Arthritis

Rheumatol Int. 2005 Jun 29; [Epub ahead of print]

The effect of pulsed electromagnetic fields in the treatment of cervical osteoarthritis: a randomized, double-blind, sham-controlled trial.

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The purpose of this study was to evaluate the effect of electromagnetic field therapy (PEMF) on pain, range of motion (ROM) and functional status in patients with cervical osteoarthritis (COA). Thirty-four patients with COA were included in a randomized, double-blind study. PEMF was administrated to the whole body using a mat 1.8x0.6 m in size. During the treatment, the patients lay on the mat for 30 min per session, twice a day for 3 weeks. Pain levels in the PEMF group decreased significantly after therapy ($p<0.001$), but no change was observed in the placebo group. The active ROM, paravertebral muscle spasm and neck pain and disability scale (NPDS) scores improved significantly after PEMF therapy ($p<0.001$) but no change was observed in the sham group. The results of this study are promising, in that PEMF treatment may offer a potential therapeutic adjunct to current COA therapies in the future.

Osteoarthritis Cartilage. 2005 Jul;13(7):575-81.

Treatment of knee osteoarthritis with pulsed electromagnetic fields: a randomized, double-blind, placebo-controlled study.

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OBJECTIVE: The investigation aimed at determining the effectiveness of pulsed electromagnetic fields (PEMF) in the treatment of osteoarthritis (OA) of the knee by conducting a randomized, double-blind, placebo-controlled clinical trial. DESIGN: The trial consisted of 2h daily treatment 5 days per week for 6 weeks in 83 patients with knee OA. Patient evaluations were done at baseline and after 2 and 6 weeks of treatment. A follow-up evaluation was done 6 weeks after treatment. Activities of daily living (ADL), pain and stiffness were evaluated using the Western Ontario and McMaster Universities (WOMAC) questionnaire. RESULTS: Within group analysis revealed a significant

improvement in ADL, stiffness and pain in the PEMF-treated group at all evaluations. In the control group there was no effect on ADL after 2 weeks and a weak significance was seen after 6 and 12 weeks. Significant effects were seen on pain at all evaluations and on stiffness after 6 and 12 weeks. Between group analysis did not reveal significant improvements over time. Analysis of ADL score for the PEMF-treated group revealed a significant correlation between less improvement and increasing age. Analysis of patients <65 years using between group analysis revealed a significant improvement for stiffness on treated knee after 2 weeks, but this effect was not observed for ADL and pain. CONCLUSIONS: Applying between group analysis we were unable to demonstrate a beneficial symptomatic effect of PEMF in the treatment of knee OA in all patients. However, in patients <65 years of age there is significant and beneficial effect of treatment related to stiffness

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Pulsed electromagnetic fields reduce knee osteoarthritic lesion progression in the aged Dunkin Hartley guinea pig.

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An experimental in vivo study was performed to test if the effect of Pulsed Electromagnetic Fields (PEMFs) on chondrocyte metabolism and adenosine A2a agonist activity could have a chondroprotective effect on the knee of Dunkin Hartley guinea-pigs of 12 months with spontaneously developed osteoarthritis (OA). After a pilot study, 10 animals were randomly divided into two groups: PEMF-treated group (6 h/day for 3 months) and Sham-treated group. Microradiography and histomorphometry were performed on the entire articular surface of knee joints used in evaluating chondropathy severity, cartilage thickness (CT), cartilage surface Fibrillation Index (FI), subchondral bone plate thickness (SBT) and histomorphometric characteristics of trabecular epiphyseal bone. The PEMF-treated animals showed a significant reduction of chondropathy progression in all knee examined areas ($p<0.05$). CT was significantly higher ($p<0.001$) in the medial tibia plateaus of the PEMF-treated group when compared to the Sham-treated group. The highest value of FI was observed in the medial tibia plateau of the Sham-treated group ($p<0.05$). Significant lower values were observed in SBT of PEMF-treated group in comparison to Sham-treated group in all knee examined areas ($p<0.05$). The present study results show that PEMFs preserve the morphology of articular cartilage and slower the progression of OA lesions in the knee of aged osteoarthritic guinea pigs. The chondroprotective effect of PEMFs was demonstrated not only in the medial tibial plateau but also on the entire articular surface of the knee.

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Optimization of pulsed electromagnetic field therapy for management of arthritis in rats.

Kumar VS, **Kumar DA**, **Kalaivani K**, **Gangadharan AC**, **Raju KV**, **Thejomoorthy P**, **Manohar BM**, **Puvanakrishnan R**.

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Studies were undertaken to find out the effects of low frequency pulsed electromagnetic field (PEMF) in adjuvant induced arthritis (AIA) in rats, a widely used model for screening potential therapies for rheumatoid arthritis (RA). AIA was induced by an intradermal injection of a suspension of heat killed Mycobacterium tuberculosis (500 mug/0.1 ml) into the right hind paw of male Wistar rats. This resulted in swelling, loss of body weight, increase in paw volume as well as the activity of lysosomal enzymes viz., acid phosphatase, cathepsin D, and beta-glucuronidase and significant radiological and histological changes. PEMF therapy for arthritis involved optimization of three significant factors, viz., frequency, intensity, and duration; and the waveform used is sinusoidal. The use of factorial design in lieu of conventional method resulted in the development of an ideal combination of these factors. PEMF was applied using a Fransleau-Braunbeck coil system. A magnetic field of 5 Hz x 4 muT x 90 min was found to be optimal in lowering the paw edema volume and decreasing the activity of lysosomal enzymes. Soft tissue swelling was shown to be reduced as evidenced by radiology. Histological studies confirmed reduction in inflammatory cells infiltration, hyperplasia, and hypertrophy of cells lining synovial membrane. PEMF was also shown to have a membrane stabilizing action by significantly inhibiting the rate of release of beta-glucuronidase from lysosomal rich and sub-cellular fractions. The results indicated that PEMF could be developed as a potential therapy in the treatment of arthritis in humans. Bioelectromagnetics (c) 2005 Wiley-Liss, Inc.

Osteoarthritis Cartilage. 2003 Jun;11(6):455-62.

Modification of osteoarthritis by pulsed electromagnetic field--a morphological study.

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OBJECTIVE: Hartley guinea pigs spontaneously develop arthritis that bears morphological, biochemical, and immunohistochemical similarities to human osteoarthritis. It is characterized by the appearance of superficial fibrillation by 12 months of age and severe cartilage lesions and eburnation by 18 months of age. This study examines the effect of treatment with a pulsed electromagnetic field (PEMF) upon

the morphological progression of osteoarthritis in this animal model. DESIGN: Hartley guinea pigs were exposed to a specific PEMF for 1h/day for 6 months, beginning at 12 months of age. Control animals were treated identically, but without PEMF exposure. Tibial articular cartilage was examined with histological/histochemical grading of the severity of arthritis, by immunohistochemistry for cartilage neoepitopes, 3B3(-) and BC-13, reflecting enzymatic cleavage of aggrecan, and by immunoreactivity to collagenase (MMP-13) and stromelysin (MMP-3). Immunoreactivity to TGFbeta, interleukin (IL)-1beta, and IL receptor antagonist protein (IRAP) antibodies was examined to suggest possible mechanisms of PEMF activity. RESULTS: PEMF treatment preserves the morphology of articular cartilage and retards the development of osteoarthritic lesions. This observation is supported by a reduction in the cartilage neoepitopes, 3B3(-) and BC-13, and suppression of the matrix-degrading enzymes, collagenase and stromelysin. Cells immunopositive to IL-1 are decreased in number, while IRAP-positive cells are increased in response to treatment. PEMF treatment markedly increases the number of cells immunopositive to TGFbeta. CONCLUSIONS: Treatment with PEMF appears to be disease-modifying in this model of osteoarthritis. Since TGFbeta is believed to upregulate gene expression for aggrecan, downregulate matrix metalloprotease and IL-1 activity, and upregulate inhibitors of matrix metalloprotease, the stimulation of TGFbeta may be a mechanism through which PEMF favorably affects cartilage homeostasis.

Lik Sprava. 1997 Sep-Oct;(5):170-2.

[A comparative evaluation of the efficacy of magneto- and laser therapy in patients with osteoarthrosis deformans]

[Article in Russian]

Selivonenko VG, **Syvolap VD**, **Porada LV**, **Medvedeva VN**, **Boev SS**, **Morozov AI**, **Slin'ko VG**, **Berest SM**, **Garbuz LN**, **Sholokh SG**.

A comparative evaluation of efficacy of magneto- and laser therapy was carried out in 82 patients with osteoarthrosis deformans. The magnetic field and laser irradiation dispelled the pain syndrome and synovitis manifestations. It is recommendable that the multiple-modality therapy of patients with osteoarthrosis deformans should involve magneto- and laser therapy (15 to 20 procedures per one course) that improve results of the treatment being received and allow the time of hospitalization to be reduced at an average by 5 bed-days. Laser appeared to be a very effective mode of treatment. No unfavourable side effects were recordable.

J Indian Med Assoc. 1998 Sep;96(9):272-5.

A study of the effects of pulsed electromagnetic field therapy with respect to serological grouping in rheumatoid arthritis.

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The positive role of pulsed electromagnetic field (PEMF) therapy in rheumatoid arthritis (RA) is known. The differential role of serological status of patients in RA is also well known. This paper presents a study of the differential effects of PEMF therapy on the two serological groups of patients. The responses of the seropositive patients are found to be more subdued. Varying effects of the therapy in alleviating the different symptomatologies indicate that the rheumatoid factor (RF) is more resistant to PEMF.

: Curr Opin Rheumatol. 2002 Sep;14(5):603-7.

Nonpharmacologic management of osteoarthritis.

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Several nonpharmacologic interventions for osteoarthritis are in different stages of development, investigation, and application. Such interventions capitalize on current knowledge of the causes of symptoms, disease progression, and disability in patients with osteoarthritis. Many nonpharmacologic interventions are low in cost and incorporate self-management approaches or home-based activities and, as such, may ultimately have substantial public health impact. Recent studies and reviews of exercise, weight loss, education, inserts, footwear, bracing, therapeutic ultrasound, acupuncture, and pulsed electromagnetic field therapy will be highlighted in this review. For many of these interventions, further investigation will be necessary to define their place in the management of osteoarthritis.

Panminerva Med. 1992 Oct-Dec;34(4):187-96.

Therapeutic effects of pulsed magnetic fields on joint diseases.

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The present paper describes the effects of pulsed magnetic fields (MF) on diseases of different joints, in chronic as well as acute conditions where the presence of a phlogistic process is the rule. Optimal parameters for MF applications were sought at the beginning of the study and then applied for 11 years; a technical modification in the MF generator was introduced 5 years ago to satisfy the requirement of a hypothesis advanced to understand the mechanism of MF treatment. 3,014 patients were treated by means of MF

at extremely low frequencies and intensities. Patient follow-up was pursued as constantly as possible. Pain removal, recovery of joint mobility and maintenance of the improved conditions represented the parameters for judging the results as good or poor. The chi-square test was applied in order to evaluate the probability that the results are not casual. A general average value of 78.8% of good results and 21.2% of poor results was obtained. Higher (82%) percentages of good results were observed when single joint diseases were considered with respect to multiple joint diseases (polyarthrosis); in the latter, the percentage of good results was definitely lower (66%). The high percentage of good results obtained and the absolute absence of both negative results and undesired side-effects, together with the therapeutic advantage due to a technical modification in the MF generator, led to the conclusion that magnetic field treatment is an excellent physical therapy in cases of joint diseases. A hypothesis is advanced that external magnetic fields influence transmembrane ionic activity.

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Effects of pulsed electromagnetic fields on articular hyaline cartilage: review of experimental and clinical studies.

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Osteoarthritis (OA) is the most common disorder of the musculoskeletal system and is a consequence of mechanical and biological events that destabilize tissue homeostasis in articular joints. Controlling chondrocyte death and apoptosis, function, response to anabolic and catabolic stimuli, matrix synthesis or degradation and inflammation is the most important target of potential chondroprotective treatment, aimed to retard or stabilize the progression of OA. Although many drugs or substances have been recently introduced for the treatment of OA, the majority of them relieve pain and increase function, but do not modify the complex pathological processes that occur in these tissues. Pulsed electromagnetic fields (PEMFs) have a number of well-documented physiological effects on cells and tissues including the upregulation of gene expression of members of the transforming growth factor beta super family, the increase in glycosaminoglycan levels, and an anti-inflammatory action. Therefore, there is a strong rationale supporting the in vivo use of biophysical stimulation with PEMFs for the treatment of OA. In the present paper some recent experimental in vitro and in vivo data on the effect of PEMFs on articular cartilage were reviewed. These data strongly support the clinical use of PEMFs in OA patients.

Bioelectromagnetics. 2005 Sep;26(6):431-9.

Optimization of pulsed electromagnetic field therapy for management of arthritis in rats.

Kumar VS, **Kumar DA**, **Kalaivani K**, **Gangadharan AC**, **Raju KV**, **Thejomoorthy P**, **Manohar BM**, **Puvanakrishnan R**.

Department of Pharmacology and Toxicology, Madras Veterinary College, Vepery, Chennai, India.

Studies were undertaken to find out the effects of low frequency pulsed electromagnetic field (PEMF) in adjuvant induced arthritis (AIA) in rats, a widely used model for screening potential therapies for rheumatoid arthritis (RA). AIA was induced by an intradermal injection of a suspension of heat killed Mycobacterium tuberculosis (500 mug/0.1 ml) into the right hind paw of male Wistar rats. This resulted in swelling, loss of body weight, increase in paw volume as well as the activity of lysosomal enzymes viz., acid phosphatase, cathepsin D, and beta-glucuronidase and significant radiological and histological changes. PEMF therapy for arthritis involved optimization of three significant factors, viz., frequency, intensity, and duration; and the waveform used is sinusoidal. The use of factorial design in lieu of conventional method resulted in the development of an ideal combination of these factors. PEMF was applied using a Fransleau-Braunbeck coil system. A magnetic field of 5 Hz x 4 muT x 90 min was found to be optimal in lowering the paw edema volume and decreasing the activity of lysosomal enzymes. Soft tissue swelling was shown to be reduced as evidenced by radiology. Histological studies confirmed reduction in inflammatory cells infiltration, hyperplasia, and hypertrophy of cells lining synovial membrane. PEMF was also shown to have a membrane stabilizing action by significantly inhibiting the rate of release of beta-glucuronidase from lysosomal rich and sub-cellular fractions. The results indicated that PEMF could be developed as a potential therapy in the treatment of arthritis in humans.

Arch Phys Med Rehabil. 1991 Apr;72(5):284-7.

Electromagnetic treatment of shoulder periarthritis: a randomized controlled trial of the efficiency and tolerance of magnetotherapy.

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The potential benefit of magnetotherapy was investigated in 47 consecutive outpatients with periarthritis of the shoulder. Using a controlled triple-blind study design, one group of patients received hot pack applications and passive manual stretching and pulley exercises; the other group received the same therapy plus magnetotherapy. Treatment was administered three times a week. For a maximum of three months, a standardized treatment protocol was used. There was no significant improvement in pain reduction or in range of motion with electromagnetic field therapy. After 12 weeks of therapy, the patients who received magnetotherapy showed mean pain scores of 1.5 (+/- .61 SD) at rest, 2.2 (+/- .76 SD) on movement, and 1.9 (+/- .94 SD), on lying, compared to scores

for the control group of 1.4 (+/- .65 SD), 2.2 (+/- .7 SD), and 1.9 (+/- .95 SD), respectively. Linear pain scale scores improved from 71 to 21 for both groups. At 12 weeks the gain in range of motion was mean 109 degrees +/- 46.8 in patients receiving electromagnetic field therapy, compared to 122 degrees +/- 33.4 for the controls (not significant). At entry, the functional handicap score was 53.5 for both groups. At 12 weeks, it was 24 for the magnetotherapy group and 17 for the control group (difference not significant). In conclusion, this study showed no benefit from magnetotherapy in the pain score, range of motion, or improvement of functional status in patients with periarthritis of the shoulder.

Bratisl Lek Listy. 1999 Dec;100(12):678-81.

[Personal experience in the use of magnetotherapy in diseases of the musculoskeletal system]

[Article in Slovak]

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Therapeutic application of pulsatile electromagnetic field in disorders of motility is recently becoming more frequent. Despite this fact information about the effectiveness of this therapy in the literature are rare. The aim of this study was therefore the treatment of 576 patients who suffered from vertebral syndrome, gonarthritis and coxarthritis. For application of pulsatile electromagnetic field MTU 500H Therapy System was used. Pulsatile electromagnetic field had a frequency valve of 4.5 mT in all studied groups and magnetic induction valve 12.5-18.75 mT in the 1st group. In the 2nd group the intensity was 5.8-7.3 mT and in the 3rd group it was 7.6-11.4 mT. The time of inclination/declination in the 1st group was 20/60 ms, in the 2nd group 40/80 ms and in the 3rd group 40/90 ms. The electromagnetic field was applied during 10 days. In the 1st-3rd day during 20 minutes and in the 4th-10th day during 30 minutes. The therapy was repeated in every patient after 3 months with values of intensity higher by 50%. In the time of pulsatile electro-magnetotherapy the patients were without pharmacotherapy or other physiotherapy. The application of pulsatile electromagnetic field is a very effective therapy of vertebral syndrome, gonarthritis and coxarthritis. The results have shown that the therapy was more effective in patients suffering from gonarthrosis, than in patients with vertebral syndrome and least effective in patients with coxarthosis. Owing to regression of oedema and pain relieve the motility of patients improved. (Tab. 3, Ref. 19.)