Porto Biomed. J. 2016;xxx(xx):xxx–xxx

PORTO BIOMEDICAL JOURNAL
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Porto Biomedical Journal

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Review article

Pulsed electromagnetic field therapy effectiveness in low back pain: A systematic review of randomized controlled trials

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Keywords:
Pulsed electromagnetic fields
Low back pain
Musculoskeletal
Therapy

A B S T R A C T

Background: Low back pain is a worldwide prevalent musculoskeletal condition in the general population. In this sense, the pulsed electromagnetic fields (PEMF) therapy has shown significant clinical benefits in several musculoskeletal conditions.
Objective: To assess the effectiveness of the PEMF therapy in reducing pain and clinical symptomatology in patients with low back pathological conditions.
Methods: It was performed a comprehensive database search using Pubmed, Scopus, Cochrane Library and PEDro databases to assess the effectiveness of the PEMF therapy in reducing pain and clinical symptomatology in patients with low back pathological conditions. The search was performed from January 2005 to August 2015 and conducted by two independent investigators, which scrutinize the reference list of most relevant studies. The methodological quality was assessed by the PEDro scale and the level of evidence was set according Oxford Center for Evidence-Based Medicine scale.
Results: Six studies were eligible inclusion on the qualitative analysis and five into the quantitative analysis, scoring an overall 6.8 points according the PEDro scale. The studies showed heterogeneity concerning the intervention protocols. Nevertheless, the effect sizes' indicated a clear tendency to reduction of the pain intensity favoring the PEMF groups, reaching a minimal clinically important difference.
Conclusion: PEMF therapy seems to be able to relieve the pain intensity and improve functionality in individuals with low back pain conditions. Further research is needed regarding PEMF effects on the different conditions of low back pain, with standardized protocols, larger samples and adjustment for low back pain confounders in order to achieve stronger conclusions.

Abbreviations: PEMF, pulsed electromagnetic field; NSAIDs, non-steroidal anti-inflammatory drugs; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; PEDro, Physiotherapy Evidence Database; CI, confidence intervals; CEBM, Center for Evidence-Based Medicine; MCID, minimal clinically important difference.

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http://dx.doi.org/10.1016/j.pbj.2016.09.001

Please cite this article in press as: Andrade R, et al. Pulsed electromagnetic field therapy effectiveness in low back pain: A systematic review of randomized controlled trials. Porto Biomed. J. 2016. http://dx.doi.org/10.1016/j.pbj.2016.09.001

Introduction

Low back pain is a very common health problem in general population and one of the major reasons for medical treatment seeking. It is expected that between 60 and 80% of the world population will experience low back pain during lifetime,[1] with 65% being recurrent and longstanding episodes. Low back pain can be caused by different etiologies, such as muscle or ligament strains, herniated discs, arthritis, alteration in the curvature of the spine or osteoporosis related fractures but, the majority of the patients do not have a clinically identified problem.[2] Despite the variety of treatments available, no modality or therapeutic approach has stand out as a definitive solution.[3] Thus, there is still a demand for new approaches, less invasive and free of side effects.

The risk/benefit ratio in pharmacotherapy for low back pain conditions often does not have strength enough to persist with the drugs usage. Moreover, the risk of pharmacologic addition, potential side-effects and adverse events, as well as long-term toxicity may weaken the potential benefit of the pharmacotherapy approach.[4,5] In this sense, the pulsed electromagnetic fields (PEMF) therapy can play an important role in the pain relief since is a drug-free, non-thermal, with low risk that works to enhance cellular activity healing and repair.[3] Therefore, it could be an option to the non-steroidal anti-inflammatory drugs (NSAIDs) medication, avoiding several potential side-effects from chronic NSAIDs usage.

The PEMF therapy is based in low frequency signal, with a wide range of frequencies, which will produce membrane disturbances and activation of multiple intracellular pathways.[6,7]

It has been reported that PEMF therapy yields several benefits into the bone unification, acute pain relief, wound healing, edema and inflammation control, as well as, chronic pain associated with connective tissue (cartilage, tendon, ligaments and bone) injury and joint-associated soft tissue injury, osteoarthritis, fibromyalgia, osteoporosis, skin ulcers and further potential applications.[8–11] Along this line, many reviews have been performed to assess the PEMF effectiveness in several conditions. In this sense, the PEMF showed moderate[7] or no benefits in knee osteoarthritis,[12] a beneficial tendency on the bone growth stimulation in acute fractures[13] and efficient in relieving pain and enhancing bone formation in osteoporosis.[14]

Although the use of PEMF therapy in low back pain is growing and there is substantial investigation on this topic, a systematization of its effects on the low back pain is still lacking. Therefore, this study aims to search for randomized controlled trials that assessed the effectiveness of the PEMF therapy in reducing pain symptomatology in patients with low back pathological conditions.

Methods

Search strategy

The systematic review was conducted according the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement, which aims to improve the standard of reporting of systematic reviews and meta-analyses.[15] Additionally, the protocol for this review was à *priori* registered in the International Prospective Register of Systematic Reviews (PROSPERO) (http://www.crd.york.ac.uk/prospero/; ID: CRD42015025308).

It was conducted a comprehensive database search using Pubmed, Scopus, Cochrane Library and PEDro, searching for relevant studies that assessed the efficacy of the PEMF therapy on reducing pain on individuals with low back pain. The search was performed according the following key-words: pulsed electromagnetic field therapy; back; spine; spinal; lumbar; and further combined with the Boolean operators (AND; OR). An example of the search can be seen in Table 1. The reference list of most relevant studies was scanned for additional studies in order to achieve the greatest number of available studies on the scientific literature. All searches were comprised to the period of January 2005 to August 2015 and were conducted by two independent investigators (R.A., H.D.), which confronted both results to check for overlapping; any disagreements were discussed by until consensus was reached.

Table 1
Example of search strategy for Pubmed database.

Search	Search term(s)	Results
#1	Search **pulsed electromagnetic field therapy**	342
#2	Search **back**	86,722
#3	Search **spine**	82,093
#4	Search **spinal**	120,484
#5	Search **lumbar**	43,342
#6	Search **(#2 OR #3 OR #4 OR #5)**	237,516
#7	Search **(#1 AND #6)**	32

Study selection

All titles and abstracts from the selected databases were screened. After, the potential relevant studies were selected and retrieved, full texts were read in order to apply the eligibility according the following inclusion criteria: (1) assessment of pain outcome; (2) use of pulsed electromagnetic field therapy; (3) prospective design; (4) randomized controlled trials; (5) English language studies. For exclusion criteria it was determined: (i) other reviews or meta-analyses; (ii) clinical commentaries or expert opinions; (iii) case series; (iv) non-randomized controlled trials; (v) animal studies; (vi) skeletally immature population.

Data collection and extraction

Two independent investigators (R.A., H.D.) retrieved all the information and matched for consensus. The main outcome of interest was the quantification of intensity of pain overtime. Thus, after the application of the eligibility criteria and the included studies were determined, the studies were analyzed based on sample demographics, study's aim, statement of conflict of interest, study duration and follow-up (period of time and percentage), PEMF devices used, treatment window, intervention protocol, parameters assessed (clinical and functional) and most significant results.

In addition, the figures of pain intensity and the Oswestry Disability Index were assessed based on their means and standard deviation values and calculated their mean differences, i.e., difference between the study's end-point and baseline values. Additionally, the Cohen's effect size, within the 95% confidence intervals (CI) was calculated. The effect sizes were computed by subtracting the experimental group mean to the control group mean and further divided by the pooled standard deviations of both groups.[16,17] Thus, a positive effect reflects a greater decrease on the pain intensity toward the experimental group. The 95% CI provides information concerning the variability of the observed effect size, its precision, as well as the accuracy with which the interval contains the population parameter (i.e., the true value). The standardized Cohen effect sizes were interpreted according to the guidelines established by Cohen[17] in which values <0.20 are trivial or not substantial, 0.20 and 0.49 are small but substantial, 0.50 and 0.79 are moderate, and ≥0.80 are large. In case of missing values (means and/or standard deviations), the authors from the respective studies were contacted in order to obtain them.

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