lower temperature were higher than those prepared at the higher temperature. Upon coating, the pore sizes of the foams decreased from 50-200 µm to 25-170 µm while those of the foams prepared at -80 oC decreased from 30-80 µm to 15-60 µm. CLSM and SEM analysis of the cell seeded scaffolds show that coating the foams with alginate enhanced cell attachment and ECM production.

**Conclusion.** Surface and mechanical properties of the alginic acid-coated PLLA-PLGA foams were significantly better than those of the uncoated ones, however, porosity decreased upon coating. The results show that the foams prepared at -20 oC have properties comparable with those of the native meniscus.

**Keywords.** Mechanical characterization, scaffold, meniscus, biodegradable polymers

![Figure 1](image) **Figure 1.** Influence of coating with algicin acid and preparation condition (freezing temperature) on compressive properties of the PLLA-PLGA foams.

**(27.O17) FABRICATION AND MECHANICAL CHARACTERIZATION OF A NOVEL THREE-DIMENSIONAL CELL-SEEDED COLLAGEN/HYDROXYAPATITE OSTEOCHONDRAL SUBSTITUTE**

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**Introduction.** When a cartilage injury occurs, the underlined bone changes, thickens and becomes pathologically altered. In these conditions, a successful procedure for cartilage regeneration should not involve only the cartilaginous tissue but the whole osteochondral compound. Nowadays, in the clinical practise, only cell-free composites are available. However, although the bone tissue is able to colonize an osteocompatible scaffold, the cartilage cannot. We believe that seeding cells into the chondral part of a biphasic substitute, could represent a promising solution for the osteochondral tissue repair. In this study, a novel three-dimensional collagen/hydroxyapatite osteochondral substitute was developed, cell-seeded and mechanically characterized.

**Methods.** A hydroxyapatite macrochanneled porous scaffold was produced by polymer sponge templating method using a reactive sub-micron powder synthesized by hydroxide precipitation sol-gel route. The ceramic scaffold was then integrated to a collagen part obtained by a freeze drying technique. Morphology and mechanical properties of scaffolds was analysed by scanning electron microscopy and compression test. Expanded swine chondrocytes were suspended within the collagen part. Samples were retrieved from culture after 1, 3, 5 weeks. All samples were processed for histological evaluation and mechanically tested to evaluate the engineered constructs stiffness.

**Results.** The ceramic part of the scaffold had high mechanical performance (compressive strength ~ 0.51 MPa) compared to literature data. The collagen scaffolds showed a regular structure and homogeneous porosity (~100 µm). The histological analysis showed cell survival and matrix production within the scaffolds’ fibres. The mechanical strength of the tissue-engineered construct increased significantly after 3 weeks of culture (from 7 to 55KPa).

**Conclusions.** Three-dimensional collagen/hydroxyapatite scaffolds could be properly fabricated and mechanically characterized. An in vivo study, to evaluate the efficacy of the scaffolds for repairing osteochondral defects is in progress in a pig model.

**Keywords.** scaffold, engineered construct, compression test

**(27.O18) EFFECT OF SUBSTRATE STIFFNESS AND PHYSICOCHEMICAL PROPERTIES ON HUMAN MESENCHYMAL STEM CELL ACTIVITY IN 3D SCAFFOLDS**

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**Introduction:** Developing scaffolds with instructive properties to control stem cell behavior is an emerging strategy in tissue engineering. With the aid of mathematical models, theories were proposed to understand the influence of mechanical stress and strain on cellular behavior, while substrate elasticity was experimentally shown to direct stem cell differentiation. Yet, it is not known whether cells adhered to the surface of scaffolds perceive a different magnitude of physical stimuli compared to cells embedded in synthetic or natural extracellular matrix (ECM). We developed finite element models (FEMs) to predict the distribution of stresses and strains in 3D scaffolds displaying variable stiffness and physicochemical properties. Assuming that different stress/strain regimes result into different cell activity, we also initiated the experimental evaluation of the influence of scaffold stiffness and physicochemical properties on human mesenchymal stem cells (hMSCs).

**Method:** 3D scaffolds from different biomaterials (300PEOT55PBT45, 1000PEOT70PBT30, PCL, PLDLA) with equal pore architecture were fabricated by rapid prototyping. Scaffolds were imaged through microcomputed tomography and converted to FEMs to
calculate the surface and volume strain distribution and fluid shear stresses upon compression and perfusion. The influence of substrate bulk and apparent stiffness on cellular activity was investigated. Static culture experiments were performed on 3D scaffolds seeded with hMSCs exposed to basic, osteogenic, chondrogenic and adipogenic medium.

**Results:** Scaffolds consistently supported a lower surface strain compared to the volume strain. This implies that the mechanical stimuli perceived by cells on a 3D scaffold are of different magnitude than cells embedded in a synthetic or natural ECM. Static culture experiments showed hMSCs adhesion and distribution on 3D scaffolds varied by biomaterial. hMSCs adhered and distributed better on 300PEOT55PBT45 followed by PCL, PLDLA, and 1000PEOT70PBT30. Further experiments will aim at correlating substrate physicochemical properties and stiffness with hMSC differentiation in 3D scaffolds in a dynamic environment.

**Keywords.** 3D scaffolds, substrate stiffness, physicochemical properties

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**Fig. 1.** (A) Reconstructed image of tubing containing cells (B) 0° and 180° sections for the model validation.

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**[27.O19] VALIDATION OF THE EFFECT OF WALL SHEAR STRESS ON CELL ADHESION FOR A PERFUSION BIOREACTOR MATHEMATICAL MODEL**

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**Introduction.** Mathematical modelling of tissue engineering bioreactors has been used to determine the best operational conditions. The lattice Boltzmann (lB) method allows the inclusion of all the parameters into a model for a perfusion bioreactor. The effects of fluid shear stress in cell seeding and cell differentiation in such systems have been studied previously; however a math model that allows the optimization of flow rate and cell concentration, among others parameters, have not yet been developed.

**Materials and Methods.** The lB code produced cell attachment and wall shear stress models depending on cell concentration and flow. Although work is still ongoing to improve the resolution of some images, current CT data has produced useful information for the math model. **Discussion and Conclusions.** The IB code produced cell attachment and wall shear stress models depending on cell concentration and flow. Although work is still ongoing to improve the resolution of some images, current CT data has produced useful information for the math model.

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**Keywords.** mathematical model, Lattice Boltzmann, perfusion bioreactor, wall shear stress, microCT