Initial Clinical Evaluation of Pointdexter – A Dexterous Prosthetic Fingertip

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Introduction and Background

The Problem:

- Current prosthetic terminal devices (TDs) require a compromise between form and function (**Figure 1**).

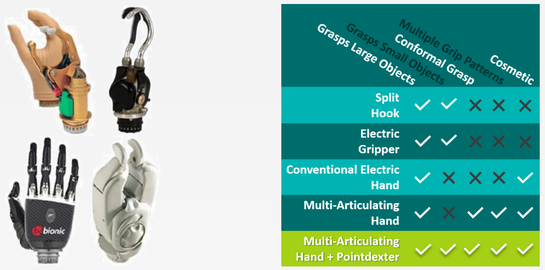

Figure 1 *– Commercially available TDs (left) and a feature comparison matrix (right)*

The Solution = Pointdexter:

- Self-contained, retrofittable index finger replacement with a gripping mechanism.
- Pointdexter combines:
  - Small object manipulation of a split hook
  - Aesthetics and conformal grasp of a multi-articulating hand (**Figure 2**)

Figure 2 *– Pointdexter features*

- Its all-mechanical design does not require additional actuators.
- Activated in 'trigger' grip via selectable mechanical mode switch (**Figure 3**).
- Uses conventional control signals.

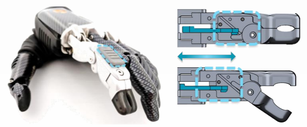

Figure 3 *– The 'top lock' mode switching mechanism*

Objective/Aim

- To use functional outcomes to quantify the change in small object grasping ability created by Pointdexter.

Methods

- Subjects performed three repetitions of the Jebsen Taylor Hand Function Test (Jebsen, et al. 1969) (**Figure 4**).

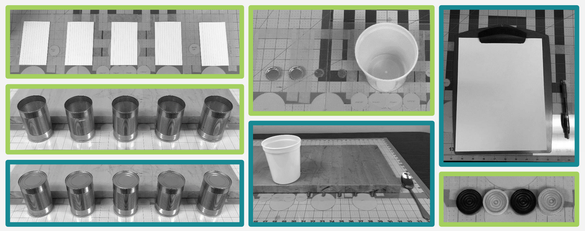

Figure 4 *– Jebsen Taylor subtasks. When allowed, subjects chose to use Pointdexter for those in green but not for those in teal*

- Three TDs were tested in random order:
  1. An unmodified beBionic hand
  2. The beBionic hand with Pointdexter
  3. A Motion Control ETD (functional gold standard)

- Participants practiced with each until comfortable to reduce learning effects of both the device and the test.
- n = 4:
  - 2 experienced myoelectric trans-radial (TR) users
  - 2 able-bodied (AB) patients using a prosthesis simulator

- Grip pattern selection:
  - Unmodified beBionic Condition - Pick desired grasp pattern
  - Pointdexter – Could also use Pointdexter or not (**Figure 4**)

Results

- Mean and variance data of TR and AB subjects similar so data was pooled (**Figure 5**).
  - Full statistical analysis not conducted due to small n
- **Pointdexter showed a > 30 second (>35%) improvement over the unmodified hand for small object manipulation.**
- Both hand conditions slower than split hook at the small objects task.

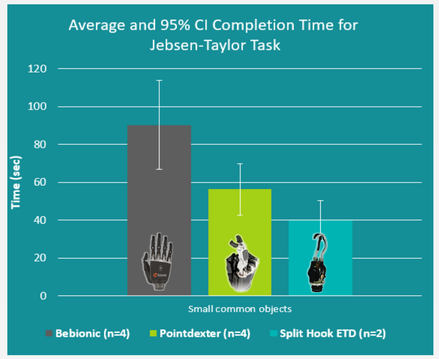

Figure 5 *– Mean and 95% CI data for the time to complete the 'Small Objects' task*

- *Note:* beBionic showed similar performance with and w/out Pointdexter on all other tasks except card turning.
  - Alignment of Pointdexter jaws more difficult

Discussion

- Pointdexter appealing for tasks that it may not be best suited for, but real world practice will identify these tasks.
- Patient conducted a one-month take-home trial to identify:
  - Areas for improvement – more grip strength was the primary request
  - Tasks it was particularly useful for (**Figure 6**)
  - Potential robustness issues – none

Figure 6 *– Photograph from take home testing*

Conclusions

- Adding Pointdexter to a multi-articulating hand improved the user's ability to grasp small objects while retaining normal function and anthropomorphic shape of the hand.
- Further funding has been procured to advance the design.

References and Acknowledgement

Jebsen, et al., Archives of Physical Medicine and Rehabilitation 50, 311-319, 1969.

Research reported in this publication was supported by the Eunice Kennedy Shriver National Institute Of Child Health & Human Development of the National Institutes of Health under Award Number R43HD090800. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.