GAIT PARAMETER CHANGES DURING SUSTAINED WALKING IN INDIVIDUALS WITH CHRONIC STROKE

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INTRODUCTION

Gait recovery is a focal point of rehabilitation following stroke. Yet despite improvements in gait speed, it is common for many with chronic stroke to still experience gait deficits and subsequent declines in community ambulation (CA) and participation. CA potential is routinely predicted based on gait speed. Perry et al. (1995) identified 3 levels based on gait speed over 10 m of walking: Unlimited CA (>0.80 m/s), Limited CA (0.40-0.80 m/s), and Household Ambulators (<0.40 m/s). However, functional distances in the community far exceed this length and time. Since fatigue is commonly reported as one of the worst symptoms after stroke (Colle et al, 2006), gait related parameters during extended walking are likely influenced by fatigue, reducing gait speed and further compounding functional recovery. Yet, it is largely unknown how gait parameters are affected during extended functional walking. It is these parameters that might be contributing factors to persistent gait deficits in the chronic stroke stage. PURPOSE: to determine if gait parameters are influenced by sustained walking in persons with chronic stroke, as well as across the 3 levels of CA. We hypothesized a reduced gait speed, with shorter step/stride lengths and more time in stance/double support; most notable in the Household Ambulator group.

METHODS

Subjects were a subset of a study on the impact of mobility on activity and participation in people with chronic stroke (Schmid et al, 2012). Forty-eight subjects performed the 10 m walk test (10MWT) and the 6 minute walk test (6MWT) in random order interspersed with questionnaires and physical outcome measures. For the 10MWT, subjects walked as fast as possible over 10 m with a gait mat (GAITRite, CIR Systems Inc, Sparta, NJ, USA) positioned in the middle. For the 6MWT, subjects walked at a self-selected comfortable pace for 6 minutes while traversing a 30 m walkway with the gait mat in the middle, allowing for multiple gait mat passes. Rating of perceived exertion (RPE) was measured just prior to and immediately after the 6MWT to assess relative task intensity.

Spatiotemporal gait parameters were measured via the gait mat and assessed for the fastest of 2 10MWT trials, and for the 6MWT on the first gait mat pass, the pass with peak gait speed, and on the last pass. Gait parameters were compared as the peak pass minus that on the last pass during the 6MWT, and the 10MWT minus the 6MWT peak pass to determine if subjects could differentiate a fast versus sustainable speed. Repeated measures t-tests were used to assess within-subject differences. Each subject’s 6MWT peak speed was used to stratify the sample into the 3 CA levels, and the same comparisons were made (Wilcoxon signed-rank test used due to small sample sizes). Statistical significance indicated at p≤0.05.

RESULTS AND DISCUSSION

As expected, the group as a whole was unable to sustain gait speed during the 6MWT (Table 1), with a significant reduction of 0.07 m/s, which is consistent with Sibley et al. (2009). The RPE was significantly greater at the end (7.7 vs. 11.8), moving from a “somewhat light” intensity to “somewhat hard”, indicating that the task became more difficult at the end. The reduced gait speed and increased RPE were associated with decreased step and stride lengths, more time spent in stance and double support, and more time to complete a step and stride. This indicates that as the task became more difficult, subjects were slowing down by taking shorter steps/strides, and spending more time in stance/double support. Over 80% of subjects were experiencing a declining speed with these altered gait parameters. Thus, even these small reductions in gait parameters might be a limiting factor on confidence and CA.

Using the same subject population, we previously reported that the majority of our subjects indicated
that walking farther was more important than walking faster (Combs et al, 2012). Thus, it is not surprising that the group self-selected a 6MWT peak speed that was 0.17 m/s slower than their 10MWT fast pace (Table 1). This faster gait speed was associated with longer steps/strides, and less time in stance/double support, and faster steps/strides/swing phases. These findings indicate an ability to differentiate and modulate a fast speed versus a slower sustainable one. With an emphasis on walking farther, subjects likely selected a slower pace and adjusted gait parameters accordingly for the 6MWT. However, they were not able to sustain this speed and maintain gait parameters. It is possible that subjects were inherently aware of their physical inability to maintain gait parameters and resulting loss in distance walked. This awareness may directly influence subject confidence, as well as CA and participation.

While extended walking resulted in gait parameter changes for the group as a whole, it was not consistent across CA levels. Surprisingly, the majority of changes were due to the Unlimited CA group (n=28), the highest functioning group. In this group, 6MWT peak gait speed significantly dropped from 1.15 m/s (0.24) to 1.07 m/s (0.22) at the end, while the 10MWT was significantly faster at 1.38 m/s (0.38). All other gait parameters (except for base of support) also significantly changed consistent with the group findings. The Limited CA group (n=14) was similar to the Unlimited CA group in that 6MWT peak gait speed dropped from 0.61 m/s (0.11) to 0.55 m/s (0.13) at the end, with a faster 10MWT of 0.71 m/s (0.18). However, changes in the other gait parameters were not consistent. No changes were observed in any gait parameters for the Household Ambulator group (n=6), the lowest functioning level (6MWT peak speed=0.30 m/s (0.07), end=0.28 m/s (0.05); 10MWT speed=0.34 m/s (0.16)). Overall, these CA subgroup findings indicate that gait parameters responded differently across subgroups, suggesting a need for ongoing assessment during rehabilitation.

**CONCLUSIONS**

Our cohort of chronic stroke survivors displayed an inability to maintain gait speed and adjusted gait parameters as extended walking became more difficult. Subjects were, however, able to differentiate between a fast speed (10MWT) and a slower speed for extended walking (6MWT). The observed differences were primarily due to the Unlimited CA group, which could potentially impact interpretation of 6MWT scores in clinical practice for individuals with chronic stroke.

**REFERENCES**


*Significant difference between 6MWT Peak and 6MWT End.  **Significant difference between 6MWT Peak and 10MWT.  ^Significant difference between 6MWT Peak and 6MWT Begin.

<table>
<thead>
<tr>
<th>Gait Speed (m/s)</th>
<th>Spatial Gait Variables (m)</th>
<th>Temporal Gait Variables (s)</th>
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<tbody>
<tr>
<td></td>
<td>Gait Speed (m/s)</td>
<td>Stride Length</td>
<td>Step Length</td>
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<tr>
<td>10MWT</td>
<td>1.06** (0.51)</td>
<td>1.16** (0.39)</td>
<td>0.58** (0.20)</td>
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<td>6MWT Begin</td>
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<td>6MWT Peak</td>
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<td>1.07***^ (0.33)</td>
<td>0.54***^ (0.16)</td>
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<tr>
<td>6MWT End</td>
<td>0.82* (0.36)</td>
<td>1.03* (0.32)</td>
<td>0.51* (0.16)</td>
</tr>
</tbody>
</table>

Table 1. Spatiotemporal gait variables for the group as a whole during the 10 m walk test (10MWT) and the 6-minute walk test (6MWT) on the first pass (Begin), the peak gait speed pass, and the last pass (End).