

Virtual reality visual feedback cues for gait improvement in children with gait disorders due to cerebral palsy

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Background: Children with cerebral palsy (CP) may have a number of bone, joint and muscle impairments, in addition to central nervous system disorders, that affect their gait and posture control. Closed-loop visual feedback cues have been shown to improve gait and balance in patients with movement disorders, such as Parkinson's disease and multiple sclerosis. The effects of such cues on the walking abilities of children with CP does not appear to have been studied before.

Objectives: To study the effects of gait training with visual feedback cues on the walking abilities of children with gait disorders due to CP.

Methods: A wearable virtual reality (VR) device was used to create visual feedback cues in the form of checkerboard black and white tile arrangement responding dynamically to the patient's motion. Ten randomly selected children of average age 13.3 \pm 6.2 yrs with gait disorders due to CP participated in the study. Baseline performance (walking speed and stride length along a 10m straight track) was measured before device use. Following 20min training with the device and 10min rest, performance without the device was measured again and compared to the baseline performance.

Results: The average improvement in walking speed was 21.70% \pm 36.06%. For participants with baseline walking speed below the median improvement was 35.75% \pm 47.76% and for participants with baseline walking speed above the median improvement was 7.65% \pm 12.85%. Average improvement in stride length was 8.72% \pm 9.47%. For participants with baseline stride length below the median improvement was 12.78% \pm 12.13% and for participants with baseline stride length above the median improvement was 4.67% \pm 3.69%. For participants with age below the median improvement in walking speed was 9.59% \pm 23.06% while for participants with age above median improvement was 33.81% \pm 44.96%. For participants with age below the median improvement in stride length was 9.41% \pm 11.97% while for participants with age above the median improvement was 8.03% \pm 7.57%.

Conclusion: VR visual-feedback cues can improve gait parameters in children with gait disorders due to CP. Baseline walking speed and stride length are good predictors of improvement, with higher improvement associated with lower baseline performance. Age is a good predictor of improvement in walking speed, but not in stride length, with significantly higher improvement in walking speed found in children of older age.