



# Literature review on walking aids for children with CP. Development of a walking aid for better lumbo-pelvic postural control.

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## Problem

Reduced lumbo-pelvic postural control and gait impairments are a common feature of gait in children with cerebral palsy. Little is known about the judicious decision for the most appropriate walking aid to keep a good balance between body structure on one hand and activity and participation on the other hand (International Classification of Functioning, Disability and Health, Rosenbaum et al, 2004).

## Purpose

- **Literature review** to describe and classify walking aids used for children with CP and to look for evidence on the impact the different walking aids have on body structure and function, activity and participation.
- **Technical development** of a walking aid facilitating hip muscle work, weight shift and postural control.
- **Cross-sectional study** to evaluate whether walking with the innovative walker indeed affects postural alignment, kinematics and dynamics of gait.

## Methods

- **Literature review** - PubMed, WoS, Embase and Cochrane were searched for 'walking aids' and 'cerebral palsy' including related terms from jan 1990 – March 2019. Inclusion criteria: Cerebral Palsy, 0-18 Y, GMFCS I-IV. Exclusion criteria: non-CP, systematic reviews. This resulted in 1815 articles of which 27 were selected based on inclusion criteria and the Oxford levels of evidence.
- **Technical development** of a new walking aid within a multidisciplinary team.
- **Ongoing cross-sectional study** - Comparison of kinematics of the lower limbs, trunk, tempo-spatial gait parameters and ground reaction force while walking with the innovative walking aid and the control walker.

## Results of literature review

HAND-HELD WALKERS	GAIT TRAINERS	ROBOTIC DEVICES			
		Static		Dynamic	
		PBWSS Treadmill	STATIC System	Overground walking systems	Wearable Exoskeleton
GRADE quality LOW	GRADE quality LOW	GRADE quality mostly LOW		GRADE quality LOW	Evidence level II RCT studies
<ul style="list-style-type: none"> <li>• <b>Posterior walker (PW) more</b> upright positioning and energy conservation than <b>anterior walker (AW)</b></li> <li>• <b>Malalignment</b> present without walker = <b>enhanced</b> by use of PW and AW</li> <li>• May effect <b>Body function and structure.</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Heterogeneity and variety of walkers</b></li> <li>• <b>May affect all levels of ICF</b> better bowel function, bony density, level of activity, motivation and participation.</li> <li>• <b>Further research needed</b> in all aspects of gait trainer assessment, selection and implementation</li> </ul>	<ul style="list-style-type: none"> <li>• <b>May affect activity level</b></li> <li>• Higher walking speed and distance</li> <li>• Improving gross motor functions.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Most are prototypes</b></li> <li>• <b>May affect all levels of ICT</b></li> <li>• Muscle strength, endurance, postural control</li> <li>• Higher walking speed and distance</li> <li>• Improve participation &amp; QoL.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Knee Extension Exoskeleton (KEE)</b> improve crouch gait</li> <li>• <b>Battery-Power Ankle assistance Exoskeleton (BPAE)</b> may improve metabolic cost (19%).</li> </ul>	

## Technical development of a new walking aid – The Hibbot

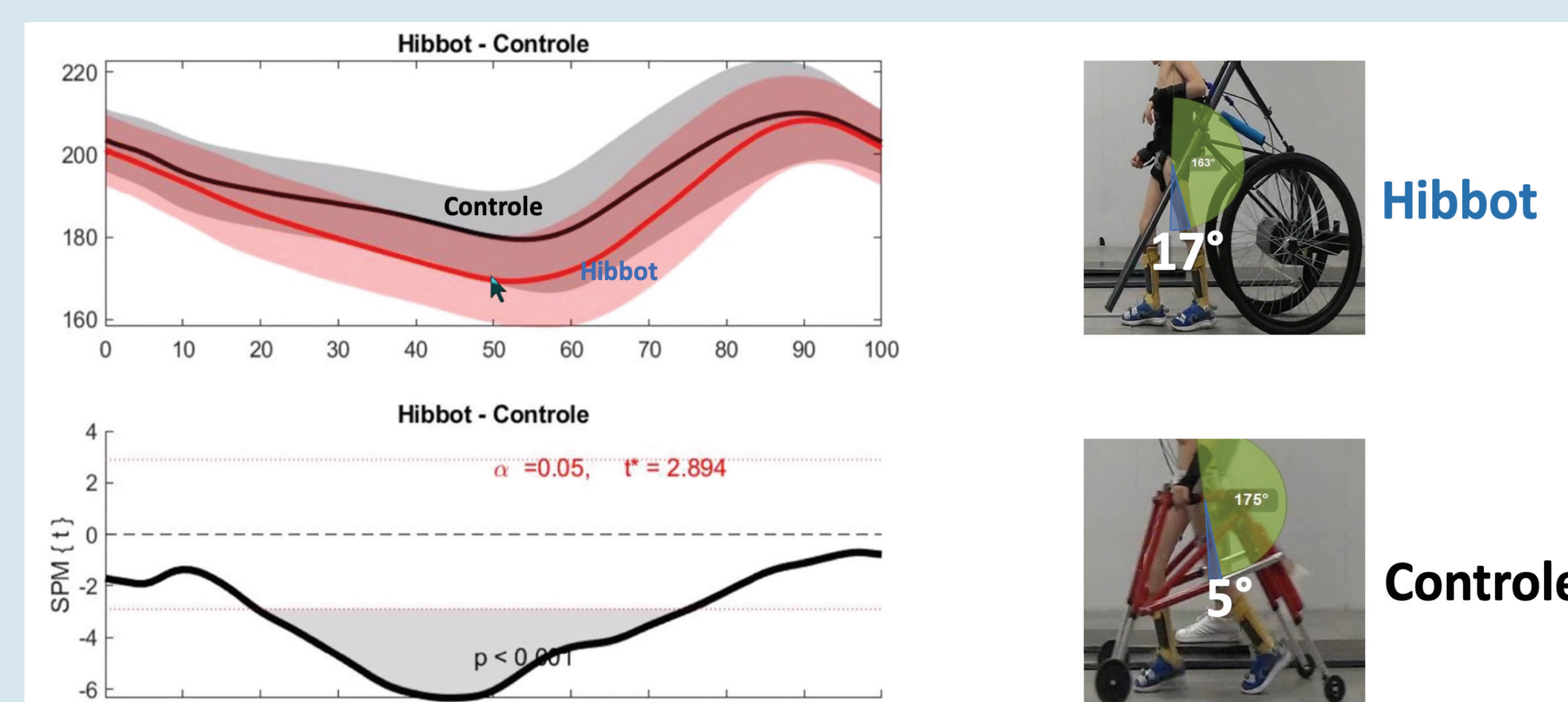
The robotic devices that are widely developed to maximize intensity and repetition of the actual practice of walking are not adapted for small children (1-5 y). Thereby they are not transportable and of a high cost. A new device is developed by a multidisciplinary team and based on:

- Replicating the hands of the physiotherapist by the device which gives support as individually is needed at the level of the pelvis and lower trunk in 6 degrees of freedom.
- The possibility of an adjustable support to challenge the child and make the child as active as possible while growing up and progressing.



## Cross sectional study - Preliminary results

Walking in the Hibbot resulted in significant higher hip extension and knee extension during stance phase and less lateral trunk movements in comparison to walking with the control walker.



## Conclusion

- No clear evidence-based recommendations regarding the use of walking aids for children with CP are currently available.
- An innovative walking aid has been developed with positive clinical experience and insight in applicability and effect.
- Preliminary positive results on gait kinematics and alignment can be revealed but further research is necessary.

## Implications

When choosing the best walking aid, therapists should carefully consider all individually influencing factors of a child and his environment. The Hibbot is a new walking aid, classified as gait trainer, that might facilitate proper muscle activity and alignment during walking, but further research is necessary to prove evidence.

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