LOCOMOTOR ADJUSTMENTS MADE BY TODDLERS WHILE STEPPING OVER OBSTACLES

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INTRODUCTION

Temporal, kinematic and kinetic patterns of independent, walking in toddlers have been characterized in various studies with postural control identified as a critical component influencing the coordination between gait mechanisms to maintain a dynamic equilibrium [1]. Variations in four parameters across development, step length, step width, double support, and cadence, indicate that toddlers possess more adult-like integration capabilities in locomotor control after 4-5 months autonomous walking [3]. However, whether this integration would be influenced in a subtle complex locomotor task −obstacle crossing− remains unknown. This study examined locomotor modulation during obstacle crossing in toddlers with 1 to 8 months independent walking experience.

METHODS

All study procedures were explained to parents and written informed consent form was obtained. All experiments were completed at Sensorimotor Neurosciences Laboratory.

Eight healthy toddlers (six males and two females; mean height = 80.6 cm) with between 1 to 8 months of walking experience participated in this study. Each toddler completed multiple trials with and without the obstacle in place. For half the trials, a 4.5 cm diameter (6% of subject's average height) foam tube obstacle was taped across the walkway, 4 m long, 1 m wide. At least five trials of each condition were digitized for quantification of gait characteristics. Each trial included at least five steps. A session ended when a full dataset occurred or if the toddler was tired or refused to walk.

The toddlers were dressed in black stretch suits and tights. Reflective surface markers were placed bilaterally on the shoulder, hip, knee, ankle, heel and toe. Anthropometric segment lengths and girths were measured with a soft measuring tape. A Vicon motion analysis system (Oxford Metric Ltd, Oxford, UK) captured the motion data. Eight MX40 cameras sampled at 200 Hz recorded the toddler's movements. Marker coordinates were filtered using a Butterworth, zero-lag, 6 Hz low pass filter. Descriptive analysis of all trials recorded focused on the number of contacts made with the obstacle by the leading and trailing foot as well as the number of falls resulting from obstacle contact. Step length, step height, obstacle toe clearance and angles of hip, knee and ankle were calculated using the Visual3D Motion Analysis System (C-motion Inc, Rockville, Maryland. US).

RESULTS AND DISCUSSION

Preliminary results (see Table 1) demonstrate that with walking experience, better obstacle crossing behaviour appears. Less contacts with the obstacle by both the leading and trailing limb as well as fewer obstacle-induced falls were recorded in the toddlers with longer walking experience.

CONCLUSIONS

Further analysis of kinematic data will provide information regarding experience-related changes in segment, joint and foot-to-obstacle relationships.

REFERENCES

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Table 1. Descriptive analysis of obstacle crossing.

Age in months	Months autonomous walking	Total numbers of trials	%leading limb contact with obstacle	%trailing limb contact with obstacle	% crawling
15	1	30	57	43	10
15	2.5	25	76	24	8
16	3	35	62	31	0
15	3.5	23	56	34	0
15.5	4	21	42	28	0
18	5	23	34	34	0
17.5	7.5	23	34	13	0
19	8	25	16	4	0