PROSTHESIS RECEIPT IS ASSOCIATED WITH IMPROVED PARTICIPATION AND DECREASED PAIN FOLLOWING UPPER LIMB AMPUTATION

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ABSTRACT

Resuming activities of daily living and lifestyle participation are primary goals for patients following upper limb amputation. In many cases, an appropriately designed and fitted prosthesis can contribute to achieving these goals by increasing physical function and overall well-being. Pain interference constitutes another pervasive challenge experienced by this population. The objective of this study was to investigate the impact of first prosthesis receipt upon two health domains - Ability to Participate in Social Roles and Activities (APSRA) and Pain Interference (PI) as measured using the PROMIS suite of patient-reported outcomes. Univariate model results demonstrated a significant improvement in APSRA T-scores after first prosthesis receipt (Baseline: 41.6±7.82 and Follow-up: 47.2±9.70, p=<0.001). Additionally, there was a significant reduction in PI T-scores following receipt of first prosthesis (Baseline: 59.8±8.46 and Follow-up: 55.7±9.56, p= <0.001). Importantly, these significant differences persisted even after controlling for potential confounding effects of age, hours worn, sex, amputation level, time since amputation, and time from first prosthesis delivery to follow-up. APSRA and PI have previously been identified as being closely correlated with well-being in this population. The increased APSRA and decreased PI associated with first prosthesis receipt in this population appears to contribute to the larger goal of enhanced well-being following upper limb amputation.

INTRODUCTION

Upper limb amputation (ULA) has a profound and severe impact on one's well-being. Not only is it associated with immediate and obvious deficits in physical function, it is also visibly apparent, affecting body image and social stigma. Other areas of concern include pain in the affected side, over-use injuries in the unaffected side, psychological and emotional distress, and restriction with participation in social roles and activities [1]. Recently, the Patient-Reported Outcomes Measurement Information System (PROMIS) [2] designed generic instruments to assess a broad range of health care domains including the Ability to Participate in Social Roles and Activities (APSRA), Pain Interference (PI), and Physical Function. The latter has been investigated previously using the PROMIS-9 UE Physical Function specifically for individuals receiving their first prosthesis [3]. However, little is known about the longitudinal impacts of prosthesis receipt upon the domains APSRA and PI.

The provision of a prosthetic device can alter a patient's care pathway. In a recent cross-sectional study, patients who received an upper limb device showed significant improvement in their physical function scores compared to those who did not have a prosthesis [4]. In another cross-sectional study, both APSRA and PI were observed to be significant predictors of well-being in persons with ULA [5]. However, ability of the PROMIS APSRA to track differences before and after the provision of a prosthetic intervention is unclear. Tracking these outcomes longitudinally may provide valuable insights to the rehabilitation care team on patient progress in addition to the patient themselves, resulting in shared decision-making between patients and the rehabilitation team.

Pain is another health indicator that profusely affect persons with ULA. One study reported that out of 104 respondents with ULA, 90% reported pain in the first 6 months following amputation [6]. Furthermore, they concluded that these pain types are associated with disability and activity interference. In another cross-sectional study consisting of 250 respondents, PI was significantly and negatively associated with well-being [5]. The literature has mixed results on the impact of a prosthesis on pain after amputation, with some studies reporting decreased pain, while others report increased pain [7].

Therefore, the aim of this study was to assess the impact of the provision of first prosthesis on APSRA and PI scores. Comparisons were made between the baseline appointment (before prosthesis delivery) and at follow-up (after prosthesis delivery).

METHOD

Study design and participants

A retrospective longitudinal assessment of outcomes among patients with upper limb amputation was performed. Outcomes were included for patients who had an initial outcome collected before the initiation of a first prosthesis and had a follow-up outcome captured at least 2-weeks after the receipt of first prosthesis. There was no exclusion based on level of upper limb amputation, side of amputation, or device type. This database review was approved by the Western Copernicus Group Institutional Review Board (protocol #20170059) and designated to be exempt from informed consent.

Measures

The PROMIS v2.0 Ability to Participate in Social Roles and Activities 4a (APSRA), utilized in this study, assesses one's perceived ability to perform social roles and activities. The APSRA is comprised of 4 items evaluating respondent's ability to perform leisure activities, family activities, usual work, and activities with friends. The APSRA was scored using HealthMeasures Scoring Services, which uses response pattern scoring. Response pattern scoring accounts for item difficulty and missing data. In addition, raw scores are converted to T-scores with a T-score score of 50 represents the average for the general United States population. Higher T-score indicate better ability to perform social roles and activities and the standard deviation of the converted score is 10 points. PI was captured using question PAININ9 from the PROMIS v1.1 Pain Interference item bank. The question captures the magnitude of pain interfering with one's daily activities in the past 7 days. Similar to the APSRA, pain interference was scored using HealthMeasures scoring service. Raw scores were converted to T-scores, with higher scores representing worse pain experience.

Statistical analysis

Patient demographics were described using means, standard deviation, and frequencies. A paired t-test was used to compare APSRA and PI scores before and after first prosthesis receipt. Two subsequent multivariate mixed models were then applied to control for possible confounding effects such as, age, hours worn, sex, amputation level, time since amputation, and time from first prosthesis delivery to follow-up.

RESULTS

A final sample size of 75 patients with upper limb amputation were included in the analysis. From this sample, 68% were male, 87% had a below-the-elbow amputation, 76% had a body-powered device, and 56% had injury as the cause of amputation Results from our univariate analysis showed a significant improvement in APSRA scores after the receipt of first prosthesis (Baseline: 41.6±7.82 and follow-up: 47.2±9.70, p=<0.001). Similarly, there was a significant reduction in PI scores following first prosthesis delivery (Baseline: 59.8±8.46 and follow-up: 55.7±9.56, p= <0.001). Importantly after adjusting for the confounding effects of age, hours worn, sex, amputation level, time since amputation, and time from first prosthesis delivery to follow-up significant differences persisted for both models (table 1).

Table 1: Linear Mixed Effect Model for APSRA and PI (n=75)

	Estimate	**95% Confidence Interval**		**P**
		Lower bound	Upper bound	
Model 1: Linear Mixed Effect Model for APSRA				
First Prosthesis Intervention				
Baseline	ref			
Follow-up	5.60	3.84	7.361	< 0.001
Model 2: Linear Mixed Effect Model for PI				
First Prosthesis Intervention				
Baseline	ref			

Follow-up	-4.133	-5.952	-2.315	<0.001

DISCUSSION

The current study's main finding demonstrated that upper limb prosthesis users tend to report improvement in APSRA T-scores following first prosthesis receipt. In this study, the average increase in APSRA T-score was 5.6, which is comparable to the recommendation of a 5-point change in score as a reasonable Minimal Clinically Important Differences (MCID) for PROMIS instruments [8]. The use of a converted T-scores facilitates a recognition that prior to prosthesis receipt, affected individuals have, on average, activity and participation scores that are approximately one standard deviation below the population mean, placing them in approximately the 15th percentile for this construct among the population. With the receipt of their first prosthesis, the average APSRA scores improved to a level that approximates the mean levels of the general population. This increase in score may indicate engagement and satisfaction with device immediately following surgery among persons with ULA leading to the willingness of respondents to engage in activities involving leisure, family, friends, and work. While it is unknown how long patients will continue see improvement in APSRA or the impact of other factors to dampen this engagement across time, future studies may investigate longitudinal life trajectory of patients with ULP. These future findings can determine what device types can maintain or improve APSRA over a longer timeframe, which may be important for community re-integration following a major life event such as an amputation.

Our findings also indicate a reduction in PI among upper limb prosthesis. Before the receipt of an upper limb prosthesis, respondents reported an average pain interference score of 59.8±8.46. The use of a converted T-score facilitates a recognition that prior to prosthesis receipt, affected individuals report pain interferences levels that are approximately one standard deviation above the general population, placing them in approximately the 15th percentile for this construct. At least 2 weeks after the receipt of an upper limb prosthesis device the score decreased to 55.7±9.56, placing these individuals within one standard deviation of population averages. This change in score of an average of 4.1 points is approaching the MCID and future work should continue to track this change over a longer timeframe. Although it is unclear what factors may have caused this reduction in pain interference score, one study suggests that an increased use of a certain prosthesis types reduces certain pain types [9]. Alternate factors might include continued healing and recovery from the original injury and an additional area of cognitive focus as patients devote their thoughts to functional activity rather than their pain experience.

This study has a few limitations. Only persons who received an upper limb prosthesis were included, which means the study's findings may not be generalizable non-prosthesis users. Secondly, the time between prosthesis delivery and the follow-up assessment was not standardized. The follow-up assessment was collected as a part of routine clinical care. Because of this, some patients may have returned without any problems while other patients may have returned due to a problem. Therefore, there are no guarantees that the follow-up appointment represents the highest possible performance after prosthesis receipt. Lastly, while the exact estimate for MCID for APSRA and PI among persons with ULA is unknown, future studies can estimate the MCID using the distribution or anchor-based approaches for individuals in the upper limb amputation population.

CONCLUSION

The current study's findings support the use of the APSRA and PI assessment instruments to track changes following the provision of an upper limb prosthesis. Specifically, receipt of a first prosthesis is associated with greater participation in social roles and activities and decreased pain interference. Using these instruments can provide valuable insight to the rehabilitation on patient progress and aid in goal setting.

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