Anticipatory Postural Adjustments in Children with Diplegic and Hemiplegic Cerebral Palsy: Preliminary Data

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Introduction
Cerebral palsy, a non-progressive neurodevelopmental insult, is caused by a lesion to the developing brain and one component of postural control is the ability to generate anticipatory postural adjustments (APAs) to minimize the loss of equilibrium, the central nervous system (CNS) activates trunk and lower extremities during the performance of fast arm or leg movements that endanger the body. Such an anticipatory reaction prevents the body from falling out of balance. These have not been well-studied in children with cerebral palsy. There is research examining the ontogeny of APAs in infants and older children is limited to anticipatory changes in center of pressure prior to perturbation. There is a need to examine anticipatory postural adjustments (APAs) in children with cerebral palsy. APAs are evoked by voluntary and involuntary perturbations and which result in EMG activity in the postural muscles of the trunk and lower extremities during the performance of functional, self-initiated upper extremity tasks in standing.

Purpose/Hypotheses
The purpose of this study was to investigate anticipatory postural adjustments (APAs) in children with diplegic and hemiplegic cerebral palsies during bilateral, unilateral and self-initiated shoulder flexion and extension tasks performed in standing. Anticipatory activity in muscles of the trunk and lower extremities, and anticipatory changes in center of pressure (COP) were studied. In addition, each subject was classified using the Gross Motor Functional Classification System (GMFCS) and Pediatric Reach Test (PRT).

Hypotheses were:
- Children with cerebral palsy can generate directionally specific anticipatory postural adjustments (APAs) in response to voluntary and involuntary perturbations
- Subjects with Diplegia will exhibit different APA patterns than those with Hemiplegia

Methods
Subjects: Nine children with a diagnosis of spastic diplegic and nine children diagnosed with spastic hemiplegic, all between the ages of 7-11 years, and with a GMFCS level I or II were recruited for this study. In addition, each subject was classified using the GMFCS and Pediatric Reach Test (PRT). Informed consent was obtained from the parent and each child was required to give both a written and verbal assent to participate, according to procedures approved by the University of Illinois at Chicago institutional Review Board.

Tasks: Seven experimental tasks involving self-initiated shoulder flexion and extension performed under bilateral, unilateral and volitional conditions were studied. Data Processing:

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In each experimental task were averaged. Force platform and accelerometer signals were filtered and obtained COP displacement in the anterior/posterior direction. Data were collected using a PC-based data acquisition system. All data were filtered and analyzed on a PC computer using Matlab Paradigm software and GraphPad software. Results were expressed in arbitrary units. Dorsal muscle groups (R/L ES, R/L BF) are shown in inverted for ease of comparison and their scales are on the right. TA and SOL are not included because muscle activity is unremarkable.

Results
Baseline muscle activity is more consistent in this subject. Note the directional specificity of muscle activity during APAs, with dorsal muscles active during shoulder flexion and ventral muscles during shoulder extension. A triphasic pattern of reciprocal muscle activity is displayed in the EMG patterns for Bilateral Shoulder Flexion (A) and Bilateral Shoulder Extension (B) for a representative subject with a hemiplegic cerebral palsy during bilateral, unilateral and self-initiated shoulder flexion and extension tasks.

Descriptive Information of Subjects

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Clinical Relevance
This study uses EMG to investigate and describe the APA patterns of children with cerebral palsy as they perform functional movements in standing. Results from this study may provide insights into how children with CP generate feedback and muscle activity for postural control during functional tasks.

References
- Nine children with a diagnosis of spastic diplegic, all under GMFCS level I or II, performed bilateral, unilateral and self-initiated shoulder flexion and extension. The purpose of this study was to investigate anticipatory postural adjustments (APAs) in children with cerebral palsy. The purpose of this study was to investigate anticipatory postural adjustments (APAs) in children with cerebral palsy during bilateral, unilateral and self-initiated shoulder flexion and extension tasks performed in standing. Anticipatory activity in muscles of the trunk and lower extremities, and anticipatory changes in center of pressure (COP) were studied. In addition, each subject was classified using the GMFCS.

Fig. 2

Fig. 3a, b

Fig. 4a, b

Fig. 5

Fig. 6