Effects of cognitive and motor dual-task on spatiotemporal gait parameters in children and adolescents with CP

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Introduction

Cerebral Palsy (CP) causes impairments in gait[1]. These impairments can be further emphasized if attention is directed to concurrent motor and/or cognitive tasks during gait. There is little evidence on how strong the dual-tasks cost is in CP. However, concurrent motor dual tasks has been shown to reduce speed, step width, and stride length in children with CP[2], whose gait is often less stable[3] and imbalanced between limbs[4].

Research question

We aimed to clarify whether the spatiotemporal gait parameters are altered more (i.e. higher dual-task cost) in children with CP than typically developed (TD) controls from normal to motor or cognitively loaded dual task.

Methods

Gait patterns were recorded from 18 hemiplegic (HP, age 13.5±2.4 years) and 11 diplegic (DP, 12.7±2 years) CP patients (GMFCS level I-II) and 30 TD controls (13.4±2.1 years) using full-body setup in a Vicon motion capture system. Participants walked barefoot with their preferred speed under three conditions: (1) normal gait, (2) motor dual task (carrying a tray) and (3) cognitive dual task (naming animals, foods and drinks, and words starting with specific letters). Statistical analysis was performed using Wilcoxon Signed Rank Test and Kruskal-Wallis test.

Results

Figure 1 presents the dual-task cost in selected gait parameters for non-dominant leg. In all groups, double support increased, step length and walking speed decreased from normal gait to cognitive dual-task ($p<0.005$). For motor dual-task, walking speed ($p<0.033$), and step length ($p < 0.004$) were reduced.

Compared to TD both patient groups decreased step length in both dual-tasks ($p<0.013$). Additionally, HP increased single support duration more in motor ($p = 0.008$) dual-task and decreased in cognitive ($p=0.001$) dual-task. DP reduced walking speed ($p = 0.001$) more in both dual-tasks.

The only difference between the patient groups was that HP increased single support duration ($p = 0.018$) more than DP in motor dual-task. Differences in the dual-task cost between dominant and non-dominant leg was primarily detected in the HP group, but were also evident for DP and TD groups.

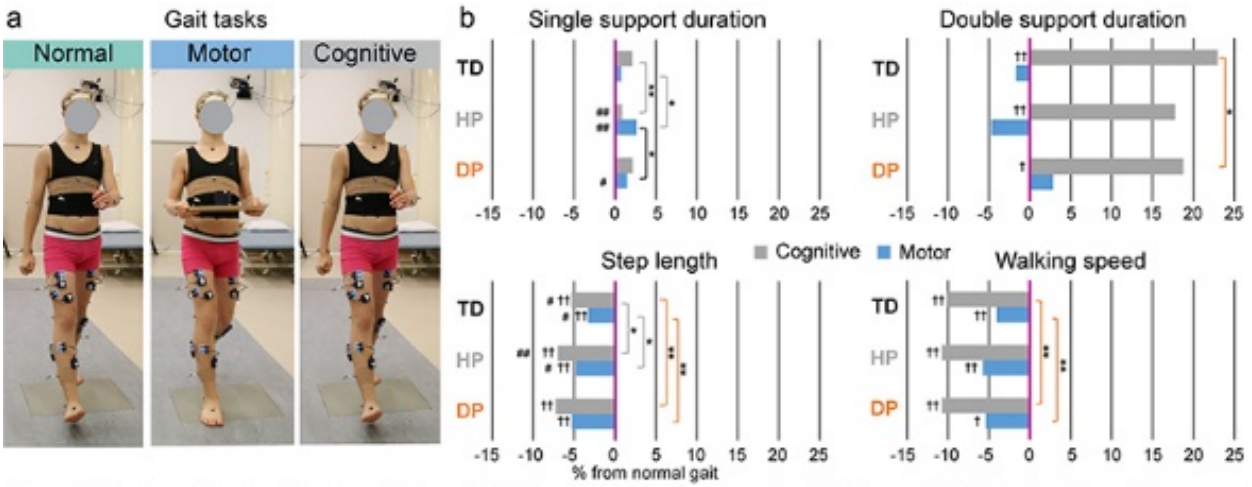

Figure 1. Experimental setup (a) and dual-task cost (b) *, ** = diffrent from TD group at $p < 0.05$ and $p < 0.01$. †, †† = different from normal gait at $p < 0.05$ and $p < 0.01$. # = difference between dominant and non-dominat legs at $p < 0.05$ and $p < 0.01$.

Discussion

The inter-individual variation was high in all groups. The dual-task cost was strongest for the CP patients, but less for the motor than for the cognitive task. Side difference was significant for single leg support duration and step length. However, this could be explained with different contributions for forward moving and weight support tasks between dominant and non-dominant sides[5]. Our results are in line with previous finding of cognitive task altering gait kinematics more in CP than TD[6]. The tray in the motor task blocked the view to the floor, which could impair the gait in patients with proprioceptive deficits. However, the proprioception was not quantified, and this hypothesis should be preferably tested on an uneven walking surface.

References

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