Thesis Project Portfolio

ECM Hydrogel Derived from Decellularized Adipose Tissue for Adipose Derived Stem Cell Differentiation to Augment Breast Reconstruction

(Technical Report)

Ignorance and Discrimination: The United States and the HIV/AIDS Epidemic

(STS Research Paper)

An Undergraduate Thesis

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Executive Summary

Overview

The two projects contained in this portfolio are loosely connected. The capstone report focuses on the formation of a hydrogel composed from the extracellular matrix of a decellularized adipose tissue, which is considered one of the most abundant and consumable biomaterials. The result of the technical project describes the hydrogel supporting the proliferation and differentiation of adipose-derived stem cells into adipocytes, thus allowing for better integration of the hydrogel into breast tissue. On the other hand, the STS research paper focuses on the human immunodeficiency virus (HIV) and acquired immunodeficiency syndrome (AIDS) as a political technology utilized to create a power gap between the LGBT community and the United States government through the creation and fortification of a stigma. The stigma that HIV/AIDS is a 'gay' disease, along with the lack of education surrounding the virus, poses a real and dangerous threat to those who are currently suffering from breast cancer. Even though the mortality rate in breast cancer has decreased by 40% in recent years, viruses and diseases such as HIV/AIDS can still maintain high mortality rates for breast cancer (Simon, n.d.). Thus, emphasizing the importance of further understanding how this stigma came to be and attempting to rectify it.

Capstone Report

40% of people diagnosed with breast cancer require a mastectomy to achieve adequate locoregional disease control, amounting to more than 100,000 U.S. women each year (O'Halloran et al., 2018). Notable techniques for breast reconstruction and soft tissue replacement include autologous tissue transfer (ATT) and prosthetic implants, which are augmented by autologous fat grafting (AFG). However, there are limitations associated with AFG that include variable and unpredictable volume retention rates due to poor supportive

vasculature (O'Halloran et al., 2018). Due to the complications associated with AFG, there is a demonstrated need to improve outcomes related to volume retention rate and implant-based soft tissue support. One of the most promising methods for soft tissue repair is tissue engineering using decellularized biological biomaterials. These biomaterials can come in the form of a hydrogel, a "3D cross-linked hydrophilic network capable of absorption and retention of biological fluids", to act as a soft tissue filler (O'Halloran et al., 2018). As adipose tissue is abundant, easily harvested, and rich in extracellular matrix (ECM) and beneficial growth factors, it was hypothesized that a human decellularized adipose tissue (hDAT) hydrogel could support adipose-derived stem cell (ADSC) viability and differentiation into stable adipocytes (Zhao et al., 2019). These ADSCs are suitable for autologous transplantation and can promote adipogenesis, providing controlled volume retention and arteriogenesis that current AFG lacks (Combellack et al., 2016). In this study, we demonstrate that an ADSC-seeded hDAT hydrogel can support cell viability, promote adipogenesis, and additionally, test the mechanical properties in order to assess the material property of the hydrogel.

STS Research Paper

The STS research paper establishes that HIV and AIDS were initially linked to the gay community due to a study published by the Centers for Disease Control (CDC) in 1981. The United States government would go on to amplify this initial linkage to the LGBT community through enacted policies and legislatures that furthered the notion of HIV/AIDS being a "gay plague." The STS research paper investigates how the U.S. government utilized the HIV/AIDS epidemic to create a power gap with the LGBT community. To investigate the power gap created, a political framework elaborated on by Langdon Winner analyzes policies and legislation from this period. Although the epidemic did not initially begin as a political

technology, the U.S. government utilized this epidemic to leave the LGBT community helpless and dying during a time of need. By investigating this epidemic and its response, the medical field and government entities can understand how marginalized communities are often left helpless and utilize these conclusions to improve healthcare policies regarding epidemics in the future.

Reflection

Throughout the past year, the capstone and STS research project have allowed me to have a closer, more personal experience with the fundamentals of engineering. My capstone project enhanced my skills by allowing me to work hands on with viable human tissue samples and further my understanding on the ethics surrounding disposed tissues from lipoaspirates and the value and importance of informed consent. At the same time, my STS paper gave me an in depth look into how stigmas surrounding health issues can last for decades and severely impact disadvantaged communities for years to come.

Most importantly, I learned the interconnectedness of these issues. Engineering comes with the responsibility to act in the best interest of humanity and to be aware of the potential social impacts that the work you take part in creates. As seen with the HIV/AIDS epidemic, once a decision is taken and a stigma/precedent is set, it is difficult and almost impossible to heal the wounds created within a community and that community's trust. As I continue my education through graduate school and begin my own research experiences, I intend to continue valuing and prioritizing the importance of maintaining an ethical perspective throughout my work and be aware of any potential impacts my work can create.

References

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