Tissue-to-Tissue Interfaces: the Macromolecular Gradient In Hydrogels to Generate ELP-PEG hybrid gel an ideal platform for future cell-matrix interaction, as well as independently tunable bio-chemical and mechanical properties make this newly designed ELP-PEG hybrid gel an ideal platform for future cell-matrix interaction studies.

Modulation of the Secretome of hBMSCs by Tailoring the Macromolecular Gradient In Hydrogels to Generate Tissue-to-Tissue Interfaces

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Tissue-to-tissue interfaces exhibit structural, biological and chemical gradients serving a wide range of physiological functions. We designed two adjacent tissues and sustaining cellular communications to retain tissue’s homeostasis.

In vitro

1. Mikos, AG. et al., T. Eng. 12, 3307, 2006

Efficient Formation of Size-regulated Hepatocyte Aggregates on Oxygen Permeable Microwell Sheets and the Size-dependency of Their Metabolic Capacities

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Three-dimensional hepatocyte aggregates are expected as a useful in vitro model for a number of assays. One of the common issues for hepatocyte aggregate formation is critical loss of oxygen supply to the culture system, because of the high oxygen consumption of hepatocyte and the low gas permeability of culture environment. Here we report efficient method to obtain size-controlled hepatocyte aggregates using an oxygen permeable poly-dimethylsiloxane (PDMS)-based microwell sheet, which enables direct oxygenation to the culture environment. We prepared PDMS-based microwell sheet in different sizes and coated with 2-methylacryloxyethyl phosphorylcholine (MPC) polymer to prevent cellular attachment. Rat hepatocytes were cultured and formed size-controlled aggregates on their surface. Our microwell enhanced inömucul cellular density up four times higher and accelerated aggregation compare to the conventional polyastrene culture plate surfaces (TCPS). Less than 88 μm aggregates were overall higher functional than other sizes aggregates or monolayer culture in terms of several different sub-families of P450s. This highly-metabolic size ranges of hepatocyte aggregates are smaller than the limited size decided by the oxygen diffusion and consumption (~150 μm). In addition, irinoxetane toxic assays showed interesting size-dependency and more than 52 μm aggregates were effective for detoxification by CYP3A2. These results demonstrate the importance of the selection of hepatocyte aggregates sizes for accurate pharmacological and/or toxicological studies simply because observed metabolic rates of exogenous chemicals are the results of the diffusion, reaction and production of both the chemics and their metabolite in the aggregates.

Improving the Multipotency of Mesenchymal Stem Cell During In Vitro Cell Expansion within the Grooves of a Micro-structure Pillar Array

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Multipotent stem cells such as mesenchymal stem cells (MSCs) have been extensively studied for the past decades to promote tissue repairs. Like any other cells, MSCs are home to 3-dimensional (3D) microenvironments where they constantly sense and respond to their environmental cues which governs their appropriate self-renewal and controlled differentiation. In regenerative medicine, donor MSCs are however culture on a flat substrate to facilitate cell expansion for achieving high number of cell population for the intended tissue repairs. The culturing on a flat substrate can possibly change their cellular morphology which affect their multipotency abilities. In this study, we investigated the effect of expanding MSCs within the grooves of micro-structural pillars (circles, rectangles and grills) on their multipotency. The grooves within the micro-structural pillars had demonstrate their capabilities to manipulate the MSCs morphology. Further investigation showed that the use of these MSCs expanded in different 3D micro-environment carried different capacities for osteogenic and chondrogenic differentiation. These findings gained us insights in creating novel cell culture platform for MSCs to improve their multipotency during cell expansion in the field of regenerative medicine.

In Vitro Models of SMCs Under Cyclic Mechanical Stimulation: a Comparative Study between 2D and 3D

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Herein, 2D (cell monolayers) and 3D (cellularized gels) cultures are directly compared as in vitro models for the investigation of the response of vascular smooth muscle cells (SMCs) to cyclic strain. Human Umbilical Artery SMCs (HUASMCs) were cultured in monolayers and inside collagen gels cast in UniFlex μ plates using specific molds and anchors. Uniaxial 7% cyclic strain was applied at 1 Hz for 2 and 5 days. For histology, 10 μm sections were stained by Masson’s trichrome. For immunofluorescence, samples were stained with phalloidin-rhodamine and DAPI. Western blot was used to detect α-actin and calponin.