Re-assessing the Design Needs of Trans-Radial Amputees in Product Design Innovation

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ABSTRACT

The previous study on design for disabled people has indicates that product development for trans-radial amputees should integrate designer's reflection in identifying significant variables such as the real needs of their users, functionality, ergonomic aspect, and aesthetic. Hence, this paper intends to re-assess the design needs of trans-radial amputees through an observation study with 15 trans-radial amputees (right side). The observation aims to understand the difficulties that occurred in the daily activities of amputees, in their home situation without the help of prosthesis. The result of the study suggests the amputees' main struggle in their daily activities; preparing meals and eating independently. Therefore, a few design criteria have been proposed, and the prototype design was successfully developed as a proposal for potential future development and production. It is hoped the outcome of this research help to surpass the kind of device constrained to help amputees preparing meals and eating independently.

Keywords: *product design, design thinking, design for disabled people*

INTRODUCTION

Trans-radial amputation is not merely a loss of one hand, but it affects a person's daily activity. According to Boyle et al. (2000) 66% of the trans-radial amputation had antagonistically influence amputee's participation in sports, hobby, and housework. The vast majority of them needed to leave their place of employment since they are unable to adapt their working activities. The backbone of treatment for hand amputation has been prosthesis. Different types of prostheses are accessible and range from a non-functional cosmetic prosthetic, to a hook, and to a further developed myoelectric prosthetic. Be that as it may, not every person could manage the cost of it. In the event that they might, they will need a proper prosthetic hand with working prosthetic fingers, which usually cost them a fortune. Moreover, an amputee will not be wearing the prosthetic hand for the entire day due to (dis)comfort factors. In spite of the fact that a prosthetic may provide an assisting hand, it is constrained by the burden of weight, inconvenience, and absence of functional feedback. It is then vital that a good design that can comfortably oblige daily activities, and simultaneously, affordable so that they will have a better life after the amputation.

Matos et al. (2014) for instance, argue that the most recent decade has seen an expanded spotlight on medical devices design for the disabled, explicitly concerning patient safety, and several initiatives have been set up to improve such elements. In any case, Matos et al. (2014) likewise contended that most multidisciplinary groups that are responsible for the product advancement for disabled or amputees neglected to consider and incorporate good design as a basic component. Aside from that, the perception was strengthened by the impression that the vast majority of the products intended for disabled or amputees do not completely respond to the users' real and practical needs. For instance, issues such as aesthetic, formal or symbolic functions, or in outrageous cases, ergonomic and functional ones are commonly not considered as important as mechanical performance, or economic and innovative variables.

Hence, it is gravely significant that the product development for trans-radial amputees ought to incorporate designer's reflection in recognising prominent variables such as the real needs of their users,

functionality, ergonomic elements, and aesthetic. Based on the above statements, our research aims to assess the product design criteria for trans-radial amputees to improve single-handed activities. Visual documentations with the amputees were conducted. The research model of the study was based on the framework of Activities of Daily Living (ADLs) and Ergonomics Ergo-system. Subsequently, a design process was initiated based on the data analysis to establish the most suitable and appropriate design preferences for single-handed activities.

Amputation

In general, amputation is defined as a surgical procedure for the removal of part or the whole of a limb (Jain and Robinson 2008). Pecoraro, Reiber, and Burgess (1990), however, defined amputation as a removal of an injured or diseased body part, which might be the after-effect of a horrendous physical issue, or it might be an arranged operation to forestall the spread of the illness such in an infected finger or hand. The reasons for amputation vary between the upper and lower limbs. For example, Jain and Robinson (2008) argue that the essential explanations behind the lower limb amputation because of trauma and vascular-related diseases (with or without diabetes). Meanwhile, the essential explanations behind the upper limb amputation are heredity, conditions during childbirth (inherent), surgical removal for trauma, vascular-related reasons, or cancer. Generally based on age, upper limb amputation in young patients is normally the result of trauma, infection, or is secondary to congenital anomalies. Meanwhile, for more older patients, amputation is almost certain an after-effect of medications or peripheral vascular diseases. The incidence of upper limb amputation is variable in the literature however it is evaluated to be 11.6 in 100,000 adults (Trofe-Clark and Levin 2017).

Upper limb amputation involves removal of all or part of the fingers, hand, forearm, upper arm, or shoulder (see Figure 1). Jain and Robinson (2008) outlined the following eight types of upper limb's amputation: (1) forequarter; (2) shoulder disarticulation; (3) trans-humeral; (4) elbow disarticulation; (5) trans-radial; (6) wrist disarticulation; (7) partial hand; and (8) digit. Based on the study conducted by Jang et al. (2011), trans-radial amputation was the most frequent (48.4%), followed by trans-humeral amputation (19.4%), partial hand and fingers amputation (17.9%), shoulder disarticulation (6.6%), wrist disarticulation (6.6%), and elbow disarticulation (1.1%).

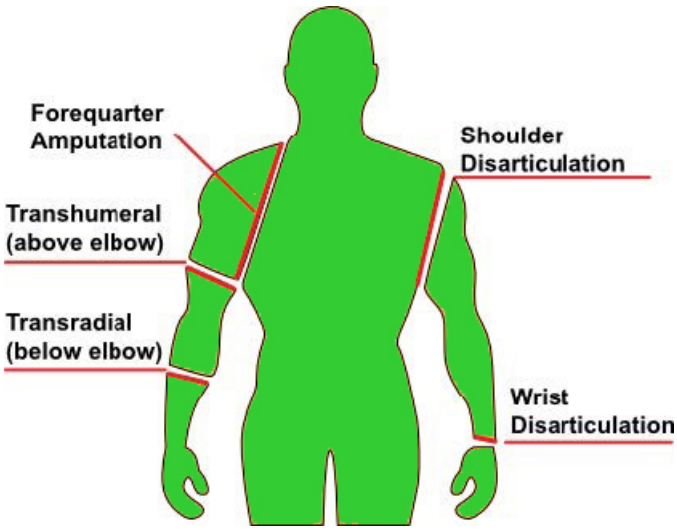

Figure 1 Types of amputation.
Source: Author's illustration.

Contrasted with the lower limb amputation, upper limb deficiency is regularly more functionally disabled because of the fine motor tasks carried out by the hands and arms. Although human beings adapt very well and the contralateral upper limb takes over the greater part of the tasks and in this way becomes the dominant limb, the degree of amputation will, to a great extent, determine the degree of functional disability—i.e., the impact on quality of life and the capacity to carry out tasks of daily living (Jain and Robinson 2008). Expressed differently, upper limb amputation, irrespective of its cause (trauma, disease, or congenital malformation), will unquestionably cause problem(s) that will definitely prompt a specific degree of functional disability.