

CHALLENGES OF UPPER LIMB FITTING IN CANADA: A SURVEY OF UPPER LIMB PROSTHESIS USERS AND CLINICAL PROSTHETISTS IN CANADA

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ABSTRACT

Purpose: This study aimed to survey Canadian upper limb prosthesis users and clinical prosthetists (who fit the device) to examine physical and psychosocial factors that influence the acceptance and rejection of using an upper limb prosthesis. *Methods:* Two separate, custom-built questionnaires were developed and sent to Canadian clinical prosthetists to participate and distribute to their upper limb patients. *Results:* This survey received responses from 47 clinicians, 22 prosthesis users, and one non-prosthesis user from nine provinces. Due to the small data set, responses did not show any statistical significance; however, the results highlight several important factors and the importance of patient-prosthetist relationships and rehabilitation services. *Conclusion:* Upper limb fitting in Canada has its challenges, and similar to other research, there are several important factors to focus on when considering acceptance of upper limb prostheses.

INTRODUCTION

Individuals with upper-limb absence (ULA) account for 3 to 15% of all amputations and have relatively lower rates of acceptance/use than those with lower-limb absence (LLA) [1]. Studies show that acceptance rates for ULA individuals are 27 to 56%, whereas LLA individuals have a 49 to 95% acceptance rate [2]. Limb loss is considered “trauma”, as the correlation between mental-self and real-self disrupted, which can affect an individual’s interaction with the sense of belonging and the acceptance of a prosthetic limb. Acquired/traumatic limb loss accounts for 80 to 90% of all ULA, which can be correlated to the high and varying rates of prosthesis rejection, ranging from 24 to 70% [3]. Canadian research regarding upper limb prosthesis acceptance and rejection rates and reasons are limited and outdated since there are no official reporting requirements [4]. Furthermore, with the technological advancements in prosthetics, these rates have changed and should be updated [5]. The purpose of this study was to survey Canadian upper limb prosthesis users and clinical prosthetists (who fit the device) to examine physical and psychosocial factors which influence the acceptance and rejection of using an upper limb prosthesis. The results of this study will help address this void in Canadian upper limb research and improve our understanding of why acceptance and rejection of upper limb prostheses occurs.

METHODS

Questionnaire

Two separate, custom-built questionnaires were developed from a literature review of existing surveys and relevant research to focus on the most prevalent factors impacting prosthesis acceptance. The prosthesis user/non-user questionnaire collected participant demographics, limb loss specifics, prosthesis user background, and prosthesis acceptance and rejection related factors. The clinician questionnaire collected clinician and clinic demographics, prosthesis availability and rehabilitation, and prosthesis acceptance and rejection factors. The surveys were provided in English and French and administered through the online survey platform Google Forms and the post if needed. Certified clinical prosthetists across Canada were the primary recruitment source, as survey links were distributed via an invitation email. The clinicians were asked for their participation in the survey, as well as, to aid in dispersing the prosthesis user/non-user survey, to their patient list that met the inclusion criteria. The inclusion criteria for the clinician questionnaire were Canadian certified prosthetists (CP), certified prosthetists orthotists (CPO) and prosthetic residents, and that the clinic at which they worked fitted upper limb prostheses. The criteria for inclusion in the prosthesis user/non-user survey were upper limb amputees of any length, age 19 years or older, and who currently use a prosthesis or have chosen to reject using a prosthesis. A total of 47 clinicians (CL), 22 prosthesis users (PU) and one non-prosthesis user (NPU) participated in the survey. Questionnaires with a minimum of 75% completed answers were used, and for questions which were not answered by all participants the response rate was included in the results separately. Data was processed using t-tests with two-tailed distribution and two-sample unequal variance and two

sample proportion z-test, with an alpha level of 0.05. All statistical analysis was computed using Minitab 19.2020 (Minitab® LLC State College, Pennsylvania, USA), and a variance equality was not assumed for this. The Research Ethics Board at the University of New Brunswick (REB #2021-135) approved this study.

RESULTS

Clinician and clinic demographics

Clinician participation came from nine provinces, with 40.4% working in hospital-based clinics. The majority, 70.2%, of CL were CP, ranging from less than five to over ten years of experience. Most clinicians' ULA patients represented less than 10% of their clinic's population, with the average age of patients between 36 to 65 years. Clinician and clinic demographics are presented in Table 1.

Table 1: CL (p=46) and PU (p=20)

Complaint	Pooled sample proportion	Test statistic	P-value (p>0.05)
Fit	0.23	-4.0845	2.000
Maintenance/repair	0.169	-2.592	1.990
Function	0.350	0.000	1.000
Glove issues	0.166	-1.203	1.771
Comfort	0.275	1.504	0.133
Cosmetics	0.228	0.356	0.722
Myo-hand/device	0.135	0.547	0.585
Harness	0.120	1.150	0.250
Durability	0.106	0.971	0.331
Skin irritation	0.092	0.776	0.438
Technology	0.064	0.305	0.760

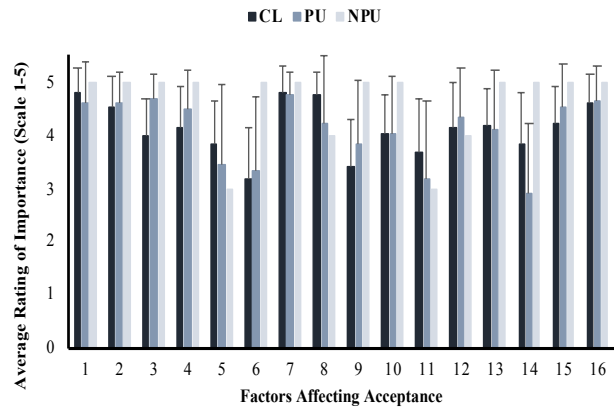


Figure 1: CL, PU and NPU ratings of importance for factors affecting acceptance. Likert scale of 1 to 5, with 1 being not at all important and 5 being very important. Standard error bars represent standard deviation. Factor Key: 1-Function of the prosthesis, 2-Ease of prosthetic device use, 3-Ease of putting on/taking off the prosthetic device, 4-Weight of the prosthetic device, 5-Cosmetic quality of prosthetic device, 6-Sufficient sensory feedback from the prosthetic device, 7-Socket and harness comfort, 8-Skin/body irritation from prosthetic device, 9- Heat produced while wearing the prosthetic device, 10-Satisfaction with prosthetic device technology, 11-Past prosthesis experience, 12-Lifestyle, 13-Availability of prosthetic services, 14-Access to therapy and training for prosthetic device use, 15-Confidence of prosthetist, 16-Quality of patient-prosthetist relationship.

Users and Non-Users demographics and limb loss specifics

Out of 23 individuals with ULA, 22 currently use a prosthetic device, and one did not. Participants identified as 43% female and 57% male and were primarily in the age range of 36 to 65 years and reported from five different provinces. 91% of the participants were unilateral amputees, mainly transradial (52%). Acquired amputation accounted for 65%, and of the acquired ULA individuals, 73% had their limb loss occur on their dominant arm. Prosthesis user and non-user demographics and limb loss specifics are documented in Table 2.

Table 2: Factors rated greater than or equal to 4.0 for the level of importance in influencing prosthesis acceptance.

	Factors																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17*	18*	19*	20*
CL	+	+	+	+	-	-	+	+	-	+	-	+	+	-	+	+	-	+	-	+
PU	+	+	+	+	-	-	+	+	-	+	-	+	+	-	+	+				
NPU	+	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+				

+ = ≥ 4.0 , - = < 4.0 , *Factors only asked in clinical questionnaire. Factor Key: Same as Figure 1, with the addition 17-Patient gadget tolerance, 18-Amputation level, 19-Time to initial fit, 20-Funding availability.

Factors affecting “acceptance” of a prosthesis

CL, PU and NPU rated a list of 16 factors on the level of importance with regards to how it would affect the “acceptance” of a prosthesis. A statistical difference was not found between the CL and PU, as their ratings of importance were relatively similar. Except for their ratings for Access to therapy and training for prosthetic device use, there was a statistical significance ($p=0.06$), with the CL rating a higher importance value, than the PU and NPU. The order of the highest-ranked factors, varied slightly between the two groups. PPU’s top 5 factors, in order of highest to lowest average rating, were: socket and harness comfort, ease of putting on/taking off the patient’s prosthetic device, quality of patient-prosthetist relationship, the function of the prosthesis, ease of prosthetic device use. Whereas the top 5 factors for CL, in order of highest to lowest average rating was: function of the prosthesis, socket and harness comfort, skin/body irritation from prosthetic device, quality of the patient-prosthetist relationship, ease of prosthetic device use.

Common complaints

In order of greatest occurrence, the following top 5 PU complaints were mentioned in clinicians’ responses ($n=46$): weight, function, comfort, cosmetics, cost, whereas the top 5 PU complaints mentioned in the PU responses were ($n=20$): fit, maintenance/repair, function, glove issues, cosmetics. Table 1 documents commonly mentioned complaints and their statistical analysis values.

Patient-prosthetist relationship

On average, PU rated their overall relationship with their prosthetist 4.55 on a scale of 1 to 5, and the NPU participants rated theirs as a 5. Furthermore, 73% of PU agreed that they believe their level of satisfaction with their prosthetist influenced their decision to use a prosthesis, whereas the NPU did not. Similarly, 89% of CL agreed that PU’s satisfaction level with their prosthetist can influence their acceptance of a prosthesis. However, there was no statistical difference between the two proportions, ($p=0.09$).

Rehabilitation services

82% of PU have worked with a rehabilitation specialist, whereas the NPU did not. 74% of CL answered yes to coordinating rehabilitation services for their patients after fitting, with 64% of the specialists being occupational therapists (OT), 26% physiotherapists (PT) and 10% covering other specialists, such as psychiatrists and psychologists.

DISCUSSION

Although the sample size for this study is relatively small and thus restricts the ability to show statistical analysis, these findings still present a great deal of preliminary data for Canadian upper limb prosthetics.

Participant demographics

Since ULA makes up a small portion of the limb loss population, it is understandable for most CL to have a limited amount of experience fitting upper limb PU and the various levels of limb loss. In the final question of the clinician questionnaire, participants are asked to provide their final thoughts on the current challenges in Canada regarding prosthesis acceptance and rejection. Prosthetist knowledge and having access to an experienced upper limb fitting prosthetist, had the third-highest occurrence rate (17%, $n=47$). It is recognized that the number of NPU does not allow for statistical analysis to occur; however, the answers provided are still considered to be a finite view of a NNPU’s reasons for rejection.

Factors affecting “acceptance” of a prosthesis

Similar to previous research, CL and PU identify factors such as function of the prosthesis, socket and harness comfort, ease of putting on/taking off prosthetic device, ease of prosthetic device use, skin/body irritation from prosthetic device and quality of patient-prosthetist relationship [5]. Table 2 shows all ratings given greater than or equal to 4.0, which represents important to very important on the provided Likert scale.

Common complaints

Comparing the common complaints listed by the PU and CL allows for an analysis of how the CL are possibly interrupting user complaints and, what complaints are important to the users. When comparing the top five occurring complaints, it is interesting to note that two of the clinician’s listed complaints are not in the top five for PU. When given the opportunity to report on their most common complaints, PU do not focus on weight or cost, unlike the CL. CL may be more focused on these two factors since they have an important influence on the PPU’s use of and ability to use a prosthesis. 72% ($n=16$) of the PU participants ($n=22$), use body-powered or myo-electric hook/hands, which is when weight implications can become more

prominent. However, the survey results show that the PU is more concerned about the fit, maintenance, and function, which is understandable. If the prosthesis does not function properly, then the weight of the device is null and void.

Patient-prosthetist relationship

All three groups scored the quality of patient-prosthetist relationship ≥ 4.0 and both CL and PU groups rated this factor in the top five highest for its importance. There is no statistically significant difference between the group's ratings. An additional comment in a clinician's survey said, "*well-fitting/comfortable device can be accepted by any patient regardless of their feelings towards the prosthetist. It is often easier to get to the well-fitting/comfortable device is both parties have a healthy working respect for each other.*" This statement aligns with the current study's data and past research where the strength of each factor affects acceptance placed the quality of this relationship in the top five highest rankings [6]. Especially for younger patients, who may be clinic clients for a longer amount of time, the relationship with their clinician could hold an even greater influence factor in their decision to accept and continually use a prosthetic device.

Rehabilitation services

Rehabilitation and training can be influential on the prosthesis user. For acquired amputation, a good rehabilitation program is often divided into four phases: acute postsurgical, subacute pre-prosthesis training, basic prosthesis training, and advanced long-term rehabilitation [7]. The sooner training can start, the greater the period of "high acceptance" is, which influences the prosthesis user's willingness to use a prosthesis [8]. A common complaint reported in the current study was the lack of functionality or having too high of expectations for how well the prosthesis would function. Research shows that quality prosthesis training can positively impact the function and use of the prosthesis, for the rest of the user's life [8]. CL, who reported not coordinating rehabilitation services after fitting, provided reasoning, such as: "*Therapists with expertise/experience with upper limb amputees are not available in our area (i.e., northern regions especially),*" "*Depends on access to publicly funded rehab therapists. No private therapists specialize in UE training*" and "*Depends on the level of confidence/experience (i.e., Often for people with new amputations we do coordinate rehabilitation with an OT and PT. However, for experienced PU we do not as they are already confident users.)*." Improving the rehabilitation coordination and quality of training, is important for the overall prosthesis fitting process, especially as prosthetic device technology becomes more advanced. As user gadget tolerance becomes more difficult, experienced rehabilitation services will become more influential in the acceptance, and long-term use, of a prosthetic device [7]. In addition, to optimize rehabilitation, previous studies report the importance of sharing experiences between rehab centres, to spread knowledge of upper limb prosthetics [9].

CONCLUSION

The results suggest that Canada's upper limb prosthesis fitting has areas in need of improvement. Many factors can influence prosthesis acceptance, mainly focusing on function, ease of use and comfort of various components. Therefore, it is important for multidisciplinary teams of CL to focus their attention on improving these factors. Additionally, elements such as quality of patient-prosthetist relationship and rehabilitation services are shown to greatly impact a PPU's willingness to try a prosthesis and then consistently use it. Future research should focus on developing validated clinical research surveys to increase Canadian data, and track improvements, as prosthesis technology continues to change, and upper limb fitting improves through awareness and education. Awareness and qualification could also impact the number of survey participants, as CL and upper limb amputees may become easier to contact and more interested in helping with data collection. This research can help initiate the surge for Canadian upper limb fitting data collection and in turn better the quality of life of Canadian's living with ULA.

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