ANKLE FOOT ORTHOSES FOR CHILDREN WITH MYELOMENINGOCELE: FUNCTIONAL EFFECTS UNDER A DUAL TASK PARADIGM

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INTRODUCTION

Ankle foot orthoses (AFOs) are a common intervention used to improve the gait of children with myelomeningocele (MMC). They are designed to improve balance, stability and efficiency (Duffy, 2000; Mazure, 2004). Recent evidence suggests that in everyday life, walking involves a cognitive component (Davis, 2011; Karakostas, 2013). The cognitive component involves allocating attentional resources to concurrently address environmental needs such as conversing or negotiating obstacles while walking. Our recent clinical observations suggest that ambulatory aids, such as AFOs, in addition to improving walking performance, may also facilitate concurrent performance of a secondary cognitive-related task. There is the need, therefore, to investigate the potential concurrent functional effects of ambulatory aids, such as AFOs, in children with pathological conditions. Consequently, the purpose of this study was to assess the potential additional effects of AFOs on the functional performance of children with MMC under a dual task paradigm, where the single task involves walking only whereas the dual task (walking while counting) involves recruitment of cognitive resources.

METHOD

Subjects: Eighteen ambulatory children with MMC at sacral and lumbar levels (ages between 7 and 13, GMFCS I-III) were tested at our institution.

Apparatus: Gait parameters were measured using a GAITRite instrumented walkway (CIR Systems Inc. Clifton, NJ 07012). Counting performance audio and gait were recorded on a video-tape recorder.

Procedures: A certified orthotist molded subjects for solid AFOs, measured them for shoes and assessed their counting ability before testing. The experimental procedure involved two visits to our institution, two weeks apart. During the first visit subjects walked at their self-selected speed on a GAITRite instrumented walkway with shoes but without their AFOs, under two conditions, a dual task involving walking and counting (WC) and a single task involving walking only (W). During the second visit they performed, again, WC and W at their self-selected speed with AFOs. Task order was randomized.

Data Analysis: Repeated measures ANOVA was performed on the variables of walking velocity, cadence, stride length, rate of correct responses and rate of responses per unit time ($a<0.05$).

RESULTS

The gait parameters and counting task variables that were statistically significant between conditions can be seen in Table 1. Velocity and stride length significantly increased with the use of the AFO in the W as well as WC conditions. Counting performance also significantly improved with the use of the AFO in the WC condition.

Condition and Parameter	Mean	SD	p
W_NoAFO_Vel (cm/s) W_AFO_Vel	65.96 77.38	29.58 27.67	0.005
W_NoAFO_StrL (cm) W_AFO_StrL	79.60 94.26	17.44 38.34	0.004
WC_NoAFO_Vel (cm/s) WC_AFO_Vel	43.89 55.88	24.63 24.47	0.002
WC_NoAFO_Rate (resp/s) WC_AFO_Rate	0.44 0.54	0.28 0.30	0.02
WC_NoAFO_Rate_Corr(resp/s) WC_AFO_Rate_Corr	0.33 0.45	0.28 0.30	0.001

Table 1. Spatiotemporal data and Verbal responses. Velocity (Vel), Stride length (StrL), Rate of responses (Rate), Rate of Correct Responses (Rate_Corr) with (AFO) and without (No_AFO) AFO during single walking (W) and dual, walking and counting (WC) tasks.

DISCUSSION

Our data support previous findings that AFOs significantly improve gait parameters in children with MMC during ambulation (W). We have also shown that the use of AFOs allowed for significant improvements in gait as well as in the simultaneous counting task in the WC condition. This is most likely attributed to the AFOs decreasing attentional demands for effective ambulation and unloading cognitive resources that would otherwise be engaged in the walking task. These, in turn, can be used to facilitate performance of the cognitive task. Future work will further explore the interaction between the spatiotemporal and counting task variables.

CONCLUSION

AFOs can facilitate performance of concurrent motor and cognitive tasks in children with MMC.

CLINICAL APPLICATIONS

This information can ultimately be used to create an outcome measure combining motor and cognitive performance to drive better clinical decision making in the orthotic management of children with MMC.

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