Balancing manual stability and 'tippiness' for functional independence

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- Introduction
- The Research Question
- Methodology
- Results
- Conclusions & Recommendations

Wheelchair assessment: Key factors

Rear Axle Position (RAP): The Theory

Adjusting RAP forward:

- Reduces castor forces and thus
- Reduces the force necessary for propulsion

Is this true?

Rear Axle Position (RAP) – Research to date

'adjust the rear axle as far forwards as possible without compromising the stability of the user' (Paralysed Veterans of America, 2005)

Aspire
Association for spinal injury research rehabilitation and reintegration

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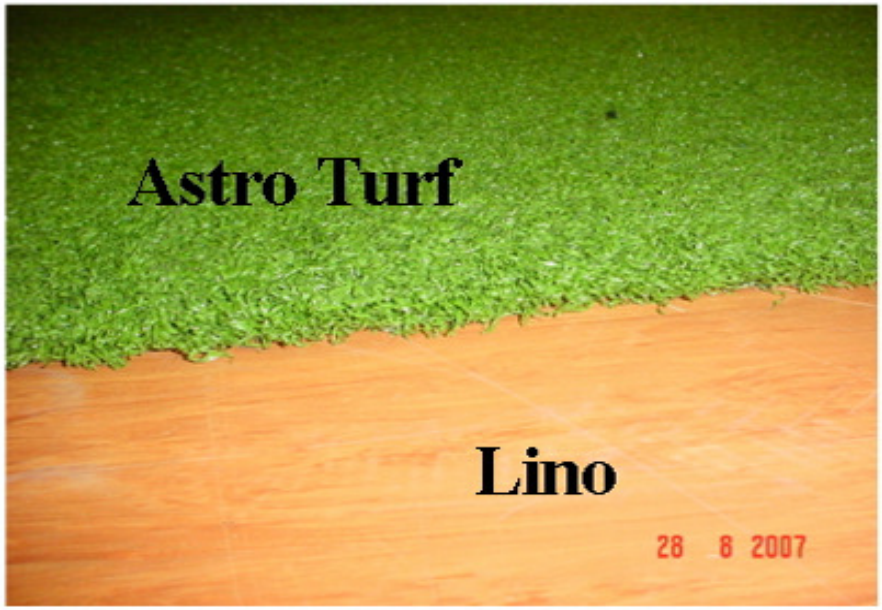
Methodology: Surfaces



Effect of surface

Hard Surface

RR Increases

Soft Surface

Flat Surface

RR Increases

Based on Brubaker, J. Rehab. R&D., 1986

Methodology: What we measured & how

- **Push rim forces**
  - **Moments**
  - **Cadence**
  - **Velocity**

With a SmartWHEEL

&

Castor Forces
Using unidirectional force transducers

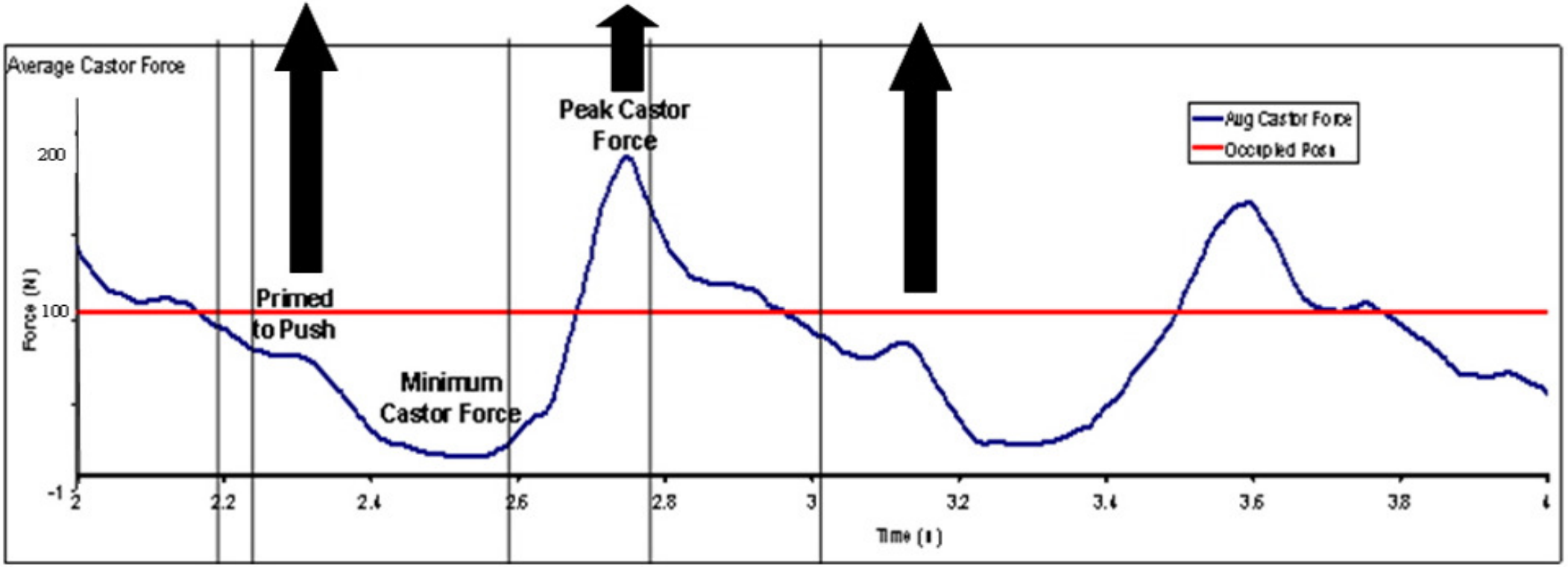
Subjects:

- 8 experienced manual wheelchair users (> 2 yrs post-injury)

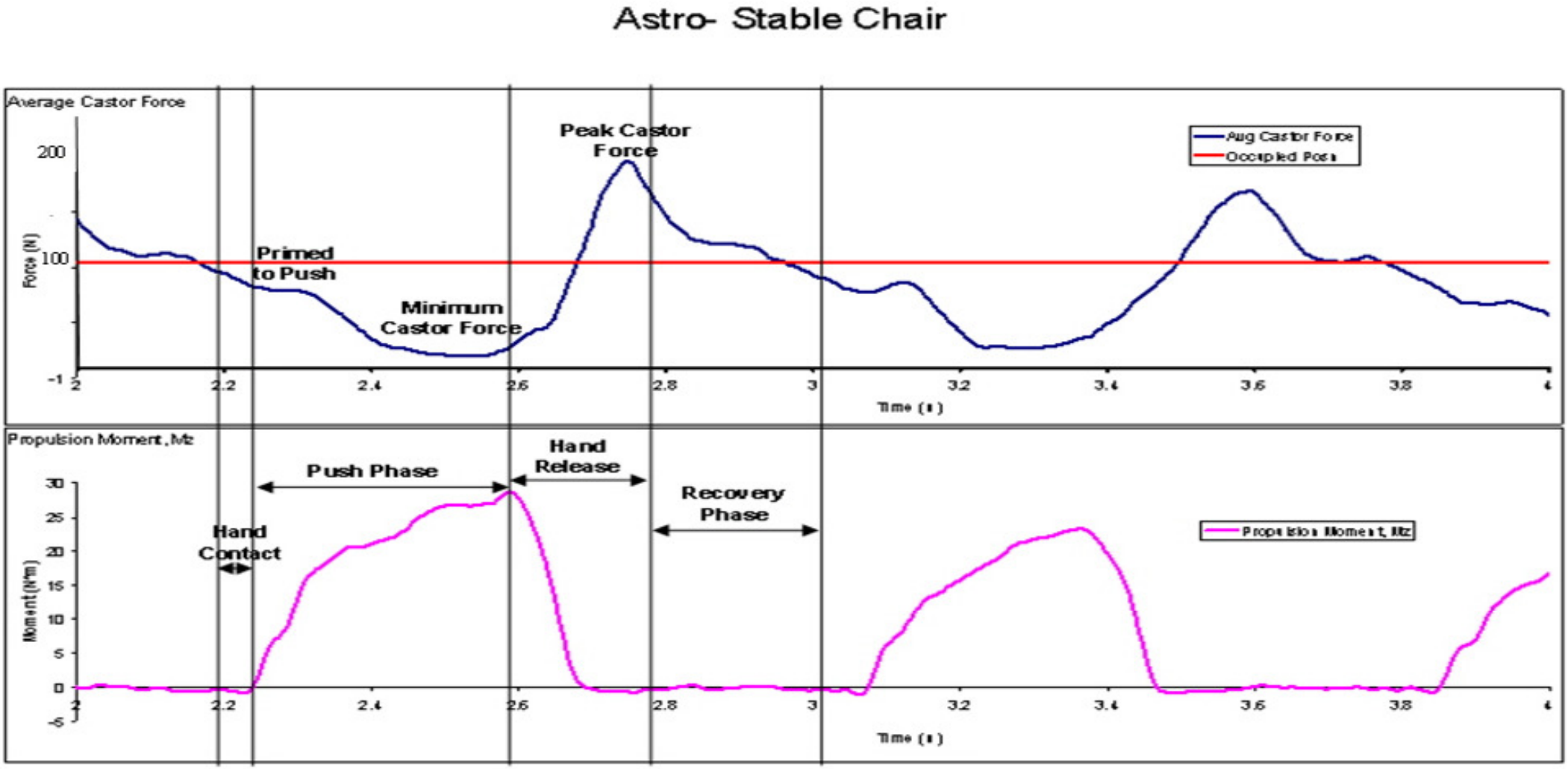
Inclusion Criteria:

- Spinal Cord Injury below the level of T1
- No history of upper limb pain/trauma

Castor Forces: Iino & Astro

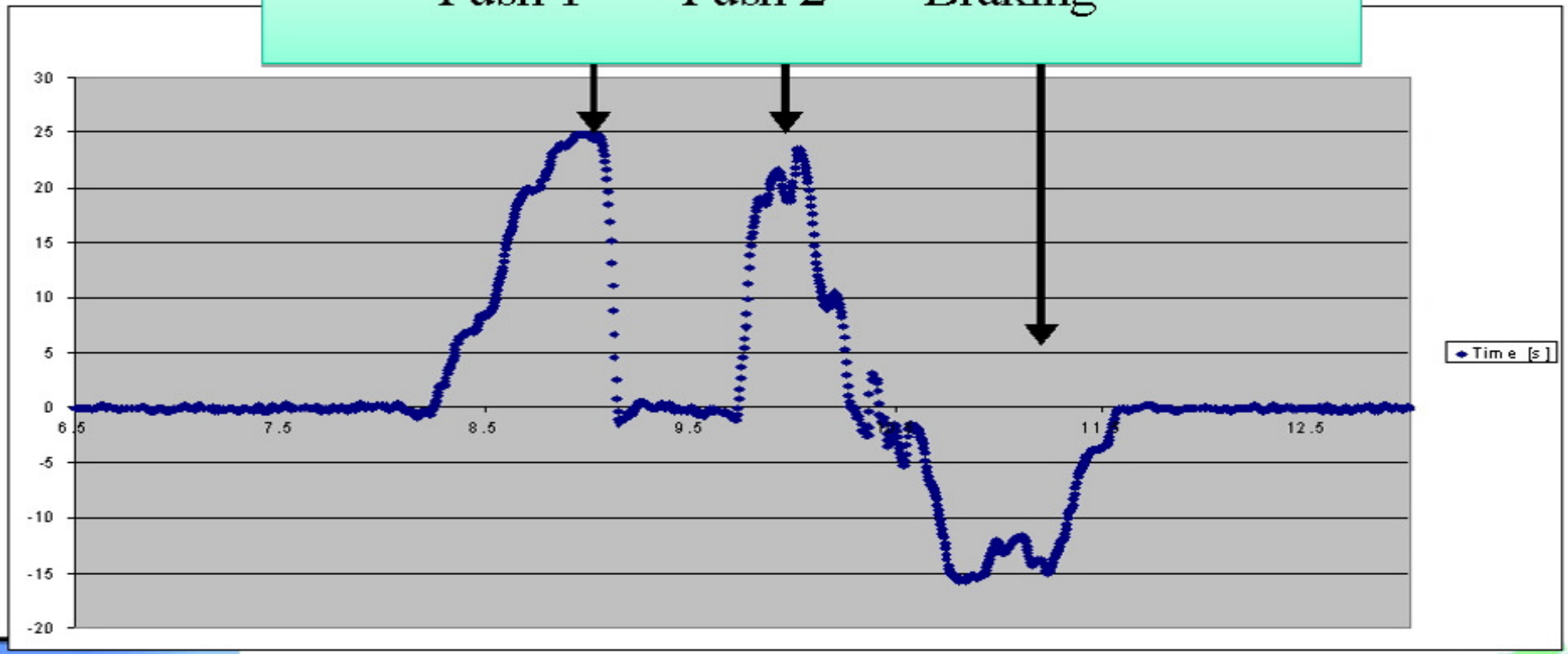


Synchronisation of Castor and Propulsion Forces



Synchronisation of Castor Force and Peak Mz showing how study parameters were extracted

Kerb Analysis: Peak Mz



Making a wheelchair more tippy:

- Reduces castor forces but
- Push-rim forces & Cadence are unaffected
- Velocity of first push decreases

Terrain & Set-up	Castor Forces	Peak MZ	Cadence	Velocity
Astro	↑	=	=	↑
Slope	→	↑	=	↑
Tippy	↓	=	=	↓

Conclusions:

- Higher castor forces **don't** = Higher propulsion forces
- Higher castor forces **do increase** rolling resistance
- People will accept a lower speed rather than increase hand-rim force

Recommendations:

- To investigate the effect of a user's capacity to push on their propulsion forces
- To investigate the castor forces and push-forces when manoeuvring

References

•Consortium for Spinal Cord Medicine. Preservation of upper limb function following spinal cord injury: a clinical practice guideline for health-care professionals. Washington (DC): Paralyzed Veterans of America; 2005 Apr

•C. E. Brubaker, "Wheelchair prescription: an analysis of factors that affect mobility and performance," J Rehabil Res Dev 23, no. 4 (1986): 19-26