

Effects of Underwater Treadmill Training with Real-Time Visual Feedback on Ambulation of a Person Who Has Experienced a Stroke

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Introduction

- Stroke is a leading cause of disability in the United States and it occurs when blood supply to part of the brain is interrupted or severely reduced, depriving brain tissue of oxygen and nutrients. Around 50-80% of people who have experienced a stroke typically recover their ability to walk, but still have many difficulties associated with their gait. This can negatively impact their body composition, physical fitness, and ability to interact in the community. Prior research has shown that using partial body weight support training, as well as visual biofeedback, has been helpful in improving gait and balance for people who have experienced a stroke. Therefore, the purpose of this research is to examine the use of underwater treadmill training with use of real-time visual feedback for improving ambulation in people who have experienced a stroke.



Methods

- Single subject design study; FGCU IRB # S2016-58
- Participant was a 58 year-old male who sustained a right cerebellar stroke 12 months ago.
- Pre- and post intervention measures for balance and gait: GAITRite© system walking, Timed-Up-and-Go, and Dynamic Gait Index.
- Outcome measures occurred on the first two visits, every two weeks on the first day of training sessions for that week, and twice on the last week.
- The intervention of underwater treadmill training using real-time visual feedback was applied for 8 sessions of about 45 minutes each session, which included warm-up exercises and a cool-down period.
- Outcome measures of gait were taken quantitatively and were interpreted using descriptive qualitative analysis.
- Balance outcome measures were compared to norms and analyzed to determine if a detectable change and minimally clinical important difference was made.

Results

- The participant showed slight trends towards improved balance in his gait analysis and functional outcome measures.
- Average time spent on each leg was closer to equal, average step length of each foot increased, the length of stride increased, and his overall step width decreased from pre-intervention to post-intervention.
- For functional tests of balance, his Timed-Up-and-Go score improved (9.0 sec to 8.2 sec).
- DGI score improved by 4 points from pre-test to post-test, which indicates a clinically importance difference was made for his overall dynamic standing balance.

Figure 1. Average Time Spent on Each Leg

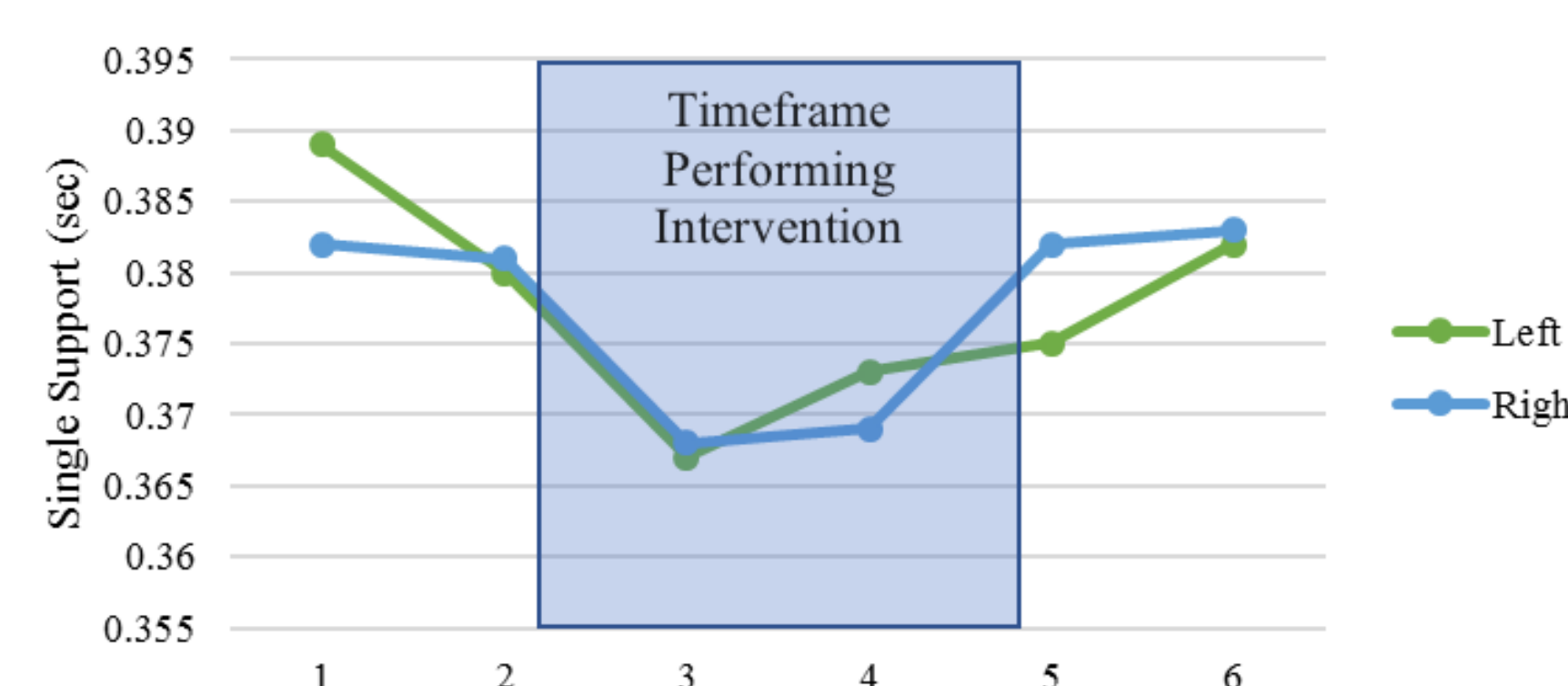


Figure 2. Average Step Length with Each Foot

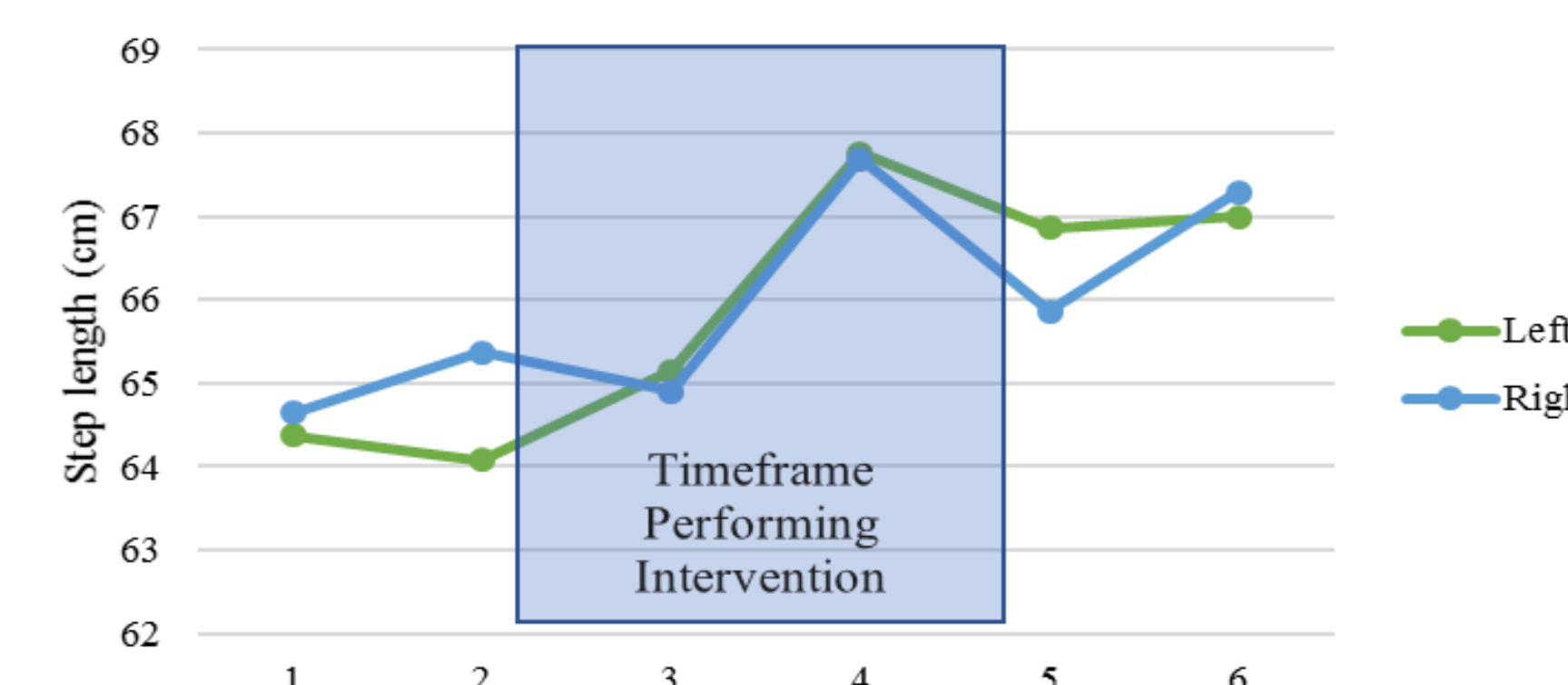


Figure 3. Length of Stride

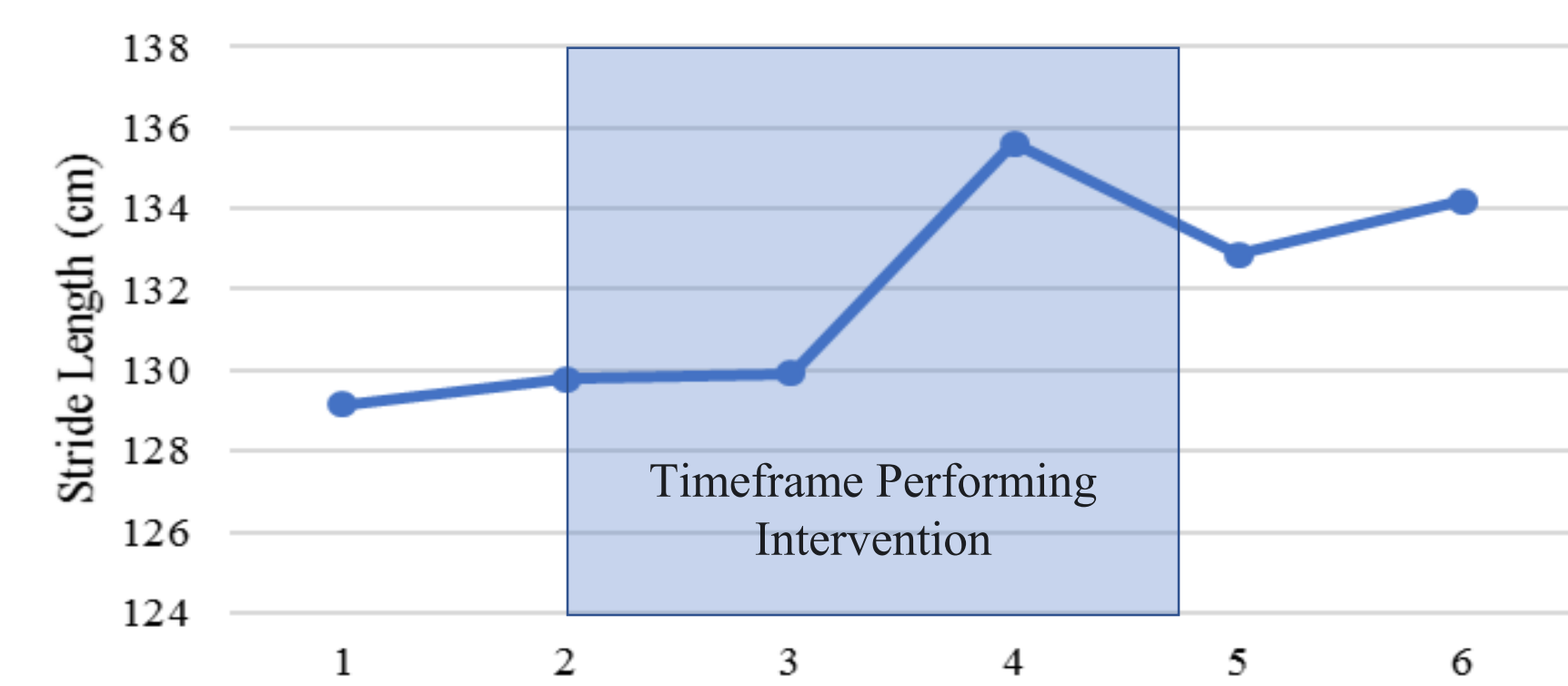


Figure 4. Base of Support

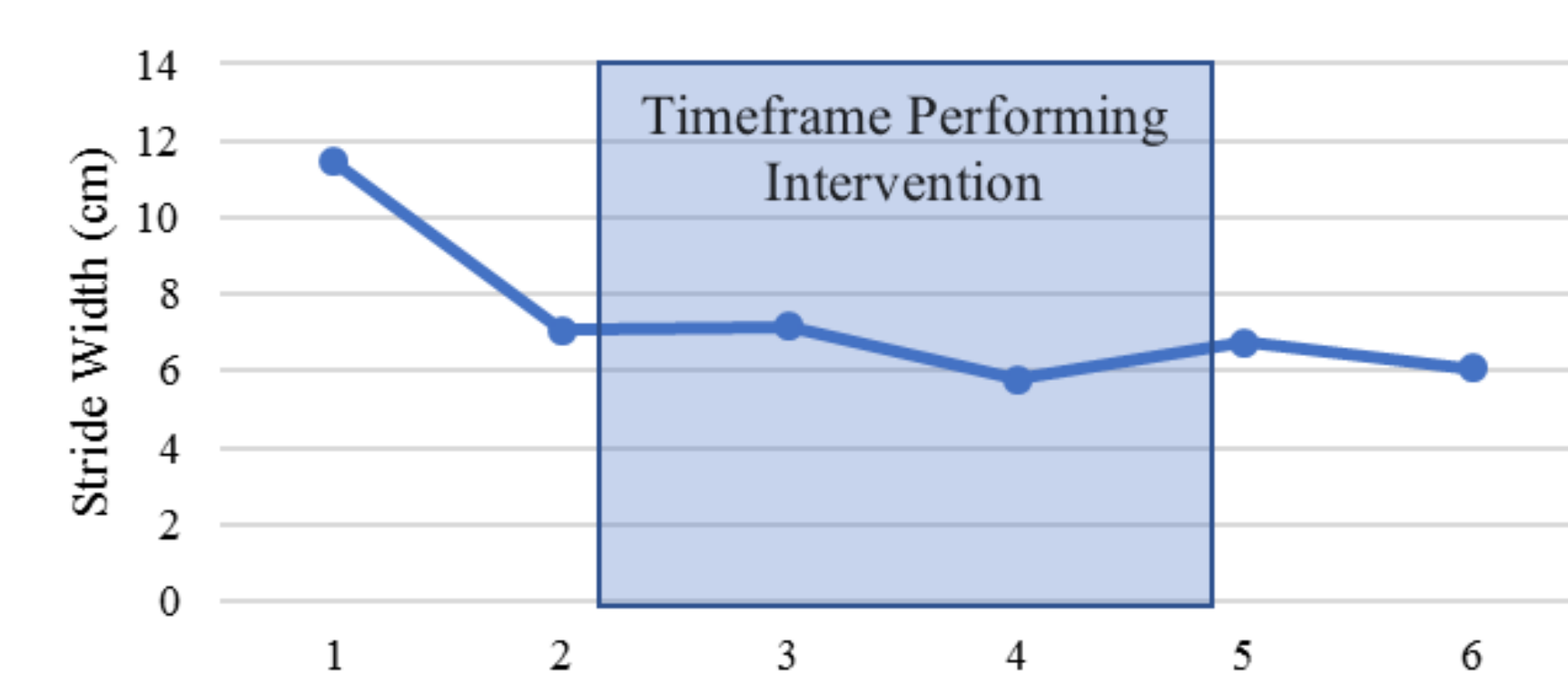


Figure 5. TUG Score

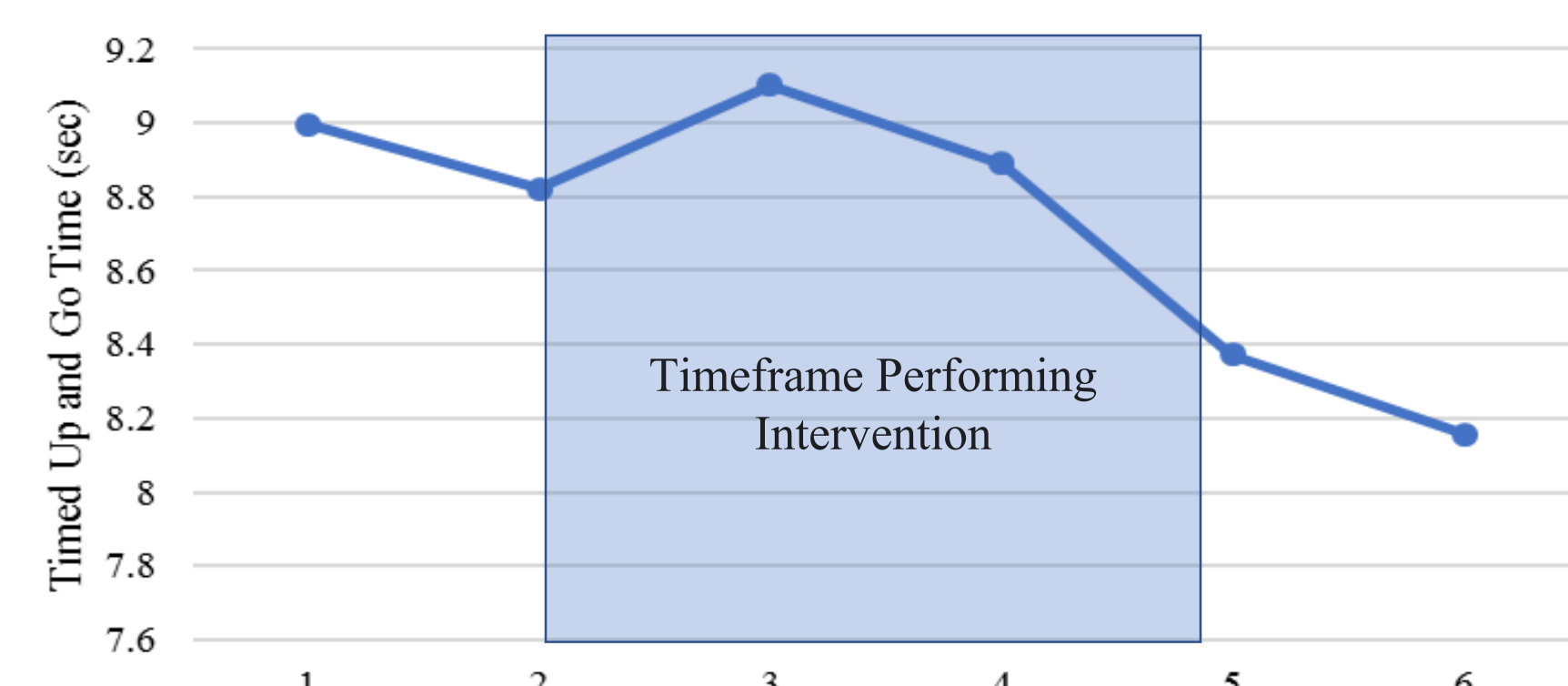
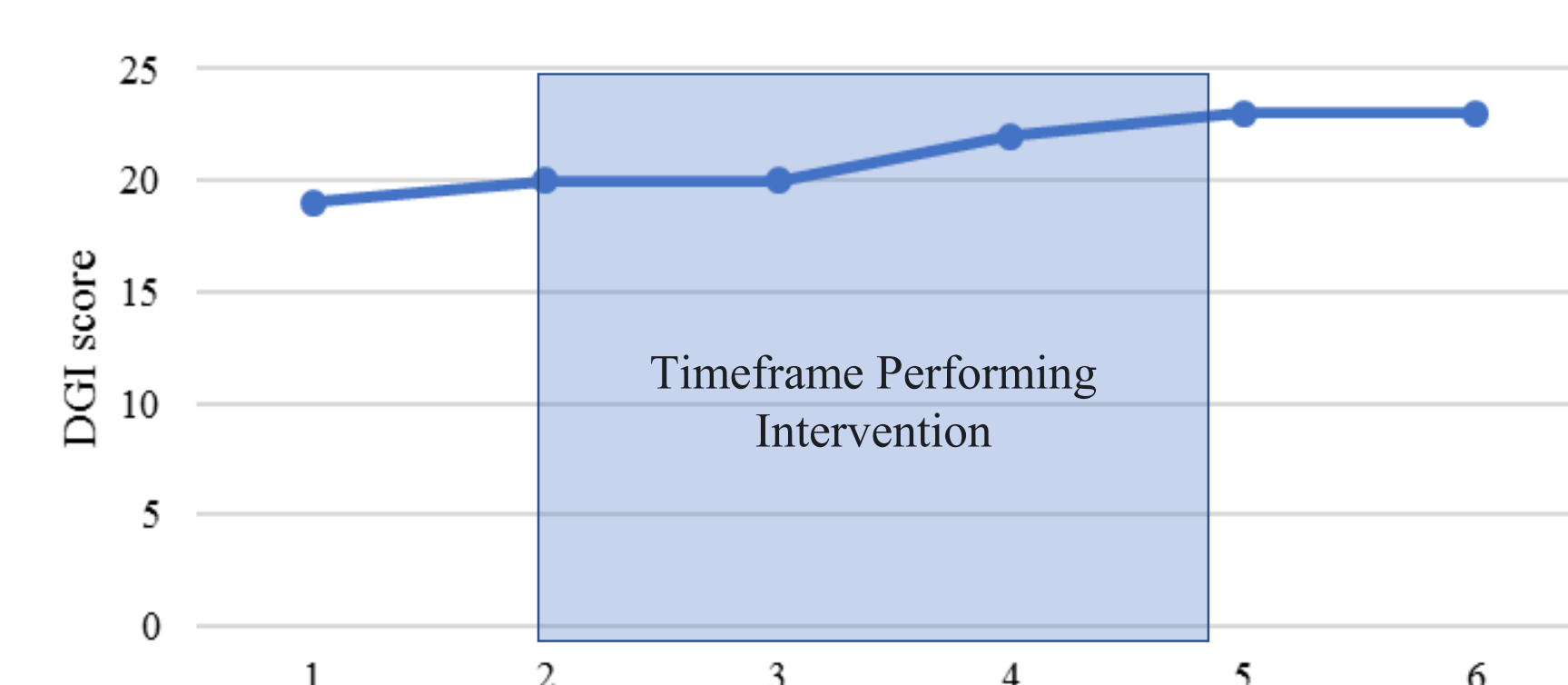


Figure 6. Dynamic Gait Index



Participant's Subjective Report

- The participant's overall perception of the changes to his balance as the weeks progressed indicated that he could feel that his balance was improving through multiple statements he made.
 - Felt more stable and less worried about checking for obstacles that may make him lose his balance working at his construction sites.
 - Tight spaces did not bother him anymore by the end of the study.
 - Noticed that he was able to bring his feet in closer as he walks because he feels that his balance is improved.
 - "I never thought I'd be back to where I was before the stroke, but now I feel I'm nearly there."**



Discussion

- When comparing previous underwater treadmill training studies to the study performed, there are some differences.
 - Balance has been examined using the Biodex, changes in gait by looking at how much weight was placed on the affected limb, as well as changes in hip and knee joint angles.
 - In all previous studies, participants who underwent underwater treadmill training, including the participant in this study, showed improvements in dynamic balance and gait.
- This study used a different type of visual feedback
 - Previous studies:
 - Computer visual of proper foot placement when stepping during gait
 - Virtual reality feedback coupled with proprioceptive feedback of gait asymmetries
 - Visual feedback utilizing weight distribution and center of pressure positioning retraining balance
 - In this study, the participant was able to view himself on a computer screen
 - Researcher able to provide cues for gait improvements during the training session.
 - Comparing this with previous studies using various forms of visual feedback, all have shown to have positive effects on improving balance and gait.
- Participant commented on how he could see there being a benefit for someone who had a tougher time ambulating and could not feel where their foot and leg was when walking.
 - "There is nothing like seeing yourself and your body moving, so that I can correct the changes."
- Limitations of this study:
 - Participant having only minor impairments
 - Participant did not rely heavily on the real-time visual feedback as the study went on.
- Further research should be conducted performing a longer randomized controlled study with more participants to determine if these results may be generalized. Furthermore, participants of the study should demonstrate higher levels of impairments. This would allow for potentially larger gains in outcomes to be seen

Conclusions

- The improvements in performance of the outcome measures, in conjunction with subjective statements made by the participant, suggest that underwater treadmill training with real-time visual feedback may be beneficial for patients who have experienced a stroke up to a year ago.
- More benefits may be seen in future studies if the participants present with higher levels of impairment.