica and Lens [16] examined 25 elderly patients with venous leg ulcers. The patients were treated with daily exposure to phototherapy using a polarized polychromatic non-coherent light (once a day for four weeks). No other therapeutic agent was used. At the end of the clinical trial, there was a decrease of 57.15% on average (p<0.01) in the wound area. The shortcomings of this study should also be pointed out: the placebo effect was not estimated and there was no comparison group.

Search engines with lower scientific reliability, namely SCOPUS and Google Scholar, are useful in finding significantly more preclinical reports and case reports than the previously mentioned RCTs from journals indexed in the Web of Science

Core Collection database. However, case reports and expert opinions have low reliability level (only 3–5) according to EBM criteria.

Summary and practical guidance

To date, it has been difficult to unambiguously assess the efficacy of polarized light in musculoskeletal disorders and for elderly conditions. It seems that polarized light irradiation may effectively support the treatment of hard-to-heal wounds, which is confirmed in two of the above cited papers [12, 16]. Concerning other musculoskeletal conditions, most reports (but not all of them) also attest to the beneficial effects of phototherapy.

The biggest concerns are currently the lack of meta-analyses and systematic reviews of the highest credibility and the small number of high-reliability publications (a lack of RCTs with a PEDro score above 8/10).

It can be concluded that the level of scientific evidence ranges between 2 and 4 (medium or weak level) according to EBP; thus, biostimulation using polarized light should be used only as an adjunctive and supportive physical agent. From a practical point of view, the following parameters are recommended: a treatment duration of 10 min (which should correlate with the size of the surface area and would need to be adjusted individually), wavelength of 480–3400 nm, beam polarization of 95%, power density of 40 mW/cm^2, and dose/energy density of 2.4 J/cm2. Undoubtedly, there is a need for further well-designed studies in this subject area.

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