EFFECTS OF AN ANKLE-FOOT ORTHOSIS ON FOOT PLACEMENT POST-STROKE: BALANCE IMPLICATIONS

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INTRODUCTION

Gait-related mobility deficits are common in the post-stroke population and persist in the chronic phase, despite rehabilitation efforts. In community-dwelling stroke survivors, these deficits are likely responsible for the increased incidence of falls compared to age-matched able-bodied individuals [1]. Falls occur most commonly while walking [1-4] with self-reports indicating poor balance as the primary cause [1, 3]. Falls are often experienced in the lateral direction, more frequently towards the paretic side [3-4]. These findings suggest an inability to redirect the mediolateral (ML) component of body center of mass (BCoM) position and velocity to maintain dynamic balance (i.e., forward progression during locomotion without falling). Key to the maintenance of dynamic balance during able-bodied locomotion may be ML foot placement with respect to BCoM position and velocity [5-6]. With each step, base of support (BoS) is re-established, weight is transferred from one leg to the other, and the ML component of BCoM position, velocity, and momentum are redirected. Foot placement impairments [7] have been reported secondary to stroke, but the extent to which foot placement is affected by an ankle-foot orthosis (AFO) during ambulation is unclear. The purpose of this study was to investigate the relationship between target and actual ML foot placement with and without an AFO to improve understanding about dynamic stability and balance in the post-stroke population.

METHOD

Subject Inclusion Criteria: >1 year post-stroke, >18 years old, currently wearing articulated or posterior leaf spring AFO, able to walk 12 m with/without AFO.

Apparatus: Data were collected using an 8-camera Eagle Digital RealTime motion capture system (MAC, Santa Rosa, CA). Marker placement (modified Helen Hayes) was performed by the same investigator for all testing sessions.

Procedures: Tape lines were placed lengthwise along a 10m laboratory walkway to indicate the following target step widths: tandem walking (0%), self-selected (100%), 150%, and twice self-selected step width (200%). Subjects were tested with and without their AFO on separate days. Six walking trials were completed for each step width condition. A stop watch was used to ensure that a consistent self-selected walking speed was maintained for all conditions.

Data Analysis: Data were processed using Cortex and OrthoTrak (MAC, Santa Rosa, CA), and analyzed with MATLAB (Mathworks Inc., Natick, MA).

RESULTS

Foot placement data for two subjects (Table 1) are shown in Figure 1.

#	Walking aid	Sex	Mass (kg)	Height (cm)	Leg Length (cm)	Affected Side
1	None	M	85.00	172	86 (R)	R
	AFO		86.25		87 (L)	
2	None	F	74.50	169	91.5	L
	AFO		75.50			

Table 1: Subject characteristics.

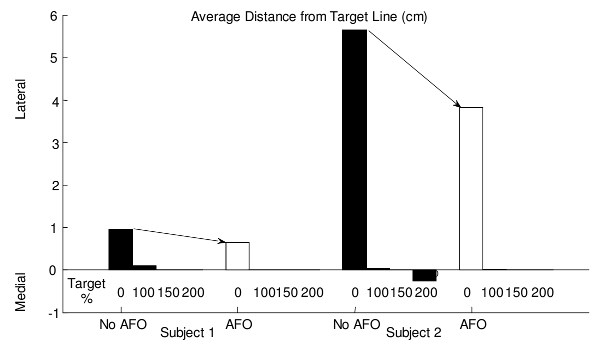

Figure 1: Average distance (cm) from affected side foot midline to target tape line. Subjects were unable to achieve the 0 step width (actual step width in this condition was 16cm and 21cm without an AFO, 12cm and 18cm with the AFO for subjects 1 and 2, respectively). Conditions with no bar indicate that every step landed on the target line.

DISCUSSION

Preliminary data indicated that an AFO provided an incremental improvement in subject's ability to reach the target step width compared to when they walked without an AFO. Given the key role of foot placement in maintaining balance during walking, these results may have implications for improved stability and balance during walking with AFO use. Data collection is currently ongoing.

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