9 PAEK Acetabular Triflange Cup Print and Test Rig Design

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IRC IMPLANT RESEARCH CORE
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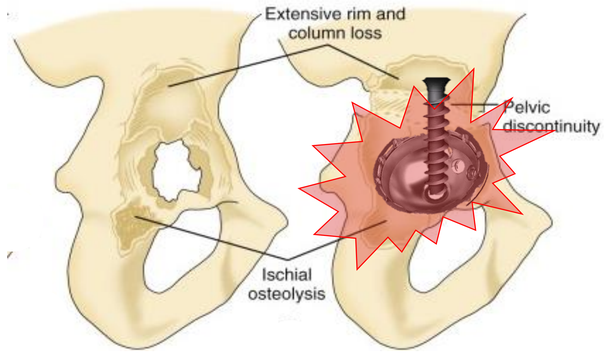
Problem

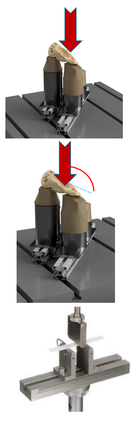


Custom acetabular cup implants for total hip arthroplasty in the case of severe bone loss. Match patient-specific anatomy where traditional cups would not fit.

Existing patient-specific cup solutions have a **lengthy fabrication time** and are made from **materials that induce further bone loss.**

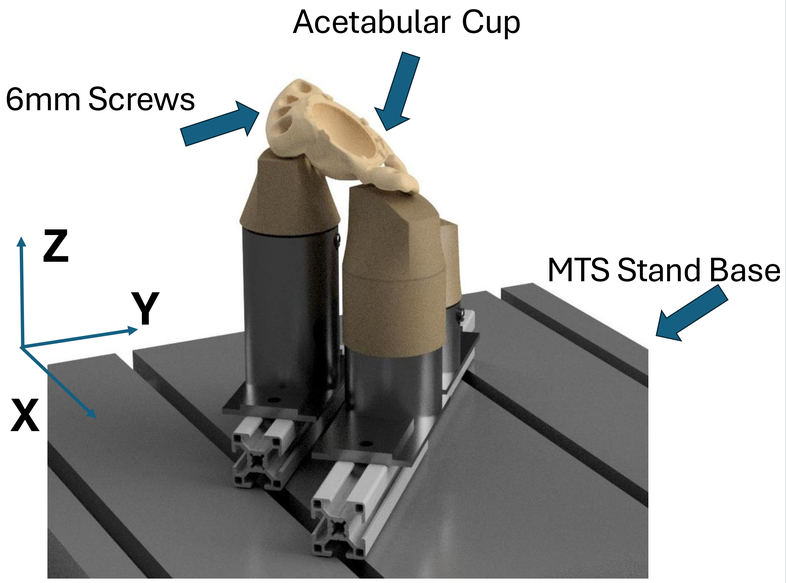
Design printing parameters and a test rig to validate a process for manufacturing custom acetabular cup triflange implants out of PAEK with 3D-printing.

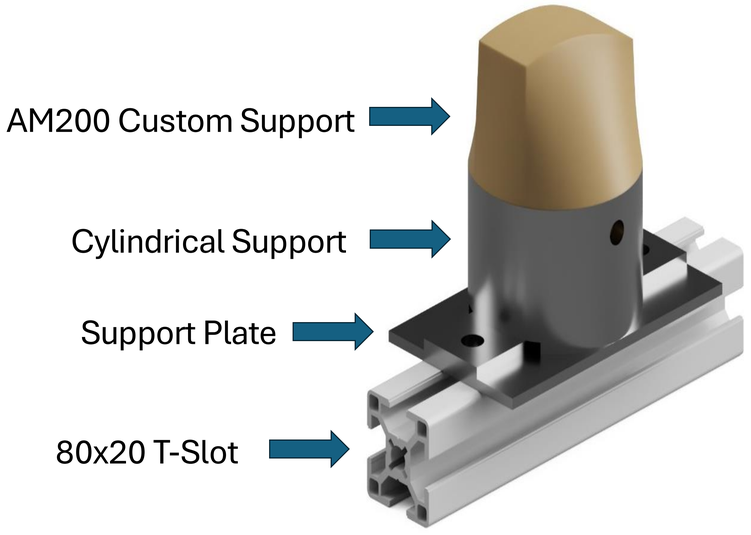
Design Inputs



- Maximum Load (1540 N)
- Physiological Load (125 ± 5°)
- Material Strength (Bending Modulus = 2.5 GPa Peak Stress = 97.1 MPa)

Solution





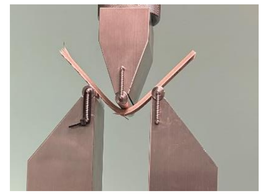
Print Conditions & Orientation

Temp. 400C
Layer Height 0.15 mm
Speed 25 mm/s
Anneal 200C, 2hrs

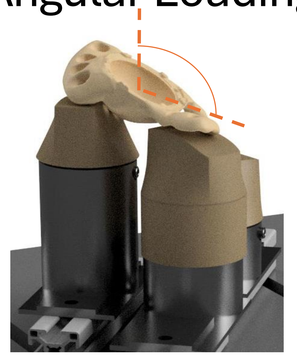
Verification

Material Strength Verification

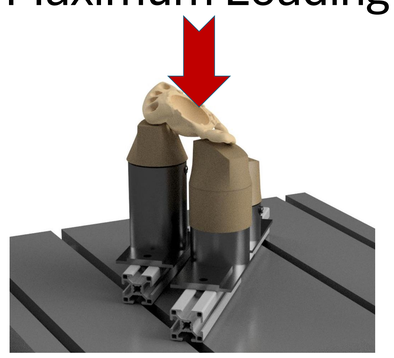
Average Bending Modulus (GPa)	Average Peak Stress (MPa)
2.84 (0.05)	114.5 (12.59)



Angular Loading



Maximum Loading



Sample and Condition	Average Loading Angle	Average Maximum Load (kN)
Female	118 (±1.70)	10.20 (±0.02)
Female Annealed	120.3 (±0.60)	2.60 (±0.44)
Male	120.3 (±0.60)	10.97 (±1.88)
Male Annealed	121.7 (±1.50)	10.50 (±2.73)

Future

- Results support further investigation into PAEK candidate materials for orthopedic implants
- Redesign AM200 custom supports to represent the pelvis more accurately
- Additional cyclic loading testing
- Surface modifications to support bone integration

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