

THE DEVELOPMENT OF A FLEXIBLE SYSTEM TO ENABLE PROGRAMMABLE PRESSURISATION FOR A HYDROSTATIC BIOREACTOR FOR ORTHOPAEDIC TISSUE ENGINEERING

Bandeira, K.A.M., Ogrodnik, P.J.

Keele University, Keele, Newcastle, ST5 5BG, United Kingdom

Introduction

Tissue engineering is a growing discipline in orthopaedics. Bioreactors have been a ground breaking tool used in the field of Tissue Engineering. These tools come in many forms, such as Hydrostatic, Perfusion and Compression bioreactors. Bioreactors serve as a vessel for both, biological and biochemical processes, allowing them to develop in a controlled environment. Typically, pH, temperature, pressure, nutrient supply and waste removal are highly controlled to ensure optimal cell growth (Martin *et al.*, 2004).

Non-static bioreactors are preferable as they can imitate *in vivo* conditions through various external forces. To appropriately engineer functional tissue, non-static bioreactors must address the metabolic demand, mechanical stimuli and chemical stimuli required by such structures (Blose *et al.*, 2014).

There exists various methods, in regard to applications of hydrostatic pressure to cells, explants and constructs, both offering various advantages and disadvantages (Elder and Athanasiou, 2009). One method is carried out by the application of a compressed gas phase that transmits load through the medium the cells are grown in.

Although this method has shown to have its uses, such as in the proliferation of bovine cartilage, this method of hydrostatic pressure application has been observed to alter the gas phase applied (Hansen *et al.*, 2001).

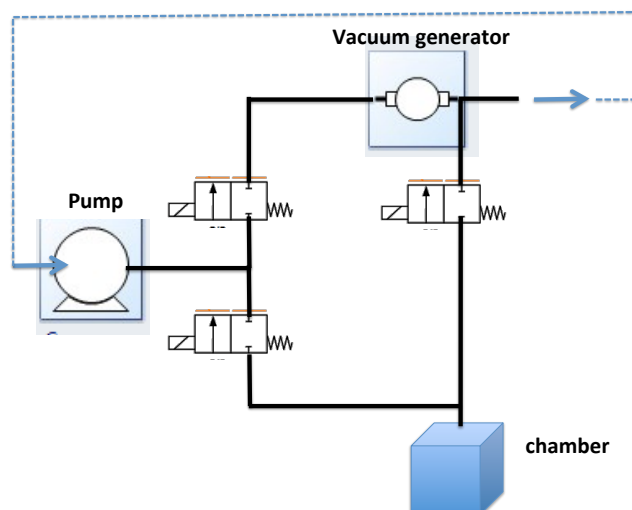


Fig 1 – System Schematic

Results

The flexible bioreactor was designed to effectively apply a mechanical loading cycle using hydrostatic pressure with a range of 5-270kPa at a frequency of 1Hz. Additionally, imaging of cell cultures during cyclic loading was possible using the current bioreactor system.

With a constant flow rate application, the bioreactor was able to apply cyclical mechanical loading over the space of one hour. The limiting factors of the amount of cycles was found to be the lifecycle of the valves employed in the system's design.

References

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