Titel des Beitrags: Influence of extremely low frequency, low energy electromagnetic fields and combined mechanical stimulation on chondrocytes in 3-D constructs for cartilage tissue engineering.

Abstract: Articular cartilage, once damaged, has very low regenerative potential. Various experimental approaches have been conducted to enhance chondrogenesis and cartilage maturation. Among those, non-invasive electromagnetic fields have shown their beneficial influence for cartilage regeneration and are widely used for the treatment of non-unions, fractures, avascular necrosis and osteoarthritis. One very well accepted way to promote cartilage maturation is physical stimulation through bioreactors. The aim of this study was the investigation of combined mechanical and electromagnetic stress affecting cartilage cells in vitro. Primary articular chondrocytes from bovine fetlock joints were seeded into three-dimensional (3-D) polyurethane scaffolds and distributed into seven stimulated experimental groups. They either underwent mechanical or electromagnetic stimulation (sinusoidal electromagnetic field of 1 mT, 2 mT, or 3 mT; 60 Hz) or both within a joint-specific bioreactor and a coil system. The scaffold-cell
constructs were analyzed for glycosaminoglycan (GAG) and DNA content, histology, and gene expression of collagen-1, collagen-2, aggrecan, cartilage oligomeric matrix protein (COMP), Sox9, proteoglycan-4 (PRG-4), and matrix metalloproteinases (MMP-3 and -13). There were statistically significant differences in GAG/DNA content between the stimulated versus the control group with highest levels in the combined stimulation group. Gene expression was significantly higher for combined stimulation groups versus static control for collagen 2/collagen 1 ratio and lower for MMP-13. Amongst other genes, a more chondrogenic phenotype was noticed in expression patterns for the stimulated groups. To conclude, there is an effect of electromagnetic and mechanical stimulation on chondrocytes seeded in a 3-D scaffold, resulting in improved extracellular matrix production.