

THE POINT DIGIT: A PASSIVE, RATCHETING PROSTHETIC FINGER MANUFACTURED USING METAL LASER SINTERING TECHNOLOGY

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ABSTRACT

Partial hand amputees represent the largest population of individuals with upper-limb amputation. However, commercially available prosthetic finger devices lack strength, durability, and anatomically correct centers of rotation. We developed a passive, ratcheting prosthetic finger that is manufactured using metal laser sintering rapid manufacturing technology, the Point Digit.

The Point Digit is a purely mechanical prosthetic finger (i.e., no actuation, electronics, etc.). A ratchet positions the finger into one of ten distinct levels of flexion. The ratchet ensures that the finger is non-backdrivable and can withstand 250 lbs. (1.1 kN) of static load without failure. An EOS M270 direct metal laser sintering 3D printer manufactures most components of the Point Digit using maraging steel powder (EOS MaragingSteel MS1). This material has a yield strength of 152 ksi and modulus of elasticity of 23 Msi ensuring ample mechanical strength. An internal honeycomb structure maintains strength and reduces weight of the individual components. The average finger mass for all lengths of the Point Digit is 45g fully assembled. The length of the Point Digit can be scaled between 80 mm to 100 mm in length, which nearly encompasses the ranges of finger lengths for 25 – 75th percentile males and 50-100th percentile females.

The extension of the Point Digit can occur in two ways: 1) a self-locking button releases the ratchet and extends the finger or 2) the full flexion of the finger causes the finger to spring-back to full extension. By allowing external features to position the finger in both flexion and extension, the contralateral limb is not required for use of the Point Digit.

A kinematic linkage system couples all three joints of the Point Digit. This linkage system flexes all three joints at an anatomically appropriate rate. The linkage system ensures a finger that behaves similar to the intact limb while maintaining mechanical strength.

Finally, the Point Digit provides an anatomically appropriate center of rotation of the metacarpophalangeal joint. This feature ensures a clinically sound system that easily integrates into a prosthetic socket. A mounting bracket provides a method for prosthetists to install the Point Digit

into the prosthetic socket and ensure appropriate positioning of the finger with respect to the physiological limb.

The Point Digit advances the field of prosthetic finger design by providing a durable, ratcheting prosthetic finger using metal laser sintering technology.