Spring 2015

Exploration in Novel Tissue Engineering Methods

Joseph Wortkoetter
Clemson University

Scott Holmes
Clemson University

Amanda Stastny
Clemson University

Catherine Demos
Clemson University

Caitlyn Jones
Clemson University

See next page for additional authors

Authors
Joseph Wortkoetter, Scott Holmes, Amanda Stastny, Catherine Demos, Caitlyn Jones, Carolyn Arthur, Madison Repp, Kalli Garzon, Jorge Rodriguez, and Delphine Dean

Department of
Bioengineering
Clemson University,
Clemson, SC, USA

Exploring Tissue Engineering

Joseph Wortkoetter, Scott Holmes, Amanda Stastny, Catherine Demos
Caitlyn Jones, Carolyn Arthur, Madison Repp, Kalli Garzon, Jorge Rodriguez PhD, Delphine Dean PhD

Chondrocyte Cell Spheroids

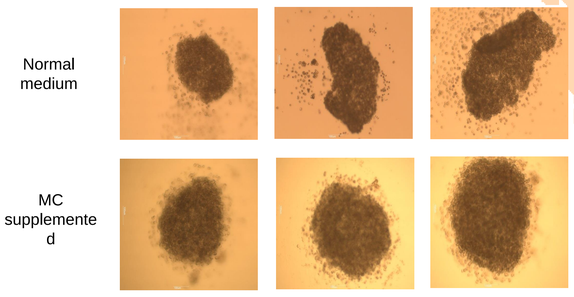
Objectives

Cartilage regeneration and implantation is a field of tissue engineering that is gaining large amounts of attention. In order to make progress within this specific field, three dimensional constructs of these cells must be developed to match the physical properties of the native tissue. The goal of this research is to characterize the mechanical properties of chondrocyte spheroids when constructed in the presence of various growth factors. Our aim is to develop spheroids that have similar mechanical properties to that of native articular cartilage.

Materials and Methods

Over the past several months, the team developed experience isolating and plating chondrocytes from pig knee joint articular cartilage. 3-dimensional culturing cells via the upside-down culturing technique on a petri dish was then utilized to form spheroids consisting of these cells in various different cell densities. After initially forming spheroids in normal chondrocyte medium, methylcellulose was supplemented to determine whether it aided in the compaction of the spheroids. This was quantitatively analyzed by calculating the sphericity of the both the spheroids formed in supplemented media and normal media using ImageJ software.

Results



Future Direction

In the near future, we plan to continue our research with chondrocyte spheroids and begin experimenting with a multi-cell spheroid comprised of chondrocytes and stems cells. The hope in this experiment is to determine whether

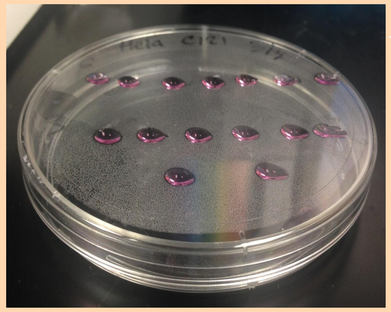
Cancerous Cell Treatment

Objectives

Culturing three dimensional microtumors (spheroids) is an effective method for drug screening. Often, preliminary drug screenings for cancer are tested on a single layer of cells, which poorly resemble the structure of an actual tumor in the body. This causes the failure of many drugs in clinical trials. By growing cancerous cells as three-dimensional structures, they actually mimic properties of a tumor. The hope is that the use of spheroids will improve drug trials and lead to better treatments to fight cancer.

Materials and Methods

This experiment began by culturing MCF-7's, MCF-12A's and HeLa cells to in their respective medias. Cell types were investigated for optimal drug treatment times using light spectroscopy. Spheroids of the cells types were formed using via hanging drop method at 2 optimal densities. Once spheroids were formed and reached optimal confluence, determined from spectroscopy, the cells were treated with differing concentrations of doxorubicin, a cancer treatment drug.



HeLa cells (cervical cancer cells) grown as three dimensional microtumors.

MCF-7 spheroids seeded at 3000 cells in 30 μl of media

Future Direction

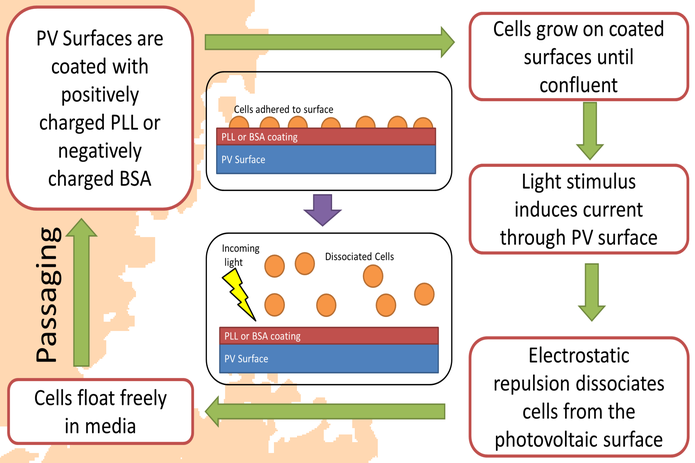
In the future, the group plans to begin testing with a more dynamic experimental tumor composed of MCF-7's and MCF-12A's. Additionally, it is the hopes to increase the effectiveness of cancer drug treatment through variation of pH and other factors.

Culture on Photovoltaic Surfaces

Objectives

Eliminating the need for trypsin in cell culture would allow the study of living cells without subjecting them to enzymatic degradation. Culturing cells on protein coated photovoltaic surfaces and dissociating them using electrostatic repulsion of charged proteins from an induced current could replace trypsinization in cell culture procedure.

Materials and Methods



Results

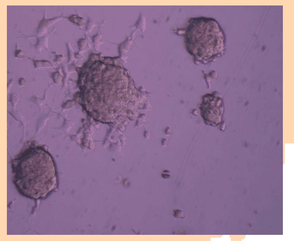


Figure 3: 3T3 Fibroblasts on Solaris Silicone Rubber. Day 6. (100x)

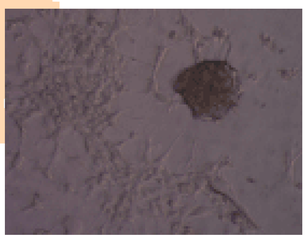


Figure 4: 3T3 Fibroblasts on Solaris Silicone Rubber. Day 12. (100x)

Future Direction

In the future, the group plans to measure the efficacy of protein dissociation from the surface when a light is shone on it. Then, cells will be seeded onto the photovoltaic surfaces and their dissociation will be measured from the surface when a light is shone.

Acknowledgements

The Authors thank the Clemson University Creative Inquiry Program for partial funding of this work.

Presented at FoCI
4/6/15

CLEMSON BIOENGINEERING

Corresponding Author: Dr. Delphine Dean
Clemson University, Rhodes Building
Clemson, SC 29634, finou@clemson.edu