SCHOOL OF MEDICINE
CASE WESTERN RESERVE UNIVERSITY

John R. Fredieu, PhD

Anatomy

10900 Euclid Avenue
Cleveland, Ohio 44106-4930

Visitors and Deliveries
Wood Building, Room WG-46

Phone 216.368.2433
Fax 216.368.8669
christine.marshall@case.edu

www.case.edu/med/anatomy

jrf6@case.edu
216-368-6012

4/9/2013
UCITE

RE: Nord Grant Proposal

Dear Committee Members,

Anatomical models have been used for many years in medical and dental education to teach the structural basic sciences (anatomy, embryology, histology). Models are important when visualization is hampered by limited accessibility, the minute size of specific structures (ciliary ganglion, inner ear) or the availability of specimens (cadavers, human embryos). The burden of models lie in their cost, storage, variable quality, and inadequate depiction of specific structures and detail. With the advent of digital 3D scanning/modeling and 3D printing, inexpensive models of anatomical, embryological, and histological structures can be produced in-house to enhance learning. In addition, access to commercial and private digital 3D scan/model libraries allows the rapid production of models to address specific student questions or to demonstrate structure variability and anomaly. The past issues of model damage or loss can be corrected by simply printing another, which saves a great deal of money.

For example, medical students have much difficulty understanding the development of the heart, congenital heart anomalies and the structural impact of those anomalies on heart function. Students could be issued scale or magnified 3D models of the heart that depict different stages of development and anomalies as tangible visualizations to help them fully understand the organ. Actual 3D Computed Tomography (CT) scans of anomalies such as Atrial Septal Defect, or Tetrology of Fallot can be obtained in a clinical setting, and then used to generate physical 3D models of the anomaly that students can handle and examine. In the small group problem-based learning, each student would be able to alter their models to demonstrate specific details of anatomy or to address issues of the case at hand. In addition, this access to the anomaly could expand volunteer patient demonstrations, in that the students can connect their learning and the models the actual patient in a real-life setting.

In this proposal, we will compare the available 3D printers on campus (several have been identified) for resolution, speed, and model variability. In addition, we will confirm the process of creating printable 3D scans from clinical CT scans (ie. CT scans of pre-surgical congenital anomalies). Medical and dental student focus groups will examine models of specific anatomical structures, embryonic structures, histological structures, and clinical models that were printed on 3D printers from scans obtained using desktop 3D scanners, publically available 3D scans, or locally available 3D CT scan stacks. The focus groups will address the accuracy of the models, the efficacy of the models in enhancing learning, the efficacy of the models in addressing congenital anomalies, implementation of model use in the medical and dental curriculum, and advantages/disadvantages of model use over

cadaver or tissue specimens. Students will also explore and develop an understanding and appreciation for 3D printing technologies and their possible applications in the field of medicine. The focus groups will consist of second year medical and dental students who have completed anatomy and embryology coursework. The focus groups may proceed as a bimonthly journal club type setting with a scheduled progression through the above issues. Implementation or expanded use of the models in the medical or dental curriculum is the goal following focus group analysis. Expanded use of the models may include resident training, patient education, community outreach, and assessment.

Generating a large volume of models to address learning issues in pre-clinical medical and dental students may not be the best in terms of time and cost. It may be more efficient to generate a reduced number of models to assign to groups of students. This question is best answered by focus groups and pilot implementations into the curriculum. However, since this technology is new, the cost/model is likely to drop with time.

This proposal is examining innovation in higher education with a desired outcome of enhanced constructivist learning. Demonstrating the efficacy of 3D models in health science education may lead to incorporation of these models into IQ or PBL group settings in the medical or dental school. In addition, outcomes of this proposal may be applied elsewhere on campus and beyond.