Curve correction techniques

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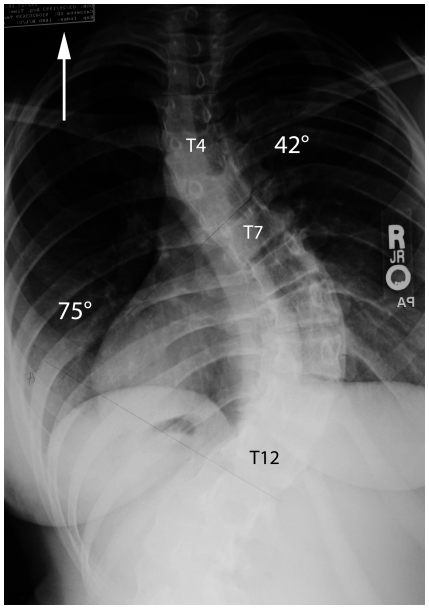
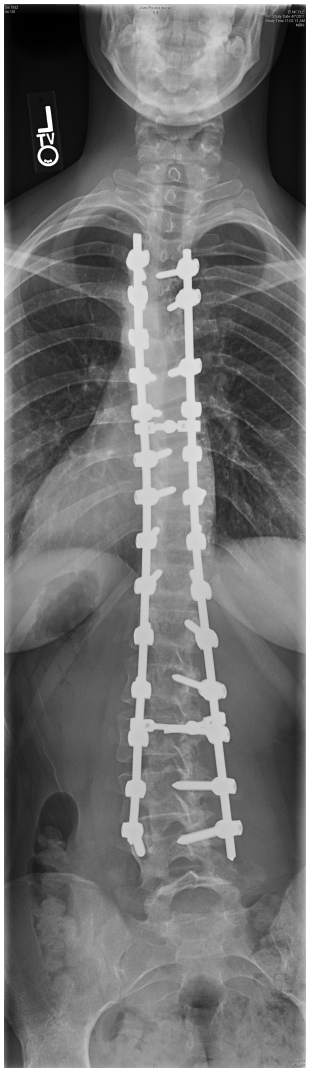
Disclosure

I have no conflicts to disclose.

Outline

1. 3-dimensionality of deformity
2. Passive correction
3. Facilitating correction
4. Active correction





SCOLIOSIS IS A 3-DIMENSIONAL DEFORMITY

LECTURES

ON THE

PATHOLOGY AND TREATMENT

OF

LATERAL AND OTHER FORMS

OF

CURVATURE OF THE SPINE.

BY

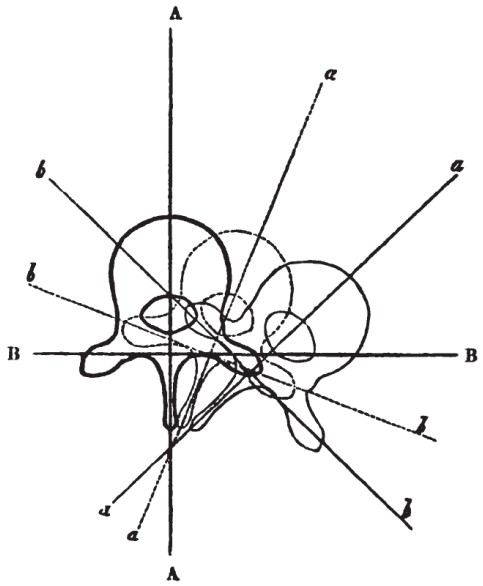
WILLIAM ADAMS, F.R.C.S.

SURGEON TO THE ROYAL ORTHOPÆDIC AND GREAT NORTHERN HOSPITALS;
PRESIDENT OF THE HARVEIAN SOCIETY;
LATE LECTURER ON SURGERY AT THE GROSVENOR PLACE SCHOOL OF MEDICINE;
FORMERLY DEMONSTRATOR OF MORBID ANATOMY AT ST. THOMAS' HOSPITAL, &c.

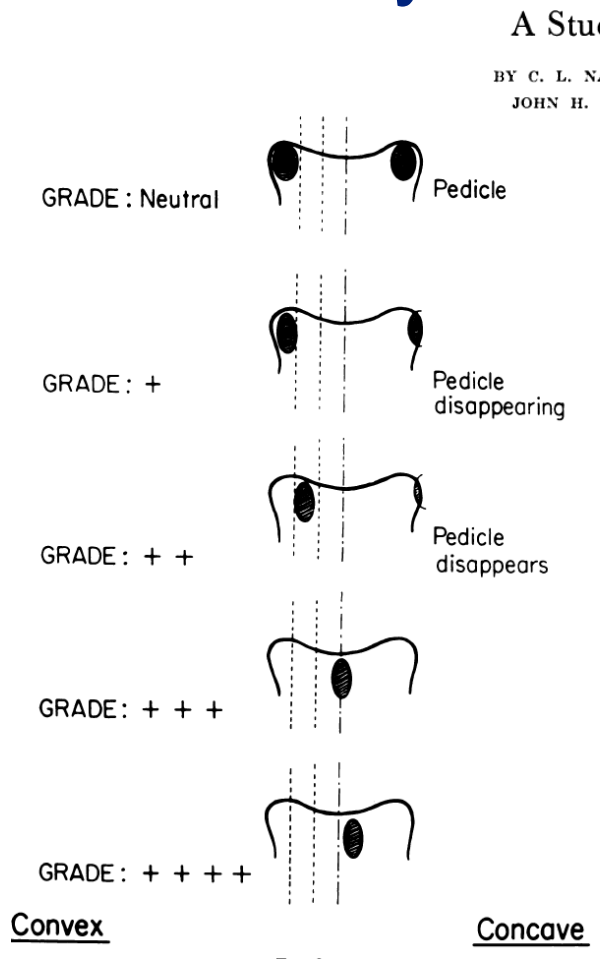
Delivered at the Grosvenor Place School of Medicine in the Session 1860—61.

ILLUSTRATED BY FIVE LITHOGRAPH PLATES AND SIXTY-ONE WOOD-ENGRAVINGS

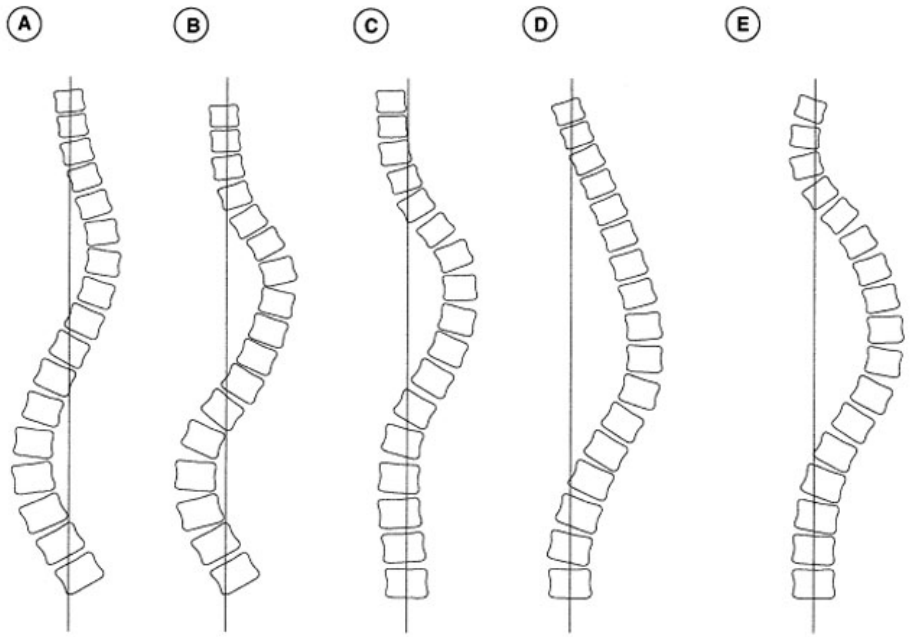
LONDON:
JOHN CHURCHILL AND SONS, NEW BURLINGTON STREET.
1865.



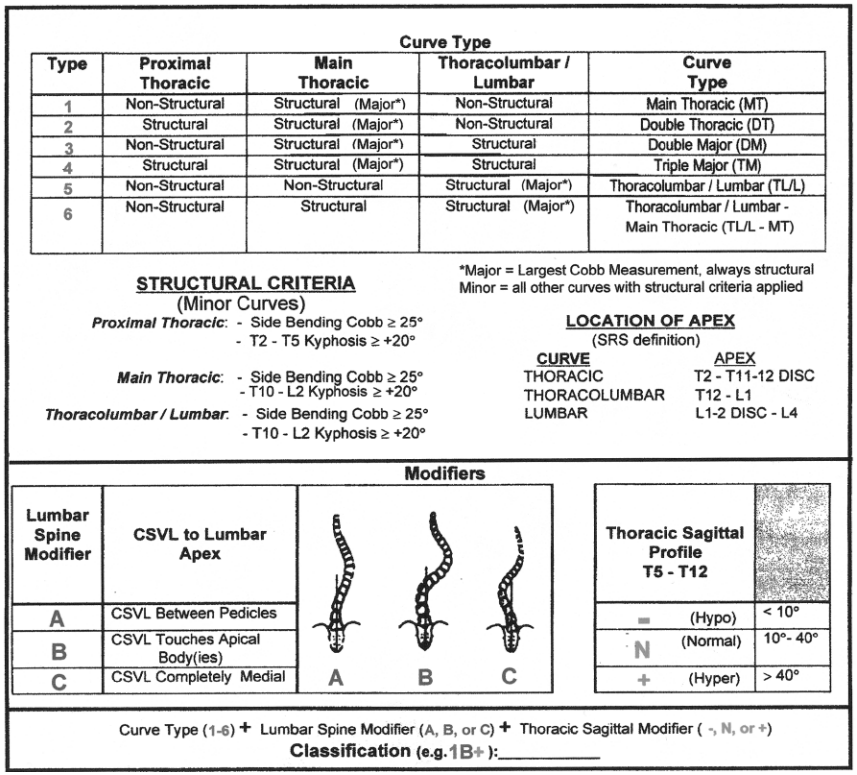
Scoliosis is a torsional deformity



King-Moe classification (AIS)



Lenke classification (AIS)



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 ≥ 25°
- T2 - T5 Kyphosis ≥ +20°

Main Thoracic: - Side Bending Cobb ≥ 25°
- T10 - L2 Kyphosis ≥ +20°

Thoracolumbar / Lumbar: - Side Bending Cobb ≥ 25°
- T10 - L2 Kyphosis ≥ +20°

LOCATION OF APEX
(SRS definition)

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

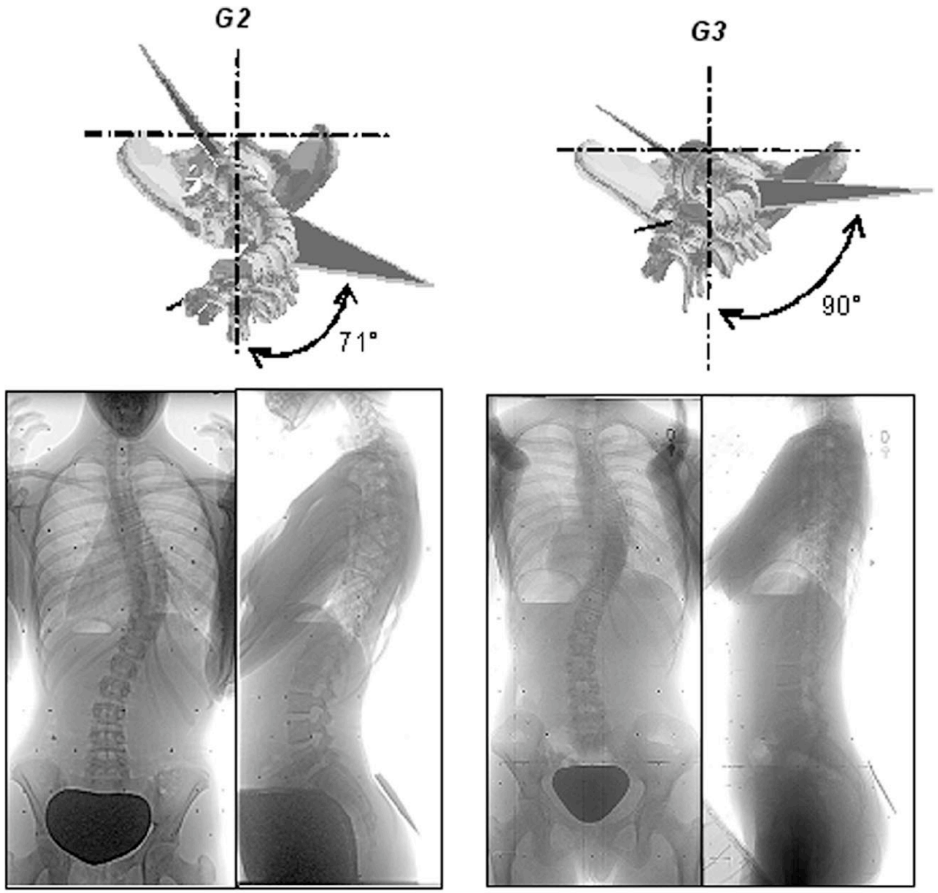
Modifiers

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

Thoracic Sagittal Profile T5 - T12	
- (Hypo)	< 10°
N (Normal)	10°- 40°
+ (Hyper)	> 40°

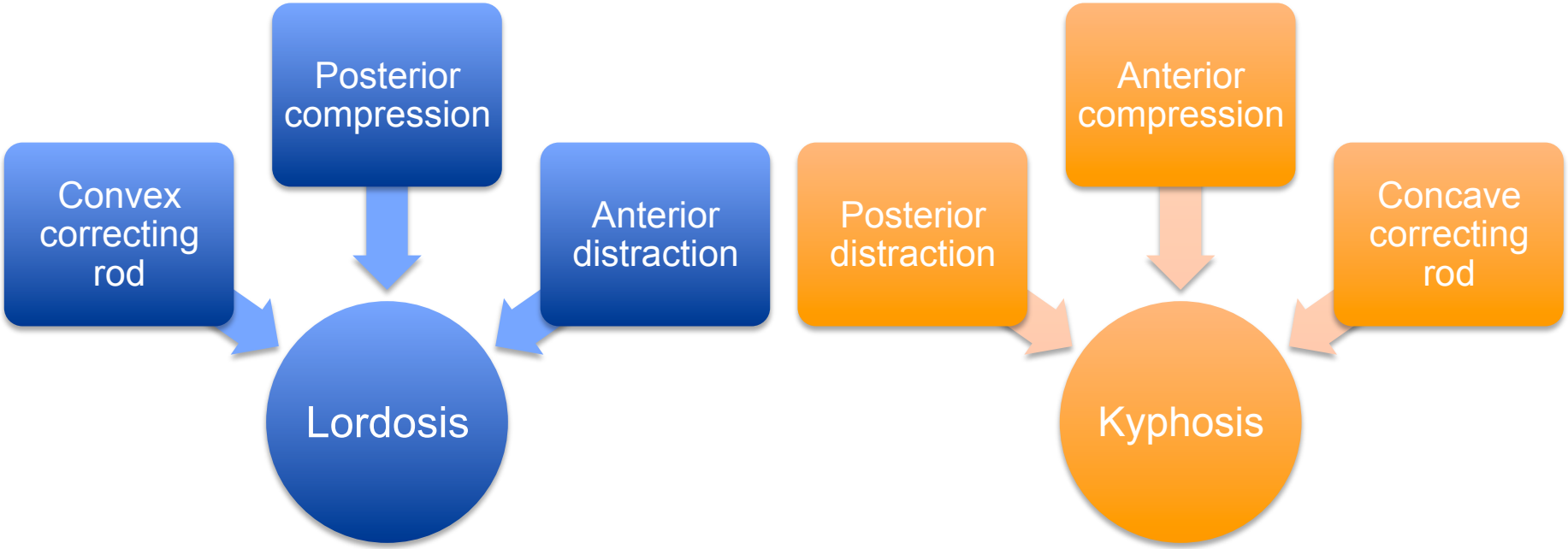
Curve Type (1-6) + Lumbar Spine Modifier (A, B, or C) + Thoracic Sagittal Modifier (-, N, or +)
Classification (e.g. 1B+):_____

Lenke LG, Betz RR, Harms J, Bridwell KH, Clements DH, Lowe TG, Blanke K. Adolescent idiopathic scoliosis: a new classification to determine extent of spinal arthrodesis. J Bone Joint Surg 83-A (8): 1169-1181, 2001.



Sangole AP, Aubin C-E, Labelle H, Stokes IAF, Lenke LG, Jackson R, Newton P: Three-dimensional classification of thoracic scoliotic curves. **Spine** 34:91-99, 2009.

Secondary effects of correction maneuvers

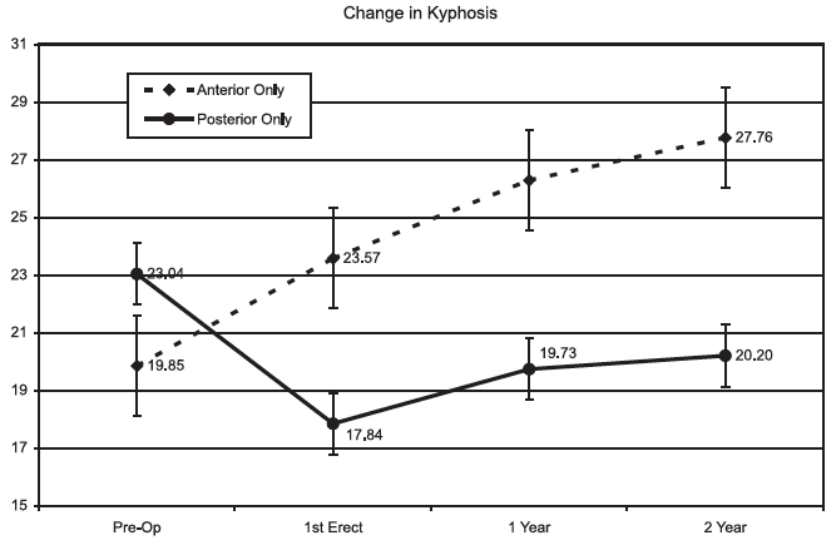


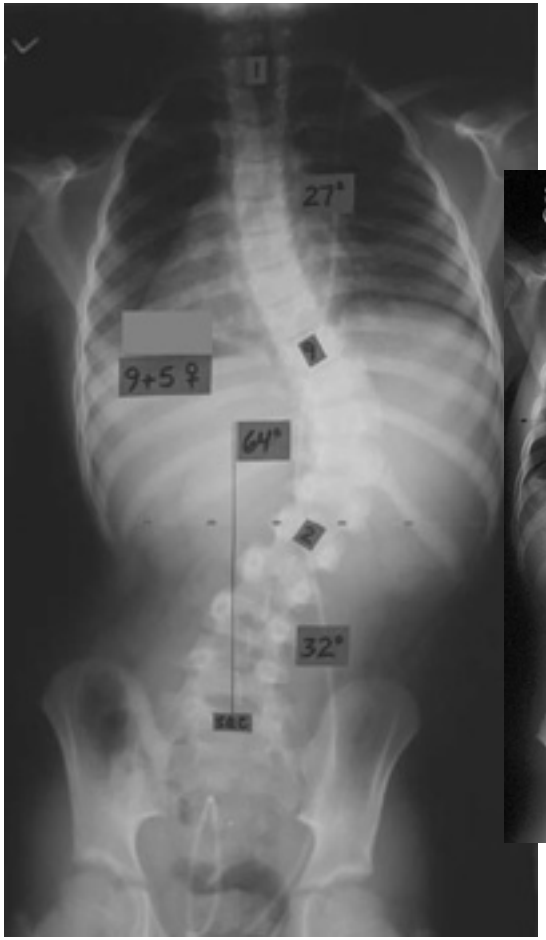
Thoracic kyphosis

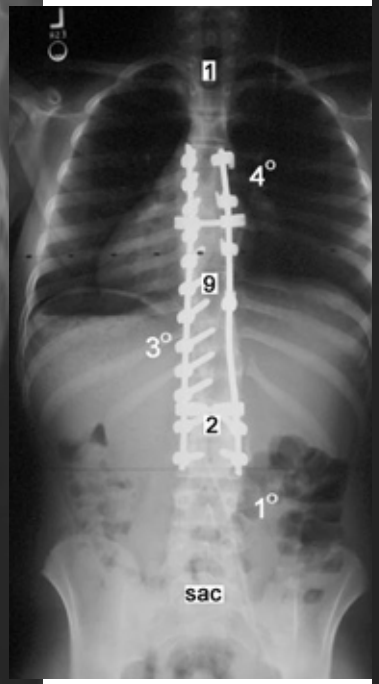
SPINE Volume 35, Number 14, pp 1365–1370

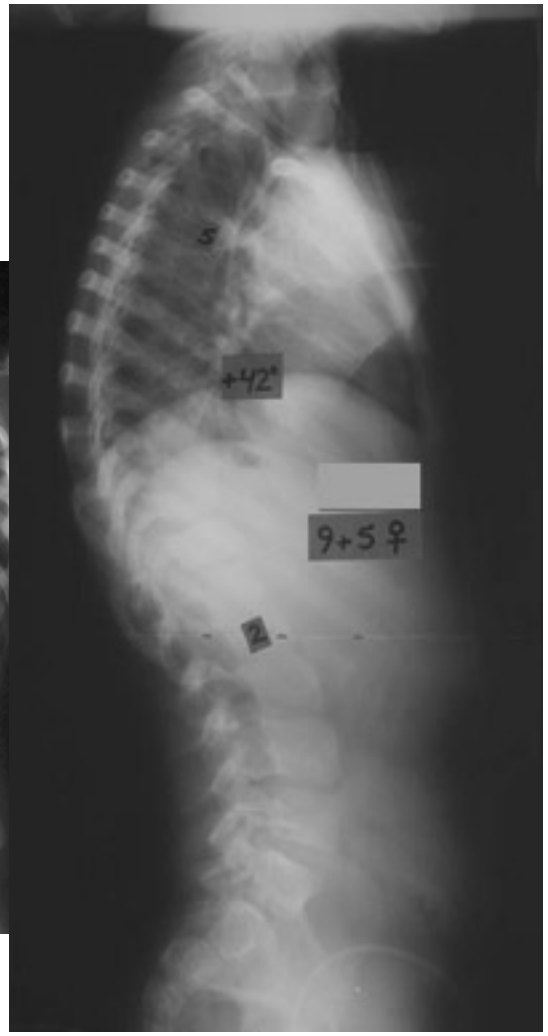
Preservation of Thoracic Kyphosis Is Critical to Maintain Lumbar Lordosis in the Surgical Treatment of Adolescent Idiopathic Scoliosis

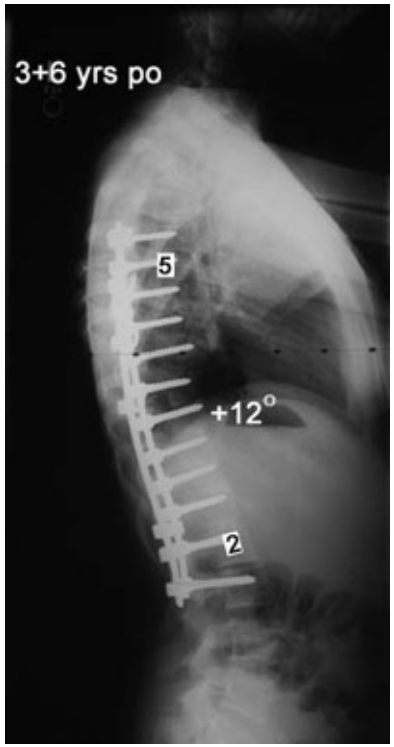
Peter O. Newton, MD,*† Burt Yaszay, MD,*† Vidyadhar V. Upasani, MD,*
Jeff B. Pawelek, BA,† Tracey P. Bastrom, MA,† Lawrence G. Lenke, MD,‡
Thomas Lowe, MD,§ Alvin Crawford, MD,¶ Randal Betz, MD,‖ Baron Lonner, MD,**
and Harms Study Group





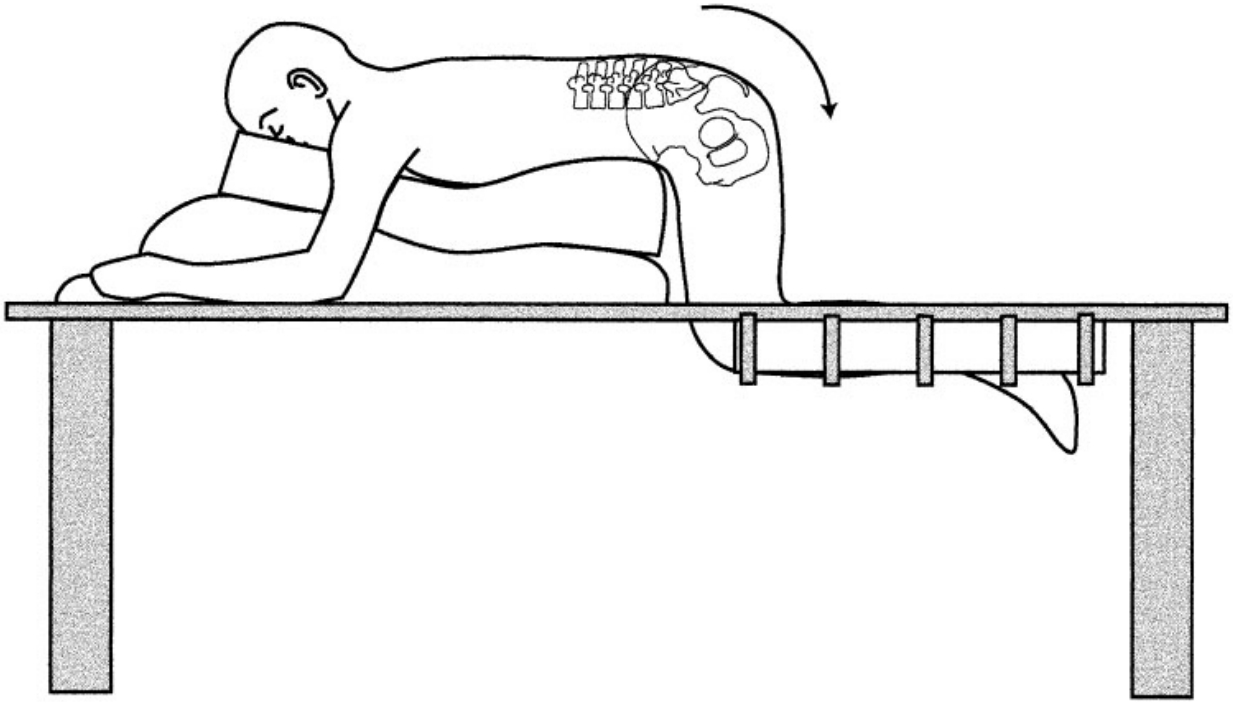


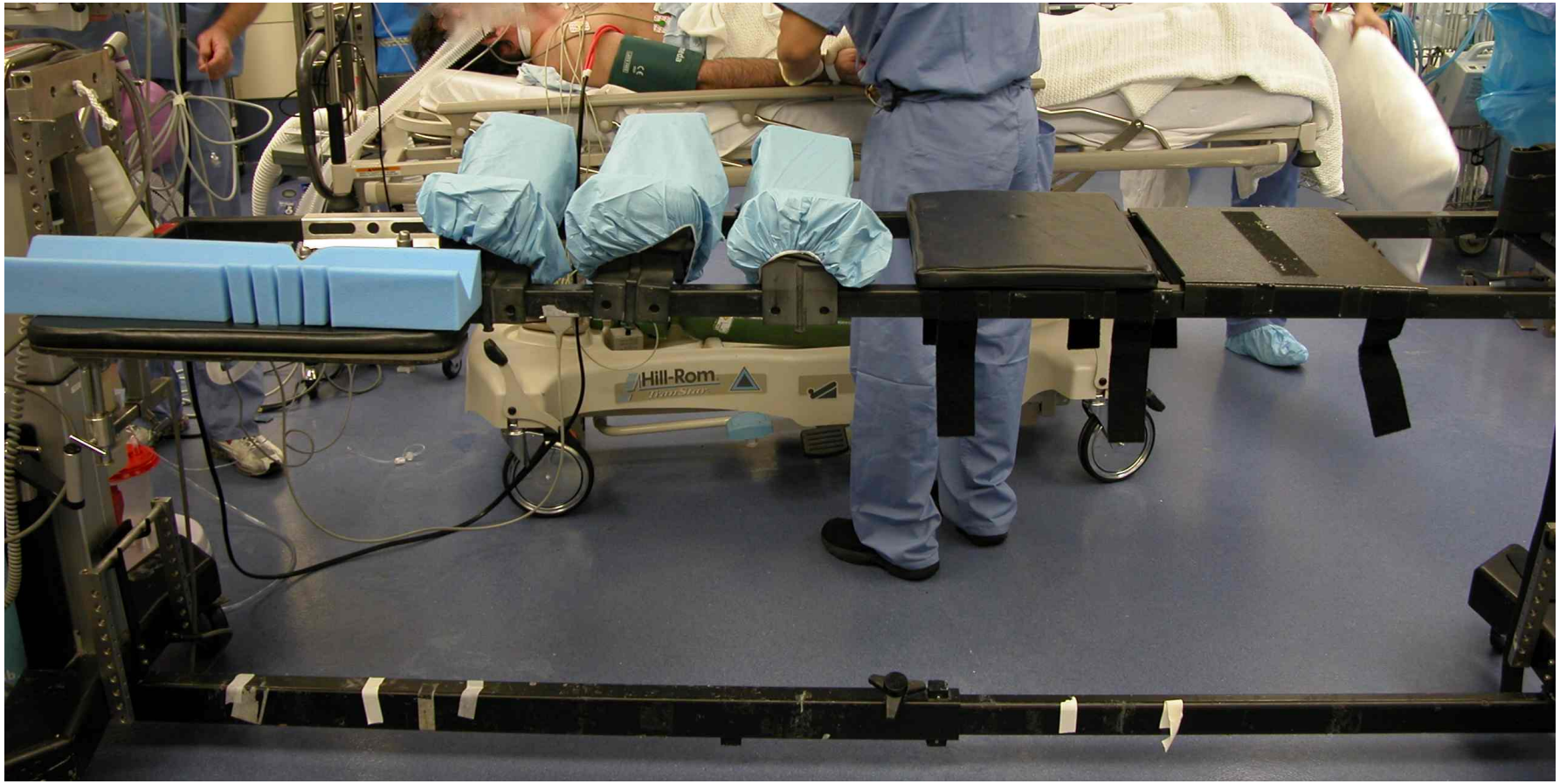




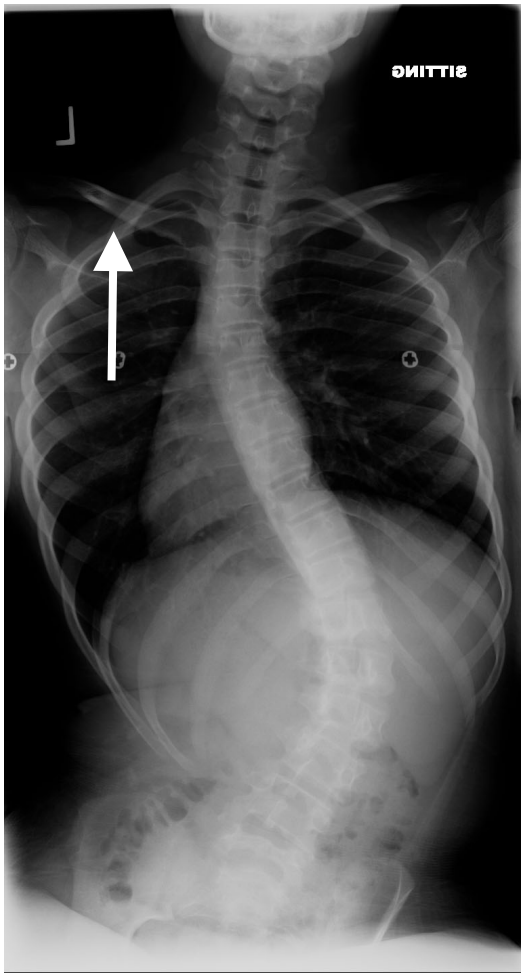
Courtesy LGL

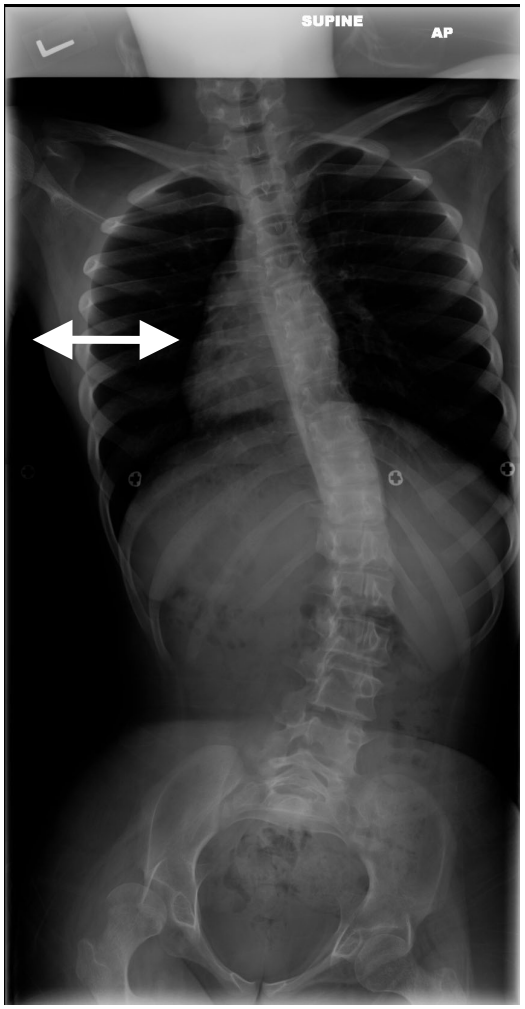
PASSIVE CORRECTION TECHNIQUES

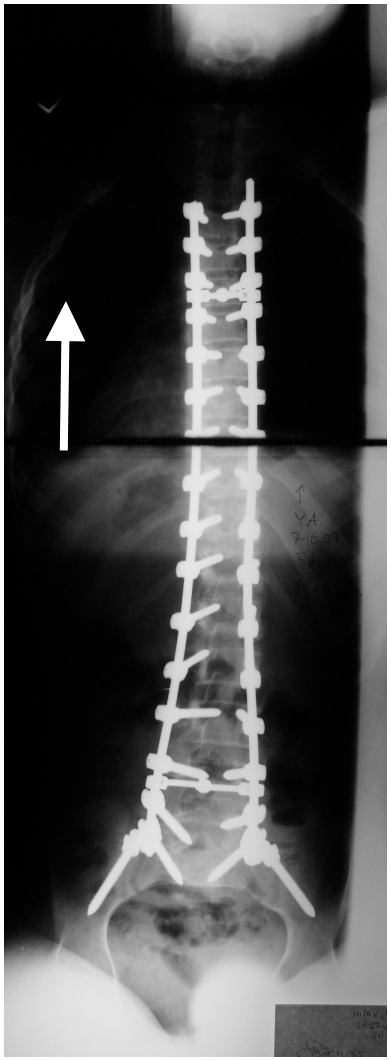



Hill-Rom

Passive curve correction



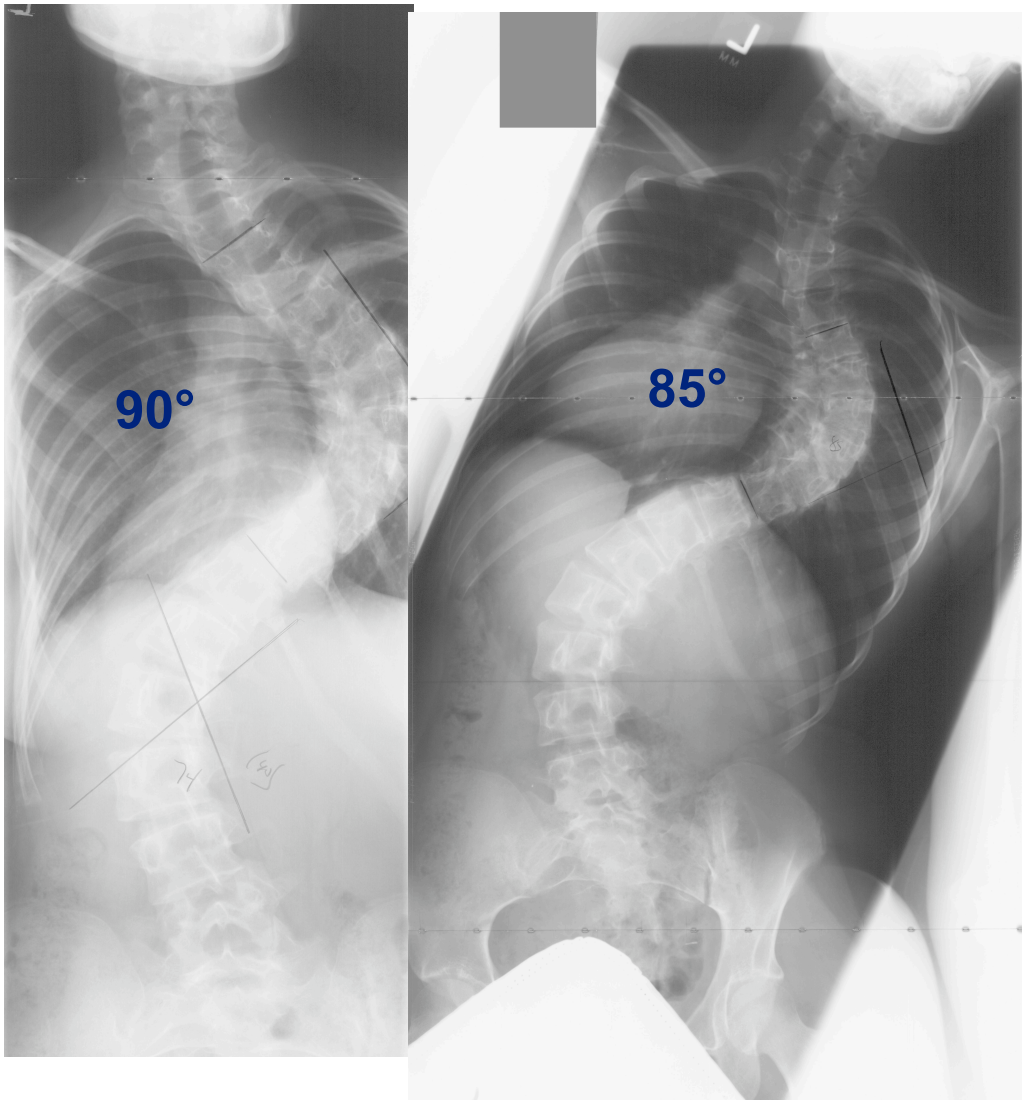




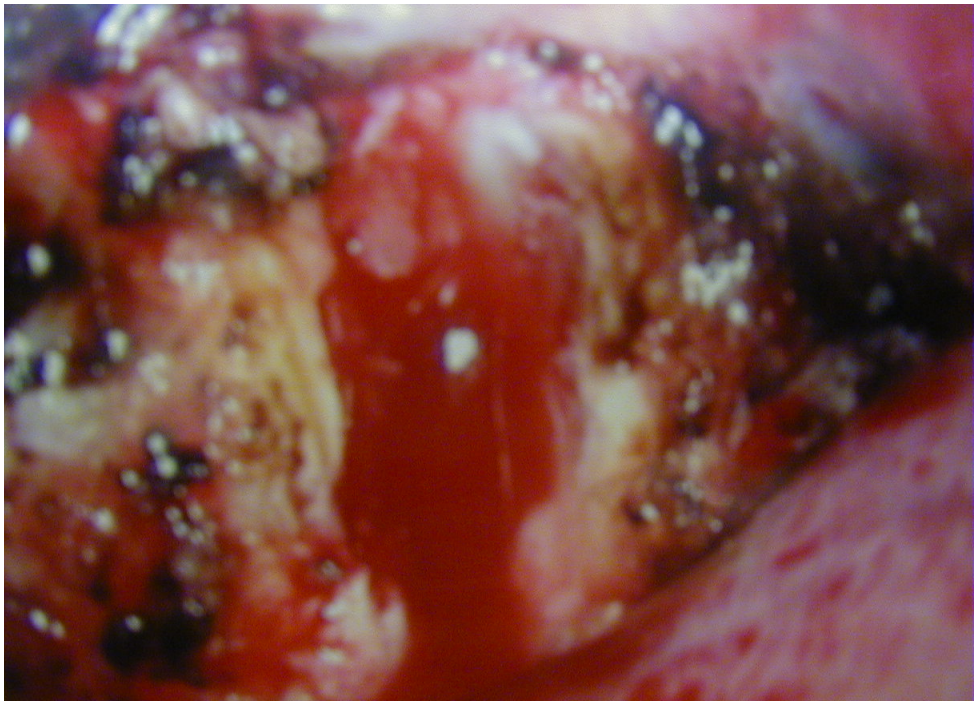
FACILITATING CORRECTION

Increasing flexibility

1. Anterior release
2. Posterior release
    1. Flavectomy
    2. Facetectomy
3. Osteotomies
    1. Smith-Petersen/Ponte
    2. Asymmetric pedicle subtraction
    3. VCR

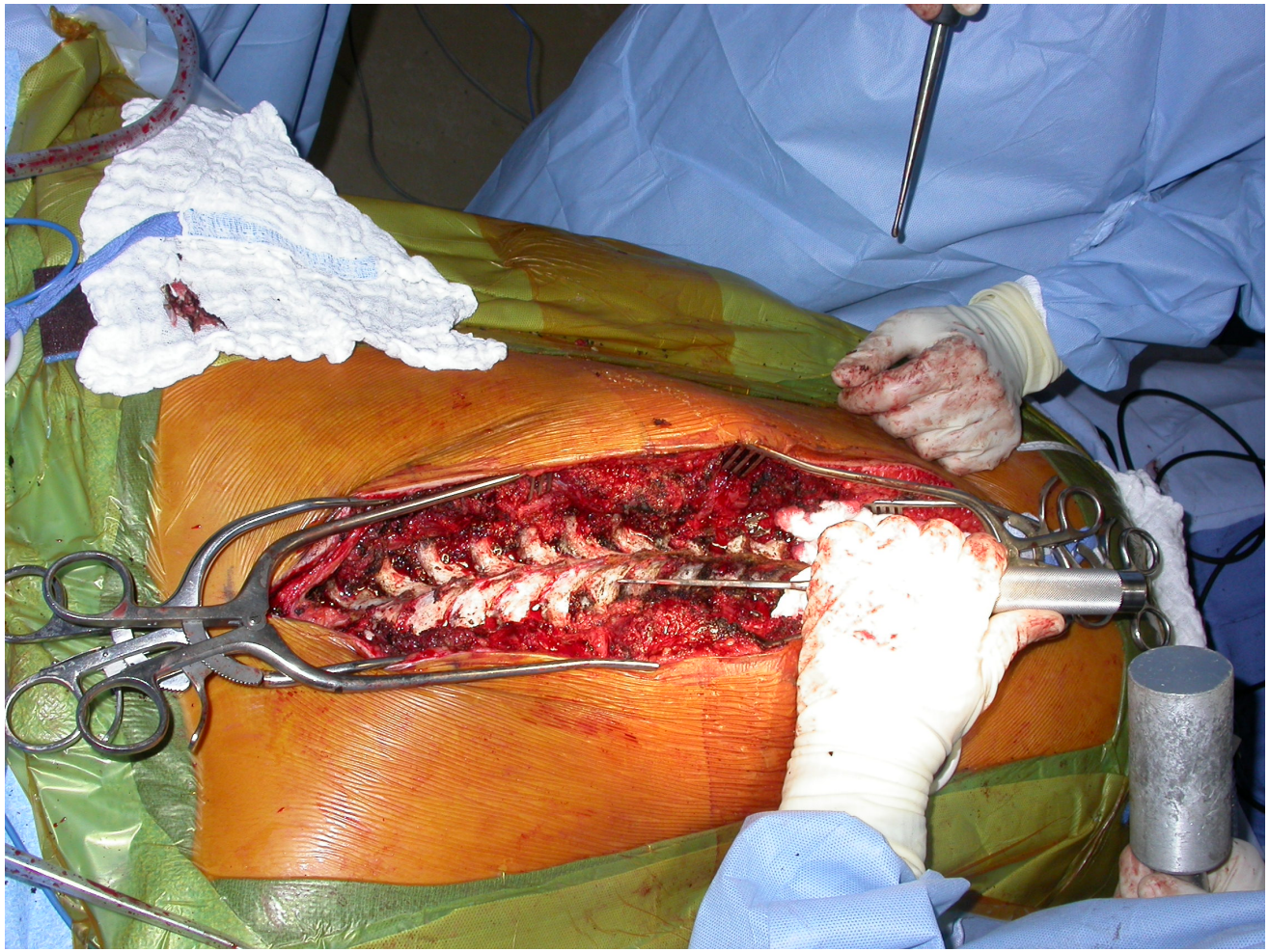


Anterior release



Courtesy M. Vitale

Partial facetectomies



Ponte osteotomies

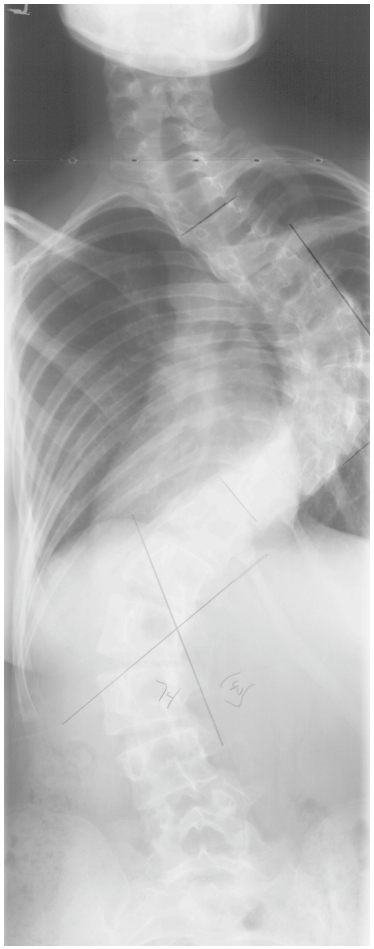
The Ponte Procedure

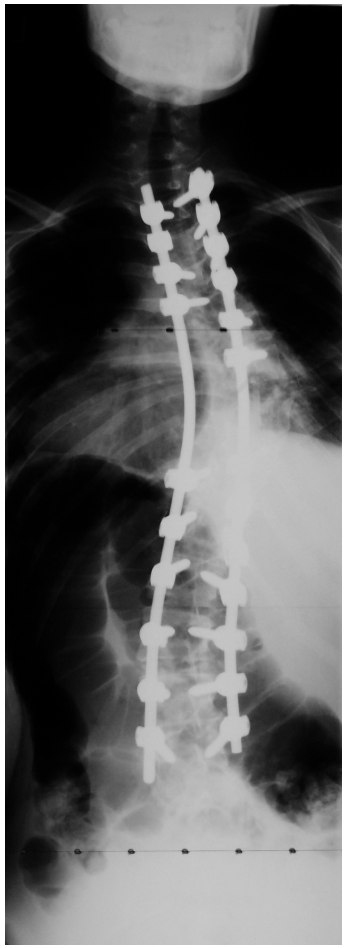
Posterior Only Treatment of Scheuermann's Kyphosis Using Segmental Posterior Shortening and Pedicle Screw Instrumentation

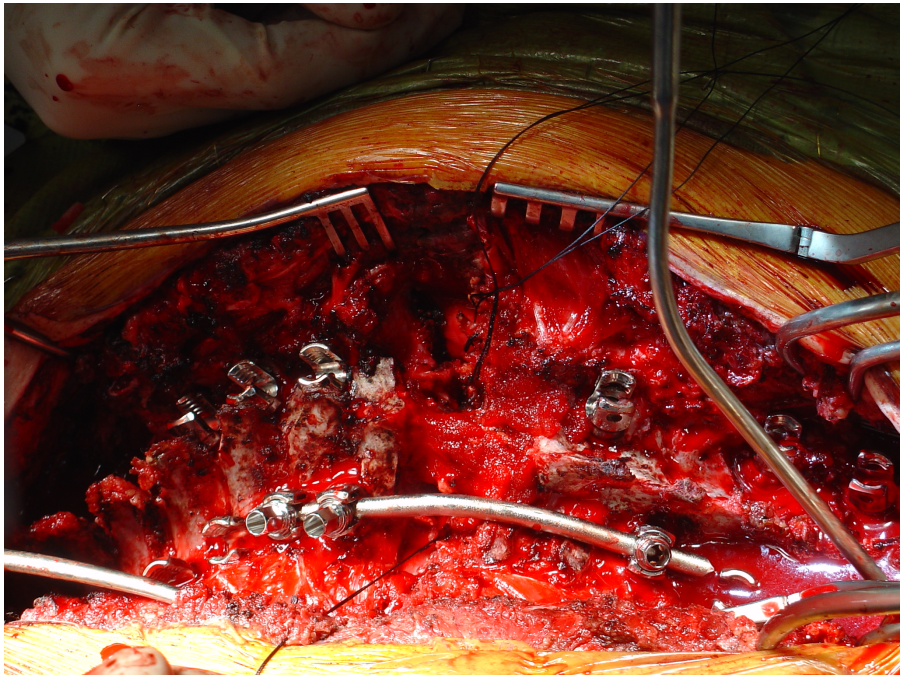
Matthew J. Geck, MD, Angel Macagno, MD,† Alberto Ponte, MD,‡ and Harry L. Shufflebarger, MD§‖*

J Spinal Disord Tech • Volume 20, Number 8, December 2007

VCR



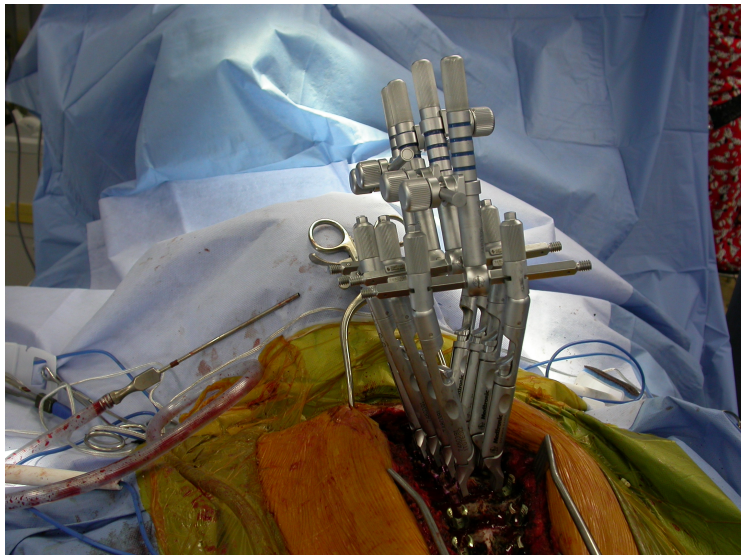




ACTIVE CORRECTION TECHNIQUES

Active curve correction

1. Compression
2. Distraction
3. Translation
4. Cantilever
5. Axial rotation



Methods of active posterior correction

1. Distraction
2. Compression

Harrington rods

3. Translation
    1. Rod rotation
    2. Coronal bending

Hooks/ hybrid constructs

4. Derotation

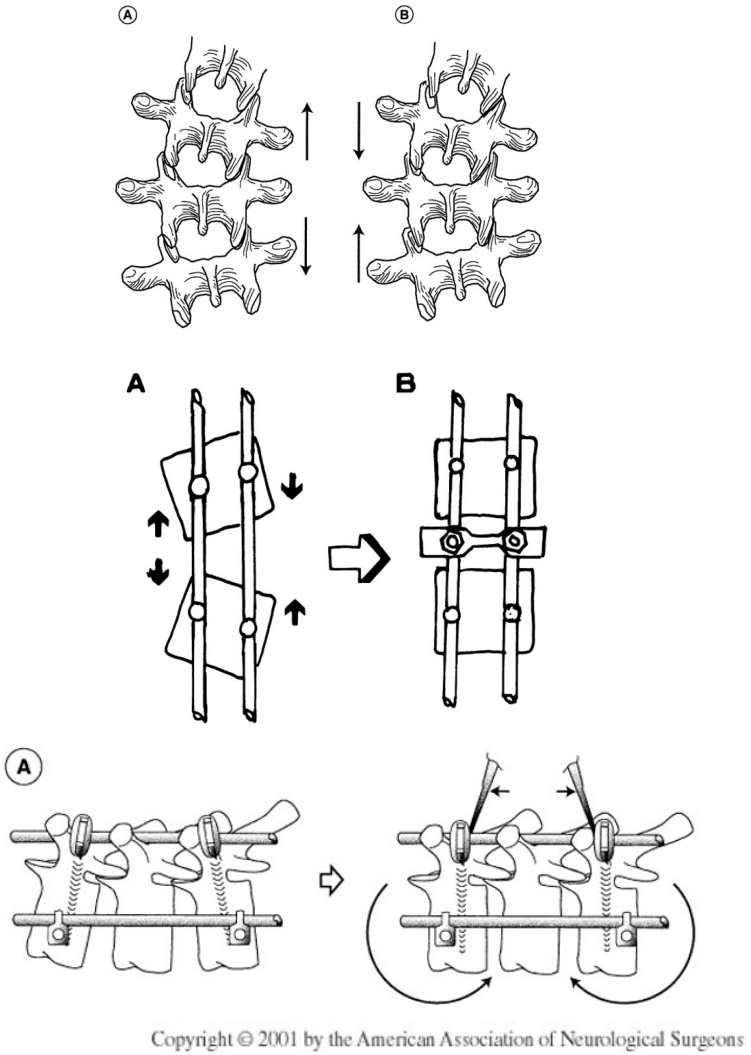
Pedicle screws

Distraction/compression

Primary technique for anterior correction of thoracolumbar/ lumbar (Lenke V) deformities

Posteriorly, mainly appropriate for final leveling of end vertebra

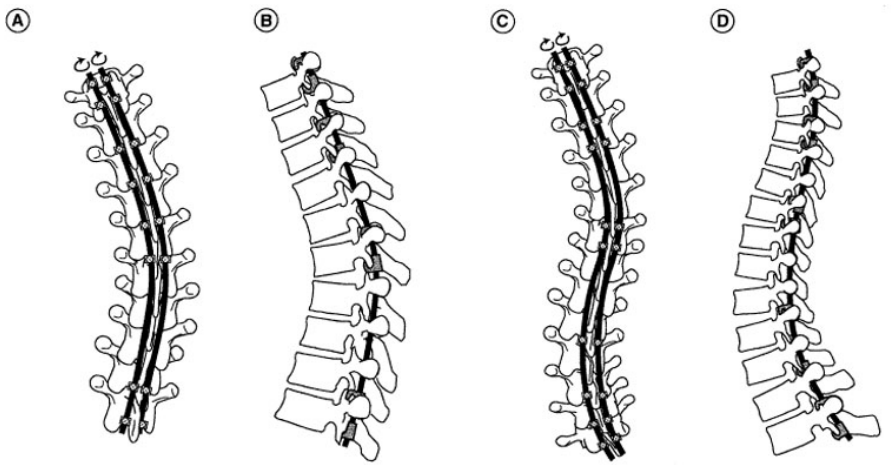
Pay attention to secondary effects (kyphosis, foraminal narrowing)



Rod (de)rotation

Basically a translational maneuver

Converting coronal deformity to sagittal plane



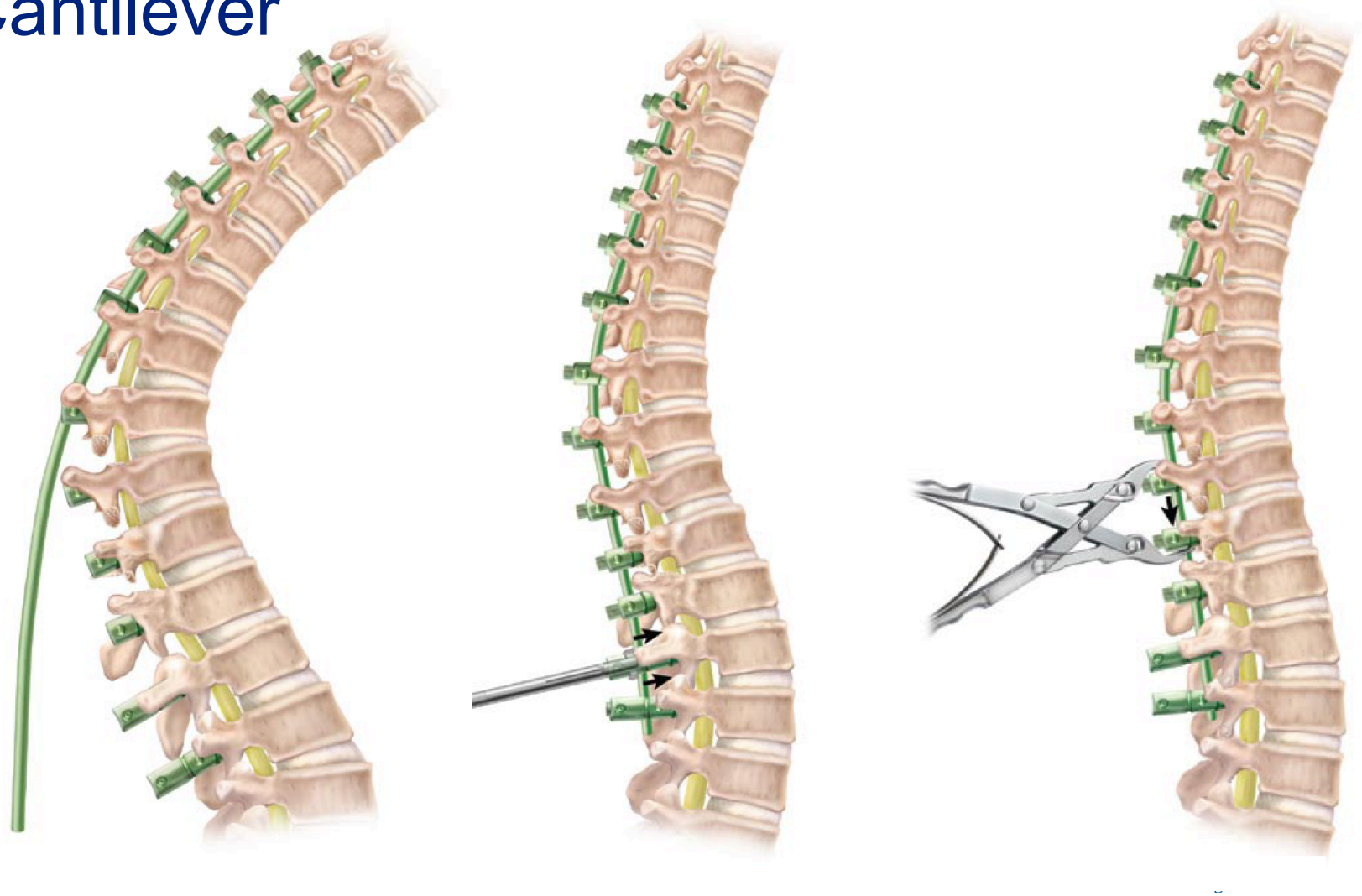
Coronal bending

Translation of apex

Useful for “fine tuning” of correction

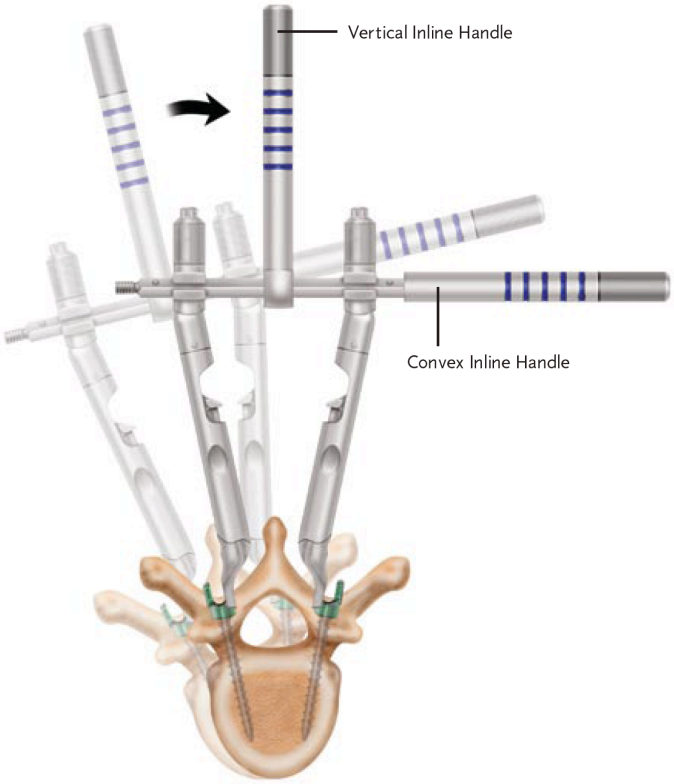
Proceed slowly- significant stress on fixation

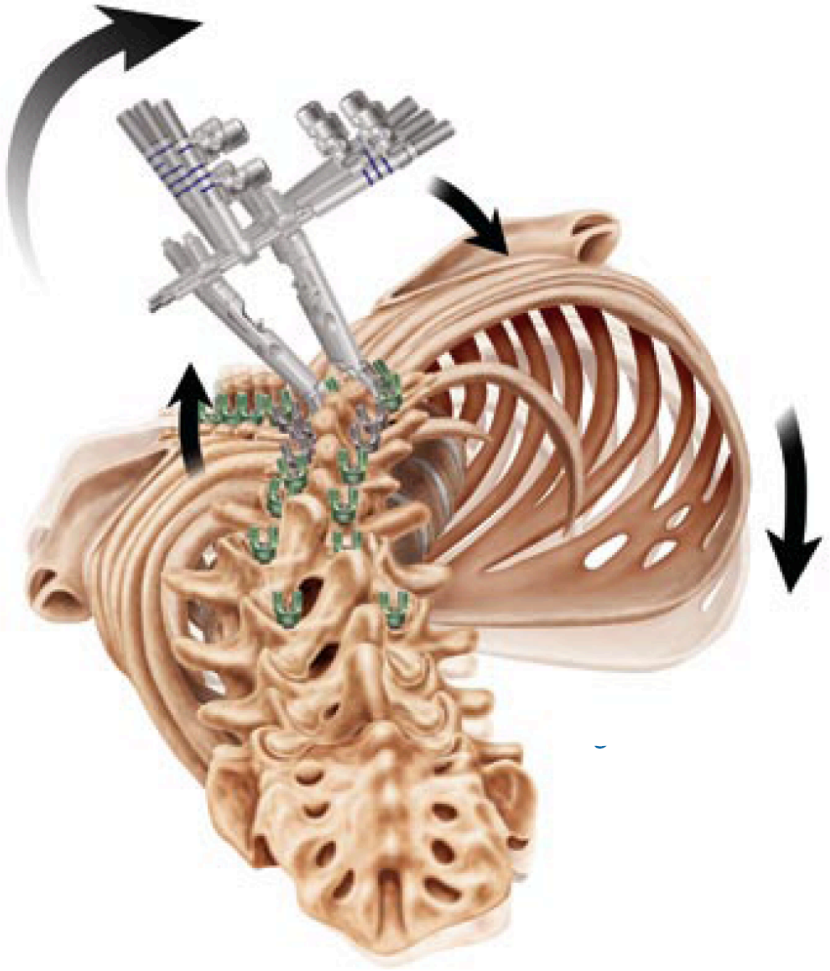
Cantilever

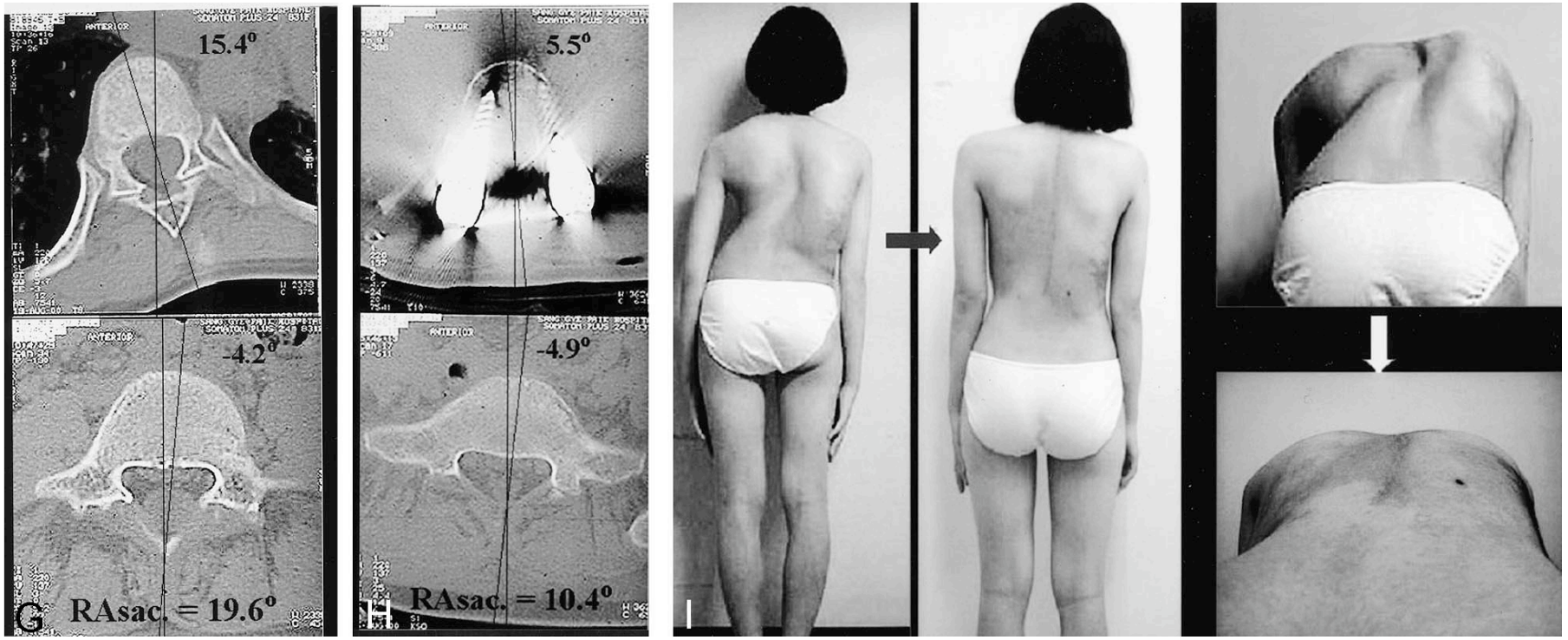


Vertebral derotation

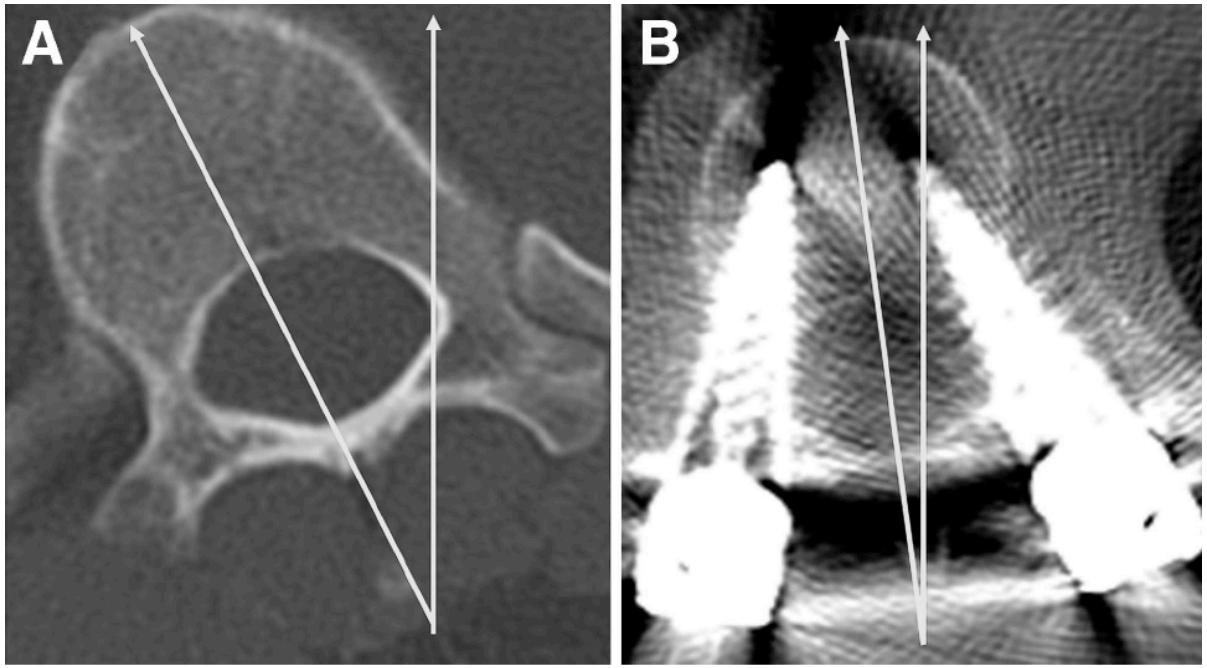
Why derotate?


Vertical Inline Handle
Convex Inline Handle

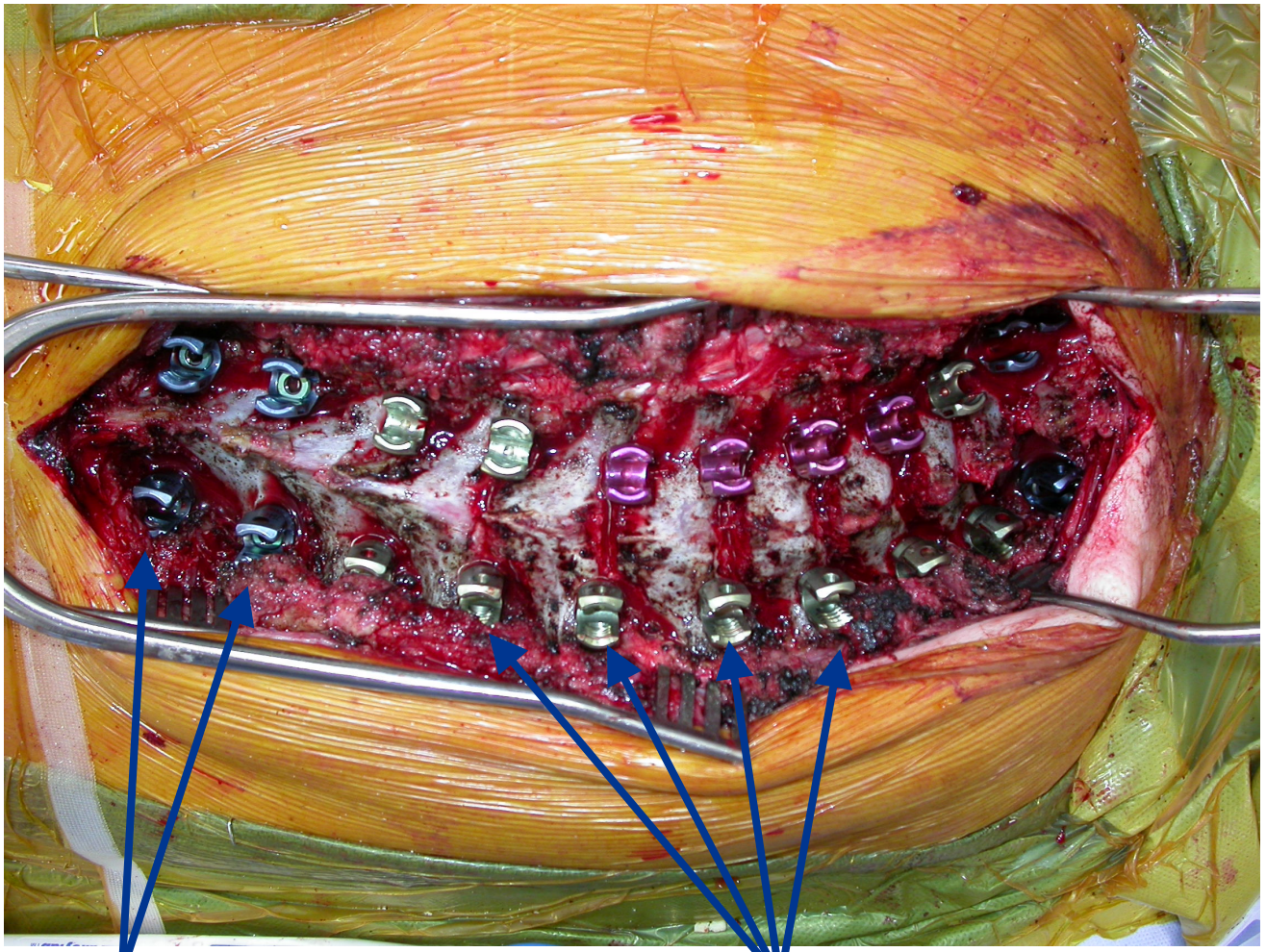




Lee S-M, Suk S-I, Chung E-R: Direct vertebral rotation: a new technique of three-dimensional deformity correction with segmental pedicle screw fixation in adolescent idiopathic scoliosis. **Spine** 29:343-349, 2004.

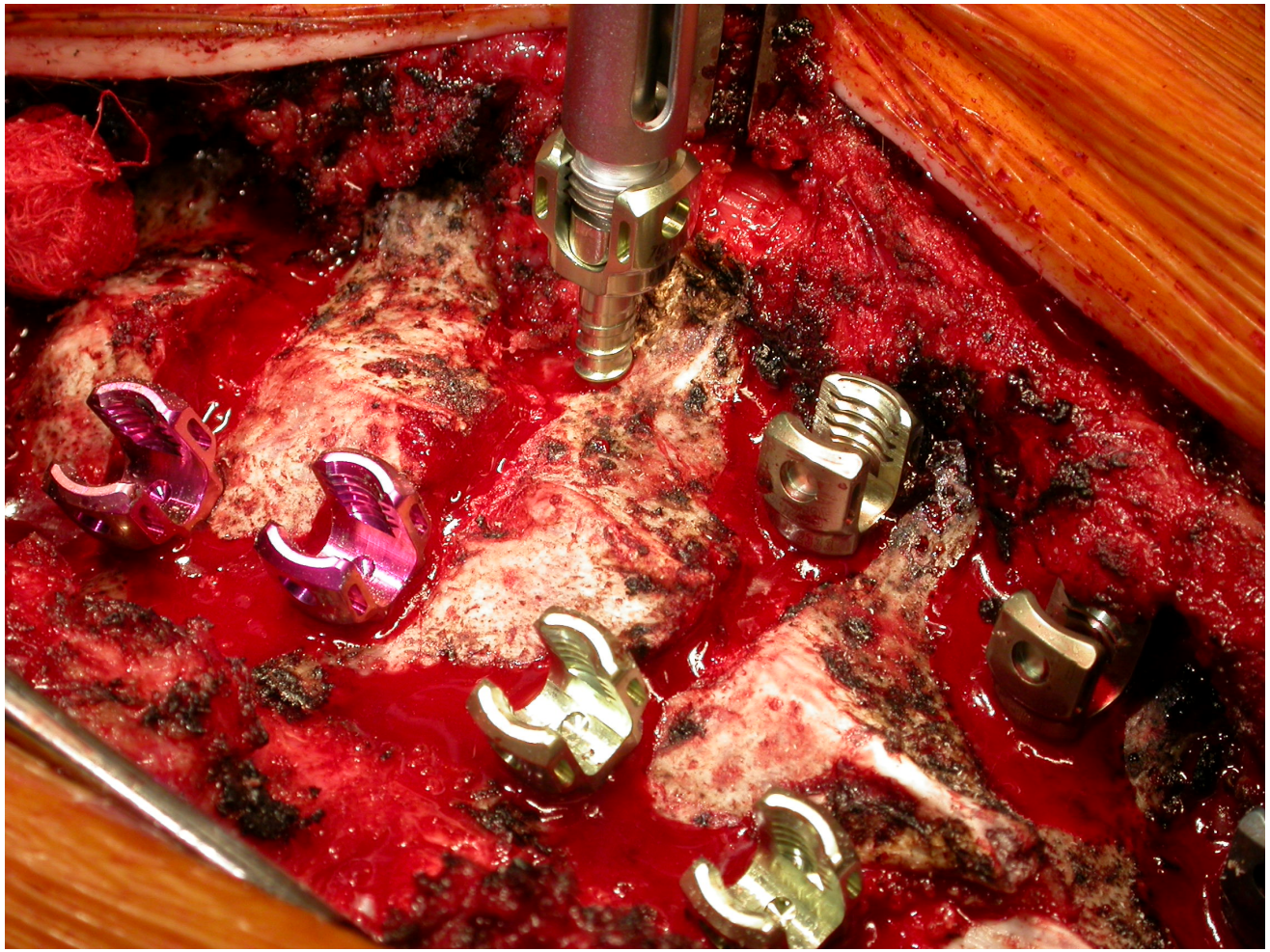


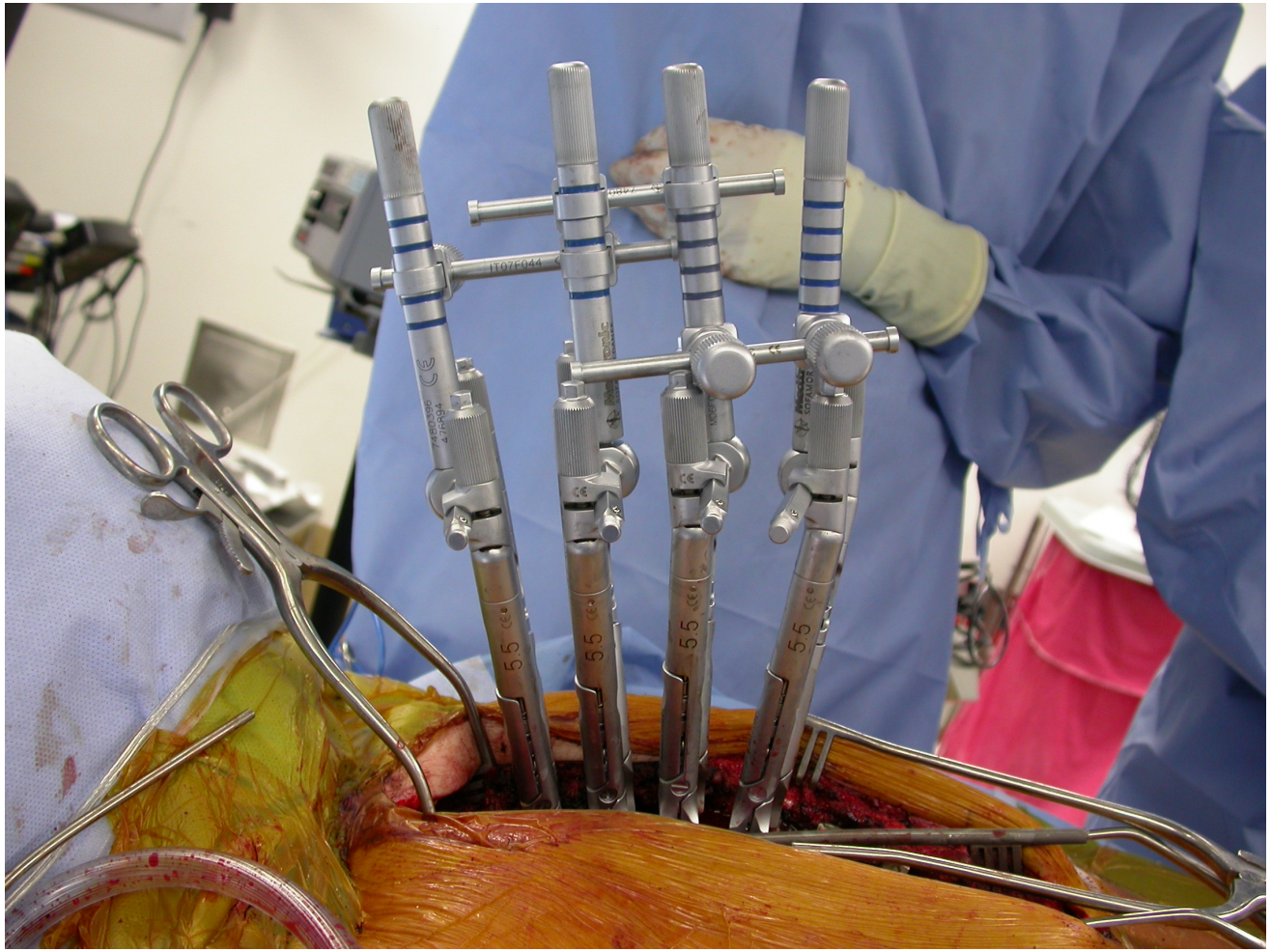
Ashgar J, Samdani AF, Pahys JM, D'Andrea LP, Guille JT, Clements DH, Betz RR: Computed tomography evaluation of rotation correction in adolescent idiopathic scoliosis. A comparison of an all pedicle screw construct *versus* a hook-rod system. **Spine** 34:804-807, 2009.

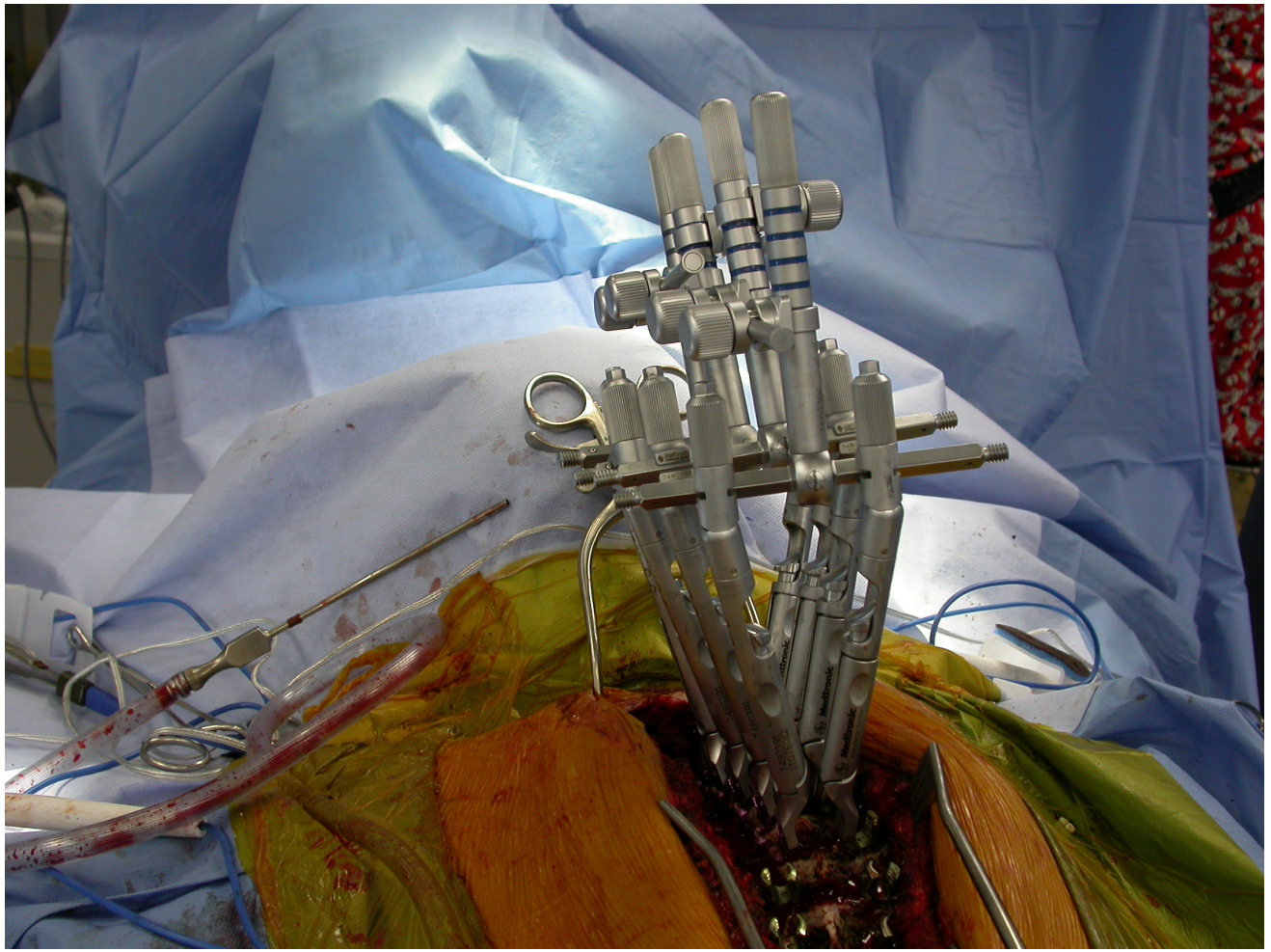


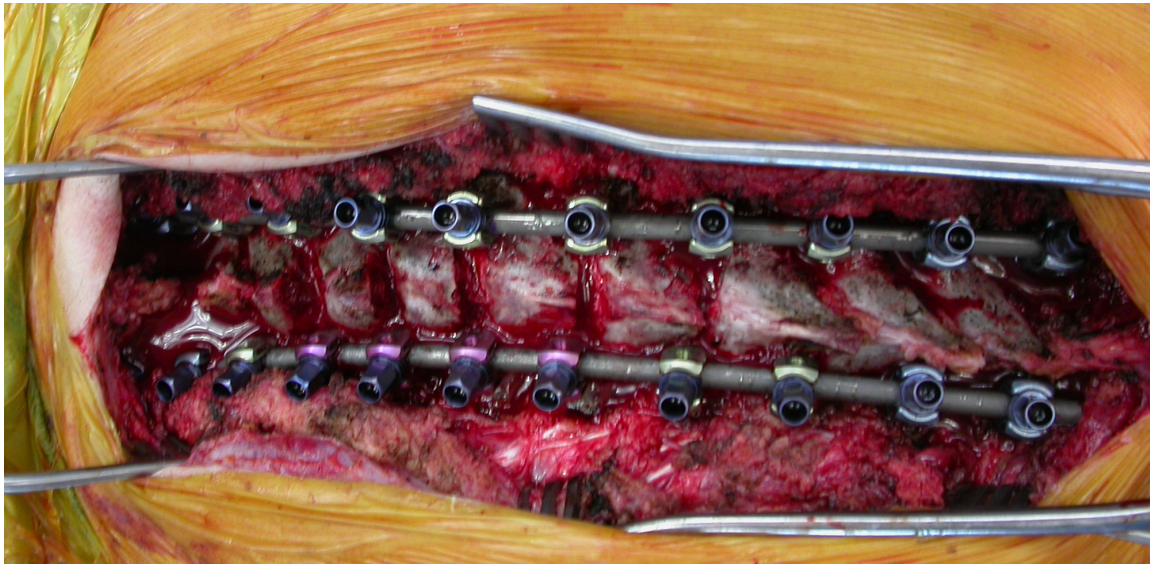
Multiaxial screws

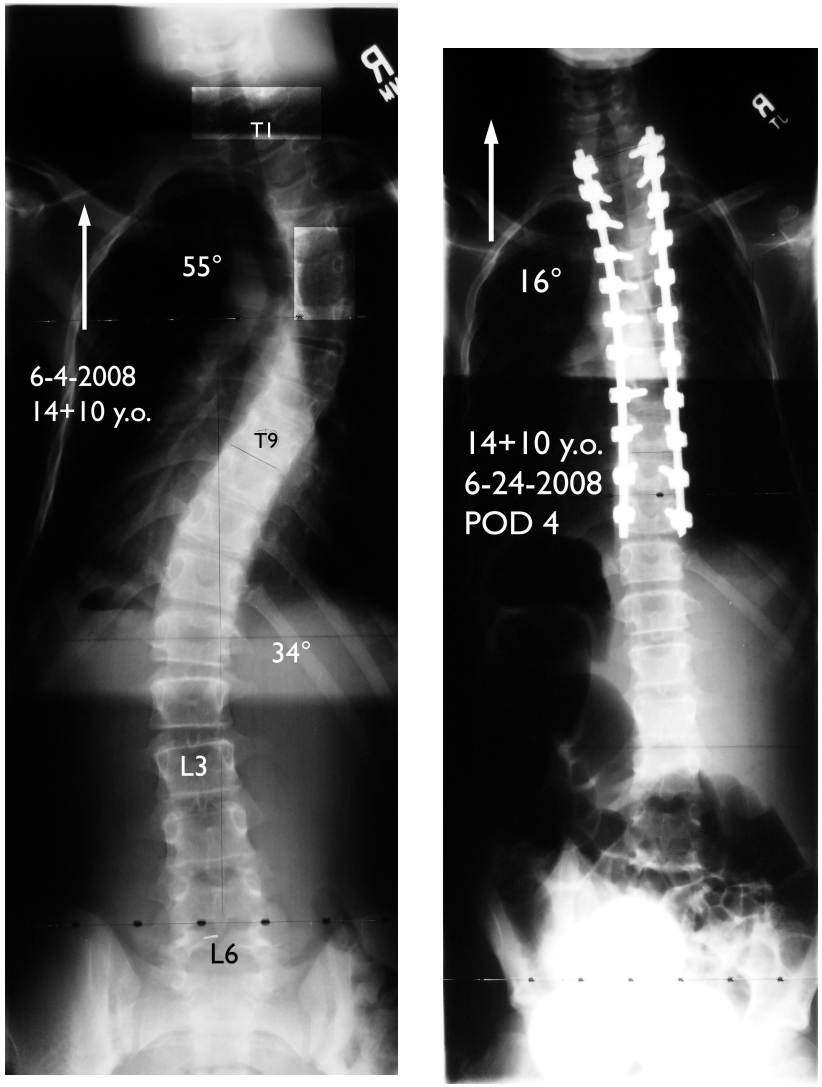
Fixed screws

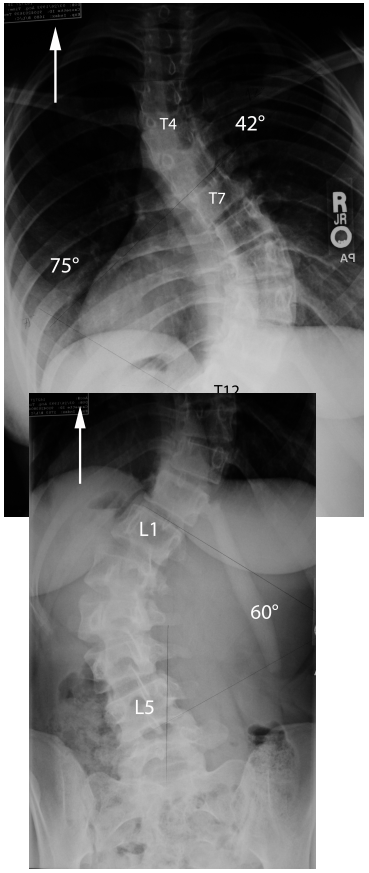


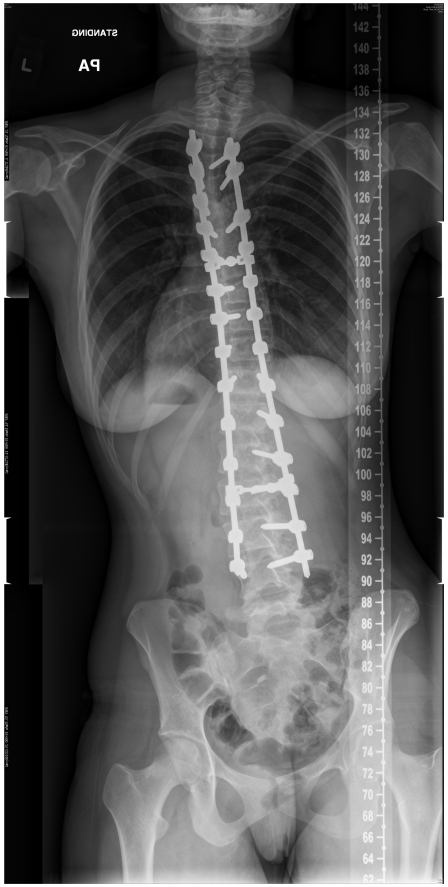

5.5
5.5
5.5
5.5






T1
55°
6-4-2008
14+10 y.o.
T9
34°
L3
L6
16°
14+10 y.o.
6-24-2008
POD 4


T4
42°
T7
75°
T12
L1
60°
L5


STANDING
PA

Conclusion

1. Scoliosis is a 3-dimensional deformity
2. A thorough understanding of a deformity's flexibility is essential to selecting appropriate curve correction technique(s)
3. Passive curve correction is powerful and (usually) safe
4. Curve flexibility may be enhanced by resecting ligament, facet, or bone
5. Secondary effects of active correction must be understood and anticipated

Advanced correction topics

1. How to get the rod to fit
2. Effects of main curve correction on shoulder tilt
3. How to select correcting rod (concave or convex)
4. How to close osteotomies
5. How to level pelvis

Thank you