

ABET Addendum - Group 03: 3D Printed Titanium FDL Tendon Fixation Screw

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1. Desired Needs Leading to Objectives

- Durable Fixation: Secure FDL tendon anchoring to the navicular bone to resist pull-out.
- Biointegration: Lattice to promote bone ingrowth and prevent stress shielding.
- Patient Customization: Adaptable geometry via additive manufacturing for optimal anatomical fit.
- Reduced Trauma: Minimize bone removal and surgical steps (e.g., self-tapping) to preserve tissue.

2. Major Constraints

- Safety/Regulatory: Strict adherence to medical-grade biocompatibility standards (e.g., ISO 10993-1).
- Risks: Tendon laceration and driver stripping.
- Global Impact: Utilizing 3D printing to bypass traditional machining costs and expand access to custom care.
- Manufacturability: Maintaining tight tolerances (± 0.25 mm) while printing complex lattices via LPBF.
- Quality/Marketability: Budget limits required validating designs with PLA before titanium printing.

3. Major Engineering Standards

- Components: ASTM F3001-14 defines requirements for LPBF 3D-printed Ti-6Al-4V ELI.
- Performance: ASTM F543 dictates exact test methods for assessing medical bone screw pull-out strength.
- Future Standards: Need for standardized quantitative metrics for evaluating 3D-printed Voronoi lattice integration.

4. Ethical, Environmental, and Societal Concerns

- Ethical: Improving patient quality of life by minimizing painful, costly revision surgeries.
- Environmental: Strict hazardous waste protocols are required for disposing of excess Ti-64 powder and lattice cleaning agents.
- Societal: 3D printing lowers production costs, allowing access to specialized orthopedic care.

5. Active Teamwork and Leadership

- Collaboration: Jointly evaluated diverse parametric CAD models (Cylinder, Self-Tapping, Buttress).
- Delegation: Divided leadership by subproject (e.g., individual leads for specific screw geometries and FEA).
- Deadlines: Coordinated MakerSpace plastic prints before final SpiTrex titanium manufacturing schedules.
- Feedback: Actively incorporated critiques from SpiTrex mentors to optimize thread pitch and testing loops.

6. Motivating Factors

- Acquire Knowledge: Mastered advanced tools like FEA and Design for Additive Manufacturing (DfAM).
- Self-Initiating: Proactively designed early benchtop tests with paracord to validate ideas before formal testing.
- Persistence: Overcame initial testing failures (lacerations, poor grip) by iteratively refining thread geometry.