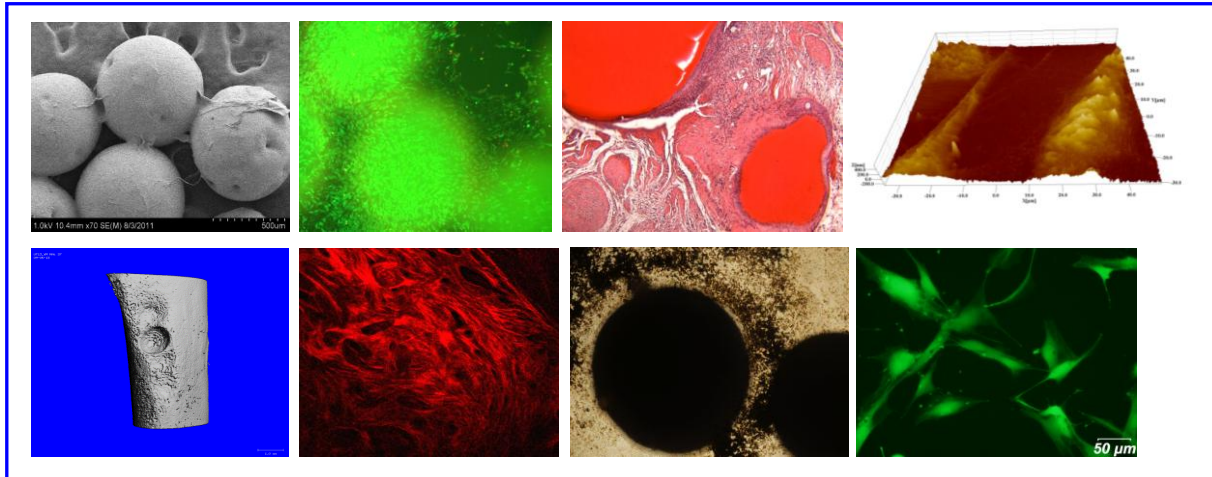


Biomaterials, Medical Devices, and Regenerative Medicine Laboratory

Research Projects



- **Biomaterials**

We are investigating biocompatible, biodegradable, and injectable biomaterials that can be applied for bone regeneration. Regarding this, we developed hybrid organic/inorganic microparticles (MPs) based on natural biopolymer chitosan and calcium containing inorganic components. Structural integrity of MPs is improved creating ionic cross-links between amine groups in chitosan and phosphate groups in tripolyphosphate which has been used as a cross-linking agent. We also plan to investigate other mechanically strong biomaterials to be used for bone scaffolds. We are also looking for high strength nanobiomaterials to make composite scaffolds that can be used in bone regeneration.

- **Bone tissue Engineering and Regenerative Medicine**

The MPs will be assessed for the biocompatibility and rate and extent of osteogenesis toward an osteoblast phenotype and production of mineralized matrix *in vitro*. Mesenchymal stem cells (MSCs) are harvested from either mice or rat bone marrow of femurs and tibia. We are studying *in vitro* MSC attachment, spreading, proliferation, and differentiation into osteoblast phenotype when cells seeded on hybrid MPs. In some cases, we directly use osteoblast cell lines to study the cell function on the MP scaffolds. We are also studying bone regeneration as a function of time in a critical size bone defect in a rat femur using osteoblasts seeded MPs. The formed bone is evaluated for strength and amount using radiographs, μ -CT, histology, and biomechanical analysis. The MPs developed have a great potential to be used as an injectable scaffold for bone regeneration including orthopaedic and craniofacial applications using minimally invasive conditions compared with conventional three-dimensional scaffolds.

In the future, we will attempt to translate this research to a human system utilizing human MSCs obtained from the bone marrow of patients undergoing surgical procedures. We are also investigating encapsulation of therapeutic drugs or growth factors in chitosan MPs, and controlled release kinetics of those therapeutic agents from MPs.