Movement control of the trunk and pelvis in cerebral palsy diplegia

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Summary

Core control was quantified using performance measures derived from a computer game driven by rotation and tilt of the trunk and pelvis. Baseline results showed reduced control of tilt in comparison to rotation, and cephalo-caudal reduction of control. Training of pelvic tilt control may improve pelvic kinematics, reducing the risk of developing low back pain.

Conclusions

Testing of movement control of the core embedded in playing a custom made computer game revealed that children with diplegia have better control over segmental rotation than tilt. Movement of the core is most difficult to control in the sagittal plane, particularly at pelvic level. If training of core control could lead to improved pelvic tilt then that could potentially reduce single and double bump pelvic patterns [1] which are associated with low back pain.

Introduction

Our ongoing pilot study exposes diplegic children to visual and somatosensory stimuli in computer games driven by 3D movements of the core (trunk and pelvis) [2] in order to improve core control and consequentially the quality of gait. Some results of the pre-training tests of core control are presented, focusing on rotation and tilt of the trunk and pelvis.

Patients/materials and methods

Core control was assessed in four children with cerebral palsy diplegia (age: 7.6 ± 1.7 years, height: 1.3 ± 0.1 m, mass: 28.6 ± 7.1 kg) before training commenced. Trunk rotation, trunk tilt, pelvic rotation, and pelvic tilt in kneeling were registered by a real-time Vicon system and used to drive a flying dragon toward targets appearing at seemingly random positions in the Goblin Post Office game implemented on a CAREN system (MOTEK, Amsterdam). An adaptive algorithm [3] adjusted the speed of the game in response to changes in target hit rates during game play. The maximum settled speed reached under each segmental control scheme was used to quantify performance.

Results

A Friedman test showed a main effect and significant differences were found between the control schemes after excluding the outlier (Fig. 1). Game speed with trunk rotation was highest (54.5 ± 0.6 m s^{-1}) followed by trunk tilt (48.3 ± 2.0 m s^{-1}) and then pelvic rotation (44.1 ± 1.6 m s^{-1}). Children were unable to play the game using pelvic tilt. Sagittal plane tilt was more difficult to control than transverse plane rotation, the trunk is better controlled than the pelvis, and there is least control over movements of the pelvis.

Discussion

A biomechanical explanation for poorer control over tilt in comparison to rotation can be that tilt has a more destabilising effect as it moves the whole body's centre of gravity more than rotation. Another factor may be that retraction of one side is unambiguously mapped to steering in the same direction but anterior tilt may be expected to produce either upward or downward movement, depending on the participant's previous experience of computer games.

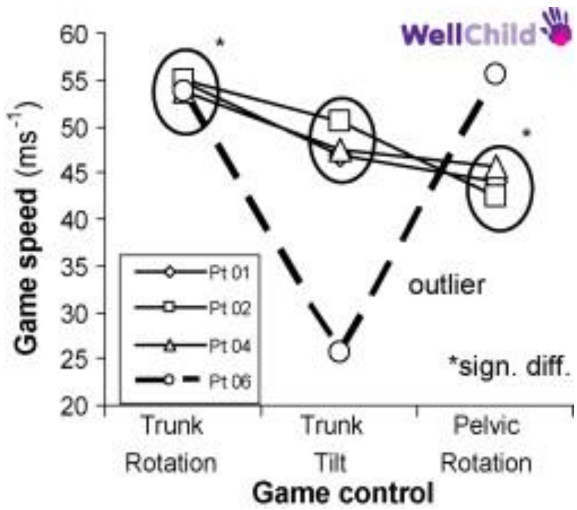

Fig. 1. Game speeds reached when using rotation and tilt of the trunk and pelvis.

References

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