e4p Evidence for Practice

Power mobility for infants and preschool children

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Introduction

This document contains a brief overview of information regarding the use and introduction of power mobility with infants and preschool children with disabilities. It is intended to provide clinicians with relevant background information and to describe the current best level of evidence.

How was the literature review completed?

An electronic search of the following databases was performed in September 2011: CINAHL, MEDLINE, EMBASE and Google Scholar. Keywords used in the search included: 'power/ed mobility', 'power wheelchair' and 'wheelchair/powered'. Studies published in English, involving at least one child with a disability, and an outcome related to the child's use of a power mobility device were included. Three specific clinical questions were identified:

1. At what age can children successfully use power mobility?
2. What is the impact of power mobility on psycho-social development?
3. What is the impact of power mobility on motor development?

Studies addressing these questions are included in the attached evidence table (see Appendix 2). The American Academy of Cerebral Palsy & Developmental Medicine (AACPDM) Levels of Evidence (see Appendix 1) [1] were assigned to relevant studies by two reviewers with consensus scores reported throughout the document.

What is Power Mobility?

Power wheelchairs are defined as 'Wheelchairs powered by electricity that provide mobility and body support for individuals with limited ability to walk'.[2] For the purposes of this paper, the term ***power mobility*** includes power wheelchairs and also any battery powered equipment used for mobility by children with disabilities. This can include powered ride-on-toys (e.g. Boss car, Cooper car), powered scooter-boards and powered standing devices (e.g. Gobot).

Why is Independent Mobility so Important?

In the past, power mobility was only considered for older children, as a last resort, once all other forms of mobility had been found to be ineffective. More recently, therapists have begun to emphasize meaningful participation rather than exclusively focussing on development of normal movement patterns. Children, along with their families and therapists may choose between different mobility options depending on the activity or the environment.[3] For example, many children with cerebral palsy (CP) who choose floor mobility at home, may use a walker at school, but need a wheeled mobility device outdoors or in the community.[4]

In children who are typically developing, the ability to move independently has been shown to influence self-awareness, emotional attachment, spatial orientation, fear of heights and visual/vestibular integration[5] as well as personality traits such as motivation and initiation.[6] Children who have restricted mobility tend to have passive, dependent behaviour and this can have long lasting consequences.[7] Children who do not have independent mobility experience early in life may potentially miss a critical time for learning cognitive, emotional and social skills.[8] If children are using great effort to move short distances, they will not be able to engage in play or have the same psycho-social experiences as their peers.[9]

Which children with disabilities need power mobility in early childhood?

For infants and preschool children, those who benefit most from early provision of power mobility are those who will never walk, and those who will not walk or achieve efficient mobility by other means until they are older – and may have passed this critical period of early development. Children who will never walk are those with diagnoses such as CP, Gross Motor Function Classification System (GMFCS)[10] levels IV and V; spinal muscular atrophy (SMA), types I and II; multiple limb deficiencies; severe arthrogryposis; and high level spinal cord injuries (SCI).

Children who may need mobility assistance in early childhood are those with diagnoses such as arthrogryposis, lumbar level meningomyelocele and osteogenesis imperfecta. Children with these conditions are often not considered candidates for power mobility as it is anticipated that they will become functional ambulators or manual wheelchair users. However, they rarely achieve efficient mobility before school age and are at risk for the negative impacts of restricted early mobility.

How young is too young?

Specialized power mobility equipment can be used with children with disabilities starting as young as 7 months of age[11] (evidence level V). Power wheelchairs can be introduced around 14 months of age and children can become competent drivers around 20 months of age.[12] (evidence level II). Further research supports that children can become safe drivers between 18 and 24 months of age.[13-17] (evidence level V)

Children with more complex physical access needs[18] and cognitive, sensory or learning needs will need a longer period of time and more specialized practise to achieve control of steering.[19]

What are the psycho-social benefits of using power mobility with young children?

Power mobility has been shown to:

- Positively influence receptive language level, social function functional skills and level of caregiver assistance.[12] (evidence level II)
- Increase self-initiated movement, positively impact communication and interaction with toys. [20] (evidence level III)
- Improve play and social skills.[21] (evidence level IV)
- Increase self-initiated movement and participation in free play.[22] (evidence level IV)
- Increase independence.[23] (evidence level IV)
- Increase receptive language and cognitive skills.[11] (evidence level V)
- Improve social, cognitive and communication skills.[16] (evidence level V)
- Increase interaction and socialization in the preschool environment.[9] (evidence level V)

Are there any negative effects of using power mobility with young children?

It is a common fear of therapists and families, that using power mobility at a young age will decrease a child's desire to move in other ways.[3] However, research suggests that:

- There is no negative influence on motor development or self care abilities.[12] (evidence level II)
- There is no influence on motor abilities.[23] (evidence level IV)
- Children may be more motivated to participate in therapy and may demonstrate increased head, trunk and arm-hand control.[24] (evidence level V)

How do families feel about using power mobility with young children?

Many parents initially respond negatively to the idea of power mobility, however once their child uses the power mobility device, most have only positive comments to make.[23] Power mobility can allow children to participate in age-appropriate activities and develop 'real' friendships with peers.[25] Parents describe power mobility as reducing frustration and allowing increased independence and participation

with family and friends.[26] Parents have also reported increased satisfaction with their child's play, social skills, and sleep/wake patterns following introduction of power mobility.[27]

Do children need to demonstrate cognitive readiness skills to benefit from power mobility?

Readiness assessments such as the Pediatric Power Wheelchair Screening Test (PPWST) [28] were developed to identify which children were likely to develop competent driving skills within a short period of training. The PPWST is not relevant for children with multiple and complex disabilities who may need to use switches or access methods other than a joystick.[29] The measure identifies skills around the two year developmental level which is older than the age when typically developing peers are moving and exploring independently. Qualitative research demonstrates that there is a continuum of power mobility skills beginning with learning the concept of movement, progressing to developing control of steering and later to becoming a proficient power wheelchair user.[30] Children may learn increased understanding of cause-effect and use of arms and hands from experience in a power wheelchair.[31] Children with IQ below 55 have been shown to be capable of learning to drive[23] although it may take children functioning at early developmental levels more time and opportunities for practise in order to gain competence.[19]

What is the best way for young children to learn power mobility skills?

Learning to use a power mobility device is not like learning to drive a car. Young children have no previous experience of mobility and it is important to use their own motivation and curiosity to learn through play, rather than to teach driving.[32] Adults need to be 'responsive partners', to encourage children's learning and keep them safe while they build skill.[30] Adults should not be verbally directive as this may suppress learning for young children. Directions such as 'go straight', 'turn right' should not be used but rather 'come to mom' or 'let's go over there'.[33]

Children with complex developmental delays may need a long period of training to develop power mobility skills.[19] For children with limited hand function, an alternative access method to using a joystick may be necessary. An assessment with a therapist experienced in alternate access for power mobility may be helpful in establishing the most appropriate access method.

Length of time practising and environmental support have been found to correlate strongly with achievement of successful driving skills.[23] In fact, time and environmental support can be more influential than differences in children's cognitive, motor or sensory abilities.[19,34] In other words, children who are supported by being given regular practise in the power mobility device are more likely to be successful in developing power mobility skills.

Clinicians should consider augmenting mobility at an early age for children who are unlikely to walk or to walk efficiently, in order to promote overall development. Power mobility experience can be provided by using power wheelchairs, toys, cars or standers during therapy sessions for children who are not yet eligible for prescription of their own power mobility device.

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Appendix 1: American Academy of Cerebral Palsy & Developmental Medicine - Levels of Evidence (December 2008)

Level	Group Intervention Studies	Single Subject Research Designs (SSRD)
I	Systematic review of randomized controlled trials (RCTs) Large RCT (with narrow confidence intervals) (n>100)	Randomized controlled N-of-1 (RCT) Alternating treatment design (ATD) Concurrent or non-concurrent multiple baseline design (MBDs) (generalizability if the ATD is replicated across three or more subjects and the MBD consists of a minimum of three subjects, behaviours, or settings. These designs can provide causal inferences)
II	Smaller RCTs (with wider confidence intervals) (n<100) Systematic reviews of cohort studies "Outcomes research" (very large ecologic studies)	Non-randomized, controlled, concurrent MBD; (generalizability if design consists of a minimum of three subjects, behaviours, or settings. Limited causal inferences)
III	Cohort studies (must have concurrent control group) Systematic reviews of case control studies	Non-randomized, non-concurrent, controlled MBD; (generalizability if design consists of a minimum of three subjects, behaviours or settings. Limited causal inferences)
IV	Case series Cohort study without concurrent control group (e.g. with historical control group) Case-control study	Non-randomized, controlled SSRDs with at least three phases (ABA, ABAB, BAB, etc); (generalizability if replicated across three or more different subjects. Only hints at causal inferences)
V	Expert opinion Case study or report Bench research Expert opinion based on theory or physiologic research Common sense/anecdotes	Non-randomized controlled AB SSRD; (generalizability if replicated across three or more different subjects. Suggests causal inferences allowing for testing of ideas)

Appendix 2: Evidence Table of Intervention Studies

	Evidence Appraisal		Sampling	Intervention	Outcomes			
Citation	**Study Design**	**Level of Evidence**	**Subjects & Size**	**Treatment Intensity**	**Outcome of Interest**	**Measure Used to Assess**	**ICF Component[35]**	**Results**
Age of successful power mobility use								
Butler et al.[13]	Descriptive/ Case studies	Level V	9 children with physical disabilities, 20-39 months	Power wheelchair at home for 7 weeks	Achievement of driving skills	Parent descriptions	Activity and Participation	8/9 children were able to drive
Butler et al[14]	Descriptive/ Case studies	Level V	13 children with physical disabilities, 20-37 months	Power wheelchair use at home	Achievement of driving skills	Study specific list of driving skills	Activity and Participation	12 children learned to drive in an average of 16 days (range 3-50)
Everard[17]	Case Study	Level V	22 month old with spinal muscular atrophy (SMA)	Power wheelchair at home	Independent control	Parent description	Activity and Participation	Able to drive within 6 weeks
Jones et al.[12]	RCT	Level II	6 matched pairs of children with severe disabilities, 14-30 months	Power wheelchair use for 1 year	Independent control	Butler's[14] list of driving skills	Activity and Participation	Children took between 4 and 42 weeks to develop basic driving skills
Jones[16]	Case study	Level V	20 month old with SMA	Power wheelchair at home	Achievement of driving skills	Butler's[14] list of driving skills	Activity and Participation	Able to drive within 6 weeks
Lynch et al.[11]	Case study	Level V	7 month old with spina bifida	2-3 times a week from 7-12 months of age	Goal directed use of power mobility	Computer measures of path length, # activations and goal achievement	Activity and Participation	Increased joystick activation, distance and goal directed driving
Zazula & Foulds[15]	Case study	Level V	Child with phocomelia	Custom power mobility device	Independent steering	Description	Activity and Participation	Able to steer in all directions by 18 months
Psycho-social benefits of power mobility								
Bottos et al.[23]	Before and after case series	Level IV	25 children aged 3-8 years with cerebral palsy (CP)	6-8 months power wheelchair use	Effect on intelligence quotient (IQ), motor level and independence	GMFM COPM Power Mobility Program[30]	Body Structure & Function Activity and Participation	Increased independence. 21/27 able to drive. 7/13 with IQ below 55.

GMFM = Gross Motor Function Measure; COPM = Canadian Occupational Performance Measure; BDI = Batelle Developmental Inventory;

	Evidence Appraisal		Sampling	Intervention	Outcomes			
Citation	**Study Design**	**Level of Evidence**	**Subjects & Size**	**Treatment Intensity**	**Outcome of Interest**	**Measure Used to Assess**	**ICF Component[35]**	**Results**
Butler[20]	Single subject Multiple Baseline Design	Level III	6 children with disabilities aged 23-38 months	Baseline compared with behaviours after achievement of independent power wheelchair use (1-3 weeks)	Effect on self-initiated exploratory behaviours	Target behaviours coded from video recordings by the author and an assistant.	Activity and Participation	All increased self-initiated movement. 3 children increased communication. 3 children increased interaction with toys.
Deitz et al.[22]	Single subject Withdrawal ABAB design	Level IV	2 preschoolers with complex developmental delays	3-4 hours power mobility toy use, during free play	Effect on self-initiated movement, initiation of contact with others and affect	Video recordings, 10 minutes of free play, with and without the toy, once a week during all phases	Activity and Participation	Increased self-initiated movement Some impact on initiation of contact with others. No effect on affect
Furumasu et al.[21]	Before and after case series	Level IV	23 children 18-72 months	4-6 months power mobility use	Psycho-social skill, play skill and language development	Adaptive Social Behavior Inventory Preschool and Kindergarten Behavior Scales Peabody Picture Vocabulary Tests Preschool Language Scale-3 Symbolic Play Assessment Survey of Technology Use	Activity and Participation	Improved social skills. Increased self-esteem, self-confidence and composure. Improved level of play skills No change in language development.
Jones et al.[16]	Case study	Level V	20 month old with SMA	3 months power wheelchair use	Developmental change	BDI PEDI	Activity and Participation	Greater than expected developmental change. Increased independence

GMFM = Gross Motor Function Measure; COPM = Canadian Occupational Performance Measure; BDI = Batelle Developmental Inventory;

	Evidence Appraisal		Sampling	Intervention	Outcomes			
Citation	**Study Design**	**Level of Evidence**	**Subjects & Size**	**Treatment Intensity**	**Outcome of Interest**	**Measure Used to Assess**	**ICF Component[35]**	**Results**
Jones[12]	RCT	Level II	6 matched pairs of children, 14-30 months of age	1 year power wheelchair use	Cognitive, language and social development	BDI PEDI	Activity and Participation	Increased receptive language and social function functional skills
Lynch et al.[11]	Case study	Level V	7 month old child with spina bifida	2-3 times a week from 7-12 months of age	Effect on overall development	Bailey III	Body, Structure and Function, Activity	Receptive Language and Cognition at 13 month age equivalent. Above chronological age of 12 months Expressive Language and Fine motor at 12 month age equivalent. Gross motor at 7 month age equivalent
Impact of power mobility use on motor development								
Bottos et al.[23]	Before and after case series	Level IV	25 children with CP, aged 3-8 years	6-8 months power wheelchair use	Changes in motor development	GMFM	Activity and Participation	No change in motor abilities
Jones[12]	RCT	Level II	6 matched pairs of children with severe disabilities, 14-30 months of age	Intervention group used power wheelchair for 1 year	Changes in motor development	BDI PEDI	Activity and Participation	No difference in motor level between subjects and controls. Subjects required less caregiver assistance even though self care abilities did not change.
Paulsson & Christoffer son[24]	Case studies	Level V	12 children, 2 ½ -5 years of age	1 year, power cart use	Changes in motor development	Therapist and parent observation	Activity and Participation	Increased arm, hand, head and trunk control.

GMFM = Gross Motor Function Measure; COPM = Canadian Occupational Performance Measure; BDI = Batelle Developmental Inventory;