The Functionality of the Bio-Mechanical Prosthetic Finger (BPF) When Compared to Results on Standardized Functional and Nonfunctional Assessments: A single case study

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Introduction

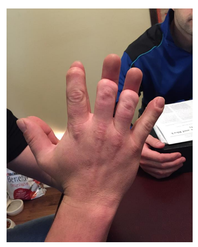
Current prosthetic options for the upper extremity include passive, myoelectric, and body powered devices. While there are many prosthetic options currently available for transradial amputations, there are few functional options available for partial hand or digit amputations. Naked Prosthetics has recently produced a functional body powered device to better serve those with partial hand and digit amputations. The aim of the Bio-Mechanical Prosthetic Finger (BPF) is to reestablish function and mobility to individuals following a digit amputation (Naked Prosthetics, 2013). The purpose of this study was to examine the functional use of the BPF through the utilization of standardized assessments, a functional outcome measure and qualitative questionnaires.

Methods

Student researchers at Alabama State University conducted research to examine the functionality of the Bio-Mechanical Prosthetic Finger (BPF). No significant previous research was located regarding the BPF, outside of the manufacturer's information. The researchers located a current user of the BPF through the use of convenience sampling. The participant was a 28-year-old male who wore two PIP driven devices on his third and fourth digits of his dominant, right hand. The researchers administered the following assessments: *Minnesota Manual Dexterity Test—Placing and Turning Subtests, Jamar Hand Function Test, and Box and Block Test.* The participant completed all assessments without and then with the prosthetic. The participant also completed *The Disabilities of the Arm, Shoulder, and Hand (DASH), The Trinity Amputation and Prosthesis Experience Scale - Revised (TAPES),* and a questionnaire to examine the participant's prosthetic use, and satisfaction with activities of daily living (ADL). With each of these assessments, the researchers compared the functionality of the BFP, compared to no prosthetic at all.

Results

As supported by the results of the various assessments, the participant gained a higher level of fine motor dexterity and grasp while utilizing his BPF devices. Improvements were noted throughout all the trials with the exception of three, ranging from .64% to 22.39%. When wearing the prosthetic, the participants in-hand manipulation skills equaled those of the unaffected hand. The only assessment to demonstrate a decline was the Box and Blocks. Regarding the areas with a decline, the participant reported this was due to an inability to "feel", slipping of the object or dependence on his index finger as the cause. Quantitative results revealed reports of decreased sensitivity and phantom pain when wearing the BPF, as well as more confidence and ease with grasping activities and ADLS.



Comparison of Subtests With and Without BPF

Subtest	Norms for Dominant: Men ages 20-59	Affected without BPF (seconds)	Affected with BPF	Change in Seconds	% Change
Writing	12.2±3.5 (8.7-15.7)	18.53	16.15	-2.38	-14.74%
Simulated Page Turning	4.0±0.9 (3.1-4.9)	4.5	4.75	0.25	5.26%
Small Common Objects	5.9± 1.0 (4.9-6.9)	9.34	8.53	-0.81	-9.50%
Simulated Feeding	6.4±0.9 (5.5-7.3)	7.38	6.03	-1.35	-22.39%
Checkers	3.3±0.7 (2.6-4.0)	5.28	5.84	0.56	9.59%
Large Light Objects	3.0±0.4 (2.6-3.4)	5.16	4.57	-0.59	-12.91%
Large Heavy Objects	3.0±0.5 (2.5-3.5)	4.82	4.16	-0.66	-15.87%

Conclusions

Based on the results of the various assessments, the BPF serves as a viable option for digit amputees. Overall, the participant had an increase in performance on the assessments, with ADLs, and with over al confidence while utilizing the BPF. The BPF may is a better option than passive or myoelectric prosthetics. The BPF is able to provide the wearer with functional movement , in hand manipulation skills and grasp not available in the passive prosthetic. It is suitable for harsh, manual environments. Myoelectric devices cannot perform in harsh manual environments. In addition, the cost of the BPF made this device affordable for the client. With the active grip and motion of the BPF, the participant in this study was able to maintain a career that involved manual labor.

References

Carey, S.L., Lura, D.J., & Highsmith, M.J. Differences in myoelectric and body-powered
upper-limb prosthesis: Systematic literature review. *J Rehabil Res Dev*. 2015;52(3):247-62.

Giladi, A., & Chung, K. (2014). Surgical Principle and Perspective on Upper Extremity Amputations. In Spires, M.C., In Kelly, B., & In Davis, A.J. (2014). *Prosthetic restoration and rehabilitation of the upper and lower extremity* (pp 4859 - 5411).

McGimpsey, G., & Bradford, T. (2008.). Limb Prosthetics Services and Devices Critical
Unmet Need: A Market Analysis. *Bioengineering Institute Center for Neuroprosthetics*.

Murphy, D., (2014). *Fundamentals of amputation care and prosthetics*. New York, NY: Demos Medical Publishing.

Musicus, M. & Davis, M.A. (2014). Upper Extremity Prosthetic Design and Function. In
Spires, M.C., In Kelly, B., & In Davis, A.J. (2014). *Prosthetic restoration and rehabilitation of the upper and lower extremity* (pp 6555 - 6923).

Naked Prosthetics. (2013).

National Center for Health Statistics: US Department of Health and Human Services. *Current Estimates From The National Health Interview Survey*, 1994.

Pendleton, H.M., Schultz-Krohn, W., & Pedretti, L.W. (2013). *Pedretti's occupational therapy: Practice skills for physical dysfunction* (7th ed.). United States: Elsevier Health Sciences.

Radomski, M.V., & Latham, C.T.A. (2013). *Occupational therapy for physical dysfunction* (7th ed.). Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins.

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