

Effects of PEMF and heat therapy in treating osteoarthritis knee pain: a preliminary clinical study

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ABSTRACT - Pulsed electromagnetic field (PEMF) therapy combined with heat has been applied to treat knee osteoarthritis (OA). This study demonstrates that the combination of PEMF and heat significantly reduces pain and stiffness associated with OA. After 15 days of treatment, a 62% decrease in average WOMAC score was observed. Furthermore, average PGIC results indicate a 43% reduction in pain score and a 79% improvement in activity limitations, symptoms, emotions, and overall quality of life.

I. Background

Pulsed electromagnetic field (PEMF) therapy has been used to treat pain and edema in soft tissue for over 60 years. It has recently been cleared by the FDA for adjunctive use in the palliative treatment of post-operative pain and edema in superficial soft tissue. The mechanism of PEMF can be explained by Faraday's Law of Induction for which the time-changing magnetic field produced induces short bursts of electrical current in injured tissue, accelerating biological signals^{1,2}.

When soft tissue injury occurs, intracellular concentration of calcium (Ca^{2+}) increases in order to initiate the healing process. In injured tissue, Ca^{2+} combines with calmodulin (CaM) to promote production of nitric oxide (NO). NO acts by signaling the production of cyclic guanosine monophosphate (cGMP), which drives growth factor production and healing in injured tissue. Heightened production of NO also increases blood and lymph flow, resulting in inflammation reduction in injured tissue¹. PEMF therapy has been shown to increase the rate at which Ca^{2+} combines with CaM, thereby increasing growth factor production and reducing healing time¹. However, there is also another, more conventional therapy for treating soft tissue injury that utilizes heat to increase blood flow and relax soft tissue.

Heat therapy is used to increase the extensibility of collagen tissues, decrease joint stiffness, reduce pain, relieve muscle spasms, reduce inflammation, and increases blood flow. The increased blood flow to the affected area provides proteins, nutrients, and oxygen to accelerate healing³. Conditions that benefit from this therapy, such as osteoarthritis (OA), have also been effectively treated using PEMF therapy⁴.

OA is a leading cause of disability in the aging population and is characterized by a gradual loss of hyaline cartilage, thus reducing joint cushion and lubrication. Current treatment options include pharmacologic intervention or electric field therapy requiring direct skin contact, which can cause side effects and discomfort respectively. However, PEMF therapy has proven to provide a non-invasive solution that is effective in relieving pain, reducing edema, and repairing soft tissue damage. This preliminary study was conducted to

demonstrate the effect of PEMF therapy and heat on osteoarthritis knee pain.

II. Methods and Materials

In this study, 33 patients suffering from knee OA were chosen at random and asked to complete the Western Ontario and McMaster Universities Arthritis (WOMAC) 3.1 Index questionnaire in order to assess the level of knee pain. The WOMAC osteoarthritis index is the most widely used metric in measuring osteoarthritis knee treatment outcome^{5,6}. It poses 24 questions to evaluate 3 dimensions of OA: pain, stiffness, and physical function.

To avoid any adverse reaction to the PEMF, each patient was also asked to fill out another questionnaire regarding health history. Out of the 33 randomly selected patients, 14 were ineligible due to low WOMAC scores and 5 were ineligible due to health history.

Eligible patients were treated with a PEMF device (OrthoCor Active Knee System; OrthoCor Medical, Inc., Minneapolis, MN) that delivered a pulsed electromagnetic field to both medial and lateral sides of the knee. In addition, this device provided radiant heat to both sides of the knee, resulting in skin temperatures of 40-45°C (104-113°F). Each patient received 2 hours of treatment per day for 15 consecutive days.

In order to obtain feedback on effectiveness, patients were required to fill out the WOMAC pain score questionnaire following each treatment session. The questionnaire consists of 23 pain-related questions assigned a value from 0 to 4 in which 4 represents extreme pain. The WOMAC score is the sum of all 23 questions.

Another metric used in this study was the Patient's Global Impression of Change (PGIC) scale which tracked therapy progress following every third treatment. Completion of the PGIC form required two separate rankings: level of improvement and pain level. The level of improvement was ranked on a scale of 1-7 where a score of 1 represented "no change". Pain level was ranked from 1-10, where 1 represented pain level being "much better."

III. Results

The WOMAC score of each eligible patient who completed the study was averaged for analysis. Figure 1 shows the average score for each day following treatment. After 15 days, the average score decreased 62%.

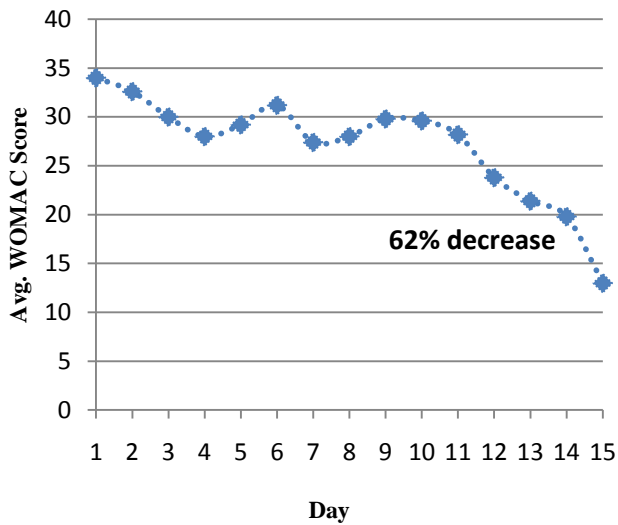


Figure 1. Average WOMAC score for eligible patients who completed the study. Results indicate a 62% decrease in average WOMAC score after 15 days of treatment.

Results for the PGIC level of improvement ranking are shown in Figure 2. A score of 0 indicates no change concerning activity limitations, symptoms, emotions, and overall quality of life. The results show an average improvement of 79% in development after 15 days of therapy.

Figure 3 shows the average score for the PGIC pain level results. A score of 10 indicates a maximum increase in pain. The results show that average pain levels decreased 43% following 15 days of therapy.

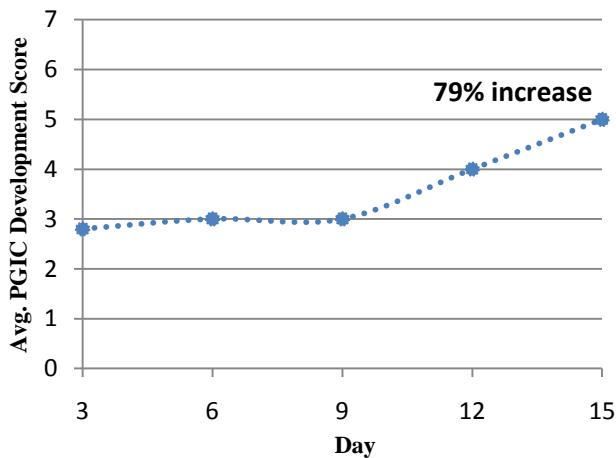


Figure 2. Average score for level of improvement portion of PGIC questionnaire. The results show a 79% improvement in development after 15 days of therapy.

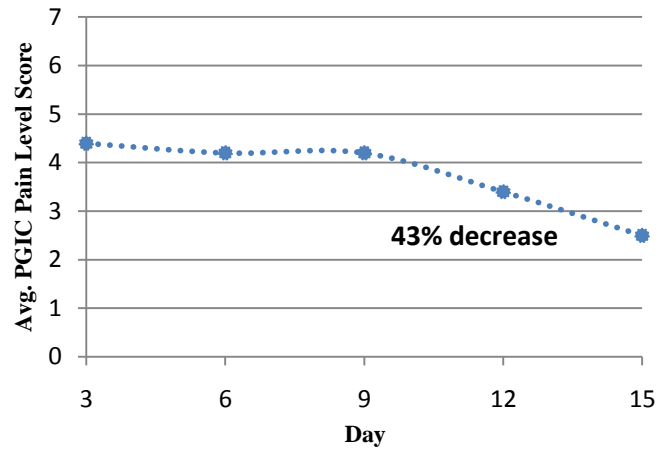


Figure 3. Average score for pain level portion of PGIC questionnaire. A score of 10 indicates a maximum increase in pain. The results show that pain level has decreased 43% following 15 days of therapy.

IV. Discussion

WOMAC results produced in this study (Figure 1) suggest that 15 days of PEMF treatment significantly reduces pain and stiffness associated with knee OA while improving physical function. In addition, the PGIC scale results indicate that PEMF therapy effectively relieves pain and reduces the physical limitations associated with knee OA.

These results are consistent with prior double-blind, randomized, placebo-controlled study studies in which PEMF therapy significantly reduced mean VAS pain scores and edema volume¹. Additional clinical studies analyzing the effect of heat and PEMF therapy on OA knee pain should be undertaken to further validate the findings presented in this paper.

References

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