THE FEASIBILITY OF BESPOKE REHABILITATION ROBOT HANDGRIPS TO MEET THE SPECIFIC NEEDS OF STROKE PATIENTS—PART 2

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Introduction

Stroke globally is a common and serious healthcare problem, which usually causes disability and brings difficulties to people's living [1]. Robotic-assisted therapy is considered one of the most effective methods to restore upper limb function in last few decades [2]. According to professionals' recommendations in the UK National Clinical guidelines for stroke [3], bespoke rehabilitation devices are recommended to use. However, the majority of existing upper limb rehabilitation robots are limited in that they provide only a generic handgrip which cannot meet the needs of all stroke survivors due to the various movement patterns (e.g. spasticity) and upper limb weakness levels. This study investigates the technical and clinical feasibility of bespoke handgrips to meet stroke survivors' needs through an online questionnaire with therapists and an estimation of manufacturing cost.

Methods

This study was conducted through two parts. The first part was the parametric design and manufacturing cost estimation of bespoke handgrips to identify the technical feasibility. The second part was an online questionnaire with 25 therapists to identify the clinical feasibility of bespoke handgrips.

Results

One wrist support and two different handgrips were designed, and their size (length and width of the handgrip) can be changed based on the individual anthropology data (Table 1). Additionally, by using additive manufacturing methods, the fabrication costs of bespoke handgrips reduced between 5%-15%.

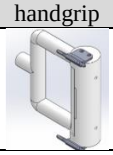
	Wrist support	Hemispherical handgrip	Vertical handgrip
Design			
Target users	1. Severe or very severe weakness 2. Wrist stiffness 3. Cannot grasp at all	1. Mild to Moderate weakness 2. Finger stiffness 3. Can do some hook or grasp grip	1. Mild to Moderate weakness 2. Can do some grasp, pinch, pencil or hook grip

Table 1: Conceptual design of bespoke handgrip for rehabilitation robots developed by therapist

Of the 25 therapists involved in this study, 76% had more than 5 years' work experience. More than 90% of professionals (n=23) stated the positive impact of bespoke handgrips on rehabilitation outcomes and 72% (n=18) would like to use a bespoke handgrip with stroke survivors due to its high accessibility and variability (Figure 1).

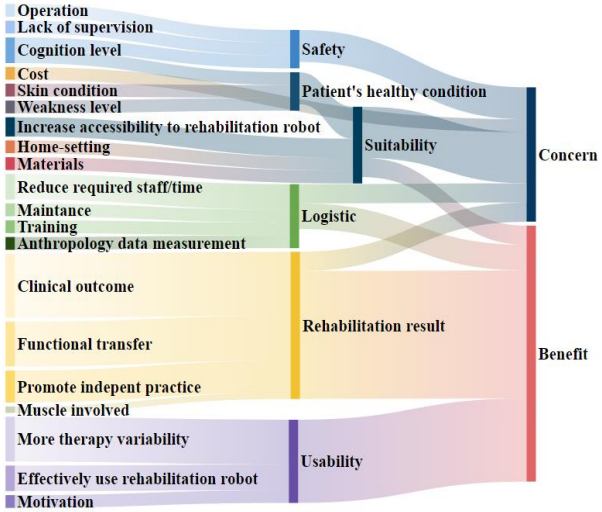


Figure 1: Sankey diagram of the benefit and concern of using bespoke upper limb rehabilitation robot handgrip based on questionnaire results.

Discussion

The results indicate that a bespoke upper limb rehabilitation robot handgrip can improve stroke rehabilitation from both a technical and clinical perspective. The parametric design allows engineers to adapt the 3D design quickly (<1 minutes) according to stroke survivors' data (e.g. palm width and length). By using the additive manufacturing method, users will be provided with more bespoke features such as the material, colour, and texture. Due to the variety of stroke survivors' weakness levels, the standard handgrip is insufficient or uncomfortable to use. Professionals highlighted the potential of bespoke handgrips to increase the accessibility of upper limb rehabilitation robots and stroke survivors' motivation. The safety and patient suitability (e.g. patients' healthy condition) was reported as the main concern of using bespoke handgrip.

References

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