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Short communication

O 040 - Gait functions in children with cerebral palsy improve when challenged with biofeedback

A. Booth[a,*], A. Buizer[a], J. Harlaar[b], F. Steenbrink[c], M. van der Krogt[a]

[a] VU University Medical Center, Amsterdam Movement Sciences, Department of Rehabilitation Medicine, Amsterdam, Netherlands
[b] Delft University of Technology, Department Biomechanical Engineering, Delft, Netherlands
[c] Motek Medical B.V., Department of Clinical Applications and Research, Amsterdam, Netherlands

1. Introduction

Children with cerebral palsy (CP) often have gait limitations and this is a key target of rehabilitation. Gait training can be an effective intervention to improve functional outcomes such as walking speed and endurance [1]. Virtual reality (VR) is a valuable tool in gait training to increase engagement, however, games must be therapeutically principled. One advantage of VR is that it allows for addition of augmented biofeedback. Biofeedback can improve communication between patient and therapist, while the implementation of gamification and motor learning principles may increase motivation and skill retention. Therapy may target gait parameters, such as step length, knee extension or ankle power generation, with a functional goal to increase walking speed. These gait parameters are interlinked and the most effective target for biofeedback is unknown.

2. Research question

What is the extent of adaptability of gait in children with CP, providing biofeedback on three related clinically relevant gait parameters?

3. Methods

Twenty-five children with spastic paresis (10y5m ± 2y11 m, GMFCS I-II), walked on an instrumented treadmill with VR environment (GRAIL, Motek, Amsterdam, Fig. 1). The Human Body Model was used to allow for real-time calculation of biomechanical parameters [2]. Following baseline gait analysis, children were challenged with patient specific targets, to improve aspects of gait with a purposeful game in which children visualised themselves as an avatar. They underwent a series of two-minute trials receiving biofeedback, while walking, challenging improved ankle power generation, knee extension at terminal swing and step length. All data from each trial were normalised to gait cycles and excessively erroneous strides removed. Between trial differences were evaluated using repeated measures analysis of variance.

4. Results

During the biofeedback trials children showed the capacity to reach clinically important improvements in aspects of gait. Peak ankle power generation was significantly increased by 36.1% ($p < 0.001$), knee extension at initial contact increased by 7.6° ($p < 0.001$) and step length increased 13.2% ($p < 0.001$). Biofeedback on one parameter influenced other parameters in gait (Table 1). While improvements were found in aspects of gait, overall gait as measured by the Gait Profile Score was not significantly changed in any feedback trial ($p = 0.18$).

5. Discussion

The results show that children with CP show a remarkable capacity to adapt and improve a number of aspects of gait, when challenged with biofeedback. The long-term plasticity is still unknown. As such, a clinically feasible tool is currently being tested, to provide avatar-based biofeedback, requiring only 8 markers and minimal preparation time.

* Corresponding author.
E-mail address: a.booth@vumc.nl (A. Booth).

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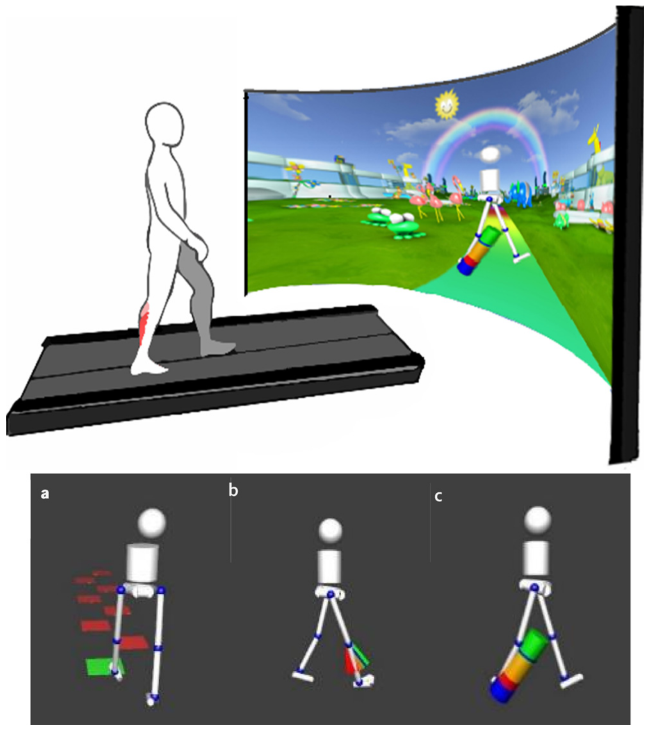

Fig. 1. *Above*: Experimental set-up. *Below*: Visual scene with colour-coded biofeedback attached to an avatar providing augmented feedback on: a) step length, b) knee extension with avatar (visualisation during swing), c) ankle power (visualisation from mid-stance until toe-off).

Table 1

Dynamic interaction of biofeedback on gait (change relative to baseline walking). A2, peak ankle power around toe-off; IC, initial contact.

		Knee Extension IC (°)	Step Length (%)	A2 (%)
Feedback Trial	Knee Extension	**+7.6 ± 6.8**	+22.4 ± 17.5	+8.7 ± 28.9
	Step Length	+1.4 ± 4.4	**+13.2 ± 11.3**	+21.0 ± 21.7
	Ankle Power	-1.0 ± 3.9	+7.87 ± 18.1	**+36.1 ± 35.9**

This tool may be used to enhance gait training protocols, across a range of clinical populations. This will make it possible to establish if these short-term gains can be retained with long-term training interventions.

References

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