

Design of a bioreactor to apply cyclic compressive mechanical stimulus on a viscoelastic material within a controlled culture environment

Articular cartilage provides a nearly frictionless and load bearing surface, which ensures the proper function of joints. However, once cartilage is damaged it will never heal resulting in a very painful disease called osteoarthritis affecting millions of patients worldwide. Thus, in cartilage tissue engineering we aim to create a replacement tissue for cartilage to improve the life quality for these patients.

Articular cartilage is a highly mechanically-sensitive tissue that can either respond favourably or unfavourably to a mechanical stimulus. Hence, a proper control of the stimulation and the culture environment is crucial for the correct development of replacement tissue. Bioreactors can provide the control of these parameters and thus ensure reproducibility and the possibility to test a multitude of culture conditions.

The aim of this project is to design a bioreactor, which can apply cyclic compressive mechanical loading on viscoelastic materials like hydrogels within a controlled culture environment. For the design of the bioreactor the student(s) should consider the following criteria:

- Precise control over cyclic compressive mechanical stimulus
- Provides controlled environment (can also be provided by placing the bioreactor in a cell culture incubator): temperature, gas exchange: CO₂ and oxygen tension
- exchange of cell culture medium
- Parts of the bioreactor can be easily sterilized
- Adapted to small samples (diameter 5mm, height 1-5mm)