Bone Breaker: Revoluntionizing Orthopedic Research

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Mission Statement

Bone Breaker's purpose is to aim to lessen the risks of treatments leading to deformities and improve diagnosis of bone fractures at the growth plate. We intend to dedicate our skills and strengths to create a combination device that advances patient care.

Background

Skeletal injuries are common in children, with musculoskeletal injuries accounting for approximately 11.8 million healthcare visits annually in the pediatric population. While most fractures in children heal without complications, growth arrest following physeal fractures (~20% of all fractures) remains a significant challenge in pediatric orthopedics. This type of growth disturbance can lead to considerable deformities and often necessitates further invasive surgical intervention. Researchers currently have no method of producing consistent, reproducible growth plate fractures to study.

Customer Needs

Durable	Ease of use	Comfort
Waterproof	Structural integrity	Legal compliances
Long-lasting	Reliable	Performance
Accurate	Affordable (reasonable cost)	Replaceable parts
Pediatric compatible	Covered or reimbursable by insurance company	Non-toxic

Project Planning

Gantt Chart & House of Quality

Acknowledgements

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Device Design

Figure 1. 3D 18 Porcine Model Femur

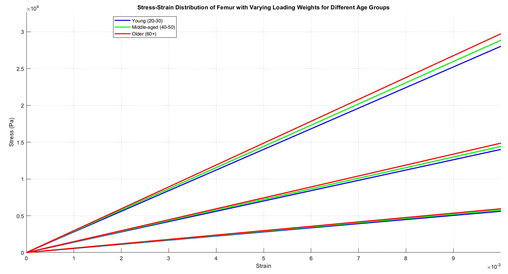

Figure 2. Stress-Strain Distribution with Varying Loading Weights Across Age Groups

Figure 3. Adjustable Compression Clamp with Controlled Force Application Initial Design

Product Architecture

$$F = \int_0^L [(P_{target} * k(x)) \times (c(x) * dx) \times (\frac{1}{1+\frac{E_{tissue}}{E_{device}}}) dx$$

$$F = -k \cdot \Delta x$$
$$\tau = G \cdot \gamma$$

$$P = I \cdot V$$
$$E = P \cdot t$$

$$q = -k \cdot A_{\text{battery}} \cdot \frac{\Delta T_{\text{battery}}}{\Delta x_{\text{material}}} + P_{\text{dissipated}}$$

$$q = -k \cdot A \cdot \frac{\Delta T}{\Delta x}$$

$$\tau = \frac{F}{A} \qquad D = \frac{N}{N_f}$$
$$\tau = G \cdot \gamma \qquad D = C(\frac{\tau_{max}}{\tau_{allowable}})^{-m}$$
$$\gamma = \frac{\Delta x}{h} \qquad R = \frac{\tau}{\tau_{critical}}$$
$$\sigma_v = \sqrt{\sigma_x^2 + \sigma_y^2 - \sigma_x \sigma_y + 3\tau^2}$$

Manufacturing

Overall costs would be ~$500

5 Stainless steel 316L for the clamp frame and force application	2 Piezoelectric force sensor
1 3.7V Samsung Lithium-Ion Battery (NR18650-30Q) and circuit wiring	3D printing Filament
1 Low power ESP32 microcontroller	Housing components
1 Resistance Temperature Detector (RTD)	1 TFT LCD Medical-grade display

Final Product Specifications

Target Metric	Target Value
Compression Force Accuracy	50 N
Bone Displacement Control	0.5mm
Battery Life	3 hours
Shear Stress Control	53 MPa
Adjustability Features	6.2 - 18 cm

Design Status & Future Work

Refine Technical Models → Finalize Virtual Prototyping → Perform Testing → Validate Testing Data