

A Patient-Centered Co-Design Usability Study of a Novel Device for At-Home Musculoskeletal Shoulder Rehabilitation

Philippa G. Tsirgiotis, David A. Hobbs, Jim S. Hannon-Tan, Tom E. Russell, Aaron A. Mohtar, Luke A. Mason and Jonathan P. Cabot

Abstract — The present study assesses the usability of a novel device for at-home rehabilitation of musculoskeletal (MSK) shoulder conditions. Patients who had previously undergone traditional exercise-based shoulder rehabilitation were recruited and completed the System Usability Scale (SUS) questionnaire after trialing the device. Open-ended interviews were conducted to identify issues with the current prototype. Results indicate excellent usability, with a number of areas for improvement identified by participants.

Clinical Relevance — This study adopted a co-design approach and investigated patient usability and acceptance of a novel robotic device for at-home shoulder rehabilitation, with favorable preliminary results.

I. INTRODUCTION

Exercise-based rehabilitation forms an important part of the treatment of several musculoskeletal (MSK) shoulder conditions, with clinical outcomes heavily reliant on patient adherence [1]. With perceived convenience and simplicity of exercises strongly linked to adherence, patient feedback is imperative when designing a new rehabilitation tool [2]. The device studied is in early stages of development. This small, portable, handheld device slowly drives the patient's arm along a flat surface as they grip the handle (Fig. 1), moving the affected arm without active patient involvement. A mobile device application monitors the distance travelled and instances of use for each movement.



Figure 1. The rehabilitation device tested, with control joystick (left inset) and application interface (right inset).

II. METHODS

This study was approved by the Flinders University Human Research Ethics Committee (Project number 4143).

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The first two authors are members of the Medical Device Research Institute at Flinders University, Tonsley, SA 5042 Australia; e-mail: philippa.tsirgiotis@flinders.edu.au and david.hobbs@flinders.edu.au

A mixed methods approach was adopted to obtain perspectives on functionality and design features, in order to improve subsequent prototypes and end user acceptance. Participants were patients from a local Physiotherapy Practice with a history of MSK shoulder pathology treated with exercise-based rehabilitation. Participants presented for a 45-minute one-on-one session, where they interacted with the device following demonstration of appropriate use. Each session comprised observation and video recording of device usage, an open-ended interview, and the standardized System Usability Scale (SUS) questionnaire.

III. RESULTS

Data was obtained from seven participants (5 females, mean age 63 years, range 47-74 years). Participants had mild to moderate pain and impairment in their relevant arm. None had prior experience with robotic rehabilitation.

The device scored very highly for overall usability (90.36 ± 4.71 out of a possible 100) given that a SUS score above 68 is considered above average. Ease of use received the maximum score from all participants. Table I lists issues raised by participants along with possible solutions for the subsequent prototype.

TABLE I. DEVICE ISSUES AND POTENTIAL SOLUTIONS

Issue	Potential solution
The index finger-controlled joystick was too recessed.	Raise the joystick above the level of the surrounding material.
Numerical progress data was difficult to interpret quickly.	Implement graphical feedback in the final user interface.
The device travelled too quickly along the table.	Allow the speed of the device to be adjusted by the end user.

IV. DISCUSSION & CONCLUSION

This study provides essential feedback from a relevant population on the usability of the device. Interviews resulted in more comprehensive collection of users' insights, and the high measures of usability (SUS) are a promising indicator of patient acceptance. Issues raised by participants will be incorporated into the next design iteration to enhance the patient experience and overall usability.

REFERENCES

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