Partially Demineralized Macroporous (PDM) Allografts for Cranial Tissue Engineering

Huseyin E. Arman[1], **Rashed Almousa**[1], Shamber Musgrove[1], Javed Syed[1], Caitlin Wunderlin[1]
[1]Department of Biomedical Engineering, Purdue School of Engineering and Technology

Decompressive Craniectomy is a cranial surgery where a large part of the cranial bone is removed in order to mitigate swelling in the brain tissue. Consequently, a scaffold biomaterial is required to substitute the lost bone. Ideal cranioplasty biomaterials should have the following features: fit the cranial defect and achieve complete closure, radiolucency, resistance to infections, no dilation with heat, resistance to biomechanical wear, pliability, and inexpensive. Partially Demineralized Macroporous (PDM) allografts exhibit such properties to correct these cranial defects. The main objectives of this study include: (1) examining the effects of demineralization and macroporosity formations on the mechanical and biological properties of allograft bone disks; (2) conducting finite element analysis (FEA) to stimulate the mechanical properties of the PDM allografts; and (3) evaluating the *in vitro* response of the PDM allografts utilizing pre-osteoblast cell lines. Tibias were harvested from Ossabaw mini-pigs and cylindrical cortical bone sections of 2 mm in thickness and 8 mm in diameter were obtained. Macropores of 600 micrometers in diameter were created to generate porosity levels of 0-40% in the bone disks. The bone disks were then demineralized in 14-wt% EDTA for 6 to 48 hours at 37℃. The relative stiffness was determined for each class using a material testing machine with a loading rate of 1 mm/min using a piston-on-ring set up. To analyze the deformation characteristics, FEA software LS-DYNA was employed. In order to understand the *in vitro* response, biocompatibility of PDM scaffolds were evaluated by culturing MC3T3-E1 cell lines where XTT and ALP assays were conducted. PDM allografts display the suitable stiffness required for cranial defects. The PDM allograft scaffolds aid in osteogenic proliferation and differentiation of pre-osteoblast cell lines *in vitro*. However, there will be further *in vivo* testing regarding the validity of PDM allografts in rat cranial defects.

Mentor: Tien-Min Gabriel Chu, Department of Restorative Dentistry, IU School of Dentistry