**Respiratory, laryngeal and articulatory behaviors during speech and non-speech tasks in children with cerebral palsy: New evidence of function from cutting edge research methodologies**

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**Overall Objectives**

To report current findings related to respiratory, laryngeal and articulatory function for speech and non-speech tasks, derived from methodology to quantify chest wall kinematics, laryngeal impedance, and orofacial kinematics in children with dysarthria secondary to cerebral palsy (CP).

**Study A: Developmental trajectories for speech breathing**

**Participants:** 25 children with CP, 25 matched controls  
**Design:** Longitudinal from birth to age 7 years  
**Method:** Chest wall kinematics  
**Results:**

- Figure 1. Developmental trajectory functions for lung volume initiation (LVI), lung volume termination (LVT), lung volume excursion (LVE), percent rib cage contribution to lung volume excursion (PRC), inspiratory duration (IND), expiratory duration (EXD), average flow, lung volume excursion per syllable, syllables per breath group.

**Conclusions:**

- When positioned optimally, infants and children with CP exhibit similar developmental trajectories for lung volume initiation, termination and excursion when vocalizing and speaking as their control counterparts.
- Developmental trajectories for rib cage contribution, expiratory duration, average flow per breath group, lung volume expenditure per syllable and number of syllables produced per breath group differed between groups indicating that children with CP use a different chest wall configuration and laryngeal control for speaking.

**Study B: Laryngeal function for speech produced at different loudness levels**

**Participants:** 5 children with CP, 5 matched controls  
**Ages:** 8 to 12 years  
**Method:** Electroglottograph (laryngeal impedance)  
**Tasks:** Conversational, 2X’s, 4X’s, 5X’s conversational loudness for the phrase, “I sell a sapapple again”  
**Measure:** Speech quotient

**Results:**

- Figure 2. Acoustic signal and resulting EGG signal in typical child speaker, during production of the “ah” vowel (A). Signal is not rectified. Simulated signal and speech quotient measurement (X1,X2) (B).

**Conclusions:**

- Speakers with CP have slower speaking rates than their matched peers and corresponds with reduction in speaking rate.
- Children with CP did not appear to make a vocal fold adjustment (i.e., similar speed quotient across loudness tasks) when producing speech at louder or softer levels.

**Study C: Articulatory kinematic correlates of speaking rate in three different speaking tasks**

**Participants:** 4 speakers with CP, 38 age-matched controls  
**Method:** Optical motion capture (Motion Analysis, Ltd.)  
**Tasks:** Diadochokinetic task (“buh”), syllable (“uhba”), sentence (“Buy Bobby a puppy”)

**Measure:** Speaking rate (syll/s), speed (mm/s), range of movement (mm), duration (s)

**Results:**

- Figure 4. Marker set used to record lip and jaw movements

**Conclusions:**

- Speakers with CP have slower speaking rates than their typically-developing peers but similar maximum speeds of their age-matched peers.
- Range of movement of speakers with CP generally increased with linguistic task demands, similar to typically-developing peers and corresponds with reduction in speaking rate.
- This may be due to the higher ranges of movement that speakers with CP have, potentially reflecting inefficient force control

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