GP9. PULSED ELECTROMAGNETIC FIELD (PEMF) STIMULATION OF NUCLEUS PULPOSUS CELLS

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INTRODUCTION: Histological and biochemical studies have shown that degenerative processes influence disc tissue structure, composition and cellular activity. Current surgical treatments for disc degeneration do not preserve normal disc function, therefore it is desirable to develop alternative treatments to slow or even reverse the degenerative process. Minimally-invasive therapy with pulsed electromagnetic fields (PEMF), as applied already for articular cartilage, may have promise. The aim of this study was to determine the influence of PEMFs on nucleus pulposus (NP) cell proliferation and the synthesis of disc-specific proteins.

METHODS: Three monolayer (2D) experiments and two 3D experiments were conducted. Bovine coccygeal NP cells were isolated and cultured directly as 2D monolayers in 6-well plates, or encapsulated first in 3D agarose beads, and exposed to PEMF for up to 14 days, with an exposure interval of 18 h per day. PEMF fields were generated within custom-built chambers employing active and passive coils. The EMF pulses had a duration of approximately 1.2 ms, a flux density of 1.5 mT, and a repetition rate of 2 and 75 Hz, respectively. Outcome measures included cell viability, proliferation, proteoglycan production and the expression of anabolic genes, evaluated via qRT-PCR.

RESULTS: Compared to non-exposed controls, the cell proliferation rate and the proteoglycan synthesis increased (+26.1% and +20.4%, respectively) for NP cells exposed to appropriate pulsed electromagnetic fields. No conclusive trends could be identified in gene expression profiles.

DISCUSSION: These results correspond to the findings of similar studies performed on chondrocytes, although the magnitude of the effect observed in the present study was substantially lower. PEMF field exposure induced a predominantly mitogenic effect in the NP cells. While the application of PEMF remains an attractive possibility for the non-invasive treatment of disc disorders, the effective field strength and high level of field control required should be critically evaluated.