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SJSU Undergraduate Research Grants

Infant Hand Prosthesis with TPE Shell

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Abstract

Infants develop a majority of upper limb neuromuscular control before reaching twelve months of age, making early exposure to a prosthesis critical to successful long-term outcomes for infants with upper limb deficiencies[1]. Current infant hand prosthesis options maintain either cosmesis or functionality, failing to simultaneously address both issues. The goal of our research is to develop a functional hand prosthesis with sufficient cosmesis to improve parent-patient compliance by encasing the functional components in a durable cosmetic shell.

Research Questions

Is it achievable to 3D print a hand prosthesis at a size suitable for an infant as young as three months?

Does the functionality of the prosthesis improve by implementing a 3D printed articulating endoskeleton?

Will a 3D printed thermoplastic elastomer shell encasing the endoskeletal components of the prosthesis maintain the safety and durability of the of the design?

Figure 1 (Left). The Light Touch Hand prosthesis [2] facilitates passive grasping tasks, but has limited cosmesis. The Physolino Babyhand prosthesis [3] has a realistic appearance, but has no functional features

Figure 2 (Right). Previous hand design is composed of a flexible aluminum wire skeleton surrounded by silicone. Design proved to be a potential hazard due to wire puncture

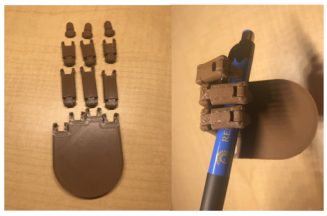

Figure 3 (Left). A prototype of the 3D printed PLA endoskeleton components were snapped together to form articulating joints capable of passive grasping [4]

Figure 4 (Right). A preliminary TPE shell of the finger was created to observe the feasibility of fabricating a flexible shell out of FilaFlex [5]

Project Activities or Findings

Completed:

- Preliminary endoskeleton design 3D printed with PLA in separate components and snapped together to form joints capable of passive grasping.
- Preliminary shell of finger 3D printed with FilaFlex to verify the feasibility of using TPE.

Ongoing work:

- 3D print entire prosthesis shell from 3D scan of toddler hand downsized to infant proportions.
- Refine endoskeleton design to fit inside TPE shell.
- Test design's ability to hold objects and its stability when simulating the compressive force of sitting up.

Citations

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4. R, N., J, M., W, J., S, M., & P, T. (2019, October 13). Silver PLA filament for 3D printing. Retrieved from https://shop.prusa3d.com/en/filament/46-pla-filament-1kg.html
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