Cartilage bioreactors: where we are and where we are going!

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Advanced biomaterials and tissue engineered constructs have been developed to improve tissue repair; nevertheless, their clinical translation has been hampered, also by the lack of reliable *in vitro* models suitable for pre-clinical screening of new implants and compounds mimicking the *in vivo* situation.

Tissue regeneration is strongly influence by the mechanical properties and behavior of biomaterials, which can be completely different when tested in "isolation" or in a biological context. Therefore, it is important to evaluate the performance of such advance biomaterials in *in vitro* models, which reproduce closely the *in vivo* tissue status.

To such end, we have developed several complex organ models (here, cartilage) which include, not only the tissue part, but the tissue is cultured within a bioreactor, reproducing loading patterns similar to the *in vivo* microenvironment. Here, we will focus on bioreactor systems that transmit a mechanical stimulus, as this is a key parameter in the homeostasis of various musculoskeletal tissues, such as bone, cartilage, tendon, and intervertebral disc. By testing regenerative therapies under conditions that are closer to the ones encountered *in vivo,* bioreactors can provide a useful screening tool and standardization opportunities for the evaluation of various biomaterials, but as well as cell types, drugs, or tissue engineered products. This will allow to reduce the number of samples for the final *in vivo* evaluation, allowing the 3R philosophy approach to be implemented.

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