Mentor Visit Assessment #2

Mentor: Melanie Ecker
Profession: Assistant Professor of Biomaterials at University of North Texas
Location: At Home
Date: 1/27/2021
Time: 6:00pm- 6:50pm

Assessment:

In my third meeting with Dr. Melanie Ecker, we discussed my original work speech, where she told me that she loved my presentation and was able to learn a lot about my past work and how passionate about the field of biomedical engineering. To continue, we discussed the first draft of the product proposal and some changes we can make to it overall. She exclaimed that rather than only looking at 15 publications about nerve conduits, I could expand my goal and screen through at least 25 publications to have a better understanding of the topic.

For the rest of the meeting, I cleared up some questions I had about nerve conduits after my last research assessment. Firstly, I was confused about the polymers and what they are made up of. So, my mentor first explained. The word polymer comes from the Greek word "poly" which means "multiple units"; therefore, polymers are a buildup of monomers from a specific biomolecule. Then I was also wondering about natural polymers that can be used for experiments and other applications. Through Dr. Ecker, I learned that collagen, a natural polymer, is made up of intertwined three amino acid chains and can be extracted from sources, like hair, and cleaned using various other proteins and buffers, to prep it for different applications. To make it into a nerve conduit, the prepped polymer would have to be cross-linked with hydrogels to get the desired shape. The advantage of such natural polymers is that they are more biocompatible with the human system because most of the proteins can be found within the body or normal food consumed by humans. Besides biocompatibility, natural polymers can degrade within the body and dissolve within bodily fluids, which shows biodegradability. Although I have heard about polymers before, with Dr. Ecker's explanation: I was able to connect polymers with tissue engineering and understand natural polymers more.

My next question was about the process of surgery for implanting the conduits at the damaged site. She explained that repairing individual nerves can be tedious work because the higher up the injury, the more nerve bundles there are in the spinal cord. Therefore, surgeons would have a harder time connecting the right nerve end when the bundles are overlapping and extremely intricate. Therefore

most of the conduit efficiency trials have been on small animals or peripheral nerve injuries because these nerves are larger and easier to conduct surgery on. Essentially the process of inserting a conduit would be to use forceps to hold the small conduit and let the ends of the nerve slip into the opposite ends of the tubes. When Dr. Melanie Ecker told me this, I was worried about problems such as dead space inside the tube and if that would cause inflammation. However, Dr. Ecker described that although inflammation is a potential risk, dead space is not always dangerous. The dead space could allow the nerve to grow radially and allow substances like fibroblasts to enter the tubes and build scar tissue around the nerve for extra protection.

Next, we discussed synthetic polymers and their impact. My mentor explained that synthetic polymers can be made by using special 3-D printers that can transport the polymer through a nozzle to build the necessary structures. Furthermore, I learned that synthetic polymers have endless possibilities for mechanical properties unlike natural polymers because they can be specially made for a specific purpose by mixing different materials. However, since these polymers are man-made, they might not be biocompatible or biodegradable. Hence scientists often combine natural and synthetic polymers, to make up for the disadvantages of both types. Also, scientists often link the polymer with hydrogels because they expand when in contact with fluids, and when dehydrated they can shrink, so when inside the body the hydrogels can expand in size and give more space for the nerve to grow. After discussing synthetic polymers, we discussed possible parameters scientists need to keep in mind when trying to create nerve conduits. For example, they need to be aware of parameters like the approximate time it takes for the nerve to regrow, how long it would take for the nerve conduit to degrade and how many nerve growth factors are required for the nerve to repair itself. Furthermore, these are the same parameters I will be using when creating an efficient virtual prototype which will most likely be made up of a composite material based on the information I learned from my mentor..

Lastly, after Dr. Ecker had answered all my questions, I had more insight into the field of tissue engineering and had a better idea of what I needed to research in the future. As I conduct more research on the shape of nerve guide conduits and I will use the following questions to guide my research: How does the type of injury affect the shape of the conduit? What types of materials would be best for spinal cord injuries?