#30 M3shketeers

On-Demand Customizable Manufacturing of Hernia Repair Meshes: Feasibility of 3D Printing with MSLA

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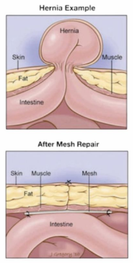
Introduction

Problem Statement



- Current Meshes are not patient-specific → poor fit, mesh migration, and revision surgeries
- +20 million annual hernia procedures a year with recurrence 10-20%, 15-30% chronic pain, ≤8% infection
- Unused/expired meshes account for ~70% of OR supply waste
- No system provides rapid, sterile, custom-fit mesh production

Mission Statement

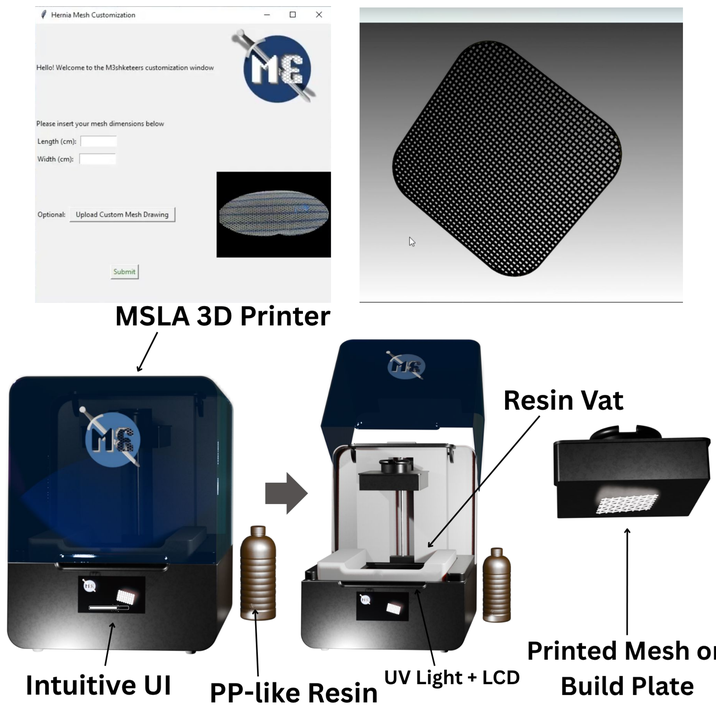
The M3shketeer's mission is to design a customizable, on-demand 3D-printed hernia mesh that eliminates intraoperative trimming and reduces hospital waste while maintaining flexibility and mechanical integrity.

Manufacturing Design

1. Final fabricated lattice mesh (5cm × 5cm) showing overall geometry and edge definition.
2. Close-up of lattice structure illustrating pore geometry and formation.
3. Perspective view demonstrating mesh thickness relative to pencil diameter.
4. Partial DOE set showing multiple mesh configurations across parameter variations.

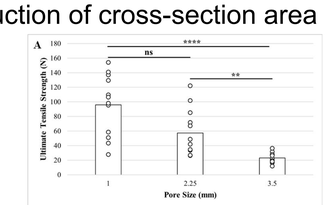
Product Design

Design Concept: Mesh Measurement → MSLA Print → Mesh

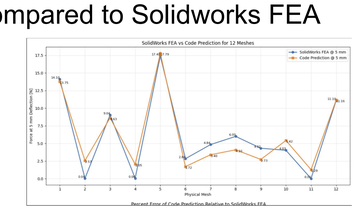


Mechanical Performance Results

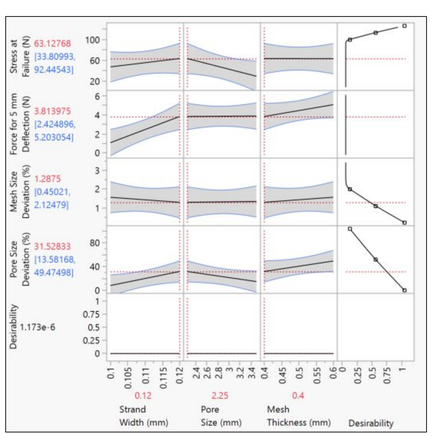
Tensile Strength vs. Pore Size: Tensile strength decreased as the pore size increased, consistent with reduction of cross-section area



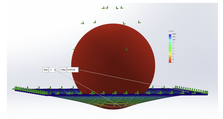
Ball Burst Simulation: Python code predictions captured general performance trends compared to Solidworks FEA



Fit Model and Prediction Profiling: Current best design specifications after taking out unfeasible pore size: 0.12mm strand width, 2.25 pore diameter, 0.4mm thickness, 10-^{6} desirability.



Verification Methods

FEA Ball Burst Simulation	Instron Tensile Testing
Predictive model simulating local deformation under physiological loading conditions. 	Uniaxial tensile testing using the Instron 3344 measured ultimate tensile strength across DOE combinations parameters. 

Final Product Specifications

Parameter	Target Value	Tolerance Range
Mesh Length and Width	5 × 5 to 50 × 50 cm #	≤ 2.3% #
Mesh Thickness	1.3 mm $	± 0.1 mm &
Strand Width	0.12 mm #	± 0.02 mm *
Pore Size	2.25 mm #	≤ 2% &
Porosity	90% #	± 1% #
Ball Burst Strength	27 N $	10-40 N $
Print Time	≤ 30 minutes	-

QR Code for additional product specifications and team resources

Future Direction

- Presentation at American Hernia Society 2026 National Conference for expert panel feedback
- GUI refinement
- Mesh optimization using medical-grade resin and higher-resolution printing
- Expanded mesh geometries
- Animal studies evaluating tissue integration
- Sterilization validation for implantable use (high-temp steam)

Class II Implantable Device → **FDA 501k Pathway**

Acknowledgements

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