Impacts of different types of wheelchair backrests on the propulsion performance on a manual wheelchair: an exploratory study

The 32nd International Seating Symposium

Guy Robert OT[1], Firass Mayassi OT[1], Annie-Pier Landry OT[1], Sara Beauregard OT[1], Rachid Aissaoui Eng PhD[2,3] Dany Gagnon PT PhD[2,4]

[1] Programme d'Aides techniques, CIUSSS Centre-Sud-de-l'Île-de-Montréal - Installation Institut de réadaptation Gingras-Lindsay-de-Montréal (IRGLM)
[2] Centre for Interdisciplinary Research in Rehabilitation - Installation IRGLM, Laboratoire de pathokinésiologie, Montréal
[3] Département de génie et d'automatisation de la production, École de technologie supérieure (ÉTS), Montréal
[4] Programme de physiothérapie, École de réadaptation, Université de Montréal, Montréal

Laboratoire de pathokinésiologie

CRIR Centre de recherche interdisciplinaire en réadaptation du Montréal métropolitain

Université de Montréal

IRGLM

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Centre intégré universitaire de santé et de services sociaux du Centre-Sud-de-l'Île-de-Montréal Québec

Study Context

- The majority of manual wheelchair users with a spinal cord injury present:
  - Trunk and lower limbs sensory motor deficiencies
  - Trunk control deficiencies
  - Manual wheelchair propulsion difficulties

Those dificencies and difficulties result in → **A lower manual wheelchair propulsion performance**

- A profiled and rigid manual wheelchair backrest, with or without lateral thoraxic supports, or a soft backrest also with or without thoraxic support, are often recommended in our clinical practice.
- The decision making process for those types of backrests for our manual wheelchair users, remain an iterative process based on our clinical experiences, intuitions, trials and errors, and adjustments following interactions between therapists and users.

Current evidence based practice

- There is minimal scientific data avalaible to informe therapists about the decision making process for the proper choice of backrests, for manual wheelchair users.

- No biomechanical studies have quantified the effects of different backrests, for experimented users, on the manual wheelchair propulsion.

Research objective

Compare the effects on propulsion of four different types of frequently used backrests, with quantative and qualitative measures, among experimented spinal cord injury users of manual wheelchairs.

The hypothesis was that a rigid manual wheelchair backrest, with lateral thoraxic supports, would optimize the propulsion performance.

Backrests used

Tension Adjustable Backrest Upholstery

JAY 3 without thoracic supports

Harmoni

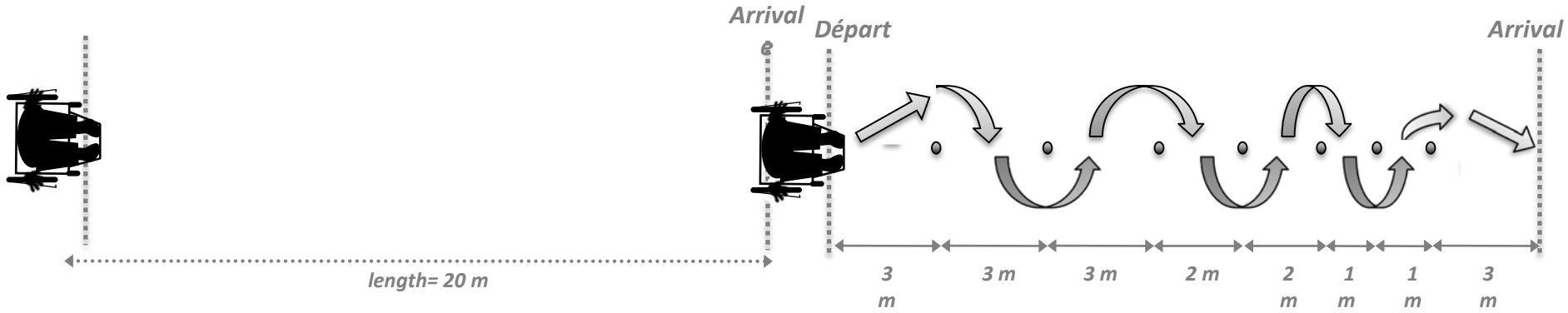
JAY 3 with thoracic supports

Methodology

1. Manuel wheelchair propulsion test:

20 meters straight line propulsion test: *20 meters slalom propulsion test*

Start line



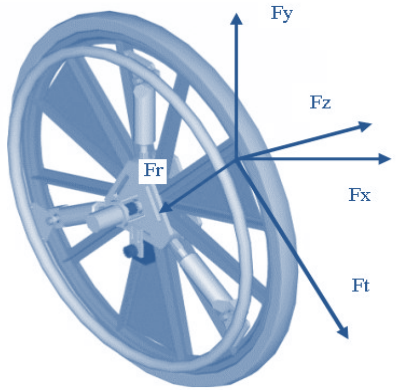
- Each test is chronometered twice with each backrest

Methodology

2. Registration of spacial - temporal and biomechanical data

- Two rear wheels with instrumented handrims where installed (SMARTWHEEL™) on the personal wheelchair of each participant.

- The registered data where analysed with a homemade program developed by our pathokinesiological reasearch laboratory team.



Methodology

Principal results :

- **Quantitative mesures**
  - **Spatial - temporal data**
    - *Propulsion and recovery time phases*
    - *Total time and speed*
  - **Biomechanical datas**
    - *Total force and tangential force (resulting in direct propulsion force)*
    - *Rate of mechanical efficiency = (Tangential force/Total force)*100*

- **Qualitative mesures**
  - **Analogue Visual Scale (comfort, stability and performance)**

METHODOLOGY

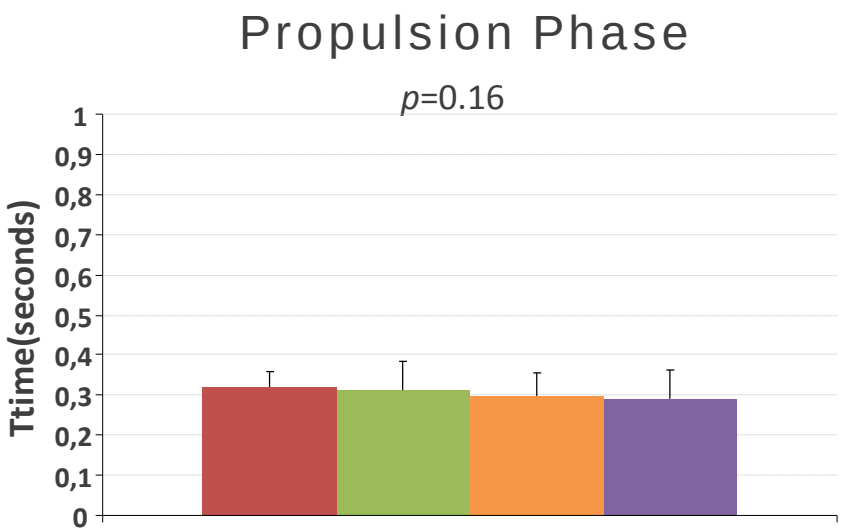
Statistics Analysis:

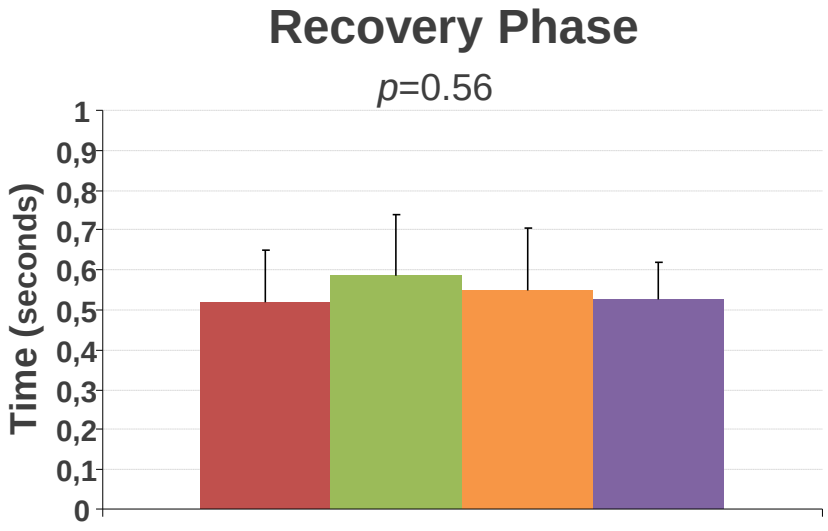
- **Descriptive Statistics**
  - Adverage and Standard deviation.
  - Number of observations and proportions.
- **Shapiro-Wilk test to verified the data distribution**
  - Average and standard deviation.
- **Friedman Test to confirme the differences between the backrests (*p<0.05*)**
  - No significant difference.

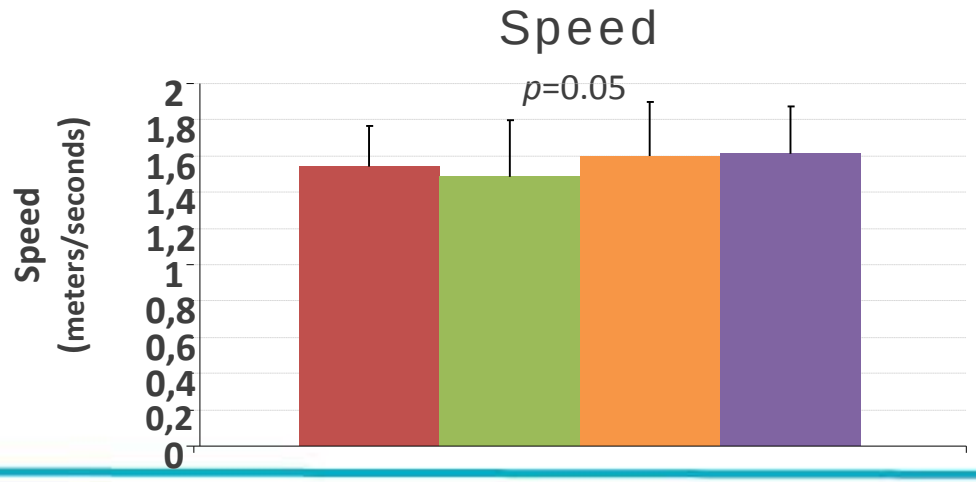
Results

Participant Characteristics (N=10)	
	Average (standard deviation)
Gender	8M/2F
Age (years)	44,4 (13,5)
Weight (kg)	75,4 (25,3)
Height (cm)	170,47 (7,85)
Spinal cord lesion level	Between C7 & T2
Severity of lesion	ASIA A or ASIA B
Time since spinal cord injury (years)	19,1 (11,1)

RESULTS 20 Meters Propulsion Test



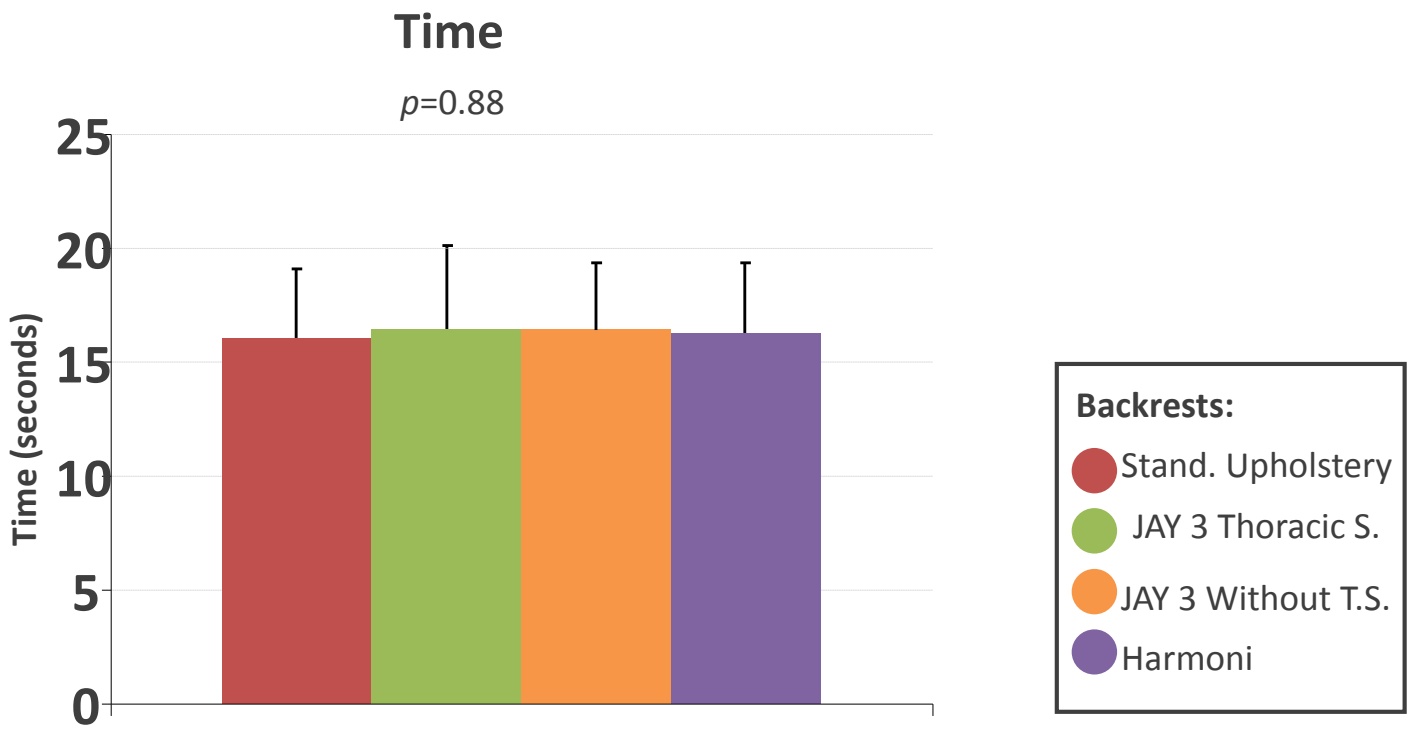




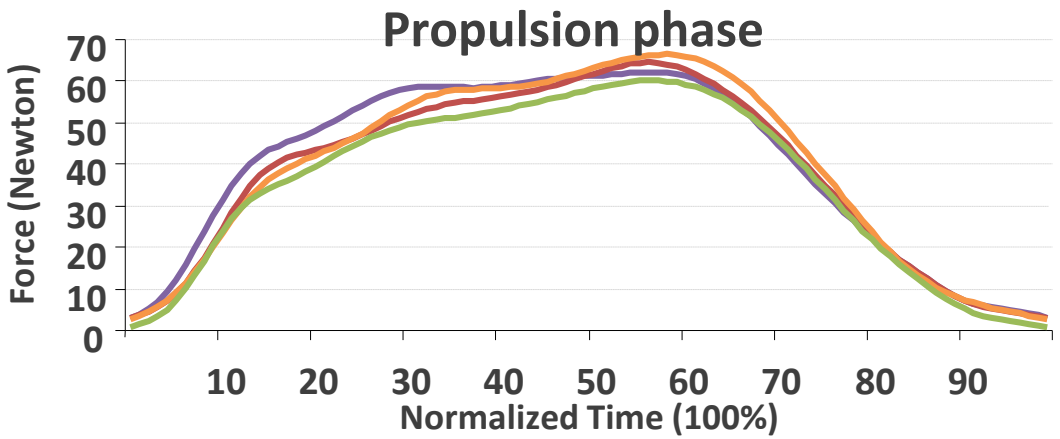
Type of backrests:

- Stand. Upholstery
- JAY 3 Thoracic S.
- JAY 3 Without
- Harmoni

RESULTS – Propulsion slalom Test



RESULTS – Total Force

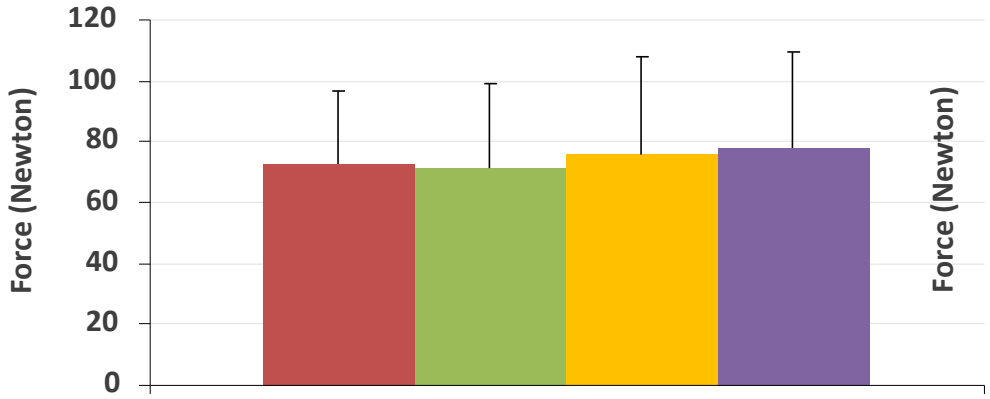


Backrests:

- Standard
- JAY 3 Thoracic S.
- JAY 3 Without T.S.
- Harmoni

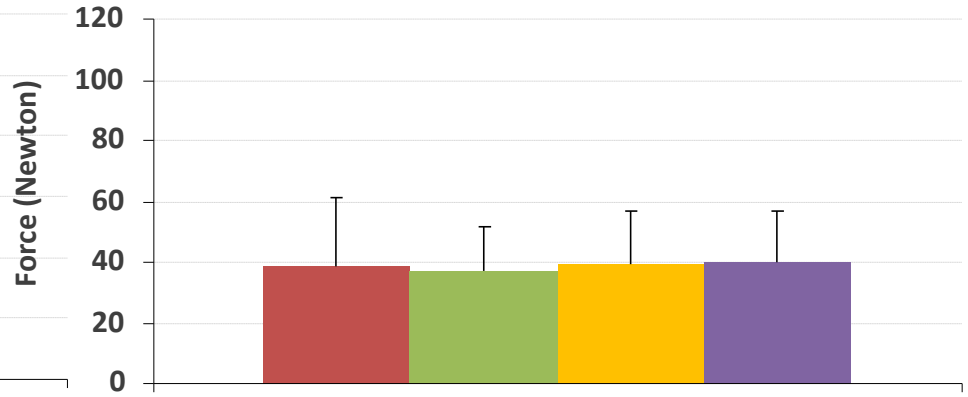
Maximal Values

p=0.70

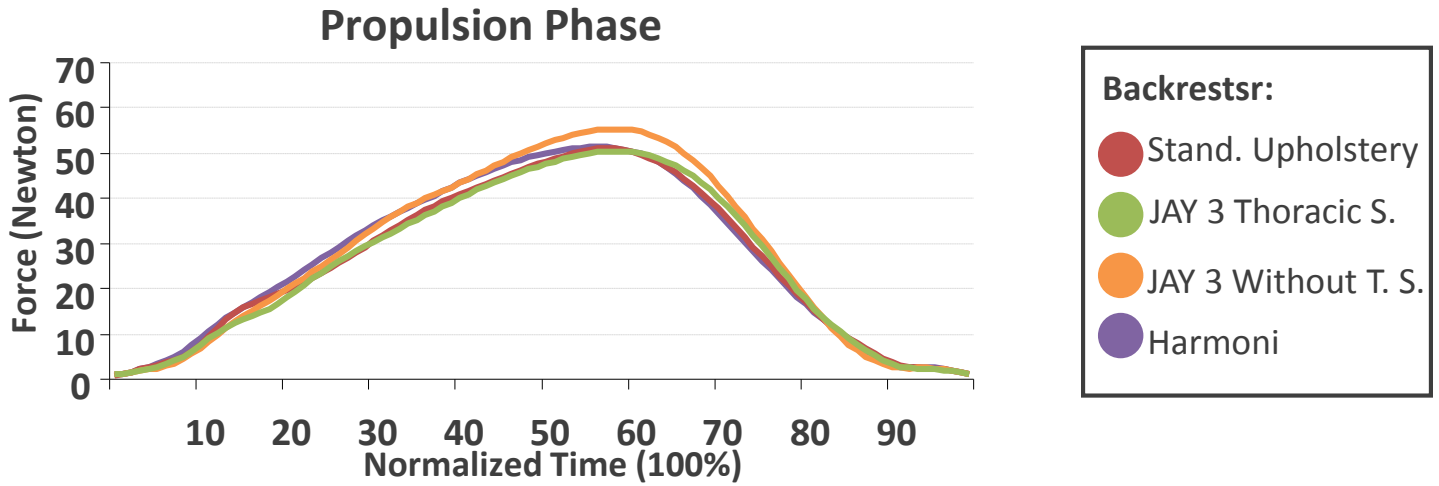


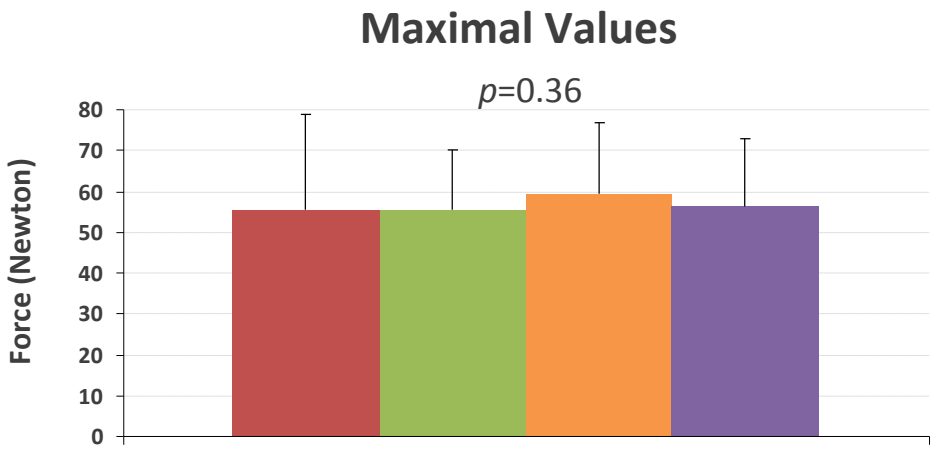
Average Values

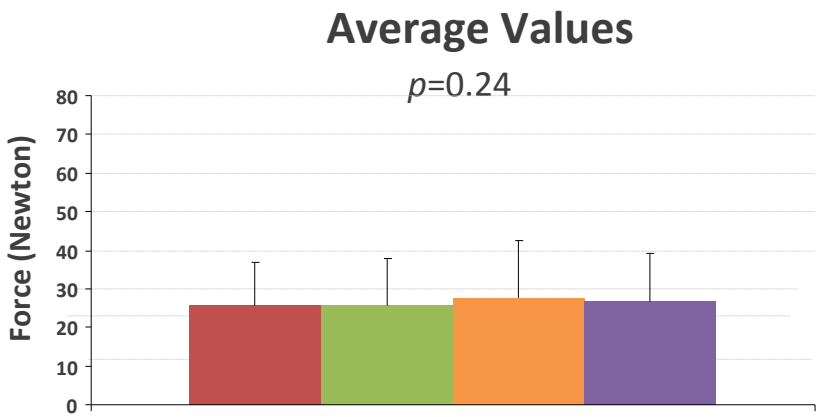
p=0.47



RESULTS – Tangential Force







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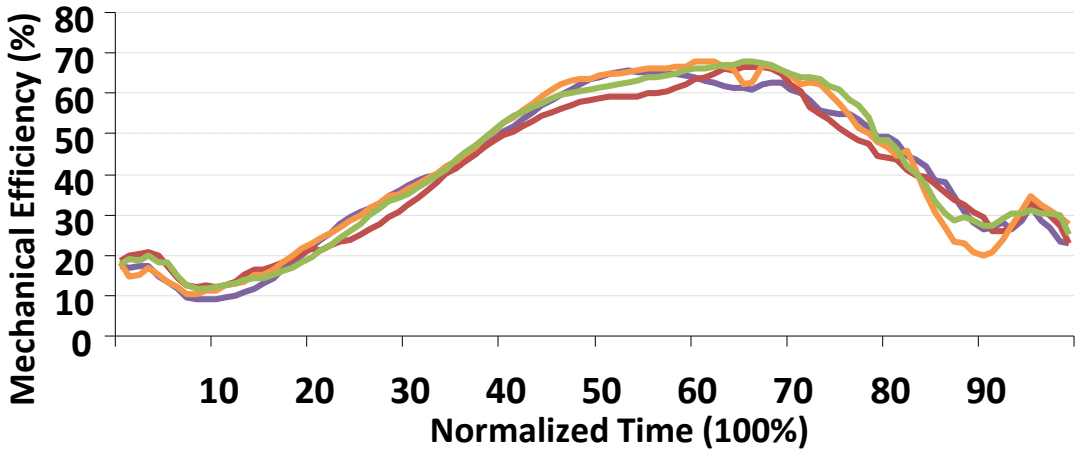
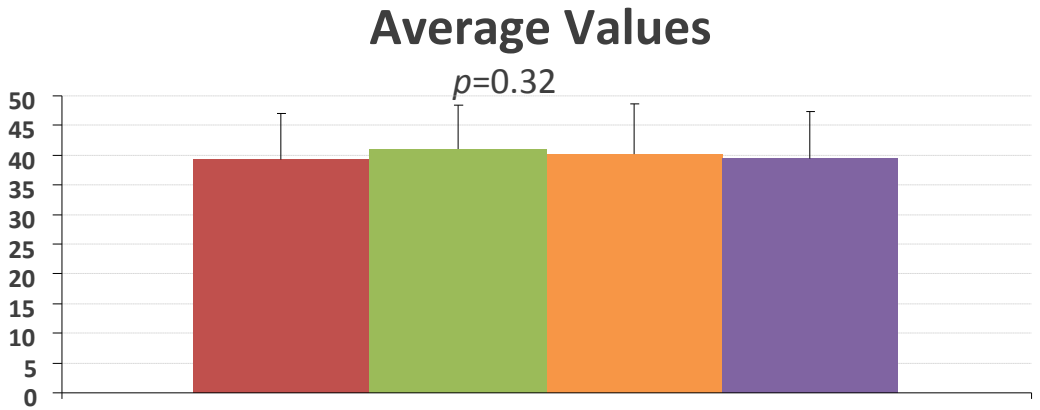
RESULTS – Mechanical Efficiency

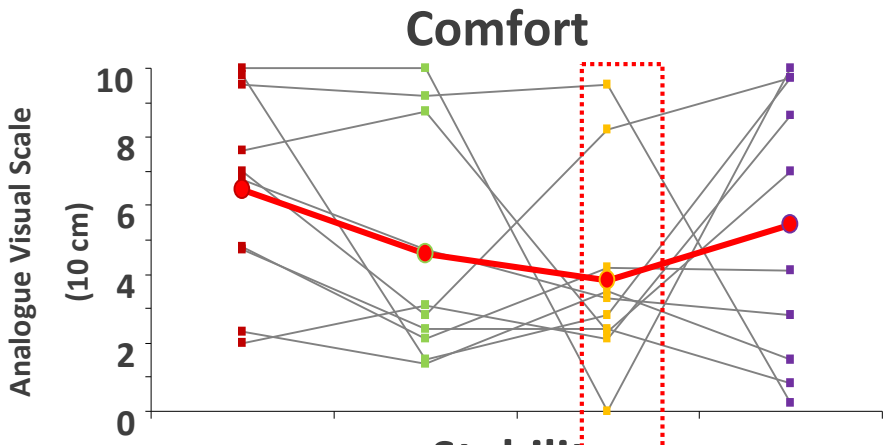


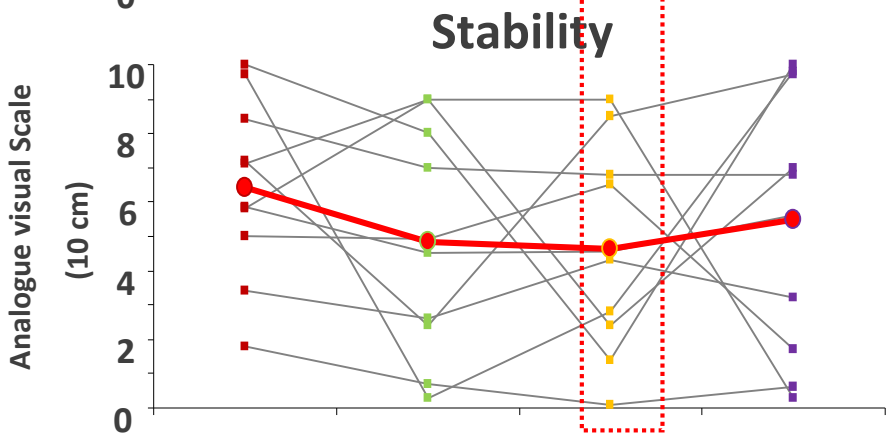


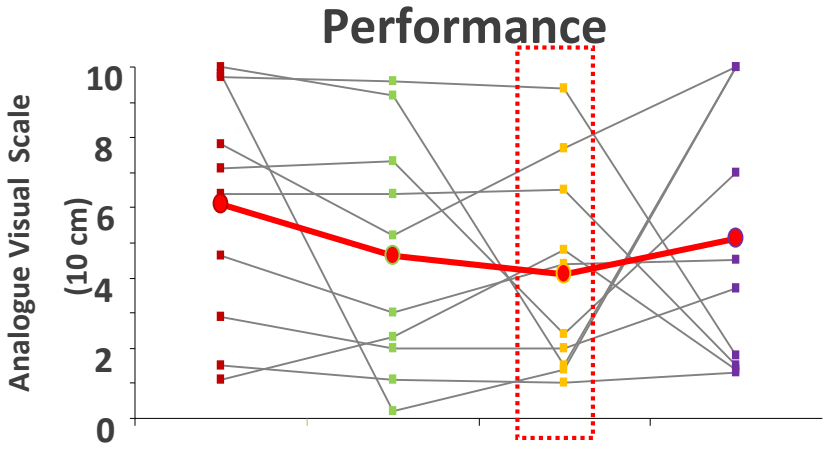
Backrests:

- Stand. Upholstory
- JAY 3 Thoracic S.
- JAY 3 Without
- Harmoni

RESULTS – Qualitative Measures





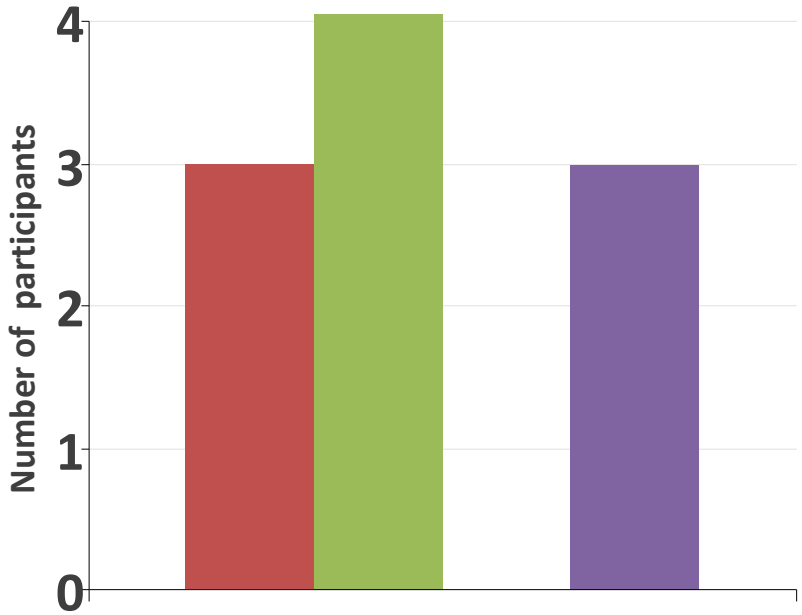


Backrests:

- Stand. Upholstory
- JAY 3 Thoracic S.
- JAY 3 Without T.S.
- Harmoni

RESULTS – User's choices

User's choice



90% Agreement between O.T. and User's Choices.

DISCUSSION

Spatial- temporal and biomechanical data remain similar

- Globally the spatial-temporal data, the applied forces on the handrims, the mechanical efficacy, are comparable between the different types of backrests during the straight and slalom propulsion.

VARIABILITY of comfort, the stability and the perceived performance:

- The comfort, the trunk stability and the performance remains also comparable between the different backrests.
- The final choice of backrests is moderately influenced by the perception of comfort, stability and performance, and this could explain the great variability of responses.

Principal limits of this study:

- Small group of participants
- Experimental effort's
- Trial period of time

CONCLUSION

- The results confirms the ***importance of personalizing the therapeutic actions leading to the recommendations of different types of backrests, according to the effects on comfort, stability and performance, on the propulsion of a manual wheelchair.***

- ***Further research seems necessary on this subject, with a larger group of experimented manual wheelchair users.***

Our Thanks

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