Why Full-time Power Wheelchair Users Tilt

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RESNA
Background

- Pressure ulcers (PUs) are a problem
- PUs are caused by loading
- Managed clinically via:
  - cushions and support surfaces (magnitude)
  - pressure reliefs (duration)
- When independent pressure reliefs are not an option, powered tilt or recline may be employed.
Other purposes for tilting?

• increased comfort and sitting tolerance secondary to the decreased pressure
• increased function
  – Secondary to increased sitting tolerance and more time out of bed
  – variable positions available for access and reach in different situations
  – improved head and neck control
  – easier transfers
• Improved sleep and rest
• increased blood flow
• easier feeding
• improved respiratory function

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Lacoste et al: A Survey about Tilt and Recline

- 40 people
- how and why they used their systems
  - comfort/discomfort/pain
  - rest/relaxation
  - posture
  - functional independence
  - physiological functions (including pressure reliefs)
- 97.5% reported using their tilt or recline system daily
- > 70% used their tilt and recline systems for comfort, rest, relaxation, and pain
- few participants reported using the chairs for prevention of pressure sores or other physiological functions.

Purpose of the Current Studies

• **Monitoring Study**: To explore how fulltime power wheelchair users utilized their tilt systems.
  – Did participants utilize their tilt feature?
  – Did participants perform regular weight shifts?
  – Why do people use their tilt?
  – Why don’t people perform regular pressure reliefs using their tilt system?

• **Tilt Angle Pilot Study**: To determine if people know how far to tilt for pressure reliefs
Monitoring Study
Methods: Subjects and Protocol

• Convenience sample: N=16 (11 men, 5 women),
• Fulltime power wheelchair users
• Varying diagnoses
• 2 weeks of monitoring
• WhAMI (Wheelchair Activity Monitoring Instrument)
  – Occupancy switches
  – Accelerometer for tilt angle
  – Record every 2 seconds
• Asked (n=15) why or when they use tilt (open ended)
Monitoring Study
Review of Tilt Results

All Tilts (Position changes of 5°)
- Nearly half of subjects tilted regularly (1x / 15 minutes)

Pressure Relieving Tilts (>30° for > 1 minute)
- Median subject = 1 pressure relieving tilt every 7 hours
- Only 3 subjects performed pressure relieving tilts at least once per hour
- Only 6 subjects tilted to 45°
- Some subjects never reached 30°

Typical Position
- Some subjects spent most of their time between 15° and 30°
## Monitoring Study
### Purpose of Tilt Use

<table>
<thead>
<tr>
<th>Subject</th>
<th>Comfort / Discomfort / Pain</th>
<th>Rest / Relaxation</th>
<th>Posture</th>
<th>Functional Independence</th>
<th>Physiological Functions</th>
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*Note: X indicates that the subject is included in the corresponding category.*

**wheeled mobility in everyday life**
Monitoring Study
Median Tilt Use By Purpose

<table>
<thead>
<tr>
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<th>Comfort/Discomfort/Pain</th>
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<tr>
<td></td>
<td>No (6)</td>
<td>Yes (9)</td>
<td>p-val</td>
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<tr>
<td>Typical Position ( )</td>
<td>7</td>
<td>15</td>
<td>0.290</td>
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<tr>
<td>Tilt Frequency / hour of</td>
<td>4.9</td>
<td>2.8</td>
<td>0.178</td>
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<tr>
<td>wheelchair occupancy</td>
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<tr>
<td>PRT Frequency / hour of</td>
<td>0.6</td>
<td>0.1</td>
<td>0.194</td>
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<tr>
<td>wheelchair occupancy</td>
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<td></td>
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<tr>
<td>% Time &gt; 30</td>
<td>12%</td>
<td>3%</td>
<td>0.194</td>
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<table>
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<th>Rest/Relaxation</th>
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<td>No (7)</td>
<td>Yes (8)</td>
<td>p-val</td>
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<td>Typical Position ( )</td>
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<td>0.102</td>
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<td>Tilt Frequency / hour of</td>
<td>4.2</td>
<td>1.6</td>
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<td>wheelchair occupancy</td>
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<td>3%</td>
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Tilt use when used for physiological purposes including pressure reliefs

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<td>No (4)</td>
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<td>Typical Position (°)</td>
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<tr>
<td>Tilt Frequency / hour of wheelchair occupancy</td>
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<tr>
<td>Pressure Relieving Tilt Frequency / hour of wheelchair occupancy</td>
<td>0.1</td>
</tr>
<tr>
<td>% Time &gt; 30</td>
<td>3%</td>
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</table>
Comparison with Lacoste et al.’s Survey Results

SIMILARITIES
• 14/15 subjects reported comfort, pain, or rest as a purpose of use

DIFFERENCES
• Many participants reported physiological purposes
• Many participants had at least one day in which they did not use their tilt feature to change position more than 5°.
Tilt Angle Pilot Study

- Do people know how far to tilt for pressure relief?
- Are people aware of how far they are tilted?
- Does training help?
Tilt Angle Study
Able-bodied Students

- N = 11 able bodied students
- Adjusted footrests on a tilt-in-space power wheelchair for optimal fit
- Asked to tilt “as far as needed for pressure relief”, measure actual angle (x3)
- Asked to tilt to 45°, measure actual angle (x3)
- Shown 45° of tilt and asked to replicate the position, measure actual angle
- 1 week later – ask subjects to tilt to 45°
Tilt Angle Study

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Tilt Angle Study
Able-bodied Students: Before Training

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Tilt Angle Study
Able-bodied Students: Training Effects

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Tilt Angle Study
Current Tilt Users

• Randomly selected people who use powered tilt wheelchairs were asked to “demonstrate a pressure relief” 3 times
• Angle with horizon was measured
Tilt Angle Study
Current Tilt Users

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Discussion

Monitoring Study
- Do frequent, small position changes offer restorative benefits to wheelchair users?
- How can we predict who will take advantage of their tilt system?

Tilt Angle Study
- How can we improve training to make sure everyone knows how far to tilt?
- What sort of follow-up can we provide to improve retention of knowledge about tilts and pressure reliefs?
- If training successfully teaches people how far to tilt, why are some people still not tilting?

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Acknowledgements

- Research Team and Co-Authors
  - Stephen Sprigle, Ph.D., PT
  - Chris Maurer, MPT, ATP
  - Frances Harris, Ph.D.

- Many students helped with instrumenting participants and conducting the pilot study

- Subjects

- Funding Sources
  - NIDRR – RERC on Wheeled Mobility
  - NSF Graduate Research Fellowship Program
Questions?
Future Work

• Future work should identify the benefits of small position changes in terms of comfort, pain reduction, and pressure ulcer prevention.

• Additionally, it should aim to demonstrate for which subjects the tilt feature will be most beneficial.