

EBPX CAT

Evidence Topic: Adaptive Seating

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Evidence Question: How effective is adaptive seating for children with orthopedic or central nervous system involvement in increasing attention or participation in class?

Question Background:

What real life situations inspired this question?

Individuals with orthopedic or a neuromuscular impairments may often demonstrate increased difficulty to maintain balance and stabilization (Washington, Deitz, White, & Schwartz, 2002). Children who experience difficulty with posture and movement often are not able to achieve or maintain stable postures necessary to fully participate in class activities (Case-Smith, 2005). Adaptive seating is an intervention occupational therapists may incorporate in treatment to enhance a client's ability to engage in and perform daily occupational tasks in varying environments. Adaptive seating is defined as, "The custom prescription and application of sitting support devices based on therapeutic principles" (Roxborough, 1995). Adaptive seating can range from high to low technology. Therapists may incorporate an adaptive seating program in order to reduce abnormal tone related to posture, increase the individual's ability to stabilize posture, and increase upper extremity function (McPherson et al., 1991). A study conducted by McDonald, Surtees, and Wirz (2003), revealed the perceptions of adaptive seating is very different for parents than therapists. In order to increase the level of satisfaction and compliance with use of the adaptive seating, therapists must remember to address the needs of the client and the caregiver not only when determining the optimal equipment needed to increase the client's function but also when recommending its daily use. The focus of this review was on the existing evidence for adaptive seating to

determine if it has shown to be an effective treatment intervention for children with orthopedic or central nervous system involvement to enhance attention, participation, and/or upper extremity function in class.

Parameters of the Search:

It is important to know how thoroughly the literature was searched for research studies concerning the question. If the search was not intensive, important information may be lacking from the review.

Parameters: All studies must include individuals with orthopedic or central nervous system involvement ages 21 and under. The focus of this review was on studies designed to determine the effectiveness of adaptive seating as an intervention to aide in increasing attention, participation, and/or upper extremity function. Studies were excluded if they were not designed to measure attention, participation, and/or upper extremity function as an outcome measure.

Keywords: "adaptive seating", function, cerebral palsy, positioning, seating, orthopedic, "upper extremity", upper extremity function, neuromuscular impairments, neuromuscular disorder, neurological, therapeutic positioning, classroom, tilt, attention, participation.

Websites, Resources: CINAL, PubMed, ERIC, Medline, Cochrane, AOTA website

Evidence Table

Contains appraisals of evidence reviewed.

Key to Level of Evidence

(Level of evidence may be adjusted downward by EBPX team if study has poor rigor.)

Level	1	2	3	4	5
Type of Evidence	Systematic Reviews and meta-analyses	Randomized Control Trials (RCT)	Quasi-experimental and Comparative studies	Correlation and Non-experimental studies	Descriptive studies & Expert Opinion articles

Citation	Type of Evidence & Access	Description of Evidence/ Type of study	Level of Evidence	Description of Population	Description of Intervention	Outcome/ Findings
McNamara, L. & Casey, J. (2007). Seat inclinations affect the function of children with cerebral palsy: A review of the effect of different seat inclines. <i>Disability and Rehabilitation : Assistive Technology</i> , 2(6) 309-318.	Systematic Review On file at Region X Service Center	A systematic review analyzing existing evidence to determine the impact of seat inclinations on postural control, muscle activity, and function of the upper extremity on children with cerebral palsy.	1 This review included level IV evidence	Children with all types of cerebral palsy.	The databases CINAHL, MEDLINE, AMED, Embase, Cochrane Library and Databases if Systematic Reviews, ISI WEB of Science, and OTDBase were searched from 1990-2006 using the following keywords: postural management, posture, positioning, seating, static seating, seat angles, seat inclinations, children, young people, paediatric, pediatric, upper extremity function , limb function, and cerebral palsy. * All studies were critically appraised using McMaster guidelines 10 articles met the inclusion criteria and examined the impact various seating positions had on children with cerebral palsy.	Common categories of outcome areas found within the 10 studies were postural control, muscle activity, and upper extremity function The seat positions evaluated across studies varied widely in degrees of position of the seat base ranging from horizontal, posterior tilt, anterior tilt, and/or supine. Across studies posterior tilt ranged from 5-45° and anterior tilt ranged from 5-30°. The findings of the review revealed within several studies anterior tilt was found to significantly ↑ in arm and hand function ; ↓ abnormal postural movements; ↓ head, trunk, and foot control; ↑ muscle activity in the back ↑ level of fatigue; ↓ muscle activity in the legs with an abductor orthosis. Posterior tilt was found to ↑ muscle activation to facilitate reaching and help maintain head control. Anterior tilt was not found to be the superior intervention across all studies. The degrees of tilt found to be beneficial were also inconsistent across studies. Results reveal children with cerebral palsy need to be assessed individually to determine what type of seating will best enhance function.

Citation	Type of Evidence & Access	Description of Evidence/ Type of study	Level of Evidence	Description of Population	Description of Intervention	Outcome/ Findings
<p>Michael,S., Porter, D., Pountney Chailey, T. (2007). Tilted seat position for non-ambulant individuals with neurological and neuromuscular impairment: a systematic review. <i>Clinical Rehabilitation</i>, 21 (12) 1063-1074.</p>	<p>Systematic Review On file at Region X Service Center</p>	<p>A systematic review analyzing existing evidence to determine how seat position can affect physiology, body parts and systems, and activity in children and adults with neurological or neuro-muscular impairments.</p>	<p>1 Review included evidence ranging from level II-IV.</p>	<p>Participants who were non-ambulant and had a congenital or acquired neurological or neuromuscular condition. Participants included were of all ages. All studies included were on populations with neurological impairment. 10 studies included children with cerebral palsy, neural tube defect, or unspecific neurological impairment. 9 studies included adults with spinal cord injury or multiple sclerosis.</p>	<p>The databases MEDLINE, Embase, CINAHL, and AMED were searched using the following keywords: wheelchair, wheelchairs, seat, seating, tilt, and tip. Studies were located and appraised if they mentioned the effects of seat tilt on outcome for the individual (physiology, body parts and systems, human activity). Randomized and nonrandomized studies were included within the review. Studies were only included in the review if they included participants with congenital or acquired neurological impairment. 15 studies met selection criteria. In three studies the seat was tilted anteriorly ranging from 10-30°, 13 studies tilted posteriorly up to 45°, and in three studies tilted in both directions posterior ranging from 15-30° and anterior ranging from 5-15°.</p>	<p>Findings were not consistent from these studies due to variation in intervention, outcome measures (interface pressure, posture and stability, muscle activity, respiratory function, and other functional activity), and heterogeneity of the population. Evidence suggests posterior seat position reduces pressure under ischial tuberosities for individuals with neurological impairment. Evidence is needed revealing the effects of tilted seat positions on the outcomes of function and participation.</p>

Citation	Type of Evidence & Access	Description of Evidence/ Type of study	Level of Evidence	Description of Population	Description of Intervention	Outcome/ Findings
<p>Roxborough, L. (1995). Review of the efficacy and effectiveness of adaptive seating for children with cerebral palsy. <i>Assistive Technology</i>, 7 (1), 17-25</p>	<p>Systematic Review On file at Region X Service Center</p>	<p>A systematic review to determine how efficient and effective adaptive seating is in achieving proposed outcomes.</p>	<p>1 Review included evidence ranging from level I-V.</p>	<p>Children with cerebral palsy (birth - 19 years old), adaptive seating independent variable, unsupported sitting comparison group or condition was used.</p>	<p>The databases Index Medicus and CINAHL and psychological abstracts were searched for studies conducted between 1982-1994 using the following keywords: seating, adaptive seating, and positioning. Proceedings of the Annual International Seating Symposia and the RESNA Annual conferences were searched manually.</p> <p>Studies were reviewed if they included all 3: 1. Children with cerebral palsy (birth -19 years old) 2. Independent variable- Adaptive seating 3. Comparison group or condition -unsupported sitting.</p> <p>Due to diversity of research designs the studies were evaluated using qualitative review procedures adapted from Sackett's appraisal criteria.</p> <p>8 articles met the inclusion criteria.</p>	<p>Diverse research designs and interventions were utilized across studies.</p> <p>Findings across studies: Parents'/clients' perceptions revealed ↑ performance in each outcome area; ↑ pulmonary function; ↑ sitting posture, head control, and grasp (motor training had no effect); ↑ head alignment, food retention, texture management; no difference between sitting and unsupported sitting in enhancing UE control; ↑ vocalization; ↑ trunk extension; ↑ test scores.</p> <p>Additional studies with more rigorous research designs are needed to further determine if adaptive seating is truly effective.</p>

Citation	Type of Evidence & Access	Description of Evidence/ Type of study	Level of Evidence	Description of Population	Description of Intervention	Outcome/ Findings
<p>Stavness,C. (2006). The effect of positioning for children with cerebral palsy on upper-extremity function: a review of the evidence. <i>Physical & Occupational Therapy in Pediatrics</i>, 26(3) 39-53.</p>	<p>Systematic Review</p> <p>On file at Region X Service Center</p>	<p>A review analyzing existing evidence to determine “the most appropriate sitting position for children with CP to promote energy conservation and optimal functional abilities” (Stavness, 2006).</p>	<p>1</p>	<p>Children with cerebral palsy (movement disorders). Spastic cerebral palsy, specifically diplegia, tetraplegia/quadruplegia, dystonic tetraplegia, and multiple handicaps (hypotonicity, mixed tone, and mental retardation).</p>	<p>The databases MEDLINE, Embase, CINAHL, AMED, Cochrane, OTSeeker, PEDro were searched for studies conducted after 1980 using the following keywords: positioning, wheelchair, postural control, posture adaptive seating devices, patient positioning, cerebral palsy, movement disorders, upper extremity, reaching, grasping, and occupational therapy.</p> <p>All studies included children with spastic cerebral palsy.</p> <p>16 articles met the inclusion criteria within the review and were placed the following categories (pertaining to function as the outcome measure): effect of neutral pelvis positioning, effect of anterior tilt, effect of seat angle, effect of body orientation, and effect of external device.</p>	<p>Several articles revealed an upright (neutral-slight anterior tilt) position improves a child with cerebral palsy’s upper-extremity function.</p> <p>Several articles suggested seat angle has no effect on function.</p> <p>The review suggests children with CP should be fitted for wheelchairs that place them in a 0-15° seated position with a hip-belt, abduction orthosis, footrests, and cutout tray.</p> <p>Additional studies with larger sample sizes and more rigorous research designs are needed to further determine if neutral to anterior tilt is truly effective.</p>

Citation	Type of Evidence & Access	Description of Evidence/ Type of study	Level of Evidence	Description of Population	Description of Intervention	Outcome/ Findings
<p>McPherson, J., Schild, R., Spaulding, J., Barsamian, P., Transon, C., & White, S. (1991). Analysis of upper extremity movement in four sitting positions: A comparison of persons with and without cerebral palsy. <i>American Journal of Occupational Therapy</i>, 45(2), 123-129.</p>	<p>Research article On file at Region X Service Center</p>	<p>Quasi-experimental design The study was designed to determine if the number of movement elements for cerebral palsy during reach was greater than the number of those with out impairments, and to determine if adaptive positioning in 1 of 4 positions altered the amount of movement needed.</p>	<p>3</p>	<p>3 men and 3 women with mild to moderate spastic cerebral palsy and 3 men and 3 women with no clinical signs of pathology that would affect movement. All participants were between the ages of 18 and 21 and could follow the directions given by the experimenter.</p>	<p>All participants were seated in two types of chairs in four experimental positions and were asked to grasp a dowel strategically placed an arm's length away. <u>Position 1:</u> Rifton chair back angle 90°. <u>Position 2:</u> wheelchair back angle 90°. <u>Position 3:</u> Rifton chair 15° posterior tilt at hip <u>Position 4:</u> Rifton chair 15° anterior tilt at hip. Electric light cues signaled the participant to begin the reach. Switches monitored when the reach was completed upon the grasp of a dowel. Muscle movements were measured separately at 3 segments (upper arm, forearm, and hand) by surface electrodes placed on the arm. All participants were allowed 10 practice trials in position 1. An OT adjusted equipment to fit each participant and the velocity and acceleration rate of the muscle was determined by a software program.</p>	<p>Differences between the number of movement elements while reaching for the dowel in participants with and without cerebral palsy were confirmed. Overall individuals with cerebral palsy had a greater number of movement elements. These differences were attributed to the number of movement elements in the hand and forearm. No significant differences were found between the different seat positions and the number of muscle movements used within each group.</p>

Citation	Type of Evidence & Access	Description of Evidence/ Type of study	Level of Evidence	Description of Population	Description of Intervention	Outcome/ Findings
<p>Miedaner,J.;; Finuf,L. (1993). Effects of adaptive positioning on psychological test scores for preschool children with cerebral palsy. <i>Pediatric Physical Therapy</i>, 5(4), 177-182.</p>	<p>Research article On file at Region X Service Center</p>	<p>Repeated measures design This study was designed to evaluate the relationship between the use of adaptive positioning and performance on the Bayley Scales of Infant Development Mental Scale.</p>	<p>3</p>	<p>12 children between the ages of 12-58 months with mild to severe spastic or athetoid cerebral palsy, diplegia, or quadriplegia. Participants selected from 3 different preschool based on their age, diagnosis, evidence of ≤ 12 month motor age, no visual, auditory, or cognitive deficits.</p>	<p>The Bayley Scales of Infant Development was administered by a certified psychologist to each participant with and without positioning devices 15-20 minutes apart. Positioning devices included: travel chairs, kinder chair with insert, prone stander Unpositioned seating included: sitting in parents lap, the floor, or at a small table without positioning devices Each participant participated in a brief assessment and trial period with equipment. The trial period aimed toward maximizing UE reaching, positional symmetry, and head/trunk and UE support. Prior to equipment selection the participant had to maintain supported midline position of head, trunk, and hips for 5 minutes.</p>	<p>Significant differences were found between both the positioned and unpositioned groups. Adaptive positioning was found to increase the speed of test performance and task completion during 67% of the positioned situations. **Additional studies are needed to determine if hand and UE function are enhanced. ** Although the scores of participants improved with positioning the conclusion of the study revealed the difference in test scores may not have reflected the true cognitive status of the children.</p>

Citation	Type of Evidence & Access	Description of Evidence/ Type of study	Level of Evidence	Description of Population	Description of Intervention	Outcome/ Findings
<p>Nwaobi,O. (1987). Seating orientations and upper extremity function in children with cerebral palsy. <i>Physical Therapy</i>, 67 (8), 1209-1212.</p>	<p>Research Article On file at Region X Service Center</p>	<p>Repeated measures single-group design Designed to measure the performance time of an upper extremity activity in four different seat angles to determine the effect positioning had on voluntary motor function.</p>	<p>3</p>	<p>Children ages 8-13 with cerebral palsy, not ambulatory, required use of adapted seating, fair-poor gross motor skills, poor fine motor skills, fair head and trunk control. The study included 3 individuals with athetoid cerebral palsy and 10 individuals with spastic cerebral palsy.</p>	<p>Individuals were seated in a positioning device with head, neck, and trunk in same vertical plane. Head and neck were supported by neck collar; trunk by backrest and anterior chest panel; pelvis by lap belt; knees and ankles were positioned at 90°.</p> <p>The individuals were randomly positioned at 0°, 15 ° (anterior and posterior tilt), and 30° posterior tilt.; asked to perform timed activity (start-shoulder abducted and asked to move hand to midline to push switch); movement to push switch repeated 10 times, time stopped on last push. 5 minute rest breaks in between position changes break time started at new position; repeat entire activity in reverse order of seat position.</p>	<p>Findings suggest seat position does affect upper extremity function in children with cerebral palsy.</p> <p>Upper extremity performance levels were the highest when all individuals were positioned at 0°. The lowest upper extremity performance levels occurred when individuals with athetoid cerebral palsy were positioned at 15° anterior tilt, and when individuals with spastic cerebral palsy were positioned at 30° posterior tilt.</p>

EBPX Summary

Summary of the EBPX team on the collective evidence reviewed.

No evidence was directly available for adaptive seating and the outcome measures of attention and participation in class. However, the effectiveness of adaptive seating on enhancing upper extremity function was tested within several studies and indirectly relates to attention and participation.

The finding across studies revealed seat inclinations affect the function of children with cerebral palsy. However, the angle of seat incline/tilt found to enhance function varied between studies and between children with different types of cerebral palsy. Research evidence suggests adaptive seating has shown to be effective in improving posture and enhancing pulmonary function. Results of studies also suggest posterior seat position reduces pressure under ischial tuberosities for individuals with neurological impairment.

The design and outcome measures of the studies reviewed widely varied and very few studies have been replicated with larger sample sizes to determine whether adaptive seating is an effective intervention to aide in increasing attention, participation, and/or upper extremity function in class.

EBPX Strength and Impact Summary

Interpretation of the collective evidence reviewed by the EBPX team.

Adaptive seating is an intervention occupational therapists use on a daily basis and find to be effective in enhancing clients' ability to engage in and perform daily occupational tasks in a variety of environments.

Adaptive seating appears to enhance function, but the inconsistency across existing adaptive seating studies findings suggests this intervention is highly individualized. Each child should be evaluated and treated on an individual basis to further determine what position helps the child to increase his or her level of engagement and performance in daily occupational tasks.

There is SUGGESTED EVIDENCE THAT THIS INTERVENTION MAY BE EFFECTIVE. Therapists are cautioned to carefully measure individual outcomes when selecting this intervention.

More research studies need to be conducted with larger sample sizes and similar study designs and outcome measures as studies conducted in the past. This research will help determine if the results of previous studies can be replicated and determine if adaptive seating is an effective intervention to aide in increasing attention, participation, and/or upper extremity function in class in children with orthopedic or central nervous system involvement.

References

- Case-Smith, J. (2003). Occupational therapy for children (5th ed.). St. Louis: Elsevier Inc.
- McDonald,R., Surtees,R., & Wirz,S. (2003). A comparison between parents' and therapists' views of their child's individual seating systems. *International Journal of Rehabilitation Research*, 26 (3) 235-243.
- McPherson, J., Schild, R., Spaulding, J., Barsamian, P., Transon, C., & White, S. (1991). Analysis of upper extremity movement in four sitting positions: A comparison of persons with and without cerebral palsy. *American Journal of Occupational Therap*, 45(2), 123-129.
- McNamara, L. & Casey, J. (2007). Seat inclinations affect the function of children with cerebral palsy: A review of the effect of different seat inclines. *Disability and Rehabilitation: Assistive Technology*, 2(6) 309-318.
- Michael,S., Porter, D., Pountney Chailey, T. (2007). Tilted seat position for non-ambulant individuals with neurological and neuromuscular impairment: a systematic review. *Clinical Rehabilitation*, 21 (12) 1063-1074.
- Miedaner,J.; Finuf,L. (1993). Effects of adaptive positioning on psychological test scores for preschool children with cerebral palsy. *Pediatric Physical Therapy*, 5(4), 177-182.
- Nwaobi,O. (1987). Seating orientations and upper extremity function in children with cerebral palsy. *Physical Therapy*, 67 (8), 1209-1212.
- Roxborough, L. (1995).Review of the efficacy and effectiveness of adaptive seating for children with cerebral palsy. *Assistive Technology*, 7 (1), 17-25.

Stavness,C. (2006). The effect of positioning for children with cerebral palsy on upper-extremity function: a review of the evidence. *Physical & Occupational Therapy in Pediatrics*, 26(3) 39-53.