

# Clinical and Evidence Based Guidelines for Seating and Wheeled Mobility

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# What are the Goals?

- 📧 Optimal postural alignment/ visual field
- 📧 Provide Comfort and stability
- 📧 Prevent pressure sores
- 📧 Means of mobility/transportation
- 📧 Improve physiological functions eg breathing
- 📧 Maximize I potential, MRADLs, selfcare, communication
- 📧 Inhibit abnormal tone and reflexes impairing alignment and function

# Seating The Process

- Referral
- Client Interview/ Medical hx
- Physical Assessment
- Determination of Goals/ Equipment needed
- Equipment Simulation
- Equipment Prescription with Justification
- Ordering and Assembling Equipment
- Equipment Delivery / Training
- Follow-up

# Complications of Poor Seating

- Pressure sores
- Deformities or contractures
- Discomfort, pain or fatigue ( decreased sitting tolerance)
- Affected performance and tolerance
- Respiratory insufficiency
- Swelling /pressure areas of the feet

# Team Approach in Evaluation Process

- Physician
- Primary therapist or Assistive Technology Provider (ATP)
- Rehabilitation Technology Supplier RTS, CRTS (ATP)
- Family/Client

Determine what equipment is medically, functionally necessary.

# Client Interview

- General Information
- Medical History
- Environmental Accessibility
- Client / Caregiver **Goals**
- Existing Mobility Equipment Issues
- Transportation
- Mobility Related Activities of Daily Living (MRADLs) / Self-management Skills
- Funding

# Medical History

- 📌 **Diagnosis;** progressive vs stable
- 📌 **Co morbidity factors,** HTN, shoulder pain cardio pulmonary issues, severe spasticity
- 📌 **PAIN:** back, shoulders, wrists, sitting tolerance

How long has the patient been diagnosed?

(SCI, MS, ALS, Polio, CP)

# Physical Evaluation

- ROM/Skeletal deformities
- Muscle Strength Limitations
- Protective sensation, skin integrity
- Proprioception /Balance ( hands free)
- Tone/ Spasticity/ primitive reflexes
- Postural Limitations and Compensations
- Orthotics / Splints
- Cognition / Sensory Awareness



# Functional Assessment

- Mobility related Activities of Daily Living
- Bladder Management
- Feeding, dressing in the wheelchair, cooking, cleaning, writing, drinking, reaching
- Transfers
- Driving a van from the wheelchair

# Transfers



# Transfers



# Driving



# Key Points in Seating

1. Pelvis is key
2. Three Points of Control
3. Control Forces as Far Away from Joint as Possible
4. Firm vs. Flexible support surfaces
5. Increase Surface Area to disperse pressures
6. Accommodation vs Correction of Deformity

# Start Proximally

- Stable base, Hips. Thighs, Feet
- BALANCE: Support/position of trunk, shoulders, head
- Movement: Free movement of head, arms and hands

# QUESTIONS .....

- Does the client need to be consistently repositioned? (Problem solve causes for sliding out)
  - Usually inadequate seat depth
    - Seat to back angle, too open encouraging extensor tone.
    - Foot plate position causing tight hamstrings to pull the pelvis forward.

# Pelvic Support





# Firm vs Flexible

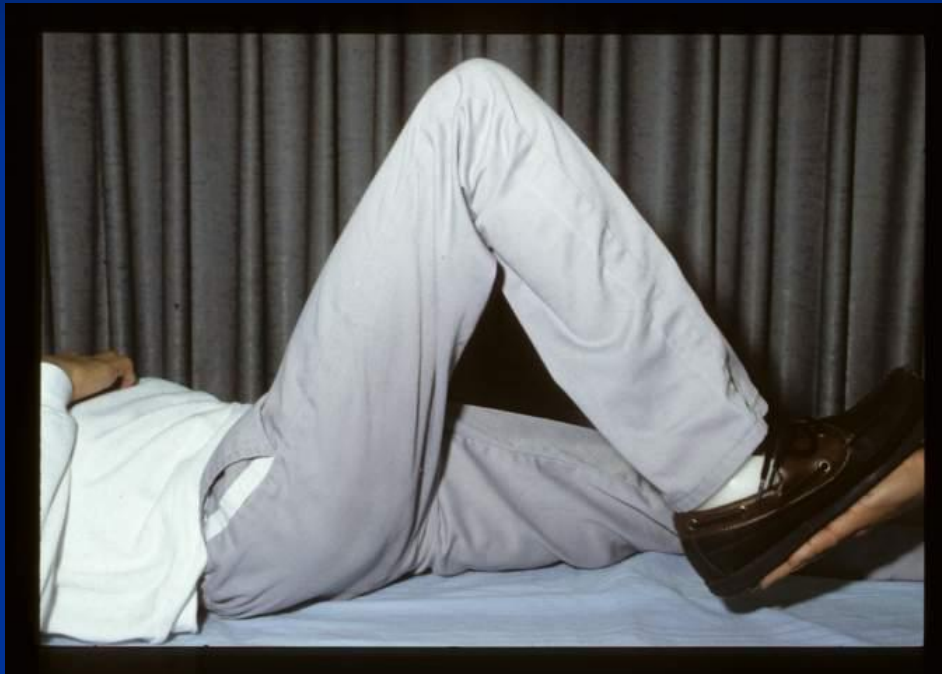
# Functional posture vs Optimal position



# Key Areas to Eval in Supine

- 1. Hip flexion ROM (asymmetries and amount of flexion needed to decrease extensor tone)
- 2. Seat depth (back of hip to popliteal)
- 3. Hamstring tone for foot placement (quick stretch into knee extension)

# Hip Flexion Asymmetries



# Supine Mat Evaluation



# Assessing for Seat to Back Angle in Sitting

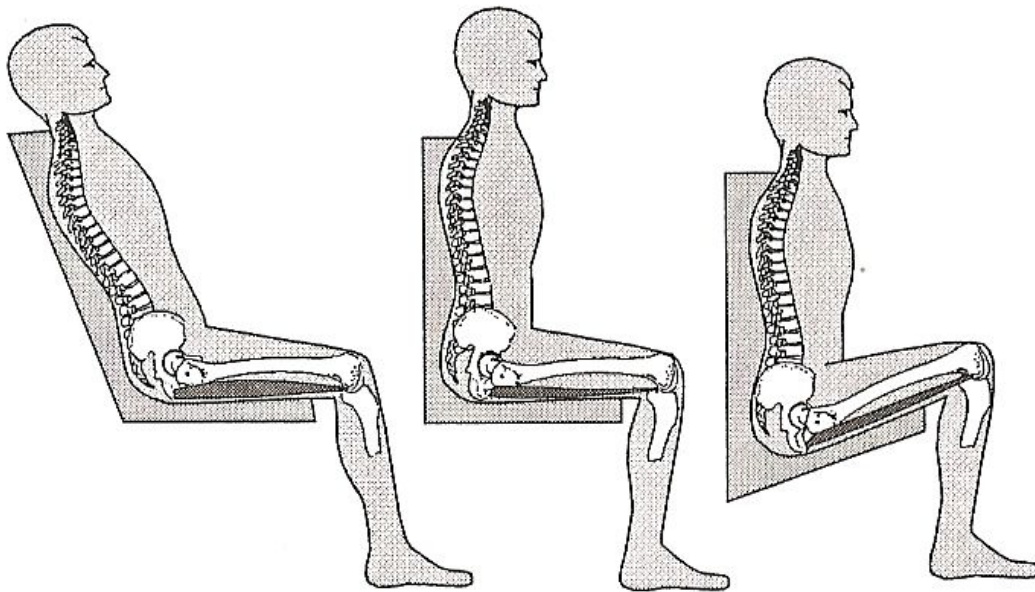
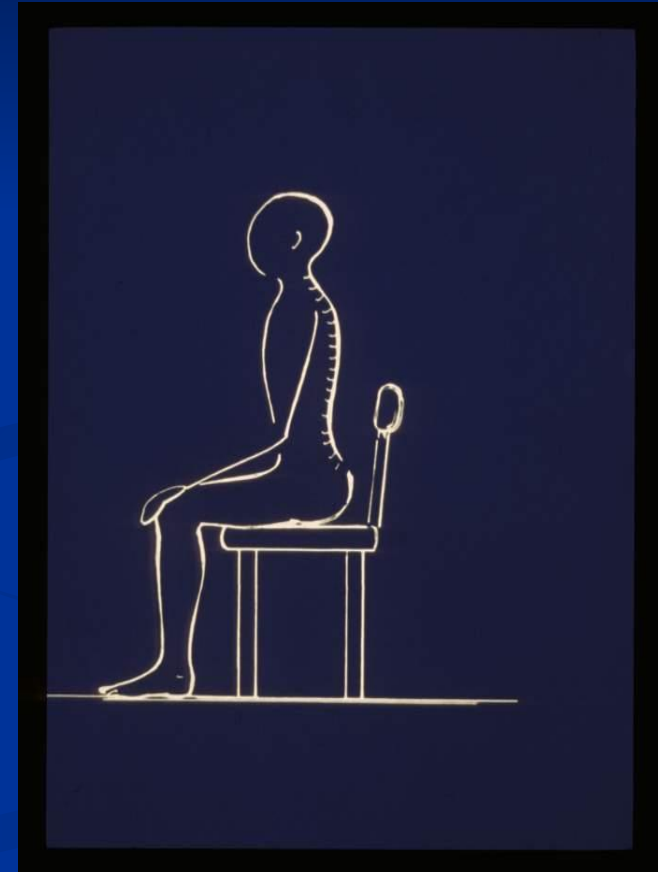





Fig. 44-6 Assessment of hip flexion, tone, and trunk control to determine seat to back angle. 10060



# Seating Assessment

Amount of Indep sitting dictates type of seating and mobility base      Hoffer

-  Hands free sitter
-  Hand dependent sitter
-  Propped sitter

(Don't “overseat” a hands free sitter)

# Hands free sitter



# Hand dependent Sitter





# Propped sitter



# Inhibiting Extensor tone



# Types of Deformities

## I. Pelvis

### A. Tilt

- 1) Posterior
- 2) Anterior
- 3) Neutral

### B. Rotation

### C. Obliquity

(windswept thighs)

## II. Spine

### A. Kyphosis

### B. Lordosis

### C. Scoliosis ( rib hump)

# 3 Points of Control



# Kyphosis

- Flexible – 3 pt. Control
- anterior chest/ shoulder support
- mid thoracic, lumbo/sacral support; curved back; tilt in frame; tray for support UEs
- Fixed – grid; foam in place; custom molded Jay Care back



# Anterior Tilt / Lordosis

- Flexible abdominal support; anterior pelvic belt
- Fixed – custom molded (no trunk control) bi-angular back; pelvic belt



# Scoliosis, pelvic obliquity windswept hips



# 3 Point Control to support Scoliosis

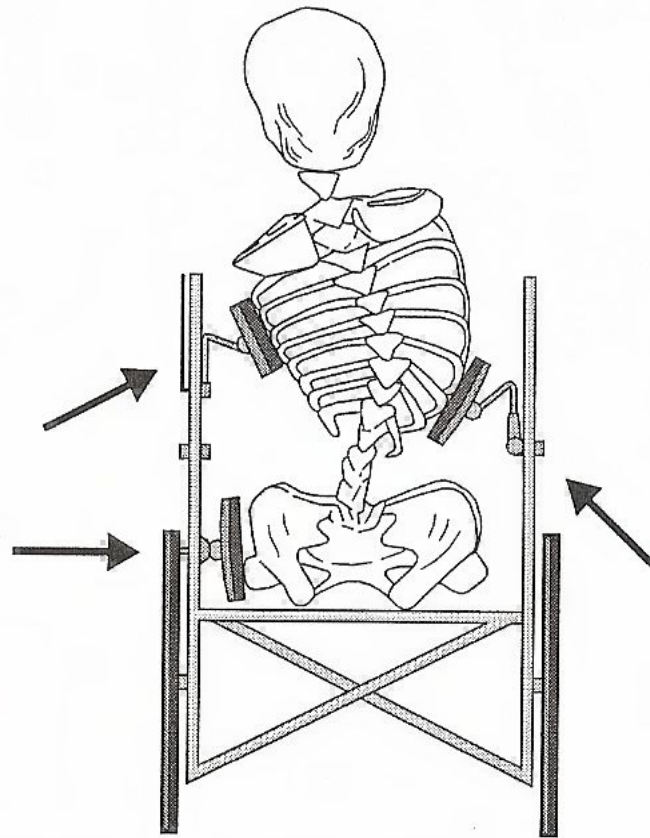


Fig. 44-10 Opposing forces of a three-point control system to control a deformity. 10100



# Scoliosis: 3 point control

## Flexible C curve:

3 point pad system  
anchor pelvis  
curved back

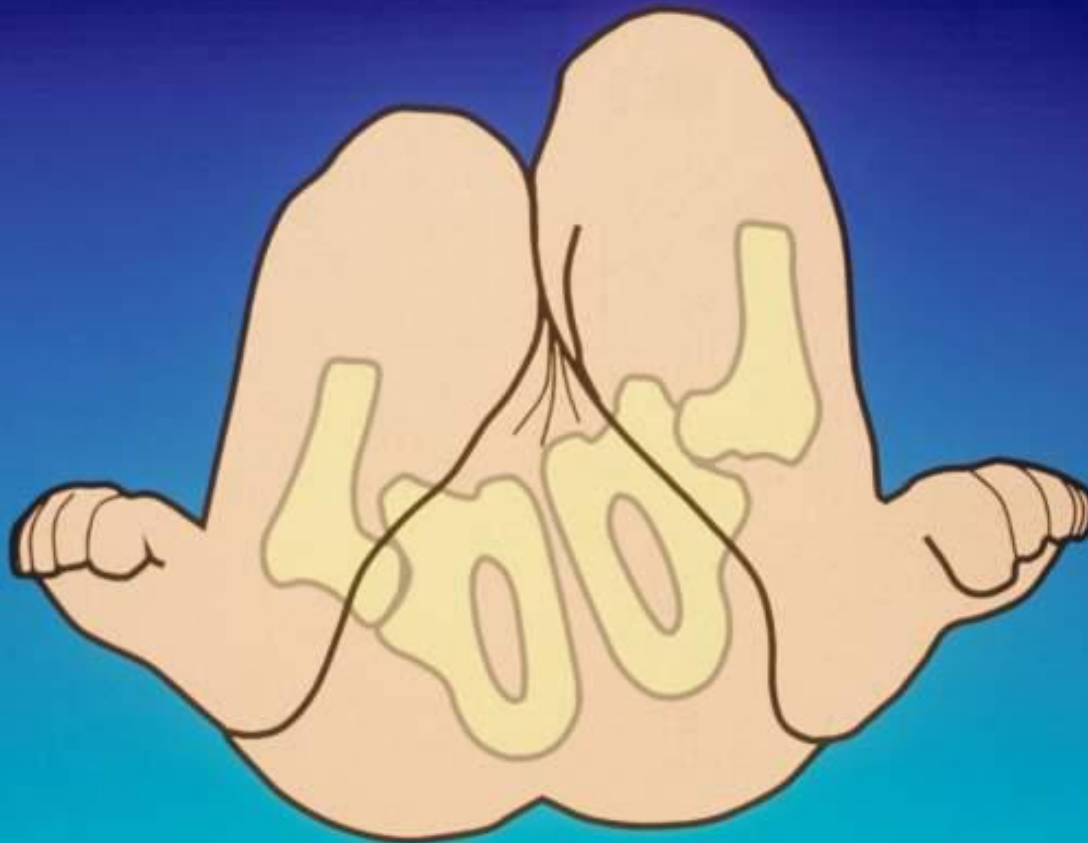
## Fixed:

custom molded  
grided back  
foam in place



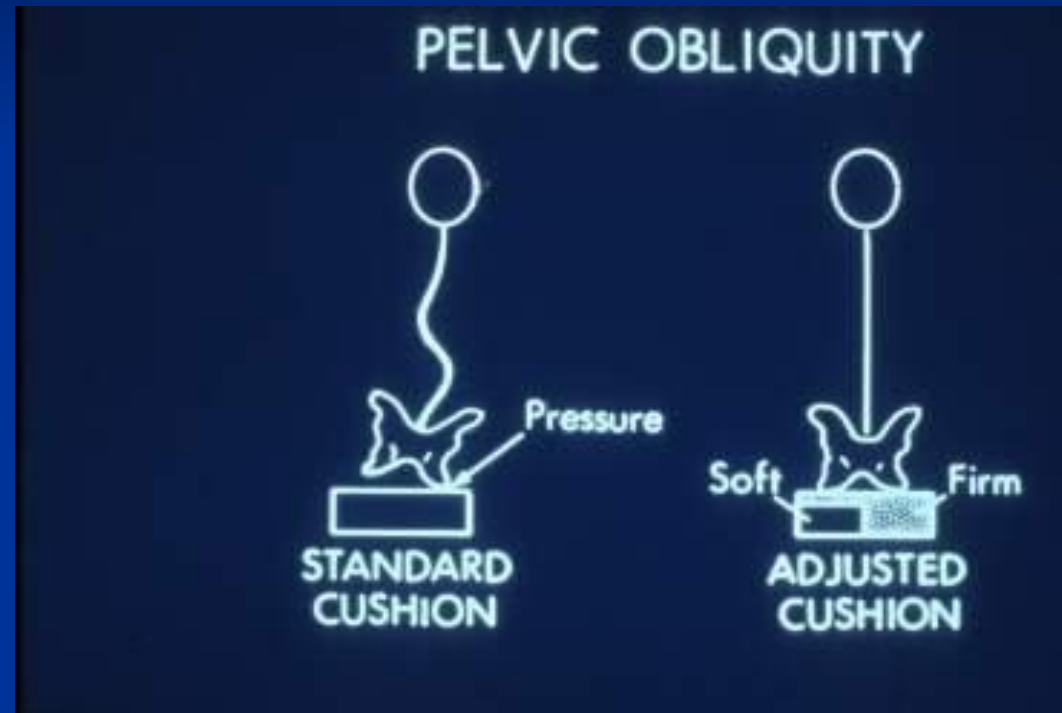
- Thoracolumbar C -  
curve with rib rotation

# Pelvic rotation and Seat Depth



# Pelvic Obliquity

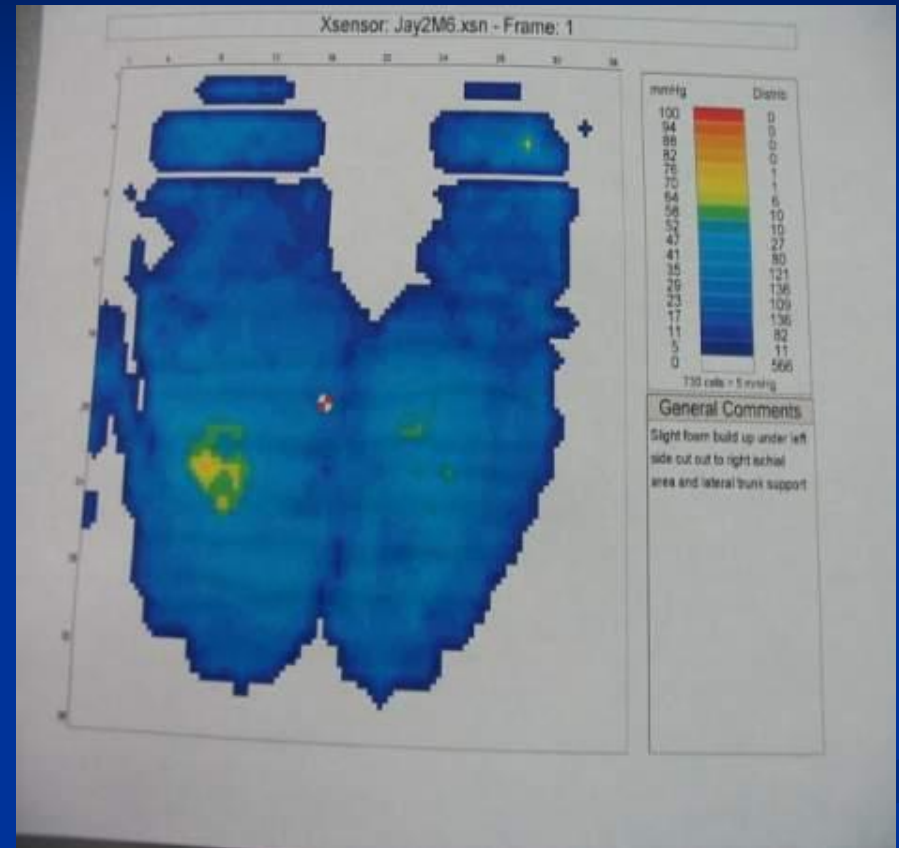
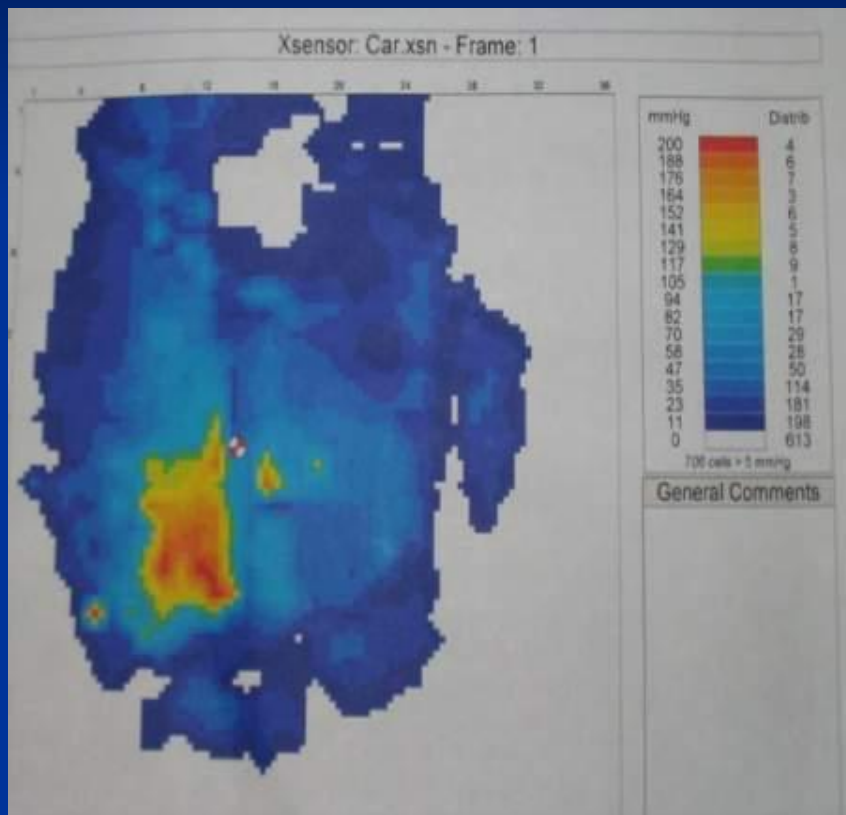
- Flexible – firmer foam on low side; softer foam on high side; grid or waffle cut on high side; build up on low side
- Fixed – build up on high side or cut down under IT under low side



# Accommodation for pelvic obliquity



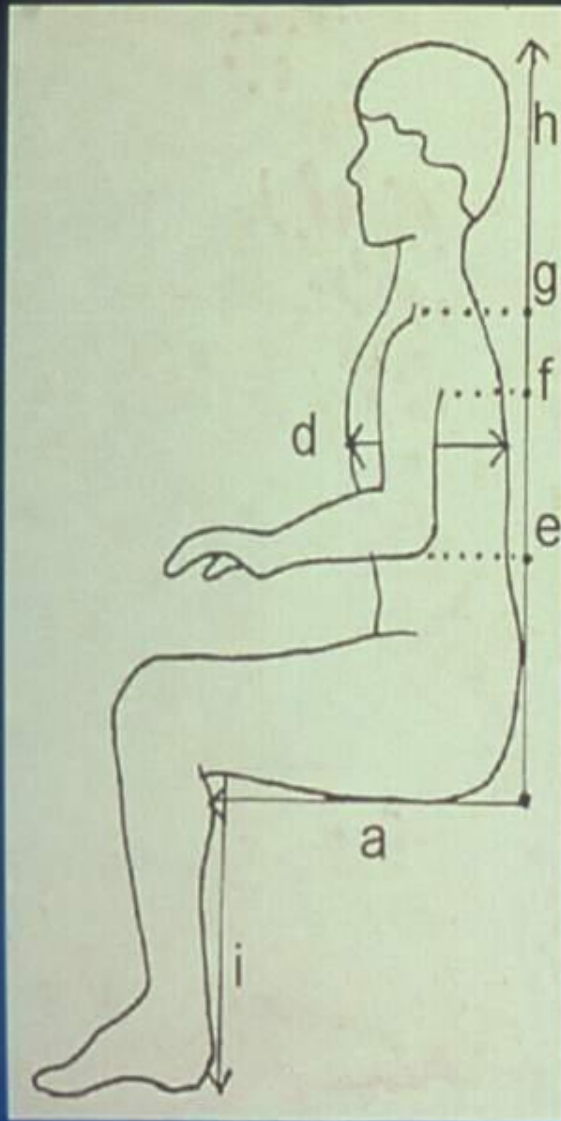
# Accommodation of Pelvic Obliquity



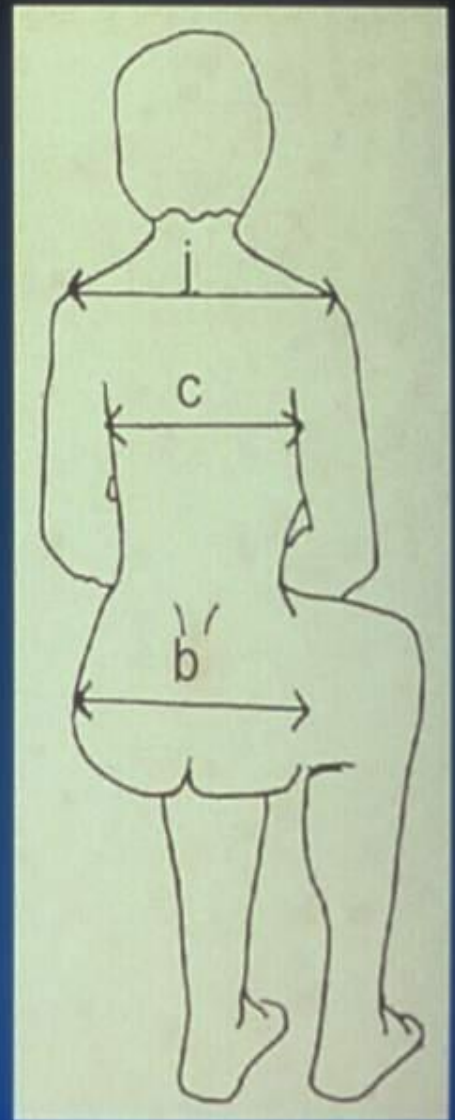
# Specialized seating



# Client Measurements



- a. seat depth
- b. hip width
- c. chest width
- d. chest depth
- e. seat to elbow
- f. seat to axilla
- g. seat to shoulder
- h. seat to head
- i. popliteal fossa to heel
- j. shoulder width



# Posterior Tilt

- Tone: low
- Flexible
- Solutions:

Planar or contoured seat  
Shoulder retraction  
tilt in space of system





# Planar seating system

- Solid seat
- Solid back
- Lateral trunk and hip supports
- Chest harness
- Headrest
- Pelvic belt 45\* angle



# Posterior Pelvic Tilt and Extensor Thrusting

- High tone/flexible
- 45\* pelvic belt  
Wedge seat  
Anti- thrust seat  
Flex hips and knees to 90 + and dorsiflex ankles



# Planar/mild contoured system

- Anti thrust seat – increase hip flexion
- Solid back
- Medial thigh support – inhibits adductor tone
- Lateral hip supports – controls pelvis
- 90\* hangers – accommodates hamstring tightness
- Shoe holders with Angle Adjustable footplates



# Custom Molded



# Access to Multiple Technologies



# Head support systems

- Capital Hyperextension  
occipital pad;
- Cervical flexion  
head strap, cap, anterior  
pad
- Lateral facial pads

Whitmyer or Stealth head  
support systems



# Back Supports



# Power w/c back with scapular cut out





# Back supports



# Case Study

- Dx: Cerebral Palsy
- Problem: sliding down in his seat causing knee pain and arm numbness
- Sitting in custom molded seat, using right hand joystick controller



# Accommodate fixed pelvic deformity

- Left seat depth 13"
- Right 18"
- Asymmetrically cut set and cushion with ischial pressure relief



# Tilt in space with custom molded back

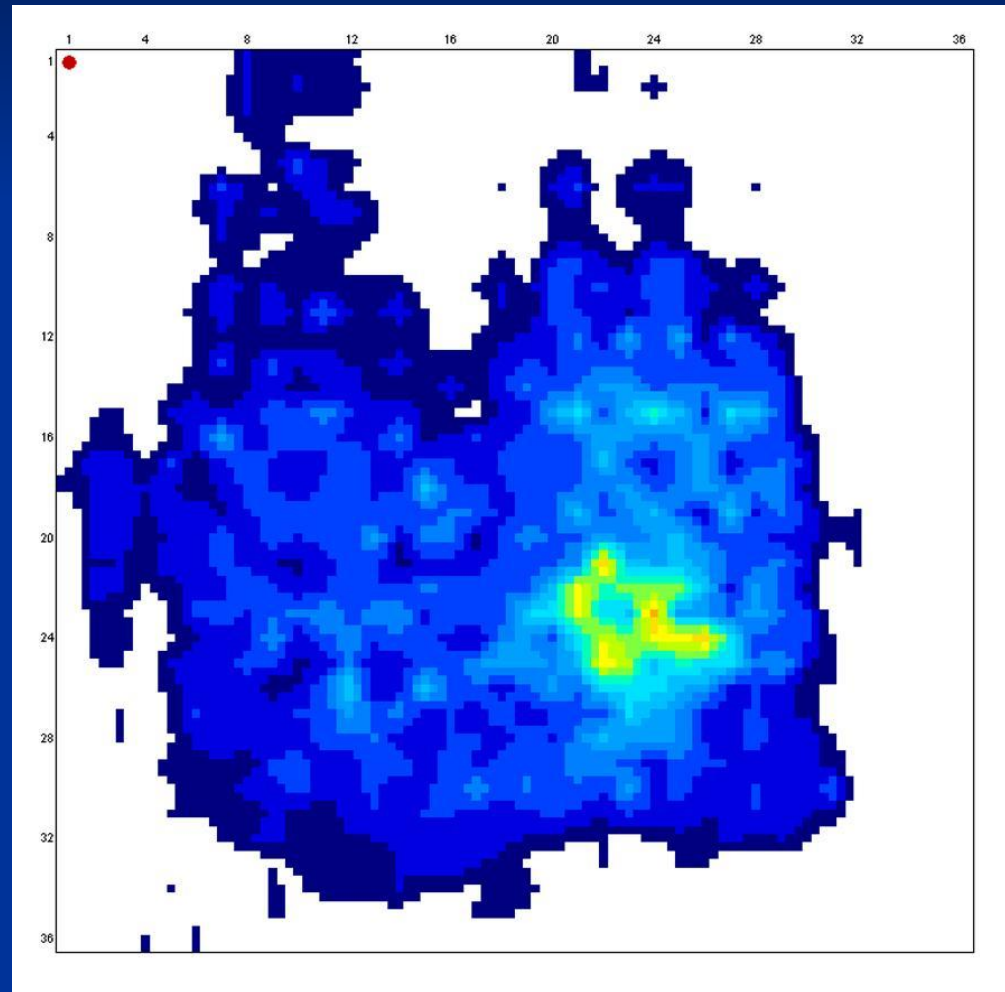


# Upright trunk and pelvis





# Incorporating Pressure Relief into Seating systems



# Pressure Ulcers

- SCI/Elderly most at risk
- 66% on pelvis
- Costs to heal:  
1,000-7,000/ulcer
- Medicare 2.2-3.6  
billion/yr
- Ulcers account for  $\frac{1}{4}$   
cost of SCI care,  
Prevention  $< \frac{1}{10}$





# Pressure Ulcers

**Pressure:** Compression Force x Area/Time

**Shearing/ Friction:** Parallel stress, shear occludes blood vessels at deeper level than friction

**Temperature/Heat:** 1 degree=10% metabolic increase

**Moisture/Humidity:** causes skin maceration

# Factors Contributing to Ulcers

- Absent/ impaired sensation
- Loss of body fat/muscle mass
- Impaired circulation
- History of pressure sore
- Cognitive
- Infections
- Immobility
- Fragile Elderly skin
- Poor nutrition

# Acceptable Pressures

- Ischial Tuberosities 40 mmHg
- Trochanters 60 mm Hg
- Sacrum less than 20 mm Hg
- Coccyx 0 mmHg

# Types of pressure relief

## Pressure distribution

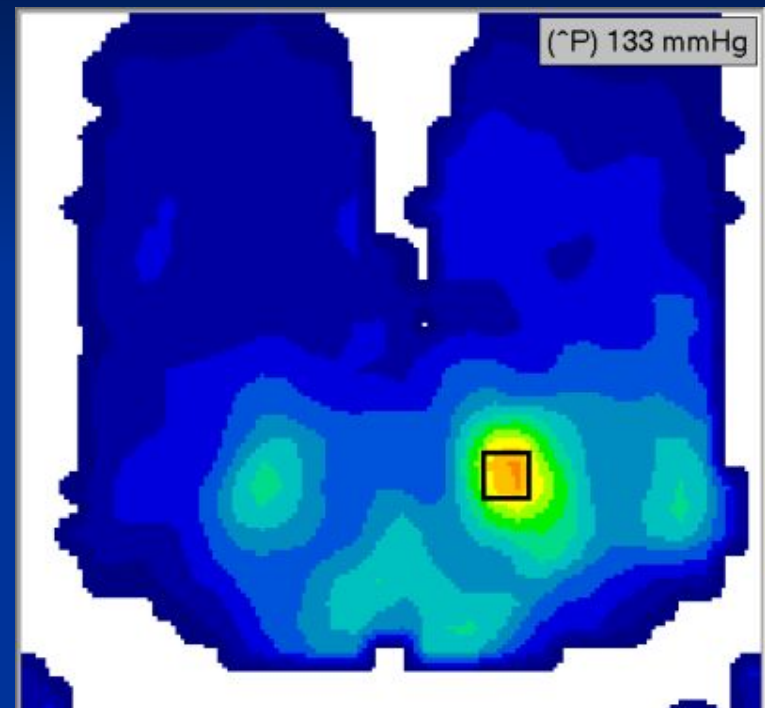
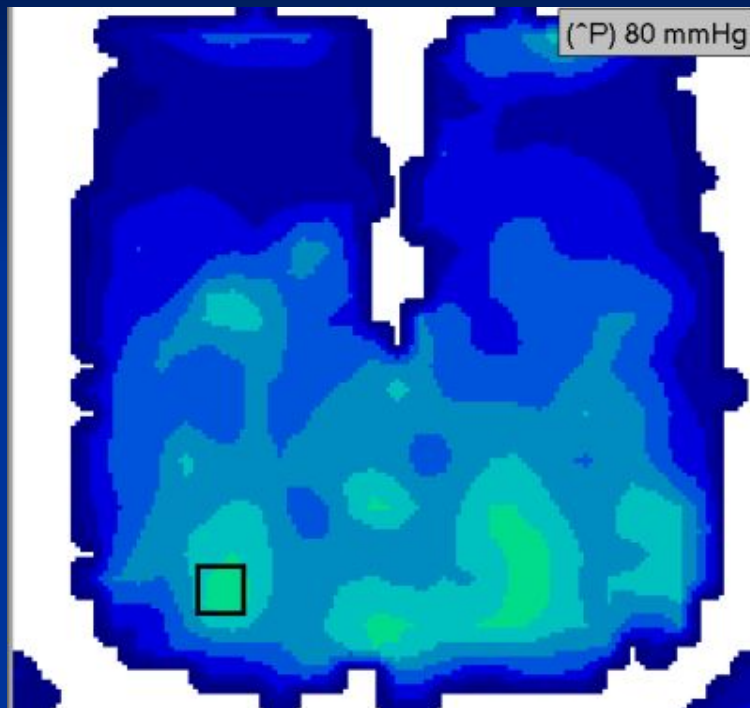
### by: Immersion

- ROHO
- Jay
- Motion Concepts Flofit
- Invacare Flovair
- Memory foam

## Pressure Redistribution

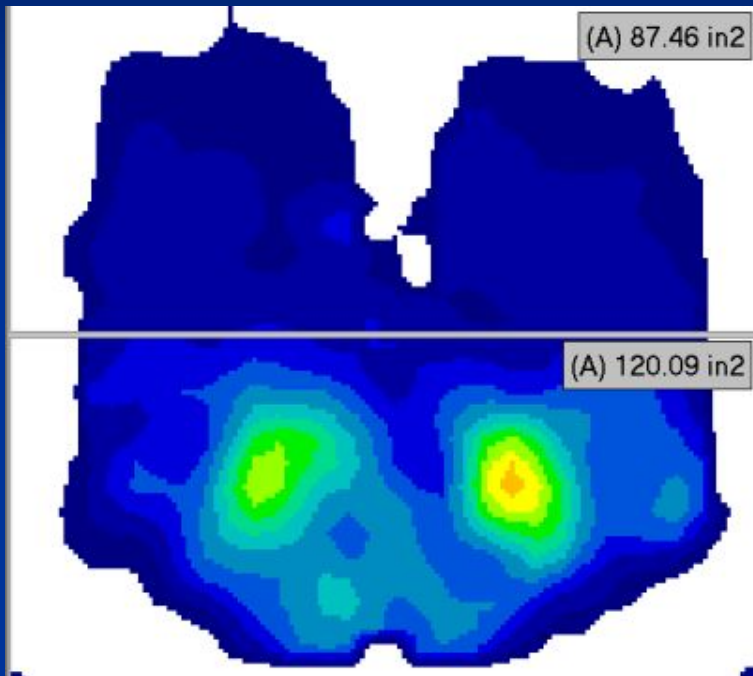
- Foam with cut outs
- Ride Designs custom cushions

# Peak pressure

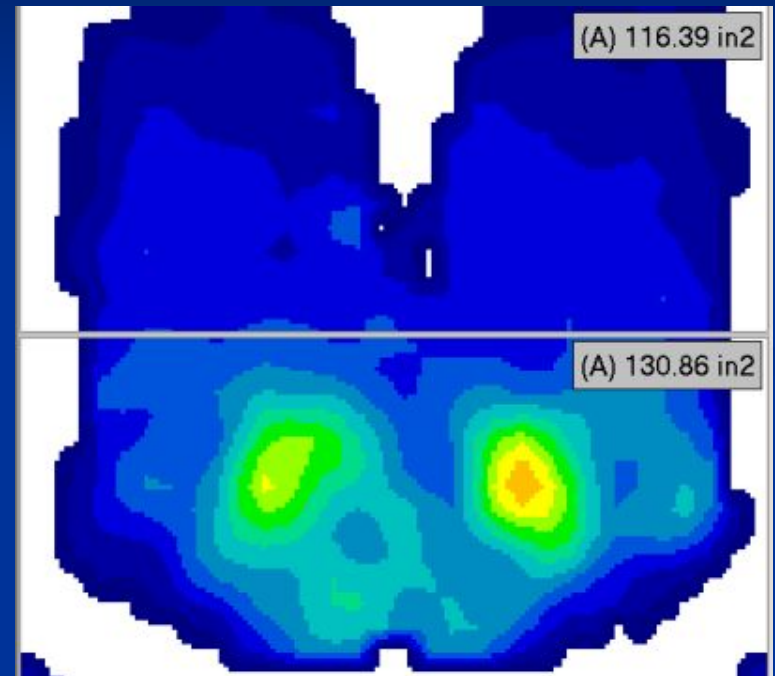


# Surface contact area

A



B



Area of only the loaded, or "contact" sensels inside the box.

# Cushion Assessment

- Things to Consider:
  - Areas of Bony Prominence
  - Ability to Shift Weight
  - Stability Provided by the Cushion
  - Transfer Ability
  - Trunk Stability

# Types of Cushions

- Comfort/General Use
- Skin Protection
- Positioning
- Skin Protection/Positioning





# Gel Cushions



# Contouring for positioning







# Temperature and Humidity

## AireRx



# Pressure Relief through Power Seating



# Power Seating: Tilt in Space

- Pressure redistribution without sliding. Seat to back angle is maintained
- Accommodates hip/knee flexion
- Minimizes extensor spasticity/shearing
- Maintains orientation to controls



# Justification for Recline

- Bladder management
- Distribute weight bearing surfaces
- Transfers
- Open hip and knee angle to manage pain/discomfort
- Dressing to avoid unnecessary transfers
- Hypotension





# Seat Elevation

- Seat elevate for down hill transfers
- Increase UE reach to decrease shld impingement from overhead reaching



# Standing Power wheelchairs



# RESNA Position Papers

RESNA Position on the Application of:

- Power Wheelchairs for Pediatric Users
- Seat-Elevating Devices for Wheelchair Users
- Wheelchair Standing Devices
- Tilt, Recline, and Elevating Legrests for Wheelchairs

<http://www.permobilus.com/Global/USA/FUNDING/Documents/Funding/ResearchArticles>

# Ultra lightweight rigid wheelchairs



# Wheel placement



# Chair Assessment

- Seat Depth: back post to front edge of seat sling
- Seat Width: outside seat rail
- Front Seat Height (FSH)  
floor to top of front seat rail
- Rear Seat Height (RSH)  
floor to top of rear seat rail
- Seat Slope – difference between FSH & RSH
- Foot placement affects knee angle



# Optimal Wheelchair Configuration

- Posture and alignment
- Backrest: perpendicular to floor
- Adjust the rear axle forward 2"
- Position the rear-axle so that when the hand is placed at the center of the top of the push rim, the upper arm and forearm angle: 100 - 120 degrees



# Wheel Axle placement





# “Wheelie Test”

- Have patient pop a wheelie. Want the front casters at least 1” off of the ground.
- If front casters are greater than 4” off of the ground, then the axle is too far back.



# Wheelchair skills



# Sports wheelchairs



# Suspension Wheelchairs



# Why is Wheelchair weight important?

- Shoulder Degeneration
- Energy Cost
- Velocity (community propulsion)
- Transfers in and out of car

# Background: Shoulder Pain with SCI

Sie et al.,  
1992



- Carpal Tunnel Syndrome: 40-70%  
Gellman, '88, '92
- Correlates to Median nerve injury
  - Boninger, '99, 2003
- Shoulder pain: 31-73%
  - Gellman, Bayley, Wylie. Nichols. Sie, Subbarao

# Alternative Manual Wheelchair Assist

Power Assisted



Gear Assisted



# Power Assist wheels





# Energy Consumption

	Rate of O <sub>2</sub> consumption	Oxygen cost	Heart rate
Standard w/c	8.4 ml/kg min	.11 ml/kg m	82
I- Glide	6.9	.11	72
Xtender	6.7	.07	75
e.motion	6.2	.08	78

# Consumer Power: Group 2

- Basic criteria
- Dx: COPD, CHF, Obesity, Rheumatoid arthritis, Diabetes, LE amputation, Osteoarthritis



# Rehab Power: Group 3,4

- Basic criteria
- Evaluation by licensed medical professional
- Neurological dx: Myopathy, SCI, skeletal deformity ie arthrogryposis, Polio



# Types of Power W/c Controllers

## Proportional

Head: RIM

Chin: Mini, MEC

Hand joystick: remote  
for center mount

Foot proportional

Infra red touch pad

## Digital

Sip and puff

Head array:  
proximity switches

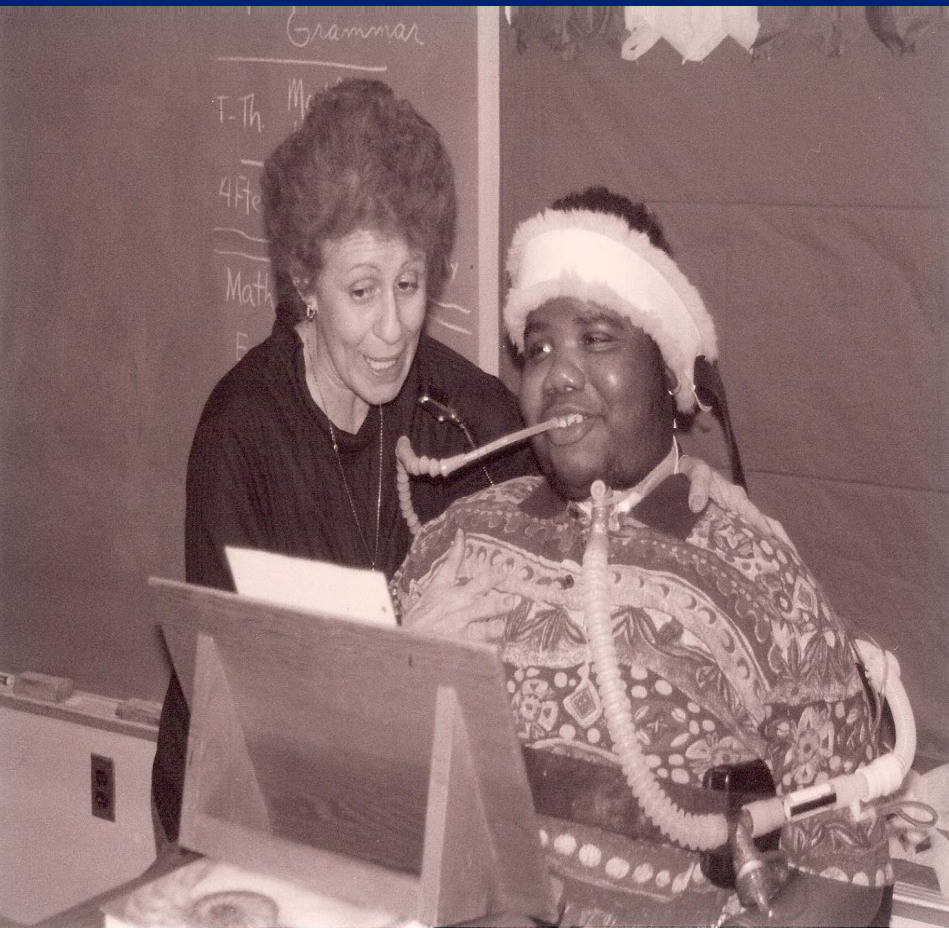
Single switches:

Mechanical

Fiber optic

proximity

# Sip and Puff



# Proportional chin joystick



# Mini joystick controller



# RIM head controller





# Powered Mobility using Switches



# Powered mobility using Switches



# Head Access



# Foot Access



# M.M.

**Diagnosis:** Cerebral Palsy

**Goal:** Use head movements for mobility, operation of communication device, and EADL's through wheelchair.

**Barriers:** Sliding out of wheelchair changing head position.



# Stable positioning for access to technologies



# New technologies for Powered Mobility Access

- Brain EMG controlled technology
- Voice technology
- Eye gaze
- Tongue Drive System

# Single switch scanning





# Pediatric Powered Wheelchair Screening Test

- **Basic Skills:**

- Problems solving = 20 mos
- Spatial relations = 25 mos

- **Functional skills:**

- Problem solving = 30 mos
- Spatial relations = 25 mos

Cutoffs yield sensitivity = 1.0, specificity =  
.80

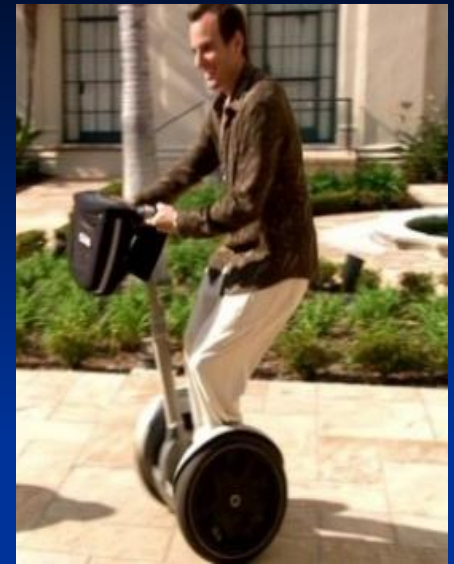
# RESNA Position paper on Pediatric Powered Mobility

- Recommends the early utilization of powered mobility for appropriate candidates as medically necessary to promote integration, psycho-social development, reduce learned helplessness and enhance independence.

# Segways



# Segs for Vets



# Thank you!

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