

Mimicking Bioimpedance of Vocal Folds Through Phantom Models

Author: Alexis Coore (The University of Alabama Department of Mechanical Engineering)

Introduction: In the United States, over 6 million citizens have been diagnosed with some form of neurodegenerative disorder (NDD), which is any illness that targets the central nervous system. Around a third of this population can be categorized as traumatic neurodegenerative disorders, which includes ailments such as some cancers, strokes, and spinal cord injuries. This subset of NDDs are more likely to cause excessive physical damage to the brain. Full recovery from this is highly unlikely, due to the development of scar tissue at the base of the injury. Hydrogels are proving to be ideal in reducing the amount of scarring produced, but must be tailored to specific biophysical needs. Our research focuses on cultivating the optimal hydrogel for this purpose.

Materials and Methods: The primary components of our hydrogels include Chitosan and Polyaniline (PANI). Chitosan is a chemical compound found in shellfish and was chosen for its ideal physical properties. It is non-immunogenic, antibacterial, and biodegradable, meaning it will dissolve in the patient's body without the need for additional surgery. PANI is a conductive polymer, which gives us greater control over drug delivery. These two elements are grafted together and allowed to dry fully. Our lab tests each hydrogel for stiffness, roughness, conductivity, and bacteriology. An Atomic Force Spectrometer is used for both stiffness and surface roughness. Because the final form of these hydrogels has not been decided, we aim to make our gels pliable and relatively smooth, in the hopes that multiple avenues of application are possible. A handheld multimeter is used for conductivity measurements. This aids us in deciding which concentration of PANI will work best once the final stages of testing are reached. Finally, we test for how the hydrogels interact with bacteria. We cultured both *Pseudomonas aeruginosa* and *Staphylococcus aureus* for placement on the hydrogels, as these are two of the more common strains found in human patients. Because the gels have a heightened conductivity, we also ran assorted voltages through the hydrogels.

Results and Future Directions: As the project is still in its early stages, our research revolved around running various trials and mapping out the results. We have found that, although we are sure of the components of the hydrogel, it is unclear how long they should be allowed to dry for. If the time is too short, we risk disintegration, but if it is left for too long, the gels may become too thin to test. In addition to this, we have found that though conductivity across concentrations is stable, the level we are striving for is unknown. In the future, we hope to find the optimal amounts for each. Our most conclusive result laid in the bacteriology tests. No matter what voltage we used, including the lack thereof, no bacteria attached itself to the hydrogels. It is also of note that even the slightest amount of electricity impeded the development of bacteria colonies. This conveys that our hydrogels will not attract any bacteria to the wound, and reduces concerns of infection.