permobil

Acquired Brain Injury: Meeting Wheeled Mobility Needs

permobil

Continuing Education Credits

APPROVED PROVIDER of CONTINUING EDUCATION by The American Occupational Therapy Association, Inc.

ProCert Recognizing quality in continuing competence

Occupational Therapy

APPROVED PROVIDER of CONTINUING EDUCATION by The American Occupational Therapy Association, Inc.

- The Permobil Academy is an AOTA approved provider of continuing education for occupational therapy by the AOTA
- This program awards occupational therapists and occupational therapy assistants 0.2 CEUs
- The assignment of AOTA CEUs does not imply endorsement of specific course content, products, or clinical procedures by AOTA

permobil

permobil

Completion Requirements

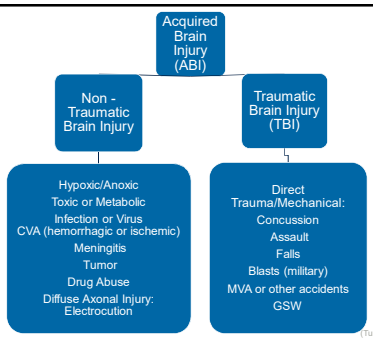
In order to obtain CEU credits, participants must COMPLETE ALL 3 criteria:

1. Attend the entire course
2. Sign in and out
3. Complete an on-line course assessment following course completion with 2 weeks

* Failure to complete each and every criteria will result in NO CEUs being awarded!

Objectives:

- Describe three common functional limitations that occur following Acquired Brain Injury (ABI)
- Identify three common postural concerns in individuals with ABI
- Describe at least two considerations when configuring a manual wheelchair for efficient propulsion and postural support following ABI
- State three current perceptions related to prescribing power mobility for people with ABI, including Cerebral Vascular Accidents (CVA) and Traumatic Brain Injury (TBI)
- Discuss two potential training techniques to allow for initiation of power mobility post-CVA.



(Turner- Stokes, 2015; shepherd.org)

Prevalence

- TBI
  - Approximately 5.3 million Americans are living with a TBI-related disability (Mahajan et al., 2011)
  - Estimated 282,000 hospitalizations annually due to TBI
- Stroke
  - Leading cause of serious long term disability
  - 795,000 people annually in the US have a stroke, 610,000 of which are new or first time strokes
  - Mobility reduced in half of all stroke survivors age 65 and older (CDC, 2017)

permobil

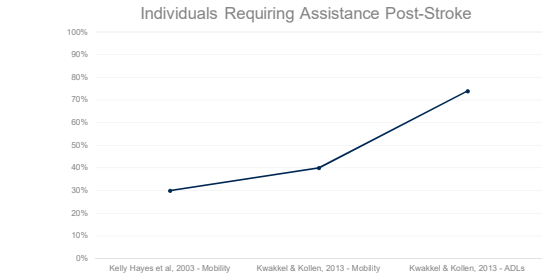
Factors Impacting Mobility Post-ABI

- Decreased muscle strength
- Spasticity
- Soft tissue/joint restrictions
- Balance impairment
- Sensory or proprioceptive impairment
- Vestibular dysfunction
- Visual impairments
- Cognitive dysfunction

(Eng, Rowe, & McLaren, 2002)

permobil

Mobility Impairment



permobil

What Are the Options for Mobility Post ABI?

permobil

Mobility and Quality of Life

- "People with stroke appear to rank the value and use of…equipment more highly when the equipment is explicitly linked to a social interaction or occupational performance goal" (Boland et al, 2017)
- Nearly one third of individuals were not leaving their home unsupervised, despite community ambulation being a meaningful goal (Lord et al, 2004)

permobil

When to Consider Wheeled Mobility?

- Early!
- If the client:
  - Is non-ambulatory at admission
  - Has a lower total admin FIM score
  - Has experienced a left hemispheric stroke
- Wheelchair assessment and training should begin within the first few days of admission (Mountain et al, 2010, p. 642)

permobil

Walking Speed and Energy Consumption

- Chronic fatigue can be present in people post-CVA
  - Reported up to 70% incidence
  - Physical function is reduced as a result
- Individuals measured > 6 months post-CVA recorded an energy consumption 1.25-1.5 times that of age-matched controls when performing MRADLs (Serra, 2016)

Ambulation Post-CVA

- Average walking speed post-CVA:
  - 0.4 mph-2.3 mph
  - 1.8 mph is a good predictor of household ambulation
  - 3.1 mph is required to safely cross a street (Young et al, 2015)
- Think about effectiveness and efficiency of mobility
- Walking at all costs?

Functional Mobility?

What Happens After Discharge from Inpatient Rehabilitation?

- **Most recovery occurs within 10 weeks of stroke**, with recovery plateaus seen at three to six months post onset (Kwakkel & Kollen, 2013)
- In study by Paolucci et al (2001), one year post discharge from inpatient rehabilitation:
  - [redacted] improved mobility levels
  - [redacted] worsened mobility levels

The Evaluation – What Are the Goals?

- Seating system:
  - Accommodate or correct postural limitations?
  - Fluctuating tone?
  - Is vision a contributing factor to postural assymetries?
- Mobility base:
  - What does the client need to achieve independent, safe and efficient mobility?
    - Configuration of mobility base
    - Cognitive, Perceptual, and Visual considerations
    - Training techniques

Postural Evaluation and Considerations Post-ABI

Postural Considerations Post ABI

- Presence of:
  - Asymmetrical strength
  - Spasticity/Tone
  - Storming
  - Visual impairment
  - Heterotopic ossification
  - Cognitive impairment
  - Perceptual impairment
  - Sensory impairment

permobil

Posture

Seated Posture

- Pelvic obliquity
- Subluxations of UE's due to weakness
- Pelvic/trunk rotation
- Status of HO in UE or LE

Acquired Posture

- Head positioning due to visual deficits
- Rotation of the trunk for functional activities on the effected side
- Flexion or extension contractures of the effected limbs

Asymmetrical Strength Considerations

- Pelvic obliquity:
  - Typically occurs opposite of the stronger side
  - Increased risk for skin breakdown due to peak pressure on low side

permobil

Asymmetrical Strength Considerations

- Scoliosis:
  - Often occurring in conjunction with a pelvic obliquity
  - Often resulting from use of the stronger upper extremity during functional tasks

permobil

Asymmetrical Strength Considerations

- Rotation:
  - Trunk rotation due to use of the stronger upper extremity during functional tasks
  - Trunk rotation due to positioning of hemiparetic upper extremity
  - Pelvic rotation due to hemi propulsion technique

permobil

Spasticity/Tone Considerations

- Postural asymmetries:
  - Examples: posterior pelvic tilt due to extensor tone, pelvic obliquity/rotation if asymmetrical spasticity or tone
- Risk of soft tissue shortening/contractures
- Difficulty with maintaining "ideal" position in seating system
- Equipment breakage or coming out of adjustment

permobil

Visual Impairment

- "Generally, after brain injury, the visual system is not comprehensively evaluated, sometimes because there is a lack of articulated complaints due to impaired subjective experience or reduced cognition." (Gianutsos, R. RamseyG., & Perlin, R.R., 1988)
- Impairment may result in:
  - Cervical rotation/flexion/extension
  - Trunk/pelvic rotation if severe

permobil

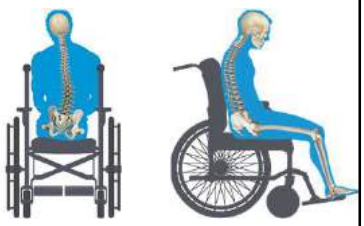
Heterotopic Ossification (HO)

- May result in:
  - Limited hip flexion and internal rotation
  - Limited ROM at other joints as well (knee, shoulder, elbow) with seating implications

permobil

Heterotopic Ossification – Postural Implications

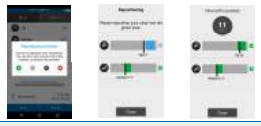
- When limitations in range of motion are not accommodated for, can result in significant postural asymmetries and peak pressures at sitting surface



permobil

Cognitive Impairment

- May result in:
  - Difficulty positioning self correctly in chair (either initially, or repositioning when needed)
  - Difficulty remembering to relieve pressure when needed
  - Impairments in motor planning required for independent propulsion
  - Safety considerations with power mobility



permobil

Perceptual Impairment

- May result in:
  - Difficulty maintaining midline or inability to recognize midline
  - Keeping extremities positioned on support surfaces

permobil

Sensory Impairment

- May result in:
  - Increased risk for skin breakdown
  - Difficulty achieving postural alignment (difficulty knowing where body is at in space)
  - Keeping extremities positioned on support surfaces

permobil

24/7 Positioning

- Bed positioning
- Bath equipment
- Support while eating/feeding
- Set-up environment to work in opposition of postural tendency or other impairment
  - Place food impaired side so that they have to work on crossing midline
  - Have TV on the side that exhibits neglect

(Lange, 2011)

permobil

24/7 Positioning in TBI – Case Example

- Cervical Spine positioning in bed
- Trunk stretching and bed positioning to counteract severity of asymmetry

permobil

Synthesize Information from Assessment

- Generate list of functional requirements
- Translate that list into seating and mobility goals
- Determine which products offer desired capabilities and features to support these goals
- Arrange an equipment trial to assist in client's final product selection (using a variety of options)
- Use objective measures to compare products (photographs, skills performance, FIM, pressure mapping, etc.)

permobil

We Don't Have All the Answers

- What comes first…seating solutions or mobility solutions?
- How do we decide?

Holistic view of the wheelchair AND seating system together!

permobil

permobil

Selecting a Mobility Base

- Evaluation for mobility device includes ruling out "least costly" alternative that is ***equally effective***
- Ensure user has the ability to functionally mobilize in the recommended device in:
  - All environments
  - All situations
  - Efficiently
  - Safely

permobil

Mobility Related Activities of Daily Living

- MRADLs – Eating, Grooming, Dressing, Bathing, Toileting, Transferring, Communicating
- IADLs – Safety Procedures/Emergency Response, Telephone Use, Parenting, Directing Caregivers, Caring for Service Animals, House Cleaning, Laundry, Meal Preparation, Use of Transportation and Community Mobility for School, Work, Shopping, Banking, Socializing, Recreation

NOTE: Movement pattern/technique used – Ensuring wheelchair design/components promote maximum function and safety

permobil

Manual Wheelchair Considerations Post-ABI

Manual Wheelchair Options

- Upright Manual Wheelchairs:
  - Standard Wheelchair (K0001)
  - Standard Hemi-Wheelchair (K0002)
  - Lightweight Wheelchair (K0003)
  - High Strength Lightweight Wheelchair (K0004)
  - Ultralightweight Wheelchair (K0005)

permobil

Why Ultralight Weight?

- If the client will independently propel, a fully adjustable ultralight weight manual wheelchair should be considered
- Highly adjustable for:
  - Optimal configuration for efficient propulsion
  - Ability to meet seating needs

permobil

Propulsion Options and Patterns

- One arm drive (lever or rim activated)
- Bilateral Upper Extremities
- Unilateral upper and lower extremity ("hemi propulsion")
- Bilateral foot propulsion
- Forward vs. Backward?

permobil

Propulsion Patterns in ABI

In skills that have higher rolling resistance or high balance demands, **difficulty many be due not to neurologic impairment but inherent in the hemi-propulsion technique** (Kirby et al, 2005)

In high rolling resistance situations, success rates were 33-50% higher in the **backward direction** (Charbonneau, Kirby & Thompson, 2013)

permobil

Learning Activity:
Try a Manual Wheelchair!

Manual Wheelchair Configuration for Independent Propulsion

- Folding vs. Rigid
- Seat to floor height
- CoG
- Seat slope
- Seat to back angle
- Primary support surfaces

Folding vs. Rigid

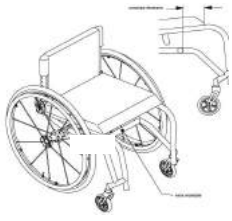
- Historically, folding wheelchairs have been prescribed to allow removal of front hangers (LE propulsion, transfers)
- What about rigid frame options?

permobil

Rigid Chair with Flip-Up Footplates

permobil

Rigid Option that Allows for LE Propulsion



Seat to Floor Height

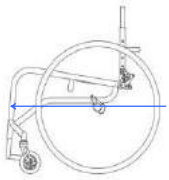
- Reducing the seat to floor height (and seat depth) improved speed, accuracy, and satisfaction in individuals using a hemi propulsion technique (Wong et al, 2001)
- Low enough to achieve full contact with foot on floor while maintaining a neutral pelvic tilt (when possible)

$$\text{FSTF (Minimum)} = \underbrace{\text{LLL} - \text{Cushion}}_{\text{Seat-to-footrest}} + \text{GC}$$

permobil

Center of Gravity

- The benefits of a forward CoG in UE propulsion are well documented
- What about the importance of CoG in hemi or bilateral foot propulsion?
  - Same principles should apply – by offloading the front casters, efficiency of propulsion is maximized



permobil

Seat Slope

- Why might seat slope effect efficiency of hemi or bilateral foot propulsion?
- When to consider seat slope?
- How much? (Regier et al, 2014)

Vs.

permobil

Back Support/Back Cane Angle

- Consider a more upright position if client has the range of motion and endurance necessary to tolerate – this may be a gradual process over time!
  - May help prevent sliding into posterior pelvic tilt
  - A more active and "ready" position for propulsion,daily activities, reaching, initiating transfers

Vs.

permobil

Primary Support Surfaces

- Consider a solid back support, with lateral contour if needed for proximal stability and prevention of postural asymmetry
- Consider a cushion that meets the client's skin protection/positioning needs while also providing a solid base of support from which to function
- Consider solid seat insert

permobil

Additional Manual Wheelchair Considerations

- Wheel locks:
  - Uni-locks
  - Extension
  - D's locks or hub lock
- Backrest Heights
  - Trunk supports
- Change the leg rests to allow easier swing-away
- Look for frames without hardware on inside to cause injury

permobil

Set-up of Legrest Assembly – Clinical Example

- Example of modifying the leg rest hanger:
  - Remove the inner tube and swap the hangers from right to left
  - Places the release lever on the inside making it easier for someone to swing-away with hemiplegia/hemiparesis.
- Note \the lack of bolts and hardware on the inner frame, decreasing potential risk of skin impairment with LE propulsion

permobil

What Do You Think?

Wheelchair Propulsion Test

permobil

Wheelchair Propulsion Test (WPT)® Version 1.0 Form

Subject #: One hand, one foot Date: Dec 6, 2010 Time: 10:30am Test #: 1

Recorded Data*	
1. Able to successfully complete the 10m distance?	Yes ☒ No ☐
2. Direction of travel	Forward ☒ Backward ☐
3. Limbs contributing to propulsion, steering or braking (tick all that apply)	Left: Hand ☐ Leg ☐ Right: Hand ☒ Leg ☒
4. Limb monitored for timing propulsion cycles (tick one limb)	Left: Hand ☐ Leg ☐ Right: Hand ☒ Leg ☐
5. Time (to nearest second)	26 s
6. Total number of propulsive cycles (to nearest full cycle)	17 cycles
7. If using one or more hands for propulsion in the forward direction, during the *contact* phases, did the subject generally begin the contact between the hands and the hand-rims behind the top dead center of the rear wheel?	Yes ☐ No ☒ Not applicable ☐
8. If using one or more hands for propulsion in the forward direction, during the *recovery* phases, did the subject generally use a path of the hands that was predominantly beneath the hand-rims?	Yes ☐ No ☒ Not applicable ☐

permobil

9. If using one or more *feet for propulsion* and going forward, did the subject make initial foot contact with the knee flexed less than 90° from full extension and finish with the knee flexed more than 90° (or the opposite if going backward)?	Yes ☒ No ☐ Not applicable ☐
10. Comments: (e.g., position on seat, trunk and arm posture, hand grip, foot contact, consistency, need for training, footwear, equipment worn, wheelchair issues) #8 - Arc recovery pattern. Arm and leg propulsion phases fairly well synchronized.	
Derived Wheelchair-Propulsion Data*	
1. Speed: 10m / 26 # seconds =	0.4 m/s
2. Push frequency (cadence): 17 # cycles / 26 # seconds =	0.7 cycles/s
3. Effectiveness: 10m / 17 # cycles =	0.6 m/cycle

*Directions on next page.

Tester signature: SA Tester name (print): _____

permobil

Power Assist Options

- When to consider
- Options
- ABI specific considerations

permobil

Alternative Uses for SmartDrive

- Use to maximize efficiency of hemi-propulsion pattern
- Thumb throttle buttons for individuals with impaired proprioception and/or coordination
- Use on tilt-n-space chair to ease ability of caregiver to assist

permobil

Power Wheelchair Considerations Post-ABI

When to Consider Power?

- Ensure user has the ability to functionally mobilize in the recommended device in:
  - All environments
  - All situations
  - Efficiently
  - Safely

permobil

An Alternative One-Arm Drive Option?

Vs.

permobil

Quality of Life

- Pilot study of 8 patients who had previous used a MWC for >6 months
- Transition to PMD
  - Resumed life roles (husband, wife, etc..)
  - Improved efficiency with activities such as laundry, household chores, and work activities
  - Improved self-esteem
- 100% of participants noted improvement of quality of life with the transition from MWC to PMD (Buning, Angelo & Schmeler, 2001)

permobil

Clinical Example – Meet Ben

- 38 y/o male with history of ABI in 2011 following a fall
- Left dense hemiplegia with clonus
- Lives independently in an accessible apartment

permobil

Clinical Example – Meet Ben

- Initially a manual wheelchair user due to cognitive deficits
- Propels solely with the right upper and lower extremity.
- Current chair is K0005

permobil

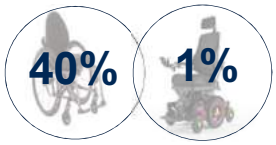
Clinical Example – Meet Ben

- Transitioned to power mobility in 2013
  - Wished to return to school
  - Gained employment where the power wheelchair was more efficient
  - Continues to use the manual wheelchair in his apartment

permobil

Current Practice and Powered Mobility

- Rates of power and manual wheelchair use in stroke:
  - 59% not requiring a wheelchair at discharge
  - 40% discharged with manual wheelchair
  - 1% discharged with power wheelchair
    (Mountain, Kirby, MacLeod, & Thompson, 2010)



permobil

Who would you rule out for power mobility?

permobil

Perceptions of Power Mobility and ABI

- Will limit neuro-recovery
- Wait to see if strength/function improves before considering power
- It is not safe or appropriate
  - Cognition
  - Vision

permobil

What Does the Evidence Say?

- "Will limit neuro-recovery"
  - "There is no evidence that compensation strategies impede recovery of physical abilities" (Boland et al, 2017)
- "Wait to see if client improves"
  - If certain predictive factors for wheelchair use are present at admission, should consider initiation of wheelchair evaluation process shortly after admission (Mountain et al, 2010)

permobil

What Does the Evidence Say?

- "Not safe or appropriate"
  - Results from several studies suggest that power wheelchair navigation skills can be improved with strategies/training for individuals with neglect (Dawson & Thornton, 2003; Punt et al, 2011)
  - Drive to learn (Nilsson et al, 2011)

permobil

Clinical Example - CVA

- HealthSouth Rehabilitation Hospital in Scottsdale, AZ
- 64 y/o male
- 6 months s/p Right CVA
- Has left sided inattention/neglect
- Right hand dominant
- The participant in this case study primarily used a manual wheelchair for mobility.
- Foot Propeller, safety issues, reported fatigue with his manual wheelchair, reported decreased motivation to be independent in manual wheelchair.
- Learned non use

permobil

Clinical Example - CVA

- Protocol:
  - Videotaping prior to the initial and final training sessions
  - Visual testing consisted of Novavision VRT for visual field cuts
  - 30-min treatment sessions for *10 consecutive days*

Clinical Example – CVA

- Treatment Sessions:
  - Gross circle
  - Figure eight
  - Spatial orientation: center alignment
  - Uneven/even terrain, winding walkway, ramps, curb cuts, speed bumps
  - Turns to affected and non-affected side
  - Interior and exterior doorways

Clinical Example - CVA

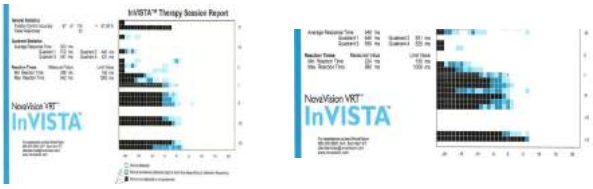
"Turn left and drive down sidewalk"

Clinical Example - CVA

Curb Cuts

Clinical Example - CVA

Visual Field – Pre/Post

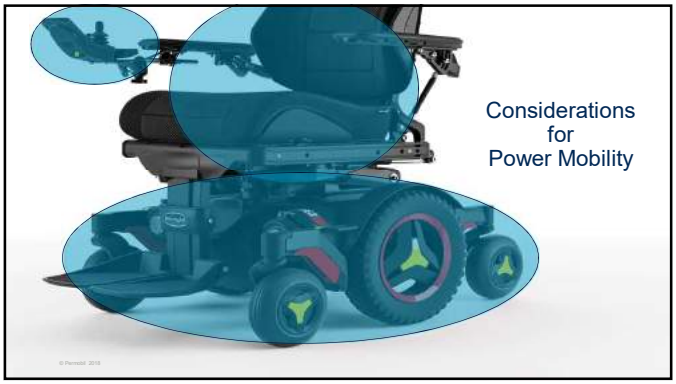


Clinical Example - CVA

- Improvements noted with cause and effect, avoiding hazardous situations, attention, scanning to neglected side, and visual spatial awareness per video results
- Speech therapists reported improvements with table top attention, vision, and cognitive tasks

Clinical Example - CVA

- Summary:
  - Powered mobility, as an adjunct tool for visual/perceptual deficits, can be an effective intervention tool
  - Participant became a more viable candidate for powered mobility upon discharge to improve his independence



Considerations for Power Mobility

Learning and Powered Mobility

Intrinsic Factors

- Cognitive processes
- Spasticity
- Vision
- Perception
- Pain
- Age
- Gender
- Motivation

Extrinsic Factors

- Lighting
- Faulty wheelchair parts
- Poor seating support
- Non-functional or inefficient drive control
- Ineffective programming
- Trainer feedback and therapeutic use of self

Skills Training Strategies – Simplify!

- Don't overcomplicate it! Many times it is appropriate to start with a standard joystick.
  - Let user interactions guide the next step

Power Wheelchair Programming Considerations

- Acceleration/Deceleration
  - Increase to make more "jerky"
  - Decrease to smooth out
- Tremor Dampening
- Throw
- Power
- Auditory options?
  - Music
  - Warning beeps?
- Inhibition of specific direction during training periods

Suggested Initial Programming Parameters

- Reduce overall speed
- Limit directionality (remove reverse)
  - Change joystick orientation if needed
- Modify acceleration and deceleration
  - Forward and turning
- Manage power and torque

Maximizing Safety

- Remote stop
- Attendant emergency stop
- Automatic timeout
- Set-up no drive profiles
- Lock the joystick
- Sleep timer
- Use of proximity sensors in cases of neglect/inattention or visual field cuts

permobil

Wheelchair Skills Training

- Why should we do it?

permobil

Principles of Motor Learning

- Early on success may be partial, inconsistent, or only possible within a certain setting
- Don't expect perfection
  - Practice doesn't make perfect…perfect practice makes perfect
- If mistakes are occurring to fatigue or frustration, best to allow for a break

permobil

Unrealistic Expectations?

permobil

Identifying Session Goals

- Speed vs. Accuracy?
- Focus on the task
  - Early on in training, focusing on the movement itself can cause decreased performance and learning overall
- As skills become more automatic, more advance learners tend to do better with focusing on the overall goal of the task rather than individual components
  - Still may have to draw attention to specific parts to improve performance
- Co-Treat with Speech Therapy

permobil

Structure of Training Session

- Warm-up
- Some time on skills already acquired but requiring further practice
- A period during which instruction is received on the principal new skill that is the focus of the session
- A cool-down activity

(WSTP Version 4.2.3, 2013)

http://www.wheelchairskillsprogram.ca/eng/testers.php

permobil

Cause and Effect – How Do I Know Someone Is Ready?

- Switch on/off with music/TV/activity of interest to gauge cause & effect
- Start with power seat functions first
- Power wheelchair driving simulator?
- Just try it!

Show Me the Evidence

- Nilsson & Nyberg (1999)
  - Which has a greater impact on establishing cause and effect?
    - Traditional initiation of computer games and switch controlled toys as pre-training before PWC trial vs starting with power mobility
  - Understanding cause and effect was stronger when all body systems were involved the motion of the wheelchair vs a static apparatus/toy
    - n=40 people with severe disability
    - 14 people showed interest in exploration of single switch toy; only 5 could wait for the effect before hitting the switch again.
    - 9 people were able to drive goal-directed
  - For people with severe cognitive impairment, tools that affect all senses may promote increased arousal, interest, and motivation

Wheelchair Skills Training – Driving Forward

- Know how to adjust speeds and accelerations
- Observe how the user is contacting the joystick
  - Fingertips vs. web space?
- Stopping is an important part of driving forwards
  - Progressively stop closer to objects without touching
  - Progress from tall to short obstacles

Wheelchair Skills Training - Turning

- Start with small changes (moving around wide pylons) and progress to tighter turns
- Know the differences between FWD, MWD, and RWD
  - Will affect when to initiate turns and strategies for navigating in tight environments
- Can break 90° turns into parts (straight, turn, straight) vs. smooth pathway
- 180° turns: start at a slow speed, focus on staying within the boundaries – speed comes later
  - "Envision the joystick like a clock"

Once mobility base is evaluated and selected…

Objective Measures to Help Justify Powered Mobility

- Timed Forward Wheeling – 23 meter push test (May et al, 2003)
- Wheelchair Skills Test (version 4.3.3)
- Wheelchair Performance Test (WPT)

Best Practice For Optimal Outcomes

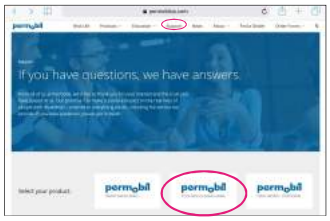
1. Keep client first
2. Be prepared to discus funding
3. Have resources and information available to client
4. Connect the dots with documentation

Funding Information & Resources

Website: www.permobilus.com
Email: US_Funding@permobil.com

EZ-Ti: Configure Your Chair & LMN Template Together

- https://orderforms.tilite.com/ezti/

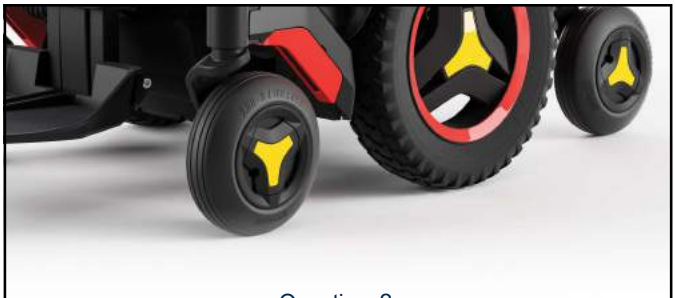


But Insurance Only Pays for One Chair…

- Alternative Funding Sources
  - Local Re-Use programs
  - Medicaid Independent Care Waivers
  - Private Pay
    - ABN Options
    - Upgrade programs from manufacturers
    - Demo chair sales
    - Care Credit
    - Crowd Funding: Help Hope Live
    - ABLEnow
    - Brain & Spinal Cord Injury Trust Funds

In Summary…

- Must consider presence of impairments (e.g., asymmetrical strength, tone/spasticity, vision, etc.) when addressing postural needs
- Configure manual wheelchair based on needs of the individual – extremely important given the inherent difficulty of the hemi-propulsion technique
- Select mobility base that is most efficient and safe in all necessary environments and situations
- Have realistic expectations for initial power wheelchair skills, and set appropriate training plan
- Know that client needs may change over time
- Inform client of options
- Be prepared to advocate for/with the client and provide funding resources



Questions?

permobil

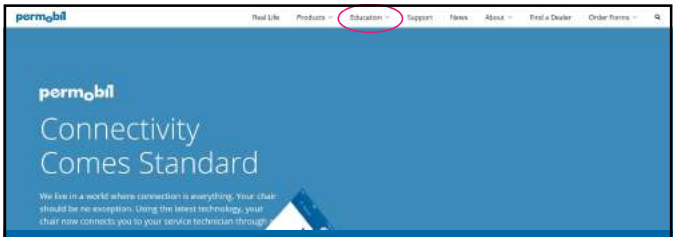
Online Assessment Info

Must sign the sign-in sheet
- Without sign in/out, NO CEUs can be issued

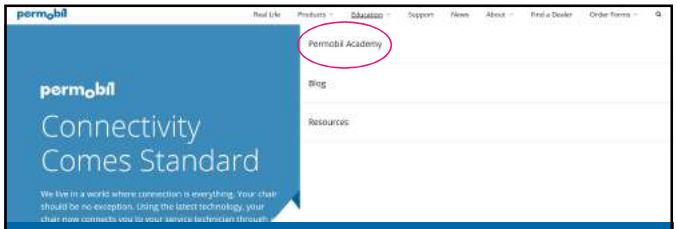
Online assessment is active for 2 weeks
- If not complete within 2 weeks, No CEUs will be issued

Need a case sensitive password to access

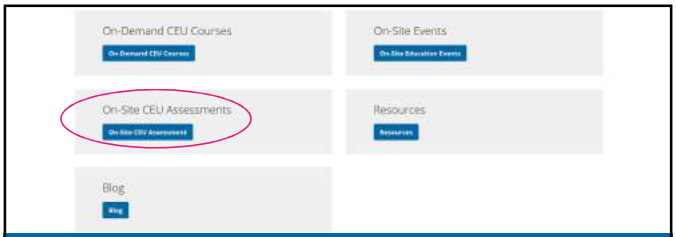
Be ready to out certificate at the end of the on-line assessment



To take the CEU assessment:
http://permobilus.com
Click on Education



To take the CEU assessment:
http://permobilus.com
Click on Education
Click on Permobil Academy



To take the CEU assessment:
http://permobilus.com
Click on Education & Permobil Academy
Click On-Site CEU Assessment

To take the CEU assessment:
http://permobilus.com
Click on Education & Permobil Academy
Click On-Site CEU Assessment
Click on Take Assessment for today's Date | Topic | Location

permobil

Case Sensitive Password

References

- Boland, P., Levack, W., Perry, M., & Graham, F. (2017). Equipment provision after stroke: A scoping review of the use of personal care and mobility aids in rehabilitation. British Journal of Occupational Therapy, 80(2), 73-88.
- Boyd, L. A., & Winstein, C. J. (2004). Providing explicit information disrupts implicit motor learning after basal ganglia stroke. Learning & Memory, 11(4), 388-396.
- Buning, M. E., Angelo, J. A., & Schmeler, M. R. (2001). Occupational performance and the transition to powered mobility: A pilot study. American Journal of Occupational Therapy, 55(3), 339-344.
- Centers for Disease Control and Prevention (CDC). (2010). Get the stats on traumatic brain injury in the united states. Retrieved from https://www.cdc.gov/traumaticbraininjury/pdf/bluebook_factsheet-a.pdf
- Centers for Disease Control and Prevention (CDC). (2017). Stroke facts. Retrieved from https://www.cdc.gov/stroke/facts.htm
- Charbonneau, R., Kirby, R. L., & Thompson, K. (2013). Manual wheelchair propulsion by people with hemiplegia: within-participant comparisons of forward versus backward techniques. Archives of Physical Medicine and Rehabilitation, 94(9), 1707-1713.
- Dawson, J., & Thornton, H. (2003). Can patients with unilateral neglect following stroke drive electrically powered wheelchairs?. British Journal of Occupational Therapy, 66(11), 496-504.

References

- Eng, J. J., Rowe, S. J., & McLaren, L. M. (2002). Mobility status during inpatient rehabilitation: a comparison of patients with stroke and traumatic brain injury. Archives of Physical Medicine and Rehabilitation, 83(4), 483-490.
- Kelly-Hayes, M., Beiser, A., Kase, C. S., Scaramucci, A., D'Agostino, R. B., & Wolf, P. A. (2003). The influence of gender and age on disability following ischemic stroke: the Framingham study. Journal of Stroke and Cerebrovascular Diseases, 12(3), 119-126.
- Kirby, R. L., Adams, C. D., MacPhee, A. H., Coolen, A. L., Harrison, E. R., Eskes, G. A., ... & Dupuis, D. J. (2005). Wheelchair-skill performance: controlled comparison between people with hemiplegia and able-bodied people simulating hemiplegia. *Archives of Physical Medicine and Rehabilitation, 86*(3), 387-393.
- Kwakkel, G., & Kollen, B. J. (2013). Predicting activities after stroke: what is clinically relevant?. *International Journal of Stroke, 8*(1), 25-32.
- LaChapelle, D. L., & Finlayson, M. A. J. (1998). An evaluation of subjective and objective measures of fatigue in patients with brain injury and healthy controls. *Brain Injury, 12*(8), 649-659.

References

- Lord, S. E., McPherson, K., McNaughton, H. K., Rochester, L., & Weatherall, M. (2004). Community ambulation after stroke: how important and obtainable is it and what measures appear predictive?. Archives of Physical Medicine and Rehabilitation, 85(2), 234-239.
- Mahajan, H., Spaeth, D. M., Dicianno, B. E., Collins, D. M., Boninger, M. L., & Cooper, R. A. (2011). Comparison of virtual wheelchair driving performance of people with traumatic brain injury using an isometric and a conventional joystick. *Archives of Physical Medicine and Rehabilitation*, *92*(8), 1298-1304.
- Mountain, A. D., Kirby, R. L., MacLeod, D. A., & Thompson, K. (2010). Rates and predictors of manual and powered wheelchair use for persons with stroke: a retrospective study in a Canadian rehabilitation center. *Archives of Physical Medicine and Rehabilitation*, *91*(4), 639-643.
- Nilsson, L., Eklund, M., Nyberg, P., & Thulesius, H. (2011). Driving to learn in a powered wheelchair: the process of learning joystick use in people with profound cognitive disabilities. *American Journal of Occupational Therapy, 65*(6), 652-660.
- Paolucci, S., Grasso, M. G., Antonucci, G., Bragoni, M., Troisi, E., Morelli, D., ... & Rizzi, F. (2001). Mobility status after inpatient stroke rehabilitation: 1-year follow-up and prognostic factors. *Archives of Physical Medicine and Rehabilitation, 82*(1), 2-8.
- Punt, T. D., Kitadono, K., Hulleman, J., Humphreys, G. W., & Riddoch, M. J. (2011). Modulating wheelchair navigation in patients with spatial neglect. *Neuropsychological Rehabilitation*, *21*(3), 367-382.

References

- Regier, A. D., Berryman, A., Hays, K., Smith, C., Staniszewski, K., & Gerber, D. (2014). Two approaches to manual wheelchair configuration and effects on function for individuals with acquired brain injury. NeuroRehabilitation, 35(3), 467-473.
- Sakakibara, B.M., Miller W.C., Eng J.J, et al. (2015). Health, personal, and environmental predictors of wheelchair-use confidence in adult wheelchair users. *Physical Therapy*, *95*, 1365–1373.
- Seaby, L., & Torrance, G. (1989). Reliability of a physiotherapy functional assessment used in a rehabilitation setting. Physiotherapy Canada, 41, 264-271.
- Serra, M. C., Treuth, M. S., Hafer-Macko, C. E., & Ryan, A. S. (2016). Increased Energy Cost of Mobility in Chronic Stroke. *Journal of Gerontology & Geriatric Research*, *5*(6), 356.
- Turner-Stokes, L., Pick, A., Nair, A., Disler, P. B., & Wade, D. T. (2015). Multi-disciplinary rehabilitation for acquired brain injury in adults of working age. The Cochrane Library.
- Ullberg, T., Zia, E., Petersson, J., & Norrving, B. (2015). Changes in functional outcome over the first year after stroke. Stroke, 46(2), 389-394.
- Van de Port, I. G., Kwakkel, G., Schepers, V. P., & Lindeman, E. (2006). Predicting mobility outcome one year after stroke: a prospective cohort study. Journal of Rehabilitation Medicine, 38(4), 218-223.

References

- Warden, D. (2006). TBI during the Iraq and Afghanistan wars. Journal of Head Trauma Rehabilitation, 21, 398-402.
- Wong, J., Seu, M., & Kieran, O. P. (2001). The effects of changing wheelchair seat position on posture and wheelchair propulsion performed unilaterally with the arm and leg. Archives of Physical Medicine and Rehabilitation, 82, 1340.
- Woodman, P., Riazi, A., Pereira, C., & Jones, F. (2014). Social participation post stroke: a meta-ethnographic review of the experiences and views of community-dwelling stroke survivors. *Disability and Rehabilitation*, *36*(24), 2031-2043.

Thank you

Regional Clinical Education Manager
Angela Regier, OTD, OTR/L, ATP/SMS
(720)369-4210
angela.regier@Permobil.com

Territory Sales Manager
Travis Carlson
(801)913-3427
Travis.Carlson@Permobil.com