Seating Matrix

3 elements:
1. The person
2. The environment
3. The wheelchair (the mobility and the support surface)

Seating, where to Start?

- Seating Assessment: Anatomical and Functional Considerations

The Pelvis

- The position of the pelvis dictates one’s alignment and ability to function in the seated position.

Movements of the Pelvis

The Pelvis-Spine Connection

- Closed kinematic chain
- Complex series of articulations
- Coupling motions
- Normal spinal alignment is a developmental process
Stability’s Relationship to Function

- Appropriate visual field improves interaction with the environment
- Proper alignment minimizes the effects of secondary complications
- Dynamic stabilization of the trunk and pelvis allows for:
  - Maximization of upper extremity function
  - Enhance respiratory function
  - Appropriate visceral function

Person and Wheelchair

To tailor is to measure!

Getting the Foundation Right

- Determine seat depth – leg length, pelvic tilt and type of backrest
- Optimal seat depth improve pressure distribution and lower limbs stability.
- Too long a seat pulls pelvis forward - sitting in a slump position
- Hamstrings, hip flexion and legrest angle

Getting the Foundation Right

- Determining seat width – shoulder and pelvis.
- Footplates: the balancing act – provide stability for the pelvis, yet assist pressure distribution

The Ideal Seated Posture (Not 90/90/90)

- Slight anterior pelvic tilt
- Level pelvic landmarks
- Neutral rotation of the femurs
- Normal lumbar curves
- Neutral trunk alignment
- Level shoulders, squarely positioned over the hips
- Neutral cervical spine

Stability and Posture......

Hierarchy of priority.....

All seating will have compromises.

As a wheelchair user my priority is skin protection, function, comfort then posture.

When I look at most able bodied people it seems that comfort is a priority (is your posture perfect now?).
A Reality Check

Stable Pelvis – now the trunk
- Same spinal curves as erect standing:
  - Mild lumbar lordosis
  - Minimal thoracic kyphosis
  - Minimal cervical lordosis
- Trunk symmetry
- Neutral alignment: head balanced over spine, spine balanced over pelvis
- Shoulders slightly posterior to pelvis
- Head in neutral position with eyes (gaze) forward

Kyphosis. Posterior tilt of pelvis
Scoliosis and trunk rotation. Rotation of pelvis, pelvic obliquity
Lordosis. Anterior tilt of pelvis

Keep the trunk in balance. 90-90-90 pushes weight forward of ITs. Two choices, fall forward or “slide” into posterior tilt of pelvis and kyphosis of trunk.

Balancing the trunk over the pelvis
- Upper Backrest Reclines
- Vertical or Forward Angle at Top of Pelvis
The Torso moves to the rear as the pelvis rotates

- Center of Torso Mass is over the Pelvis when standing
- Pelvic Tilt Changes to Seated “Neutral”
- Lumbar Curve Flattens
- Back of Torso is Behind the Buttocks (1.5 - 2.0 inches)

Out of balance

- A tall backrest with a 90° seat-to-back Results in:
  - Forward Trunk Lean or:
  - Rounded Trunk Posture (Hanging on Chest/Shoulder Straps)

Out of balance

- Can lead to the unnecessary use of Tilt-in-Space Wheelchairs
- Using tilt to control torso lean may interfere with reach, propulsion, and other ADL tasks.

Backrest Angle

Strive for Balance Against Gravity

- Fixed Kyphosis Requires Recline at Backrest
- Asymmetric Shape Requires Contoured Backrest

Open seat to back angle

- An Open Seat-to-Back Angle Will Allow the Trunk to be in Balance Against Gravity
- BUT The Pelvis Usually Drifts Into Some Degree of Posterior Tilt

Seat Dump with Shorter Back

- Helps stabilize pelvis
- Back offers support to the PSIS to minimize posterior tilt
- Scapula free move into balanced position and allow efficient propulsion
- How much Dump? All seats have it.
- Hip Flexion!
Seat Dump with High Bi-Angle Back

- Helps stabilize pelvis
- Back offers support to the PSIS to minimize posterior tilt
- Scapula free to move into balanced position

High Back For Self Propellers

- Shape of back to allow “freedom” for Scapula
- Bi-Angle can be achieved with tension adjustable upholstery
- Off the shelf solid backs may use foam inserts, hinges or other methods to achieve bi-angle

Kyphosis

- Rounding of the Spine
- Accompanied by Posterior tilt
- Flexible
- Fixed

Posterior Pelvic Tilt

Caused or Influenced by:
- Tight Hamstrings (legrest angle)
- Habitual Posture
- Gravity (footrest height, seat “dump”, pelvic block incorporated cushion)

Back Rest Choices

Upholstery – tension adjustable
- Back cane angle
- Utilise to create spinal curvature and back angle

Back Rest Choices

Rigid Backrest

- Utilise to create spinal curvature and back angle, more positive positioning and more efficient propulsion

Considerations: Weight, maintenance, cost, lateral support, head supports, shoulder harnesses

Back Rest Choices

Custom Backrest

- Utilise to create spinal curvature, complex shape fits and back angle, more positive positioning

Considerations: Weight, maintenance, cost, lateral support, head supports, shoulder harnesses
Take Home Message

Avoid 90 degree planar backs that are higher than the lower ribs. Use back angles and tension adjustable upholstery to improve posture, function, pressure care and comfort.