Title:
Grow Your Own Bone

How 3D modeling and printing can be used to fabricate personalized, living bone implants.

Epibone Introduction and Project Motivation:
Over 900,000 patients undergo a bone-related surgery each year that may require a bone implant. The immune system is very good at fighting foreign bodies, so implant rejection is a frequent concern. Epibone is a Brooklyn-based biotech startup aiming to grow personalized bone implants. Using stem cell samples from a patient and micro-CT scans of their bone defect, Epibone can create an implant that will be recognized as the patient's own tissue.

Autodesk's Collaboration with Epibone:
Epibone seeds bone scaffolds with stem cells that grow into osteoblasts, or bone cells, and deposit minerals onto the scaffold. Autodesk collaborated with Epibone to print bone scaffolds for cell growth. The design and construction of these scaffolds are exceptional examples of Autodesk technologies working in concert to create an innovative product.

How to Grow a Bone:
Building a personalized bone implant begins by collecting tissue samples from a patient and micro-CT scan data of their bone defect. Stem cells are harvested from the tissue sample, and saved for implant growth. CT scan data are stitched together to create a 3D model of the future implant.

The modeled implant is then populated with a trabecular lattice, which mimics the calcium lattice found naturally in bone. This lattice design is produced with the Autodesk Within Medical software. Within Medical lets the designer control the lattice's pore size, and even vary the porosity throughout the model.

The trabecular model is then printed in Polyethylene Glycol Diacrylate (PEGDA) on an Ember printer. PEGDA is an inert hydrogel and a popular scaffold material for tissue engineering. The Bio/Nano Research team at Autodesk's Pier 9 Workshop developed a PEGDA resin that is compatible with the Ember printer. The Ember's high degree of adjustability allowed it to be customized as needed to work with the PEGDA resin.

Once printed, the scaffold is placed in a bioreactor designed with a custom tool in Autodesk MeshMixer. MeshMixer automates the placement of bioreactor channels that feed cells and nutrients into the scaffold, assuring even and constant flow for proper bone growth.

Stem cells cling to the scaffold and grow into osteoblasts over a period of six to twelve months. The osteoblasts deposit minerals onto the scaffold as the PEGDA resin slowly breaks down. Surrounding bone introduces vasculature into the implant, ensuring a successful recovery.