2 Osseointegrative 3D-Printed Ankle Fusion Cage for Diabetic Patients

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IRC Implant Research Core

Need

- → Osteoarthritis: degenerative joint disease that causes **pain**, **stiffness**, and **reduced mobility**
- → Impacts **47%** Type 2 Diabetes Mellitus (T2DM) patients, many needing ankle fusion surgeries
- → Current implants fail to match patient anatomy or support bone growth, leading to **high failure** and **revision surgery rates**
- → Dr. Selene Parekh seeks a personalized approach to implants to reduce revisions

Objective

For T2DM patients, design an **osseointegrative**, **3D-printed PAEK** ankle cage that maximizes **bone fusion** while maintaining **mechanical integrity.**

Design Inputs

Constraints

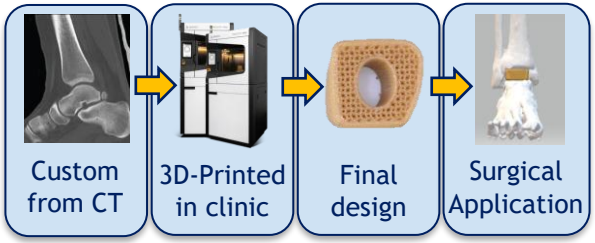
- Time
- CT Database
- Printer Capabilities
- Policy

Requirements

- Dimensional Fidelity
  ±2% expected
- Porosity Fidelity
  ±5% expected
- Static Ultimate Load
  axial ≥ 2.001kN
  shear ≥ 1.534kN

Solution

Intended Use

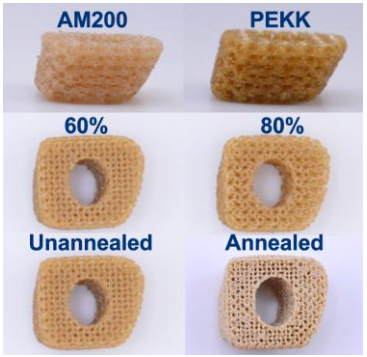


Specimen Details

1 Material:

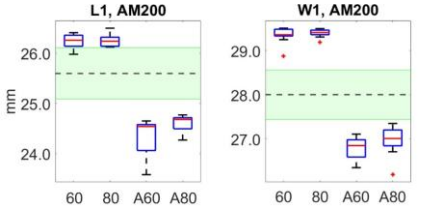
2 Porosity:

3 Post-Processing:

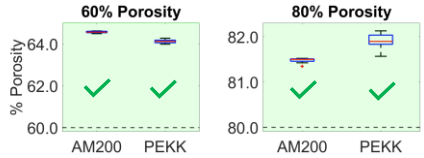


Verification Tests

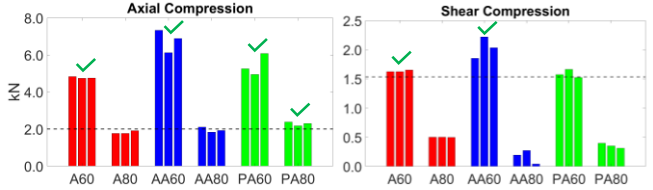
VT1: Dimensional Fidelity



VT2: Porosity Fidelity



VT3: Static Ultimate Load



Impact & Future

Impact

- → Reduces chronic pain
- → Improves ankle fusion
- → Better quality of life for OA patients

Future

- → Torsion testing
- → Porosity gradient
- → Selective cage wall placement