

BACK IT UP!
Back Supports' Impact on Body Systems and Scapular Function

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Disclosure

Eleni Halkiotis is a full-time employee at Permobil Inc. She works as a Regional Clinical Education Manager in New York City, New Jersey, and Eastern Pennsylvania.

Brenlee Mogul-Rotman is a full-time employee at Permobil Ltd. She works as the National Clinical Education Manager in Canada.

This presentation is generic in nature and not related to Permobil-specific products.

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By the end of the presentation, participants will be able to:

01

Describe the anatomy and kinesiology of the scapulae in relation to propulsion and reach for MRADL performance

2


List 2-3 body function systems affected by optimal use of a wheelchair back support

3

Identify 4 features of back supports and summarize how proper application can positively affect body functions.


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What Dictates Posture?



- Seated posture
- Alignment
- Ability to function in sitting




- Protect spinal cord
- Enables trunk mobility
- Connects UEs & LEs




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The "Ideal" Posture

Neutral Midline in all planes




Upright Midline Level eye gaze








Upright Midline Normal curves




Midline with femurs parallel to seat surface Feet flat on footplates












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What Happens if Something is 'off'?



Did the pelvis cause the spinal abnormality?
or
Did the spinal abnormality cause the pelvic abnormality?



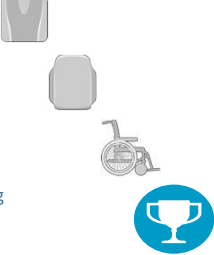
That we will **NEVER** be able to correct or accommodate for one **without** addressing the other.
So we **MUST** consider **more** than just the cushion!
We **MUST** consider utilizing specialized back supports **and** appropriate wheelchair models too!





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Consider the Primary Seating System

Cushion +
Back Support +
Mobility Base
= Optimal Seating System



- Postural stability
- Pressure redistribution
- Postural alignment



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Back Support Systems





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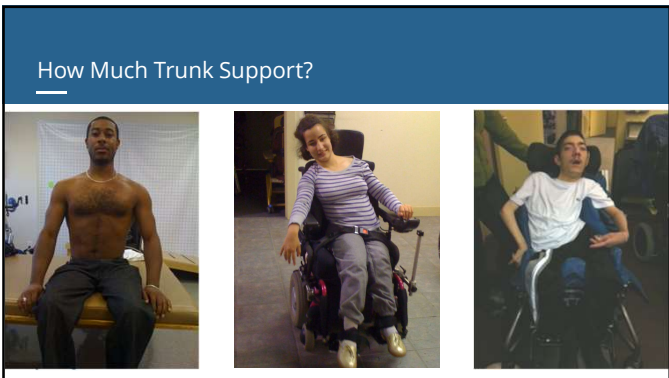




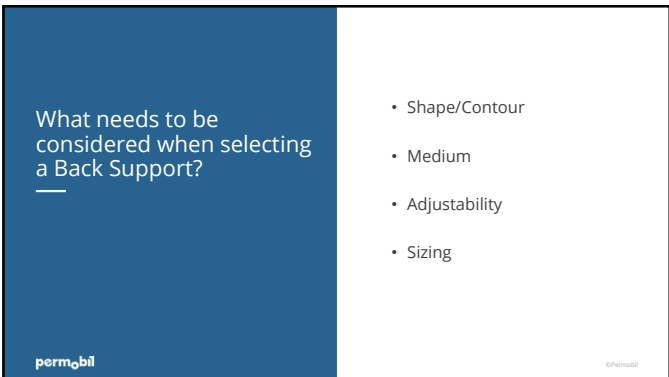
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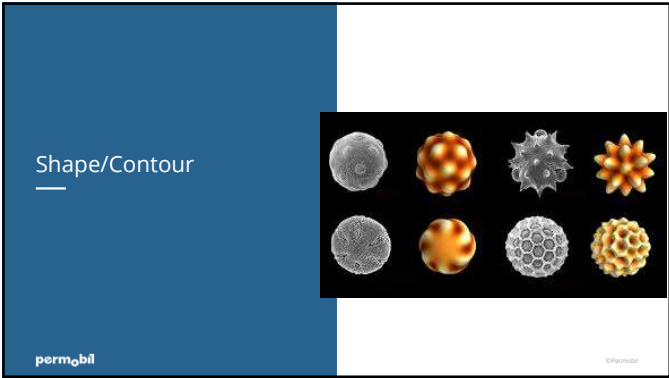
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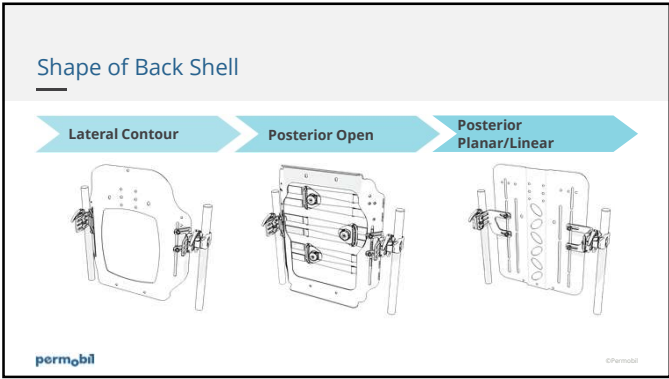
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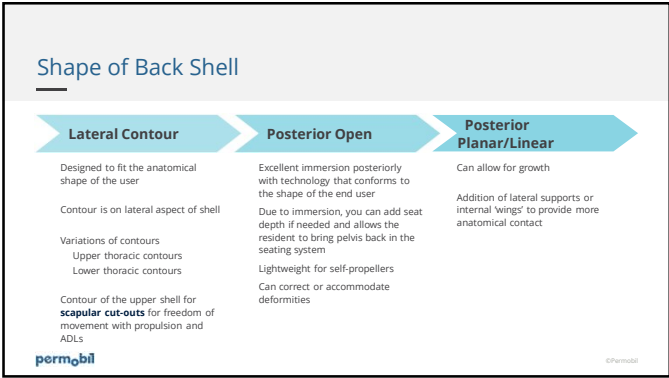
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Back Shape/Contour- Functional Implications






- Stability
- Lateral/sideways reach
- Propulsion (interference with arms?)
- Transfers



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Medium





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Medium of Back Support

Foam

Fluids; Air

Elastomers/Gel

Combination







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Medium of Back Support

Foam	Air /Gel	Combination
Quality foam allow for good immersion and envelopment of a person's shape	Allows for envelopment and pressure redistribution	Stability of foam with the pressure management properties of air
Comfort, Pressure management	Shear/friction reduction	Provides immersion and shock absorption
Be cautious of shear/friction/heat risks	Air circulation-AIR	Air circulation
	Envelops to the shape of the user's body-AIR	May require some maintenance
	Requires some maintenance-AIR	
	Adjustable and adaptable-AIR	





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Back Medium/Material- Functional Implications





- Stability
- Comfort/pain management
- Pressure distribution during movement
- Respiration



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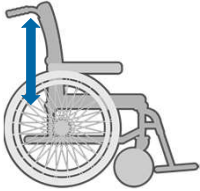
Adjustability





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Back Height- How High the shell is mounted on the chair

- Sitting balance, tone, posture, propulsion, type of wheelchair
- Scapula (inferior angle of the scapula)
- BUT...**
- Do you have a gap lower down if you try and get the back support to reach the scapula?
- What to do?
- How to decide?










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Back Height (and length)

- Key landmark when deciding where to mount the back support= PSIS
- Provides lower trunk control and control of the pelvis
- If you need more height, then get a taller back support, don't mount it higher...= BACK LENGTH





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Back Height- Functional Implications






- Pressure
- Reach
- Access to rear wheels for propulsion
- Stability
- Respiration, digestion





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Depth

- Moving the back support forward or back will affect the seat depth
 - Forward = less seat depth
 - Backward = more seat depth
- BUT...**
 - Does stability bar interfere?
 - Is the cushion depth correct?
 - Do the back canes now interfere with client's body?





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Depth- Functional Implications





- Stability/balance
- Access to rear wheels for propulsion
- Reach
- Pressure distribution of seat surface



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Back Angle



- Angle can cause client to sit anterior, neutral or reclined.
 - Open seat-to-back angle = recline
 - Closed seat-to-back angle = anterior or forward



Pivot point is key:

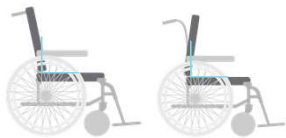
- Do you lose PSIS contact?
- Is the pelvis (bum) pushed forward?
- Do the back canes get in the way of the body?





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Back Angle-Functional Implications



- Stability
- Head control and position
- Reach
- Shear/friction (sliding)
- Access to rear wheels for propulsion
- Digestion, respiration, bowel/bladder


Afnan M. Alkhatteeb, Noha S. Daher, Bonnie J. Forrester, Bradford D. Martin Hatem M. Jaber (2019): Effects of adjustments to wheelchair seat to back support angle on head, neck, and shoulder postures in subjects with cerebral palsy. Assistive technology, DOI: 10.1080/10400435.2019.1641107

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Customization-mold to the shape of the body

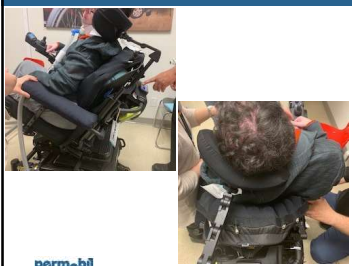
- Allows for accommodation and/or correction
- Provides custom fabricated or designed shape and features
- Provides specific sizing for the client



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Customization- Functional Implications



- Stability
- Accommodation/correction of posture
- Pressure
- Respiration, swallowing, digestion
- Ability to drive wheelchair
- Ability to engage

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Secondary Supports

- Lateral Trunk
- Head
- Anterior Chest
- Anterior Pelvic
- Foot

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Lateral Trunk Supports

- Symmetrical or asymmetrical placement?
- Upper or lower trunk support?
- What size and shape?
- Swing away, fixed or built-in to shape of back support?
- Measurements: trunk depth
- Lateral support depth, length, height, thickness




Functional Implications:

- Prevent lateral leaning
- Correct or accommodate for a scoliosis or trunk rotation and prevent further progression of the postural abnormality
- Decrease pressure points
- Act as a proprioceptive input to minimize leaning and promote optimal midline, upright posture

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Head Supports

Shape of pad
Contour of pad
Height, depth and angle adjustment
Material/medium of pad

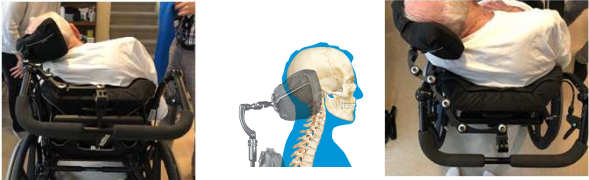


Functional Implications:

- Support of head/neck
- Pressure distribution
- Optimal line of sight
- Swallowing, speaking, respiration
- Stability

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Offset Head Support



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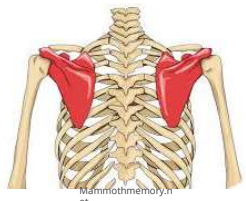
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The Scapula

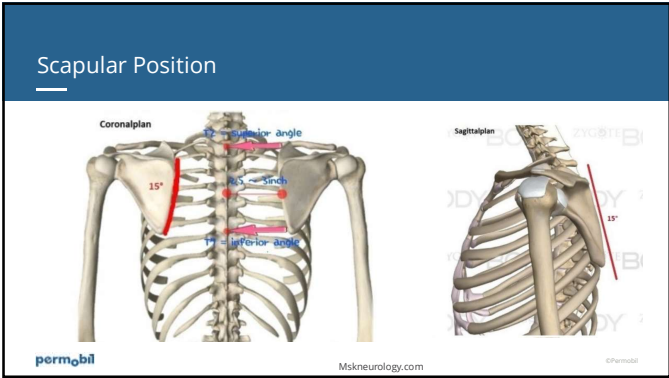
- Wing-like bone
- Links spine & UE
- Origin of proximal UE movement



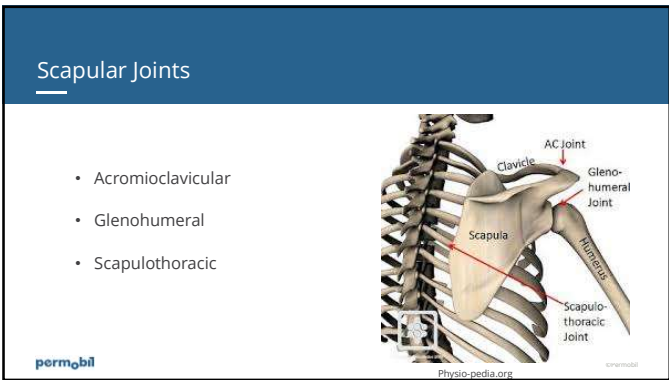
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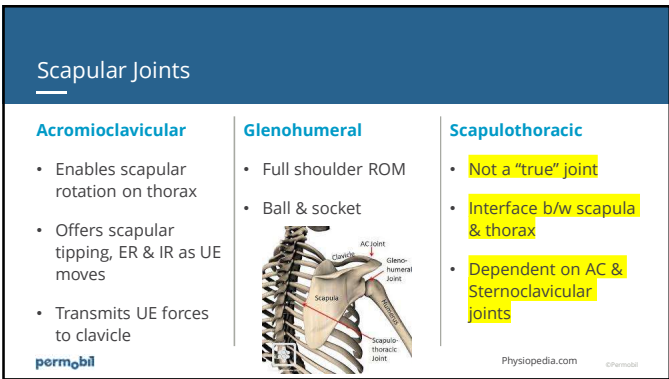
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Scapular Kinematics

Scapulohumeral Rhythm



<https://www.youtube.com/watch?v=rpaBGIOEW4E>


Shoulder Flexion/Extension



https://www.youtube.com/watch?v=xhcydl_Htwk

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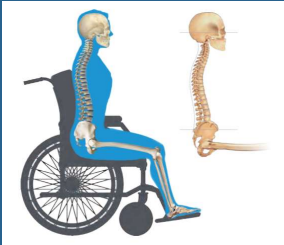
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Manual Propulsion

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Optimal Alignment



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Neutral Pelvis

↓

Normal Lumbar Curve

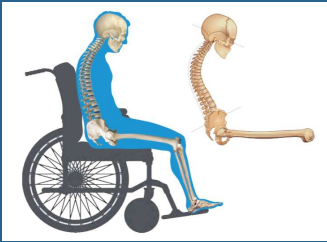
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Natural Thoracic Kyphosis

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Hyperkyphosis & Posteriorly Tilted Pelvis



Posterior Pelvic Tilt

↓

Flattened Lumbar Spine

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Thoracic Hyperkyphosis

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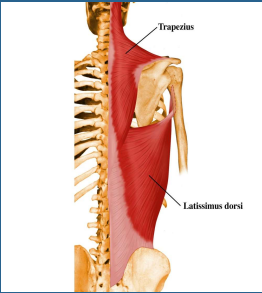
Latissimus Dorsi

Origin

- Inferior angle of scapula
- T7-L5 spinous processes
- Thoracolumbar fascia
- Lower 3-4 ribs
- Pelvic Iliac crest

Insertion

- Humerus



Trapezius

Latissimus dorsi

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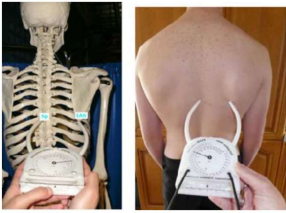
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Hyperkyphosis & Forward Scapular Position

Effects of thoracic posture correction exercises on scapular position

- Kyphosis
 - Pre: $47.40 \pm 3.5^\circ$ ($p < 0.05$)
 - Post: $41.60 \pm 6.60^\circ$
- Scapular forward distance
 - Pre: $8.40 \pm 1.78\text{cm}$
 - Post: $7.86 \pm 1.74\text{cm}$



Yoo, W.(2018). Effects of thoracic posture correction exercises on scapular position. *The journal of physical therapy science*, 30(3), 411-412. doi: 10.1589/jpts.30.411

Anne, M. T., Alya, B., Lee, H., & Ann, C. (2015). The palpation meter (palm) is reliable for measuring scapular upward rotation in the coronal plane. *International journal of physical education, sports and health* 2(2): 54-59. doi.org/10.1016/j.physio.2009.06.007

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Respiratory Muscles

Primary Muscles of Inspiration

Diaphragm C3-C5

Scalenes C2-C7

Accessory Muscles of Inspiration & Muscles of Expiration

Sternomastoid
Accessory Nerve & C2-C3

Intercostals T1-T11

Abdominal Muscles
especially Transversus
Abdominus T7-L1

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Crytzer, Theresa. (2019). Cardiopulmonary function and wheelchair Seating and mobility. International Seating Symposium, Nashville, TN, USA. 22 March 2019.

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Respiration in Spina Bifida

Inspiration Capacity (IC)

Expiratory Reserve Volume (ERV)

Residual Volume (RV)







Crytzer, T., Cheng, Y., Bryner, M., Wilson, R., Scurba, F., Dicianno, B.(2019). Impact of neurological level and spinal curvature on pulmonary function in adults with spina bifida. *Journal of Pediatric Rehabilitation Medicine: An Interdisciplinary Approach*, 11(4), 243-254. doi: 10.3233/PRM-179451

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Respiration in Spina Bifida

Inspiration Capacity (IC)

Expiratory Reserve Volume (ERV)

Residual Volume (RV)



Crytzer, T., Cheng, Y., Bryner, M., Wilson, R., Scurba, F., Dicianno, B.(2019). Impact of neurological level and spinal curvature on pulmonary function in adults with spina bifida. *Journal of Pediatric Rehabilitation Medicine: An Interdisciplinary Approach*, 11(4), 243-254. doi: 10.3233/PRM-179451

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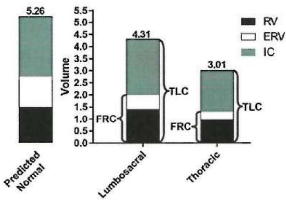
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Respiration in Spina Bifida

RV- Reserve Volume

ERV- Expiratory Reserve Volume

IC- Inspiration Capacity

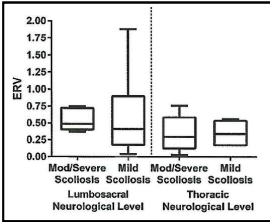
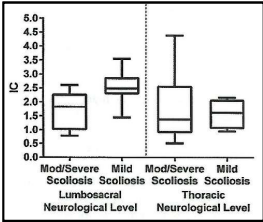


Crytzer, T., Cheng, Y., Bryner, M., Wilson, R., Scurba, F., Dicianno, B.(2019). Impact of neurological level and spinal curvature on pulmonary function in adults with spina bifida. *Journal of Pediatric Rehabilitation Medicine: An Interdisciplinary Approach*, 11(4), 243-254. doi: 10.3233/PRM-179451

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Respiration with Scoliosis



Crytzer, T., Cheng, Y., Bryner, M., Wilson, R., Scurba, F., Dicianno, B.(2019). Impact of neurological level and spinal curvature on pulmonary function in adults with spina bifida. *Journal of Pediatric Rehabilitation Medicine: An Interdisciplinary Approach*, 11(4), 243-254. doi: 10.3233/PRM-179451

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Back Support & Respiratory Functioning

Scoliosis Management

Contour

Deep, laterals

Respiratory Functioning

Medium

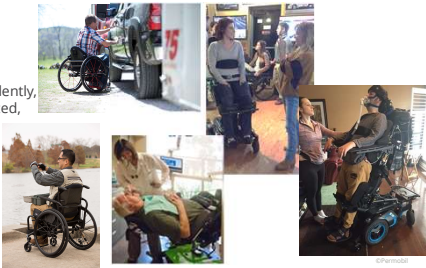
Air vs. foam

permobil Crytzer, Theresa. (2019). Cardiopulmonary function and wheelchair Seating and mobility. International Seating Symposium, Nashville, TN, USA. 22 March 2019. ©permobil

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Back Supports: Helping Clients Get Through Their Day

- Hooking
- Lean to the side to reach
- Propulsion
- Transfers:
 - can client transfer independently,
 - can transfer board be inserted,
 - can sling be inserted?
- Dressing/undressing
- Bladder care
- Transport in vehicle
- Respiration
- Swallowing
- Power Seat Function Use



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Back Supports Summary

Materials

Contour

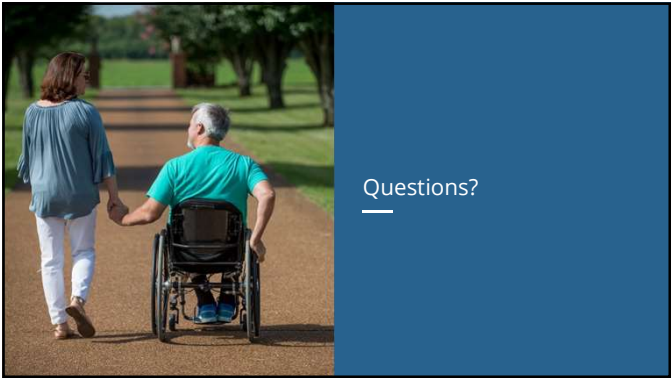
Adjustments

Mounting

Posture & Function

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Thank You



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