Indian J Orthop. 2009 Jan;43(1):17-21.

Biophysical stimulation in osteonecrosis of the femoral head.

Leo M, Milena F, Ruggero C, Stefania S, Giancarlo T.

Abstract

Osteonecrosis of the femoral head is the endpoint of a disease process that results from insufficient blood flow and bone-tissue necrosis, leading to joint instability, collapse of the femoral head, arthritis of the joint, and total hip replacement. Pain is the most frequent clinical symptom. Both bone tissue and cartilage suffer when osteonecrosis of the femoral head develops. Stimulation with pulsed electromagnetic fields (PEMFs) has been shown to be useful for enhancing bone repair and for exerting a chondroprotective effect on articular cartilage. Two Italian studies on the treatment of avascular necrosis of the femoral head with PEMFs were presented in this review. In the first study, 68 patients suffering from avascular necrosis of the femoral head were treated with PEMFs in combination with core decompression and autologous bone grafts. The second one is a retrospective analysis of the results of treatment with PEMFs of 76 hips in 66 patients with osteonecrosis of the femoral head. In both studies clinical information and diagnostic imaging were collected at the beginning of the treatment and at the time of follow up. Statistical analysis was performed using chi-square test. Both authors hypothesize that the short-term effect of PEMF stimulation may be to protect the articular cartilage from the catabolic effect of inflammation and subchondral bone-marrow edema. The long-term effect of PEMF stimulation may be to promote osteogenic activity at the necrotic area and prevent trabecular fracture and subchondral bone collapse. PEMF stimulation represents an important therapeutic opportunity to resolve the Ficat stage-I or II disease or at least to delay the time until joint replacement becomes necessary.

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[The efficacy of pulsed electromagnetic fields used alone in the treatment of femoral head osteonecrosis: a report of two cases]

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Abstract

Long-term radiologic and clinical results of pulsed electromagnetic fields (PEMF) are presented with illustration of two patients having Ficat-Arlet grade 2 osteonecrosis of the femoral head. One patient (female, age 33 years) had bilateral involvement due to systemic steroid use, the other (male, age 39 years) had right-sided involvement of unknown etiology. Surgical treatment was ruled out because of aplastic anemia associated with significant thrombocyte deficiency in the first patient, while the other refused surgery. Pulsed electromagnetic fields were applied as the sole treatment modality in three hips for six months with a duration of 10 hours daily (at nights). At the end of 12-year- and five-year-follow-ups, respectively, clinical improvement was observed in all hips, with no radiologic deterioration. It is concluded that application of PEMF stimulation alone may be an alternative treatment modality in patients in whom surgical treatment cannot be performed for femoral head osteonecrosis, in particular Ficat-Arlet grade 1 and 2 disease.

PMID: 14963399 [PubMed - indexed for MEDLINE]

Rheum Dis Clin North Am. 2000 Feb;26(1):51-62, viii.

Electromagnetic fields and magnets. Investigational treatment for musculoskeletal disorders.

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Abstract

Certain pulsed electromagnetic fields (PEMF) affect the growth of bone and cartilage in vitro, with potential application as an arthritis treatment. PEMF stimulation is already a proven remedy for delayed fractures, with potential clinical application for osteoarthritis, osteonecrosis of bone, osteoporosis, and wound healing. Static magnets may provide temporary pain relief under certain circumstances. In both cases, the available data is limited. The mechanisms underlying the use of PEMF and magnets are discussed.

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Clin Orthop Relat Res. 1989 Sep;(246):172-85.

Effects of pulsed electromagnetic fields on Steinberg ratings of femoral head osteonecrosis.

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Abstract

Between 1979 and 1985, 95 patients with femoral head osteonecrosis met the protocol for treatment of 118 hips with selected pulsed electromagnetic fields (PEMFs). Etiologies included trauma (17), alcohol (9), steroid use (46), sickle cell disease (2), and idiopathy (44). The average age was 38 years, and the average follow-up period since the onset of symptoms was 5.3 years. PEMF treatment had been instituted an average of 4.1 years earlier. By the Steinberg quantitative staging method of roentgenographic analysis, none of the 15 hips in Stages 0-III showed progression, and grading improved in nine of 15. Eighteen of 79 hips (23%) with Stage IV lesions progressed and none improved. In the Stage V category, one of 21 hips (5%) worsened and none improved. Three Stage VI lesions were unchanged. The overall rate of quantified progression for the 118 hips, 87% of which had collapse present when entering the program, was 16%. This value represents a reversal of the percentage of progression reported recently by other investigators using conservative and selected surgical methods. PEMF patients also have experienced long-term improvements in symptoms and signs, together with a reduction in the need for early joint arthroplasty.

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Effects of pulsed electromagnetic fields on human osteoblastlike cells (MG-63): a pilot study.

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Abstract

BACKGROUND: Although pulsed electromagnetic fields (PEMFs) are used to treat delayed unions and nonunions, their mechanisms of action are not completely clear. However, PEMFs are known to affect the expression of certain genes.

QUESTIONS/PURPOSES: We asked (1) whether PEMFs affect gene expression in human osteoblastlike cells (MG63) in vitro, and (2) whether and to what extent stimulation by PEMFs induce cell proliferation and differentiation in MG-63 cultures.

METHODS: We cultured two groups of MG63 cells. One group was treated with PEMFs for 18 hours whereas the second was maintained in the same culture condition without PEMFs (control). Gene expression was evaluated throughout cDNA microarray analysis containing 19,000 genes spanning a substantial fraction of the human genome.

RESULTS: PEMFs induced the upregulation of important genes related to bone formation (HOXA10, AKT1), genes at the transductional level (CALM1, P2RX7), genes for cytoskeletal components (FN1, VCL), and collagenous (COL1A2) and noncollagenous (SPARC) matrix components. However, PEMF induced downregulation of genes related to the degradation of extracellular matrix (MMP-11, DUSP4).

CONCLUSIONS AND CLINICAL RELEVANCE: PEMFs appear to induce cell proliferation and differentiation. Furthermore, PEMFs promote extracellular matrix production and mineralization while decreasing matrix degradation and absorption. Our data suggest specific mechanisms of the observed clinical effect of PEMFs, and thus specific approaches for use in regenerative medicine.

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