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The Effect of Biophysical Stimulation on Cartilage Repair with Osteochondral Autograft

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1 Introduction

Osteoarthritis is one of the most frequent pathology of the joints, that involve cartilage and subchondral bone, and it is the main responsible of disability in the adult population. Therapeutic options for treating damaged cartilage include the use of local and systemic anti-inflammatory drugs and chondroprotective treatments. Osteochondral autologous grafts are instead indicated for the treatment of joint lesions with subchondral bone exposure.

Recently, *in vitro*, it has been also demonstrated that Pulsed ElectroMagnetic Fields, PEMFs (I-ONE, Igea, Carpi, Italy) exert an adenosine-agonist action anti-inflammatory effect in human neutrophils and it is able to inhibit the catabolic effects of inflammatory cytokines in full-thickness cartilage explants. *In vivo*, in a model of spontaneous osteoarthosis, PEMF is able to prevent articular cartilage degeneration, namely its thinning and fibrillation, exerting a chondroprotective effect on the whole articular cartilage. The aim of this study was to evaluate the effects of PEMFs on osteochondral graft healing by favouring subchondral bone integration and by limiting inflammation and cartilage degeneration.

2 Materials and Methods

Osteochondral grafts were performed in the right knee of 20 sheep. Animals were treated with PEMFs for 6 hrs/day or Sham-treated. Six animals were sacrificed at 1 month. Fourteen animals were treated for 2 months and sacrificed at 6 months. Grafts were evaluated by microradiographic and histological analyses. At 6 months IL-1, TNF-α and TGF-β1 were assayed in the synovial fluid.

3 Results

At 1 month the osteogenic activity at the transplant-host subchondral bone interface was increased in PEMF-treated animals compared to controls ($p < 0.03$). Articular cartilage was healthy in control and stimulated animals. At 6 months, 4 grafts were reabsorbed in control animals. More resorption areas were observed within the graft of sham-treated animals versus PEMF-treated ($p < 0.005$). The extension of cyst like resorption areas in the grafts was significantly higher in Sham-treated animals compared to PEMF treated ($p < 0.005$). The histological score showed no significant differences between control and stimulated animals, but the % of surface covered by fibrous tissue was higher in the control group (32%) than in the stimulated (15%). IL-1 and TNF-α concentration was significantly lower and TGF-β1 was significantly higher in PEMFs-treated animals compared to controls.

4 Conclusion

Osteochondral grafting is an effective technique used in articular cartilage resurfacing. Mechanical stability represents a key element in determining the success of the technique. PEMF exposure favoured the healing of osteochondral grafts in sheep. These results provide a rational basis for clinical studies, evaluating the effect of PEMFs in patients undergoing osteochondral grafting for cartilage defect repair.

Our experiments demonstrate that using a biophysical stimulus with adenosine-agonist action,

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it is possible to perform on an individual joint a chondroprotective biophysical anatomic (CBA) treatment of the cartilage and subchondral bone, on its whole extension and thickness.