

Functional Measures of Dexterous Fingertip Prosthesis



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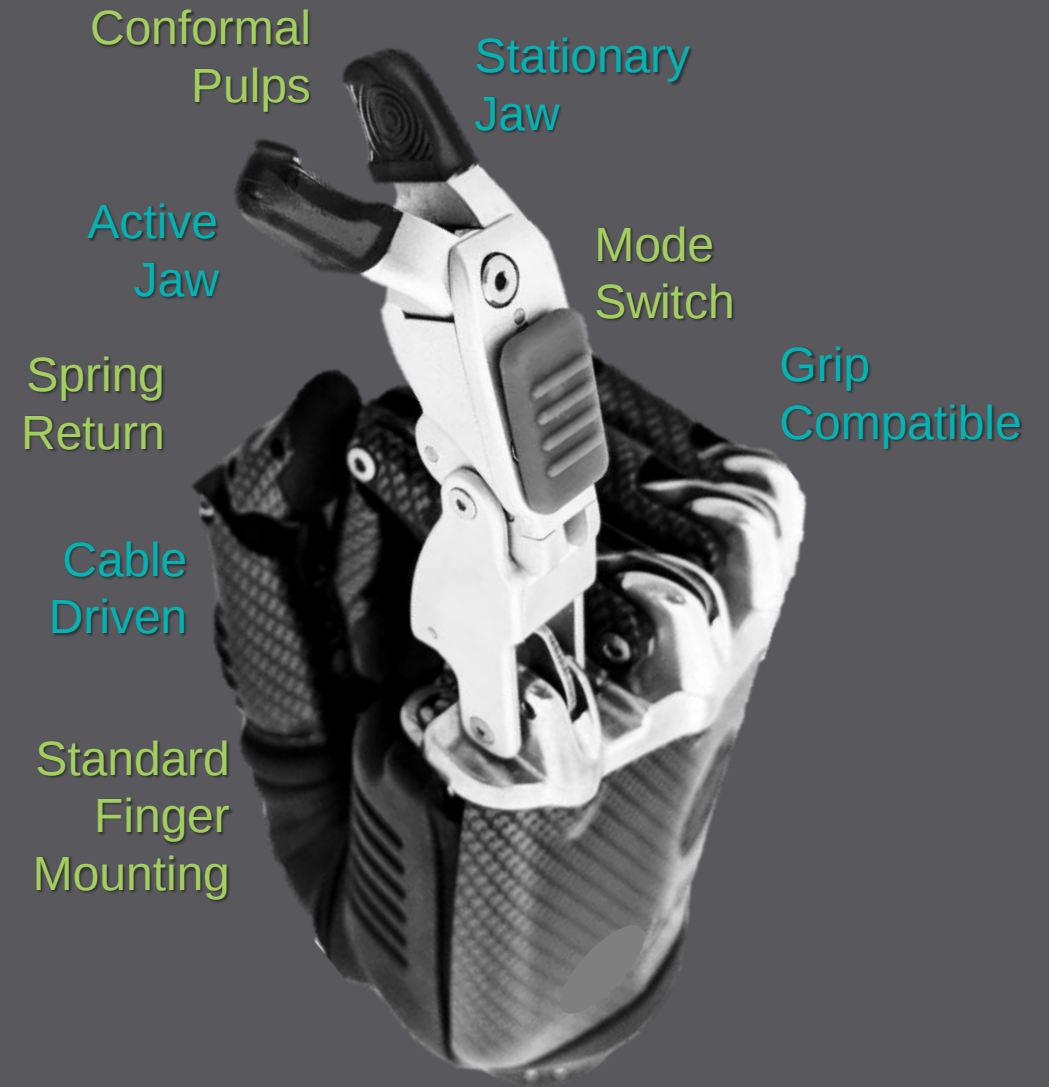
BACKGROUND

- Existing terminal devices offer trade-offs
 - Form
 - Function
- Some users swap between multiple devices per task
- Aim:
 - Design a solution within a single terminal device

					
	Split Hook	Electric Gripper	Electric Hand	Multi-Articulating Hand	Multi-Articulating +Pointdexter
Large Objects	✓	✓	✓	✓	✓
Small Objects	✓	✓	✗	✗	✓
Conformal Grasp	✗	✗	✗	✓	✓
Multiple Grips	✗	✗	✗	✓	✓
Cosmetic	✗	✗	✓	✓	✓

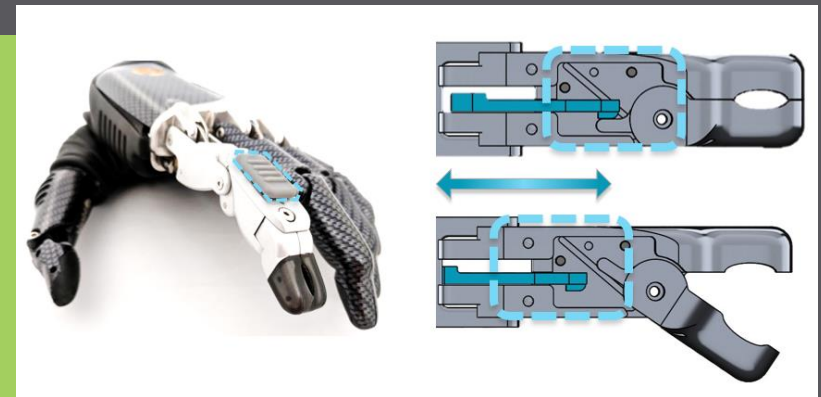
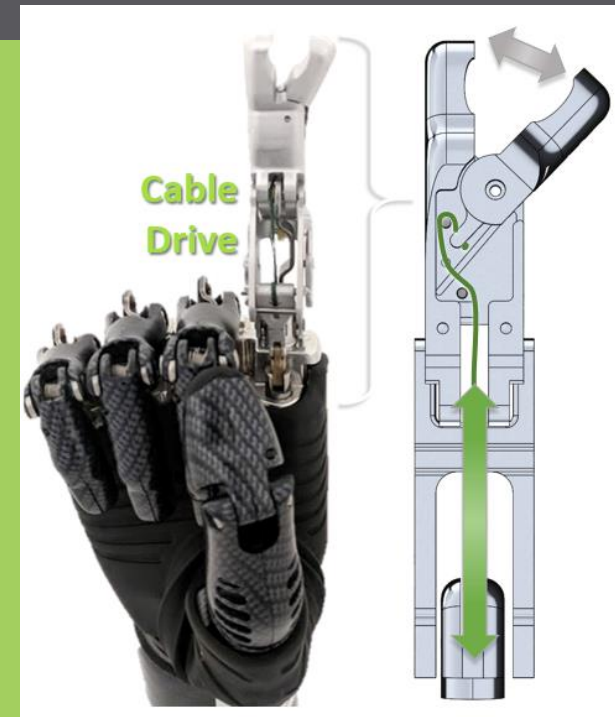
POINTDEXTER

- Prosthetic fingertip gripper
- Add-on for existing multi-articulating hands
- Combines the best aspects of grippers and hands
- Improve small object manipulation of multi-articulating hands
- Patent-pending design



DEVICE

- Fully mechanical design
- Uses existing finger motor
- Mechanical switch between finger and dexterous modes
- Controlled in Trigger Grip



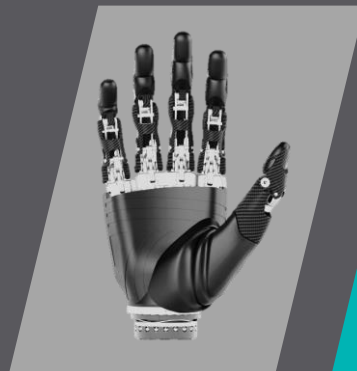
STUDY DESIGN

- Quantify improvements in small object grasping ability using objective functional outcomes measures
- Increase prosthesis use to reduce overuse injuries in the intact limb from this relatively young population



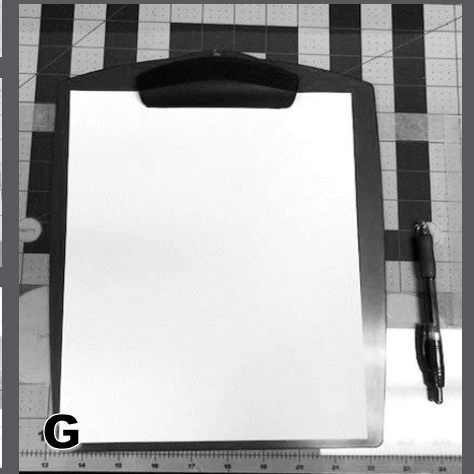
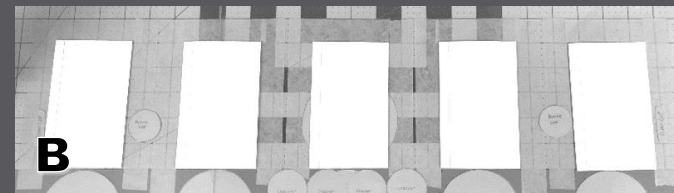
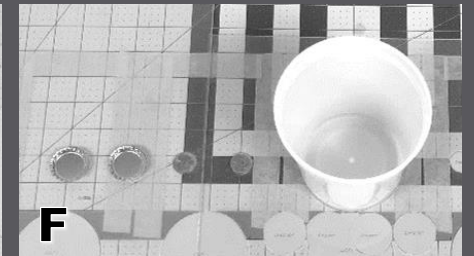
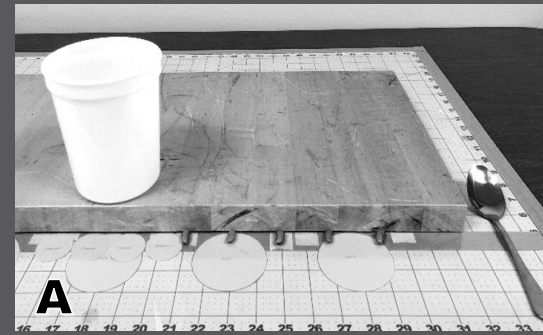
TEST CONDITIONS

- Confirm that Pointdexter does not interfere with standard hand function
- Compare to highly-functional split-hook
- Conditions:
 - Unmodified Bebionic Hand
 - Bebionic Hand w/ Pointdexter
 - Motion Control Split-hook ETD
- Order of the test conditions was randomized



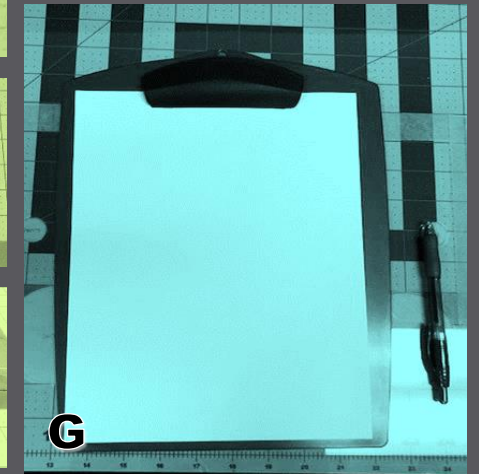
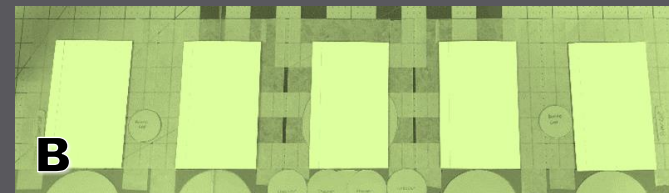
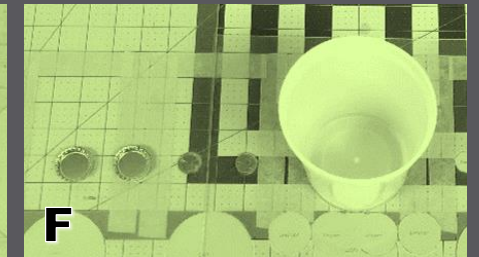
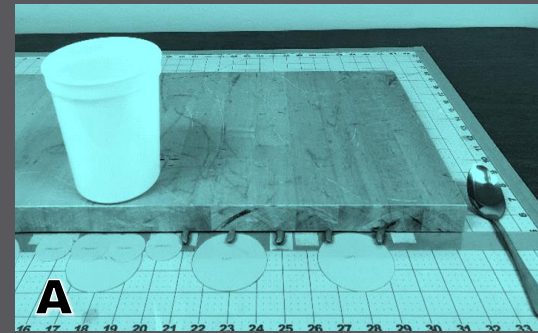
FUNCTIONAL MEASURE

- Several hand functions tests evaluated
- Jebsen-Taylor Test of Hand Function
 - Gross and dexterous grasping
 - Subtasks
 - A – Spoon Feeding
 - B – Card Turning
 - C – Empty Cans
 - D – Full Cans
 - E – Stacking Checkers
 - F – Coins and Bottle Caps
 - G – Writing
- Three repetitions of tasks



METHODOLOGY

- Allowed to select the desired grasp pattern in the Hand condition
- Choose whether or not to use gripper in Pointdexter condition
 - Pointdexter selected for
 - coin/caps (F), card turning (B), stacking checkers (E), and lifting an empty can (C)
 - Pointdexter not selected
 - for holding a pen (G), holding a spoon for feeding (A), and picking up a full can (D)



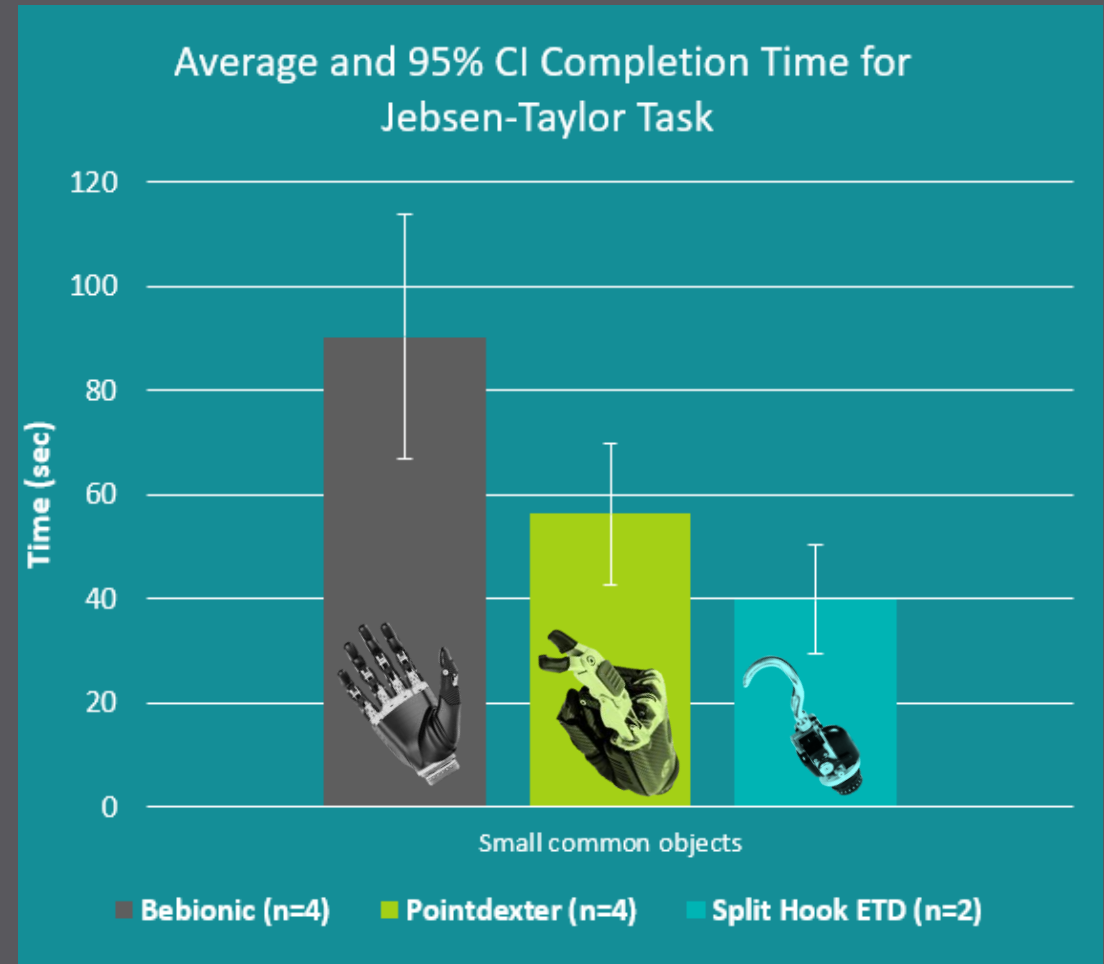
RESEARCH PARTICIPANTS

- $n = 4$
 - 2 experienced trans-radial users of myoelectric multi-articulating hand prostheses
 - 2 able-bodied using a prosthesis simulator
- Means and SDs of scores were comparable so the results were pooled
- Informed consent received
- Participants practiced until comfortable with each device to reduce learning effects



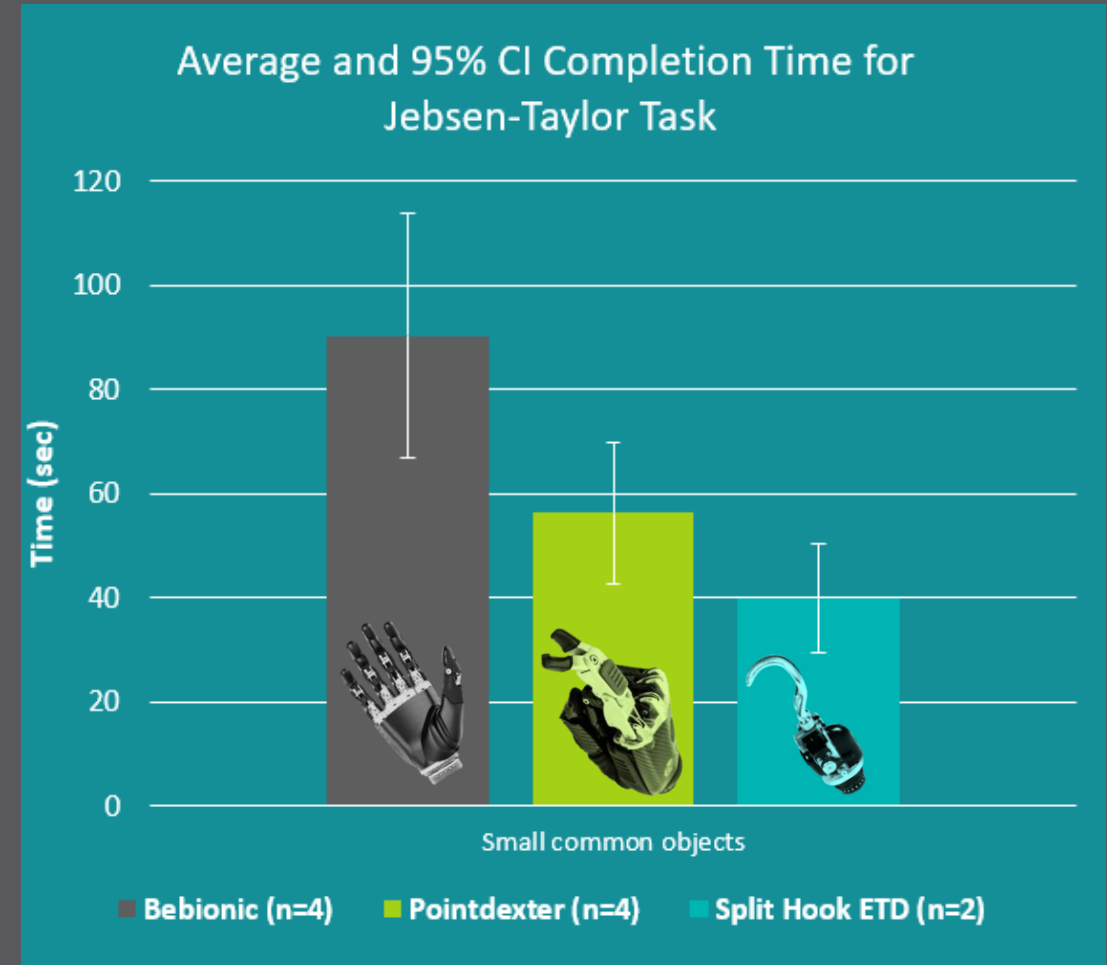
RESULTS

- Jebsen-Taylor tasks were scored by completion time
- Lower time is faster
- Full statistical analysis not conducted due to small n, but several trends were clear
 - Pointdexter showed a 37% improvement over the unmodified hand for small object manipulation
 - Almost as fast as split-hook



DISCUSSION

- Pointdexter performed similar or better on all other tasks, except card turning
 - Alignment of the small jaw took more precise placement
 - Pointdexter appealing for tasks that it may not be best suited for
 - Real world practice would help to identify these tasks
- Subject feedback for Pointdexter improvements
 - Greater grip strength
 - Wider opening
 - Fit different size hands



CONCLUSION



Pointdexter functioned as an upgrade to existing multi-articulating hands with an improved ability to manipulate small objects while retaining the form and functions of the hand as a whole.

ACKNOWLEDGEMENT

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