Low-Cost 3D Printed Modular and Adjustable Pediatric Prosthesis Leg

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Existing pediatric prosthetic legs become obsolete after several months due to a child's rapid growth. The purpose of the 3D printed modular prosthetic leg, consisting of interchangeable foot and pylon components, allows for height adjustments of up to 6.5 centimeters (average of 2 years of growth). The 4-step project includes (i) Computer Aided Design (CAD) of the foot and pylon; (ii) tensile testing of thermoplastics including polylactic acid (PLA), ultra (polyester added) polylactic acid, acrylonitrile butadiene styrene (ABS), and nylon carbon fiber (PA-CF) to determine the optimal material based on strength and cost; (iii) failure testing to determine strength; and (iv) cyclic testing to determine durability. Mechanical testing results showed that PLA was the optimal filament with an ultimate failure point of 1,598.7N (360 lbs) and cost $0.03 per gram. The pylon with four aligned holes and push-pin locking mechanism (with assembled foot) was the optimal design, withstanding at least 900N (202 lbs) and 10,000 steps. Further cyclic results reached up to 71,000 steps, lasting about 8 months for a low-activity child. CAD and 3D printing allow the components to be easily redesigned, resized, and reprinted for mass production. The device weighs about 1 pound. Assembly time is approximately 15 minutes. The prosthesis costs approximately $10 compared to similar devices on the market which cost hundreds to thousands of dollars. The components are compatible with a patented socket which only costs $7, rendering the entire leg affordable for large-scale distribution in third-world countries.