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ORIGINAL PAPER

Pulsed electromagnetic field therapy results in healing of full thickness articular cartilage defect

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Abstract This study aimed to determine the efficacy of PEMF (pulsed electromagnetic field) treatment in experimental osteochondral defect healing in a rabbit model. The study was conducted on 12 New Zealand white rabbits. Six rabbits formed the study group and six rabbits the control group. The right knee joints of all 12 animals were exposed and a 3.5-mm diameter osteochondral defect was created in the trochlear groove. The defect was filled with calcium phosphate scaffold. Six animals from the study group were given PEMF of one hour duration once a day for six weeks with set parameters for frequency of 1 Hz, voltage 20 V, sine wave and current ±30 mA. At six weeks the animals were sacrificed and histological evaluation was done using H&E, Safranin O, Maissons trichrome staining and immunohistochemistry for type 2 collagen. The quality of the repair tissue was graded and compared between groups with the Wakitani histological grading scale and a statistical analysis was done. The total histological score was significantly better in the study group (p =0.002) with regeneration similar to adjacent normal hyaline cartilage. Immunohistochemistry for collagen type II was positive in the study group. PEMF stimulation of osteochondral defects with calcium phosphate scaffold is effective in hyaline cartilage formation. PEMF is a non-invasive and cost effective adjuvant treatment with salvage procedures such as abrasion chondroplasty and subchondral drilling.

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Introduction

Pulsed electromagnetic field therapy is used as an adjuvant therapy in the management of un-united fractures and in osteoarthritis. This treatment has well documented physiological effects on cells and tissues such as the upregulation of gene expression of members of the TGF-β (transforming growth factor) super family [1, 2]. It also enhances chondrogenic proliferation, differentiation and synthesis of cartilage extracellular matrix proteins [8, 9]. It additionally promotes subchondral bone healing which in turn augments cartilage regeneration [12]. In vitro culture models have shown an increase in growth factor synthesis when human chondrocytes are exposed to magnetic field [9]. Although in vitro effects of PEMFs on articular cartilage are proven, there are very few in vivo studies proving its efficacy [7, 11].

In a previous study, local expression of TGF-β by treatment with pulsed magnetic field therapy resulted in better bone healing in animal study osteotomy models compared to controls [6]. Our hypothesis was that in full thickness articular cartilage defects resulting in marrow stimulation, growth factors delivered locally by pulsed electromagnetic field (PEMF) should help in the formation of hyaline cartilage. This study aimed to determine the efficacy of PEMF in the treatment of experimental osteochondral defect healing in a rabbit model.

Materials and methods

A total of 12 male adult New Zealand white rabbits were used. The study was approved by the Institutional Animal ethics committee (approval number 02/2008). Six animals formed the study group and six more the control group. The rabbits were anaesthetised using a combination of intramuscular

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