CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
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Project Number
S0407

Project Title
Enhancing Mechanotransduction of Aging Human Dermal Fibroblasts

Abstract

Objectives/Goals

Aging is an inevitable yet complex process that has significant ramifications. Elderly people are more prone to wounds with diminished healing efficiency, diseases such as diabetes, and tissue degeneration. This study proposes to identify the cause of such problems and find a potential treatment.

Methods/Materials

1. Prepare Hydrogel Substrate
2. Measure cell proliferation by using hemocytometer to count the cells and plot in a growth curve
3. Analyze actin structure under confocal microscope after staining the cells with 3.7% Formaldehyde (FA), 3% Propidium Iodide (PI) and 3% Alexa Fluor (AF).
4. Conduct Agarose Droplet Migration Assay by preparing 0.2% agarose, fixing cells with FA, and staining cells with 0.1% Crystal Violet dye. Use SPOT 3.0 Software to analyze samples.
5. Measure the tractional forces exerted by preparing HA Hydrogel, adding a 100% sonicated bead solution, and using Digital Image Speckle Correlation (DISC).

Results

The proliferation of cells decreased as age increased, thus indicating that older cells are not as healthy as younger cells. The confocal images show that the 18 year old cells spread better and the photomicrographs in the Agarose Droplet Migration assay show that they migrate better than the 63 year old cells.

The DISC technique and the tractional force assay tracked the movement of beads in the substrate and mapped the deformation. The three-dimensional traction maps are obtained using FEA, which calculates the strain energy. The substrate deformation and strain energy caused by the 47 years old cell was more than that caused by the 81 years old cell.

Since the older cells are not as strong, the next step in this study was to try to increase the tractional force by adding PDGF, a growth factor absent in the environment of older cells, to the supernatant.

The deformation and strain energy caused by the control cell was lower than the cell exposed to PDGF. This indicates that the tractional force exerted by cells with PDGF in their environment increases, which may lead to an improvement in wound healing and migration into damaged tissue.

Conclusions/Discussion

This study identifies the tractional forces to be one of the most fundamental factors of mechanotransduction. The finding that PDGF can reduce the deterioration of tractional forces with aging denotes that PDGF may be a potential treatment available to elderly people.

Summary Statement

This project is about identifying the critical cause behind wound healing deficiency in older people and designing a potential solution.

Help Received

Used lab equipment at SUNY Stony Brook under the supervision of Dr. Miriam Rafailovich and Dr. Clark; Participant in Research Scholar Program