Anticipatory Postural Adjustments in Children with Typical Motor Development

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Introduction

Any perturbation on the body, such as a fast arm or leg movement, serves to move the body equilibrium. To maintain the loss of balance, the central nervous system (CNS) initiates trunk and leg movements prior to the perturbation (Pfau et al., 2003). Anticipatory postural adjustments (APAs) have been primarily studied in healthy adults and the effects on neuromuscular and motor performance under conditions which impair posture and balance (Hulliger et al., 2001). In children, APAs have been studied with regard to changes in center of pressure (COP) position (Hulliger et al., 2001) and motor development, but little is known regarding anticipatory muscle activity during these tasks.

Hypotheses and Study Questions

We hypothesized that children with typical motor developmental impairments will have abnormal anticipatory muscle activity during static tasks, such as stationary standing, that co-occurring motor and sensory impairments and changes in center of pressure position.

Our study questions included:

1. Can children with typical motor development produce distally specific anticipatory muscle activity (AMA; APA) and COP displacement? (AMA and COP displacement?)

2. Do children with typical motor development produce reciprocal APA during shoulder flexion and extension tasks? (AMA and COP displacement?)

Methods

Twenty-four typically developing children age 7-16 years participated in the study. Each child was pre-screened for visual and auditory acuity. The children were divided into two age groups: 7-10 years and 11-16 years. All children gave written and a verbal assent to participate, according to the procedures of the University of Illinois at Chicago Institutional Review Board.

Measures:

Children were tested for the experimental tasks, standing on a force platform. Signals from the platform were collected and then digitized for offline data analysis. Surface EMG activity was recorded by placing pairs of disposable pre-gelled electrodes over the muscle bellies of the following proximal muscles on both sides of the body: Rectus Abdominus (RA), Erector Spinae (SS), Rectus Femoris (RF), Biceps Femoris (BF), Triceps Brachii (TB), and Tibialis Anterior (TA). Customized Labview software was used to collect the mean-normalized measurement and EMG signals, which were then digitized for offline data analysis.

Data Processing

Raw EMG data were digitally filtered and integrated over 300 ms. The peak-to-peak amplitude of the accelerometer signals were filtered and integrated over 700 ms. The results of each of the seven tasks were analyzed as a function of the activity of the integrated accelerometer signals. The results were then compared between the two age groups of children.


Figure 2: EMG patterns for Bilateral Shoulder Flexion (left) and Bilateral Shoulder Extension (right). A. Anterior muscle groups. B. Posterior muscle groups.

Results

All subjects were able to perform the experimental tasks.

1. Children with typical motor development produce distally specific anticipatory muscle activity (AMA) and COP displacement.

2. Children with typical motor development produce reciprocal anticipatory muscle activity (AMA) and COP displacement during shoulder flexion/extension.

3. For children with typical motor development, sequence anticipatory muscle activity during shoulder flexion and extension tasks.

Conclusions

The results of the study indicate that children with typical motor development activity specific anticipatory muscle activity (AMA) and COP displacement during shoulder flexion and extension.

The children were able to perform reciprocally specific APA during bilateral flexion tasks and reciprocal APA were present in the left and right lower leg muscles during reciprocal and unilateral shoulder flexion/extension tasks. Changes in center of pressure (COP) were consistent with the direction of displacement of the co-occurring and unilateral shoulder flexion/extension tasks.

Information from this study provides a foundation for the investigation of functional control in children with physical impairments. A better understanding of anticipatory muscle activity may be useful in the development of treatment strategies to improve postural control in children with developmental delays.

Limitations

The limitations of the study includes small sample size and need for increased number of participants. Future research should focus on the examination of anticipatory muscle activity in older children, as well as in children with and without motor impairment.

References