

SATISFACTION OF PROSTHESIS USERS WITH ELECTRICAL HAND PROSTHESES AND THEIR SUGGESTED IMPROVEMENTS

Lewis S^{1,2}, Russold M F¹, Dietl H¹, Kaniusas E²

¹Otto Bock Healthcare Products, Vienna, Austria
²EMCE, Vienna University of Technology, Austria

soeren.lewis@ottobock.com

Abstract: To obtain input for future development of myoelectric upper extremity prostheses that meet users' needs better, the presented survey asked them about their satisfaction with and suggested improvements of their current prosthesis. Analysis of 108 responses has shown that 80% of respondents were satisfied with their current prosthesis. Highest satisfaction for a single feature of the prosthesis was present for donning & doffing and the prosthetic hand itself, while satisfaction was lowest with wearing comfort and weight of the prosthesis. Improvements that were most often suggested referred to the cosmetic glove, hand & fingers and the socket. Satisfaction with the prosthesis during different activities was highest for driving a car, interaction with others and grasping of objects and lowest for manual work, drinking from a glass and eating with cutlery.

Keywords: Survey, upper extremity, amputee, myoelectric prostheses, satisfaction, improvements

Introduction

By evaluating the satisfaction of prosthesis users with current prostheses and collecting their suggestions for future prostheses, user surveys provide an important input for development of prostheses.

Previous surveys evaluated satisfaction of users with their prosthesis [1],[2] and with their ability to perform different activities with their prosthesis [1],[3]. Also the design priorities and suggestions for developments of future prostheses were investigated [2]-[5]. The presented survey aimed at repeating these measurements for current myoelectric prostheses while establishing a detailed picture of satisfaction with different features of the prosthesis and prosthesis performance during different activities of daily living (ADLs).

Results of this survey related to sensory feedback were already presented [6] and are not part of this article.

Methods

The part of the survey presented in the following asked participants about their satisfaction with and improvement of current prosthesis. Inclusion criterion was use of myoelectric upper limb prosthesis.

All 108 questionnaires that met the inclusion criterion were included into statistical analysis. Responses are presented in stacked bar diagrams showing percentage of respondents who have chosen each level. The question wording is given in the caption and the legend shows

response scales, from 0 (not satisfied at all) to 3 (absolutely satisfied), that were presented to the participants with the corresponding numeric value for each level. If applicable, these numeric values were averaged over all responses for each item and shown on the right side of each graph. These mean values were used for ranking of items.

Results

Respondents had a mean age of 43 (±17) years and more than three quarter of them (77%) were male. Only 31% of the respondents had a congenital absence of the upper limb. The vast majority of amputations (91%) were carried out due to trauma and only 7% of respondents underwent bilateral amputation. Most respondents were amputated at the forearm (60%) and the upper arm (14%). Joint exarticulations were less frequent and performed at the wrist (13%), at the shoulder (7%) and at the elbow joint (5%).

Overall satisfaction: When asked to give their overall satisfaction with their prosthesis the majority of 59% is rather satisfied and 21% of respondents are absolutely satisfied with their current myoelectric prosthesis. Average satisfaction is 1.96 (±0.75) corresponding to an individual score of rather satisfied.

Satisfaction with prosthesis' features: More detailed information about the satisfaction with different features of the prosthesis is presented in Figure 1. The highest average satisfaction is found for donning and doffing of the prosthesis, followed by the opening and closing of the hand. Average satisfaction for the most features is in the range between 2.0 and 1.9. Less satisfaction is only present for wearing comfort and the weight which is the feature with least satisfaction. Average satisfaction with different features of the prosthesis is 1.98 (±0.59).

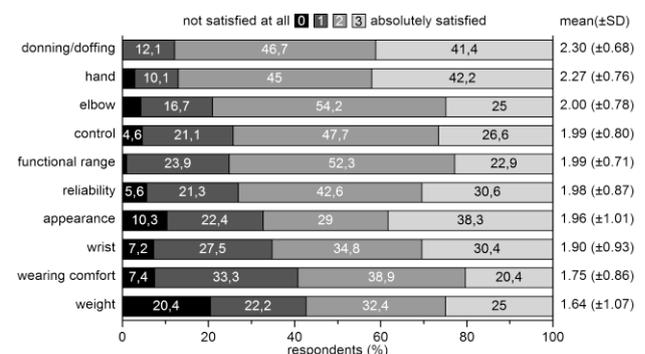


Figure 1: Satisfaction with different features of myoelectric prostheses. "How satisfied are you with the following features of your prosthesis?"

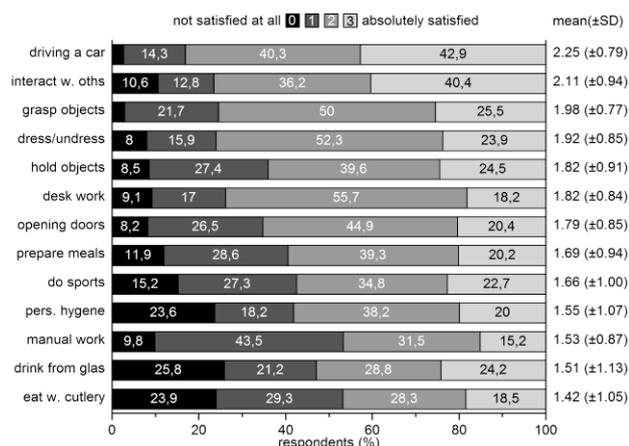


Figure 2: Satisfaction with myoelectric prostheses during different ADLs. "How satisfied are you with your prosthesis when carrying out the following activities?"

Satisfaction during activities: Satisfaction of respondents with the prosthesis during different activities is presented in Figure 2. The highest average satisfaction with prosthesis performance is present for driving a car and contact with others. During these activities over 40% of respondents are totally satisfied with their prosthesis. Average satisfaction between 1.98 and 1.51 is present for most of other activities. Only for eating with cutlery respondents are rather not satisfied than satisfied in average. Satisfaction with the prosthesis averaged over all investigated activities is 1.77 (±0.67). This is significantly lower than the overall satisfaction ($p < 0.01$) and the average satisfaction with different features of the prosthesis ($p < 0.001$).

When asked to give the three activities in which prosthesis use is most important to them, 27% of respondents name manual work, 23% eating with cutlery and 21% grasping of objects. Evaluation of activities for which prosthesis are not used showed that 48% of respondents do not use their prosthesis for personal hygiene, 39% do not drink from a glass and 37% do not use their myoelectric prosthesis for doing sports. 28% do not drive a car with the help of their prosthesis and 22% prepare meals without utilizing their prosthesis. On the other hand, 98% of respondents actively use the prosthetic hand for grasping and holding objects.

Suggested improvements: Table 2 summarizes the wishes and ideas of respondents when asked how their prosthesis could be improved. When evaluating the particular suggestions respondents most often asked for improvements of the cosmetic glove ($n=51$) making it less sensitive to dirt, easier to clean, more durable and giving it a more natural look. Second most often addressed were the prosthetic hand and its fingers ($n=47$) mainly wishing for independent movement of single fingers and a relaxed position of the hand when not in use. The socket was addressed 36 times, demanding less sweating and a slim design. Improvements of the wrist were suggested 22 times asking for enhanced movability. A reduction of the weight is mentioned by 19 respondents, 12 respondents demand a more reliable grasping and 9 ask for provision of sensory feedback by their prosthesis.

Table 1: Suggested improvements.

Category	Times Suggested	Often Mentioned
Cosmetic glove	51	Less sensitive to dirt, better to clean, more natural look, durability
Hand & Fingers	47	Ability to move separate fingers, relaxed position of the hand
Socket	36	Reduce sweating, slim design
Control	26	Improved control of movement, less prone to interference
Wrist	22	Rotation, flexion, extension, ulnar/radial deviation
Weight	19	lighter
Grasping	12	Reliability, grasping small objects
Sensory Feedback	9	Information about grip force and position.

Discussion

This study reveals that 80% of respondents are rather or absolutely satisfied with their current myoelectric prosthesis in general while satisfaction with the prosthesis during different ADLs is significantly lower.

Improvements respondents suggested most often were related to the cosmetic glove. This might be addressed by providing interchangeable gloves suited for different activities, e.g. durable ones for manual work and more natural looking ones for social interaction. Another approach for improvement would be accepting the convenient process of donning and doffing to become more difficult which might give room for development of sockets that lead to more wearing comfort and less sweating.

Acknowledgement

The authors thank all participating technicians for the distribution of the survey and all respondent for the time they took to thoroughly fill out the questionnaire.

Bibliography

- [1] J. Davidson, "A survey of the satisfaction of upper limb amputees with their prostheses, their lifestyles, and their abilities," *Journal of Hand Therapy*, pp. 62-70, 2002.
- [2] P. J. Kyberd, et al. "Survey of upper extremity prosthesis users in sweden and the united kingdom." *Journal of Prosthetics & Orthotics*, vol. 19, pp. 55-62, 2007.
- [3] C. Pylatiuk, S. Schulz and L. Döderlein, "Results of an internet survey of myoelectric prosthetic hand users." *Prosthetics and Orthotics International*, vol. 31, pp. 362-370, 2007.
- [4] D. J. Atkins, D. C. Heard and W. H. Donovan, "Epidemiologic overview of Individuals with upper-limb loss and their reported research priorities." *Journal of Prosthetics & Orthotics*, vol. 8, 1996.
- [5] E. Biddiss, D. Beaton and T. Chau, "Consumer design priorities for upper limb prosthetics." *Disability & Rehabilitation: Assistive Technology*, vol. 2, pp. 346-357, 2007.
- [6] S. Lewis, M. F. Russold, H. Dietl, E. Kaniusas, "User demands for sensory feedback in upper extremity prostheses," *Medical Measurements and Applications*, 2012.