Improve your Confidence Prescribing Active Manual Wheelchairs with your Adult and Pediatric clients

What are the most common Goals?

- Safety
- Efficient propulsion
- Decreased repetitive strain injury (RSI)
- Postural stability
- Increased sitting tolerance

Key Assessment Information

Clinical Factors
- Method of propulsion - UE, LE, both
- Strength, ROM, orthopedic status, tone
- Endurance, cardiopulmonary status
- Potential for change in function or size
- Seating/Positioning needs

Lifestyle Factors
- Environmental needs
  - Access
  - Terrain
  - Transportation

Accurate Measurements

Frame Selection

Successful Tilt in Space Set Up

Proper seating set up:
- Appropriate seating support
- Seat depth sufficient for pressure distribution
- Feet supported
- Accommodate hip flexor and hamstring length

Successful Tilt in Space Set Up

Proper wheelchair set up:
- Appropriate STFH for transfers, environmental access
- Appropriate wheel size for terrain
- Care-giver friendly options
- Optimal weight distribution between casters and rear wheels
- Optimize tilt range
Who is Appropriate for Dynamic Tilt:

- Cannot independently change position
- Risk for skin breakdown
- Cannot maintain pelvic/trunk/head position or balance against gravity for prolonged periods
- Risk of respiratory complications
- Risk of digestive complications
- Risk for postural hypotension
- Risk of autonomic dysreflexia

Transport:

- Low weight frame
  - < 10kgs
- 115 weight capacity
- Short term use
- “transport” from car to appointment, visit
- Not used for daily mobility

Breezy Basix

Successful LE Propulsion:

Proper seating set up:
- Flat or anterior sloped seat
- Firm sacral support
  - Back contour
- Proper back height and angle
- Shorter seat depth

Successful LE Propulsion:

Proper wheelchair set up:
- Low seat to floor height
- Shorter seat depth
  - For full LE stroke
- Maximal chair “roll - ability”
  - Small caster turning radius; wide caster tire
  - Rear wheels forward
  - Light weight chair and components

Low Seat to Floor Height:

- Hemi height wheelchair
- Smaller wheels/casters
- Adjust axle plate
- Drop seat

Breezy Basix

- Light Al chair
  - 13.5 kg
- Quick release spoke wheels
- Adjustable arm rests
- Swing in/out footrests
- Hemi height available
- Adjustable seat depth
Successful UE propulsion

Proper seating set up:
• Posterior seat slope with necessary contour
• Backrest with firm posterior pelvic support
• Appropriate back height
  • Allow thoracic mobility
• Seat depth sufficient for full femur loading
• Feet supported

Successful UE Propulsion

Proper wheelchair set up:
• Appropriate size
  • Width and depth
• Appropriate rear wheel size
• Appropriate caster size and width
• Optimal rear wheel position
  • Optimal wheelchair stability
  • Maximum wheel access and efficiency of propulsion

Critical Factors

Frame Weight, Material & Quality
Frame Size and shape
Frame orientation in space
Rear wheel position
  • Vertical
  • Horizontal
Caster position and size

Balance between Maneuverability and Stability

Quality chair
= less flex, less force to propel

• Materials and smart engineering
• Quality components such as bearings = less rolling resistance, less force needed to push
• Durability and tighter tolerances for non-moving parts as well as ease of motion for moving parts

Propally Positioned Rear Wheel

• Less rapid loading of the pushrims
• Less strokes needed to maintain the same speed
• More of the pushrim is used
• Quicker to accelerate
• Enhances mobility
  • decreases: turning radius, downhill turning

• What is the best way to propel a wheelchair?

  • Propulsion Patterns and Pushrim Biomechanics in Manual Wheelchair Propulsion
  Boninger, 2001
  • Plotted path of hand
  • Patterns were identified
Optimal Wheel Position

- Tip of middle finger at hub
- 100-120° of elbow flexion at top of push cycle
- 70-80% weight over rear wheels
- Good lateral access/camber
- Some posterior tilt in space or "dump"

Rear Wheel Position

- Adjust horizontal, vertical, lateral position and camber using adjustable axle plate or camber tube

Horizontal position affects:
- Wheel access/UE position
- Maneuverability
- COG/stability

Lateral position affects:
- Wheel access/UE position
- Overall width

Vertical position affects:
- Wheel access/UE position
- STFH
- Orientation in space

Camber affects:
- Wheel access/UE position
- Maneuverability
- Stability

Horizontal Position - Rearward

- More weight on casters
- ↑ strength required
- ↑ work for UE muscles
- ↑ overall length/turning radius
- ↑ rearward stability

Affect on wheel access:
- Shoulder in excessive extension to initiate stroke
- Poor lever arm of force, inefficient stroke
- Increase risk of UE stress and damage

Horizontal Position - Forward

- ↓ weight on casters
- ↓ strength required
- ↓ work for UEs
- ↓ overall length/turning radius
- ↓ rearward stability
- ? how much stability does your client need

Affect on wheel access:
- Shoulder in more neutral position
- More efficient stroke
- Decrease risk of UE stress and damage

Horizontal Rear Wheel Position

To change horizontal wheel position:
- Move axle sleeve horizontally in axle plate
- Move axle plate horizontally on frame
- Move camber tube horizontally on frame

Remember impact to wheel locks.....

Vertical Wheel Position

Move wheels up/down on frame to affect:
- Access to pushrim - which affects:
  - UE position during propulsion
  - STFH – which affects:
  - Access to environment
  - Transfers
  - Foot propulsion
  - Orientation in space – which affects:
  - Postural stability
Gravity

**Vertical Position – Orientation in space**

- Flat Seat
- Posterior Seat Slope

**Vertical Wheel Position**

To change vertical wheel position:
- Move axle plate up/down on frame
- Move axle sleeve up/down in axle plate
- Move camber tube on frame

Remember impact to caster angle…

**Vertical rear wheel position - Dump/Fixed Tilt in Space**

**Lateral Wheel Position - Camber**

Camber provides:
- \( \uparrow \) lateral stability
- \( \uparrow \) efficiency of turns/propulsion
- \( \uparrow \) wheel access
- \( \uparrow \) overall width at base

Change camber by:
- Axle plate – add/subtract spacers
- Camber tube - change tube
- Dual camber axle – put wheel into other axle sleeve

0º Camber

8º Camber

**Caster Angle**

- Caster housing must be perpendicular to ground
- Not “squared” cause:
  - Caster float, caster float
  - Increased effort to turn
  - Poor tracking of chair

Check after changes:
- Wheel/caster size
- Camber
- Fork/stem bolt length
- Axle plate adjustment

**Caster re-alignment**

- Caster stem pivots inside the frame

Pivot caster adjuster

Spline caster angle adjuster
Type of Rear Wheels

- Spokes
  - Lighter
  - Less flex
  - More efficient
  - Require some maintenance

- Spinergys
  - Lightest
  - Absorb Energy
  - Strongest

- Mags
  - Heavier
  - More flex
  - Less efficient
  - Only one benefit = maintenance-free

Type of Tires

Solids
- Less roll resistance
- Less shock absorption
- Less grab over obstacles
- No flats/maintenance

Pneumatics
- More roll resistance
- Better shock absorption
- More grab over obstacles
- Risk of flats
- Need maintenance

Airless inserts
- Significantly heavier
- Little shock absorption
- No flats/maintenance

Wheels

Caster Size

<table>
<thead>
<tr>
<th></th>
<th>Small caster</th>
<th>Large caster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propulsion (flat surfaces)</td>
<td>Easier</td>
<td>More difficult</td>
</tr>
<tr>
<td>Turning</td>
<td>Easier</td>
<td>More Difficult</td>
</tr>
<tr>
<td>“Grab” on uneven surfaces</td>
<td>Less</td>
<td>More</td>
</tr>
<tr>
<td>Interference with footplates</td>
<td>Less</td>
<td>More</td>
</tr>
</tbody>
</table>

Open Frame Design

- Durable
- Lighter than folding
- Efficient

Caster Size

<table>
<thead>
<tr>
<th></th>
<th>Narrow tire</th>
<th>Wide tire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propulsion (hard surfaces)</td>
<td>Easier</td>
<td>More Difficult</td>
</tr>
<tr>
<td>Turning</td>
<td>Easier</td>
<td>More Difficult</td>
</tr>
<tr>
<td>Propulsion in soft surfaces</td>
<td>More difficult</td>
<td>Easier</td>
</tr>
</tbody>
</table>

Rigid Frame

- Durable
- Lighter than folding
- Efficient
Folding Frame:
- Folds
- Heavier than rigid
- Less energy efficient
- Less durable

Squeeze Frames
- Fixed or adjustable
- Create closed seat to back angle
- “Buckets” the pelvis for increased stability and positioning
- Helps promote upright trunk
- Might help prevent extensor tone

Suspension Frames
- 4-Link Suspension - each wheel is suspended independently
- Suspension is adjustable

Power Assist
- Push activated power assist
- Special wheels with a motor in each hub
- Reduces push force required

Pediatric Frames
- Folding frame or rigid?
- Postural Support requirements
- Weight matters
- Look for adjustability
  - Skill
  - Size
- Light weight, small components
- Transportation
Dynamic Positioning Manual Chairs

- Folding frame or Rigid?
- Postural Support requirements
- How much tilt is required?

Weight matters
- Look for growth adjustability
- Light weight, small components
- Transportation needs

CASE STUDIES