

Effects of Pulsed Electromagnetic Fields on Post-operative Pain in Patients with Fresh Fracture

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Abstract

Background and Objective: Pulsed electromagnetic fields (PEMFs) have shown therapeutic outcomes in bone and wound repair and pain and edema reduction. This study was aimed to investigate the effectiveness of PEMFs on post-operative pain in the patients with fresh fracture. **Method:** This open-label clinical trial was conducted on 20 patients with tibial and femoral fresh fractures. The patients were treated with surgery and received PEMF therapy undergoing a protocol with 20 Hz and 4.25 mT for 4 weeks (20 min daily and 5 consecutive days per week and for 4 consecutive weeks). A visual analog scale was used for recording pain. **Results:** During the first day of treatment patients had low pain during rest, activity, and nighttime. Each treatment session significantly reduced the mean pain score ($P = 0.05$). We observed a cumulative pain reduction effect where on day 4 the pain score was significantly reduced compared with day 0 (95.1 ± 2 mm on day 0 to 46.5 ± 3 mm on day 4) ($P = 0.001$). Furthermore, during the 2 days each week with no treatment session, the pain score increased to the early values. It indicated the temporary effect of PEMF on pain which lasted about 12 h posttreatment. **Conclusion:** PEMF showed significant clinical value in reducing the pain of post-operative pain in fracture patients. However, it seems that this effect is temporary and does not last more than 24 h after the treatment session.

Key words: Pulsed electromagnetic field, treatment, pain, tibial fracture, femoral fracture

INTRODUCTION

The patients experience pain and swelling after surgery because of inherent biochemical, histological and mechanical changes. One of the ways to achieve maximal function with minimal complications is controlling pain and swelling in the early stage.^[1] Pulsed electromagnetic fields (PEMFs) have been used as alternative or adjunctive treatment options for different disorders including musculoskeletal disorders, soft tissues, and as bone growth stimulators.^[2-10] This form of therapy was approved in humans by the United States Food and Drug Administration in 1979, for the treatment of various types of fractures such as delayed and nonunion fractures.^[11] The application of external electrical or mechanical energy may affect disorders of dense connective tissue with induces changes to the cell environment.^[12-14]

Results of several studies have shown that exposure to EMFs was effective in reducing pain and edema after soft tissue injury. They suggested that exposure to EMF may affect at cellular, and neurobiological level and reduce pain sensitivity and pain inhibition.^[15-20] PEMFs have been reportedly effective for promoting the regeneration of nerves.^[21-26]

In this study, we aimed to investigate the effectiveness of applications of PEMF in reducing post-operative pain in the patients following tibial and femoral fracture.

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Patients and methods

A total of 29 patients who applied to the bio-electromagnetic clinic of Imam Khomeini hospital with post-operative pain following tibial and femoral fresh fractures were evaluated.

The exclusion criteria were contraindications for PEMF such as pregnancy, cardiac pacemaker, epilepsy, history of seizures, brain implant and any foreign object inside the body that interfering with external magnetic and electric fields, and accompanying painful conditions such as inflammatory arthritic conditions and tendon ruptures. All the patients were advised not to have moderate or severe daily activities as much as they could. In addition, they were instructed to modify the daily lifestyle such as avoiding smoking, alcoholic drinks, opioid, and narcotic substances. All of the experimental procedures of this study were approved by the guidelines set by the ethics committee of Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran (No.: IR.AJUMS.REC.1394.718) which were in complete accordance with the Helsinki declarations of ethical principles for medical research involving human subjects. The study was registered in Iranian registry of clinical trials (No.: IRCT2016042324635N3).

Five patients were excluded, and four patients did not want to participate, so 20 patients were included in the study. Therefore, 20 patients aged 17-42 years old with tibial or femoral fresh fractures who have been underwent open reduction and internal fixation (ORIF) surgery, were enrolled in this study. All of the patients signed a written consent form for participation in this study. All enrolled patients gave informed consent, and this study was approved by a local ethics committee.

The patients underwent a PEMF stimulation using a commercial Magneto therapy device (Automatic EASY Quattro PRO, ASA Co., Italy). The device uses a solenoid applicator and works on low intensity and extremely low frequency (0.5-100 Hz). The protocol was selected according to the recommendations of the manufacturer. The stimulation protocol was a daily 20 min session, for 5 consecutive days per week and for 4 consecutive days per weeks (total of 20 sessions) with the frequency of 20 Hz and an intensity of 4.25 mT. The treatment was applied Saturday to Wednesday during each week, therefore total treatment period lasted 26 days. The pain scores using a visual analog scale (VAS) (0-100 mm) were assessed before start of PEMF treatment (day 0), and after each treatment session at night (day 1-25). The patients were asked to score their perceived pain at night before bed. The averaged VAS pain scores for all the days were compared.

Data analyses were performed using Statistical Package for the Social Sciences (SPSS/PC, Windows, V:20.0) to compare mean VAS scores between the first day and other days of treatment. The statistical significance level of 0.05 was set for all analyses.

RESULTS

In this study, 20 patients were investigated (14 men and 6 women) with tibial and femoral fresh fractures that have been undergone ORIF surgery. The mean age of patients was 26.25 ± 8 years (age range 17-42 years). All the participants completed the study.

The mean pretreatment VAS pain score (day 0) for all patients (N = 20) was 95 ± 2 mm on the VAS pain scale used (0-100 mm). The results of the mean VAS pain score for the day 1 to 25 are shown in Figure 1.

As the results show, the mean post-operative VAS score (day 0) was 95.1 ± 2 mm for all patients. Mean VAS score decreased to 85.5 ± 3 mm on the day 1, 64.2 ± 2.5 mm on day 2, 57 ± 3.7 mm on day 3, and 46.5 ± 3 mm on day 4. The analysis of variance showed the mean pain score was significantly reduced after each session ($P = 0.05$). There was sum cumulative pain relieving effect where the amount of pain reduction in the consecutive days was higher than the previous day. In this regard, day 4 showed a significant reduction of VAS pain score compared with the day 0 ($P = 0.001$). The interesting finding was that for the 2 days (Thursday and Friday) that the patients did not receive treatment session, their pain score was gradually increased. For instance, the mean VAS score increased to 53 ± 5 mm and 87 ± 3.5 mm in day 5 and 6, respectively, during which the patients did not receive PEMF stimulation. The similar trend of the pain increase was repeated at day 12 and 13. The results showed that PEMF treatment is effective in pain reduction, but it seems that this effect is temporary and exists for several hours after the treatment session. Any adverse events were not reported.

CONCLUSION

This open-label clinical study aimed to investigate the effectiveness of PEMF on pain reduction in patients with tibial and femoral fractures. The results demonstrated a significant beneficial effect on pain reduction and modulation at the studied protocol. The results showed VAS pain score significantly decreased after each treatment session which lasted up to the night of the treatment day. In conclusion, PEMF seems to reduce pain and may be a helpful modality in the treatment of post-operative pain. According to our findings, PEMF therapy can be applied as an adjunct treatment to enhance the effects of controlling post-operative swelling and pain.

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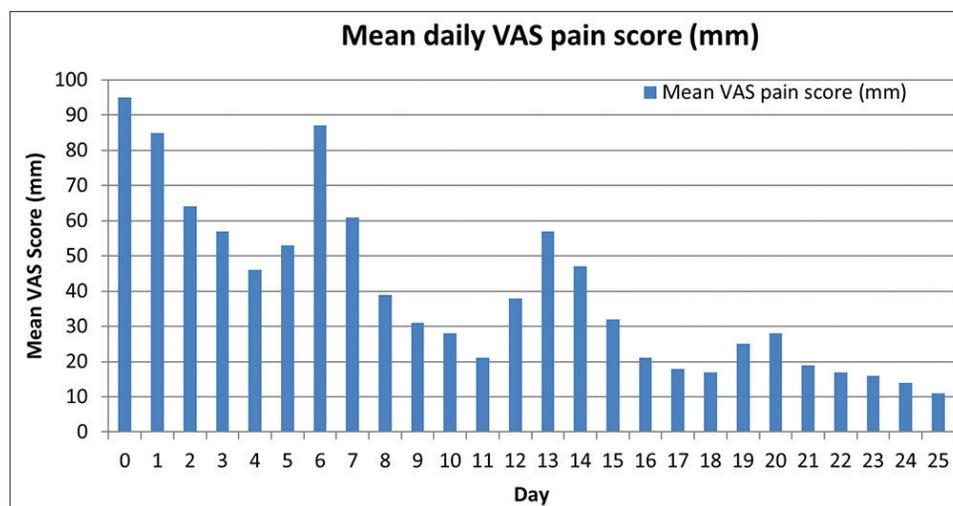


Figure 1: Mean daily visual analog scale pain score of patients during pulsed electromagnetic fields therapy

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