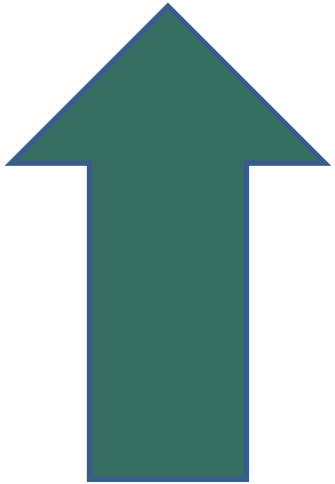
Adaptive Seating for Participation:

What does the research say?

Levels of Evidence

1. **Systematic Review**
2. Randomized Controlled Trial (RCT)
3. Cohort Study
4. Case-Control Study, Case-Series
5. Case Study, Expert Opinion



Sackett, 2000 cited in Chung, 2008 (p307)

GMFCS: sitting

Gross Motor Function Classification System

I.

Gets in/out of seating without support

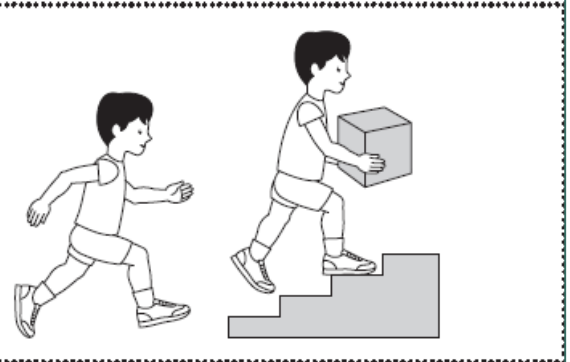
II.

Sits with both hands free.
May require support to stand.

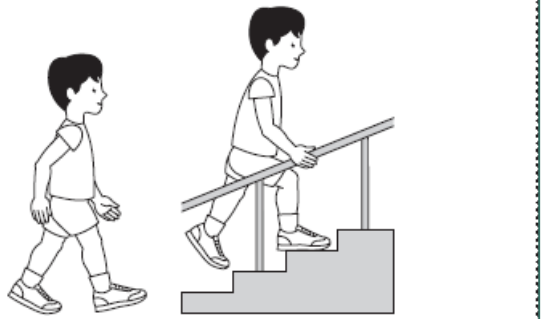
II.

May require pelvic or trunk support for hands-free sitting. Uses support to stand up from sitting.

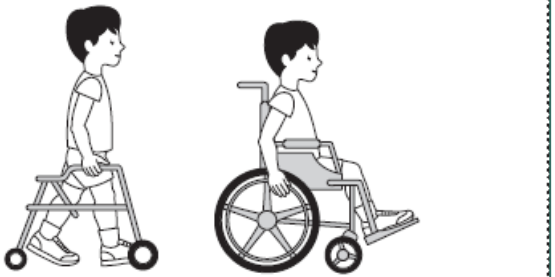
I



II



III



Palisano, 1997, 2008 Ryan, 2012 www.canchild.ca

40% of children with CP are IV or V

Himmelmann, 2007 cited in Anguspaisal, 2015

IV.

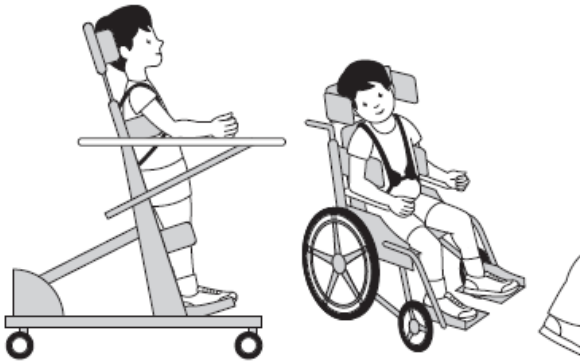
Requires trunk support for hands-free sitting. Uses support or adult assist to stand up from sitting.

V.

Seating device required for head alignment and seated posture. Full support required for any changes in position.

IV

V



Palisano, 1997, 2008 Ryan, 2012 www.canchild.ca

Adaptive Seating for Participation:

What does the research say?

Sitting postural control

Upper extremity function

Head control

Sitting Postural Control

What does the research say?

- Saddle Seat
- Functional Sitting Position
- Seat Surface Inclination
- Dynamic Seating

Systematic Review	Articles
Efficacy and Effectiveness of Physical Therapy in Enhancing **Postural Control** in Children With Cerebral Palsy. Harris, 2005 (update from Roxborough, 1995)	12 studies 5 studies on postural control/adaptive seating
Tilted **seat position** for non-ambulant individuals with neurological and neuromuscular impairment: a systematic review. Michael, 2007	17 studies 8 studies of children with cerebral palsy
Effectiveness of **adaptive seating on sitting posture** and postural control in children with cerebral palsy. Chung, 2008	14 studies All with non-ambulatory children
Adaptive seating systems in children with severe cerebral palsy across International Classification of Functioning, Disability and Health for Children and Youth version domains: a systematic review. Angsupaisal, 2015	16 studies; 9 = moderate quality All GMFCS IV and V Outcomes across ICF domains

Saddle Seat

Outcome:
Increases trunk/spinal extension

Study	Disability	Intervention/Measure	Outcome
Stewart, 1987 **n = 10** **age = preschool** Level 5 Evidence*	Cerebral Palsy – athetoid, "floppy," quadriplegic	Saddle posture ("straddle") Qualitative observation (one session)	Hypotonic: **improved trunk extension** Hypertonic: improved midline symmetry, upper body control
Pope, 1994 **n = 9** **age = 2.5 – 9 yr** Level 4 Evidence*	Cerebral Palsy – Severe spastic tetraplegia Unable to sit independently	Saddle posture 0-8 hours per week x 3 years Annual assessment: photographs and Level of Sitting Ability Scale	Improvement in symmetry **Improved trunk extension** 3 of 9 children improved by one level (Sitting Ability Scale)
Reid, 1996 **n = 6** **age = 3 – 8 yr** Level 2 Evidence*	Cerebral Palsy - Spastic (4 diplegia; 2 tri/tetraplegia) Able to sit on flat bench	Flat bench, 40 min Saddle Seat , 40 min SACND (Sitting Assessment for Children with Neuromotor Dysfunction)	**Increase in spinal extension** Response scores indicate improved postural control

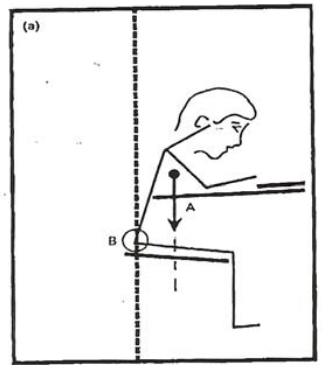
*Chung, 2008

Erect versus crouched sitting

Study	Disability	Intervention/Measure	Outcome
Brogren, 2001 n = 20 age = 3-7.5 yr	Cerebral Palsy – spastic diplegia n = 10 Non-impaired children n = 10	Compare erect versus crouched sitting while on movable platform EMGs to neck, trunk, leg muscles Kinematics of head, body sway, pelvis during forward translation and during backward translation	Non-impaired children: demonstrated distinct capacity for adaptation of postural adjustment to sitting position under all conditions Children with CP: deficient adaptational capacity. This was more pronounced in the erect position. **In the child's usual crouched position, they demonstrated better postural modulation.** Crouched sitting did not induce postural deficiency. Instead it offered a compensatory solution to the sensorimotor problem of the instability experienced.
Van der Heide, Fock, Otten, et al, 2005 n=77 age=2-11 yr	Cerebral Palsy Spastic hemiplegia n=33 Bilateral CP n=18 Non-impaired children (typically developing TD) n=26	Compare kinematic characteristics of sitting posture during reaching movements of dominant arm, the kinematics of reaching movement, and functional performance in daily activities.	Children with CP: sat with more reclined pelvis and more collapsed trunk versus TD children; more reclined pelvic positon was associated with better quality of reaching movements. Children with CP: those children who presented with a more stable head, more mobile trunk, and more stable pelvis were related to better quality of reaching and better functional performance in daily activities.

Functional Sitting Position

Outcome: Improved postural control



Myhr & Von Wendt, 1990, 1991, 1995

Study	Disability	Intervention/Measure	Outcome
Myhr & Von Wendt, 1990 **n=2** **age = 7 yr and 15 yr** Level 5 Evidence*	Cerebral Palsy Severe, spastic (1 diplegia, 1 tetraplegia/dystonic)	Functional Sitting Position 1 session, 6 different positions, 5 min in each position Video/Observation: postural control of head; number of pathological movements	**Improved postural control** (longest duration; decreased pathological movements) when anteriorly inclined and using abduction orthosis and table.
Myhr & Von Wendt, 1991 **n=23** **age = 2-16 yr** Level 4 Evidence*	Cerebral Palsy Severe, spastic (15 diplegia, 3 tetraplegia, 5 dystonic)	Functional Sitting Position 1 session, 6 different positions, 5 min in each position. Sitting Assessment Scale	**Improved head, trunk, foot control** and arm/hand function
Myhr & Von Wendt, 1995 **n=10** **age=7-10 yr** Level 4 Evidence*	Cerebral Palsy Spastic diplegia (3 mild, 4 moderate, 3 severe)	Functional Sitting Position 5-year follow-up Sitting Assessment Scale (5 min at random during session) Control intervention – discontinued use of Functional Sitting Position	8 of 10 children **improved head, trunk, foot control** and arm/hand function 2 of 10 children deteriorated; worsened trunk control

*Chung, 2008

Seat Surface Inclination

Outcome: Various results

10° anterior tilt may improve trunk/spinal extension

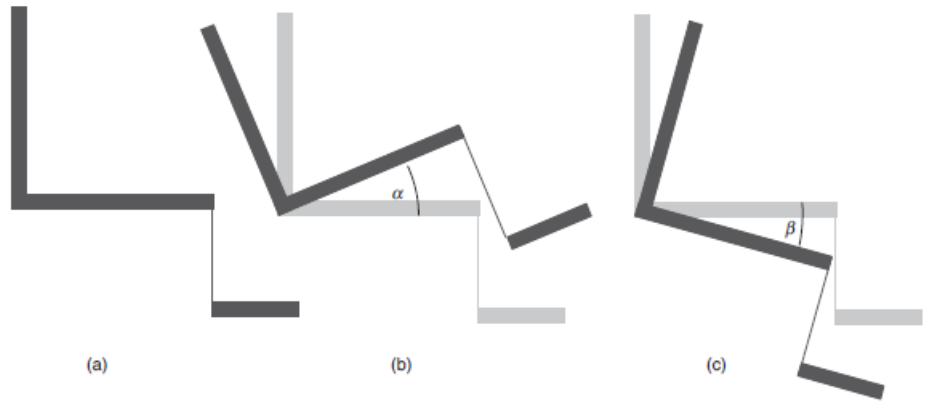


Figure 1 Schematic lateral views of seat showing (a) upright, (b) posteriorly and (c) anteriorly tilted seat orientations. α = posterior tilt angle, β = anterior tilt angle.

Study	Disability	Intervention/Measure	Outcome
Miedaner, 1990 **n = 15** **age = 2-6 yr** Level 2 Evidence*	Developmental delay (n=3) Cerebral Palsy – hypotonic or hypertonic (n=12)	Five positions: Floor; Level sit 90/90; Bench - 20° anterior tilt; 30° anterior tilt; Adaptive Chair 1 minute quiet sitting: Visual observation MSM (Modified Schober Measurement of Spinal Extension	**Trunk extension improved** with anterior tilt
Sochaniwskyj,1991 **n = 22** **age = 5-11 years** Level 3 Evidence*	Cerebral Palsy Spastic diplegia, mild n=14 Able to sit independently Non-impaired children n=8	0° 10° anterior 15° anterior Four 20 min sessions over 3 weeks 3D Sitting Tracking System EMG to erector spinae	*Both groups:* 10° anterior tilt: -significantly **increased back extension** and head height 15° anterior tilt: -decreased radius of stability -greatest EMG activity
McClenaghan, 1992 **n-=20** **age = 4-15 years** Level 3 Evidence*	Cerebral Palsy n=10 spastic, mild-to-moderate severity Able to sit independently Non-impaired children n=10	0° seat, 90° back 5° posterior, 90° back 5° anterior, 95° back 3 sessions, (randomly ordered) 2D video digitizing system Kistler amplifiers to locate center of pressure (COP) Functional measures tool to evaluate UE performance	5°posterior tilt (quiet sitting) -improved lower limb stability 5°anterior tilt (quiet sitting) -decreased head stability -COP forward Active sitting w/ UE activity: - No difference

*Chung, 2008

Dynamic Feature

Outcome:
Improved positioning of pelvis/trunk
Improved UE movement

Study	Disability	Intervention/Measure	Outcome
Cimolin, 2009 **n=9** **age = 6-10 years** Level 4 Evidence*	Cerebral Palsy Severe, spastic and dystonic tetraparesis GMFCS Level V	X-Panda (R82) 2 sessions: -dynamic backrest; -rigid backrest Kinematic measurement of body segments before, during, and after extensor thrust	Dynamic backrest: -more anterior and posterior trunk movement; decreased sliding down in seat -improved upper limb coordination; decreased UE dyskinesia/dystonia -decreased force against backrest
Hahn, 2009 **Dynamic group n=8** **Static group n=4** **age = 4-13 yr**	Cerebral Palsy or similar neuromuscular disorder Spastic, hypotonic, dystonic/athetoid) GMFCS Levels 2-5	KidsROCK Chair Dynamic motion hip & knee/can lock out Initial fitting, then 3 month and 6 month follow-ups. Assessed -range of motion ROM -spasticity MAS (Modified Ashworth Scale) -motor function GMFC (Gross Motor Function Measure) -daily function PEDI (Pediatric Evaluation of Disability Inventory)	No statistical significance between groups. Both groups showed trends toward improved sitting, crawling, self-care, mobility, social-function. Dynamic group showed trends toward increased range of motion, “normal tone,” and standing, walking (vs. static group.)
Avellis, 2010 **n=10** **age=6-19 yr**	Cerebral Palsy Severe, spastic and dystonic tetraparesis GMFCS Level V	X-Panda (R82) 2 sessions: -dynamic backrest; -rigid backrest Optoelectronic kinematic measures of body segments, synchronic Video system, pressure distribution assessment on seatback	Dynamic backrest: -increased anterior-posterior movement; decreased vertical lowering of trunk in chair -reduced large movement excursion of UEs; improved smoothness of UE movement -decreased extensor thrust; lower force on backrest

*(Angsupaisal, 2015)

Adaptive Seating for Participation:

What does the research say?

- ✓ **Sitting postural control**

Upper extremity function

Head control

Upper Extremity Function

What does the research say?

- Saddle Seat (Pope, 1994, Ried, 1996)
- Functional Sitting Position (Myhr & Von Wendt, 1991, 1995)
- Seat Surface Inclination
- Segmental Control

Systematic Review	Articles
The effect of positioning for children with cerebral palsy on upper-extremity function: A review of the evidence. Stavness, 2006	16 articles published between 1980 and 2005
Seat inclinations affect the function of children with cerebral palsy: a review of the effect of different seat inclines. McNamara, 2007	10 studies – all on effects of seat inclination (UE function, postural control, muscle activity)
Adaptive seating systems in children with severe cerebral palsy across International Classification of Functioning, Disability and Health for Children and Youth version domains: a systematic review. Angsupaisal, 2015	16 studies 9 = moderate quality All GMFCS IV and V Outcomes across ICF domains
Postural Control Influence on Upper Extremity Function among Children with Cerebral Palsy: A Literature Review. Zulkapli, 2016	19 articles published between 2000 and May 2015 Includes two systematic reviews on adaptive seating: (Stavness, 2006) (Chung, 2008) "Postural control has a major influence on upper extremity function."

Saddle Seat

Outcome:

No impact on fine motor, dexterity, upper limb function

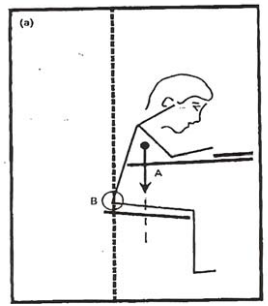
Pope, 1994
Reid, 1996

Functional Sitting Position

Outcome:

Improved arm/hand use

Myhr & Von Wendt, 1991, 1995



Seat Surface Inclination

Outcome:

Influence of seat tilt
on upper extremity function may vary
with each child and task context.

Study	Disability	Intervention/Measure	Outcome
Nwaobi, 1987 **n=13** **age = 8-16 yr** Crossover Design Evidence Level 2 NHS (Michael, 2007)	Cerebral Palsy Spastic n=10 Athetoid n=3 Cognitive Non-ambulatory	Timed switch use with upper extremity, on cue. Random placement/testing: 0° horizontal 15° posterior tilt 30° posterior tilt 15° anterior tilt Re-test in reverse order	Average **performance times were different** for both types of subjects at all seating orientations. *Fastest:* Re-test of Spastic subjects at 0° horizontal *Slowest:* Re-test of Athetoid subjects at 15° anterior
McClenaghan, 1992 **n=20** **age = 4-15 years** Level 3 Evidence (Chung, 2008)	Cerebral Palsy n=10 spastic, mild-to-moderate severity Able to sit independently Non-impaired children n=10	3 sessions, (randomly ordered) 0° seat, 90° back 5° posterior, 90° back 5° anterior, 95° back 2D video digitizing system Functional measures tool to evaluate UE performance	Active sitting with UE activity: **no significant differences on UE performance** between different positions Only 2 of 6 tasks were affected by seat tilt: -one task decreased with posterior tilt -one task improved with anterior tilt
Hadders-Algra, 1999 **n=17** **age=3-18 months** Evidence Level not identified (McNamara, 2007)	Cerebral Palsy n=7 (spastic hemiplegia n=5 spastic tetraplegia n=1 spastic tetraplegia with athetosis =1) Non-impaired infants n=10	Longitudinal study, intermittent assessments between age 4 months and 18 months. Simultaneous video data and surface EMGs of body segments while reaching in supine lying, semi-reclined sitting, upright sitting, and long-sitting positions.	All infants showed more specific muscle activation related to reaching **when in the semi-reclined sitting position.** This position may help compensate for child's postural sway induced by reaching. Researchers concluded **deficient capacity to modulate postural adjustments to task-specific constraints.**

Seat Surface Inclination

Further studies….not in these systematic reviews:

Outcomes:

- **Influence of seat tilt may be different for children with unilateral spastic cerebral palsy versus children with bilateral spastic CP.**

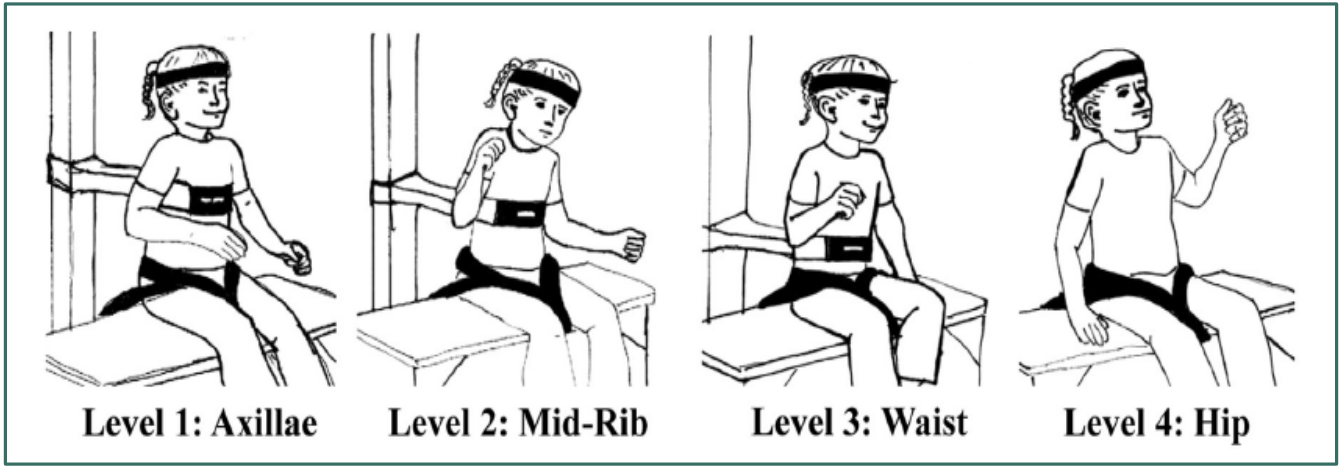
- **With posterior tilt position, children with CP may demonstrate more postural sway (versus non-impaired controls.)**

Study	Disability	Intervention/Measure	Outcome
Hadders-Algra 2007 n=58 age=2-11 yr	Cerebral Palsy Unilateral spastic n=34 Bilateral spastic n=24	Reaching with dominant arm, three conditions: -0° horizontal -15° anterior -15° posterior	*Unilateral spastic CP:* Anterior tilt -improved postural efficiency -improved quality of reaching *Bilateral spastic CP:* Anterior and Posterior tilt -more postural instability -no effect on reaching
Angsupaisal 2017 n=19 age=6-12 yr	Cerebral Palsy Unilateral spastic n=10 Bilateral spastic n=9 GMFCS Levels I, II, III	Four sitting conditions: -0° horizontal, no foot support -0° horizontal, foot support -15° anterior, no foot support -15° anterior, foot support Kinematic data recorded -head sway -reaching with dominant arm	*Head sway/stability:* no difference between 4 positions. *Reaching:* foot support had no impact *Unilateral spastic CP* Anterior tilt improved reaching *Bilateral spastic CP* Anterior tilt worsened reaching
Cherng 2009 n=26 age=	Cerebral Palsy Spastic n=10 Non-impaired children n=16 GMFCS Levels I, II, III	Static sitting and forward reaching task Seat at 0° horizontal and at three anterior positions and at three posterior positions Evaluated postural stability and UE reach efficiency -Center of Pressure (COP) displacement -timed reach to target	*For both groups:* Anterior tilt positions -improved postural stability -improved reaching efficiency Posterior tilt -increased COP displacement for both -more medial-lateral displacement for CP children

Standard Chair, Adaptive Seating, Custom-made Orthosis

Study	Disability	Intervention/Measure	Outcome
Sahinoğlu D, 2017 **N=20** **Age=**	Cerebral Palsy Spastic n=20 GMFCS III - V	Comparison -standard chair -adjustable seating system -custom-made orthosis Evaluated with Seated Postural Control Measure (SPCM) Sitting Assessment Scale (SAS)	For arm control, foot control: Adjustable seating system **>** standard chair GMFCS Level IV Trunk and arm control and Total sitting score: Custom-made orthosis **>** standard chair SAS for entire group: Adjustable seating system **=** Custom-made orthosis

Segmental Control



Saavedra & Woollacott 2015
(Fig 1, p3)

SATCo

Segmental Assessment of Trunk Control

“The SATCo is a reliable and valid measure allowing clinicians greater specificity in assessing trunk control.”

Butler et al, 2010

“The SATCo is a clinically applicable assessment tool. Relative reliability is excellent and absolute agreement is good.”

Hansen et al, 2018

Effect of Segmental Trunk Support

Study	Disability	Intervention/Measure	Outcome
Santamaria, 2016 N=17 Age=2-15 yr	Cerebral Palsy GMFCS Levels III, IV, V SATCo levels: mild – trunk control (LE deficits only) Moderate upper lumbar, thoracic deficits Severe Cervical/upper thoracic deficits	Varying levels of trunk support provided during reaching tasks: -axillae -mid-ribs -pelvis Kinematic measurement of posture and arm	*Mild* Level of support had no effect on posture or reaching *Moderate* Pelvic support resulted in decrements in posture and reaching compared to higher supports *Severe* Pelvic support were unable to maintain posture Mid-ribs support resulted in decrements in posture and reaching compared to higher support Conclusion: Improved motor performance when external support matches intrinsic level of trunk control

Jocelyn Newell Jarzynski, PT

Prince George's County Public Schools, Maryland

Adaptive Seating for Participation:

What does the research say?

- ✓ Sitting postural control
- ✓ Upper extremity function

Head control

Head Control

What does the research say?

- Tilt-In-Space
- Segmental Control
- Head Pod

Tilt-in-Space

Study	Disability	Intervention/Measure	Outcome
Angelo, 1993 **n=1** **age = 9 yr** Evidence Level not identified (McNamara, 2007) Evidence Level 5 NHS (Michael, 2007)	Cerebral palsy	Comparison of head control, in tilt-in-space positions: 0° horizontal 15° posterior tilt 30° posterior tilt Time sample recording: Clinical observation and scoring of head control weekly for ten weeks during classroom activities.	Head control was most consistent during 15° posterior tilt compared to horizontal position. Difficult to generalize findings as study involved only one child.

Segmental Control

Study	Disability	Intervention/Measure	Outcome
Saavedra S, Woollacott M, van Donkelaar P. (2010) n=52 age=4 yr to adult	Cerebral palsy children: n = 15 age = 6-16 yr Spastic hemiplegia and diplegia, ataxia, dystonia GMFCS I, II, III Able to sit on bench Non-impaired children n=26 age= 4-14 yr Non-impaired adult controls n=11	Head stability during quiet sitting. -varying levels of trunk support (torso, pelvic, none) -eyes open vs. eyes closed Magnetic tracking to collect head sway data	Non-impaired children -did not differ significantly from adults. Cerebral Palsy children -More head sway vs. adults when sitting with no support and with eyes closed -More head sway vs. adults under all conditions except for head movement in frontal plane when sitting with support at torso -Spastic CP - <u>more</u> head sway with eyes closed -Dyskinetic CP - <u>less</u> head sway with eyes closed Conclusion: Children with mild to moderate CP have deficits in head stability even during quiet sitting.

Study	Disability	Intervention/Measure	Outcome
Saavedra SL, Woollacott MH. (2015) n=15 age=4-16 yr	Cerebral Palsy GMFCS IV n=8 GMFCS V n=7 And: Previous longitudinal data from typically developing (TD) infants (3–9 months of age).	Head alignment and head stability during quiet sitting. Comparison of data with external support at four levels (axillae, mid-rib, waist, and hip). Kinematic data to document head alignment and stabilization (sway). Clinical Assessment -SATCo -behavioral assessment of stage of trunk control	*GMFCS Level V –* No level of support improved head alignment. Support at level of axillae reduced head sway compared to hip support. Note: this was similar to findings with typically developing (TD) infants. *GMFCS Level IV –* Better alignment and reduced variability of position with l lower levels of support Head sway was no different between levels of support. Note: this was different to TD infants who had increased variability of position and increased head sway with lower levels of support. **Conclusion: GMFCS Level IV had developed an intrinsic motor strategy for alignment.**
da Costa CS, Saavedra SL, Rocha NA, Woollacott MH. (2017) n=15 age=4-16 yr	Cerebral Palsy GMFCS IV n=8 GMFCS V n=7 And: Previous longitudinal data from typically developing (TD) infants (3–9 months of age).	Head stability (head sway) in quiet sitting. Comparison of data with external support at four levels (axillae, mid-rib, waist, and hip). Kinematic data in anterior-posterior and medial-lateral directions for complexity, predictability, and active degrees of freedom.	-Higher levels of support resulted in better head control, with increased complexity and decreased predictability for the GMFCS V and youngest TD groups. - Lower levels of support resulted in better head control, with increased complexity and decreased predictability for the GMFCS IV group. **Conclusion:** **Too much support can interfere with postural sway quality.**

Head Pod

southwestmedical.com

Study	Disability	Intervention/Measure	Outcome
Brown JE, Thompson M, Brizzolara K (2018) n=14 (43% attrition) age=3-11	Cerebral Palsy GMFCS V	Use of Headpod, 45 minutes per day for six months. Observe effect on head control. Video before, at 3 months, and at 6 months. Counted number of head bobs and active time that head is upright during period of 5 minutes. Parent survey.	Significant improvement in active time (head upright). Average head bobs decreased but not statistically significant. Surveyed parents reported that the changes to head control were apparent

Activity

Execution of a task or action

Head control to look.

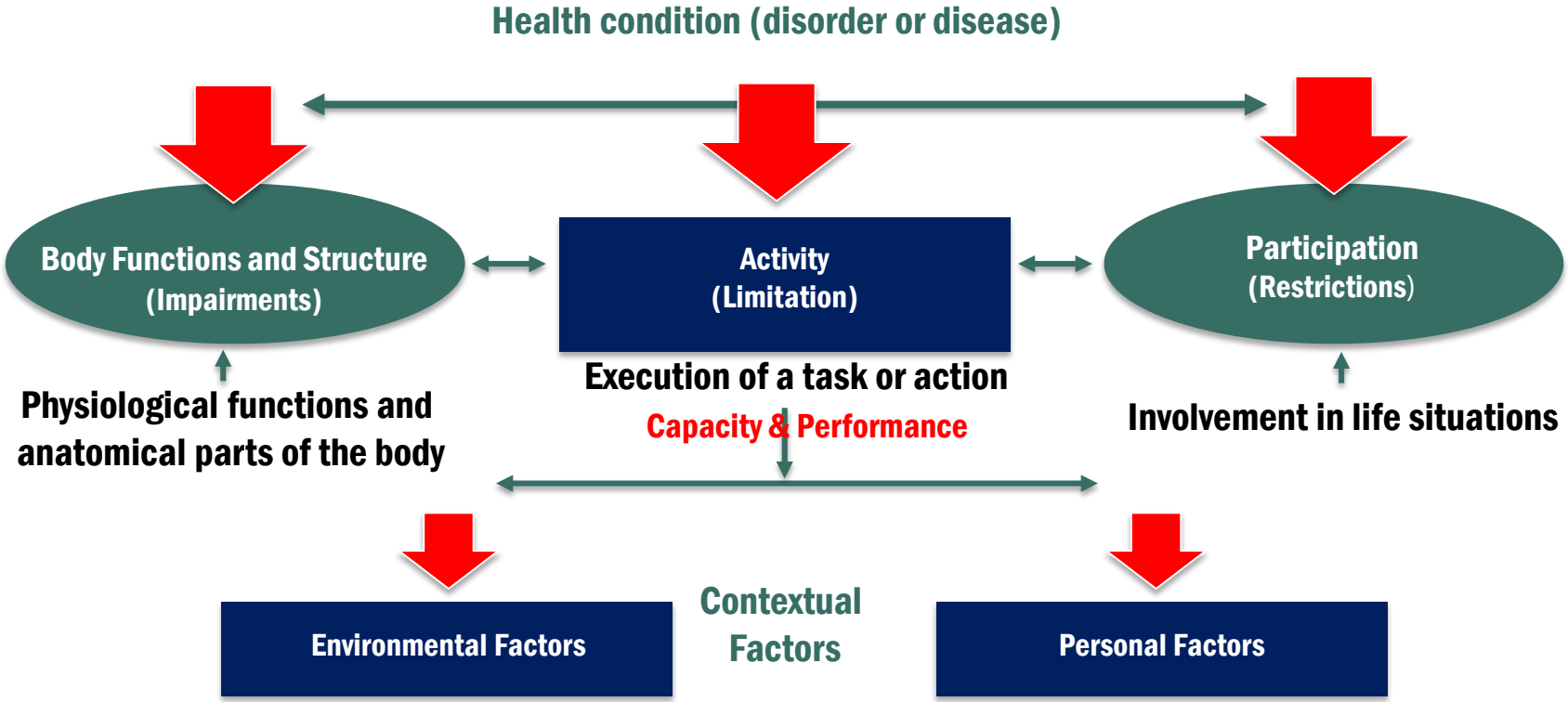
Upper extremity function to reach.

Sitting postural control to sit.

Carlberg & Hadders-Algra, 2005
De Graaf-Peters, 2007
van der Heide & Hadders-Algra, 2005

Bidabe, 2016
Zulkapli, 2016
Rachwani, 2015

The ICF



McDonald, Surtees & Wirz, 2004

Capacity

A child's abilities in a defined situation apart from real life.

Capacity relates to Body Functions and Structures (physiological functions and anatomical parts of the body) - it demonstrates the child's intrinsic ability without any support from environmental factors.

Capacity relates to Activity (execution of a task or action by an individual) and may indicate the highest level of functioning without supports.

Body Functions and Structure

What does the research say?

- Tone (EMG)
- Scoliosis
- Skin Integrity (Pressure Relief)
- Respiration

Tone (EMG)

Functional Sitting Position Myhr & Von Wendt, 1993

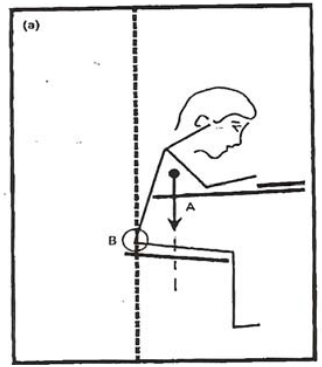
Abduction Orthosis Ekblom & Myhr, 2002

Seat Surface Inclination Nwaobi, 1983 and 1986

Functional Sitting Position

Outcome:
Lowest EMG recordings of leg muscle activity with use of an abduction orthosis and horizontal and forward-leaning seats.

Myhr & Von Wendt, 1993

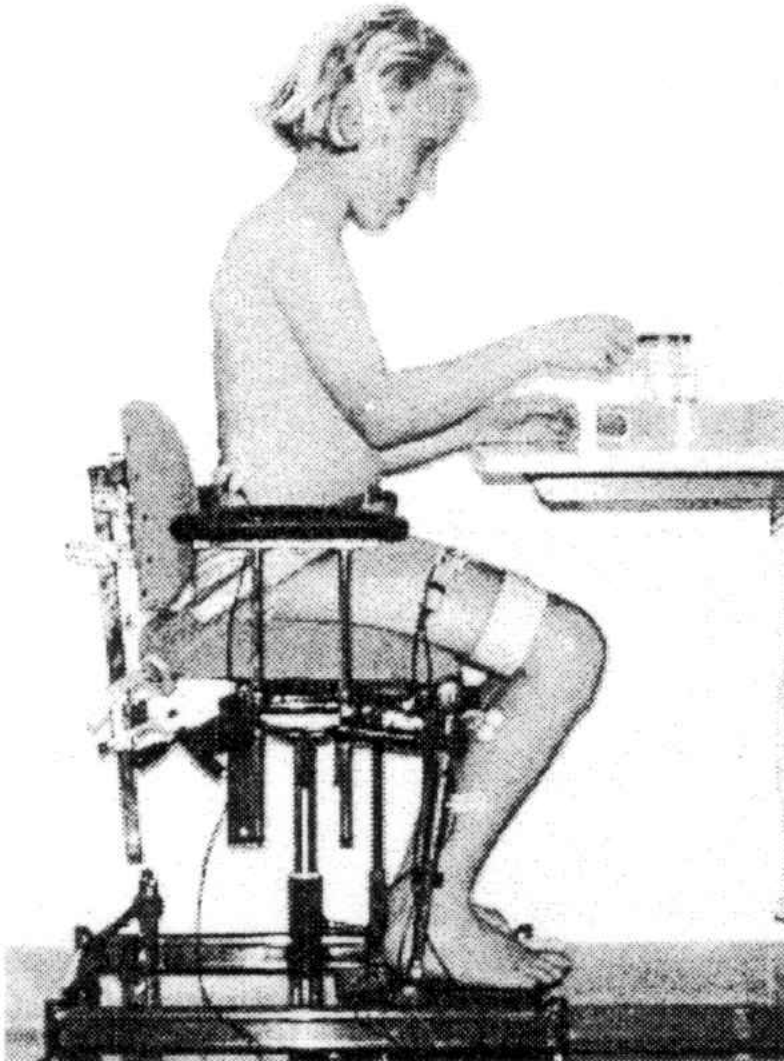


Abduction Orthosis

Findings suggests that if functional sitting position is assured, additional hip orthosis may not further influence muscle tone.

EMG of back and LE muscles during reaching tasks (with or without orthosis): no significant difference

Ekblom & Myhr , 2002



Seat Surface Inclination / Backrest Angle

EMG of back was decreased at 0° horizontal seat position. Nwaobi, 1983

EMG of back/LE muscles was decreased at horizontal compared to 30° recline. Nwaobi, 1986

Scoliosis

Trial: 3-point force system Holmes, 2003

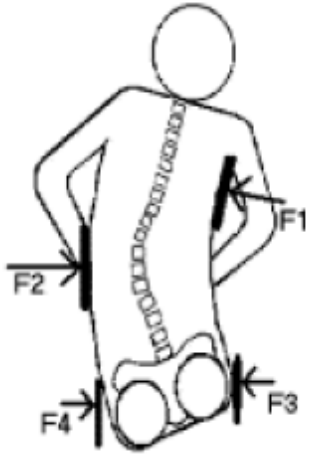
Product: i2i Uyama, 2015

(upper torso, head/neck support system)

3-Point Force System

Non-ambulatory children with cerebral palsy who had scoliosis. Digital image measurements taken for 10-second intervals in test positions.

Asymmetrical lateral supports arranged in a 3-point force system were associated with static correction of scoliosis and improved symmetrical trunk posture.



Holmes, 2003

Product: i2i

Direct application to head rather than pelvis.

Resulted in favorable effect on alignment of spine and prevention of scoliosis.

Provided for improved respiration and improved activities of daily living (ADLs.)

stealthproducts.com

Uyama, 2015
PMID: 25931766

Skin Integrity (Pressure Relief)

Pressure Injury – explained

Positioning for Pressure Relief

Vaisbuch, 2000 Michael, 2007 Sonnenblum, 2011

Tilt-In-Space versus Recline

Pressure Injury

Pressure injury can be a consequence of

- **Pressure** - cell deformation, occlusion of small blood capillaries
- **Friction** - skin is dragged across surface
- **Shear** - skin is pulled in opposing directions
- **Prolonged moisture** - softens tissues, increases susceptibility to damage

Bidabe, 2014

Pressure vs. Shear Forces

Pressure: sustained pressure results in cell deformation, collapse of blood vessels, reduced blood flow, tissue ischemia.

(Gawlitta, 2007)

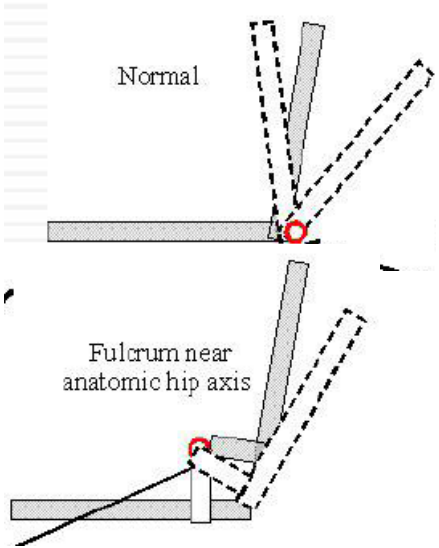
Shear: with higher shear forces present, amount of pressure required to result in blood flow occlusion is cut in half.

(Bennett, 1979)

Backrest: fulcrum position may effect shear

Recline: forward migration tendency, person slides downward, shear forces increase

Pivot point of backrest near hip:
Less shear, less skin deformation



Ball, 2017

Positioning for Pressure Relief

Body-seat interface pressure in four positions: neutral position, versus test positions: recline; posterior tilt; combined tilt & recline; lean forward.

For the myelomeningocele subjects, **maximum pressure at all tested positions was significantly lower than at the neutral position.**

Vaisbuch, 2000

Positioning for Pressure Relief

Posterior seat tilt of 20° or more reduces pressure under the pelvis.

Michael SM, 2007

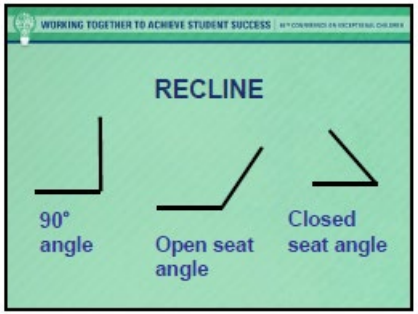
To maximize blood flow increase and pressure relief, perform the posterior tilt as far as the seating system permits. Small tilts provide some benefit.

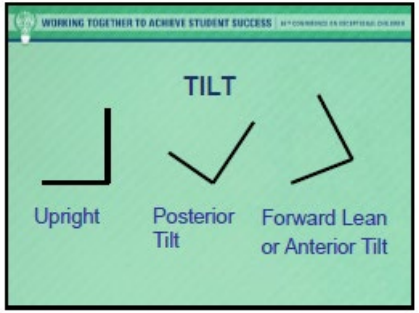
Sonnenblum SE, 2011

Posterior tilt-in-space (TIS) combined with recline reduced pressure more than tilt-in-space alone. Small posterior TIS re-distributes backrest pressure.

Aissaoui, 2001

Backrest Angle vs. Tilt-in-Space





Combined Positioning

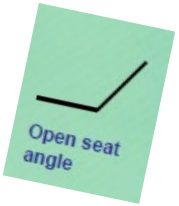
Paleg, 2014

Posterior tilt-in-space (TIS) combined with recline reduced pressure more than tilt-in-space alone.

Aissaoui, 2001

Children with CP extensor spasticity: combined seat angles above horizontal (anterior TIS) with hip flexion angles above 90 degrees (open seat angle). No significant difference to hand function. However, anterior TIS was least often described as "uncomfortable."

Seeger, 1984



Respiration

Use of Adaptive Chair Nwaobi & Smith, 1986

Seat Surface Inclination Reid & Sochaniwskyj, 1991
Shin, 2015

Adaptive Chair

Increases in all respiratory measures (VC, FEV, ET) when child is in adaptive seating as compared to regular sling-like wheelchair.

Nwaobi & Smith, 1986

Measures

- Vital Capacity (VC) - the greatest volume of air that can be expelled from the lungs after taking the deepest possible breath.
- Forced expiratory volume (FEV) in one second - how much air exhaled during a forced breath (in first second)
- Expiratory time (ET) - time taken to exhale a specified volume or fraction of VC

Measures

- **Tidal Volume** - lung volume; normal volume of air displaced between normal inhalation and exhalation
- **Respiratory rate** – breaths per minute
- **Minute Ventilation** - volume of air that can be inhaled or exhaled during one minute (= respiratory rate x tidal volume)
- **Forced Vital Capacity (FVC)** - the amount of air which can be forcibly exhaled from the lungs after taking the deepest breath possible

Seat Surface Orientation

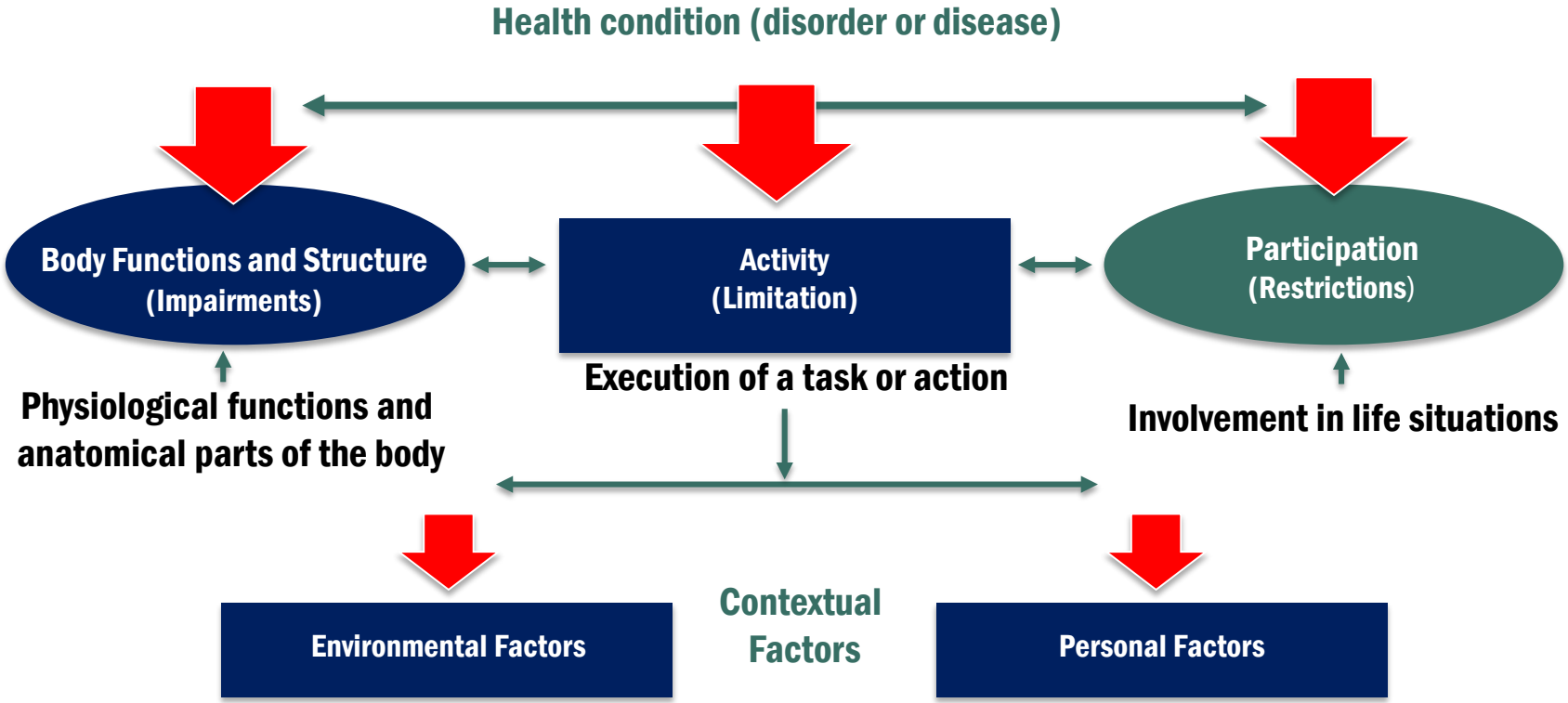
Anterior-tilt seat resulted in improved tidal volume and minute ventilation.

Reid & Sochaniwskyj, 1991

15° anterior-tilt resulted in significantly greater FVC than 15° posterior tilt.

Shin, 2015

The ICF



McDonald, Surtees & Wirz , 2007

Performance

The interaction of the child with the environment.

Performance relates to Participation (involvement in life situations) and is strongly influenced by environmental factors that may facilitate performance or may be a barrier to performance.

Performance relates to Activity (execution of a task or action by an individual) and reflects what the child actually does in everyday settings.

Participation

What does the research say?

Speech

Feeding

AAC-device Use

Activities of Daily Living (Self-Care / Play)

Psychological / Social Interaction

Speech

Higher speech intelligibility scores when adaptive seating used as compared to wheelchair.

Smith, 1985 cited in Miedaner, 1993

Nonverbal children with CP were studied before and after receipt of adaptive seating devices. Diversity of speech sounds and total speech tokens increased.

Hulme, 1989

Children with cerebral palsy were more successful in uttering multi-syllable sentences on one breath when in upright vs. semi-reclined position.

Redstone, 2005

Feeding

Custom-designed foam rubber headpiece eliminated ATNR reflex resulting in increased correct bites of food.

Lee, 1985

Use of adaptive seating resulted in improved oral-motor functioning and progression of eating skills.

Hulme, 1987

Use of thoracic-lumbar-sacral orthosis (TLSO) with a non-rigid frame that provides elasticity to the TLSO had beneficial effects on feeding.

Verkedy, 2007

AAC-device use

Positioning changes for 37-yr-old with spastic quadriplegia affected head control and improved head-typing (increased rate of typing and accuracy rate.)

Bay, 1991

Functional sitting position versus reclined position for 5-yr-old with quadriplegia resulted in improved UE accuracy in selection of one target.

Costigan & Light, 2010

Custom-molded seat back for 19-yr-old with CP/scoliosis slightly improved accuracy in UE activation of switches. Reported social approachability and student-initiated communication increased.

Lee, 1985

Activities of Daily Living (ADLs)

Positive impact on child and family life (parent survey) Ryan, 2009

Improvements in self-care and play in daily life situation (parent survey) Rigby, 2009

Improved ADLs - feeding, computer activities (3 year follow up) Pope, 1994

Psychological

Improved performance and higher psychological test scores when positioned in therapist-recommended adaptive equipment, with increased ability to perform fine motor tasks.

Miedaner, 1993

Social Interaction

Contoured foam seat in infant highchair: parents report improved social interaction, greater independence in hand use and play. Washington, 2002

Use of adaptive seating devices had an overall positive effect…the greatest benefits were in relation to the children's social interactions. Kurne, 2016

"More objective measurements are needed to capture the magnitude of change in social skills and performance of ADLs." Chung, 2007

Adaptive Seating for Participation:

What does the research say?

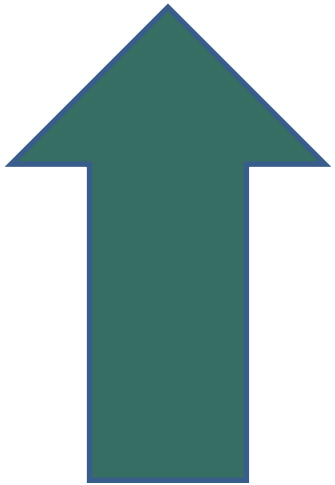
There is generally positive, but inconclusive evidence of effectiveness for postural control and management, seated posture, upper extremity function, and overall clinical outcomes.

Authors of systematic reviews consistently report that they were unable to combine data from original research studies to make sound clinical recommendations.

"An overview of systematic reviews of adaptive seating interventions for children with cerebral palsy: where do we go from here?"
Ryan, 2012

Levels of Evidence

1. Systematic Review
2. Randomized Controlled Trial (RCT)
3. Cohort Study
4. Case-Control Study, Case-Series
5. Case Study, **Expert Opinion**



Sackett, 2000 cited in Chung, 2008 (p307)

Functional Sitting Position

1. **Pelvic Position** [seat surface inclination; seat depth; seat width; seat belt position]
2. **Weight Bearing Surfaces** [posterior thigh surface from buttocks to knees, surfaces supporting the back, feet, and upper extremities]
3. **Body alignment** [backrest angle, seat surface inclination, use of supports/accessories]

Expert Opinion

Kangas, 2000
Paleg, 2014
Bidabe, 2016
Stavness, 2006
Harbourne, 2015
Costigan & Light, 2010
Costigan & Light, 2011
www.childdevelopment.ca

Thank you