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Institute for Research in Rehabilitation Medicine and Technology

Schouderbelasting tijdens rolstoelrijden met en zonder power assist

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Platform for medical technology innovation for an aging society

- Laser micro applications for medical techniques
- Active therapeutic devices
- Active assistive devices
  - Active hoist
  - Power assisted wheelchair

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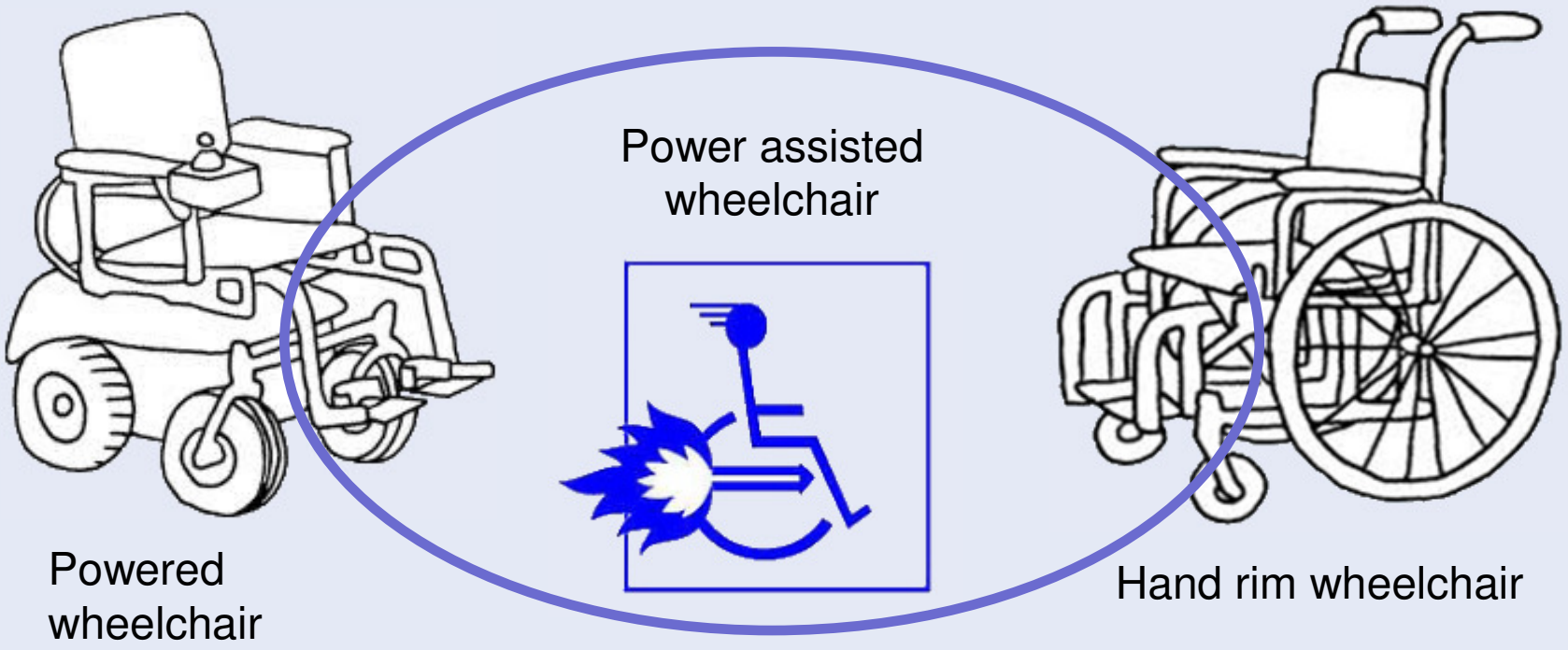
Power assisted wheelchair



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Power assisted wheelchair

- Power assist during push phase
- Motor at wheelaxis
- Wheels fit on subjects own wheelchair frames

Project partners

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INDES CONSULTANCY . DESIGN . MANAGEMENT

Use-Lab

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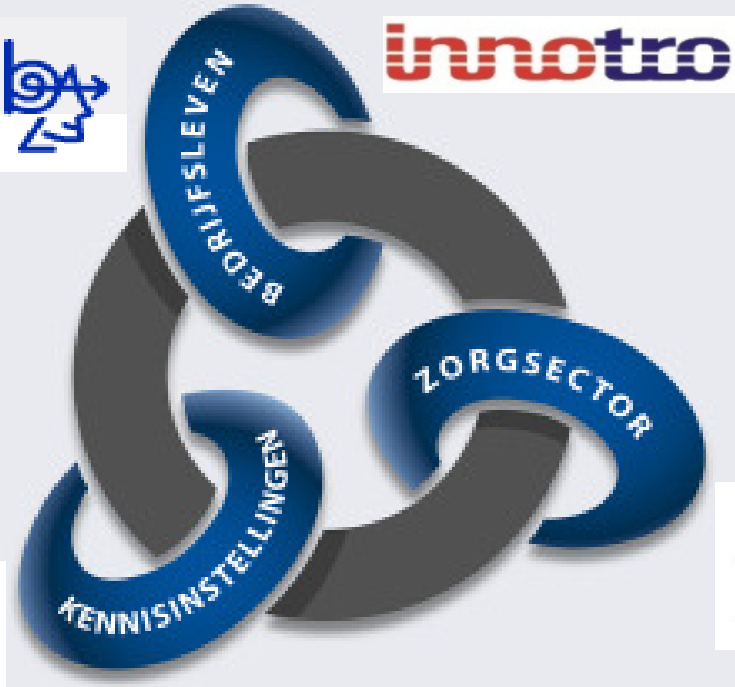

Het Roessingh centrum voor revalidatie

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Europäischer Fonds für Regionale Entwicklung der Europäischen Union

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Europees Fonds voor Regionale Ontwikkeling van de Europese Unie

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Overview research

Shoulder load

Activity

Participation

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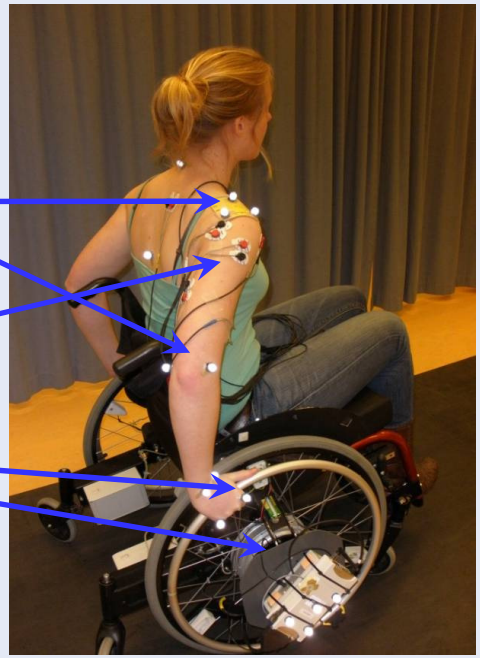
Measurements

Driving a wheelchair with less shoulder load?

Movements

Muscle activity

Force



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Measurements

Performing more activities?

- Daily distance travelled
- Used mode
- Performed activities
- Participation in social activities
- Experienced shoulder pain

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Measurements

Are activities easier to perform?

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Measurements

Less energy necessary for wheelchair propulsion?

- Heart rate
- Energy expenditure

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Measurements shoulder load

- USA 1.4 % and Europe 1.5% of total population

  LaPlante 2010; Vignier 2008; Van Drongelen 2002

- High strain on upper extremity

  Dyson-Hudson 2004; Van der Woude 2006; Van Drongelen 2005

- Shoulder injuries 50-62%

  Curtis 1999; Finley 2004

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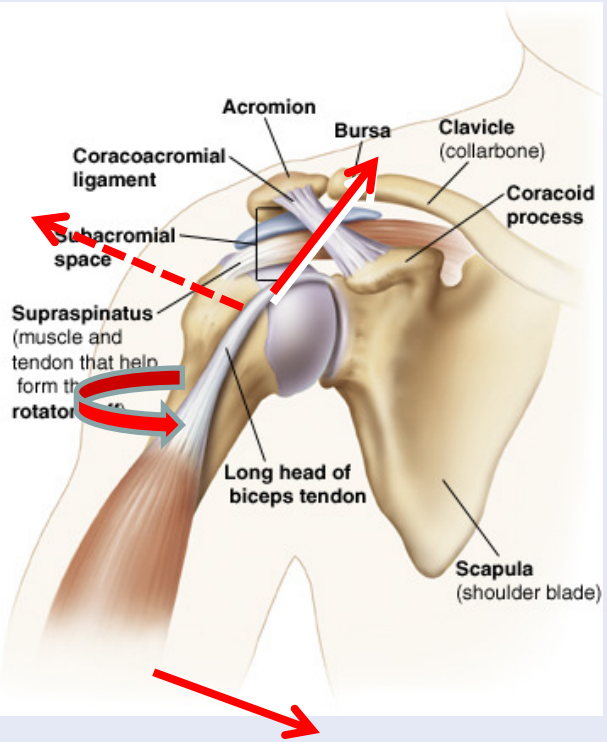
Work requirements related to shoulder injury

- Repetitive (high) forces and moments
  - Superior force with internal rotation moment
  - Radial force on rim



Boninger 2003; Mercer 2006

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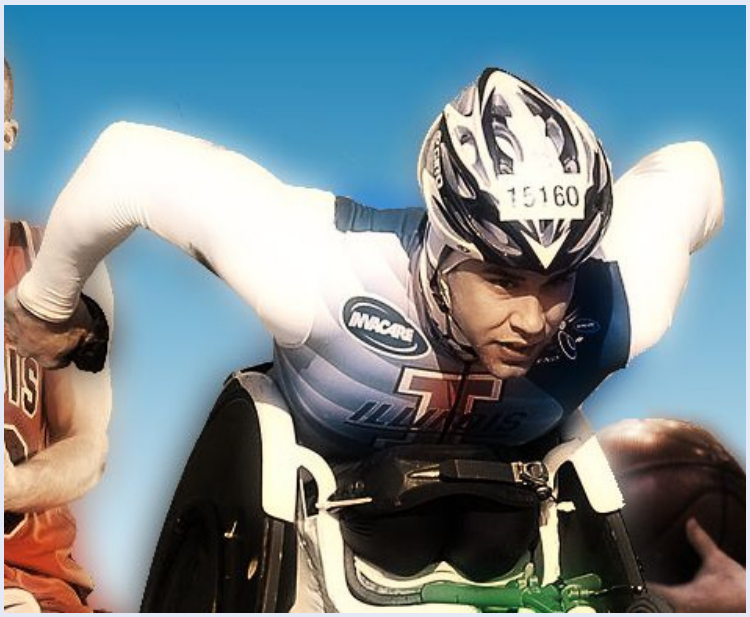
Work requirements related to shoulder injury

- Power generation in extreme joint angles
  - extension with internal rotation



Collinger 2008; Corfman 2003

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Work requirements related to shoulder injury

- Imbalance in upper extremity muscles
  - Dominance of adduction and internal rotation

Burnham 1993, Lee 2002

Reduced work requirements

- Use a light wheelchair
- Avoid weight gain
- Adjust wheelchair ergonomically
- Optimize propulsion technique

Boninger 2005; Consortium for spinal cord medicine 2005

- Use of a power assist wheelchair

Consortium for spinal cord medicine 2005

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Objective pilot

To investigate the influence of power assisted propulsion on shoulder kinematics, kinetics, and muscle activation patterns.

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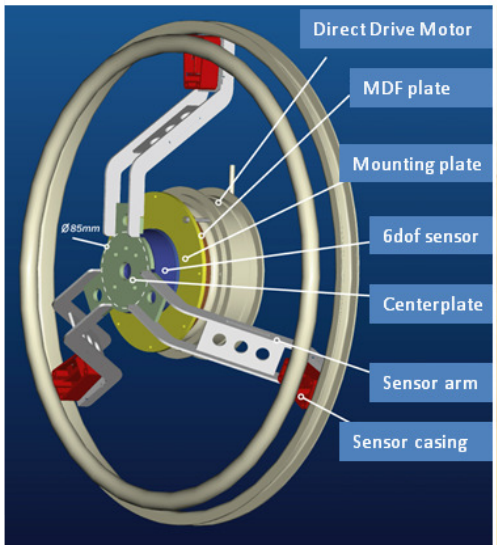
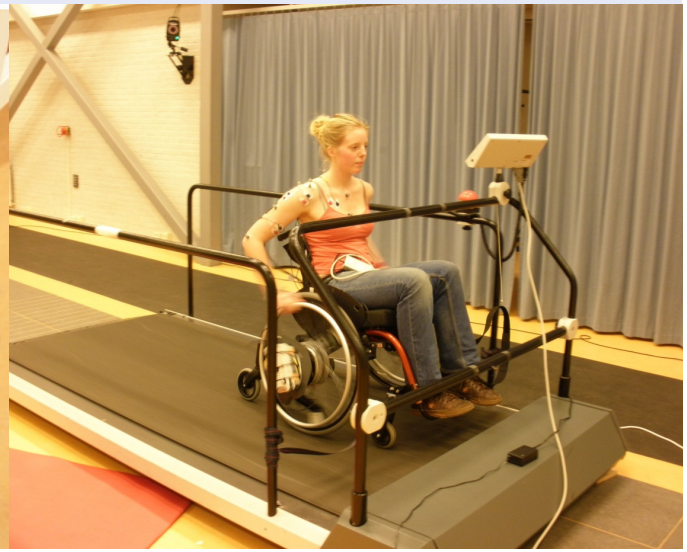
Methods

- 9 healthy subjects
- Instrumented wheelchair
- Propulsion on treadmill at 0.9 m/s





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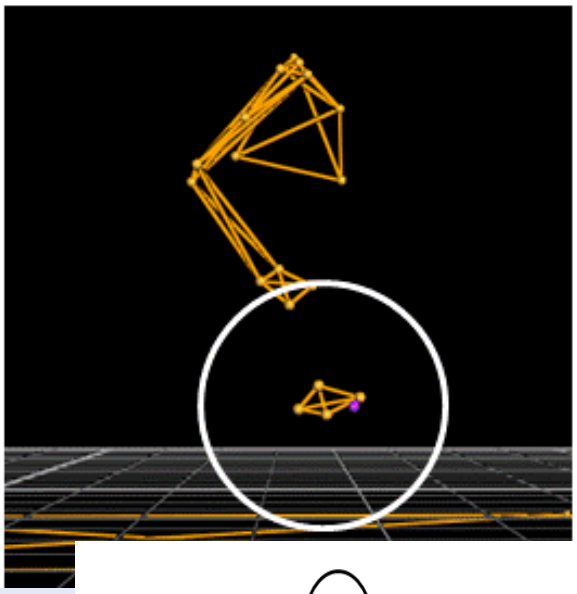
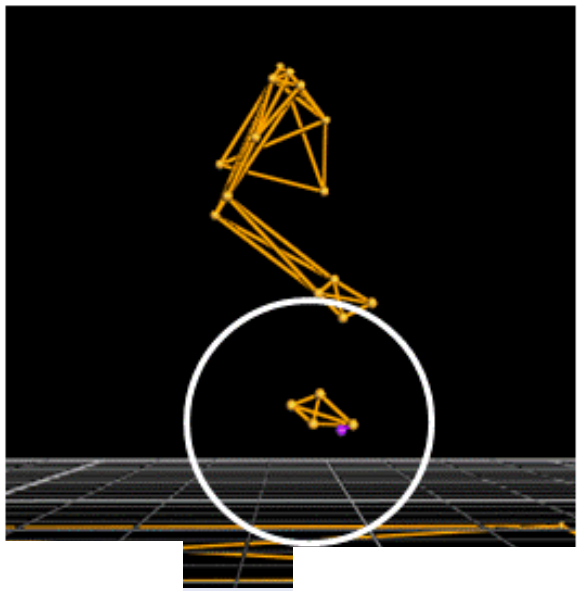
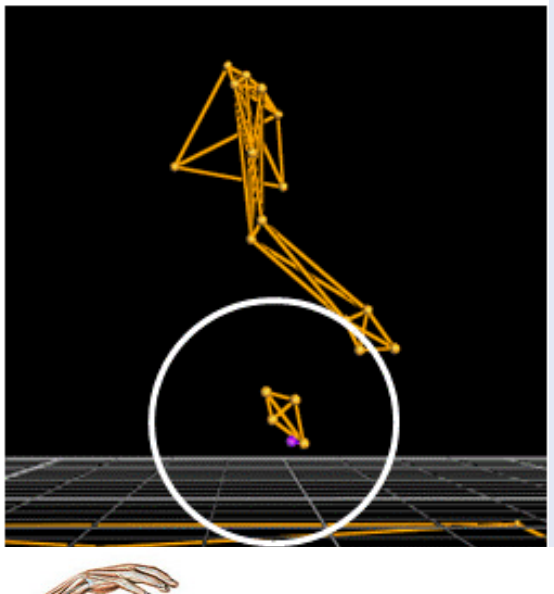
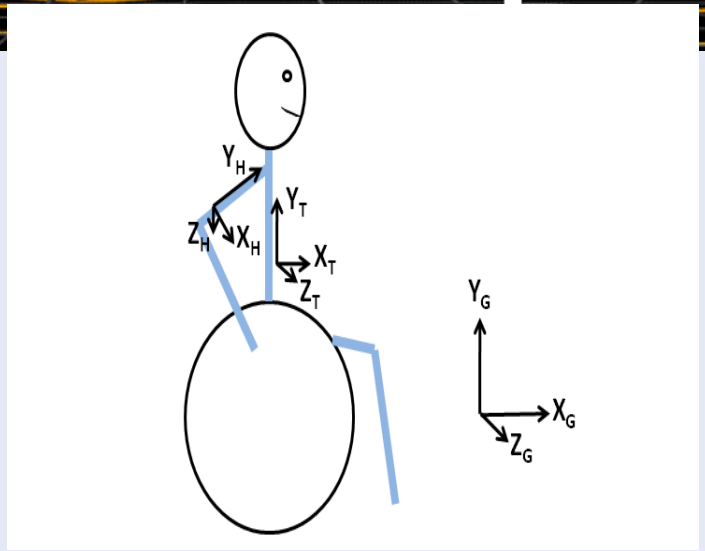
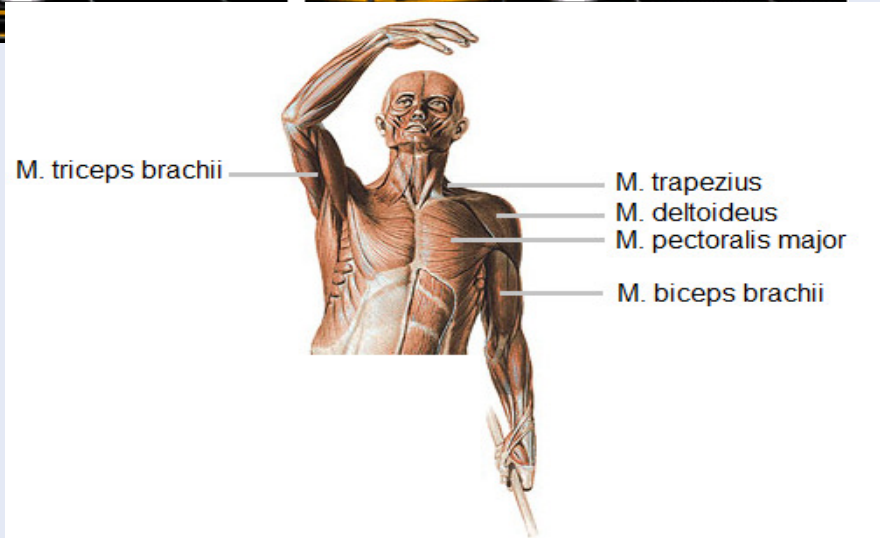
Methods











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Results kinematics

Kinematic outcome measures	Mean (SD) without PA	Mean (SD) with PA	Significance level
Propulsion frequency (strokes / min)	60.6 (14.1)	63.2 (14.7)	.314
Maximal flexion (°)	22.1 (6.8)	14.9 (5.5)	.015
Maximal extension (°)	40.4 (6.2)	40.9 (6.9)	.678
Minimal abduction (°)	25.8 (4.7)	24.5 (6.2)	.678
Maximal abduction (°)	37.7 (5.3)	35.8 (5.2)	.314
Maximal external rotation (°)	6.2 (7.7)	9.8 (8.2)	.066
Maximal internal rotation (°)	20.4 (12.2)	12.8 (11.3)	.008

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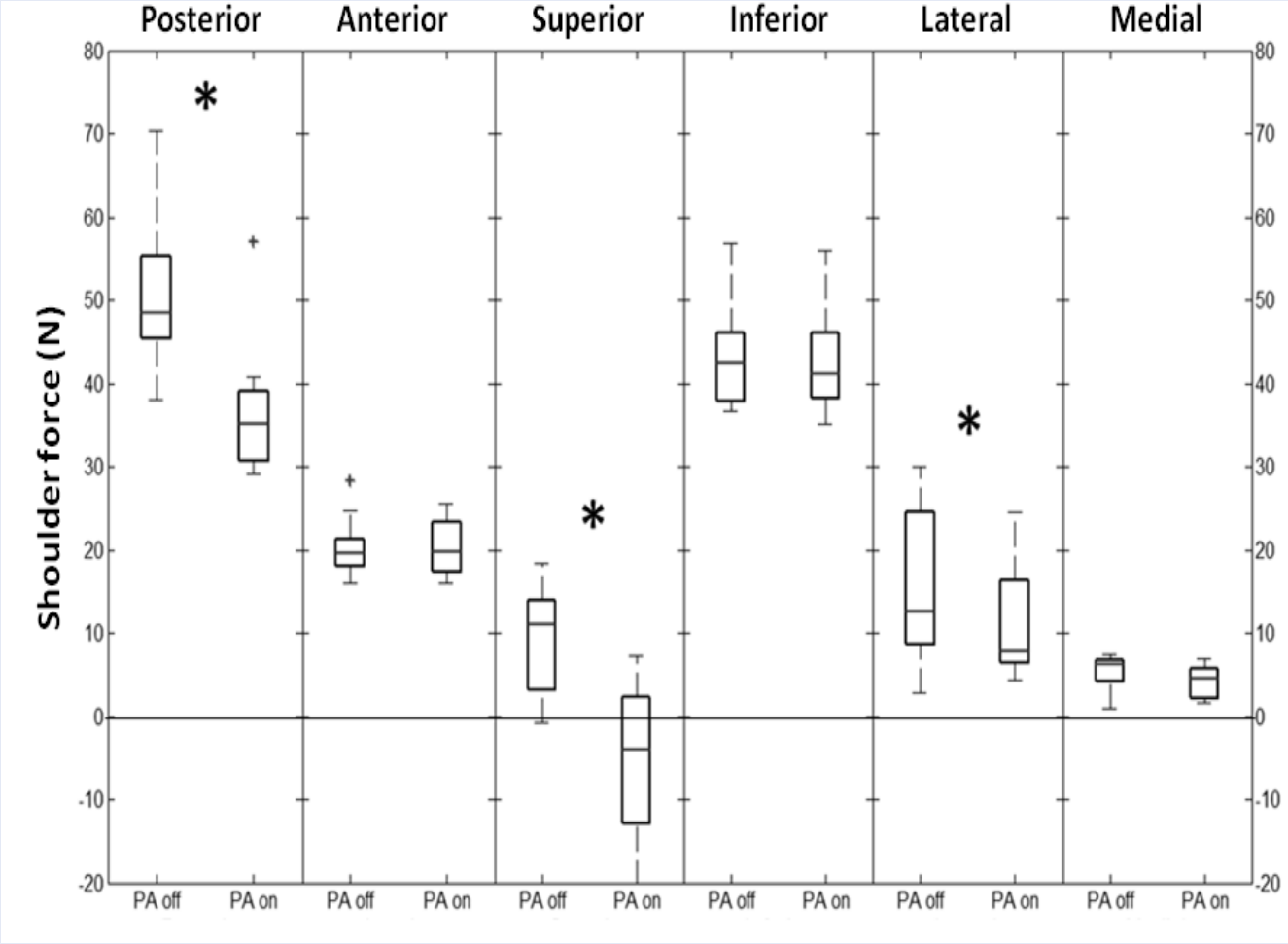
Results kinetics:
Forces acting on the shoulder



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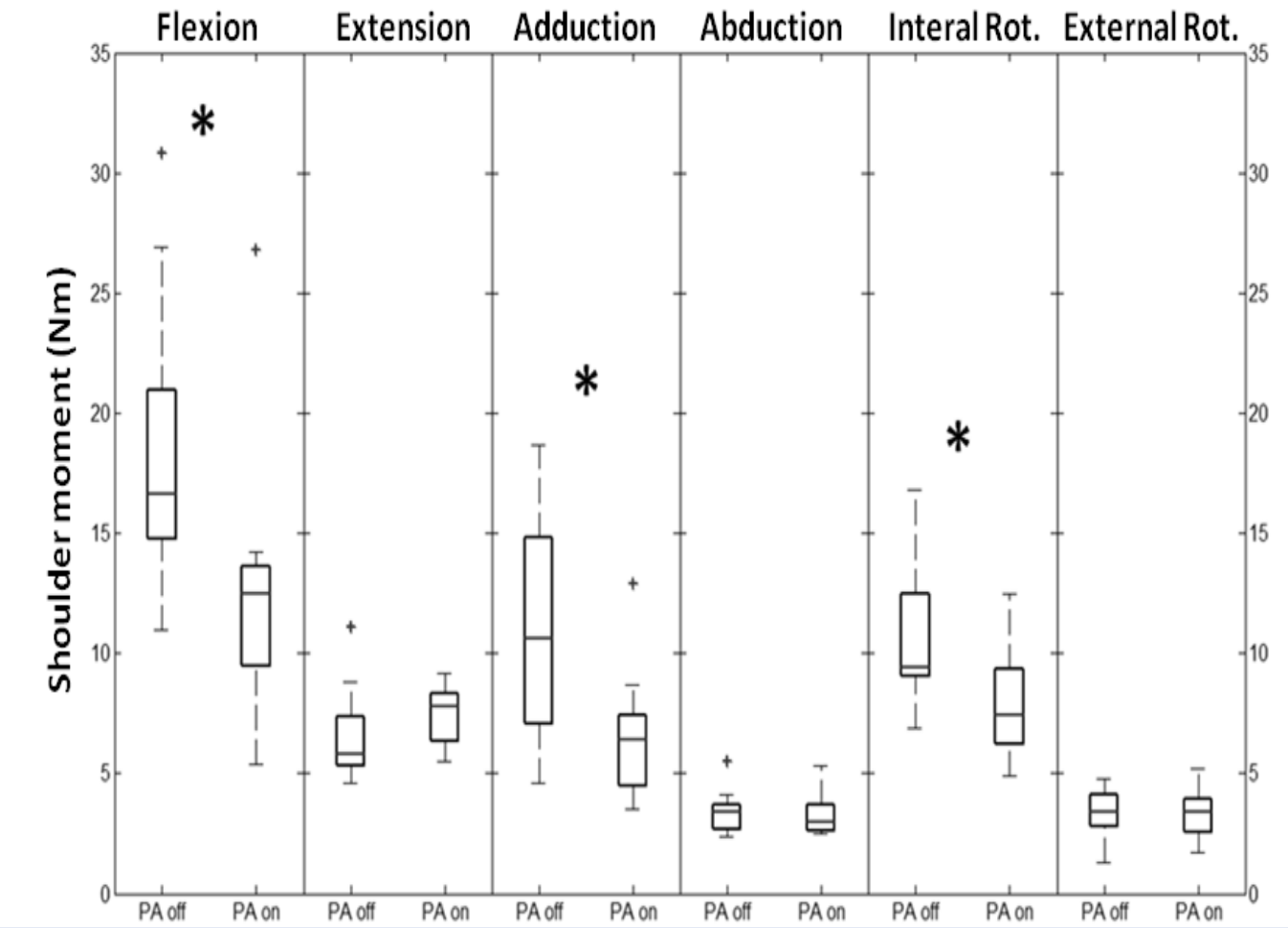
Results kinetics:
Moments acting around the shoulder



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Results surface EMG

Decreased area under the curve

Muscles	Change in RMS (%)	*Significance level*
Anterior deltoid	10.8	.260
Middle deltoid	2.5	.594
Posterior deltoid	12.3	.015
Pectoralis major	27.0	.038
Trapezius	6.4	.314
Biceps	13.5	.066
Triceps	13.4	.021

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Implications & impact on rehabilitation medicine

Repetitive (high) forces and moments

Power generation in extreme joint angles

Imbalance in upper extremity muscles

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Implications & impact on rehabilitation medicine

Repetitive (high) forces and moments

- Unaltered stroke frequency
- Reduced posterior, superior, and lateral forces at the shoulder
- Reduced flexion, adduction, internal rotation moments around the shoulder

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Implications & impact on rehabilitation medicine

Power generation in extreme joint angles

- Decreased maximal flexion and internal rotation angles

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Implications & impact on rehabilitation medicine

Imbalance in upper extremity muscles

- Surface EMG decreased
  - M. deltoideus pars spinalis
  - M. pectoralis major
  - M. triceps brachii caput longum

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Conclusion

In healthy subjects a power assisted wheelchair can intervene in risk factors of shoulder injury.

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Thank you for your attention

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