Fitting the Wheelchair Like a Prosthetic: How to Do it and Why it Matters

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Completion Requirements

In order to obtain CEU credits, participants must:
1. Attend the entire course
2. Sign in and out
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Objectives of Presentation

- Describe a situation where an individual would require a custom frame depth and lead a discussion on how to prescribe the correct frame depth.
- List 3 factors that guide the prescription of front and rear seat height for the individual manual wheelchair user.
- Summarize and participate in a discussion on the impact of proper seat width on the biomechanics of manual wheelchair propulsion.
- Identify 2 consequences of improper frame geometries (impacting the overall wheelchair footprint) in relationship to stability and balance of the manual wheelchair.

Why It Matters

- Repetitive Strain Injuries (RTI)
  - Up to 73% reported incidence
  - Longer the time since injury, greater chance of reported pain
  - Shoulder is the most commonly reported site of injury
- Causes?
  - Manual wheelchair propulsion (biomechanics/fit, weight, technique, duration)
  - Transfers
  - ADLs
- What can we do about it?

Evidence Based Practice (EBP)

Prevention is key!!

- How do we preserve upper limb function?
- Evidenced-based answers:

[Sources and references provided in the original document]
Evidence and Recommendations

Both the Clinical Practice Guidelines (CPG) and the RESNA Paper provide evidence-based recommendations:

- CPG Recommendation #7: “Provide manual wheelchair users with SCI with a high-strength, fully customizable manual wheelchair made of the lightest possible material.”
- RESNA Paper: “The person cannot conform to the wheelchair, but the wheelchair must conform to the individual.

The wheelchair should be fit to the exact measurements of the individual in the same way that a prosthetic is fitted.

Fitting the Wheelchair Like a Prosthetic

- Fitting across all dimensions (length, width, height)
  - Proportional to the individual
- Seating/Positioning should be considered WITH the frame… not separately
- A proper fit influences the forces needed to propel the chair
- By fitting a wheelchair like a prosthetic, the preservation of upper limb function is maximized:
  - Shoulder is more likely to be in an anatomically neutral position
  - Propulsion forces are minimized

When Chairs are Not Properly Fitted

- When chairs are not fit properly on all dimensions, people seem to be surviving, right?
  - Right! But they are compensating all the time!
- Can lead to discomfort, poor function, pain, and injury
- May not realize that they are at a disadvantage

Measuring the Wheelchair

Measure the current or demo wheelchair as an assessment tool

- “Functional Footprint”
- Wheelbase
- Frame Length
- Rear seat to floor
- Front seat to floor

Rethinking Center of Gravity (COG)

- Front to Back COG
- Vertical COG
- Horizontal COG
- 75% to 80% of the user Wt over the axels this will minimize front loading of casters
- Balance From a Proportional Fit
**Front Seat Height (C) – Function First!**

- Anatomical measurement: Back of Knee to heel
- Chair Measurement C Measure from floor to top of seat tube at beginning of bend.
- Ground Clearance: Often equivalent to cushion for optimal COG
- Must know what cushion will be used to get accurate front seat height!

**Rear Seat Height (D) and COG (H)**

**Chair Measurements:**

- Measure from ground to top of seat sling where backrest and seat frame meet.
- Back Angle Measured in comparison to the ground, not the seat
- Seat slope is the difference between front and rear seat height.

**Body Measurements:**

- When using a demo chair, fingertips should touch bottom of hub.
- Possible exception: higher level injuries with decreased hand function (palm to hub).
- With hand at top of handrim, recommended elbow angle is between 100° and 120°.

**Take Away’s: Front and Rear Seat Height**

- Don’t make Front any higher than it needs to be
- 17.5”-19” is Sweet Spot
- Consider Cushion in the equation, cannot choose front seat height if you haven’t chosen a cushion
- If you must go high, you should extend frame depth/length for improved stability
- Rear seat height is a question of seat slope that’s functional and rear wheel access. Don’t use too much seat slope Ex: 3.5” plus (Consider Ergo)
- Use your eyes and ANY demo chair; you don’t need a perfect demo
**Seat Depth (B) & Frame Depth (M)**

- Upper Leg Length Anatomical measurement: Back of sacrum to popliteal fossa (consider knee angle).
- Seat Depth: Chair Measurement B Measure from front of back post to the front edge of seat sling.
- Frame Depth: From front of back post to the front frame bend. (i.e. should be close to vertically parallel with bend in knee.)

**Overall Footprint (W)**

**Overall Frame Length (Y)**

**Overall frame length/Front Frame Angle**

**Take Away’s: Seat Depth and Frame Depth**

- Seat depth is all about maximizing pressure redistribution without interfering with the lower leg.
- Frame depth should mirror client proportional to upper leg.
- Increase center of gravity setting to match functional footprint.

**EBP: Wheelchair Axle Position - Tetraplegia**

CONCLUSIONS

"The up and forward axle position resulted in an increase in speed and acceleration with a higher stroke frequency and decreased shoulder ROM. The down and backward axle position resulted in the lowest speed and acceleration with a lower stroke frequency and increased shoulder ROM. These findings are extremely important for these subjects." (p. 666)
Front Frame Angle (L)

Frame Angle (L)/ Seat Depth (B)/ Caster Position

Front Wheel Placement

Seat Width (A)

- Anatomical measurement = trochanter to trochanter. Widest part of the body for Seat Width.
- Chair Measurement A Measure from outside of seat tube at back post to the outside of the opposite seat tube at back post.
- Use to assist with LE positioning
- In combination with side guards

Seat Width, Wheel Spacing & Camber For Different Body Types

Seat Width (A), Wheel Spacing (J) & Camber (K) Adjusting the Whole Frame

- What Happened?
  - In addition to adjusting the Seat Width, we also adjusted the Wheel Camber to align the push direction with the shoulder
  - We did a tapered backrest to make sure that the back won’t interfere with the user’s arms
Side Guards - Adjustability

Footrest Width (I or V)
- Anatomical Measurement: Width of feet with shoes.

Footrest Width

Take Away’s: Seat Width/Footrest Width
- Fit seat width to the client’s anatomical measurement with confidence!
- Can always add extra space if needed.
- Consider transfers when measuring footrest width.
- Footrest width impacts lower extremity positioning especially when navigating over rough terrain/obstacles.

Lack of Seat Slope

CAD Study

Additional Seat Slope

CAD Study
CAD Study

On-line Assessment Info

- MUST sign the sign-in sheet
  - No sign in/out, NO CEUs will be issued
- On-line assessments ONLY active for 2 weeks!
  - If not complete within 2 weeks, NO CEUs will be issued
- Access via www.roho.com
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