

When seated in a wheelchair, how many degrees tilt is needed to improve postural stability for function in children with a neurological disorder?

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Clinical Question

“When seated in a wheelchair, how many degrees tilt is needed to improve postural stability for function in children with a neurological disorder?”

Clinical Scenario

Occupational therapists working with children with a neurological disorder often prescribe tilt in space wheelchairs to improve postural stability and enhance function. In most situations clinical decision making is based on a therapists' experience rather than evidence based practice.

Tilt in space is a costly feature to add to a wheelchair. Justifying the need for this feature is an increasingly more difficult task, as available funding does not equate to the equipment needs of people with a disability.

In the current economic climate we as prescribers of equipment must be accountable and able to provide evidence to justify cost /benefits. What is the evidence that the provision of tilt in a child's wheelchair assists to improve postural stability and function?

Summary of Key Findings

- 2 studies (case series) were located that met the inclusion/exclusion criteria
- 11 expert opinions were also located and appraised

Clinical Bottom Line

Currently available literature does not substantiate the use of tilt to improve postural stability for function in children with a neurological disorder. Each case for tilt in space should be individual and methods as outlined in the research may be a useful starting point for this process.

Methodology

Search Strategy

Using the levels of evidence as defined by the NHMRC (2000), the search strategy aimed to locate the following study designs:

Level I	Systematic reviews and meta-analyses;
Level II	Randomised controlled trials'
Level III	Controlled trials, cohort or case-control analytic studies;
Level IV	Case series: Post-test only, Pre-test/Post-test;
Level V	Expert opinion including literature/narrative reviews, consensus statements, descriptive studies and individual case studies.

A search was also conducted for clinical practice guidelines based on these levels of evidence.

Search Terms

- Patient/Client:
 - Children with a neurological disorder/disease/condition
 - Children with a physical disability
 - Paediatrics/pediatrics
 - Neuromuscular disorders
 - Developmental disability
 - Cerebral Palsy
 - Muscular Dystrophy
 - Spina Bifida
- Intervention:
 - Degrees of tilt in a wheelchair
 - Tilt in space
 - Gravity assisted positioning
- Comparison:
 - Nil
- Outcome:
 - Improved postural stability
 - Improved postural alignment
 - Improved function
 - Improved/increased comfort
 - Functional head position

Sites/Resources Searched

- Guidelines
 - National Association of Neurological OT's (NANOT)
 - NHMRC
 - New Zealand Guidelines Group
 - Healthbase

- UK Guidelines
- Scottish Intercollegiate Guidelines Network (SIGN)
- Clearing house
- Systematic Reviews
 - Cochrane
 - DARE
 - PEDro
 - Centre for Clinical Effectiveness (Monash University)
- General Research
 - Pubmed
 - Medline
 - CINAHL
- Other
 - Tania Roncolato (Seating Clinician, Invacare)
 - Iona Novak (Research Fellow, Spastic Centre)
 - RESNA

Inclusion/Exclusion Criteria

Inclusion Criteria

- Studies relating to paediatrics
- Studies only relating to functional outcomes
- Studies published in English

Exclusion Criteria

- Studies that discussed functional outcomes in relation to pressure relief
- Articles based on an authors 'expert opinion'

Results

13 relevant studies were located and categorised as follows:

Table 1: Study designs of articles retrieved by search

Methodology of Studies Retrieved	Number Located	Sources of Evidence
Clinical Practice Guidelines (Evidence Based)	0	N/A
Systematic Reviews or Meta - Analyses	0	N/A
Randomised Controlled Trials	0	N/A
Controlled trials, cohort or case-control analytic studies	0	N/A
Case series: Post-test only, Pre-test/Post-test	2	Iona Novak x 1 CINAHL x 1
Expert opinion including literature/narrative reviews, consensus statements, descriptive studies	11	CINAHL x 1 Tania Roncolato x 10

Specific Results

Due to the low level of evidence found, all studies located were critically appraised, so as to report on current findings in order to suggest alternative research designs.

SUMMARIES OF EVIDENCE

STUDY 1

Nwaobi, O.M. (1987). Seating orientations and upper extremity function in children with cerebral palsy. *Physical therapy*, 67(8):1209-1212.

Objective

To determine the effect of body orientation on upper extremity function in children and adolescents with cerebral palsy.

Method

- The sample consisted of 13 children with cerebral palsy aged between 8 and 16 years. 10 were diagnosed as spastic and 3 as athetoid cerebral palsy. No children had an intellectual disability or were on medication.
- Baseline data was taken on upper extremity and head control and given a rating of poor, fair, good or excellent. The tool used was not described.
- All children were positioned in the same positioning device, with a switch placed in the middle of a tray in front of them.
- Each child was then given the same upper extremity activity to do (end result was to hit the switch) and their speed was timed.

- The seat was randomly moved between 0, 15 (anterior and posterior) and 30 degrees. This resulted in 8 functional scores (0, 15 (ant and post), 30 and then a retest of these 4 positions)
- Outcome Measure recorded was the performance time of a prescribed upper extremity activity in four different seating orientations.
- The four positions were repeated in reverse sequence to evaluate the reliability of each result, in each position, and the influence of time on the results.
- Trials were repeated if subject became distracted.

Results

- A statistically significant result ($p < 0.05$) was found between using 0 and 15 (anterior and posterior) degrees tilt. Best time was at 0 degrees tilt during the retest phase.
- Children with spastic cerebral palsy generally did better than those with athetoid cerebral palsy
- Children with spastic cerebral palsy generally improved during the retest phase of the trial (practice effect).
- Children with athetoid cerebral palsy generally did worse during the retest phase of the trial. For further detail see table 1, 2 and figure 3.

Conclusions and Clinical Implications

Author

- That orientation of body in space affects upper extremity function for children with types of disorders involved in this study
- Suggest need for intragroup evaluation of research data obtained from persons with cerebral palsy.
- Suggests that the upright position should be used to re-educate and strengthen voluntary movement patterns in **these individuals**

Reviewer

- Some statements in the discussion relate to expert opinion and were not directly evaluated in the study or could not be seen as valid conclusions considering the small nature of the study. Eg, "Thus, although the child may appear to be comfortable and well seated in these positions (15 and 30° tilt), the results of this study show that these are not the preferred positions for maximizing the type of upper extremity function used for this study".
- Extraneous variables were not measured in this study but still discussed as possible indicators as to why tilt was not as successful eg, need for horizontal eye contact, fatigue of using arms against gravity, increase in intensity of abnormal patterns over time.
- Can't generalise these results as possibly suggested by this author
- Although the results are statistically significant, the author does not say whether the results are of clinical significance.
- The study design was limited and no confidence intervals were provided (nor were these able to be calculated). As a result, can be made on the clinical significance of the results.

STUDY 2

Angelo, J. (1993). Using single-subject design in clinical decision making: The effects of tilt-in-space on head control for a child with cerebral palsy. *Assistive Technology*, 5: 46-49.

Objective

To determine the effect of tilt in space on head control for a child with cerebral palsy.

Method

- Observed a 9yr old girl with cerebral palsy once a week for 10 weeks.
- This took place in a non graded mainstream classroom.
- Observation was made on the same day each week for 2 hours in the morning.
- 0, 15 and 30 degrees tilt where applied randomly every 20 minutes during the 2 hour period.
- Time sampling recording was used. Data collected each minute over 15 minute period. Score:
 - 1 = faced activity
 - 2 = unclear if faced activity
 - 3 = didn't face activity
- Data recorded on activities the subject enjoyed.

Results

- Given in graph form as a % of time the child spent directly facing activity over the number of sessions:
 - 0° - 74.8%
 - 15° - 98.5%
 - 30° - 90.7%

Conclusions and Clinical Implications

Author

- Although a small effect size, the study did indicate that this child had more consistent head positioning at 15°.
- This information would be generalised to the child's other activities so that she would fatigue less quickly.
- Concluded that if a subject has high energy and motivation and tolerates an upright position, should be tilted to 15°. As they tire, change the tilt to 30° for more trunk and head control.
- The author stated that statistical analysis was not necessary in this study.

Reviewer

- Can't generalise these results to other activities as possibly suggested by this author
- No base line data taken of how she was positioned prior to this study taking place
- No information given on severity of disability, quality of tone, other existing disabilities eg CVI

- May be useful to replicate for one client only at a time as an observation tool to measure the effect of tilt in space. Other extraneous factors such as fatigue, type of activity, time of day, existing conditions were not accounted for in this study.

SUMMARY OF LEVEL 5 ARTICLES – EXPERT OPINIONS

Several articles related to degree of wheelchair tilt were excluded for the following reasons:

- (a) only discussed tilt in space in regards to pressure control,
- (b) looked only at recline, and
- (c) looked only at adults.

1. Scmeler, M.R., Boninger, M.D., Cooper, R., & Vitek, M. (2002). Using peer reviewed literature and other evidence to justify wheelchair seating and mobility interventions. *Paper presented at the 18th International Seating Symposium.*

“The purpose of this paper was to provide a brief review of the levels of evidence, briefly review the current state of evidence in the field of wheelchair seating and mobility, and present methods for locating evidence and assessing the level of evidence. The majority of the paper focussed on how evidence can be used to strengthen a practitioner’s request to funding bodies.”

In regards to tilt in space, no systematic reviews or RCTs were identified. This paper provided a comprehensive reference list to assist with searching for articles.

2. Kreutz, D. (1997). Power tilt, recline or both. *Team Rehab Report*, March. 29 – 31.

Amongst other things this article discusses how “postural alignment can be improved by changing the orientation of the body and seating system relative to the pull of gravity. This so called gravity-assisted positioning can address some of the postural support needs of the user and at the same time allow for improved function.”

The article lists some of the technology considerations and related thought provoking questions. These can be useful as a checklist when needing to justify equipment prescription to funding bodies.

3. Pfaff, K. (1993). Recline and tilt: Making the right match. *Team Rehab Report*, October. 23 – 27.

This article reviews the various reasons why a recline and / or tilt may be of benefit to a particular client. It outlines the reasons why a change of position can be helpful whether for function, comfort or pressure relief, and/or for caregiver. The article provides a nice summary on (1) when to tilt and (2) when to recline. It also covers issues raised regarding environmental access when using tilt / recline.

4. Babinec, M. (Undated). Benefits of “weight shift” technology: Manual tilt in space. *Rehab Training & Education* handout.

Simple one page handout outlining the difference between “traditional” tilt in space systems, and “weight shift” tilt in space systems.

5. Babinec, M. (Undated). Manual tilt in space wheelchairs: Benefits with clinical and functional applications. *Rehab Training & Education* handout.

Simple one page handout which sets information out in a table format. Information is provided on the clinical and functional applications of manual tilt in space, covering the following benefits :

Pressure relief, positioning, orthopedic / neurological considerations, endurance, function, medical and caregiver issues.

6. Fields, C.D. (1991). Getting centered with tilt in space. *Team Rehab Report*, September / October. 22 – 27.

This article reviews how to make the right client-to-product match when prescribing a tilt frame. It covers the following topic areas:

- Defining tilt in space
- When to choose tilt in space
- Tilt specific concerns
- How much tilt is enough
- Caregiver considerations
- Products on the market

7. Fields, C.D. (1992). Living with tilt-in-space. *Team Rehab Report*, June. 25 – 26.

Short two page article which outlines common issues which the rehab team must be aware of to ensure a client’s tilt-in-space wheelchair is functional in their home environment. It also covers transportation issues.

8. Sommerfreund, J. & Masse, M. (1995). Combining tilt and recline. *Team Rehab Report*, October. 18 – 20.

This article outlines the difference between tilt and recline as well as their respective benefits and limitations. Also discusses how the two can be used in combination.

9. Kemper, K. (1993). Gravitating toward tilt-in-space. *Team Rehab Report*, March / April. 31 – 35.

This article discusses the fact that over the past several years (article published 1993) there has been a huge increase in the popularity of tilt-in-space wheelchairs. It reviews the wide range of problems and diagnoses that tilt-in-space is being used to address. It also reviews several particular systems, some of which are not, to our knowledge, available in Australia.

10. Howell, B. (1994). Full tilt. *Team Rehab Report*, September. 25 – 28.

This article is a single case study description of Zack. Zack is a young man who was diagnosed with Spinal Muscular Atrophy type II when he was 1 year old. The article describes the clinical reasoning involved with prescribing a power wheelchair and seating system for Zack. The aim for Zack's rehab team was to prescribe a wheelchair which would provide an appropriate positioning system and pressure relief and still let him be a kid!

11. Tatum, L. (1996) . Tilt and recline: A balance of cost and consumer need. *Team Rehab Report*, April. 31 – 32.

Short two page article which reviews new paediatric systems and the two most important issues for family and client. These are (1) the ability to transport the system, and (2) the ability to "grow" the system.

REFERENCE LIST

Articles appraised and/or summarised

- Angelo, J. (1993). Using single-subject design in clinical decision making: The effects of tilt-in-space on head control for a child with cerebral palsy. *Assistive Technology*, 5: 46-49.
- Babinec, M. (?). Benefits of "weight shift" technology: Manual tilt in space. *Rehab Training & Education* *handout*.
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- Tatum, L. (1996). Tilt and recline: A balance of cost and consumer need. *Team Rehab Report*, April. 31 – 32.

Related articles not included in this summary of evidence

- Leiper, C.I., Miller, A., Lang, J., & Herman, R. (1981). Sensory feedback for head control in cerebral palsy. *Physical Therapy*, 61 (4). 512-518.
- McPherson, J.J., Schild, R., Spaulding, S.J., Barsamian, P., Transon, C., & White, S.C. (1991). Analysis of upper extremity movement in four sitting positions: A comparison of persons with and without cerebral palsy. *American Journal of Occupational Therapy*, 45(2). 123-129.
- Neilson A.R., Bardsley, G.I., Rowley, D.L., Hogg, J., Malek, M., Morrison G.C., & Kirkwood, C.A. (2001). Measuring the effects of seating on people with profound and multiple disabilities – A preliminary study. *Journal of Rehabilitation Research and Development*, 38(2). 201-214.
- Roxborough, L. (1995). Review of the efficacy and effectiveness of adaptive seating for children with cerebral palsy. *Assistive Technology*, 7. 17 – 25.