

An Investigation of Infant Neuromotor Development through Proximal and Distal Arm Joint Movements



Michelle Kee¹, Leah Gentner¹, Isabelle Kang¹, Denise Kao¹, Semanti Naiken¹, Theresa Moulton², and Colleen Peyton²
 Northwestern University¹, Feinberg School of Medicine Department of Physical Therapy and Human Movement Sciences²
 Northwestern University, Evanston, IL



Is the frequency of proximal and distal infant arm joint movements different between groups (typically developing vs. cerebral palsy (CP))?

Background:

Early infant spontaneous movements can provide insight on neuromotor development.

- Cerebral palsy (CP) is a neurological disorder due to brain injury or atypical development to the cerebral cortex at an early age, marked by impaired movement and balance.⁽¹⁾ There is a delay in diagnosing CP before 12 months, so it is important to find earlier indicators.
- Distal joint movements require more direct neural connections from the cortex than proximal joint movements.⁽²⁾
- Preliminary observations suggest fewer distal joint movement in infants with CP than infants with typical development.

Proximal = joints near body torso (shoulder)

Distal = joints far from body torso (forearm and wrist)

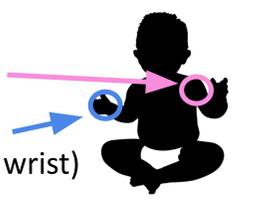


Figure 1. Proximal and distal joints in infants' arms.

Methods:

- Preterm infants at 12-14 weeks corrected age were studied (n = 16; 8 with CP).
- One-minute videos of infants were coded for the onset and offset times of arm joint movements.
- Raters were blinded to the outcome or CP and used Datavyu software to code active movements.

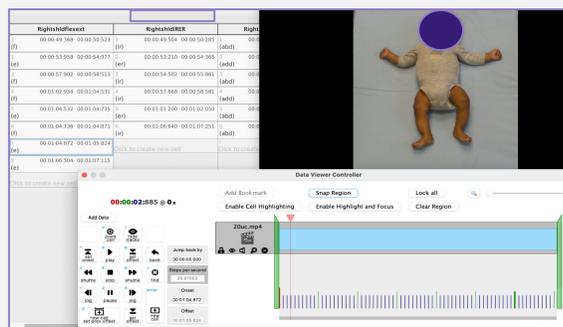


Figure 2. Datavyu software coding example

Results:

KEYPOINT 1: No significant difference between average proximal and distal movements between groups.

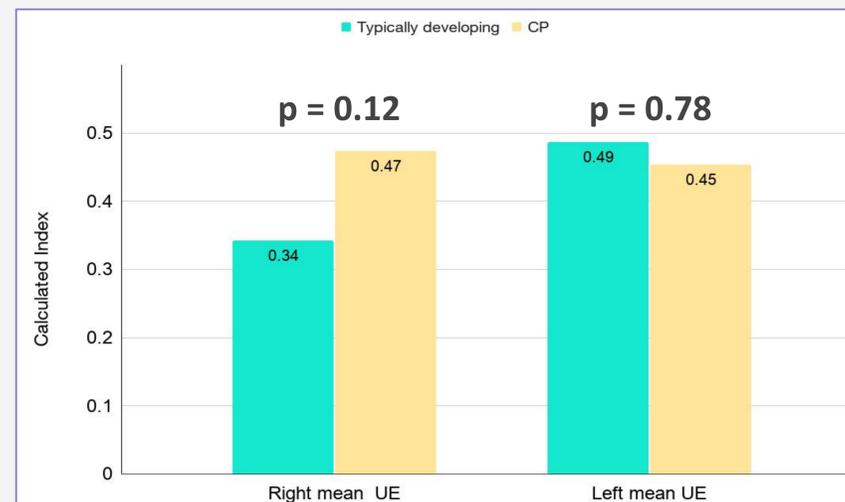


Figure 3. Indexes of the difference in average frequency of proximal and distal arm joint movement divided by the sum of instances for infants with and without CP on both right and left sides. Index = (all proximal joints) - (all distal joints) divided by the sum of all joints for left and right sides.

KEYPOINT 2: Infants with CP have significantly more adduction/abduction movements.

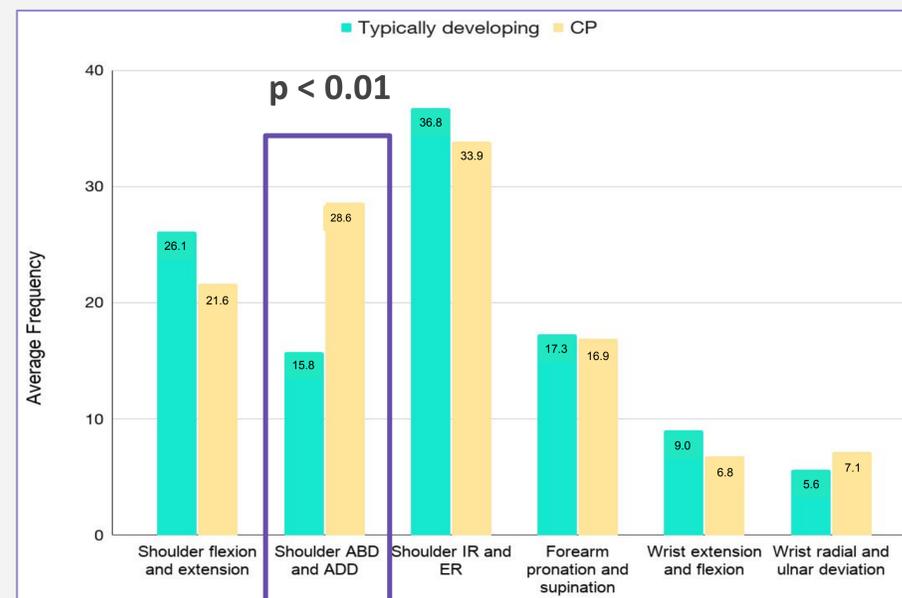


Figure 4. Average frequencies of individual arm joint movements in infants with and without CP.

Conclusions:

- For both groups, all indexes > 0, indicating that the number of proximal movements analyzed were greater than that of distal movements analyzed.
- There is no significant difference in the frequency of proximal and distal joint movements in infants' upper extremities between both groups.
- However, infants with CP show significantly greater adduction/abduction shoulder joint movement, a joint that is possibly influenced by neurons from outside the cortex.
- A limitation of this study was a small sample size.
- Future studies include examining differences in the duration of joint movement between groups and further investigating neuron connections in abd/add movements.

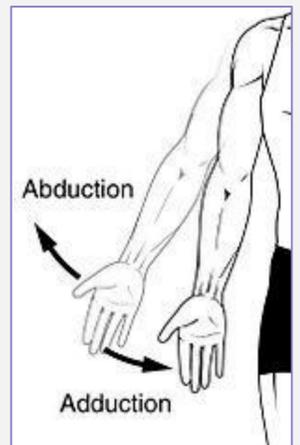


Figure 5. Adduction/Abduction Shoulder Movement

References:

1. Vitrikas K, Dalton H, Breish D. Cerebral Palsy: An Overview. *Am Fam Physician*. 2020 Feb 15;101(4):213-220. PMID: 32053326.
2. Lemon, Roger N. "REVIEW: Mechanisms of Cortical Control of Hand Function." *The Neuroscientist* 3.6 (1997): 389-398.

Acknowledgements:

Thank you to Dr. Colleen Peyton and Dr. Theresa Moulton for their mentorship and support. Special thanks to the families that voluntarily submitted videos in this study. The study resulting in this presentation was assisted by a grant administered by Northwestern University's Office of Undergraduate Research. However, the conclusions, opinions, and other statements in this presentation are the author's and not necessarily those of the sponsoring institution.