

Coronal Plane Deformity Principles

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Disclosure

- I have no relevant financial relationships with the manufacturer(s) of any commercial product(s) and/or provider of commercial services discussed in this CME activity.
- I do not intend to discuss an unapproved or investigative use of a commercial product or device in my presentation.
- Thanks to Dr. La Marca for some of his slides!



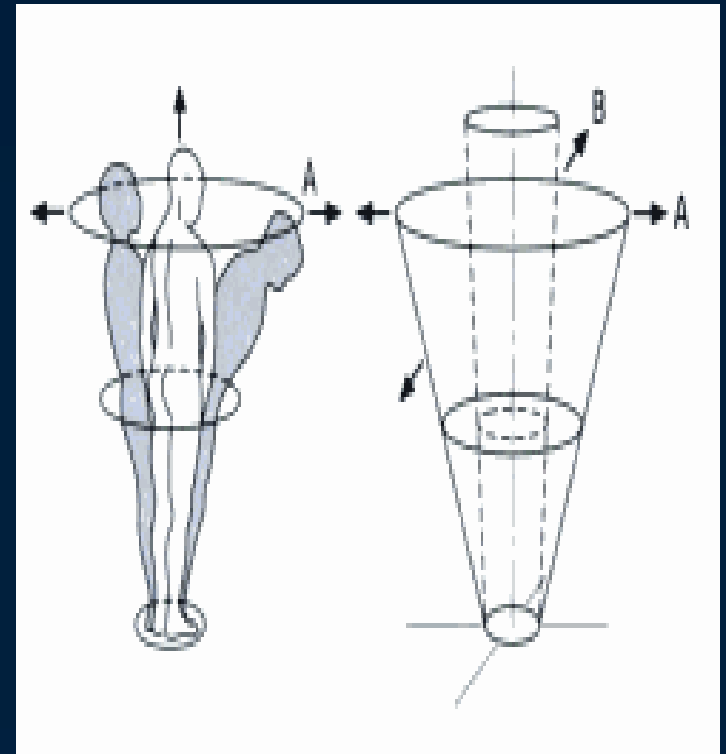
Core Competencies

- Patient Care
 - Evaluation & treatment of adult deformity.
- Medical Knowledge
 - Biomedical and clinical data for evaluation and management of patients with adult deformities.
- Practice-Based Learning and Improvement
- Interpersonal and Communication Skills
- Professionalism
- Systems-Based Practice
 - Costs associated with adult deformity surgeries.



Balance Is Everything!

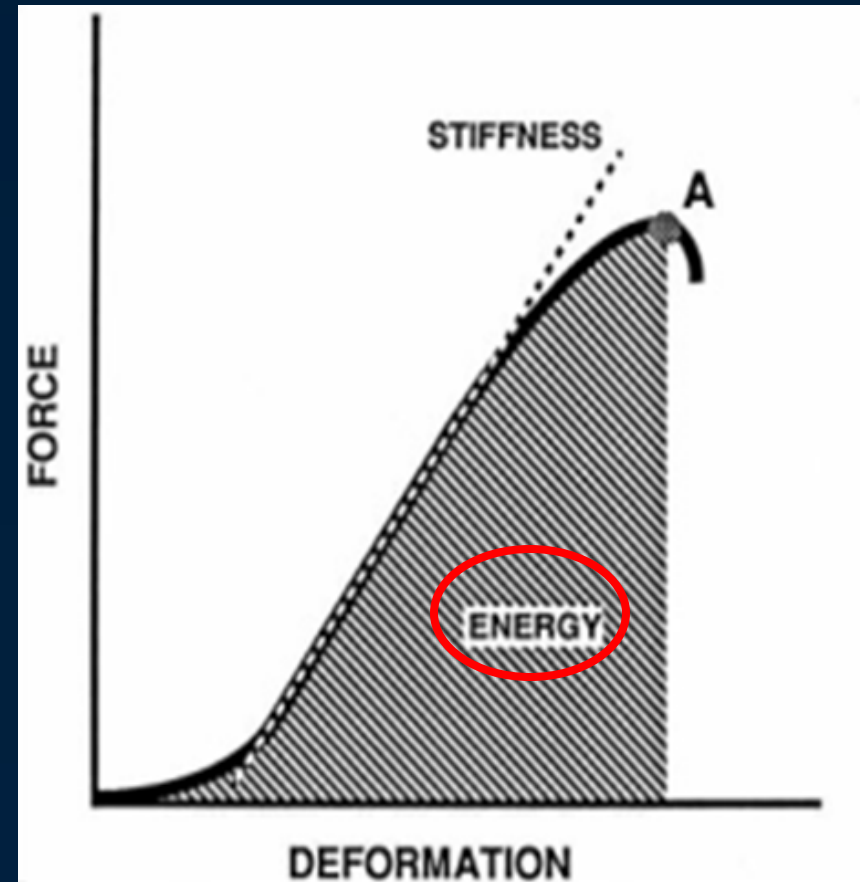
- Dubousset
 - “Cone of Economical Function”
 - Range of posture to remain balanced with physiological effort
- Periphery has increased effort of musculature for posture
 - Supraphysiologic energy
 - Causing fatigue and pain



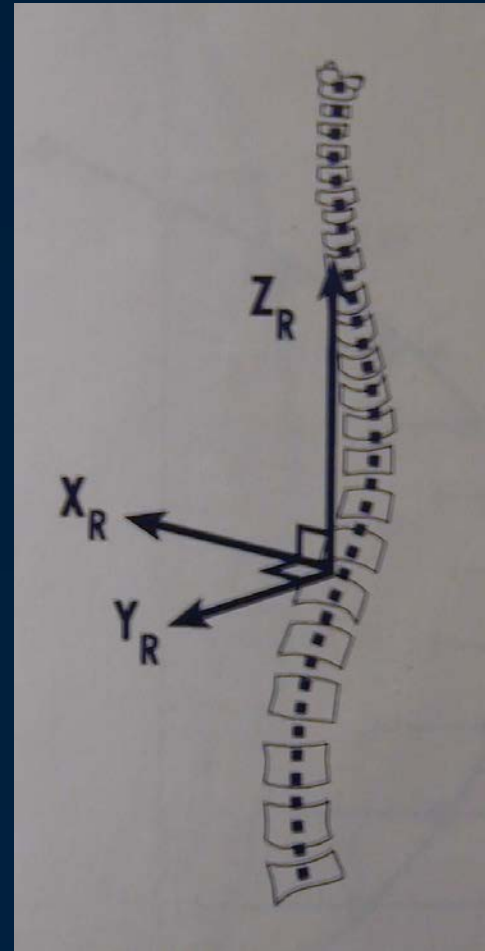
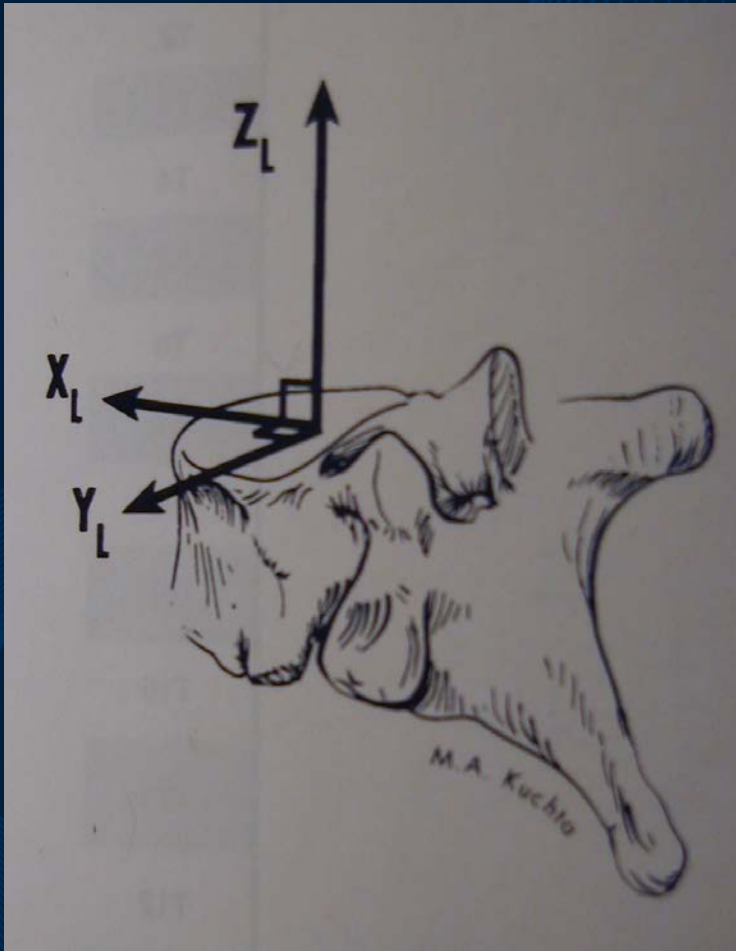
Biomechanics of Energy

- Energy
 - Area under the force-deformation response
 - Point of failure describes the structure's total energy-absorbing ability

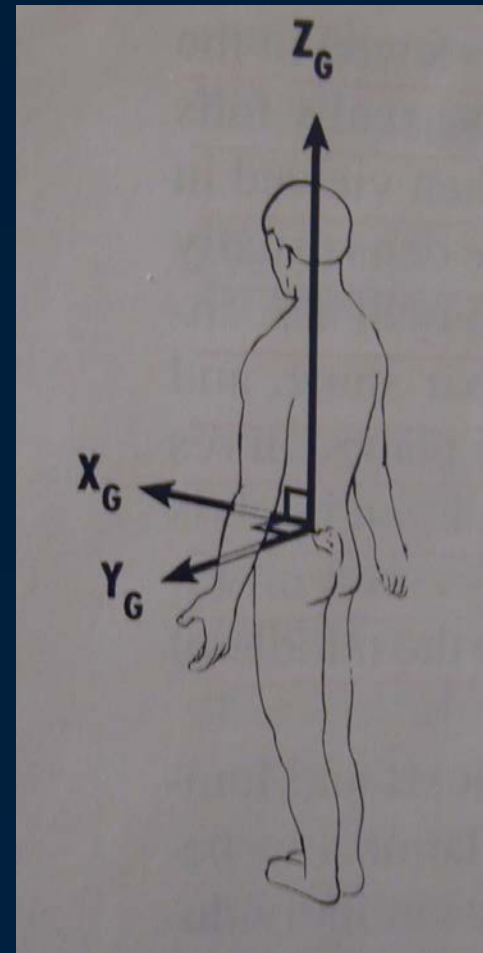
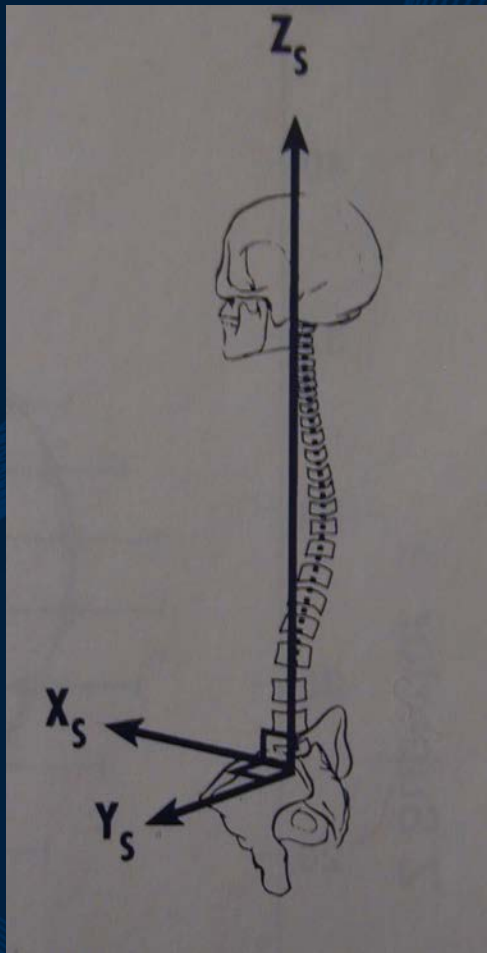
$$1 \text{ J} = 1 \text{ N} \cdot \text{m}$$



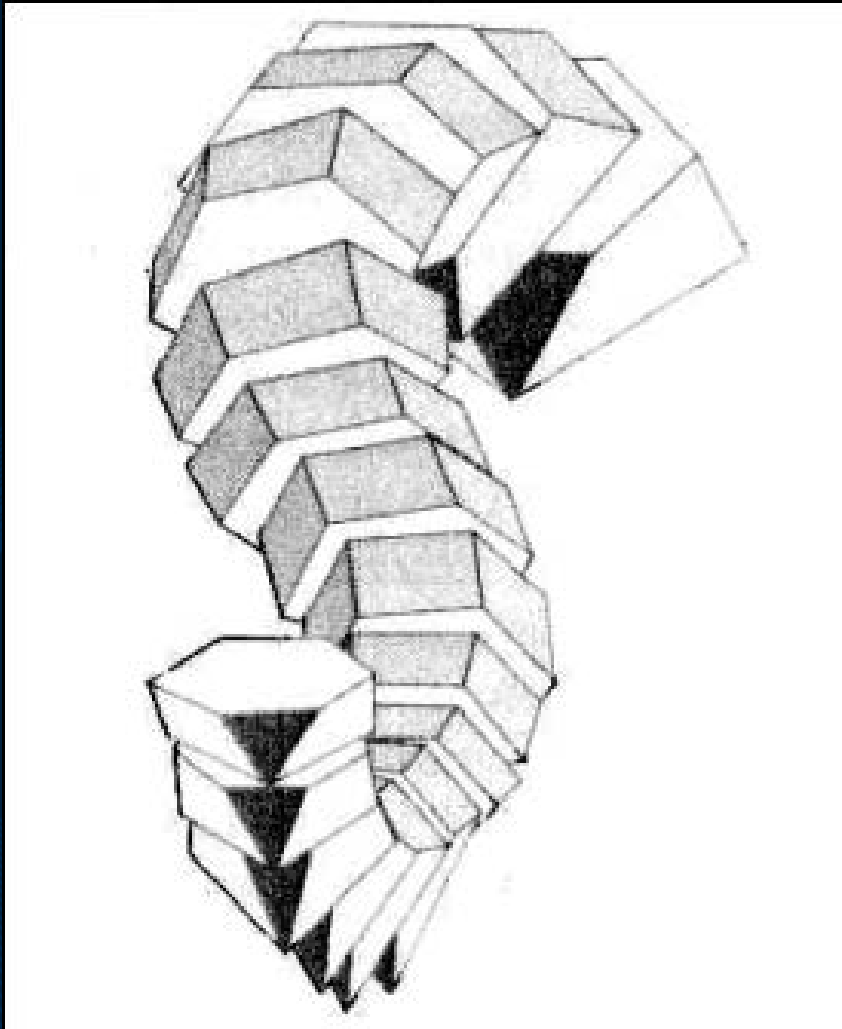
Spinal Balance: Local vs. Regional



Spinal Balance: Spinal vs. Global



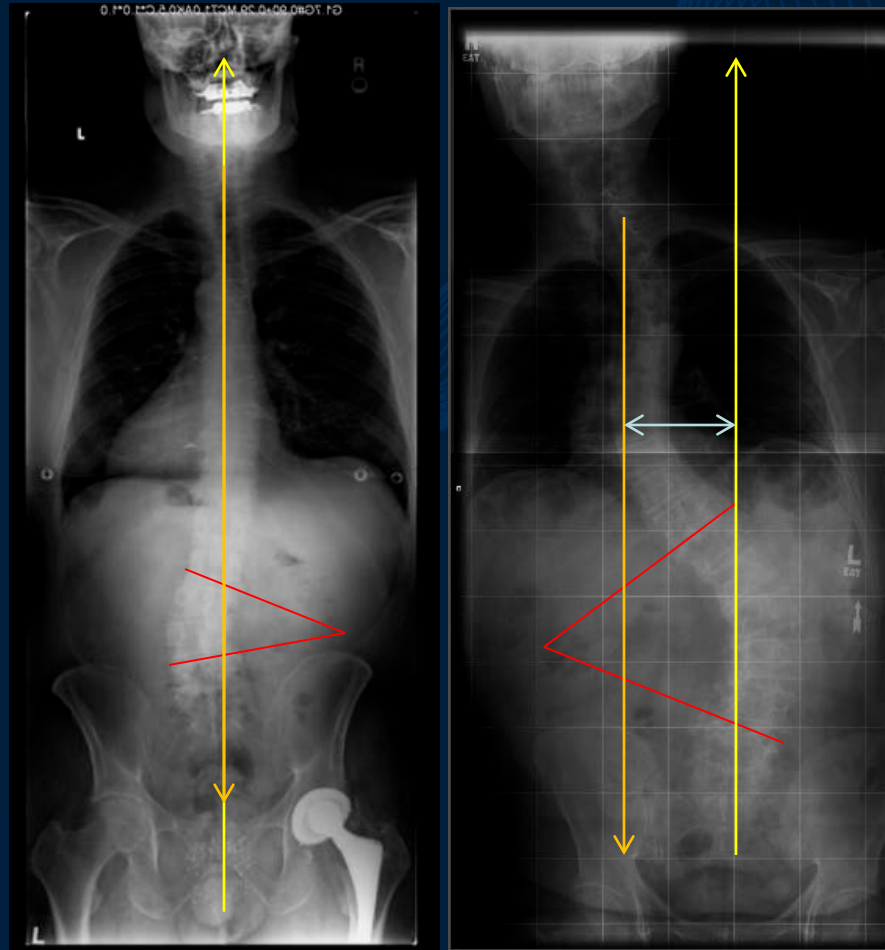
Spinal Balance: Planes of Deformity



- Coronal
- Sagittal
- Axial



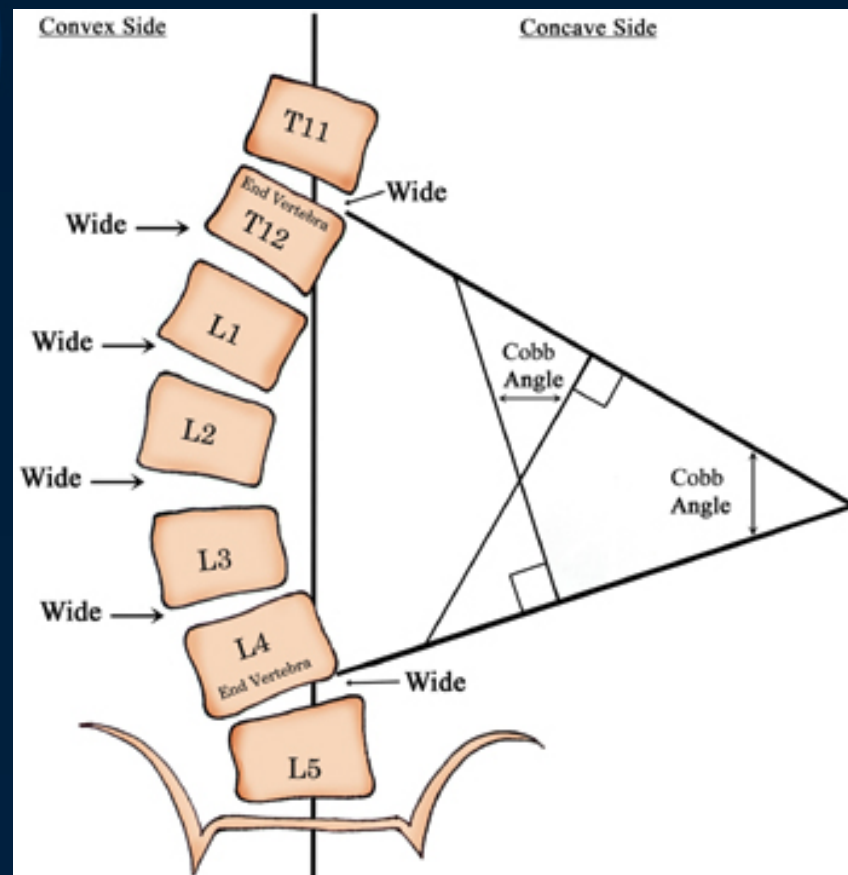
Measuring Spinal Balance



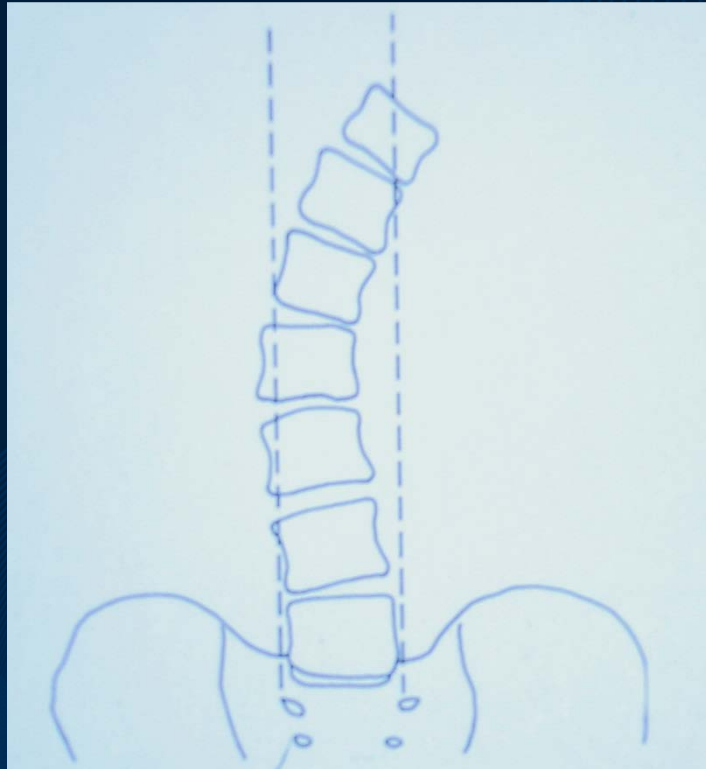
- C7 Plumb Line
- Central Sacral Vertebral Line (CSVL)
 - Straight up from middle of sacrum
- Trunk shift
 - Translation of C7 plumb line from CSVL
- Apical vertebral translation (AVT)
 - Translation of apex from the CSVL

Regional Balance

- Cobb Angle
 - Angle formed by the endplates of the 2 most tilted levels
 - Coronal plane $>10^\circ$
 - Intra-observer variability of $\pm 3-6^\circ$
 - Curve progression $> 6^\circ$ per year is significant



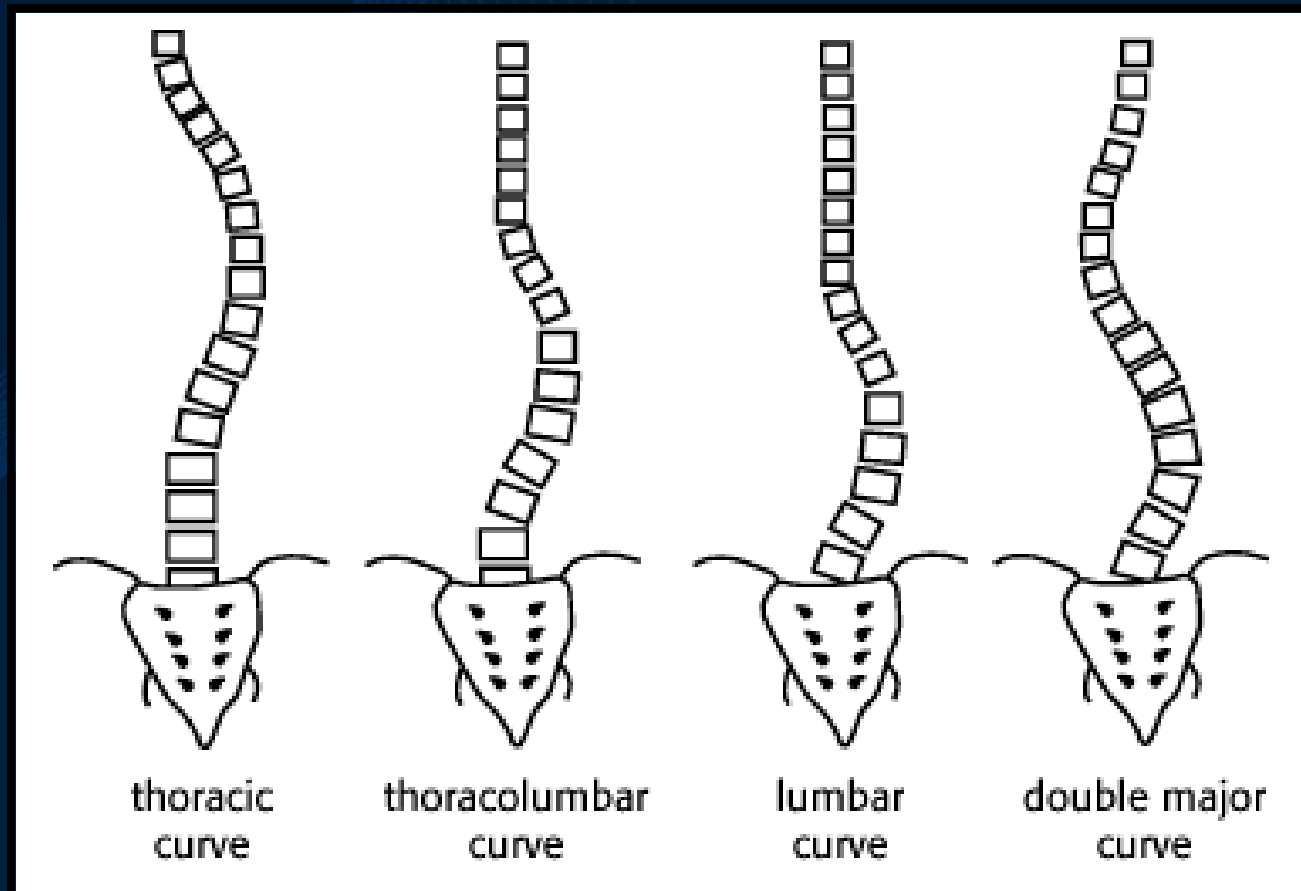
Coronal Plane Curves



- Major (Structural) Curves
- Minor (Compensatory) Curves
- Stable Zone of Harrington
 - VB that fall within parallel lines thru L5-S1 facets (perpendicular to iliac crests)
 - Less accurate than stable vertebra as bisected by CSVL

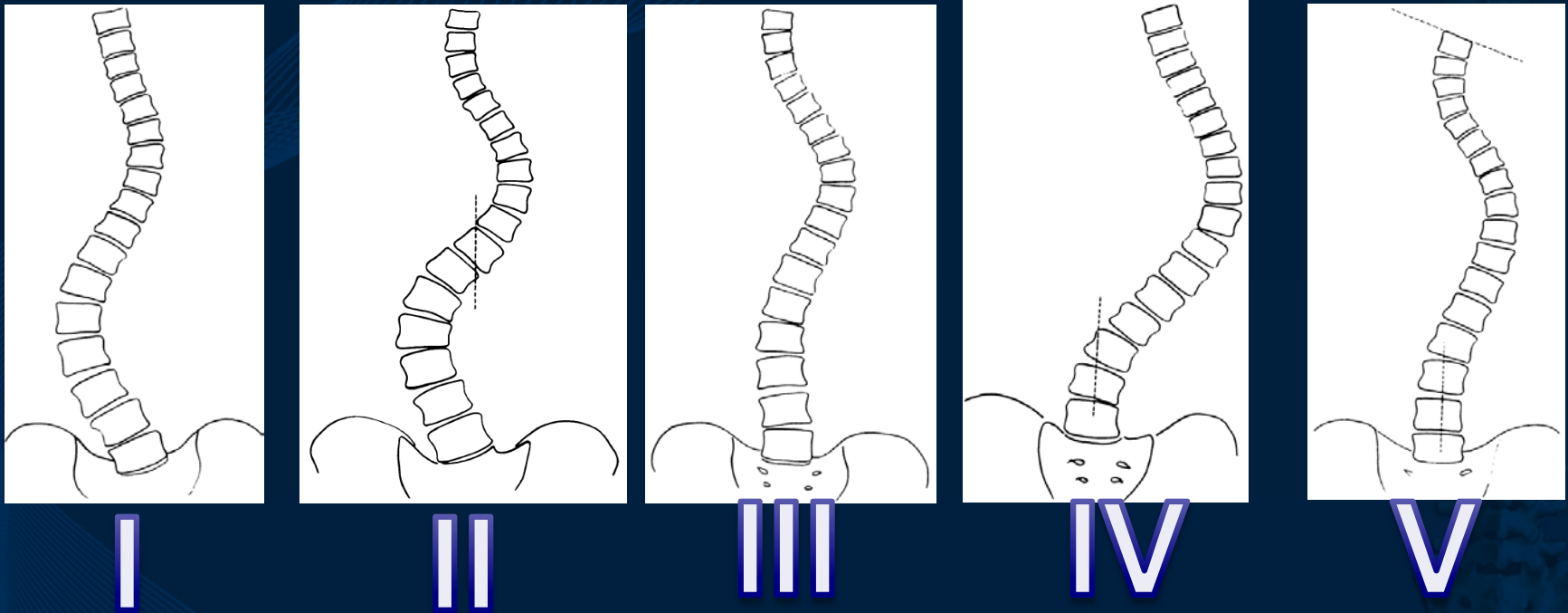


Classifications



Classifications

- King HA, Moe JH, Bradford DS, et al. The selection of fusion levels in thoracic idiopathic scoliosis. J Bone Joint Surg [Am] 1983;65:1302-13.



Classifications

| Curve Type | | | | |
|------------|-------------------|---------------------|------------------------|--|
| Type | Proximal Thoracic | Main Thoracic | Thoracolumbar / Lumbar | Curve Type |
| 1 | Non-Structural | Structural (Major*) | Non-Structural | Main Thoracic (MT) |
| 2 | Structural | Structural (Major*) | Non-Structural | Double Thoracic (DT) |
| 3 | Non-Structural | Structural (Major*) | Structural | Double Major (DM) |
| 4 | Structural | Structural (Major*) | Structural | Triple Major (TM) |
| 5 | Non-Structural | Non-Structural | Structural (Major*) | Thoracolumbar / Lumbar (TL/L) |
| 6 | Non-Structural | Structural | Structural (Major*) | Thoracolumbar / Lumbar - Main Thoracic (TL/L - MT) |

*Major = Largest Cobb Measurement, always structural
Minor = all other curves with structural criteria applied

STRUCTURAL CRITERIA (Minor Curves)

Proximal Thoracic: - Side Bending Cobb $\geq 25^\circ$
- T2 - T5 Kyphosis $\geq +20^\circ$




Main Thoracic: - Side Bending Cobb $\geq 25^\circ$
- T10 - L2 Kyphosis $\geq +20^\circ$

Thoracolumbar / Lumbar: - Side Bending Cobb $\geq 25^\circ$
- T10 - L2 Kyphosis $\geq +20^\circ$

LOCATION OF APEX (SRS definition)

| CURVE | APEX |
|---------------|------------------|
| THORACIC | T2 - T11-12 DISC |
| THORACOLUMBAR | T12 - L1 |
| LUMBAR | L1-2 DISC - L4 |

Modifiers

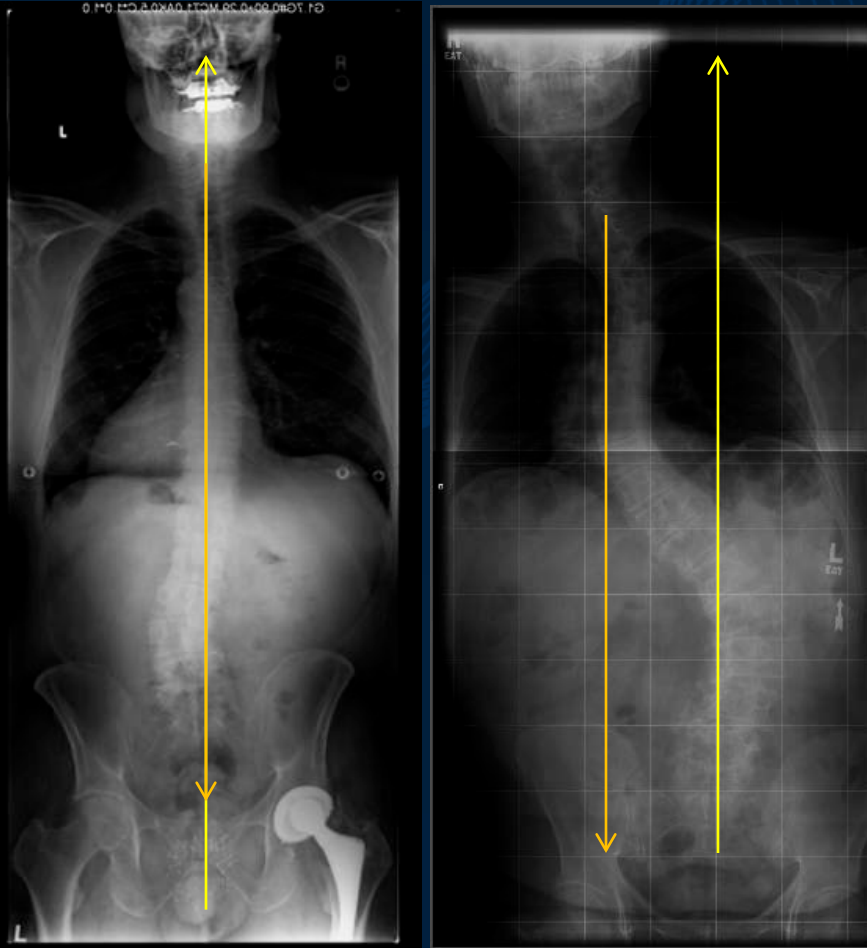
| Lumbar Spine Modifier | CSVL to Lumbar Apex | | | |
|-----------------------|-------------------------------|---|--|---|
| A | CSVL Between Pedicles |  |  |  |
| B | CSVL Touches Apical Body(ies) | | | |
| C | CSVL Completely Medial | | | |
| | | A | B | C |

| Thoracic Sagittal Profile T5 - T12 | | |
|------------------------------------|----------|-----------------------|
| - | (Hypo) | $< 10^\circ$ |
| N | (Normal) | $10^\circ - 40^\circ$ |
| + | (Hyper) | $> 40^\circ$ |

Curve Type (1-6) + Lumbar Spine Modifier (A, B, or C) + Thoracic Sagittal Modifier (-, N, or +)

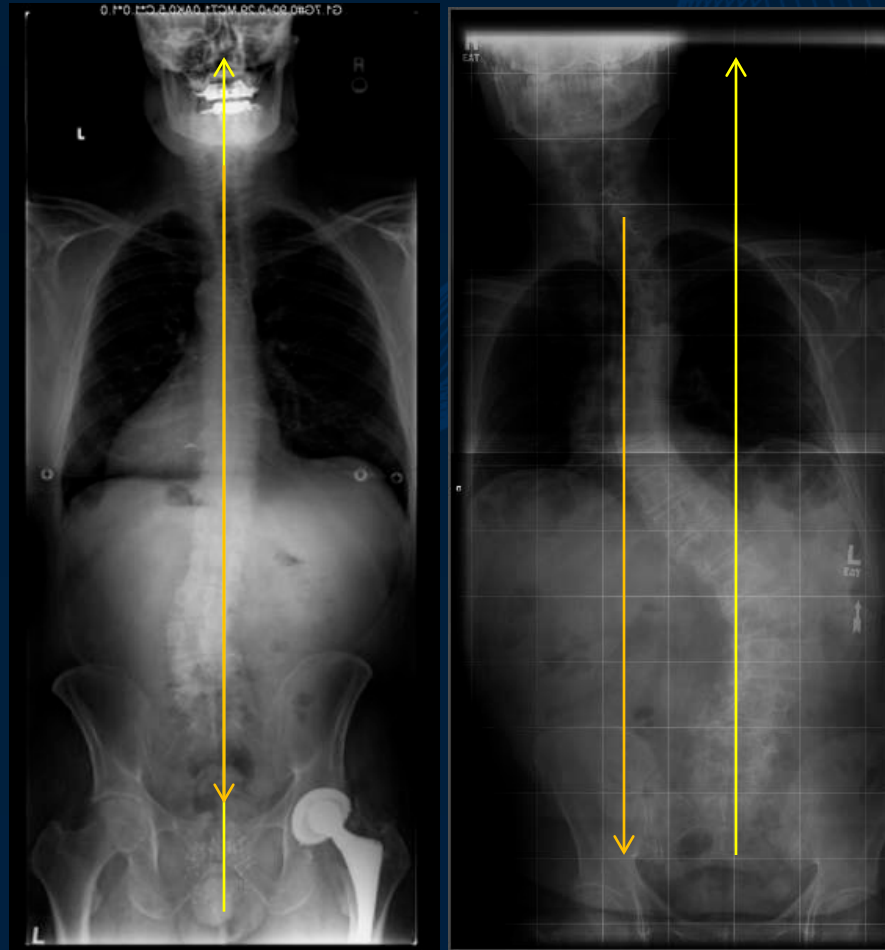
Classification (e.g. 1B+): _____

Clinical Decision Making



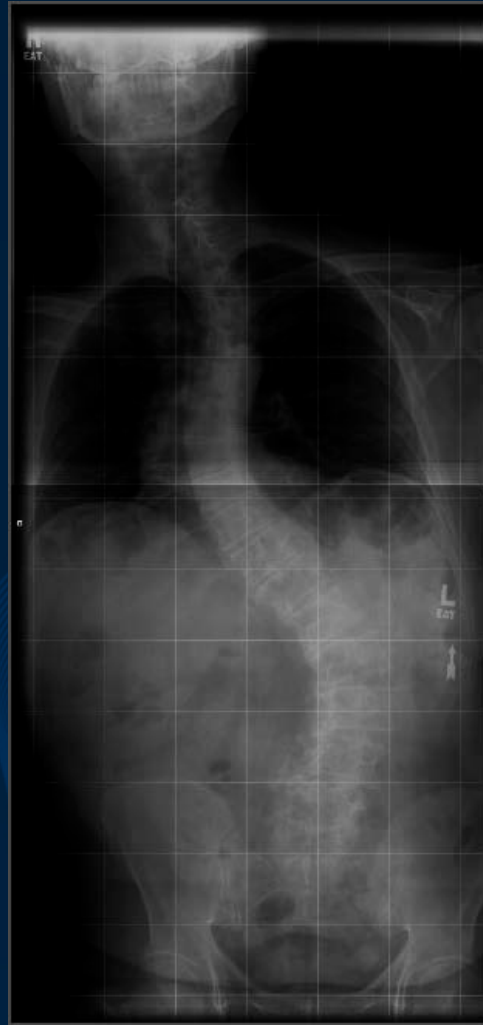
- Global Imbalance
 - Rotational
 - Translational
- Compensated or Non-Compensated
- Degenerative with local deformity

Clinical Decision Making



- Observation
 - $< 60^\circ$
 - No progression
 - Manageable clinical symptoms
- Brace
 - No real role in adult deformity
- Surgery
 - $> 60^\circ$

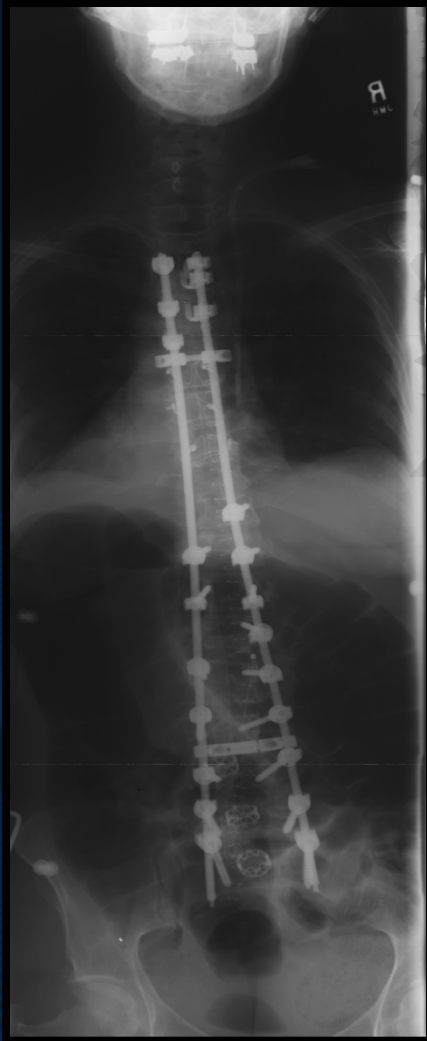
Surgical Goals In Coronal Plane Deformities



- Create a stable balanced spine
 - Centered over the pelvis (feet)
 - Adjust for compensatory curves, shoulder asymmetry, pelvic tilt and/or leg length discrepancy
- Minimize number of fused segments
 - Fuse all painful segments
 - Adequate neural decompression
 - End at vertebra neutral
 - End at vertebra over a normal disc



Errors To Avoid



- Over correction of a curve creating a new imbalance.
- Fusion to the sacrum with poor balance above.
- Residual trunk shift.
- Introduction of shoulder imbalance.



Conclusion

- Understanding the basic principles of coronal plane deformities is essential to assess and plan treatment of patients with spinal deformities.
- Goal of treatment is a balanced spine, not a straight spine!

Thank You!

Vanderbilt Spine Fellowship Position Open for 2014



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