UC San Diego
MOORES CANCER CENTER

2019 Gleiberman Head and Neck Cancer Center Pilot Grant

In-Vivo Efficacy of 3D-Printed Multichannel Nerve Scaffolds in Long-Gap Facial Nerve Repair

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Scientific Abstract:

Facial nerve reconstruction in the setting of Head and Neck malignancy poses unique technical challenges. As opposed to traumatic peripheral nerve transections which may be repaired primarily or with a short autologous cable graft, cancer resection requiring sacrifice of the facial nerve can result in long-gap nerve defects from within the temporal bone to multiple distal branches in the face. Repair with cable grafting can be complicated by limited nerve graft length or limited neurorrhaphy space for multiple branches at the proximal stump, forcing difficult choices between restoring ocular protection with eyelid blink, oral competence, smile, and other aspects of facial expression. Synthetic nerve grafts could potentially address the issues of length, branching, nerve diameter mismatch, and reduce donor site morbidity; however, current commercially available synthetic nerve grafts (often empty tubes) have not been proven to work beyond short-gap defects, possibly due to the lack of biomechanical cues. The Tuszynski laboratory has recently developed novel technology to fabricate 3D-printed nerve guidance scaffolds containing microscale multichannels to guide and accelerate axonal regeneration across long-gap peripheral nerve injuries. These biocompatible and bioresorbable nerve scaffolds have led to successful axonal regeneration in 1cm rat sciatic nerve injuries after 1 month. We propose to adapt the design of these microscale multichannel nerve scaffolds for long-gap, branched facial nerve injury and evaluate their *in-vivo* efficacy compared to autologous nerve graft repair. If successful, this could significantly improve the treatment paradigm for patients with Head and Neck malignancy requiring facial nerve sacrifice.

Lay Abstract:

Surgical treatment of Head and Neck cancer can risk facial function if the facial nerve is invaded by the cancer and needs to be sacrificed to remove the tumor. Permanent facial paralysis can result in loss of vision from poor eye closure, difficulty speaking and eating, as well as the devastating psychological morbidity from the inability to smile or express nonverbal emotions. Cable graft repair of the facial nerve is possible with non-essential sensory nerves taken from elsewhere in the body; however, limited length, nerve diameter mismatch, the additional surgical site morbidity and the additional time under anesthesia are drawbacks and may limit the reconstruction. Engineered nerve grafts could potentially provide abundant length, branching patterns of varying diameters, as well as reduce donor site morbidity; however, current commercially available synthetic nerve grafts (often empty tubes) have not been proven to work beyond short gap defects, possibly due to the lack of structure within the tubes. The Tuszynski laboratory has recently developed new technology to fabricate 3D-printed nerve guidance scaffolds with microscale multichannels to guide and accelerate axonal regeneration across long-gap peripheral nerve

injuries. We propose to adapt the design of these microscale multichannel nerve scaffolds for long-gap, branched facial nerve injury repair and compare to the clinical gold standard of cable graft repair. If successful, this could significantly improve the treatment paradigm for Head and Neck cancer patients requiring facial nerve sacrifice.