Conclusions: In summary, we have characterized a novel targeting peptide and showed its specificity as well as its competetive binding to articular cartilage. Surface functionalisation of PPS nanoparticles was carried out and showed similar binding at 10% surface functionalisation as the free peptide. After further optimisation, the functionalized nanoparticles will be labeled and loaded with small molecule drugs to determine the in vivo targeting of the articular cartilage and their capability of sustained intra-articular drug release in the cartilage matrix.

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MECHANO-ACTIVE CARTILAGE TISSUE ENGINEERING USING A HIGHLY ELASTIC SCAFFOLD AND BONE MARROW STEM CELLS

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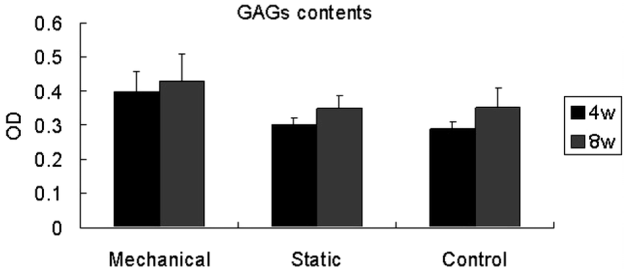
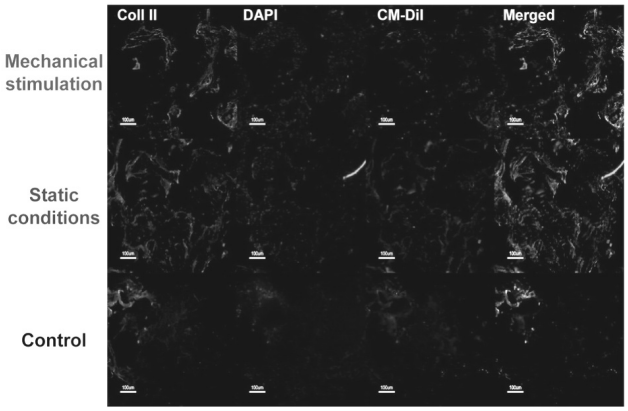
Purpose: Articular cartilage is subjected to complex loading, which include compressive and shearing forces. These mechanical forces play a major role in the growth, development and maintenance of the articular cartilage in the body. It is known that proper stimulation is necessary to promote chondrogenesis. This means the compressive mechanical stimulation is a very important factor for the formation of articular cartilage using a tissue engineering technique. Therefore, it is essential to develop a mechano-active bioreactor that can deliver the mechanical signals to adherent cells on polymer scaffolds during the application of mechanical strain application. The objective of this study is to evaluate the effect of dynamic compression for the differentiation of bone marrow stromal cells (BMSCs) within an elastic scaffold and the formation of cartilaginous tissue.
Methods: The mechano-active scaffolds were fabricated from a very elastic poly(L-lactide-co-caprolactone) (PLCL) with 85% porosity and a 300∼500 μm pore size using a gel-pressing method. The scaffolds were seeded with BMSCs and the continuous compressive stimulation was applied at 0.1Hz for 10 days in chondrogenic media in order to evaluate the effect of dynamic compression on differentiation of BMSCs and the secretion of the chondral extracellular matrix. In addition, the BMSCs seeded constructs were implanted subcutaneously into nude mice to determine their biocompatibility and cartilaginous tissue formation. Cell-polymer constructs were characterized by biochemical analysis, histological studies, and immunofluoresecence staining. For defining the gene expression for mechanical stimulation, reverse transcription-polymerase chain reaction was performed.
Results: Mechano-active scaffolds having a complete rubber-like elasticity were prepared by a gel-pressing method. They could be easily twisted and bended and showed almost complete (over 97%) recovery at strain applied of up to 500%. In *in vitro* tests, the accumulation of extracellular matrix of cell-polymer constructs showed that chondrogenic differentiation was sustained and enhanced significantly by dynamic compressive stimulation. The GAGs contents of implants stimulated by the dynamic compressive deformation were higher than them without stimulation. Histological analysis showed that implants stimulated mechanically by compression formed mature and well-developed cartilaginous tissue, as evidenced by chondrocytes within lacunae and an abundant accumulation of sulfated GAGs. From the results, the periodic application of dynamic compression can encourage bone marrow stromal cells to differentiation to chongenic lineage and to maintain their phenotypes. Consequently, it may improve the quality of cartilaginous tissue formed in vitro and in vivo.





Conclusions: In conclusion, the appropriate periodic application of dynamic compression can encourage the BMSCs to maintain their phenotypes, promote differentiation and enhance GAGs and type II collagen production, as evidenced by the improved quality of the cartilaginous tissue formed *in vitro* and *in vivo*. Therefore, it is believed that tissue engineering techniques using mechao-active PLCL scaffolds and dynamic compression would be very beneficial for cartilaginous tissue formation.

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ASSESSMENT OF CARTILAGE REPAIR TISSUE, FOLLOWING AUTOLOGOUS CHONDROCYTE IMPLANTATION, BY HISTOCHEMISTRY AND FOURIER TRANSFORM INFRARED IMAGING SPECTROSCOPY

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Purpose: Current methods used to repair localized articular cartilage defects include autologous chondrocyte implantation (ACI). There has been limited success in correlating clinical outcome with quality of the repair tissue formed. More sophisticated techniques that can assess the molecular features of repair tissue would aid the evaluation of treatments. Fourier transform infrared imaging spectroscopy (FT-IRIS) can be used to assess articular cartilage based on molecular vibrations that arise from its primary constituents, collagen and proteoglycan (PG). In this study tissue biopsies obtained one year post-ACI treatments were analyzed by immunohistochemistry and FT-IRIS to assess the molecular features of the repair tissue.
Methods: Five male patients (aged 21, 25, 34, 42 and 52 yrs) were treated with ACI for cartilage defects. Their follow-up treatment included an arthroscopic assessment and biopsy of the treated area at 12 months post-treatment. Biopsies were sectioned for histological, immunohistochemical (collagen types I and II) and FT-IRIS analyses and compared to normal human articular cartilage. Sections on BaF_2 windows were analyzed