COMPARISON OF THE FUNCTIONALITY OF VOLUNTARY-OPENING AND VOLUNTARY CLOSING TERMINAL DEVICES USING THE SHAP TEST

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INTRODUCTION

Body-powered devices use one of two types of prehensors. Voluntary opening (VO) prehensors require the user to pull on the cable to open the device but can then relax, allowing the rubber bands on the device to provide the grasp force. This method is easy to use but limits the grasp force to that of the rubber bands. Voluntary closing (VC) devices require the user to pull on the cable to close the device in a grasp, thus giving the user more pinch force and control. However, VC prehensors typically require continued user-generated force to maintain the grasp.

This study had two goals: First, to compare the objective function of VO and VC devices across a range of grasp patterns and activities of daily living.

Second, to analyze if a new type of device that could switch between the VO and VC modes would improve function.

METHOD

All participants gave informed written consent for a research study approved by the Northwestern University's Institutional Review Board.

Thirteen able-bodied subjects wearing a bypass transradial prosthesis performed the Southampton Hand Assessment Protocol (SHAP) (Light, Chappell et al. 2002) using a Hosmer 555 VO device and an APRL VC device. The order of these two devices was randomized per subject. The SHAP protocol is a self-selected timed test that uses abstract objects and objects of everyday life to test six different grasps in proportion to the frequency they are used in daily life.

RESULTS

The average index of functionality (IOF) was 54.4 for the VO device, 53.1 for the VC device, and 56.2 for a device if the best device for each task was used. There was no statistical difference between the IOF of the VO and VC device ($p = 0.47$), but there was a statistically significant improvement when each subject was allowed to use their best device ($p=0.02$).

DISCUSSION

The average index of functionality was higher for the VO device, but several subjects commented that the VC device took less energy to use, since they didn't have to overcome the resistance of the rubber bands with each movement. Thus allowing users to choose between the two modes in order to choose between functionality and energy minimization may also be a useful feature.

This abstract provided results from 13 able-bodied subjects. We will present data at AAOP on 24 able-bodied subjects and several persons with a transradial amputation.

The processed results in this abstract only reported on compared the switch between VO and VC at a user level, rather than a task level. Further processing will compare the performance increase that results when users are allowed to switch the state of the device per task.

CONCLUSION

The most efficient way to complete all of the tasks in a SHAP test would be to use a device that could switch between VO for some of the tasks and VC for others.

CLINICAL APPLICATIONS

This study supports the need for a terminal device that can switch between voluntary opening and voluntary closing, which would be clinically relevant for many persons.

REFERENCES

Light, C., P. H. Chappell, et al. (2002). "Establishing a Standardized Clinical Assessment Tool of Pathologic and Prosthetic Hand Function: Normative Data, Reliability, and Validity." Archives of Physical Medicine and Rehabilitation **83**: 776-783.

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