RISE RESEARCH INNOVATION SCHOLARSHIP ENTREPRENEURSHIP

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Northeastern University

Mitochondrial Network Analysis of Multi-Drug Resistant Tumor Cells Integrated In 3D Hydrogel Matrices

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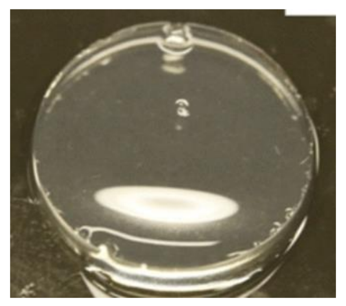
Background and Goals

Mitochondria, being more than just the powerhouse of the cell, regulate several processes that are known to be altered in cancer cells, from metabolic stress to apoptosis. In this study, we tried to evaluate the changes in such mitochondrial networks in an ovarian cancer cell line (SKOV-3's) as a response to stress introduced by overlaying hydrogels with different gradients of thicknesses. The addition of hydrogels makes our model more biomimetic to the varying stresses of the actual tumor microenvironment while remaining biocompatible with the cancer cells. Furthermore, this hydrogel-based model tries to draw parallels with other Hypoxic related work, a condition of low oxygen concentration facilitating reactions within mitochondrial networks that promote tumor survival and progression. Thus, developing an affordable and accessible model by application of hydrogels can help scientists better understand the multidrug resistance nature of tumors.

How does a hydrogel-based model of cell stress change mitochondrial networks and induce multidrug resistance?

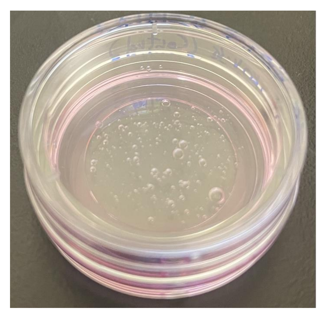
Process and Methods

PREPARATION OF HYDROGEL
Biocompatible with cells And maintains structural Integrity



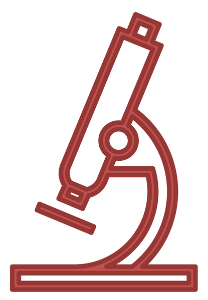
10% w/v GelMA & 1% Gellan Gum

CELL CULTURE
SKOV-3's and Hydrogel

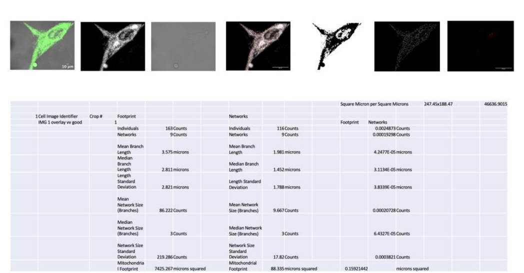


250ul and 500ul

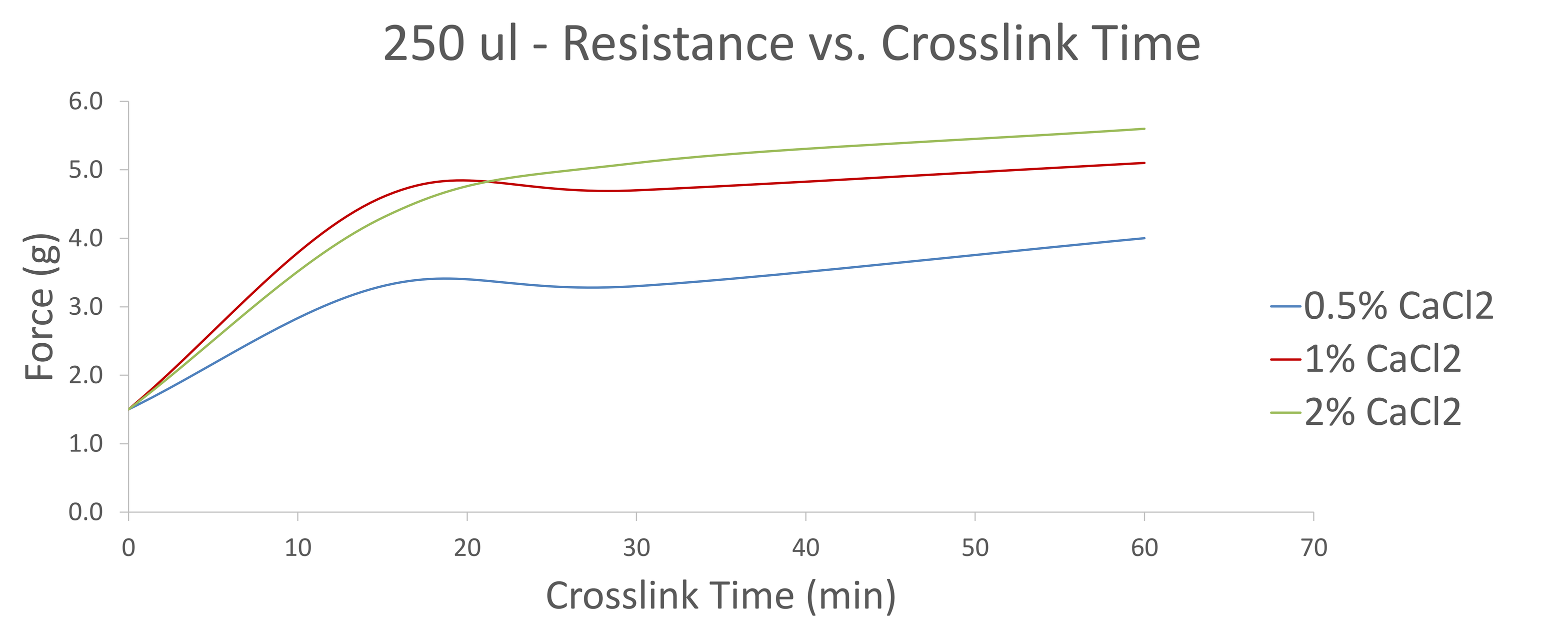
MICROSCOPIC ANALYSIS
Imaging with 63x Confocal microscopy

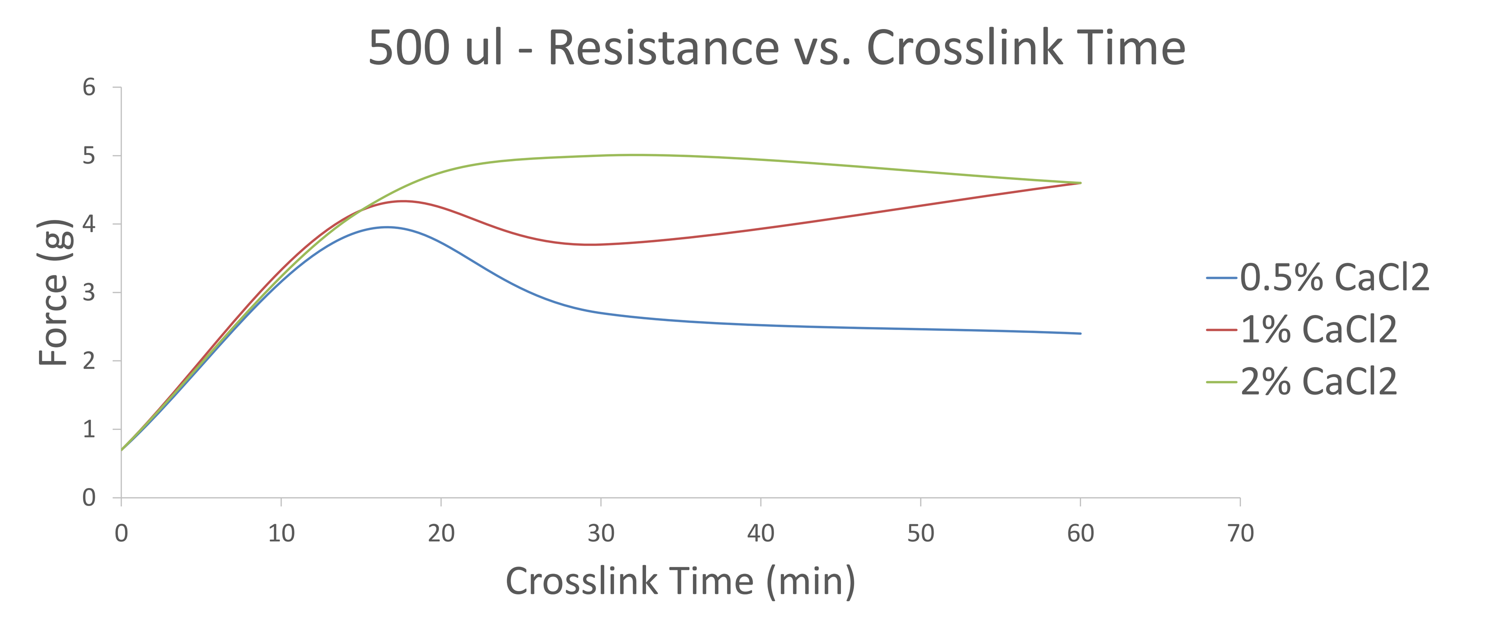


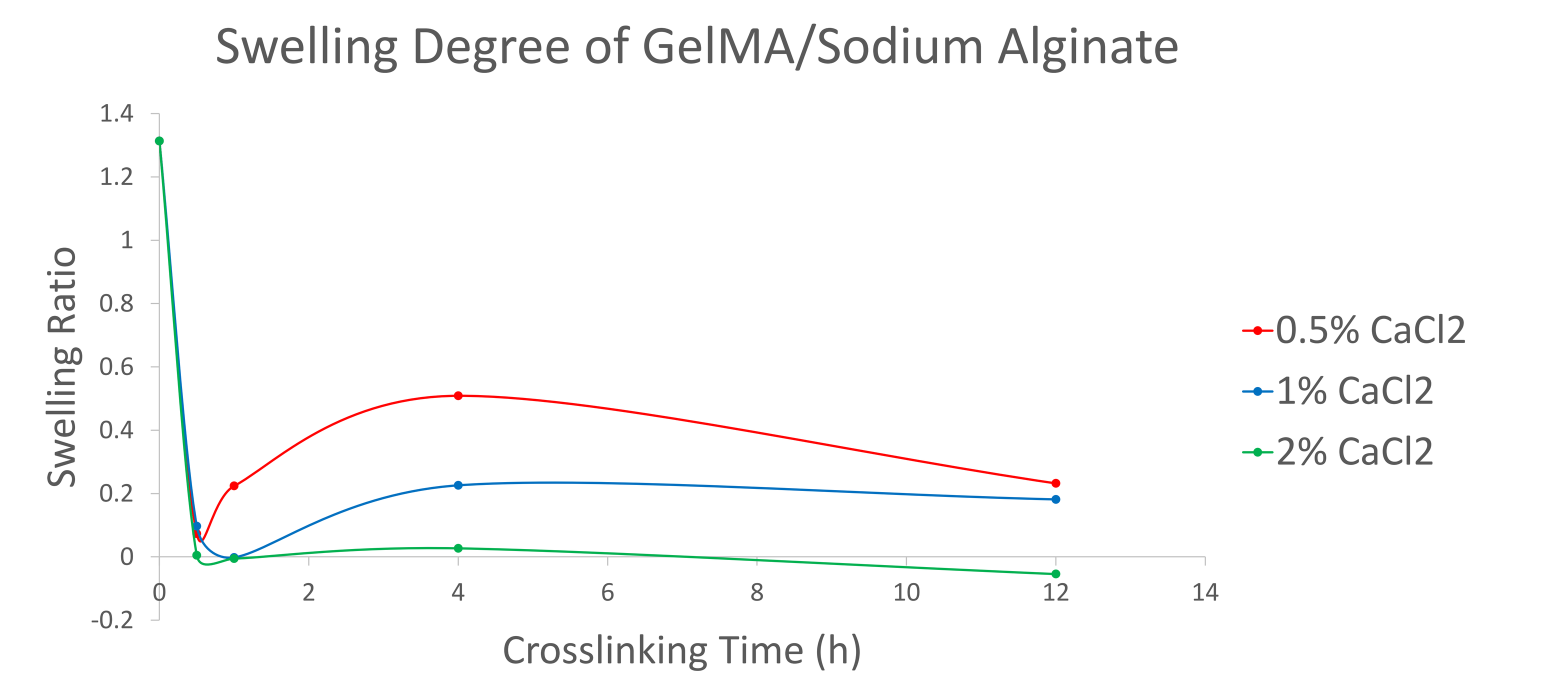
MITOCHONDRIAL ANALYSIS (MiNA)
Quantification of mitochondrial networks

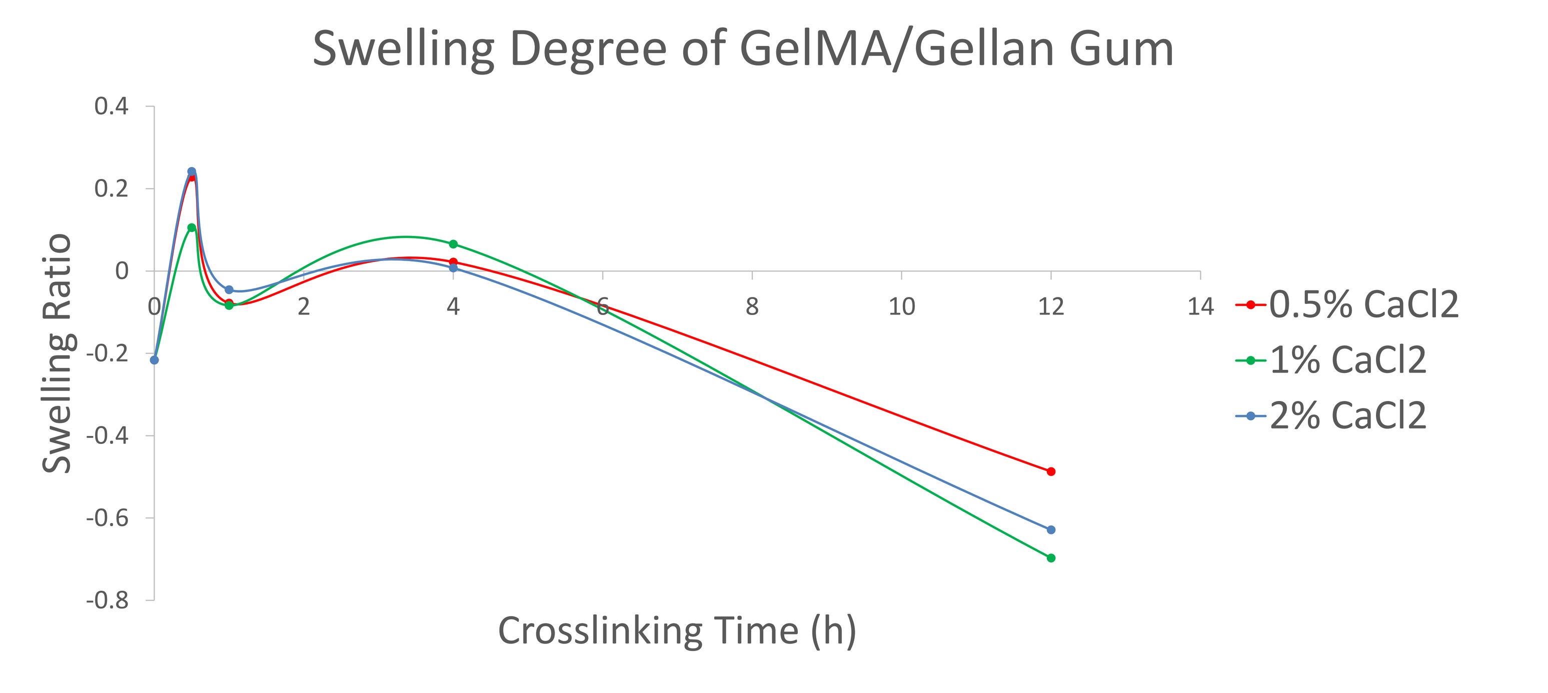


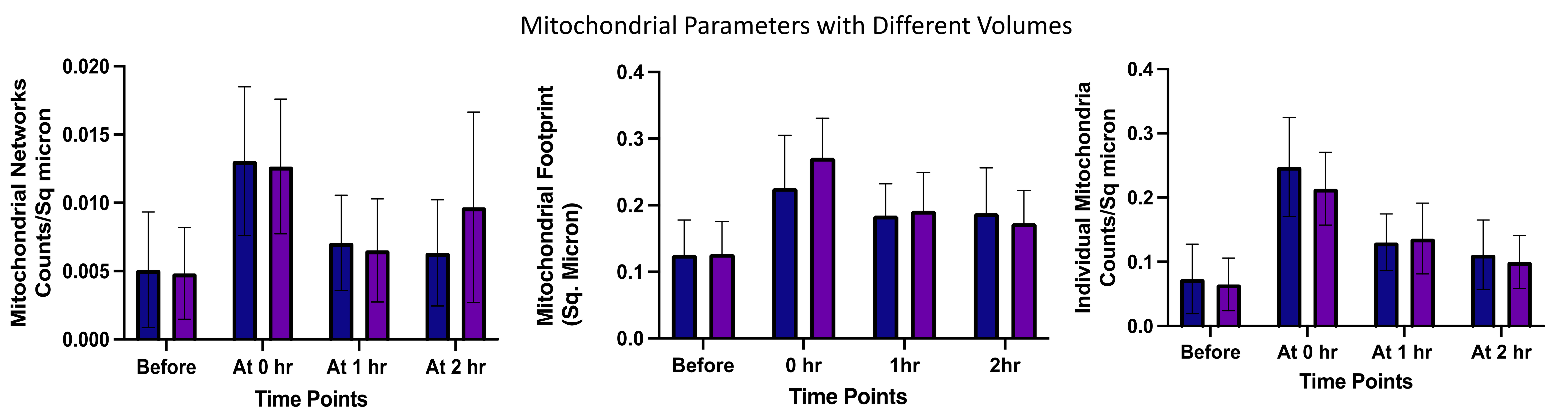
Findings











Conclusion and Future Scope

The imposition of hydrogel on top of the adherent cell had a stress response in the mitochondrial networks as demonstrated by the graphs. The model needs to be further validated by the following proposed studies-

MACHINE LEARNING
Predict mitochondrial activity using machine learning algorithms

PRESSURE ANALYSIS
Quantify actin amount and alignment

3D BIO-PRINTING
To standardize and optimize 3D hydrogel model

Acknowledgment

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References

Elosegui-Artola, A., As, J.-P., Moreno-Arotzena, A., Oregi, O., & Lasa, A. (2014). Image Analysis for the Quantitative Comparison of Stress Fibers and Focal Adhesions. *PLoS ONE*, *9*(9), 107393. https://doi.org/10.1371/journal.pone.0107393

Figueiredo, L., Le Visage, C., Weiss, P., & Yang, J. (n.d.). *Quantifying Oxygen Levels in 3D Bioprinted Cell-Laden Thick Constructs with Perfusable Microchannel Networks.* https://doi.org/10.3390/polym12061260