Optimizing Balance and Function

How to achieve optimal outcomes with manual wheelchairs...

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OBJECTIVES

Upon Completion of this course participant will be able to:

- Apply 3 Concepts of Clinical Practice Guidelines with regard to prescription of Ultralight Manual Wheelchairs for full time manual wheelchair users.
- Accurately measure and recommend ideal Center of Gravity (COG) for Ultralight Manual Wheelchairs.
- Accurately measure and recommend Ideal Rear Seat to Floor Height for optimal wheel access in accordance with Clinical Practice Guidelines.
- Appropriately measure and recommend Seat Depth with consideration to frame angle.
- Apply concepts of custom frame length to achieve optimal Wheel Base.
CLINICAL PRACTICE GUIDELINE: PRESERVATION OF UPPER LIMB FOLLOWING SPINAL CORD INJURY

Begin With Best Practice

- Adjust the rear axle as far forward as possible without compromising the stability of the user.
- Position the rear axle so that when the hand is placed at the top dead-center position on the push rim, the angle between the upper arm and forearm is between 100 and 120 degrees.
- Educate the patient to: Use long, smooth strokes that limit high impacts on the push rim.

ACHIEVING BALANCE

Strive for Optimal Balance

- Weight Distribution: 75-80% concentrated directly over the rear axle.
- Center of Mass as low as possible with consideration to appropriate UE Biomechanics
- Wheel Base/Frame Depth should be Proportionate to the users lower body and of sufficient length as to not front load casters
WHAT'S WRONG WITH THIS PICTURE?

WHAT HAPPENED?

Axel
- Wheel brought forward 3” to allow for 70/30 weight distribution.
- Lowered Center of Mass by 2”
- Decreased Camber/Overall Chair Width

+ Frame
- Decreased Seat Width to True Anatomical Dimensions.
- Decreased Seat Depth
- Increased Frame Length by 2.5”

= Balance/Stability/Function/Health
**FRONT STF...HOW DO WE DO IT?**

Start from the front...Desired front seat to floor height informs the functionality of the frame.

- Know the users exact lower leg measurement and desired cushion thickness
- Starting Point: Footrest Ground Clearance of approximately 2” = Ideal balance of ground clearance while keeping user center of mass as low as possible.

![Diagram](image)

Lower Leg=18.5

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**REAR STF...HOW DO WE DO IT?**

**Calculate Rear STF**

- Start with a known point of reference....Any wheelchair with known Rear Seat to Floor and a wheel diameter equaling that to be prescribed.
- Use same cushion thickness as that to be prescribed or calculate difference.

Ideal rear seat to floor will allow middle finger to align naturally with the hub.

****May be lower for higher level injuries.****
MEASURE IT......

- Ask the client to allow UE’s to hang naturally to their side.
- Measure vertical distance from finger to hub and adjust rear STF accordingly.

Middle finger 2.5” above Hub  
Ideal Rear STF would be adjusted to 14.5”

CENTER OF GRAVITY...HOW DO WE DO IT?

Center of Gravity is measured as the distance from the front of the back cane to the center of the hub or axel.

- Ask the client to allow UE’s to hang naturally to their side.
- Measure horizontal distance from finger to hub and adjust wheel position forward or rearward accordingly.

Distance of middle finger to center of hub= 3”

Prescribed Starting COG = 4”
WHY DO WE DO IT?

Optimizing Rear Seat to Floor Height and COG provides significant benefit to the user:

- Optimal Wheel Access = Optimal Efficiency of Propulsion.
- Decreased Rolling Resistance via appropriate distribution of mass.
- Reduction in Downhill Turning Tendency (DTT)
- Improved Postural Alignment- Neutral shoulder throughout the stroke; reduces potential for destructive compensatory patterns.
- Improved balance for function and comfort.

CONTROLLING FRAME DEPTH.....HOW DO WE DO IT?

Frame Depth Should be equal to the users anatomical Upper Leg Measurement. Failure to attend to this measurement can results in:

- Decreased front end stability/loading of front casters/ Disproportionate Wheel Base
- Interference of LE's at the upholstery level.
- Difficulty with foot positioning/stability
- Postural Compensation

Know the measurement and how different manufacturers address this issue.
CONTROLLING FRAME DEPTH...WHY DO WE DO IT

Frame Depth should be controlled first and is considered separately from Seat Depth or Upholstery Depth

➢ Frame depth correlates proportionally with wheel base.
➢ Wheel base in combination with distribution of mass has significant impact on rolling resistance, DTT and the ability to navigate over obstacles such as thresholds.
SEAT DEPTH...HOW DO WE DO IT?

- Seat Depth must be calculated with consideration to the frame angle and intended LE position. Visual point of reference should be at the level of the seat sling with the LE’s placed in the anticipated degree of flexion.

<table>
<thead>
<tr>
<th>90 DEGREES</th>
<th>85 DEGREES</th>
<th>80 DEGREES</th>
<th>75 DEGREES</th>
<th>70 DEGREES</th>
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- Back of leg should comfortably clear seat sling (2" of clearance cushion to back of knee may not correlate with upholstery clearance @ the calf)
- Accurate measurement from the posterior buttocks to back of the knee @ both seat cushion and seat sling level with LE in desired angle of flexion

2" clearance at Cushion Level

Contact @ Upholstery with 85 Degree Front Rigging
SEAT DEPTH..... WHY DO WE DO IT?

When seat depth is to great we get:

- Potential for compromised blood flow/edema.
- Irritation and possible skin injury at the level of the seat sling.
- Postural compensation.
- Decreased stability of foot position on footplate.

SEAT WIDTH....HOW DO WE DO IT?

- Begin with Accurate Measurements. (No Flexible Tapes... Metal Tapes must be used with a point of reference....Calipers are superior for accuracy.
- Seat width should be sized anatomically, no extra or give too width.

****With Rigid manuals there are measures we can take to increase available width but we can’t decrease...
SEAT WIDTH...WHY DO WE DO IT?

Appropriate prescription of seat width/COG/Rear STF allows us to remain consistent with Clinical Practice Guidelines:

- Avoid potentially injurious or extreme positions at the shoulder, including extreme internal rotation and abduction.

CAMBER WHEEL SPACING AND Seat WIDTH

What to Look For:

- Wheel spacing and camber should allow the user’s arms and shoulders to align with the wheels
- Aligning the shoulder allows for the most efficient push stroke, reduces risk of injury from repetitive stress.
- Maintains maximum function
Seat slope is utilized for the purpose of “Creating Stability and Balance for the user.”

- Lower Center of Mass.
- Improved Wheel Access and Stroke.
- Improved Pitch Axis Control in combination with COG.

Seat Slope is determined somewhat organically as a natural relationship between functionally indicated Front and Rear Seat to Floor Heights.

- We must consider that the greater the slope the greater the back angle.
SEAT SLOPE...ASSOCIATED ISSUES

- When Seat Slope is utilized appropriately with COG to create wheel access we frequently:
  Close the Seat to Back Angle Beyond Anatomic Limits
  
  Create Postural “Dead Space”
  
  Alter: Posture/Function/Balance

Positive Effects of The Ergo Seat: Sit Deeper

- Contouring of the seat ensures a larger angle between seat and seat-back.
- Result: Less pressure on the internal organs in the abdominal area

Chairs with **Wedge Seat** and **Ergo Seat**
Same Front and Rear Seat Height
3” seat slope = 1” lower Sitting Height
POSITIVE EFFECTS OF THE ERGO SEAT: STABILITY

- Improved Pelvic alignment and Stability - Reduces Shearing/ Sliding
- Improved Overall Postural Alignment
- Balanced Position allows more dynamic movement of Torso. The individual is able to produce more power and better balance by using the weight of the torso when climbing or navigating over obstacles
- Reduces Tippiness by allowing for a more forward head position while climbing
- Improves wheel access

ERGO SEAT....HOW DO WE DO IT?

Measure the Well
Should End Approximately 1” in front of Greater Trochanter 2” in front of IT’s.

- Account for backrest
- Use Pressure Mapping
- Use RIDE® Foam Gauges
- Use your Eyes
- Know Your Cushion
SUMMARY...START FROM THE IDEAL

SUMMARY...EDUCATE YOUR CLIENT ON CLINICAL BEST PRACTICE
SUMMARY....WORK OUTWARD

Work outward from the ideal- accommodating the individual’s unique needs for balance and function.

- Propulsion and Wheelchair Skills Training... **Overcome Apprehension!!!**
- Use the 90/10 rule.
- Consider Anti-Tips for the inexperienced user.
- Discuss the compromise.....educated users make informed decisions.

Questions?
CONTACT INFORMATION

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Course transcripts and additional copies of certificates of completion are available upon written request: 5501 Wilshire Blvd NE Ste C ABQ, NM 87113 1.800.500.9150.

Thank You!
REFERENCES


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