

# Seating Biomechanics

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## Acknowledgements



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### Advisory Team

- Kendra Betz, MSPT, ATP
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- Darrell Misick, PT



## What Do Clinicians Want From Seating and Mobility Devices?

- Symmetry
- Accommodate medical problems
- Prevent secondary problems
- Promote function



## What does a Payer Want?

- Established medical need
- Well-documented need
- Evidence of effectiveness
- Least costly, reasonable alternative
  - Cost vs. reasonableness is hard to define



## Pain et al., 2000

### Parents:

- Perceived comfort
- Ease of use
- Appearance
- Safety
- Posture

### Clinicians:

- Posture
- Adjustability
- Only sees client for a short time — limited attention to comfort through the day



## Consumer Reported Features

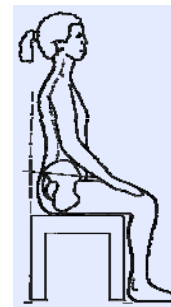
(Mills et al, 2002)

- Operate
- Transport
- Outdoor mobility
- Indoor mobility
- Comfort
- Health needs
- Access surfaces
- Transfer
- ADL
- Durability/Reliability

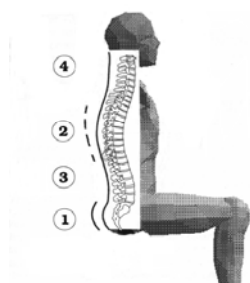


## Evidence — 90/90/90

- Old school of thought
  - No evidence
- Let's all sit this way — all day



## A Straight Posture?



- A "straight" posture is misleading



## 90/90/90

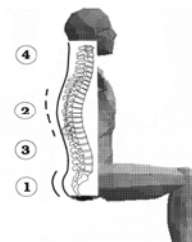
- Can it be maintained?
- Is only a reference



## 90/90/90 Doesn't Work

Consider the following:

- Function
- Comfort
- Stability and balance
- Joint range of motion
- Muscular flexibility
- Tone/spasticity/reflexes
- Individual preferences



## Sitting is Very Dynamic

- Need to change positions
- No single position is perfect over time



## Everyday Sitting Positions



## Why?

The body is unstable —  
We were never designed to sit



## Analyzing the Spine



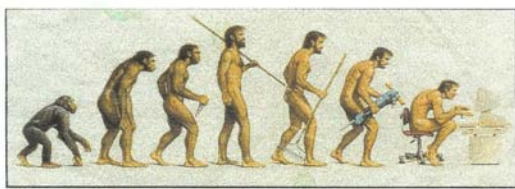
### THREE MAJOR JOINTS

C3-C6 (Cervical)

T5 (Mid-Thoracic)

T10-T12 (Thoracic - Lumbar)

## Somehow Something Went Terribly Wrong!



## Posterior Pelvic Tilt

Bengt Engstrom, [www.posturalis.se](http://www.posturalis.se)

- Pressure on sacrum
- Increases sliding in seat
- Causes kyphotic spine posture
  - Trouble holding head up
  - Trouble with physiologic function
    - Breathing
    - Digestion

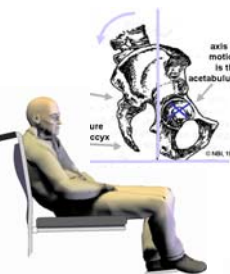


Image Courtesy of Bengt Engstrom

## Anterior Pelvic Tilt

Bengt Engstrom, [www.posturalis.se](http://www.posturalis.se)

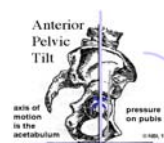


Image Courtesy of Bengt Engstrom



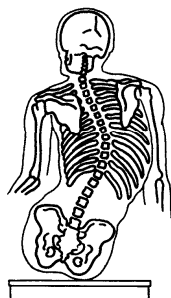
## Anterior Pelvic Tilt

- Pressure on pubis symphysis
  - Can also have pressure between ASISs and thighs
- Center of gravity anterior; often leads to arm-dependent sitting
- Leads to lordotic sitting posture



## Pelvic Obliquity

- Pressure on one ischial tuberosity
  - Possible pressure on rib cage
- Can lead to scoliotic posture



## Scoliosis

Bengt Engstrom, [www.posturalis.se](http://www.posturalis.se)

- Side-to-side curve is called scoliosis and may take the shape of an "S" (double curve) or a long "C" (single curve).



Image Courtesy of Bengt Engstrom



## Kyphosis

Bengt Engstrom, [www.posturalis.se](http://www.posturalis.se)

- Kyphosis is an anterior curvature of the spine.



Image Courtesy of Bengt Engstrom



## Windswept Deformity

Bengt Engstrom, [www.posturalis.se](http://www.posturalis.se)



Image Courtesy of Bengt Engstrom

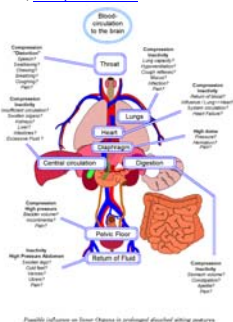


## Vital Organ Function

Bengt Engstrom, [www.posturalis.se](http://www.posturalis.se)

- Breathing
- Cardiovascular
- Digestion
- Bowel/Bladder
- Integument

Image Courtesy of Bengt Engstrom



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## Analyzing Stability, Function, and Comfort

- There is always a reason people sit the way they do:
  - Preference or
  - The seating system makes them sit that way



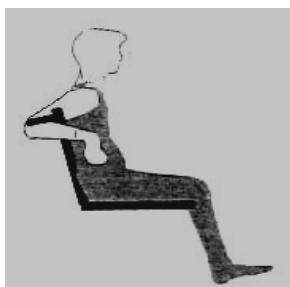
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## If The Sitter Does Not Feel Stable

-Compensatory techniques are used

Bengt Engstrom, [www.posturalis.se](http://www.posturalis.se)



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## Physical Motor Assessment



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## Mat Assessment: Sitting



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## Mat Assessment: Supine



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### Mat Assessment: Hips



### Mat Assessment: Upper Extremities



### Mat Assessment: Measurements



### Mat Assessment: Measurements



### Summary

- Body not designed to sit
- 90-90-90 doesn't always work
- Sitting can be pathological
- Different positions for functions
- Body wants to move
- Observe, Assess, Measure

