

The Effect of an Underwater Treadmill Aquatic Exercise Program On The Functional Ability of K2, Trans-Tibial, Unilateral Amputees

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Background

Physical activity is known to improve health through the prevention of cardiovascular and metabolic diseases. At this time, 54% of lower limb amputations are due to vascular dysfunction with a comorbidity of diabetes. It is estimated the number of people with an amputation will increase by 90% by the year 2050. Up to 55% of patients with an amputation due to diabetes will require an amputation of the second leg within two to three years. In order to prevent amputation of the second leg, amputees must first be able to engage in regular physical activity.

To do this, it is first necessary to boost an amputee from a Medicare Functional Activity Level of K2 to a K3. With this, third party insurance providers will supply a better prosthetic device that will improve mobility. Exercise protocols are needed to strengthen the participant's muscles and improve their speed while ambulating in a normal environment. As a result, the activity level will increase access to better prosthetic componentry that will aid them in traversing multiple environments and engage in a healthy lifestyle.



Purpose

Over eight weeks, this program will strengthen the participant's muscles and improve their speed while ambulating in their normal environment. As a result, the activity level will increase access to better prosthetic componentry that will aid them in traversing multiple environments. From a physiological standpoint, balance, agility, speed, power, and force may increase because of the exercise program. From a lifestyle standpoint, this exercise program may improve their quality of life and performance of their activities of daily living (ADL's) as well as their instrumental activities of daily living (IADL's).

Methods

Participants will be unilateral, transtibial amputees with K2 activity level status. Only established amputees are included, which means the amputation must have occurred at least six months prior to the start of the study. All amputees will be set up in a "locking" prosthetic suspension system in which they are secured into their prosthetic socket by a shuttle lock. The amputees will complete their training in a self-contained underwater treadmill unit. The underwater treadmill unit contains a water filter, skimmer, water heater, pump, and piping to furnish the recirculation system. The participants will partake in a 6-week aquatic exercise program. There will be two exercise sessions a week, making a total of 12 aquatic exercise sessions. All participants will undergo the aquatic exercise intervention program, will receive psychosocial questionnaires, and will be evaluated by a licensed prosthetist at the end of the study. Exercise intensity will be measured by heart rate reserve (HRR).

1st Cycle: Session 1-4	2nd Cycle: Session 5-8	3rd Cycle: Session 9-12
Exercise Bout 1 (10 min): 40% HRR	Exercise Bout 1 (10 min): 50% HRR	Exercise Bout 1 (10 min) : 60% HRR
Rest (5 min)	Rest (5 min)	Rest (5 min)
Exercise Bout 2 (10 min): 50 % HRR	Exercise Bout 2 (10 min): 60% HRR	Exercise Bout 2 (10 min): TBD
Rest (5 min)	Rest (5 min)	Rest (5 min)
Exercise Bout 3 (10 min): 60 % HRR	Exercise Bout 3 (10 min): TBD	Exercise Bout 3 (10 min) TBD
Rest (5 min)	Rest (5 min)	Rest (5 min)

Preliminary Results

One participant has been identified to begin the exercise training protocol. The following scales are useful predictors of functional outcomes for people who have experienced painful events. The *Tampa Scale of Kinesiophobia* (TSK) was used to measure fear of movement. Questions included "I'm afraid that I might injure myself if I exercise", "My pain would probably be relieved if I were to exercise", and "Pain lets me know when to stop exercising so that I don't injure myself". Each question uses a four point Likert scale (1= strongly disagree and 4= strongly agree). The *Pain Catastrophizing Scale* (PCS) was also used in order to measure a magnified negative 'mental state' after an actual pain experience or an anticipated one. These questions included "I worry all of the time about whether the pain will end", "I become afraid that the pain will get worse", and "I keep thinking of other painful events". PCS also uses a Likert scale (0 = not at all and 4 = all of the time).

- A TSK score of ≥ 39 indicates a high fear of movement. The initial participant had a TSK score of 42.
- A clinically relevant PCS score is > 38 . The initial participant had a PCS score of 23.

Anticipated Results

The resistance of water, along with the weight of the prosthesis, will force the participant's muscles to work at a greater force than they would on dry land. The resistance of the water will work against the prosthesis and the participant's body while removing a portion of body weight. If the hypothesis is correct, upon completion of the underwater treadmill training protocol the amputees will improve gait speed, stability, functionality, and classify as a K3 level amputee.

- Increased ability to perform physical activity
- Increased mobility from K2 to K3 level
- Medicare provides better devices
- Increased daily activity
- Prevent amputation of the sound leg



Acknowledgements

We would like to extend thanks to Adan Vazquez, CP LP, and Fourroux Prosthetics for their ongoing support of our research efforts.