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Short Communication

The effects of EMF (ELECTROMAGNETIC FIELDS) on the Bone and Cartilage Tissue

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ABSTRACT

Environmental electromagnetic fields are nowadays available in all environments today. These areas affect the biological system. Controlled interactions with elecrtomagnetic fields can have positive effects when unrestricted interactions have negative effects. Uncontrolled exposure to low-frequency electromagnetic fields can cause adverse effects such as signal transduction in cells and tissues, cell membrane structure, ion channels, molecular interactions, DNA damage. But contrary to controlled exposure, it positively affects tissues. The most obvious example of this is seen in the bone and cartilaginous tissue. Repairing fractures and damage in bone and cartilage. This has been shown in many studies. Below is a summary of the relevant information.

GENERAL INFORMATION

Low-frequency electromagnetic fields display several effects on a variety of biological tissues as bone and cartilage. A very scientific researchs has investigated and confirmed the activity of EMF (Electromagnetic fields) on this tissue [1]. *In vitro* and *in vivo* studies have shown that EMF can change some physiological parameters of bone cells, such as proliferation [2], differantiation [3], the synthesis extracellular matrix components [3-5] and the production of growth factors. Also, EMF can stimulate osteogenesis on the bone. This has been shown in many studies [6].

Clinical studies showed EMF exposure might be useful fort he treatment of degenerative cartilage disorders such as osteoarthritis [6]. Several studies have investigated the effects of EMF on cartilage cells and tissue showing that EMF can stimulate chondrocyte proliferation and increase the amount of cartilage ECM (Extracellular matrix) components. EMF stimulate proteoglycans (PG) synthesis *in vivo* and *in vitro*. PG are fundamental components of cartilage ECM and PG loss from tissue is observed in OA. EMF can stimulate PG synthesis [7].

Electromagnetic fields have positive effects on bone and cartilage tissue. These effects come from wolf law and piezzoelectricity. EMF affects the mobility of K, Ca, Mg ions in bone and cartilage. Increases collagen synthesis [8].

Magnetic fields, as another extrinsic factor, were traditionally used complementary or alternative therapy. Recent studies found that magnetic fields had some effects on cells, tissues, and also on living organisms as a whole. EMF have been shown to affect the extracellular matrix of the hyaline cartilage, stimulate bovine condrocyte proliferation, increase cartilage extracellular matrix formation, and synthesis of proteoglycans. Low- frequency EMF also had positive effects on cartilage proliferation, chondrocyte differantiation and matrix production in the rats. It has been shown that

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0,6 T static magnetic field increased metabolic activity in human cartilage tissue, whereas moderate intensity SMF induced cell proliferation, and high intensity SMF (3T) reduced human chondrocyte cell proliferation and induced cell apoptosis [9].

Moderate-intensity SMF have also been shown to promote bone formation and prevent decrease in bone mineral density in an ischemic rat model [9]. Decreasing inflamation and edema are among the other effects of SMF [9].

According to these experiments and other studies that have emphasized the effect of moderate-intensity SMF from 1mT to 1T on many biological functions [10]. It was tried to determine the effects of a moderate intensity permanent magnetic field in mT levels on cartilage repair in an animal model. It is hypothesizedthat permanent magnetic fields would improve cartilage defect healing and matrix production [10].

Collagens are proteins composedof three polypeptide subunits known as α-chains that exist in a unique triplehelix.More than 20 types of collagen exist in animal tissue [11]. ECM, fibrillar proteins, proteoglicans, and glycosaminoglycans (GAGs), provides an electrochemical environment surrounding cells and conveying signals from the exterior of that cell to the interior and vice versa. Many ECM components can be affected by EMF, including soluble ions and charged groups in GAGs and pteins. It was reported that proteins moved along EMF to reach the binding sites on cell membrane receptors. Electromagnetic stimulation also reportedly influenced the adsorbtion of serum proteins, specifically fibronectin [12].

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