

2025 Research Ais Award
Dr. Gregory Chaffin, Indiana University



AAOF Resident Research Award Synopsis

Title: Novel Engineering of Masseter Muscle Tissue Using Hydrogel Scaffolds with Cod Skin Particulate

Principal Investigator: Dr. Gregory Chaffin, Indiana University

I am currently a first-year orthodontic resident in the Department of Orthodontics and Oral Facial Genetics at Indiana University School of Dentistry (IUSD). I received my bachelor's degree at the University of Texas at Austin and completed my dental training at the University of Texas School of Dentistry at Houston. I am a major in the United States Air Force with nine years of active-duty service. I completed a one-year advanced education in general dentistry from 2016-2017, subsequently serving as a general dentist for seven years. Outside of orthodontics, I enjoy exploring the outdoors, playing acoustic guitar and singing, and practicing the way of Jesus with my wife, Neri, and our daughter, Evelyn.

At IUSD, I have had the pleasure of working with the Shah Lab and have focused my research on engineering craniofacial muscle tissue. Hard and soft craniofacial defects resulting from genetic conditions, such as cleft lip and palate, or from pathologic or traumatic tissue loss, negatively impact quality of life. Current reconstructive techniques for hard and soft tissues utilize a hybrid of autologous harvesting and graft or allografts and prostheses. While the hard tissue repair is reliable, long-term reconstruction of the soft tissue remains challenging and is fraught with limitations including donor site morbidity and mismatched tissue types. Tissue engineering provides a realistic alternative to current techniques. Muscle tissue engineering approaches often utilize collagen scaffolds to support early growth and development, primarily due to the importance of natural collagen structural sheets that surround muscle fibers *in vivo*. However, collagen scaffolds are prone to mechanical weakness and lack conductive properties. Therefore, the objective of this study is to investigate a novel material derived from minimally processed cod skin (Kerecis®), which could serve to strengthen the collagen scaffolds currently used in muscle tissue engineering.

The Kerecis product is FDA-approved for treatment of wound management and has never been used before for muscle regeneration. We will assess the cell viability and myogenicity of the C2C12 mouse muscle cell line and those derived from mouse masseter muscle. Additionally, utilizing a bioreactor that can support maintenance of 3D muscle constructs *in vitro*, we will investigate 3D collagen hydrogels reinforced with cod

skin particulate when compared to 3D hydrogels alone, assessing for myogenic behavior and mechanical strength.

I believe orthodontic education will benefit from this AAOF award because it will aid the development of craniofacial muscle engineering, which is still in its infancy compared to engineering of limb muscle. Patients suffering from craniofacial defects may be able to experience a normal life without the morbidity associated with current harvesting techniques should we successfully engineer craniofacial muscle in the future for use in patients. Without the Foundation, the funding for such research would not be possible due to the cost of laboratory supplies and current political challenges with university funding.

AAOF funding has already had a significant impact on my career as an orthodontic resident, funding an opportunity that I never dreamed possible. The AAOF has provided funding for other projects within the Shah lab, which inspired us to seek the Foundation's support of our project. I plan to utilize my experiences as a student researcher and clinician to encourage others to pursue further research that will benefit the specialty. Ultimately, I hope to return to the university setting to teach and act as a mentor to orthodontic residents.