Announcing the Final Examination of Ariege Bizanti for the degree of Master of Science

Time & Location: October 30, 2018 at 2:30 PM in ENG1 381
Title: Probing the Effects of Substrate Stiffness on Astrocytes Biomechanics

Astrocytes are among the most functionally diverse population of cells in the central nervous system (CNS) as they are essential to many important neurological functions including maintaining brain homeostasis, regulating the blood brain barrier, and preventing build-up of toxic substances within the brain, for example. Astrocytes importance to brain physiology and pathology has inspired a host of studies focused on understanding astrocyte behavior primarily from a biological and chemical perspective. However, a clear understanding of astrocyte dysfunction and their link to disease has been hampered by a lack of knowledge of astrocyte behavior from a biomechanical perspective. Furthermore, astrocytes (and all cells) can sense and respond to their external biomechanical environment via the extracellular matrix and various other biomechanical cues.

One such biomechanical cue, substrate stiffness changes within the brain under certain pathologies, which subsequently leads to changes in the biomechanical behavior of the cell. For example, increased tissue stiffness is a hallmark of brain tumor that subsequently alters astrocytes biomechanical behavior. Therefore, to gain a better understanding of this process we cultured astrocytes on stiffness’s that mimicked that of normal brain, meningioma, and glioma and investigated astrocyte biomechanical behavior by measuring cell-substrate tractions and cell-cell intercellular stresses utilizing traction force microscopy and monolayer stress microscopy, respectively. Our findings showed an increase in traction forces, average normal intercellular stress, maximum shear intercellular stress, strain energy proportional to increased substrate stiffness. A substrate stiffness of 4 kPa showed 2.1-fold increase in rms tractions, 1.8-fold increase in maximum shear stress, 2.6-fold increase in average normal stress, and 1.6-fold increase in strain energy. While 11 kPa showed a 4.6-fold increase in rms tractions, 6.6-fold increase in maximum shear stress, 5.2-fold increase in average normal stress, and 2.3-fold increase in strain energy. Cell velocity, on the other hand, showed a decreasing trend with increasing stiffness. This study demonstrates for the first time that astrocytes can bear intercellular stresses and that astrocyte intercellular stresses and traction can be modified using substrate stiffness. We believe this study will be of great importance to brain pathology, specifically as it relates to treatment methods for brain tumors.

Major: Biomedical Engineering

Educational Career:
Bachelor’s of Biomedical Sciences, BS, 2016, University of Central Florida

Committee in Charge:
Robert Steward, Chair, Mechanical and Aerospace Engineering
Helen Huang, Mechanical and Aerospace Engineering
Mohtashem Samsam, Burnett School of Biomedical Engineering

Approved for distribution by Robert Steward, Committee Chair, on October 15, 2018.

The public is welcome to attend.