Evaluating the Effectiveness of the Bridging Bionics Foundation's Neuro-Rehabilitation and Mobility-Assisted Exercise Program 2022-2023

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Executive Summary

This white paper examines the effectiveness of Bridging Bionics Foundation's (BBF) Neuro-Rehabilitation and Mobility-Assisted Exercise Program which is designed to enhance the functional abilities and quality of life for individuals with neurological conditions. The program aims to address the unique needs of participants through a multidisciplinary approach, incorporating rehabilitation interventions distinctly designed for patients with neurological diagnoses. This document presents a formal evaluation of the program outcomes between September 2022 and September 2023, discusses key findings, and offers insights into the impact and potential areas for improvement.

Introduction

Neurological conditions, including stroke, spinal cord injuries, multiple sclerosis, cerebral palsy and Parkinson's disease can significantly impact an individual's mobility and quality of life. The BBF program is designed to assist mobility-impaired individuals with neurologic diagnoses maintain a healthy body and mind, facilitate potential recovery, and live a more independent and self-sufficient life. Our program is conducted in an outpatient, non-hospital based setting and has been operating for seven years. It has evolved in combining various therapeutic techniques (traditional physical therapy and fitness/performance training) with the use of mobility assisted technology including, whole body vibration, the Galileo Tilt Table, Lokomat, Esko GT exoskeletons, Indego exoskeleton, Keeogo dermoskeleton, New Gait walking harnesses, Rifton E-pacer, Upsee Harness for children, and most recently virtual reality (VR) movement training. Functional outcomes (strength, gait, balance), number of falls, skin irritations, urinary tract infections, and emotional/mental well being were identified as important indicators of the success of the program and are presented here.

Methodology

The effectiveness of the program was evaluated through a mixed-methods approach, incorporating quantitative and qualitative data collection methods.

The analysis included 60 individuals (aged 47.2 ± 24.3 y, 32 male, 28 female) who provided weekly self-reported feedback via survey, as well as physical therapist evaluations from September 2022 through September 2023 (50 weeks). Not all individuals completed all tasks due to the seasonal nature of the program and, on average, 30 individuals completed weekly evaluations during the 50-week time period.

1. Quantitative Analysis: Each individual was scored using the neurological impact score (NIS)[2]. The NIS is a 13-item tool that records motor activity, spasticity, and contracture. The score range is 0-50. Key motor muscles are evaluated from C2 to S4-5 and ranked on a 1-5 scale where 0 = total paralysis and 5 =

active movement against full resistance. On average, the BBF population scored 15/50 on NIS scale and this remained stable with little to no change over the assessment period.

Other outcome measures included: (1) patient reports of number of skin irritations, falls, and urinary tract infections, (2) functional assessments measured by BBF physical therapists, used to assess participants' progress in mobility, strength, balance, coordination, and (3) quality of life was assessed at the beginning and end of the time period using questions developed by the BBF staff. The patient specific functional scale (PSFS) was administered for each individual upon entry into the program and used by the physical therapists for goal setting and specific training [1].

2. Qualitative Feedback: Interviews with physical therapists and self-reported surveys were conducted to gather participants' and caregivers' perspectives on the program's impact on their daily lives and emotional well-being.

Key Findings

1. **Improved Health Related Outcomes:** Quantitative analysis revealed that most participants demonstrated improvements in various aspects of functional abilities and health related variables.

   The number of patient-reported skin irritations, falls and urinary tract infections was stable throughout the course of the assessment period. Skin irritations (average 2.1 ± 1.2 per week, range 0-5) represented 0-17% of the entire group. Number of falls (average 2.0 ± 1.0 per week, range 0-5) was stable and was weakly correlated (r = 0.25) with skin irritations (r = 0.25) and urinary tract infections (r = 0.07), respectively (Figure 1).

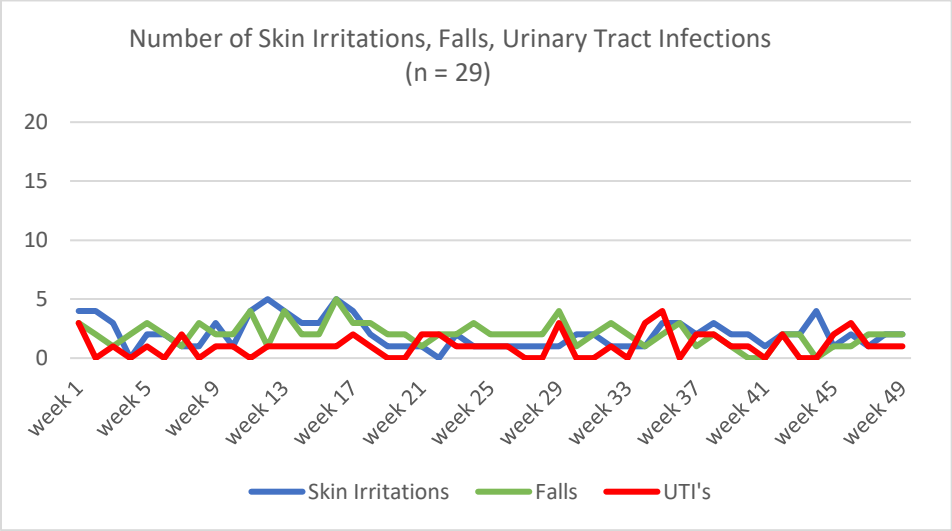

Figure 1. Number of Skin Irritations, Falls and Urinary Tract Infections from 2022-2023.

Participant self-reports indicated that they perceived that falling (less falls), muscle strength, balance, spasticity, range of motion and tolerance to weight bearing **improved** throughout the year. While less

clear, muscle and neuropathic pain, muscle atrophy, and skin irritations data were perceived or reported on average as positive (indicating improved or slightly better) (Figure 2).

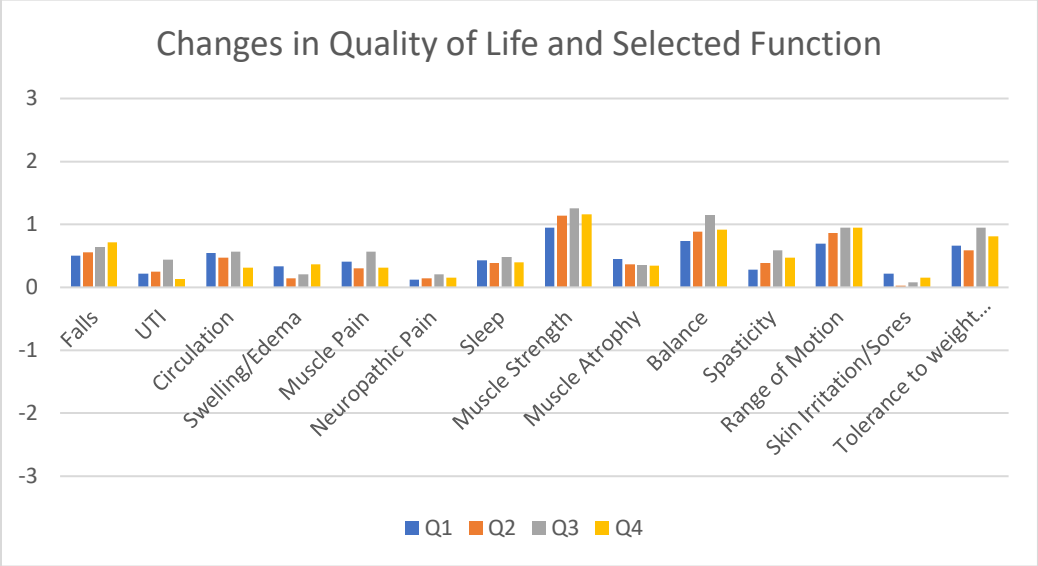

Figure 2. Changes in Quality of Life and Selected Function from individual self reported data2022-2023

Notes for Quality of Life Scale (-3 to +3 scale) : 0 = no change, +3 =positive change (things better), -3 = negative change (things worse)

2. **Quality of Life:** Participants reported improvements in their quality of life, including confidence, activities of daily living (ADL's), attitude, social connectedness, and less depression and anxiety (Figure 3).

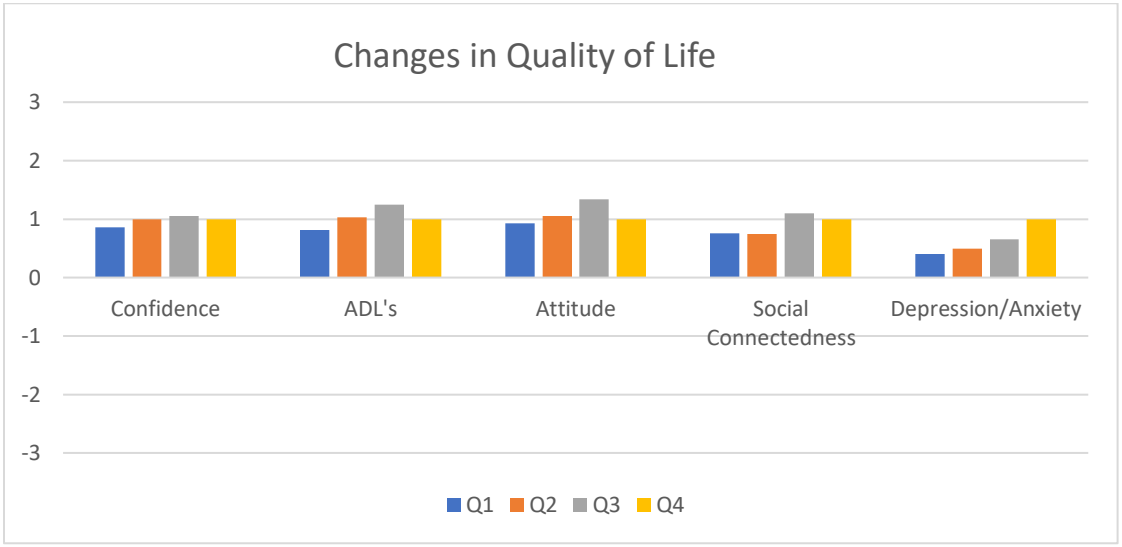

Figure 3. Changes in Quality of Life from individual self-reported data from 2022-2023 by quarter.

Notes for Quality of Life Scale (-3 to +3 scale) : 0 = no change, +3 =positive change (things better), -3 = negative change (things worse)

Patient Specific Functional Scale Data Collected in 2022-2023

The Patient Specific Functional Scale (PSFS) was developed by Stratford et al., 1995 as a self-report outcome measure of function that could be used in patients with varying levels of independence[1]. The aim of PSFS is to provide clinicians with a valid, reliable, responsive and efficient outcome measure for patients with back, knee and upper extremity problems. It is easy to use and applicable to a large number of clinical presentations and is clinically responsive to changes over time with chronic pain patients

Patients are asked to identify up to five important activities they are unable to perform or are having difficulty with as a result of their problem e.g., putting socks on, shopping.

1. Patients are asked to rate (on an 11-point scale) the current level of difficulty associated with each activity.
2. Following the intervention, patients are asked again to rate the activities previously identified (and are given the chance to nominate new problematic activities that might have arisen during that time).
3. "0" represents “unable to perform” and "10" represents “able to perform at prior level”
4. Patients select a value that best describes their current level of ability on each activity assessed.

Individuals reported, on average, low PSFS on three tasks they identified as important (range 3.1-4.8 on an 11-point scale). Data suggest that there were slight individual improvements on self-identified tasks. However, given the nature of the assessment, if a person indicated a level 10 on a task (no difficulty) or improved to a level 10, that task was removed from subsequent analysis and is not reflected in the averaged data. The scale however, is a useful tool for the physical therapy staff for goal setting in order to tailor the individualized rehabilitation programs.

Discussion

The findings from this evaluation demonstrate the program's effectiveness in achieving its primary objectives. By addressing the unique needs of individuals with neurological conditions, the program has succeeded in enhancing both functional abilities and overall quality of life. **The survey responses also indicate positive changes in every construct measured indicating improved physical and mental wellbeing during the assessment period.** It is also clear from the self-reported data that individuals improved mental well-being and reduced feelings of isolation and depression as a result of program participation. Additionally, many participants experienced greater independence in their daily routines and reduced reliance on caregivers and assistive devices. From a psychological perspective, participants expressed increased self-esteem and a sense of accomplishment

Challenges and Recommendations

While the program has shown significant success, several challenges have been identified.

1. *Resource Limitations*: Limited funding and resources affected the program's capacity to reach a broader audience and provide more extensive services. As a foundation that provides rehabilitation services at reduced or no cost to the participant, it is imperative that fund raising remain a top priority.

2. *Transportation Barriers*: Accessibility issues related to transportation to Snowmass Colorado limited participation for some individuals.

To further enhance the program's effectiveness and impact, the following recommendations are proposed:

1. *Expanded Resources*: Secure additional funding and resources to expand the program's reach and provide more specialized services.

2. *Transportation Assistance*: Develop transportation solutions to address accessibility issues for participants to our Snowmass location.

3. *Advanced Technology Integration*: Explore clinical decision making for the integration of technology, such as robotic mobility devices, virtual reality, and tele-rehabilitation, to enhance program effectiveness.

4. *Collaboration*: Partner with international, national and local healthcare providers and support organizations to create a more holistic support system for participants. Partnering with technology group(s) interested in assessing their products with our clientele seems reasonable.

5. *Long-Term Follow-Up*: Establish a system for long-term follow-up to monitor participants' progress and address potential setbacks.

Conclusion

The neuro-rehabilitation and mobility-assisted exercise program has demonstrated significant effectiveness in improving the functional abilities and quality of life for individuals with neurological conditions over the 22-23 data collection period. This evaluation underscores the importance of comprehensive, individualized care, and ongoing support for this population. By addressing the identified challenges and implementing the recommended improvements, future iterations of the program can build upon these successes, ultimately enhancing the lives of those living with neurological conditions.

References:

1. Stratford P, Gill C, Westaway M, Binkley J. Assessing disability and change on individual patients: A report of a patient specific measure. Physiotherapy Canada. 1995; 47(4):258-63.

2. Turner-Stokes L, Thu A, Williams H, Casey R, Rose H, Siegert RJ. The Neurological Impairment Scale: reliability and validity as a predictor of functional outcome in neurorehabilitation. Disabil Rehabil. 2014;36(1):23-31. doi: 10.3109/09638288.2013.775360.