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Biomechanics and mechanobiology for bone tissue engineering *in vitro*

Abstract

Mechanical stimulation can regulate cellular activities *in vivo*, e.g. differentiation, proliferation and extracellular matrix (ECM) production. *In vivo* evidence has shown that higher bone mineral density can be achieved under mechanical stimulation (mechanical strain and/or fluid induced wall shear stress). If mechanobiological findings can be translated to bone tissue engineering *in vitro*, we may accerlate osteogenisis and enhance mineralised bone tissue formation, which for example can be used for drug testing to treat osteoporosis. Therefore, we aimed to explore this possibility by applying different mechnical stimulations to the cells (stem cells and bone cells) using different bioreactor techniques. Furthermore, to refine the *in vitro* bone tissue engineering experiments and reduce trial-and-error experiments, we used *in silico* (computational) approach to find the optimal cellular mechanical stimulation for bone tissue engineering, and predicted how mineralised bone tissue grew within biomaterial scaffolds under different mechanical stimulations.