Deformity Surgery

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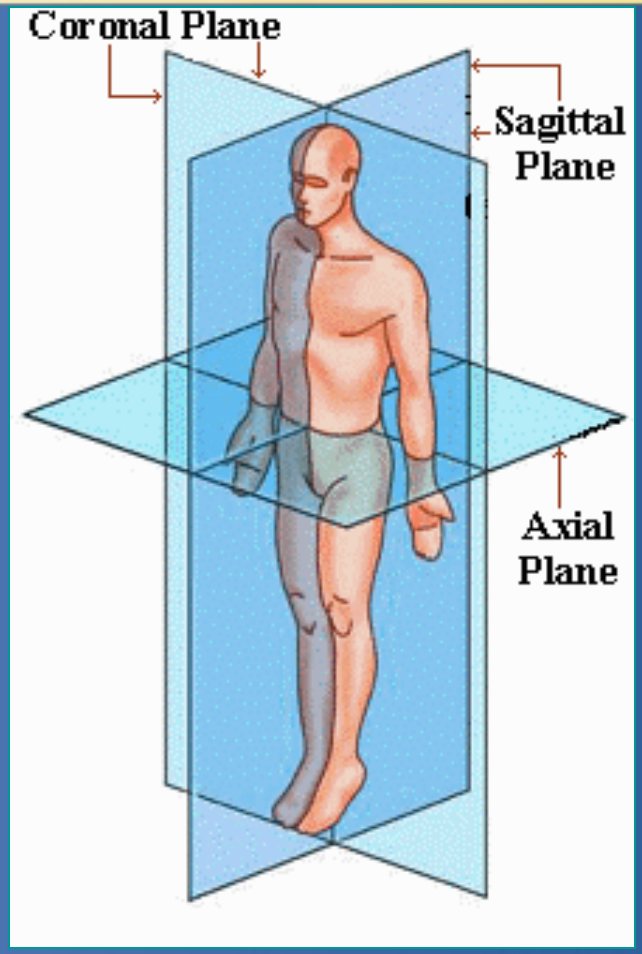
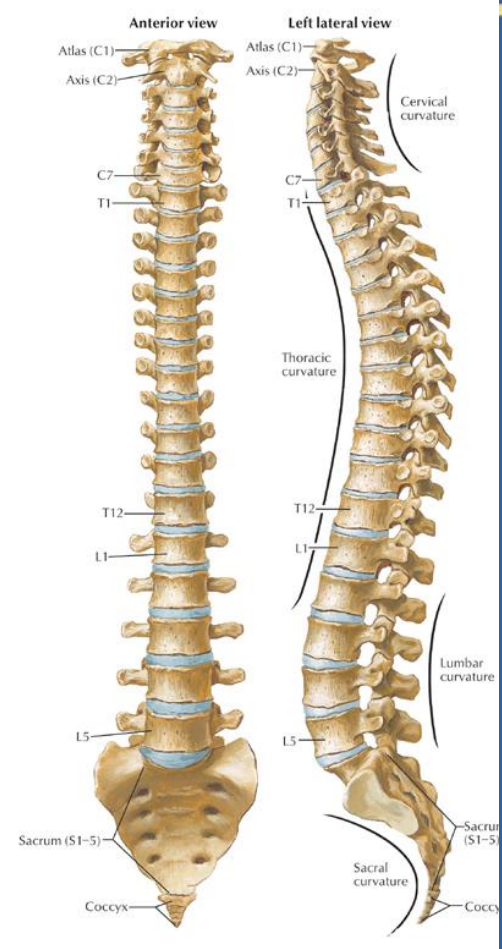
"Normal" Adult Posture



- Desired Posture:
  - Head over
  - Shoulders over
  - Pelvis over
  - Feet

"Normal" Adult Posture



- Cervical Lordosis 30^{o} – 40^{o}
- Thoracic Kyphosis 10^{o} – 40°
- Lumbar Lordosis 30^{o} – 60^{o}
- Lumbo-Sacral Lordosis 35^{o} – 60^{o}
- Pelvic Incidence 40^{o} - 60^{o}

Definitions of Normal

JOHNS HOPKINS MEDICINE

Normal sagittal alignment

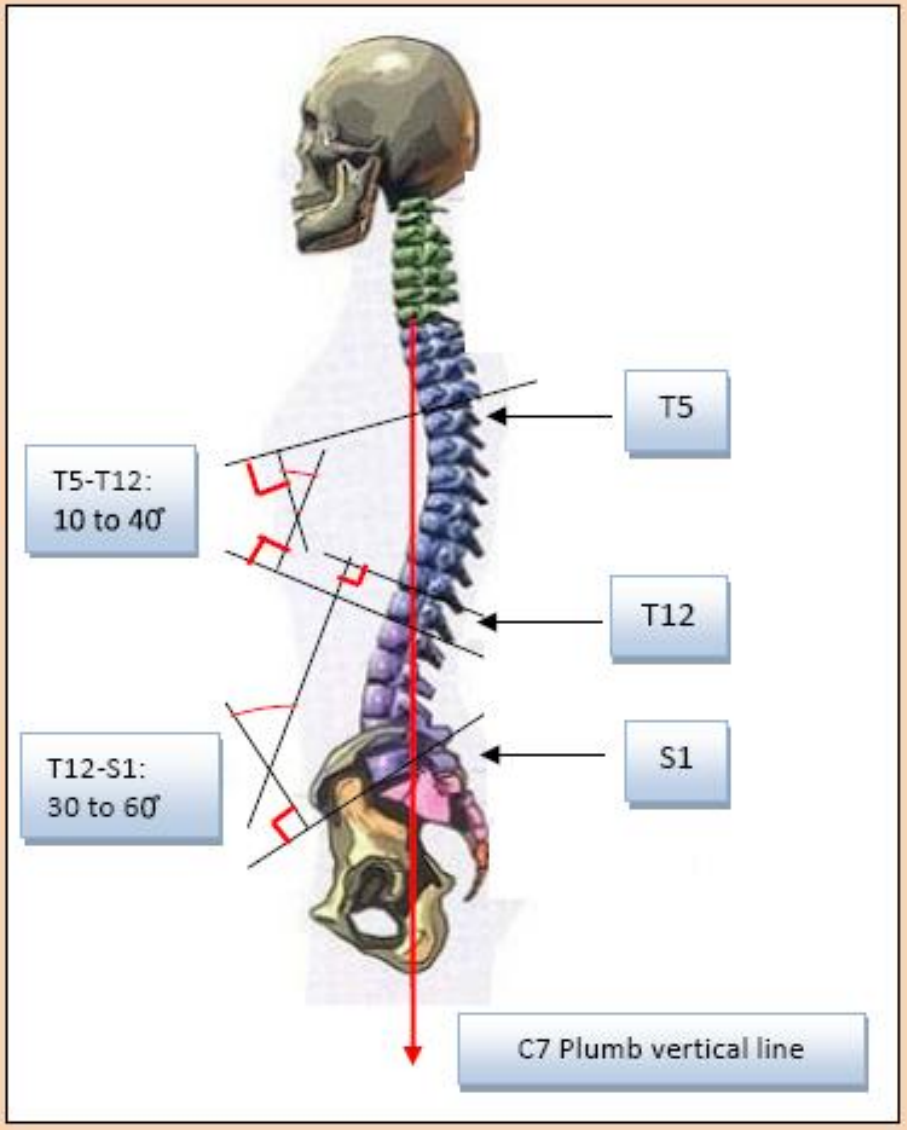
Thoracic kyphosis (T5-T12): 10 to 40°

Lumbar lordosis (L1-S1): 30 to 60°

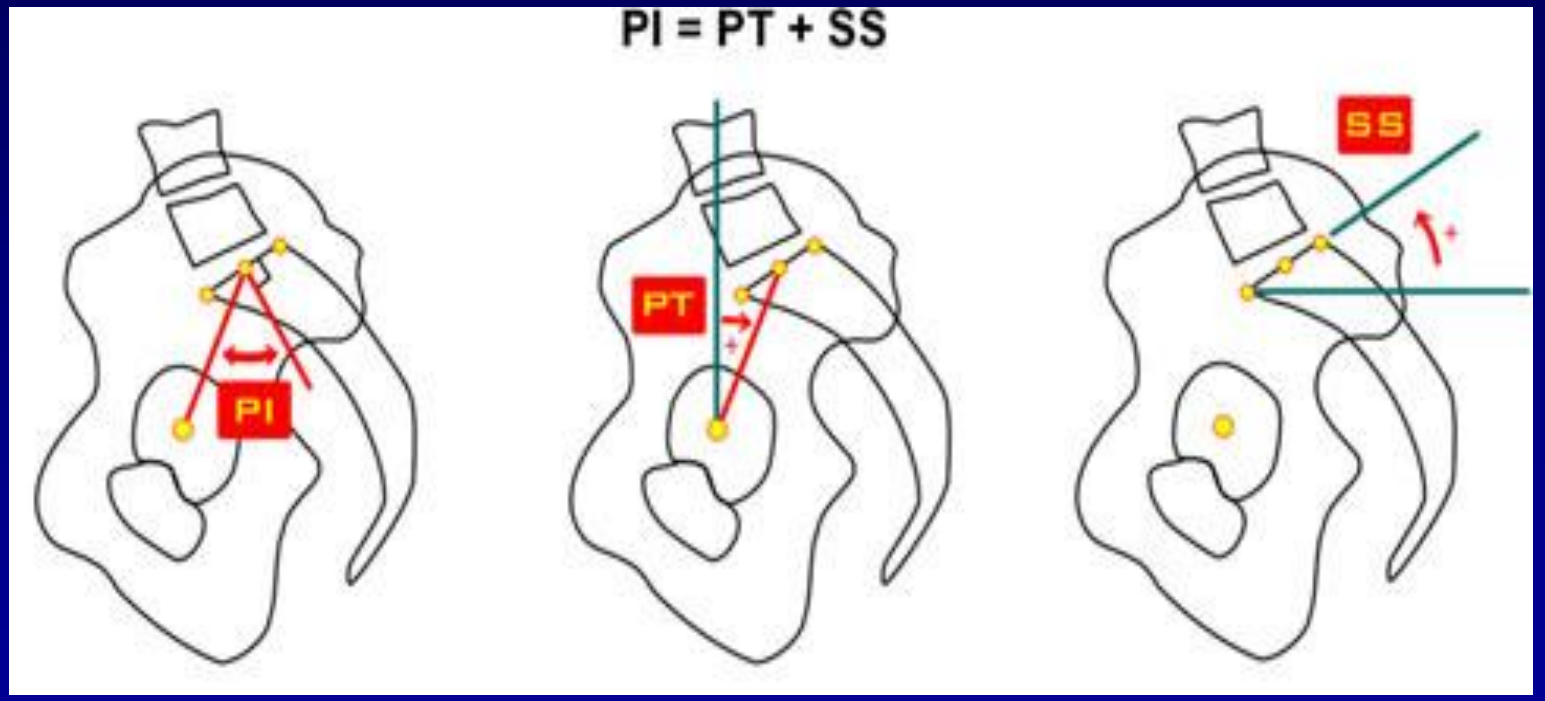
A Plumb line dropped from the center of C7 vertebral body (C7PL) should pass within 2mm of the posterior-superior S1 endplate.

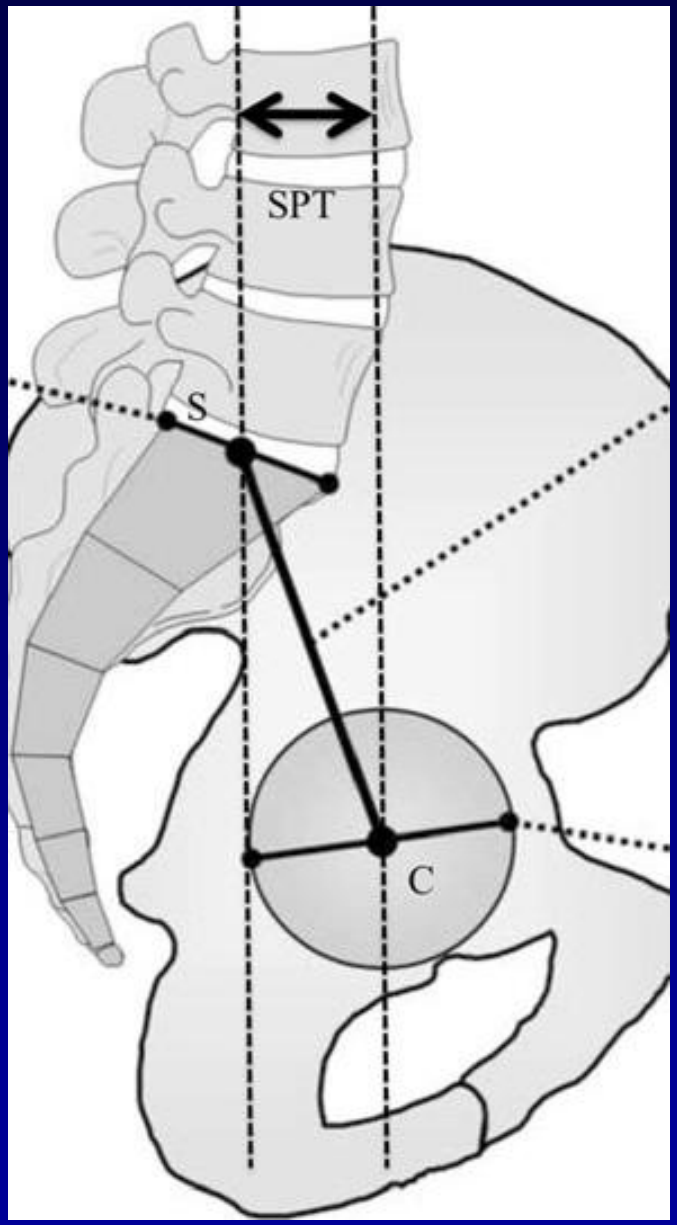
C7PL posterior more than 2mm = Negative balance

C7PL anterior more than 2mm = Positive balance



PELVIC PARAMETERS

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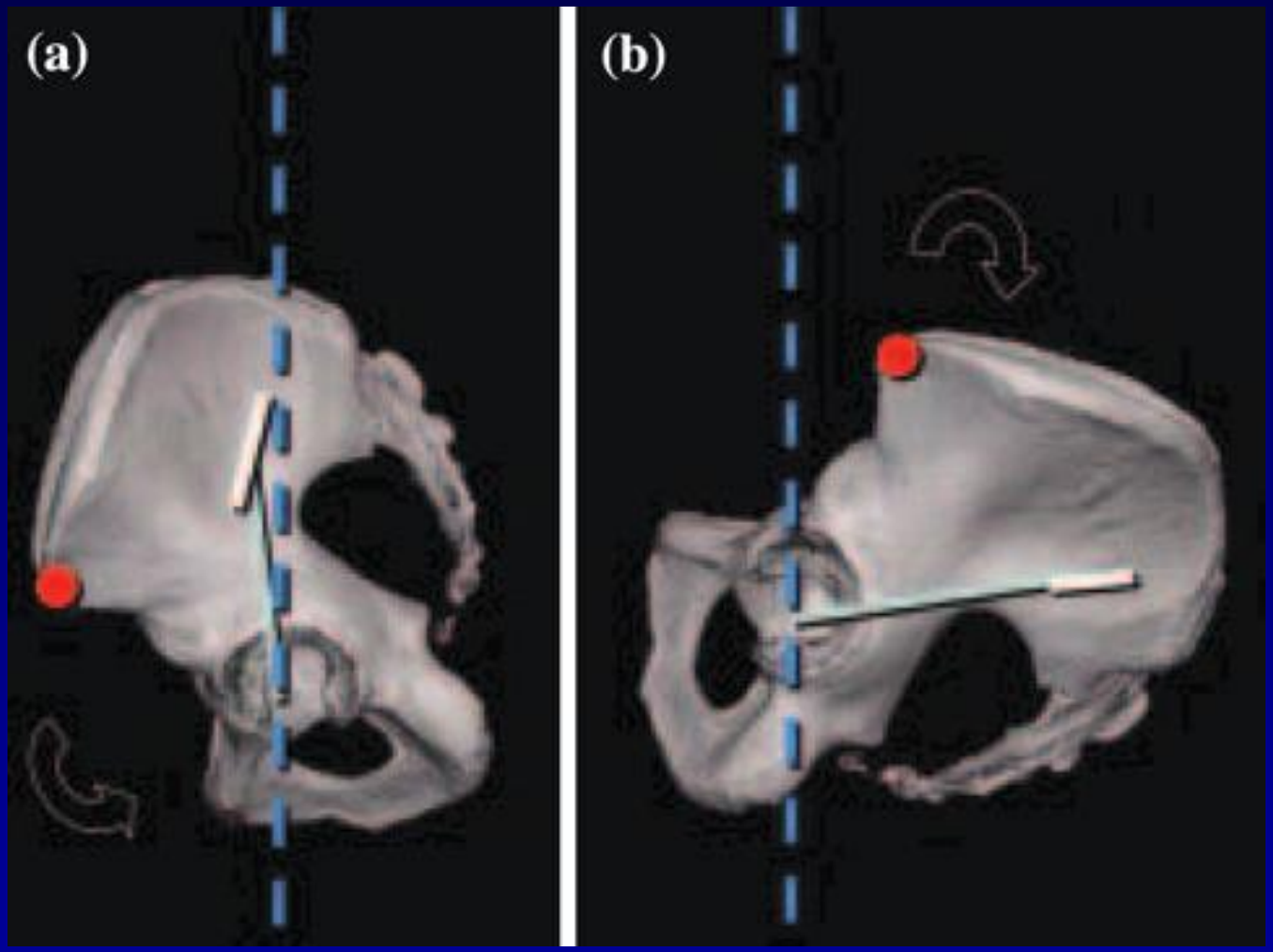
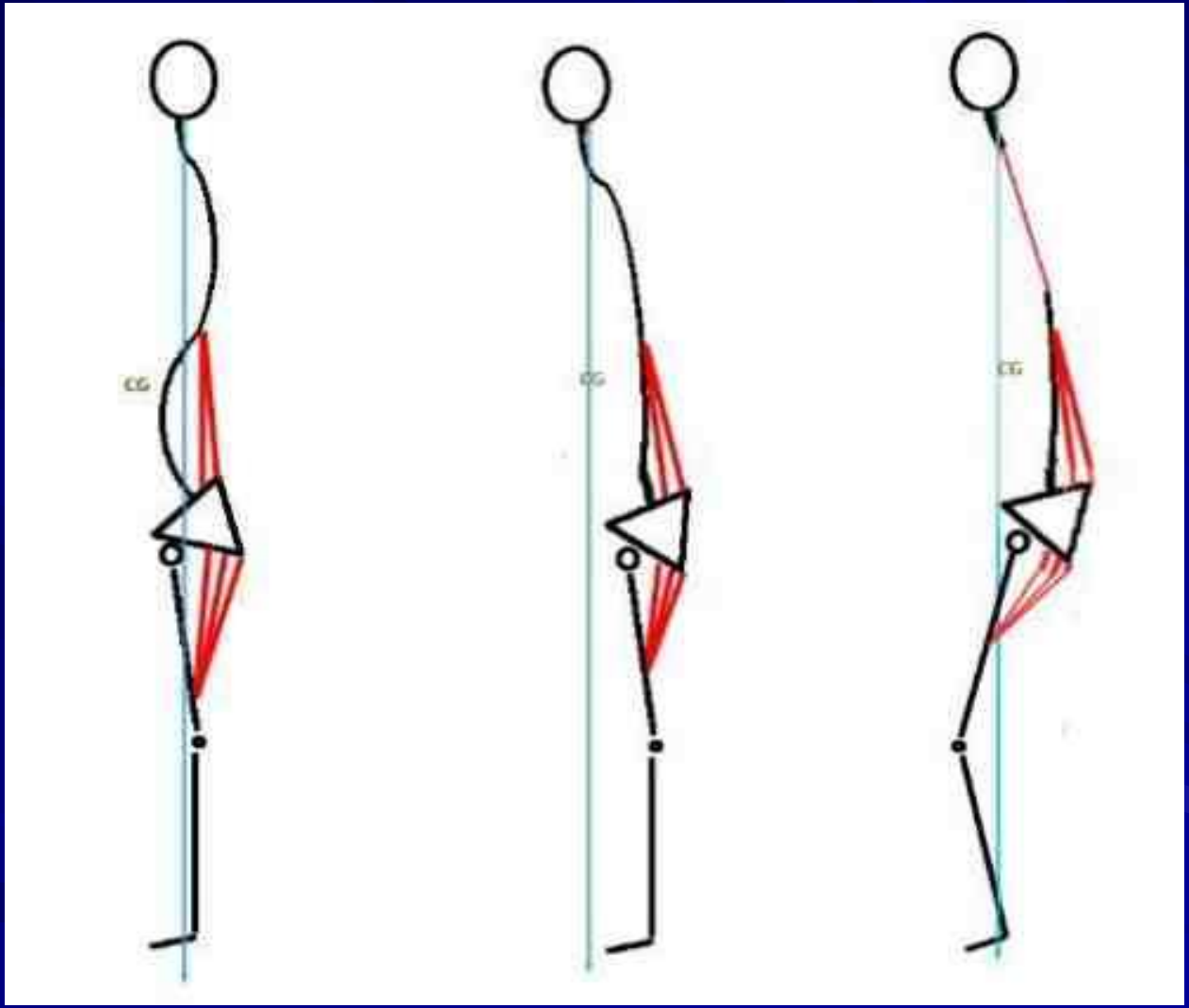

(a)
(b)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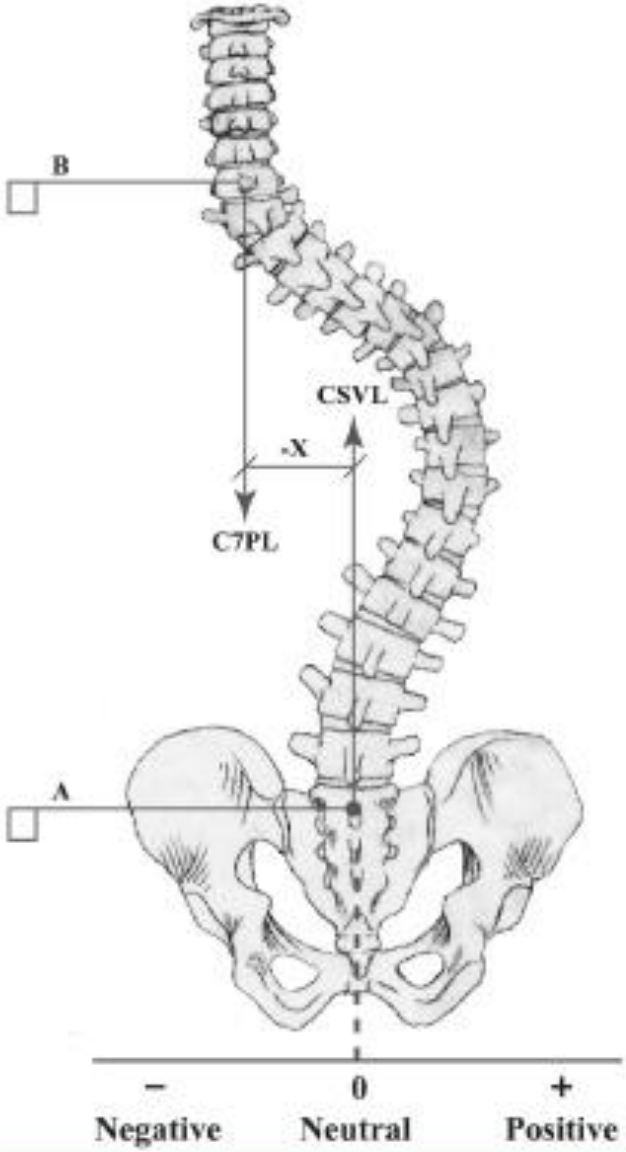


FIGURE 6. *Coronal alignment is measured as the horizontal displacement of the centroid of C7 relative to the* CSVL. C7PL, *C7 plumb line* (courtesy of Medtronic Sofamor Danek USA, Inc., Memphis, TN).

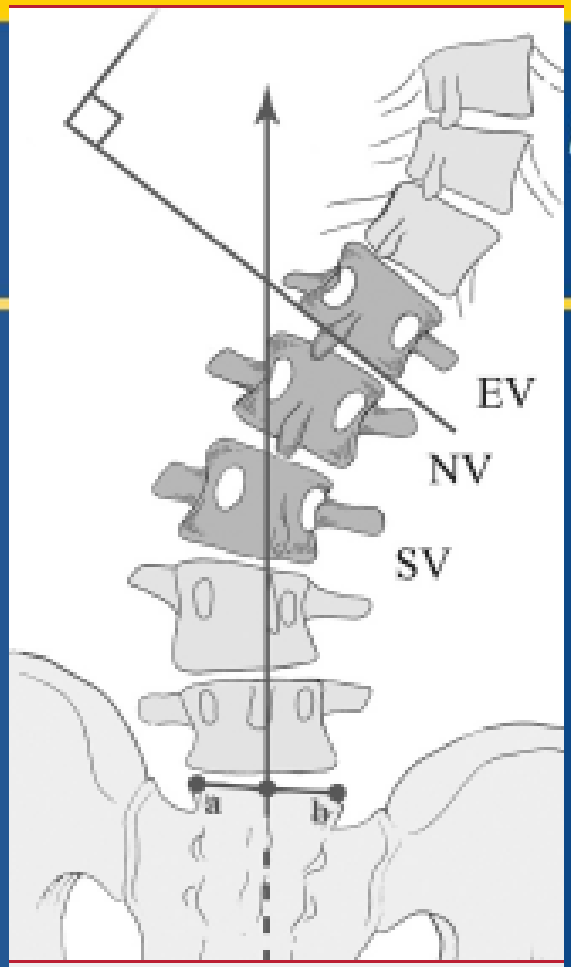


FIGURE 4. *End* (EV), *neutral* (NV), *and stable vertebrae* (SV) *of a deformity. The end vertebra is maximally tilted into the curve. The neutral vertebra is minimally rotated. The stable vertebra is bisected by the center sacral vertical line* (vertical line with arrow).

JOHNS HOPKINS MEDICINE

Basic Definitions

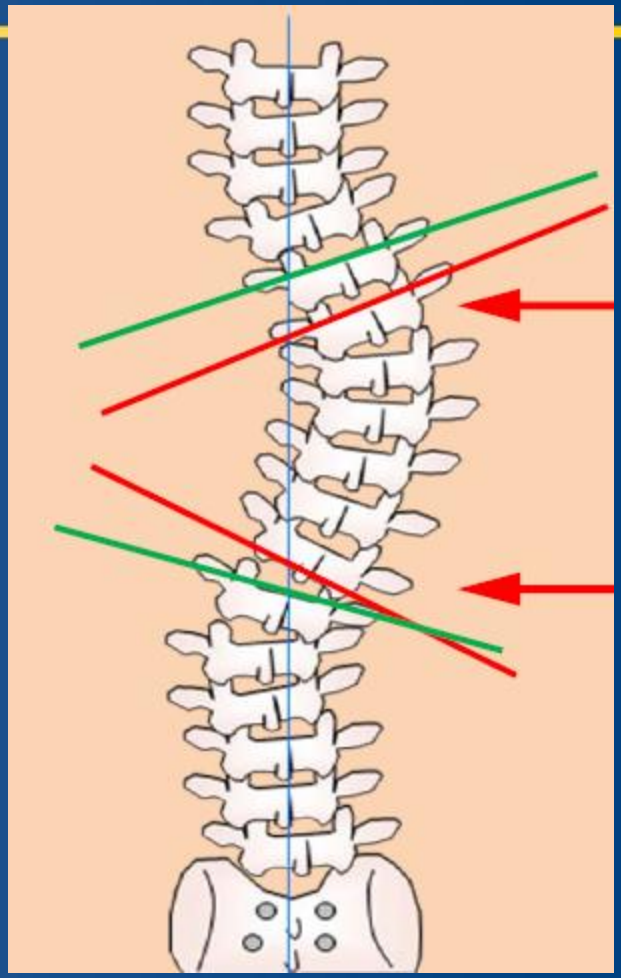
JOHNS HOPKINS MEDICINE

Cobb angle - determined between the most tilted vertebrae

Neutral vertebrae - Segments without axial rotation

Stable vertebrae – Segments bisected most closely by the central sacral line

End vertebrae - the two bodies at the end of the curve, most tiled inward towards the concavity

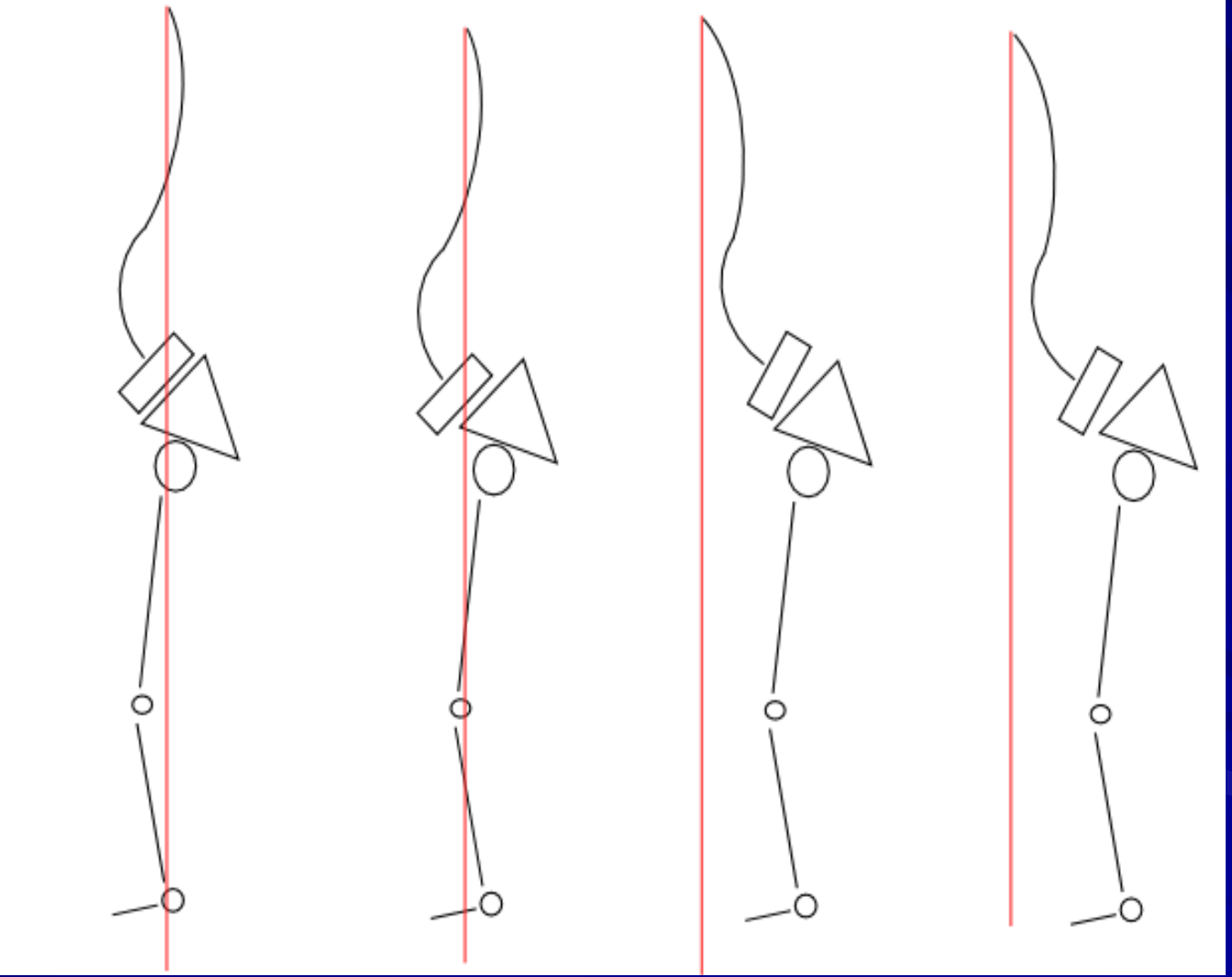


Normal Sagittal Alignment

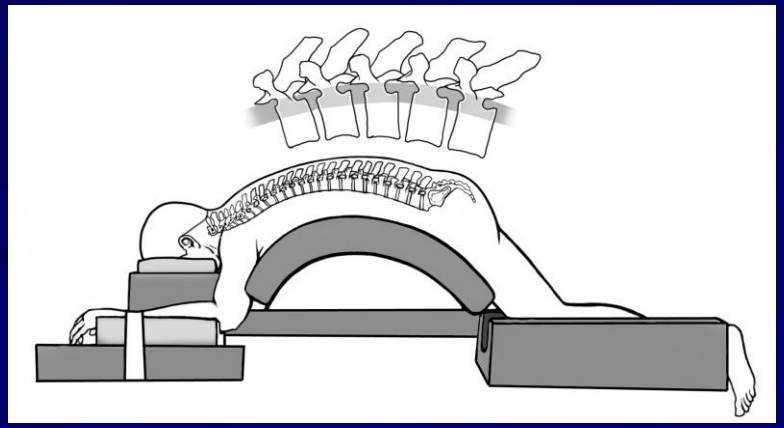
- Ravishankar, V et al, Spine 23; 1998
- Gelb, D et al, Spine 20; 1995
- Jackson, RP, Spine 19; 1994
- Bernhardt, M, Spine 14; 1989
- Stagnara, PS, Spine 7; 1982

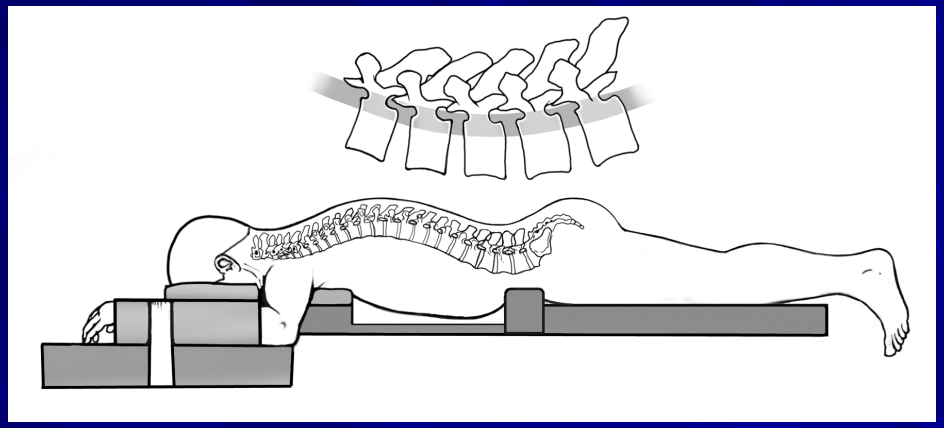
From D. Gelb

The effect of sagittal translation and rotation on sagittal vertical axis



Iatrogenic Flat Back Deformity





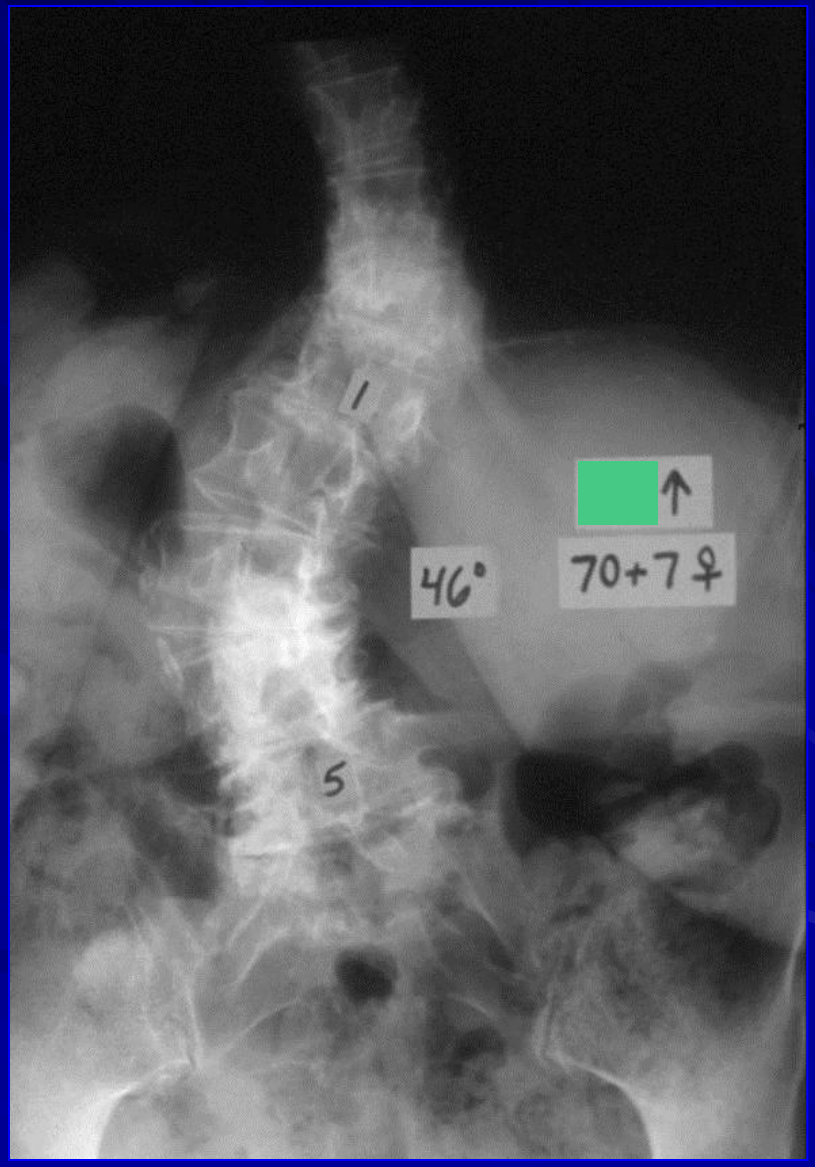
- Lumbar Flexion on the Wilson Frame
  - (+) Assists Decompression
  - (-) Places Sagittal Vertebral Axis (SVA) Anterior to L/S Jct
    - **FLAT BACK !!!**

Adult Deformity What is it?

Types

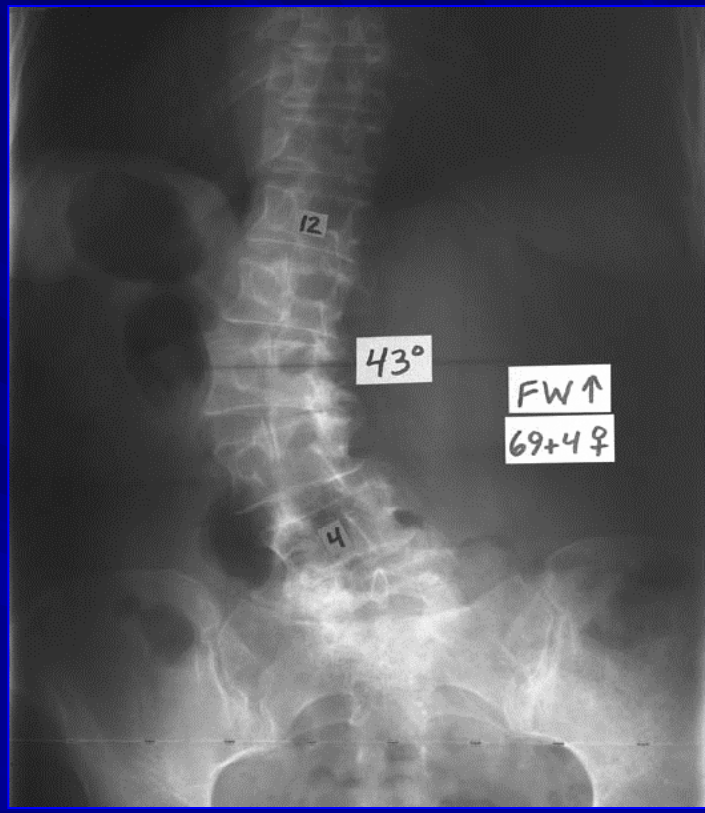
- AIS
- De novo – Degenerative Scoli
- Iatrogenic
- Traumatic

- Curve is mid-lumbar spine (L2-L3)
- Fractional lumbosacral curve present (L4-SAC)
- “rotatory subluxation” of adjacent vertebrae
- Sagittal plane variable but often hypolordotic/kyphotic



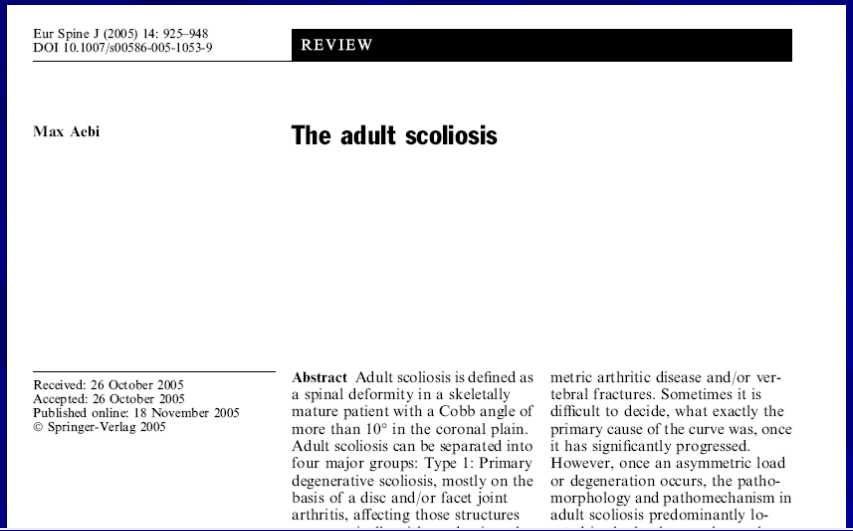
Patient Complaints

- Pain: % axial back vs. % L.E.
- Neurogenic claudication
- Imbalance - coronal and/or sagittal
- Limited exercise/activity tolerance
- Cosmetic concerns



Aebi Classification

- Targeted at Adult deformities
- Classification based upon pathology



Eur Spine J (2005) 14: 925–948
DOI 10.1007/s00586-005-1053-9

REVIEW

Max Aebi

The adult scoliosis

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Accepted: 26 October 2005
Published online: 18 November 2005

Abstract Adult scoliosis is defined as a spinal deformity in a skeletally mature patient with a Cobb angle of more than 10° in the coronal plain. Adult scoliosis can be separated into four major groups: Type 1: Primary degenerative scoliosis, mostly on the basis of a disc and/or facet joint arthritis, affecting those structures

metric arthritic disease and/or vertebral fractures. Sometimes it is difficult to decide, what exactly the primary cause of the curve was, once it has significantly progressed. However, once an asymmetric load or degeneration occurs, the pathomorphology and pathomechanism in adult scoliosis predominantly lo-

TABLE 2. Aebi adult deformity classification

Type	Description	Cause
I	Primary degenerative scoliosis; Most commonly has curve apex L2–3 or L4	Disc degeneration (asymmetric); Facet joint degeneration
II	Idiopathic scoliosis that has progressed; Lumbar and/or thoracolumbar	Progression of idiopathic scoliosis (present since childhood) caused by degenerative disease and/or mechanical/bony reasons
IIIa	Secondary adult scoliosis; Typically thoracolumbar or lumbar-lumbosacral	Secondary to an adjacent curve of idiopathic, neuromuscular or congenital origin; Obliquity of pelvis caused by leg length discrepancy or hip abnormality; Lumbosacral transitional anomaly
IIIb	Deformity resulting from bone weakness (e.g., osteoporotic fracture)	Metabolic bone disease, osteoporosis

Schwab Classification

- Targeted at Adult deformities
- Classification based upon clinical outcomes
- Database of 947 patients assessed clinically and radiographically

SPINE Volume 31, Number 18, pp 2109–2114

A Clinical Impact Classification of Scoliosis in the Adult

Frank Schwab, MD,* Jean-Pierre Farcy, MD,* Keith Bridwell, MD,† Sigurd Berven, MD,‡ Steven Glassman, MD,§ John Harrast, MS,|| and William Horton, MD¶

Study Design. Multicenter, prospective, consecutive clinical series.

Objectives. To establish and validate classification of scoliosis in the adult.

Summary of Background Data. Studies of adult scoliosis reveal the impact of radiographic parameters on self-assessed function: lumbar lordosis and frontal plane obliquity of lumbar vertebrae, not Cobb angle, correlate with pain scores. Deformity apex and intervertebral subluxations correlate with disability.

Methods. A total of 947 adults with spinal deformity had radiographic analysis: frontal Cobb angle, deformity apex, lumbar lordosis, and intervertebral subluxation. Health assessment included Oswestry Disability Index and Scoliosis Research Society instrument. Deformity apex, lordosis (T12–S1), and intervertebral subluxation were used to classify patients. Outcomes measures and surgical rates were evaluated.

Results. Mean maximal coronal Cobb was 46° and lumbar lordosis 46°. Mean maximal intervertebral subluxation (frontal plane) was 4.2 mm (sagittal plane, 1.2 mm). In thoracolumbar/lumbar deformities, the loss of lordosis/higher subluxation was associated with lower Scoliosis Research Society pain/function and higher Oswestry Disability Index scores. Across the study group, lower apex combined with lower lordosis led to higher disability. Higher surgical rates with decreasing lumbar lordosis and higher intervertebral subluxation were detected.

Conclusions. A clinical impact classification has been established based on radiographic markers of disability. The classification has shown correlation with self-reported disability as well as rates of operative treatment.

Key words: scoliosis, adult, classification, clinical outcomes. **Spine 2006;31:2109–2114**

scoliotic deformities, there are no accepted classification systems, and a transposition of pediatric/adolescent classification systems is not feasible. In adults, the clinical impact of the deformity and the treatment approaches are not related to skeletal age and rarely to projected progression, but rather to pain and disability. The lack of a classification in the adult deformity population has limited the study of prognostic markers and progress in establishing treatment algorithms.

Although the prevalence of scoliosis in the adult population has been reported as ranging from 2% to 32%, a recent study targeting elderly volunteers showed a prevalence of more than 60%.[3–8] With an increasingly aging population in the United States and increased attention to quality of life issues, adult scoliosis is becoming a considerable health care concern. Aside from the esthetic considerations of scoliosis in the adult, significant pain and disability can develop.[9]

A number of investigators have examined the impact of radiographic parameters on self-assessed function (outcomes instruments) in the setting of scoliosis in the adult.[10] In one recent study, the loss of lumbar lordosis and obliquity of lumbar vertebrae, but not Cobb angle, on a coronal radiograph were significantly correlated with pain scores. Other investigations have shown global imbalance, apical level of a scoliotic deformity, and intervertebral subluxation to be significantly related to outcomes scores.[10–12]

The purpose of this study was to create, and validate, a classification of scoliosis in the adult. The approach was based on a number of previously established clinically sig-

Schwab Classification

Introduced emphasis on different principles:

- Importance of lumbar segments
- Loss of lordosis and sagittal balance
- Segmental subluxation in either plane

TABLE 3. Schwab adult deformity classification

Classification	Radiographic criteria
Type	
I	Thoracic-only curve (no other curves)
II	Upper thoracic major, apex T4–T8
III	Lower thoracic major, apex T9–T10
IV	Thoracolumbar major curve, apex T11–L1
V	Lumbar major curve, apex L2–L4
Lumbar lordosis modifier	
A	Marked lordosis (>40 degrees)
B	Moderate lordosis (0–40 degrees)
C	No lordosis present (Cobb > 0 degrees)
Subluxation modifier	
0	No intervertebral subluxation any level
+	Maximal measured subluxation 1–6 mm
++	Maximal subluxation > 7 mm

SRS Classification

- Targeted at Adult deformities
- Attempts to capture all the major radiographic features of the deformity

SPINE Volume 31, Number 19 Suppl, pp S119–S125

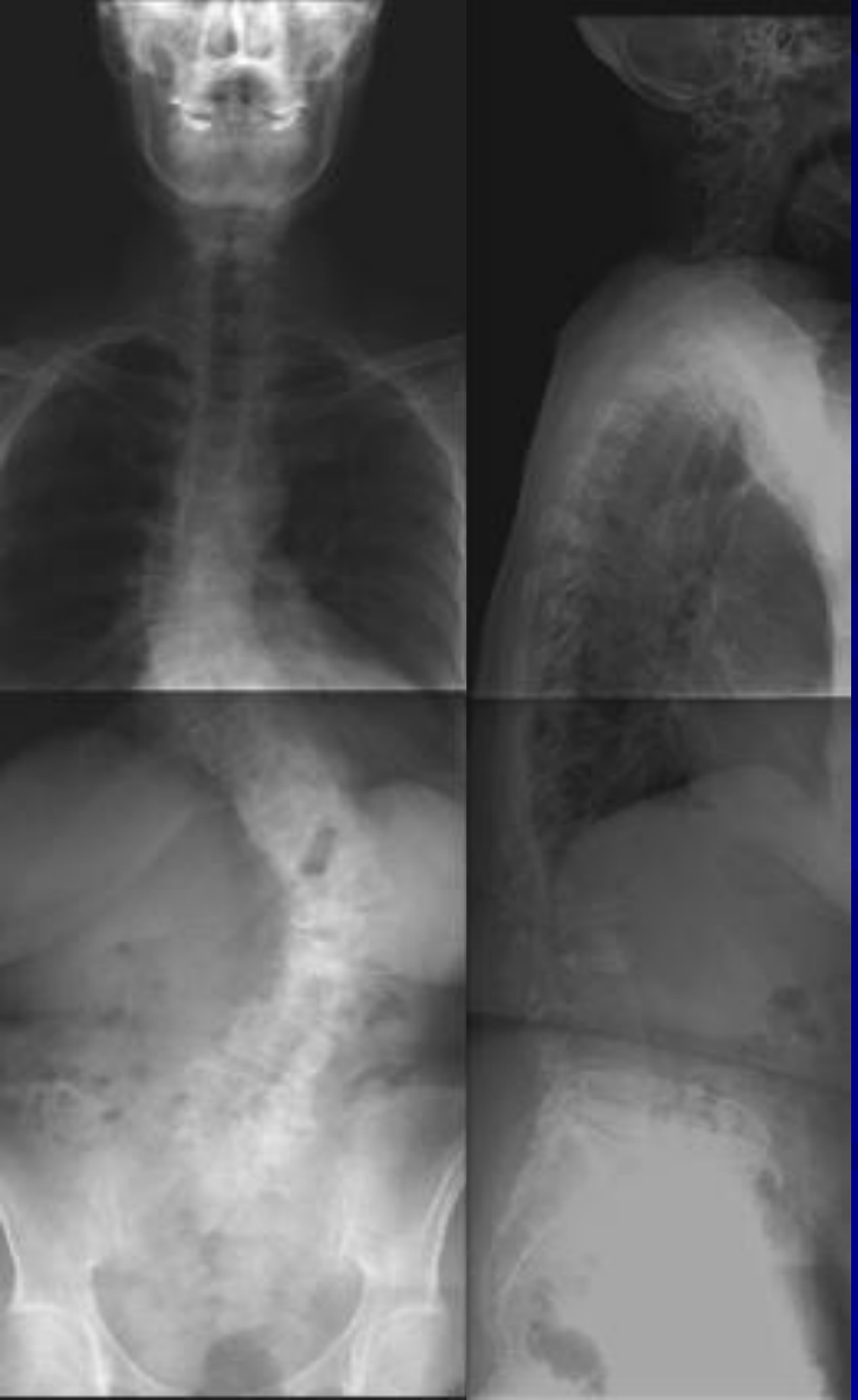
The SRS Classification for Adult Spinal Deformity

Building on the King/Moe and Lenke Classification Systems

Thomas Lowe, MD,* Sigurd H. Berven, MD,† Frank J. Schwab, MD,‡ and Keith H. Bridwell, MD§

TABLE 4. Scoliosis Research Society adult deformity classification[a]

Primary curve types
Single thoracic (ST)
Double thoracic (DT)
Double major (DM)
Triple major (TM)
Thoracolumbar (TL)
Lumbar "de novo"/idiopathic (L)
Primary sagittal plane deformity (SP)
Adult spinal deformity modifiers: regional sagittal modifier (include only if outside normal ranges as listed)
Proximal thoracic (T2–T5): ≥ +20 degrees (PT)
Main thoracic (T5–T12): ≥ +50 degrees (MT)
Thoracolumbar (T10–L2): ≥ +20 degrees (TL)
Lumbar (T12–S1): ≥ –40 degrees (L)
Lumbar degenerative modifier (include only if present)
Decreased disc height and facet arthropathy based on x-ray: include lowest involved level between L1 and S1 (DDD)
Listhesis (rotational, lateral antero, retro) ≥3 mm: include lowest level between L1 and L5 (LIS)
Junctional L5–S1 curve ≥10 degrees (intersection angle superior endplates L5 and S1) (JCT)
Global balance modifier (include only if imbalance present)
Sagittal C7 plumb ≥ 5 cm anterior or posterior to sacral promontory (SB)
Coronal C7 plumb ≥ 3 cm right or left of CSVL (CB)
SRS definition of regions
Thoracic: apex T2–T11–T12 disc
Thoracolumbar: apex T12–L1
Lumbar: apex L1–L2 disc–L4
Criteria for specific major curve types
Thoracic curves: 1) curve ≥ 40 degrees; 2) apical vertebral body lateral to C7 plumbline; 3) T1 rib or clavicle angle ≥ 10 degrees upper thoracic curves
Thoracolumbar and lumbar curves: 1) curve ≥ 30 degrees; 2) apical vertebral body lateral to CSVL
Primary sagittal plane deformity: no major coronal curve



- Aebi IIIa
- Schwab VB+
- SRS L+DDD(L1-S1)+LIS(LL2-5)+SB

Most recently

Spinal deformity: a new classification derived from neutral upright spinal alignment measurements in asymptomatic juvenile, adolescent, adult, and geriatric individuals.

Kuntz C 4th, Shaffrey CI, Ondra SL, Durrani AA, Mummaneni PV, Levin LS, Pettigrew DB.

Neurosurgery. 2008 Sep;63(3 Suppl):25-39.

What correction does one need to obtain balance?

PI + LL + TK < or =45 degrees showed 91% sensitivity for predicting ideal sagittal balance at 24 months

- Spine (Phila Pa 1976). 2009 Apr 15;34(8):785-91.
- **Role of pelvic incidence, thoracic kyphosis, and patient factors on sagittal plane correction following pedicle subtraction osteotomy.** Rose PS, Bridwell KH, Lenke LG, Cronen GA, Mulconrey DS, Buchowski JM, Kim YJ.

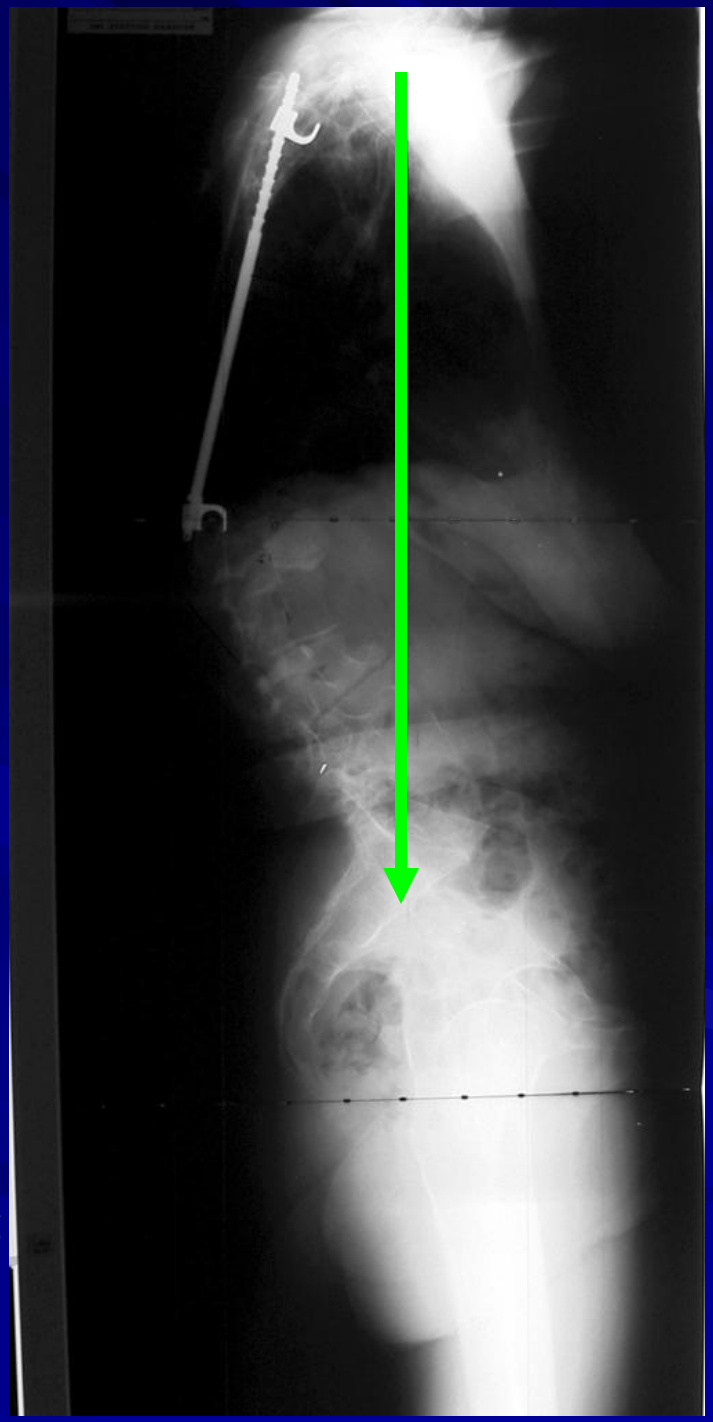
Sagittal Plan abnormalities

- Fading into Kyphosis

C7 Plumb line

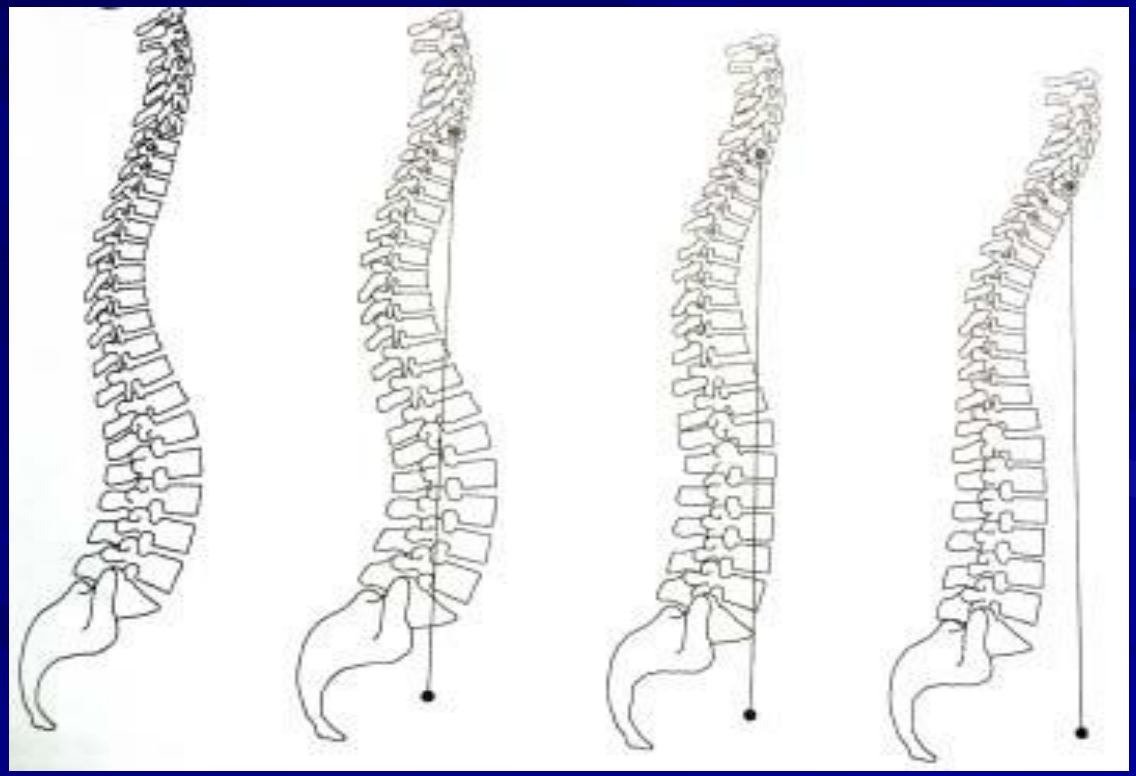
- Sagittal balance
  - Pain
    (Schwab Spine 2002)
- Positive Sagittal Balance
  - Most important reliable radiographic predictor (SF-12)
  - Worse pain, function, and self image

Glassman, Bridwell et al Spine 2005



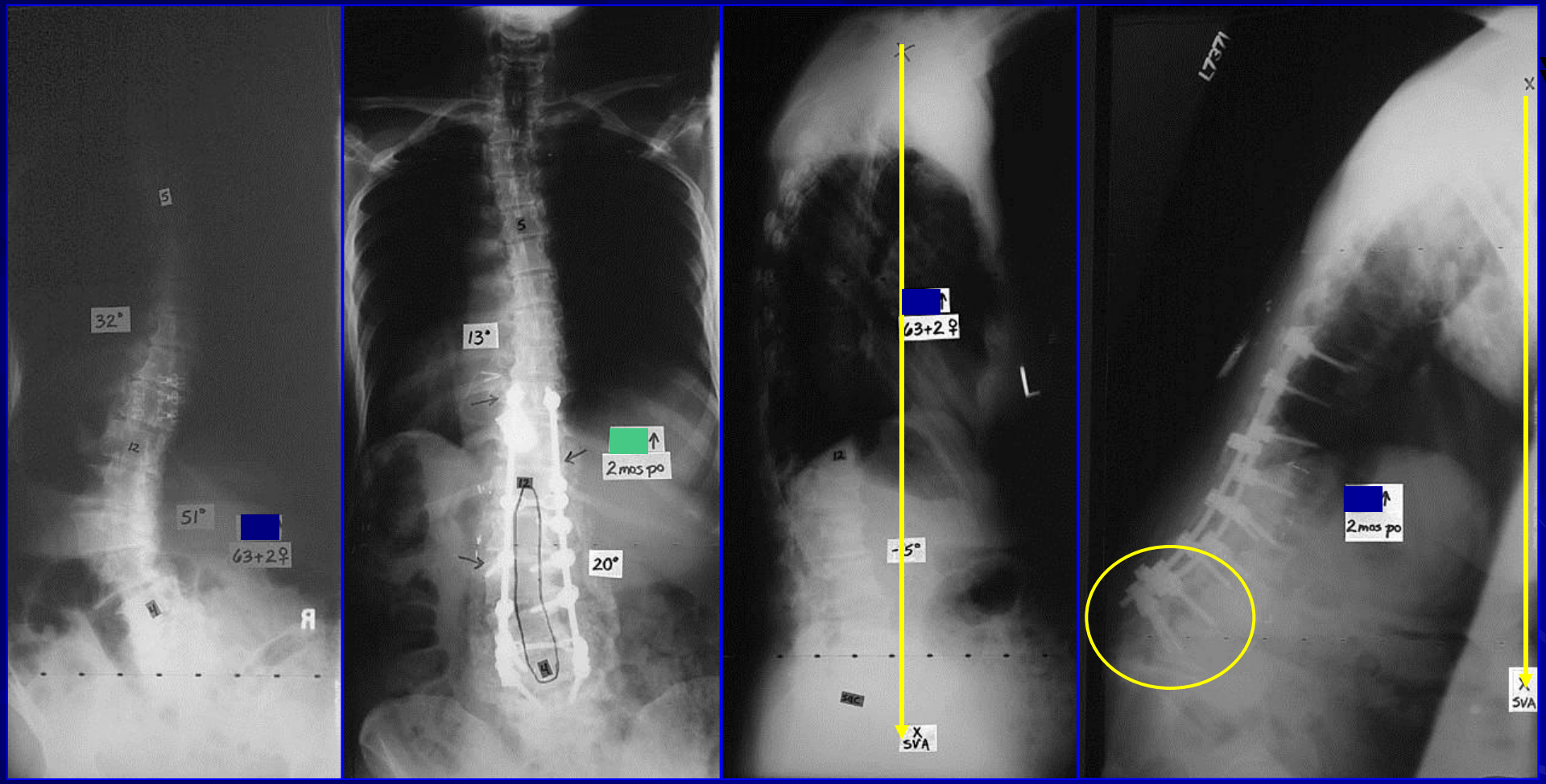
Flat Back Deformity

- Powerful Multiplier




Comments: CHEST

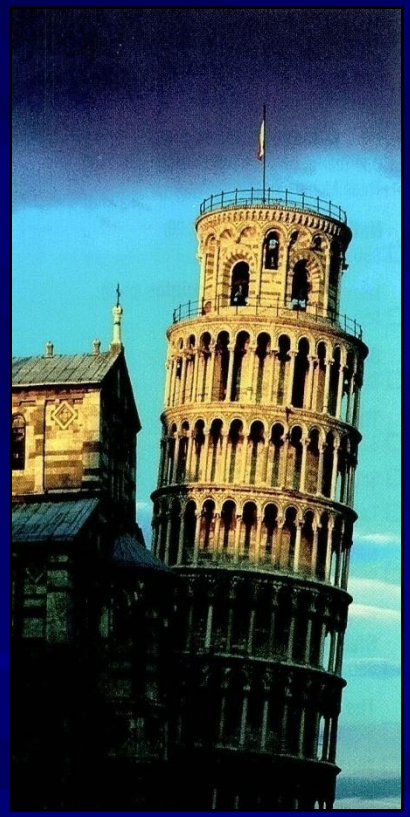
ADULT LUMBAR DEGEN SCOLIOSIS

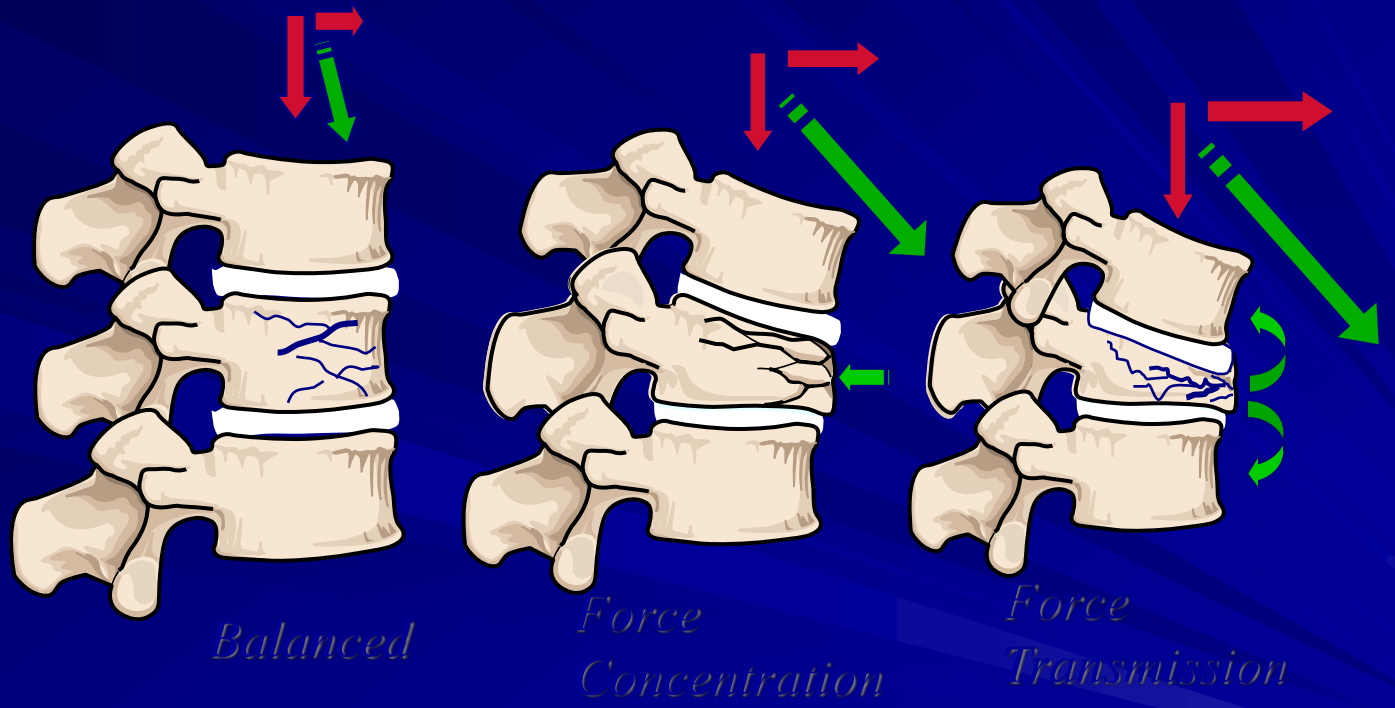


EARLY L5 SCREW PULLOUT/SAGITTAL IMBALANCE!!!

Biomechanics of Kyphosis

"Kyphosis Begets Kyphosis"



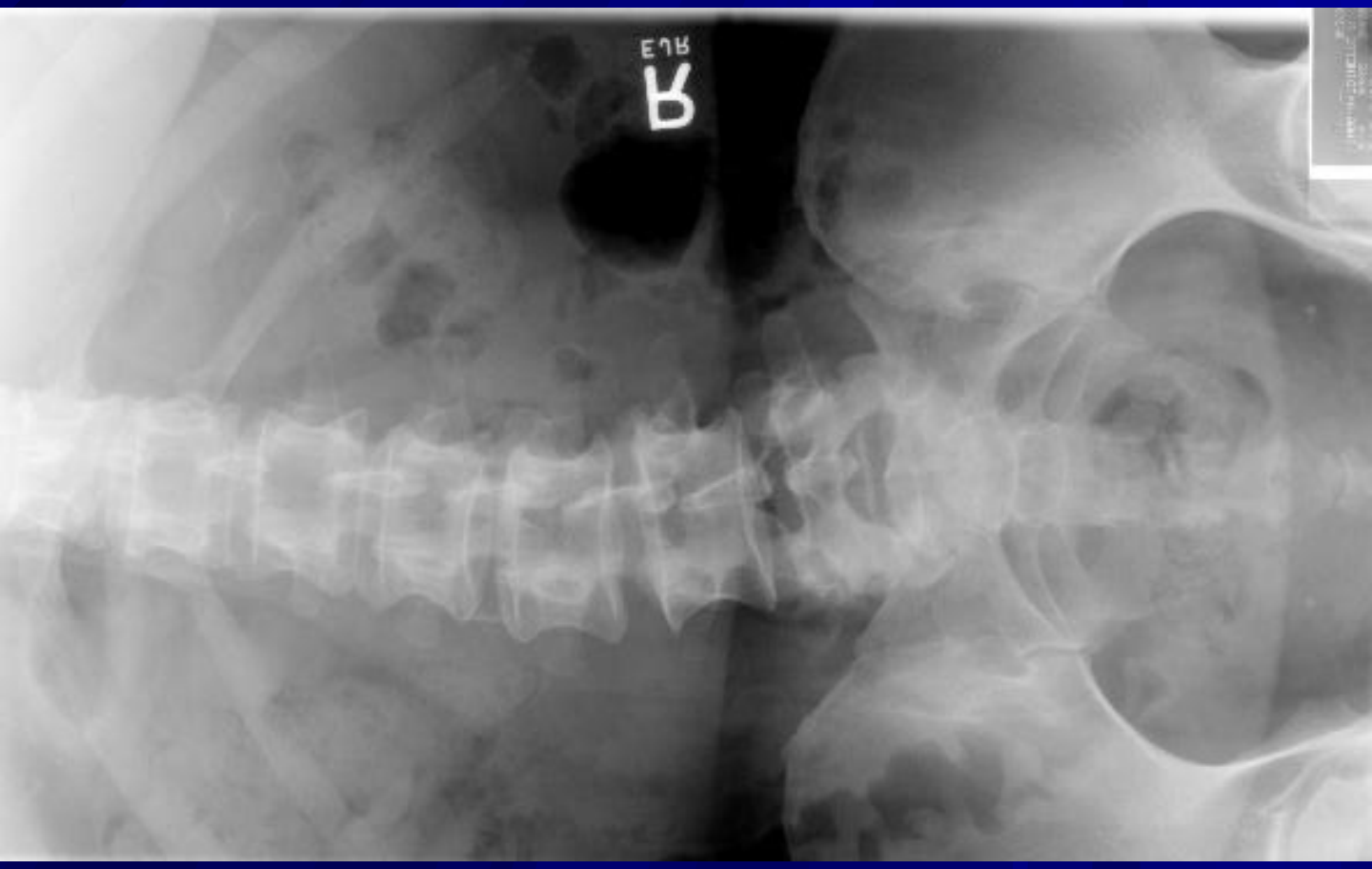


Indication for Treatment

- Neurological compromise
- Pain and functional debilitation
  - Failed pain management and non-surgical treatments for greater than 6-12 months
  - Negative prognostic indicators
    - Positive sagittal balance
    - Lateral listhesis
- Deformity progression
  - Failed bracing
  - Skeletal immaturity
  - Curves > 45 degrees
  - Greater than 5 degree progression in 1 year
  - Greater than 3 degree progression in 2 consecutive years
- Cosmesis


R


R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Standard Work-up

- Calcium
- Vitamin D(25-hydroxyvitamin D)
- PTH
- Testosterone (males)
- DEXA scan

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NEUROSURGERY 18 96 JOHNS HOPKINS

Vitamin D

- 1000 -2000 IU/day D_3 (cholecalciferol)
- Higher doses for deficiency
- D_2 (ergocalciferol) for severe deficiency

- D_2 6-12 weeks of 50,000 units 1-3 times/week (at least 600, 000 IU)
- Forteo 20ug SQ/wk for 12 weeks

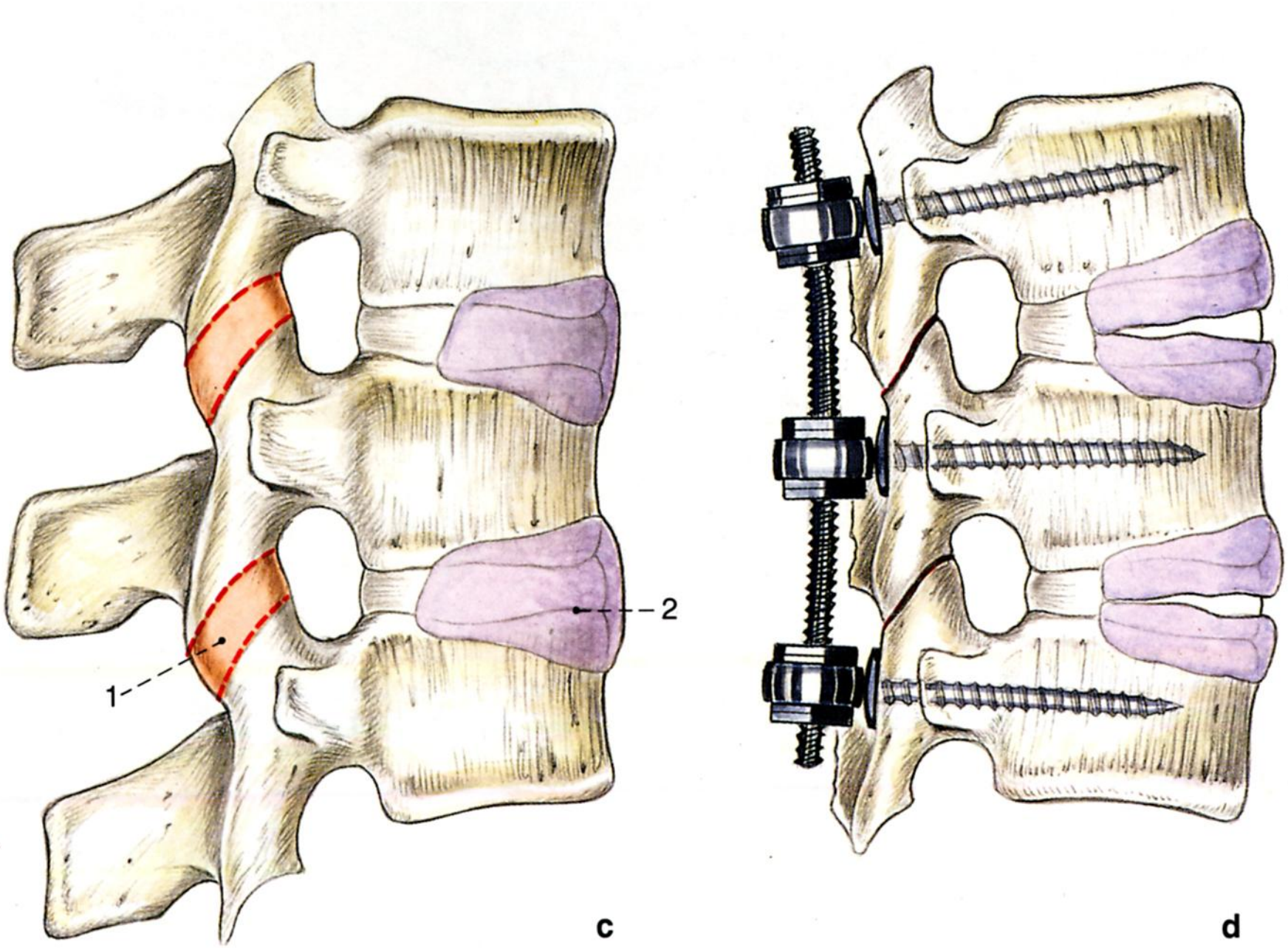
JOHNS HOPKINS MEDICINE

NEUROSURGERY 18 96 JOHNS HOPKINS

Sagittal decompensation Issues

- Anterior column lengthening vs. posterior column shortening or both
  - 1 vs. 2 approaches
    - medical issues
  - correction per osteotomy
    - Smith-Peterson: 5-10°/level
    - Thomasen: 30°
  - dural kinking

JOHNS HOPKINS
MEDICINE



From: Bauer R et al. **Atlas of Spinal Operations**. Thieme Medical Publishers Inc. New York, NY. 1993. p. 230. Fig 4.4

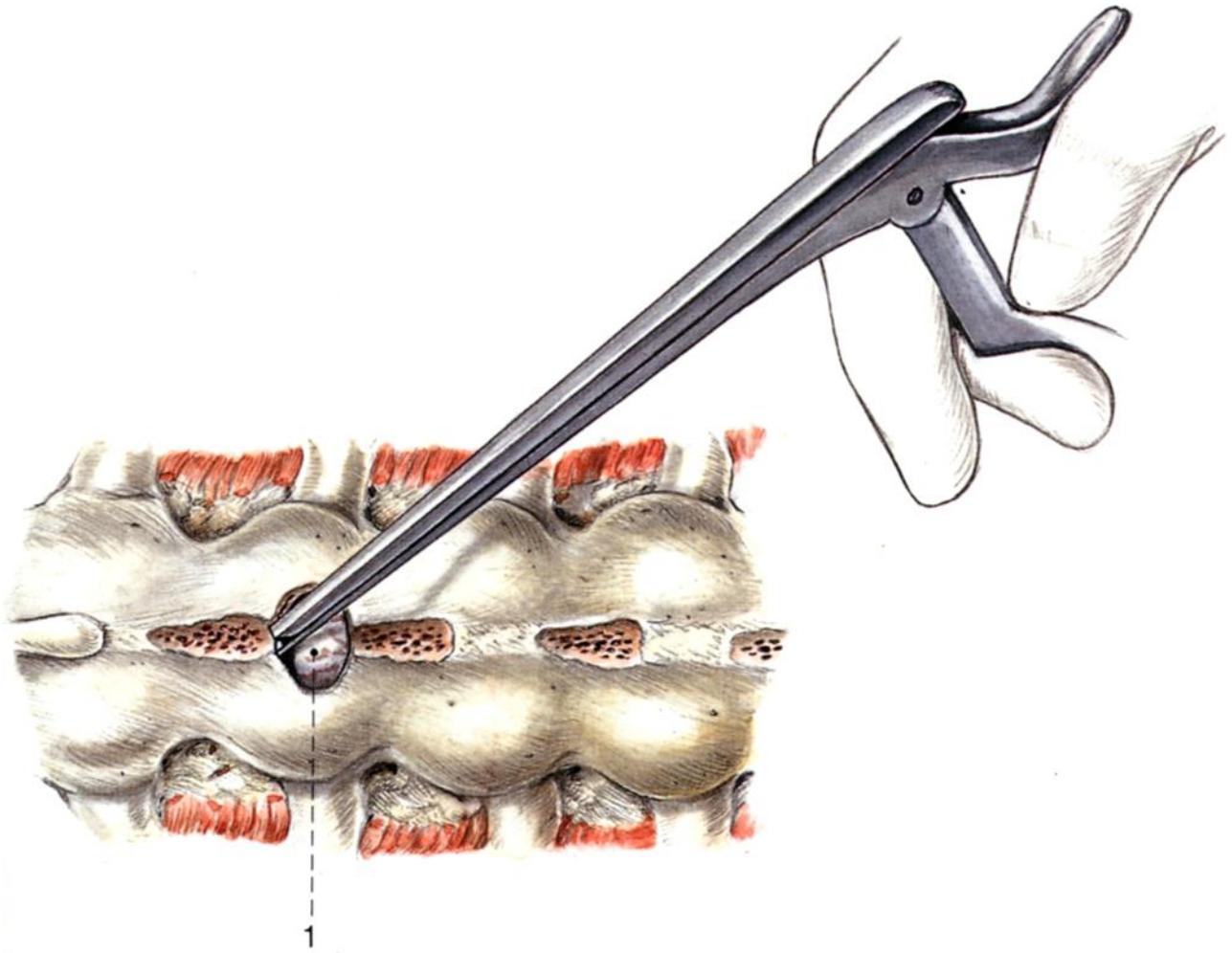


Fig. 4.**5** Median interlaminar osteotomy by resection of the ossified yellow ligament.

1 Spinal dura mater

From: Bauer R et al. **Atlas of Spinal Operations**. Thieme Medical Publishers Inc. New York, NY. 1993. p. 231. Fig 4.5

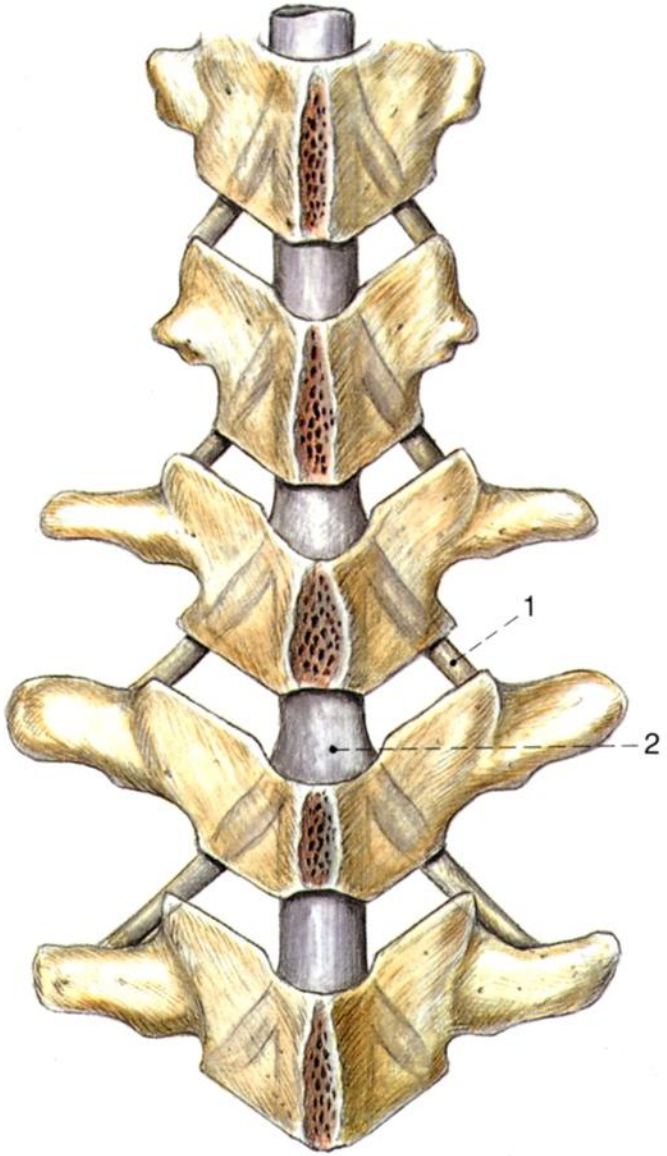


Fig. 4.**6** Position of osteotomies in relation to the posterior vertebral elements and the neural structures.

1 Spinal nerve
2 Spinal dura mater

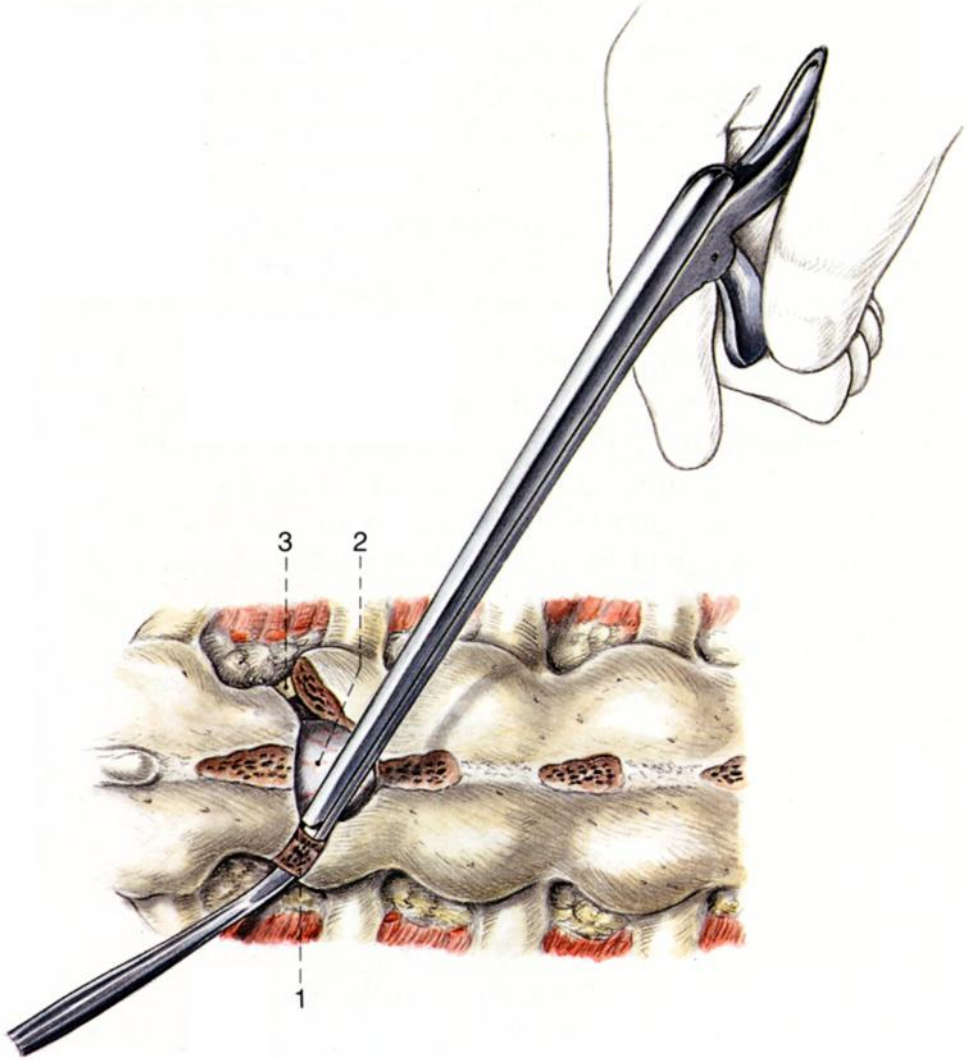


Fig. 4.**7** Oblique lateral osteotomy shortly before completion.

1 Remaining osseous bridge in front of the intervertebral foramen, the spinal nerve being protected by a dissector
2 Spinal dura mater
3 Spinal nerve

From: Bauer R et al. **Atlas of Spinal Operations**. Thieme Medical Publishers Inc. New York, NY. 1993. p. 232. Fig 4.7

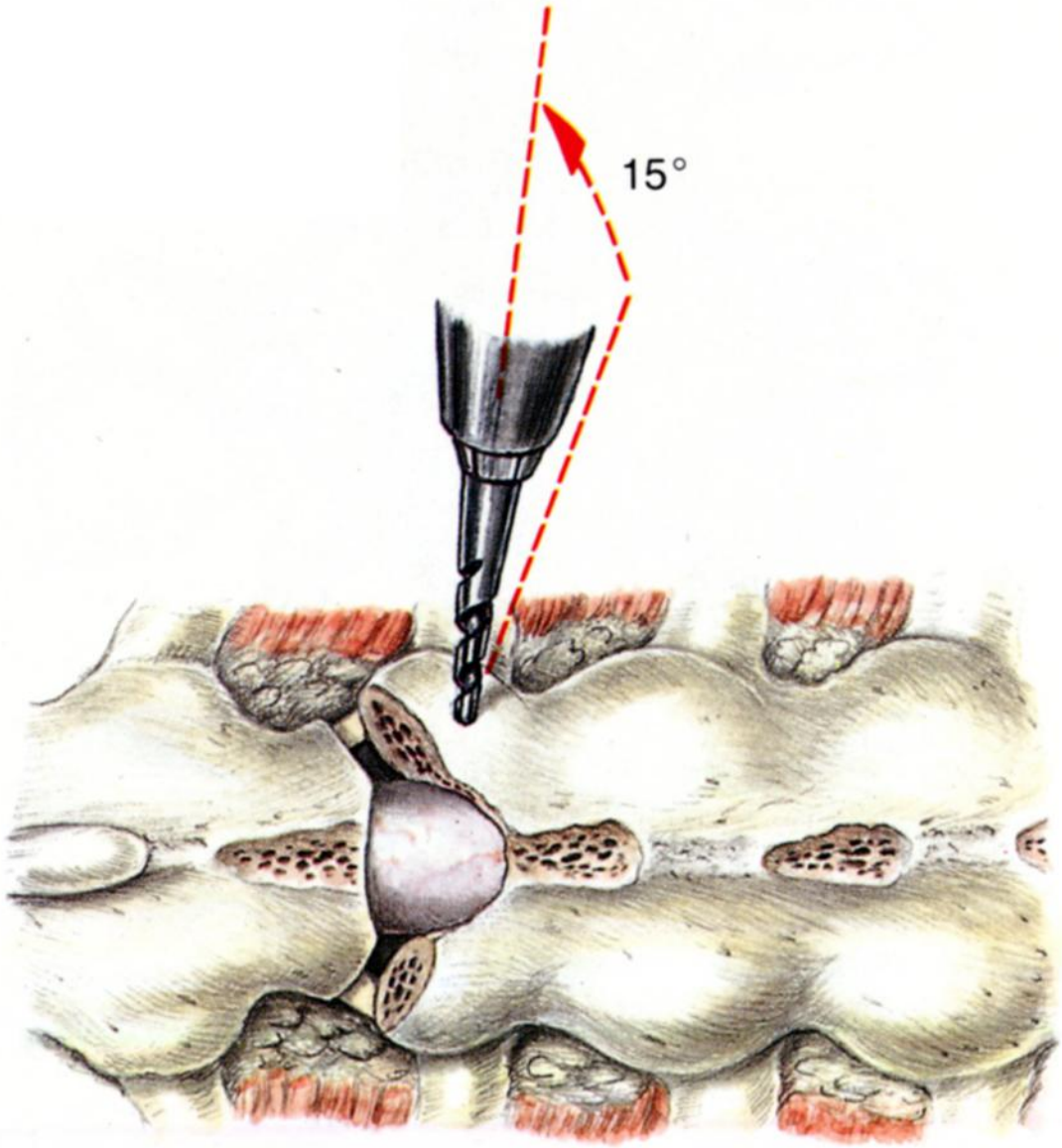


Fig. 4.**9** Drilling of a hole for screw implantation in anteromedial direction at an angle of 15 degrees to the sagittal plane.

From: Bauer R et al. **Atlas of Spinal Operations**. Thieme Medical Publishers Inc. New York, NY. 1993. p. 232. Fig 4.9

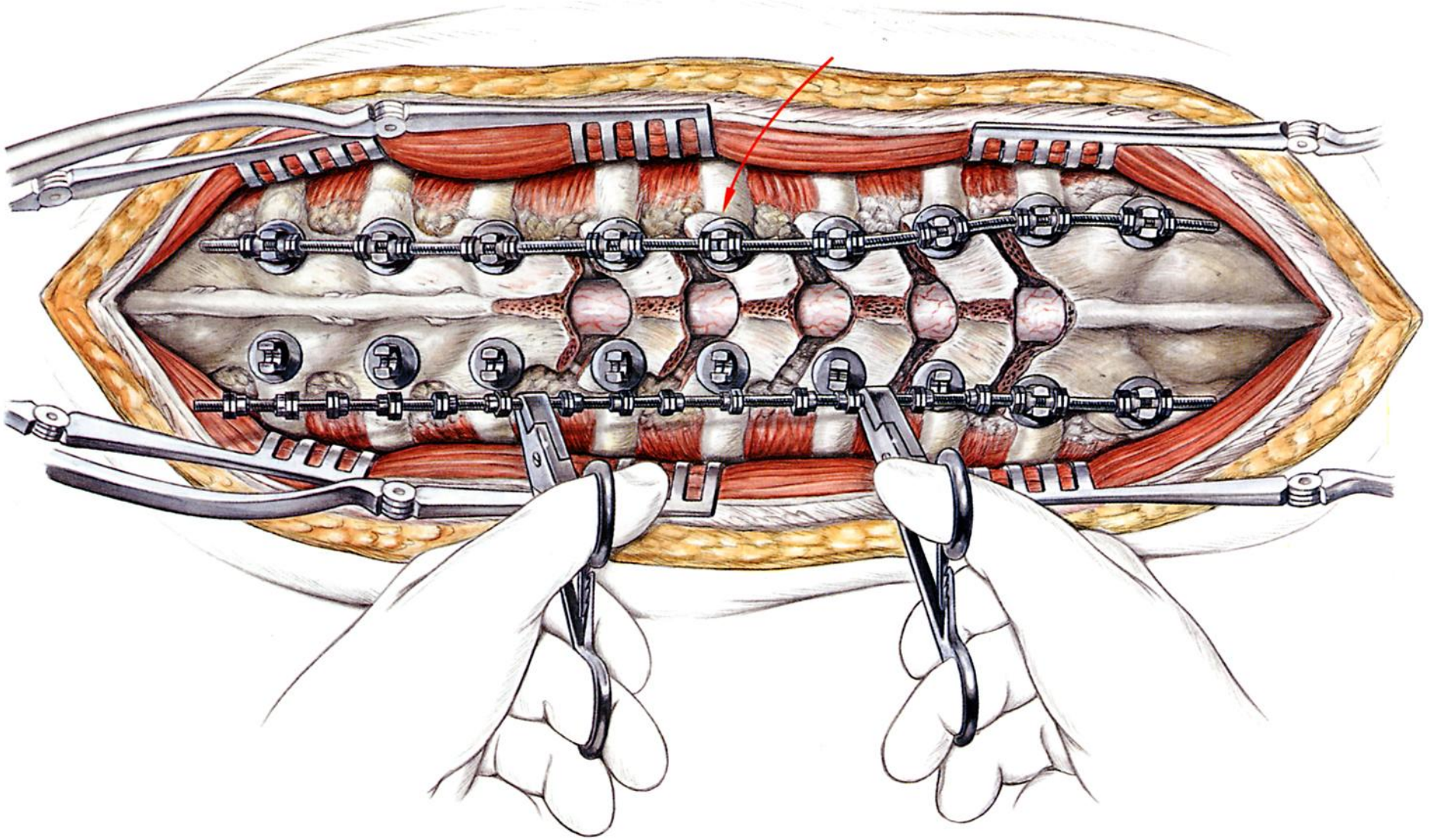


Fig. 4.**11** Site after insertion of the right threaded rod between T10 and S1. Fixation of nuts on the central screw at L2 (see arrow), and insertion of the left threaded rod.

From: Bauer R et al. **Atlas of Spinal Operations**. Thieme Medical Publishers Inc. New York, NY. 1993. p. 233. Fig 4.11

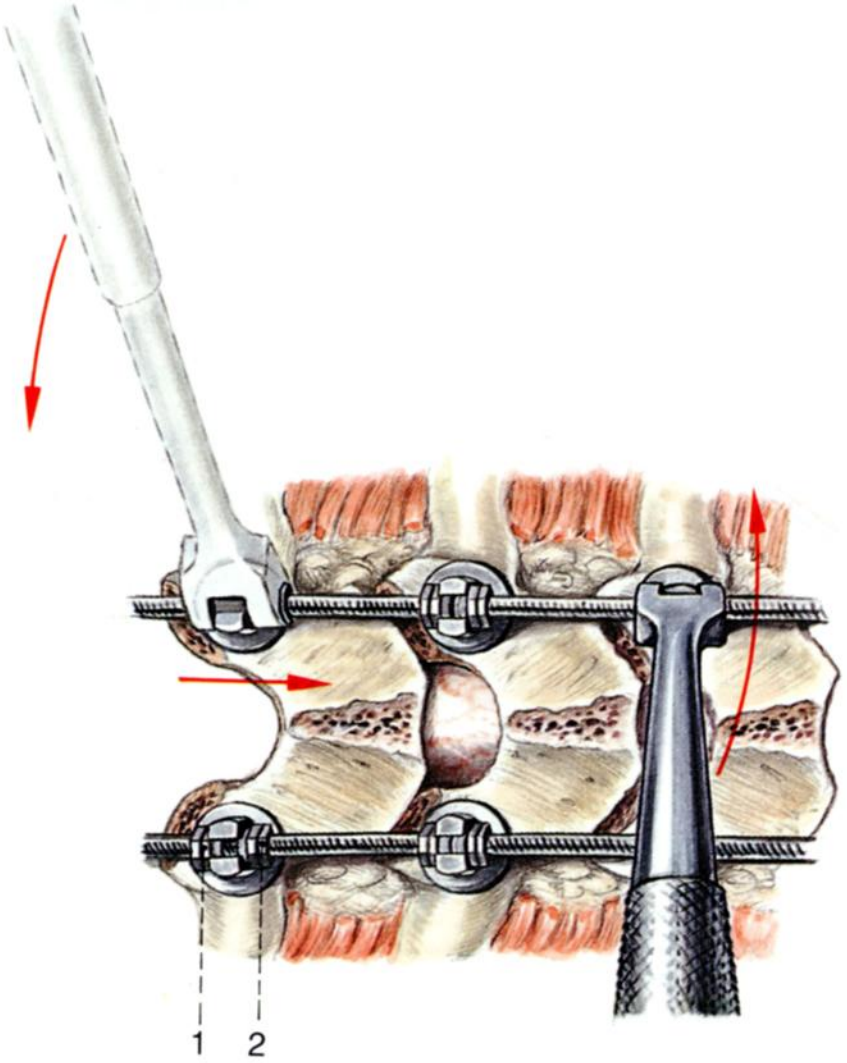


Fig. 4.**12** Correction of the nuts peripheral to the central screw by centripetal tightening. The counternuts loosely seated in the screw hole are moved simultaneously with the Zielke double-key Haifaa wrench.

1 Correcting nut
2 Counternut

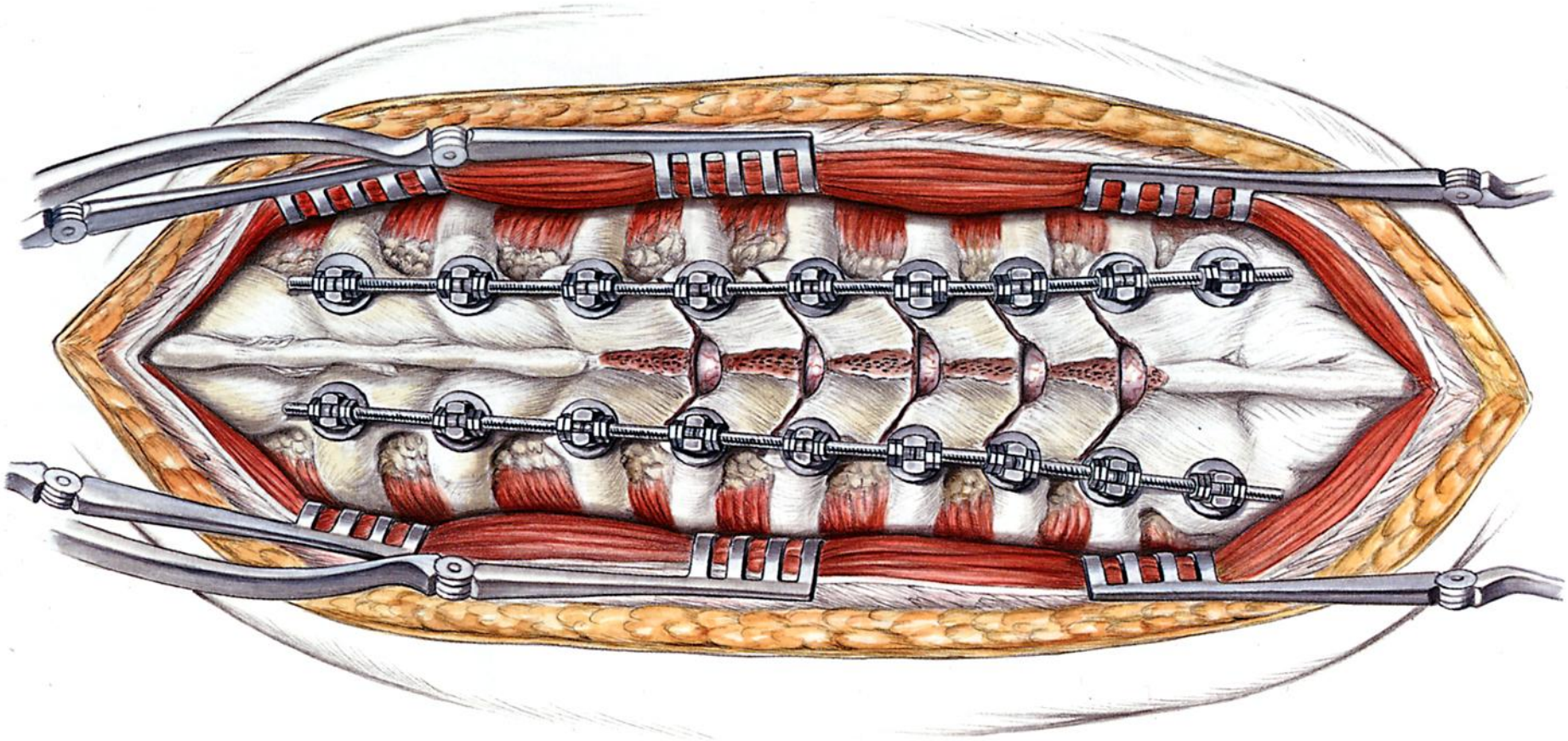


Fig. 4.**13** Site after correction. The lateral osteotomies are closed.

From: Bauer R et al. **Atlas of Spinal Operations**. Thieme Medical Publishers Inc. New York, NY. 1993. p. 234. Fig 4.13

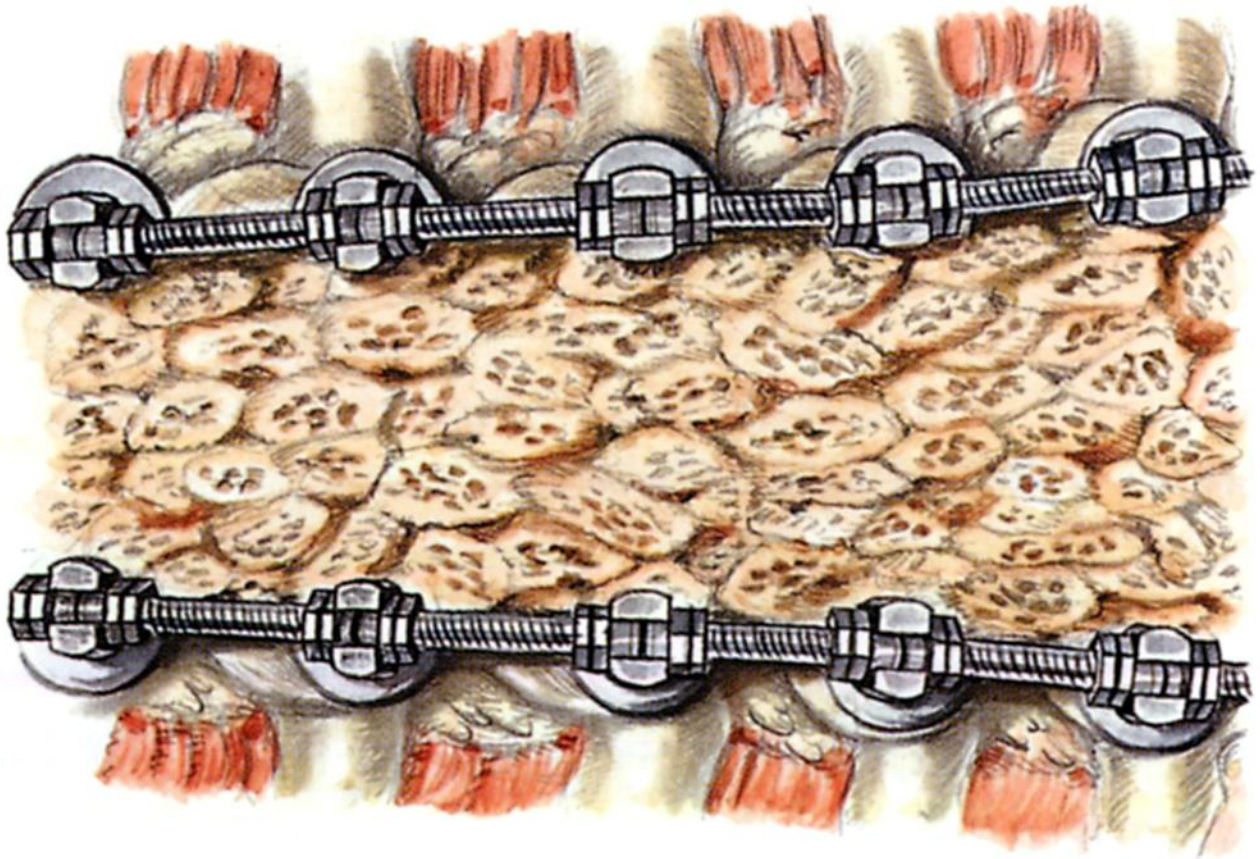
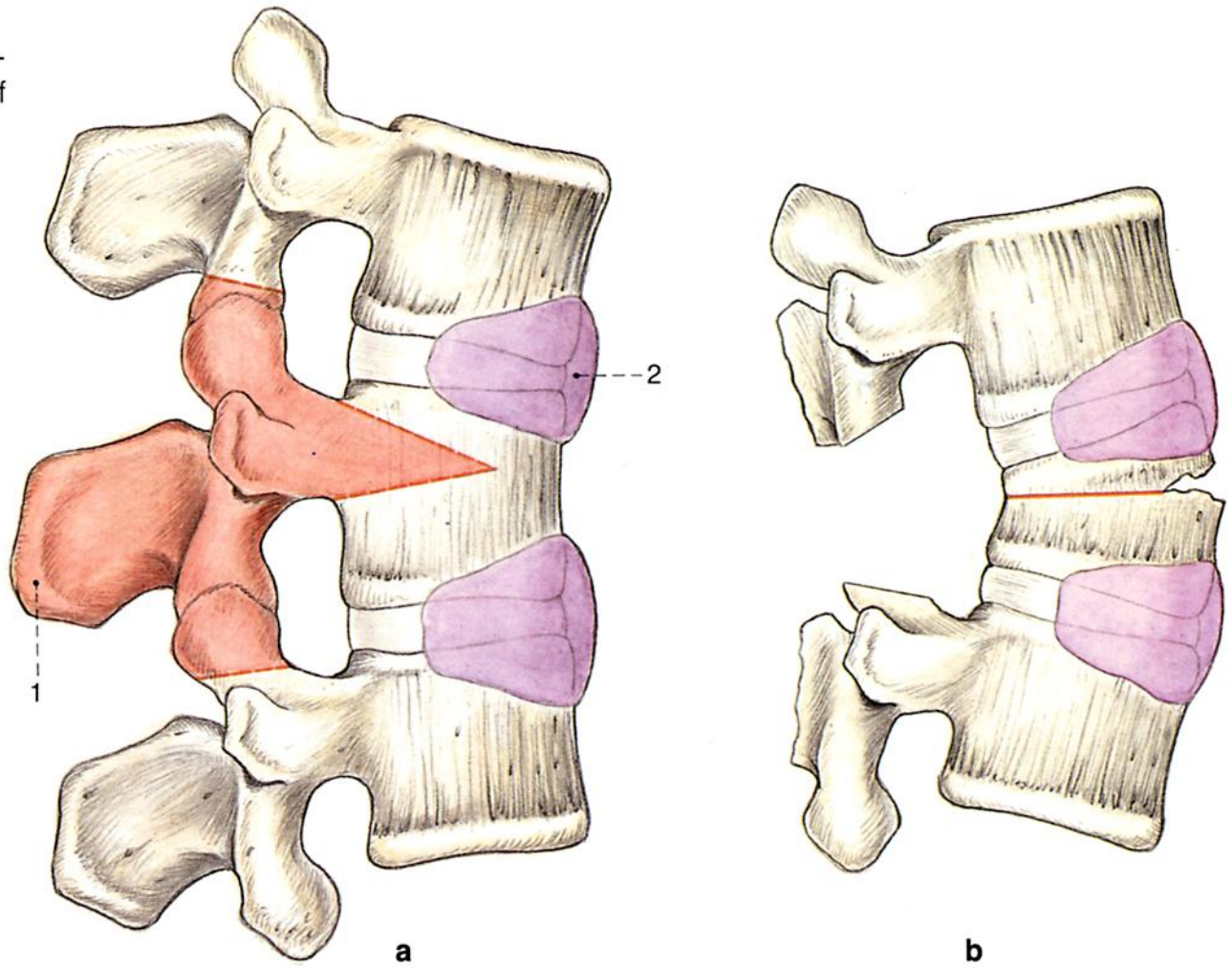


Fig. 4.**14** Detail of site after grafting. It is important to apply the large chips from resection of the spinous processes to the median osteotomies.

From: Bauer R et al. **Atlas of Spinal Operations**. Thieme Medical Publishers Inc. New York, NY. 1993. p. 234. Fig 4.14

Fig. 4.**16** Principle of correction.
a Lumbar segments with resected posterior portions and partial osteotomy of the vertebral body.
b Lumbar segments after correction.

1 Resected bone
2 Syndesmophytes



From: Bauer R et al. **Atlas of Spinal Operations**. Thieme Medical Publishers Inc. New York, NY. 1993. p. 237. Fig 4.16

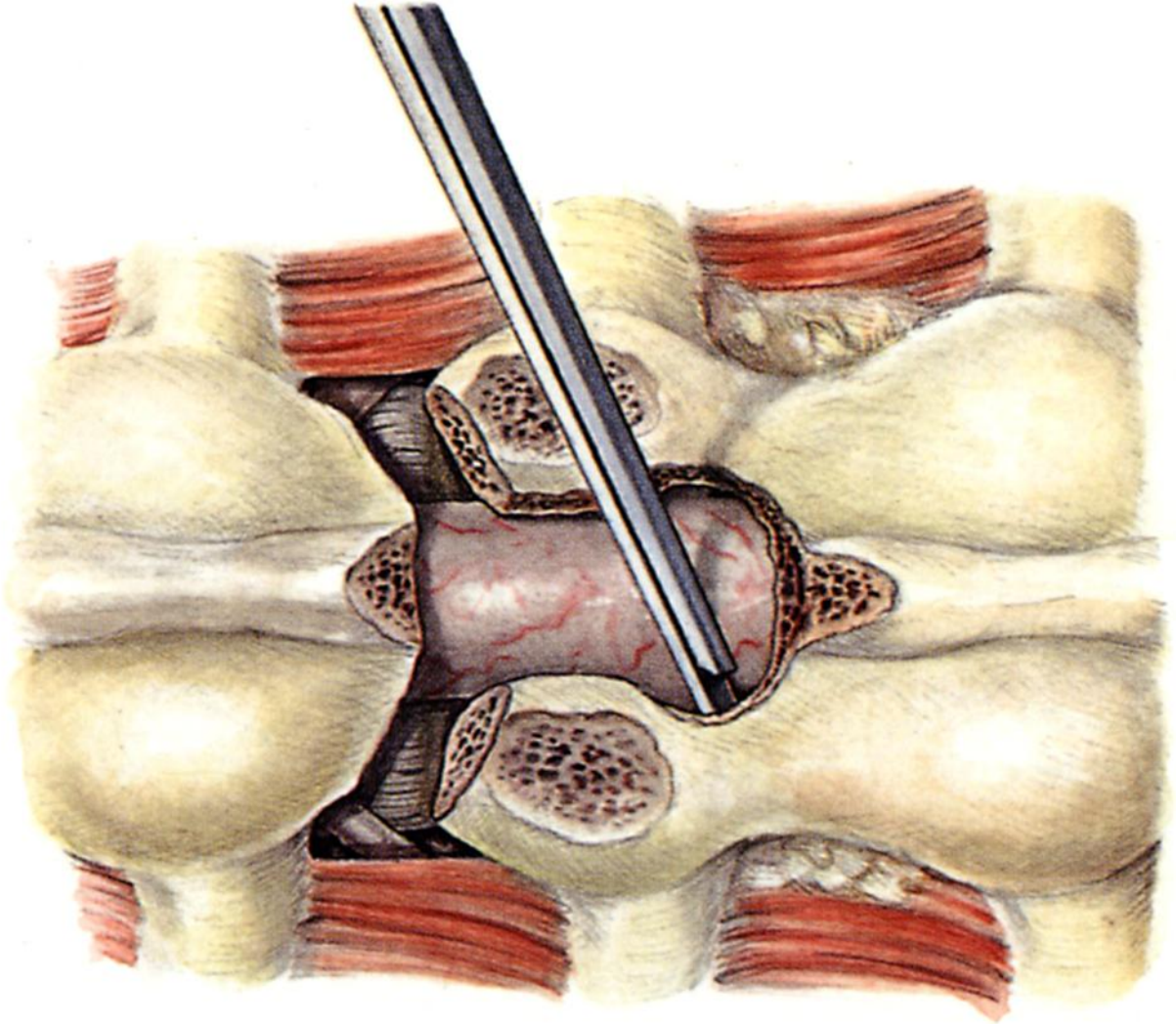


Fig. 4.**17** Detail of the site after the lateral osteotomies and laminectomy. Resection of the upper articular process of the next lower vertebra.

From: Bauer R et al. **Atlas of Spinal Operations**. Thieme Medical Publishers Inc. New York, NY. 1993. p. 237. Fig 4.17

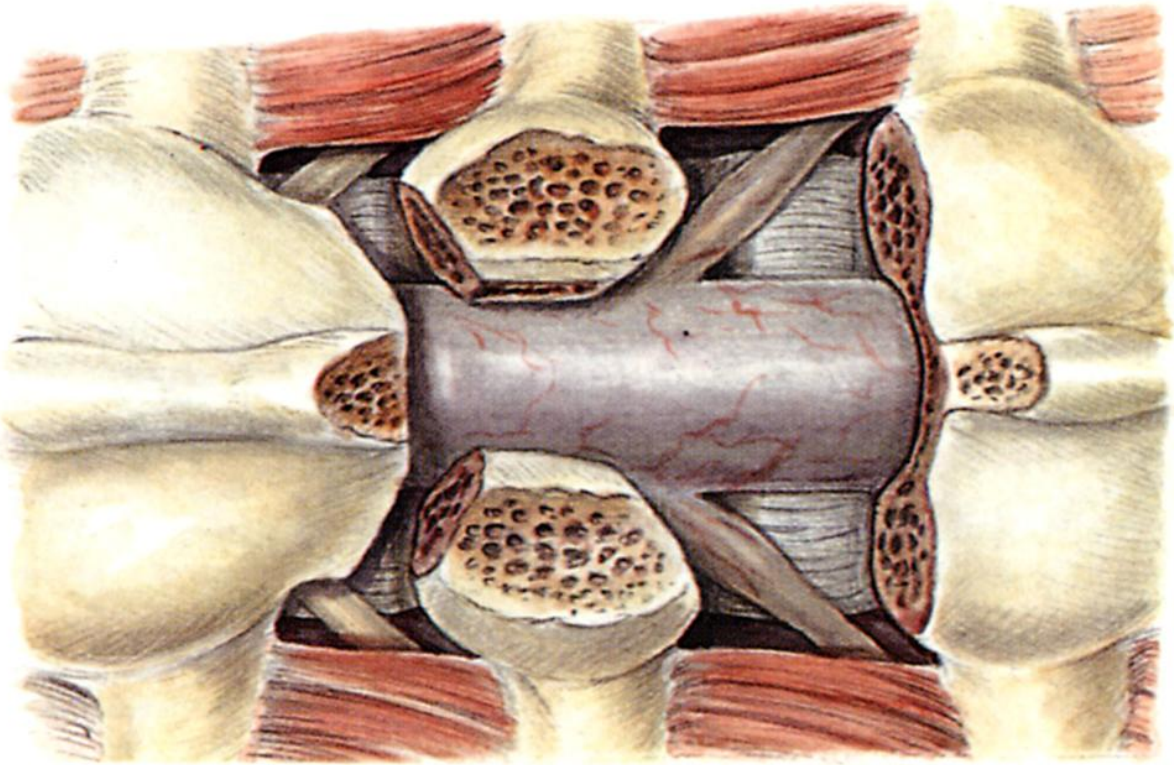


Fig. 4.**18** Detail of the site after lateral and median osteotomies. The articular components are still partly intact, and the transverse processes and pedicles are completely intact. The dura and the four adjacent spinal nerves are visualized.

From: Bauer R et al. **Atlas of Spinal Operations**. Thieme Medical Publishers Inc. New York, NY. 1993. p. 237. Fig 4.18

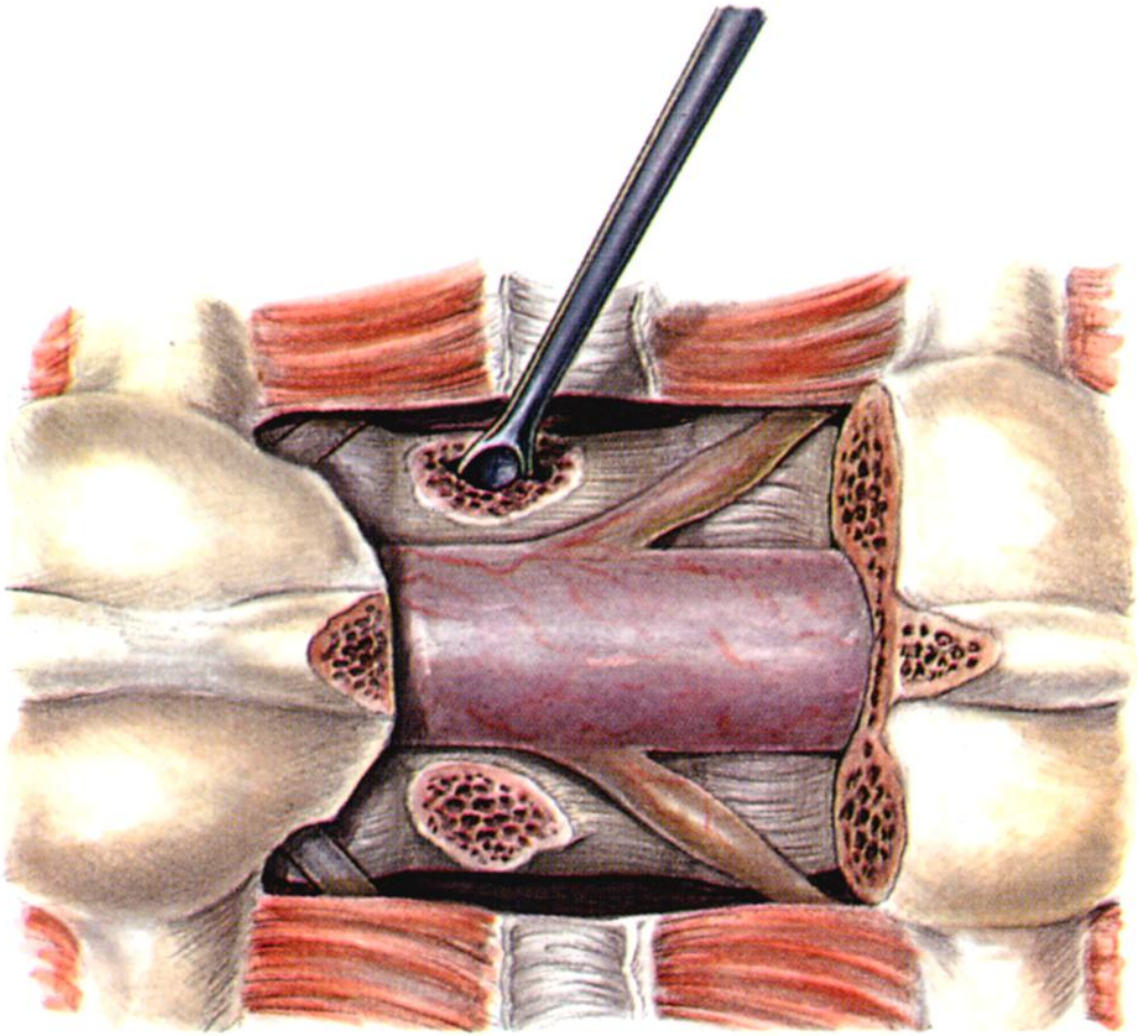


Fig. 4.**19** Cancellous bone is scooped out of the vertebral body from the base of the right pedicle. The left pedicle is still intact. The transverse processes have been resected together with the articular components.

From: Bauer R et al. **Atlas of Spinal Operations**. Thieme Medical Publishers Inc. New York, NY. 1993. p. 238. Fig 4.19

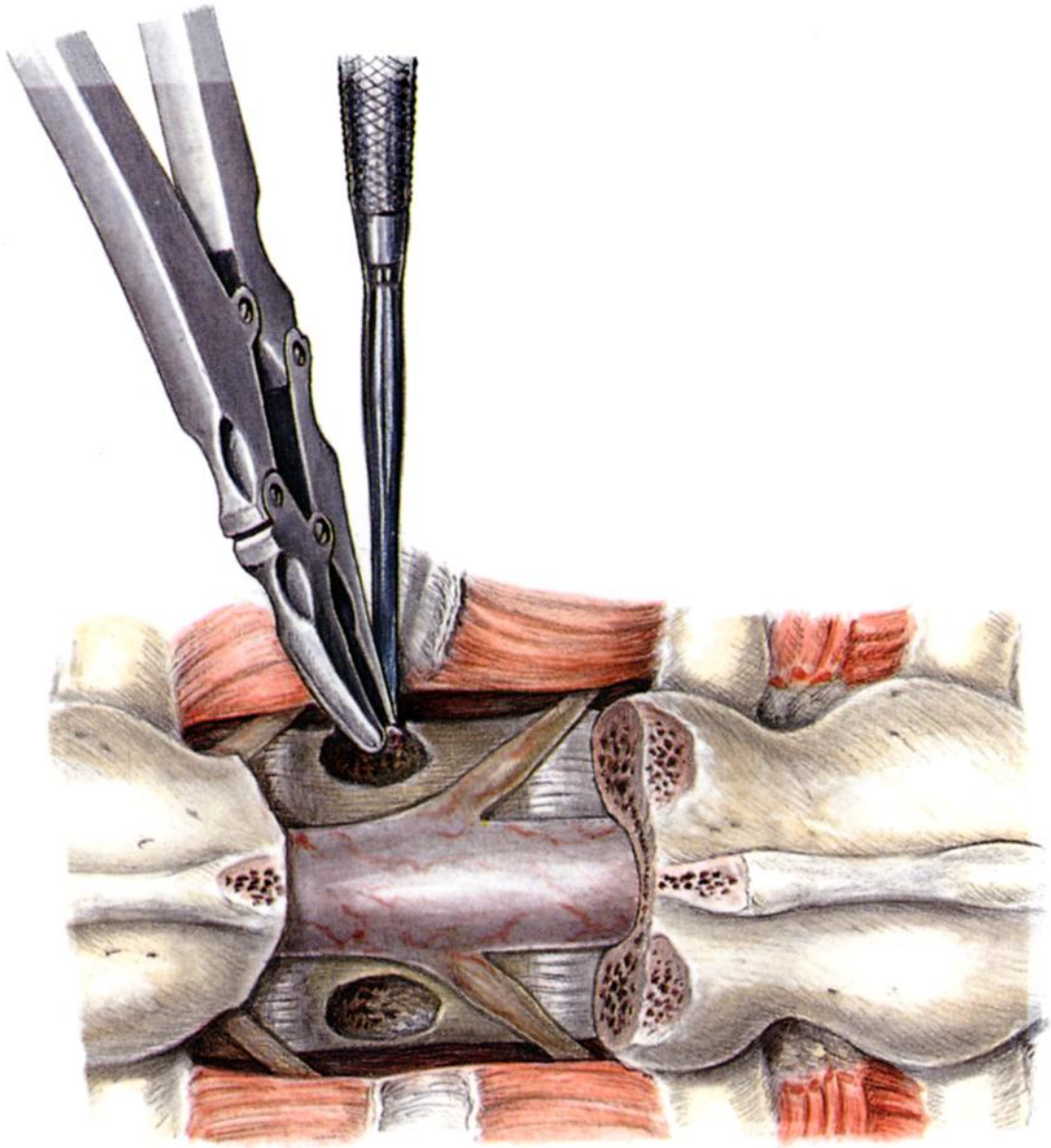


Fig. 4.**20** Osteotomy of the left wall of the vertebral body from the base of the pedicle.

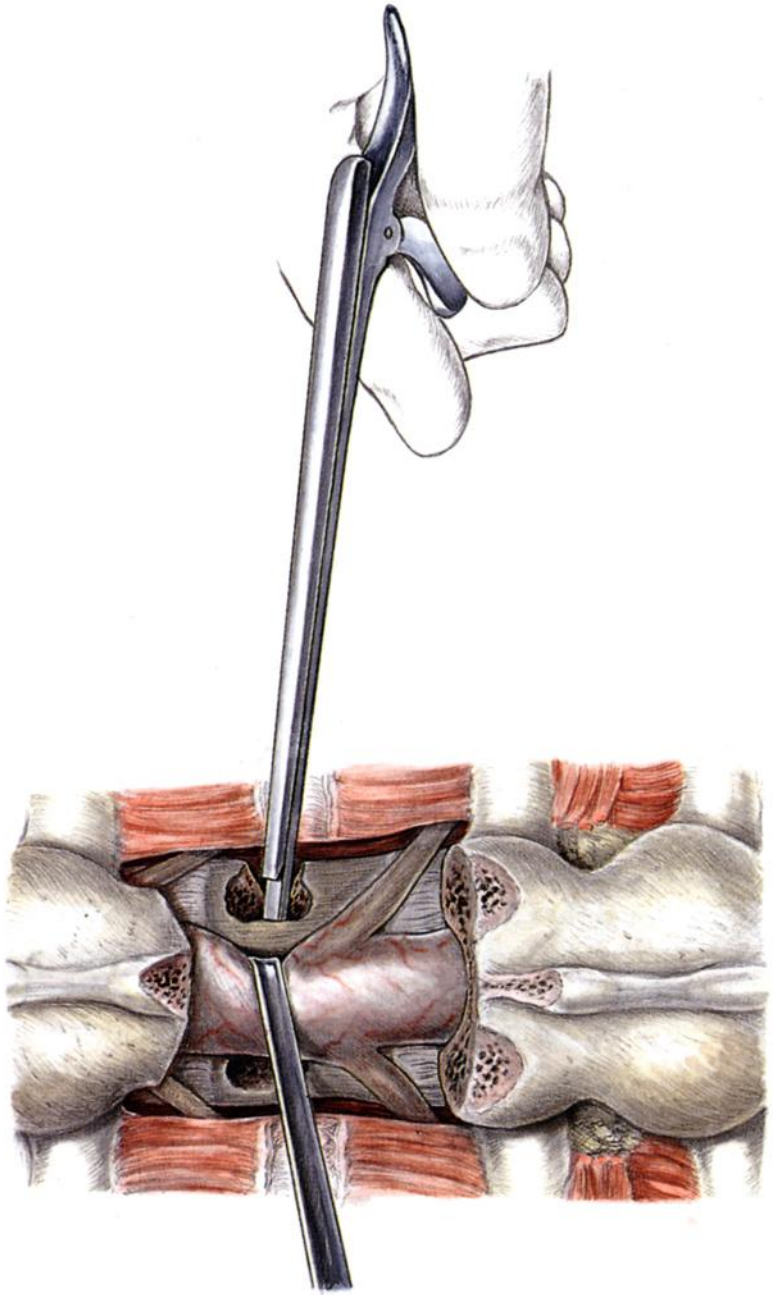


Fig. 4.**21** Osteotomy of the posterior wall of the vertebral body.

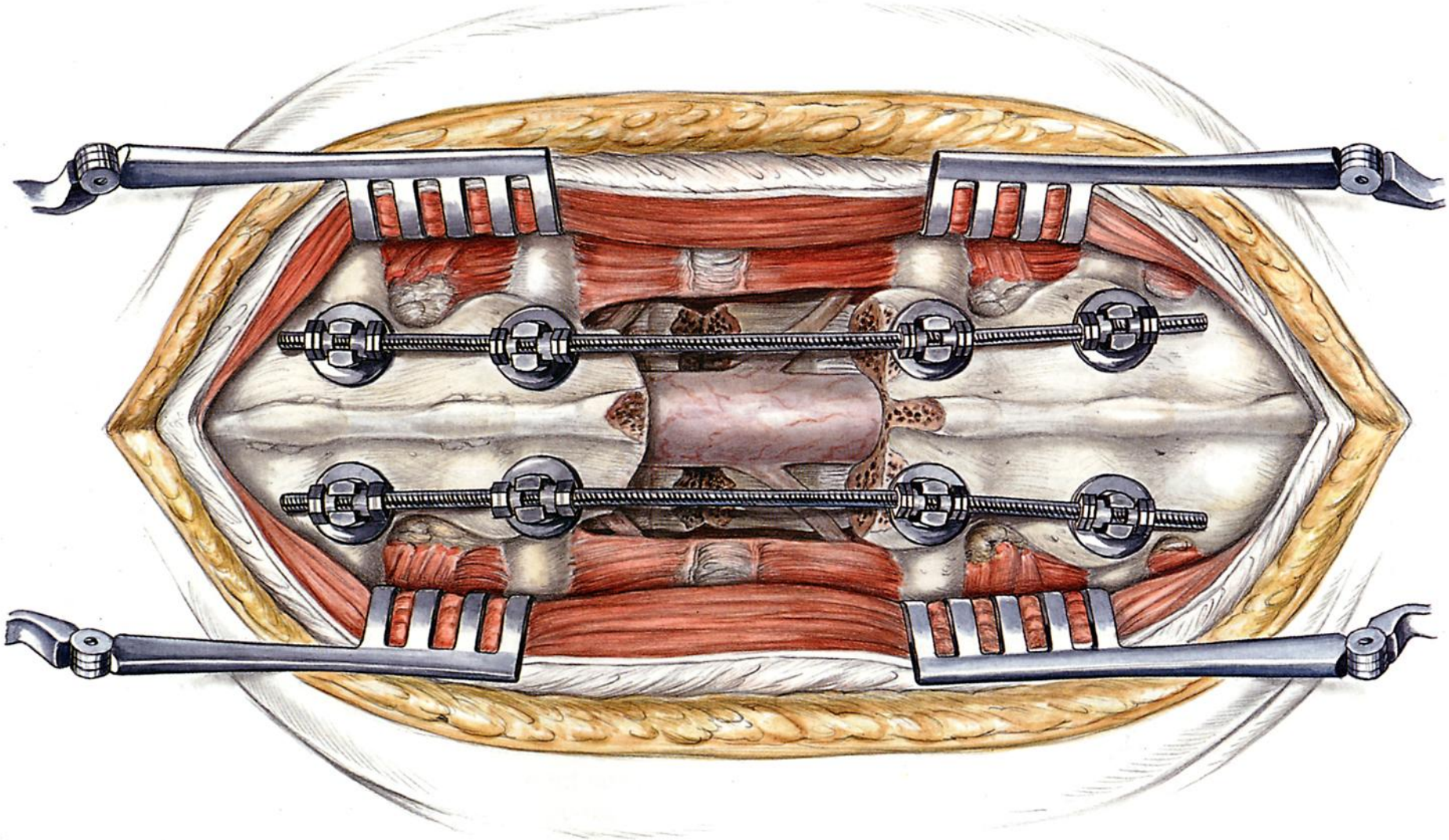


Fig. 4.**22** Site after implantation of the complete USI system.

From: Bauer R et al. **Atlas of Spinal Operations**. Thieme Medical Publishers Inc. New York, NY. 1993. p. 239. Fig 4.22

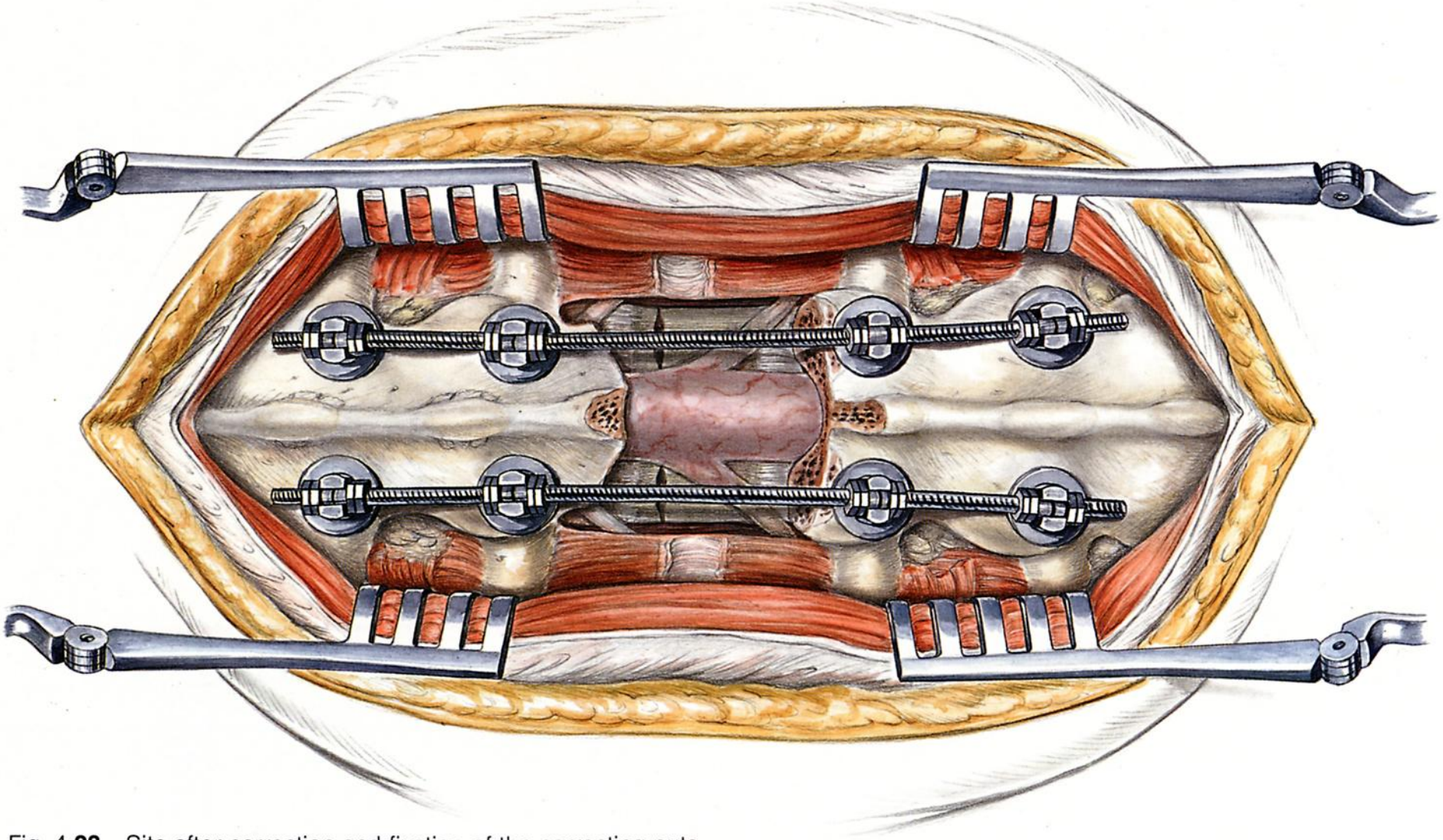


Fig. 4.**23** Site after correction and fixation of the correcting nuts and counternuts. The vertebral body osteotomy has been closed.

From: Bauer R et al. **Atlas of Spinal Operations**. Thieme Medical Publishers Inc. New York, NY. 1993. p. 239. Fig 4.23

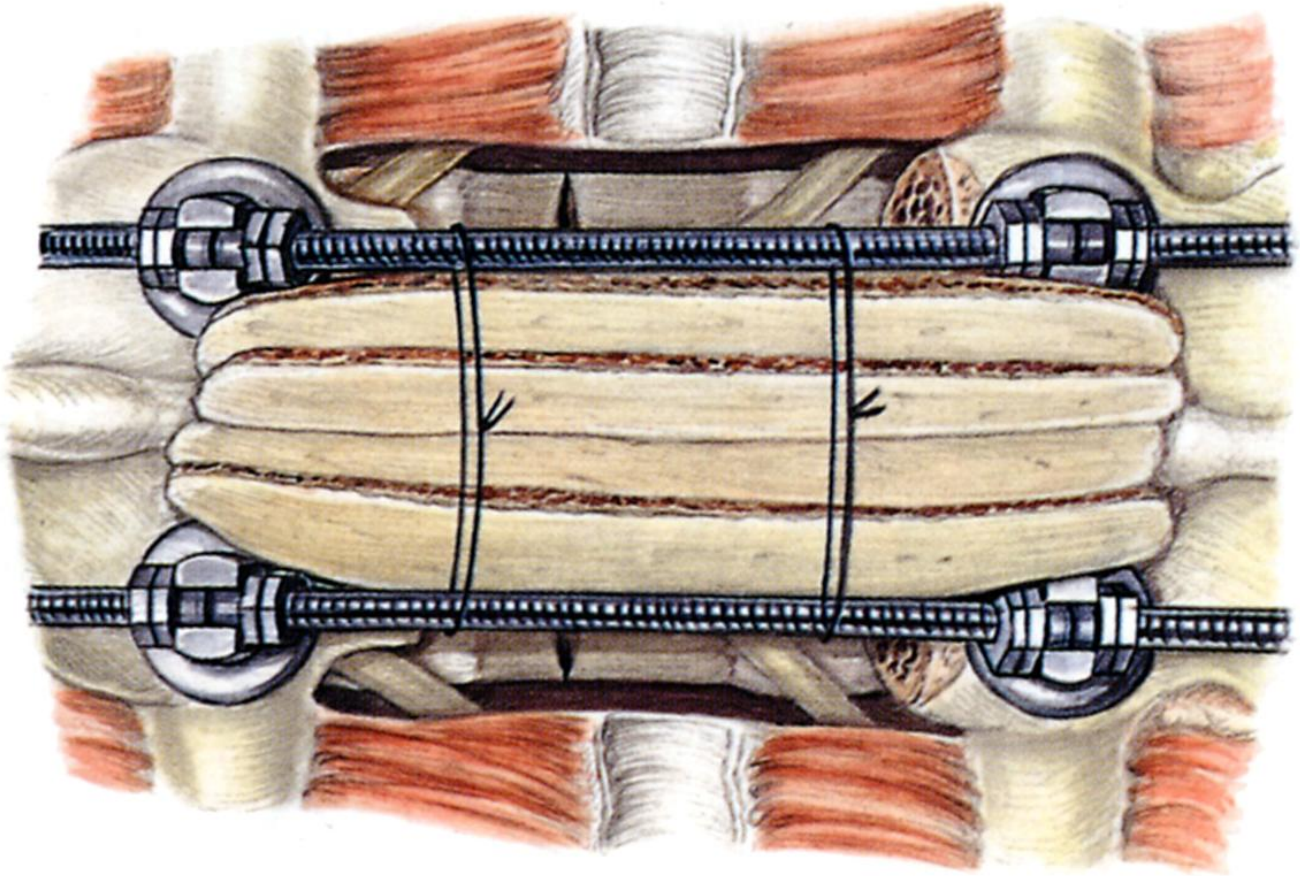


Fig. 4.**24** Detail of the site after application of corticocancellous iliac crest chips to the adjacent decorticated laminae. The chips are attached to the threaded rods with sutures.

Anterior Segmental Manipulation

Intervertebral disc space distraction via:

- ALIF
- XLIF/DLIF
- PLIF
- TLIF

Very powerful for restoration of anterior column height (and restoring lordosis)

Allows for loosening of deformities without osteotomies

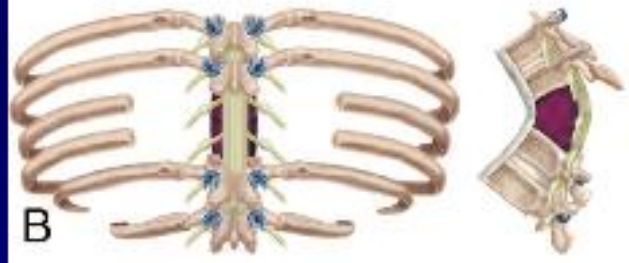
Effective for focal curves/listheses

Manages focal disc and facet joint pain generators

Vertebral Column Resection

Vertebral Column Resection.
Depiction of a Sharp Angular Kyphosis
In the Thoracic Spine

Vertebral Column Resection.
Resection of Two Vertebral Segments and
Three Discs, Anteriorly and Posteriorly



Vertebral Column Resection.
Closure of the Vertebral Column Resection
With Reconstruction of the anterior Column
With Cage and Posterior Column With Pedicle
Screw Instrumentation

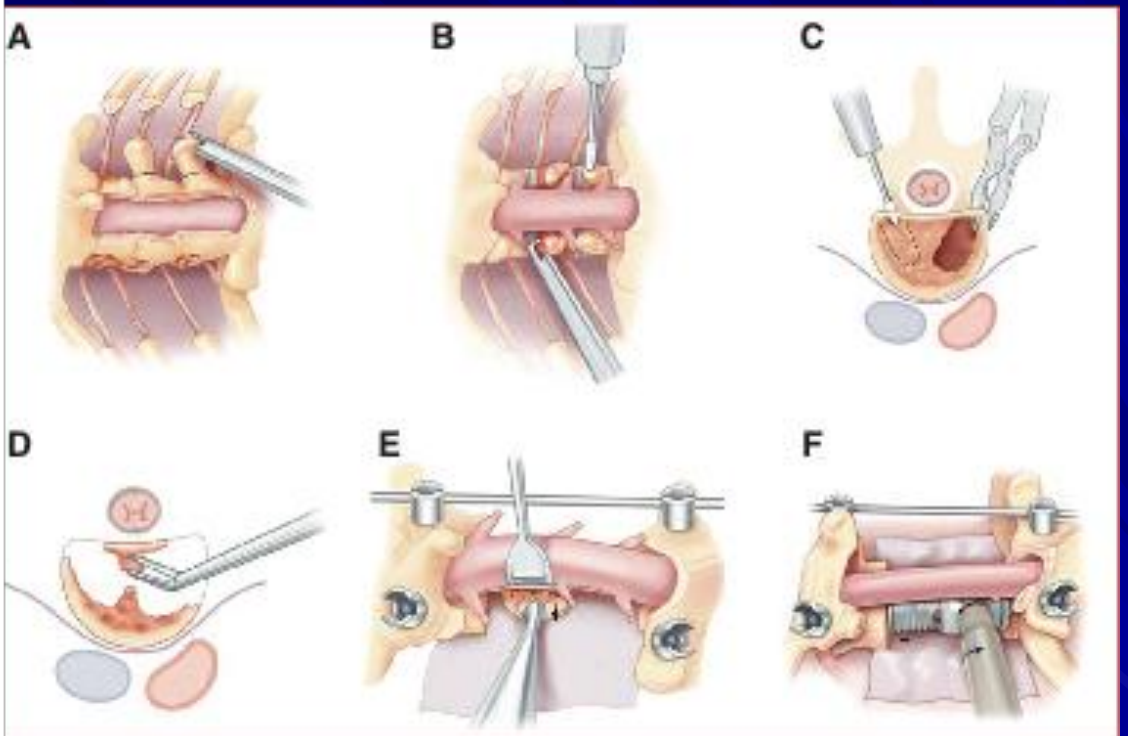


FIGURE 3. *Diagrammatic representation of the steps for VCR using a posterior-only approach. See Posterior-Only Approach for a detailed description of parts* A–F.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R


R
43


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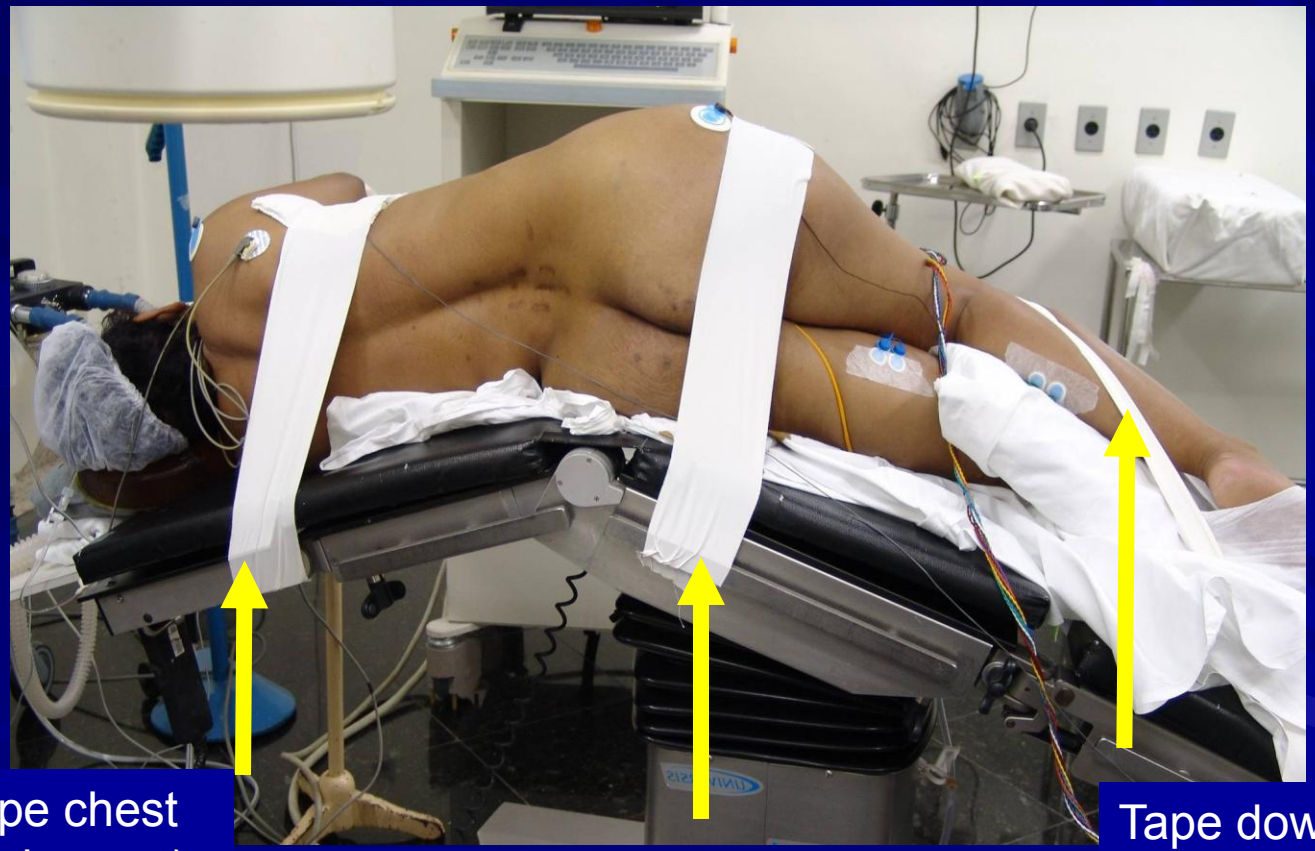
SERIES: #6B
L Spine Bone 2.0 SPO cor

Tape *prior to* breaking table

The tape will help get leverage over the break

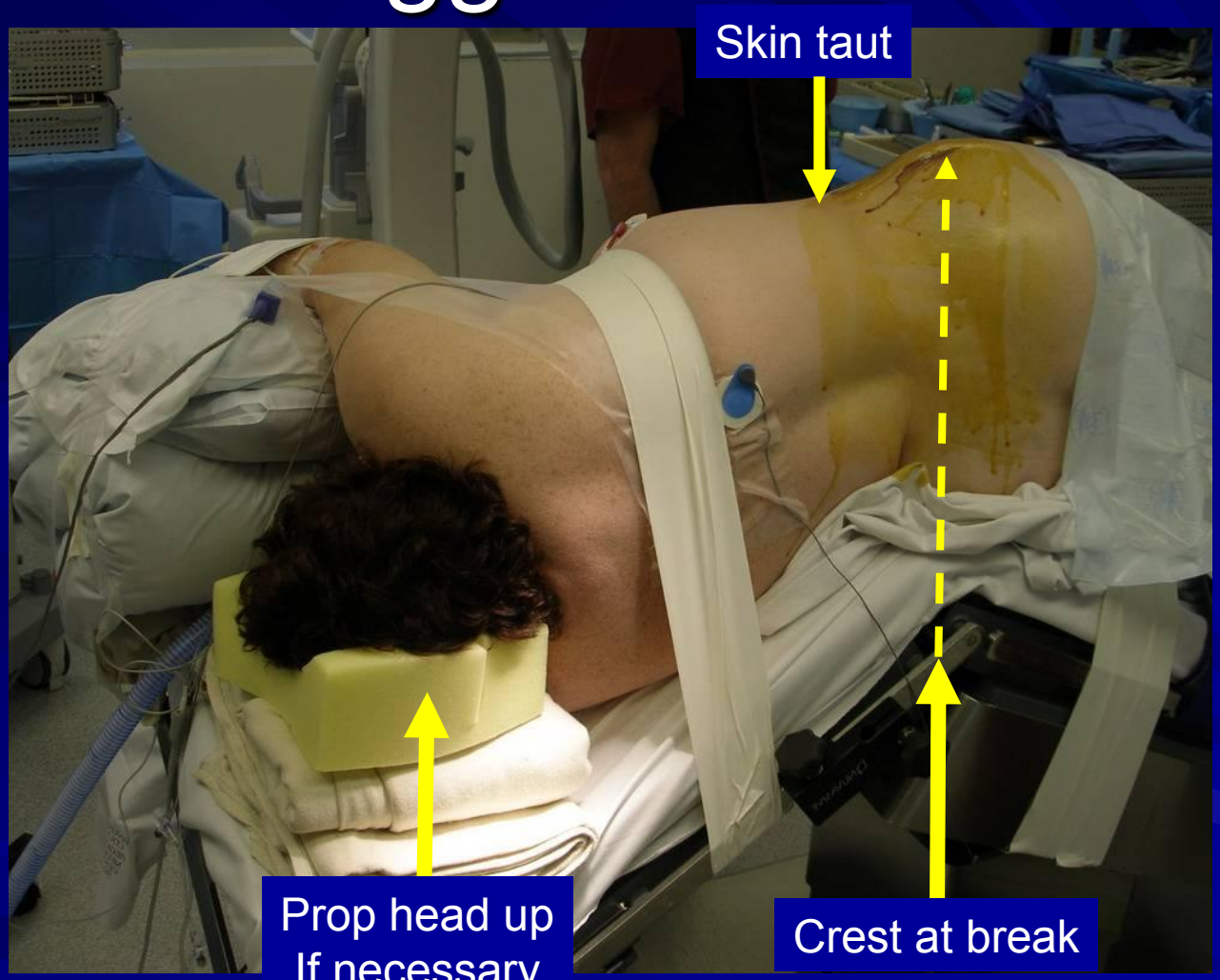


Tape chest (under arm)

Tape down thigh and across knee

Tape pulling crest inferiorly

Aggressive Break



99.9% of L4-5 disc spaces can be accessed!

Implant Placement

BMP

- Should already have been prepared
- Pack both apertures (med or lg kit)
- Optional – tie suture around implant to contain BMP during implant insertion
- Caution – can lose BMP through suction (especially if irrigating prior to close)
- If endplates destroyed, BMP may cause osteolysis

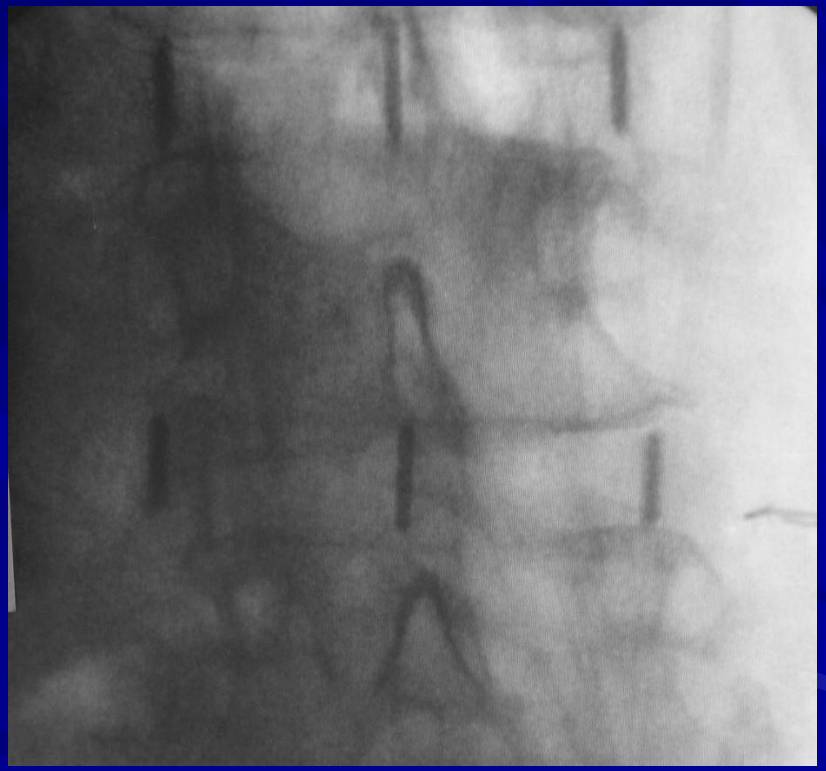
Implant Placement

- Choose larg… of ring apophy…
- Unbreak tal… oss

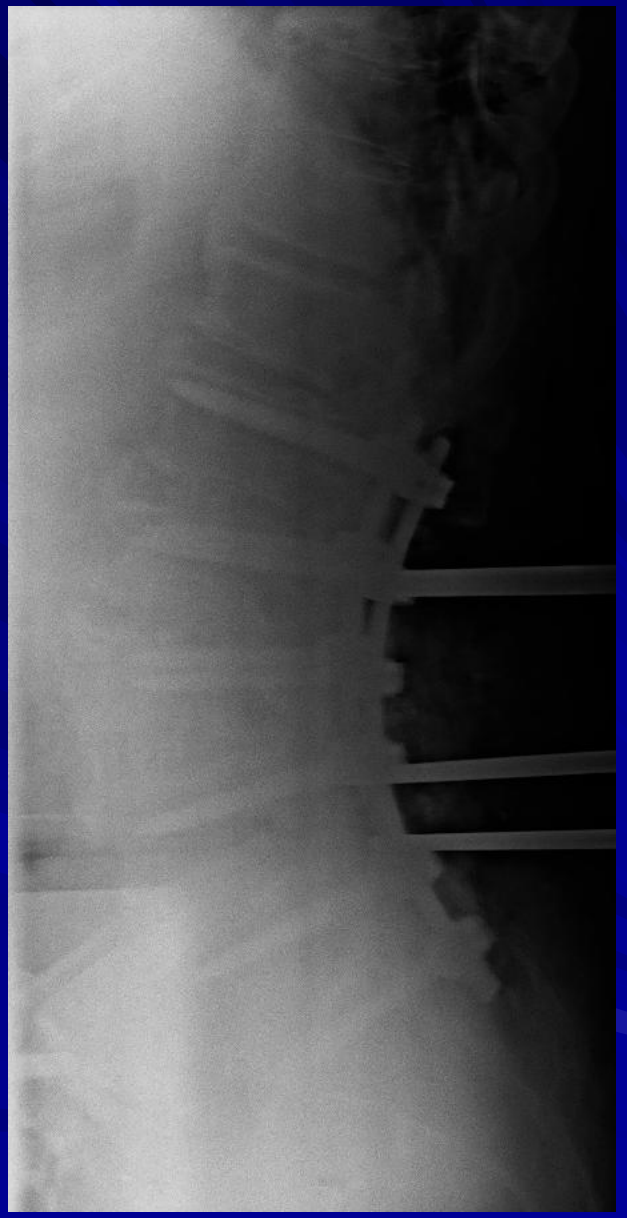
Implant Placement

<u>Lateral view</u>:
Anterior half of disc space,
Endplates intact

<u>AP view</u>:
Center marker along spinous processes,
Lateral markers along margins of vertebrae

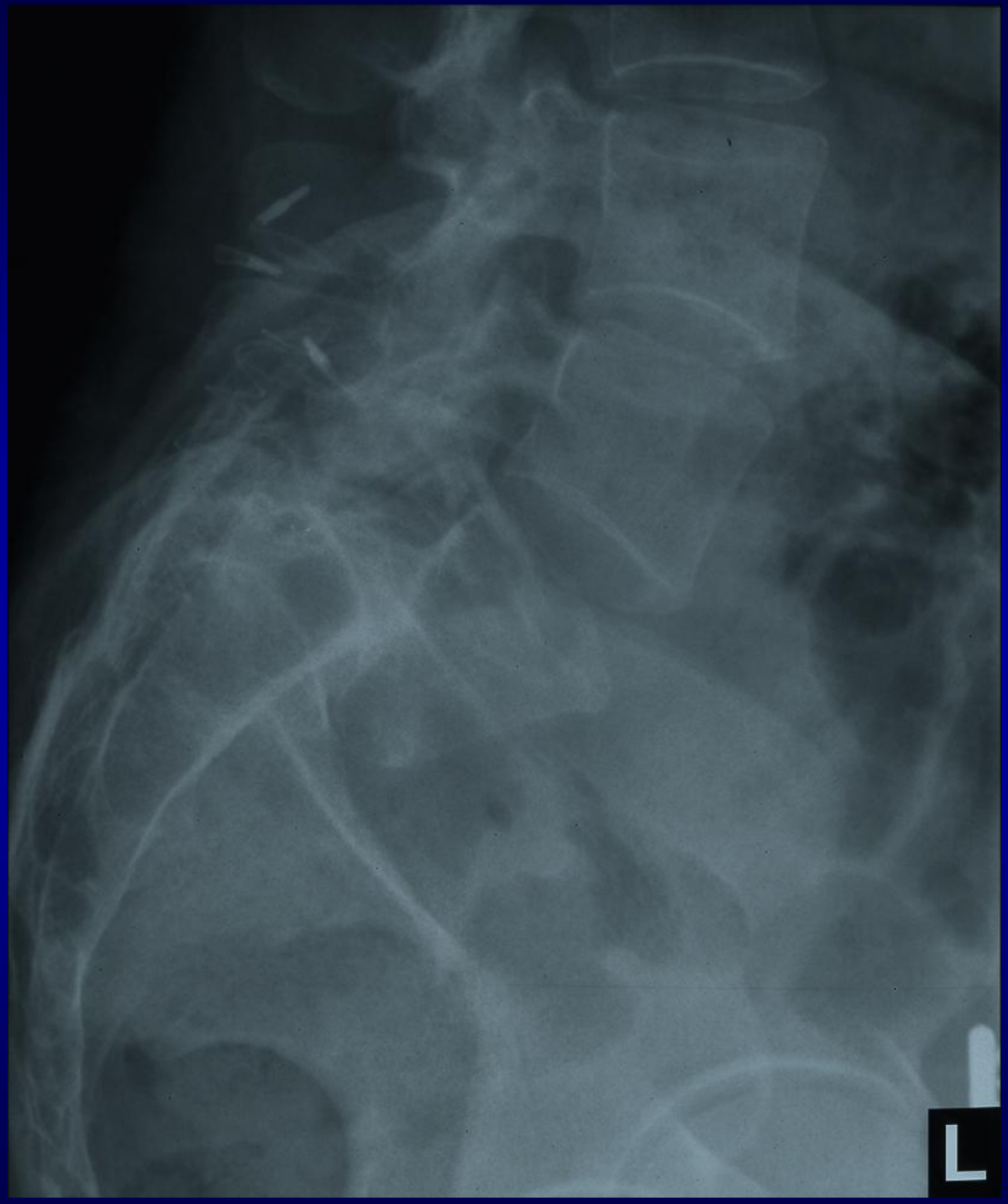



1500HRS
Portable
PA

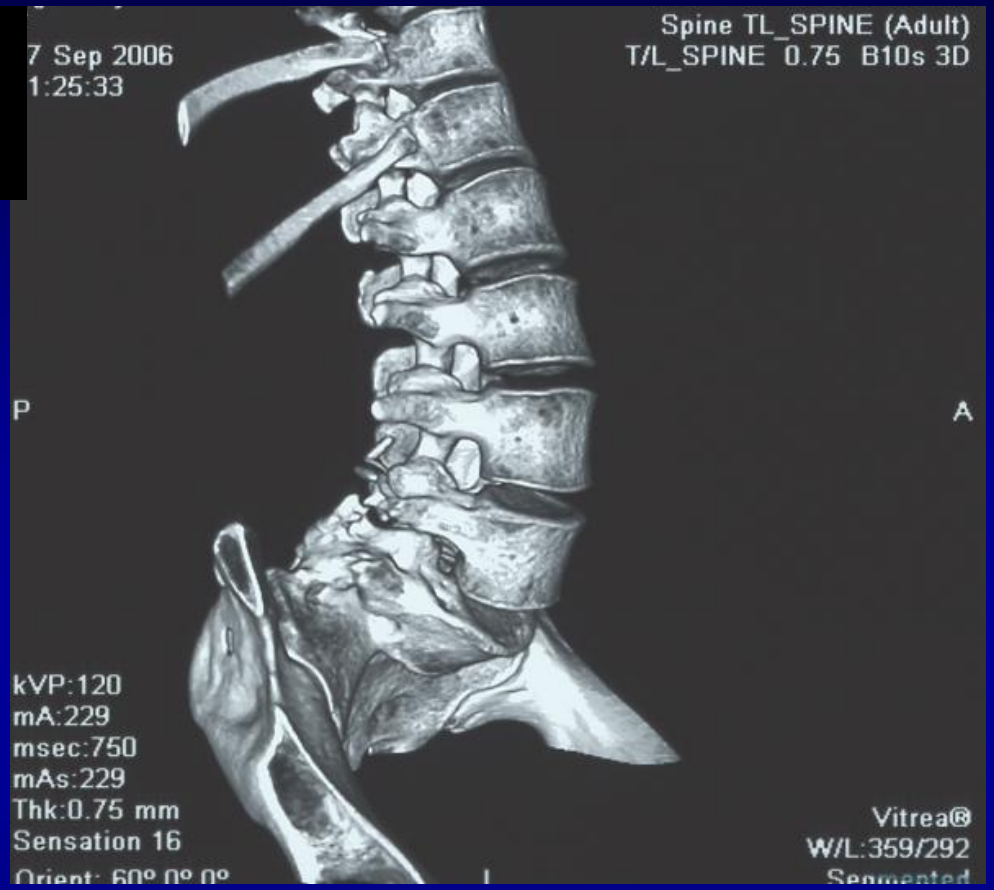


Case 4

- 41 y. o. female
- Injured back doing gymnastics as a 13yo
- S/P L5 laminectomy/*in situ* fusion 1991
- Progressive debilitating mechanical LBP
- Radiating LE pain/posterior thighs to knee


L


Spin: -90
Tilt: 0
A
SAGITTAL
SL 2.0


7 Sep 2006
1:25:33
Spine TL_SPINE (Adult)
T/L_SPINE 0.75 B10s 3D
P
A
kVP:120
mA:229
msec:750
mAs:229
Thk:0.75 mm
Sensation 16
Vitrea®
W/L:359/292


A
TR 4609.0
TE 134.0\1
TA 05:38
AC 2
F:13
W 1764
C 634
LUMBAR


A
TR 4609.0
TE 134.0\1
TA 05:38
AC 2
F:13
W 1230
C 645
LUMBAR


AF
MF 1.50
R


AF
MF 1.50
R
tse1_7
*RI D
TR 5605.0
TE 117.0/1
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AC 1
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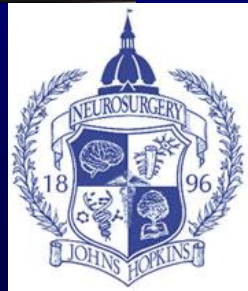
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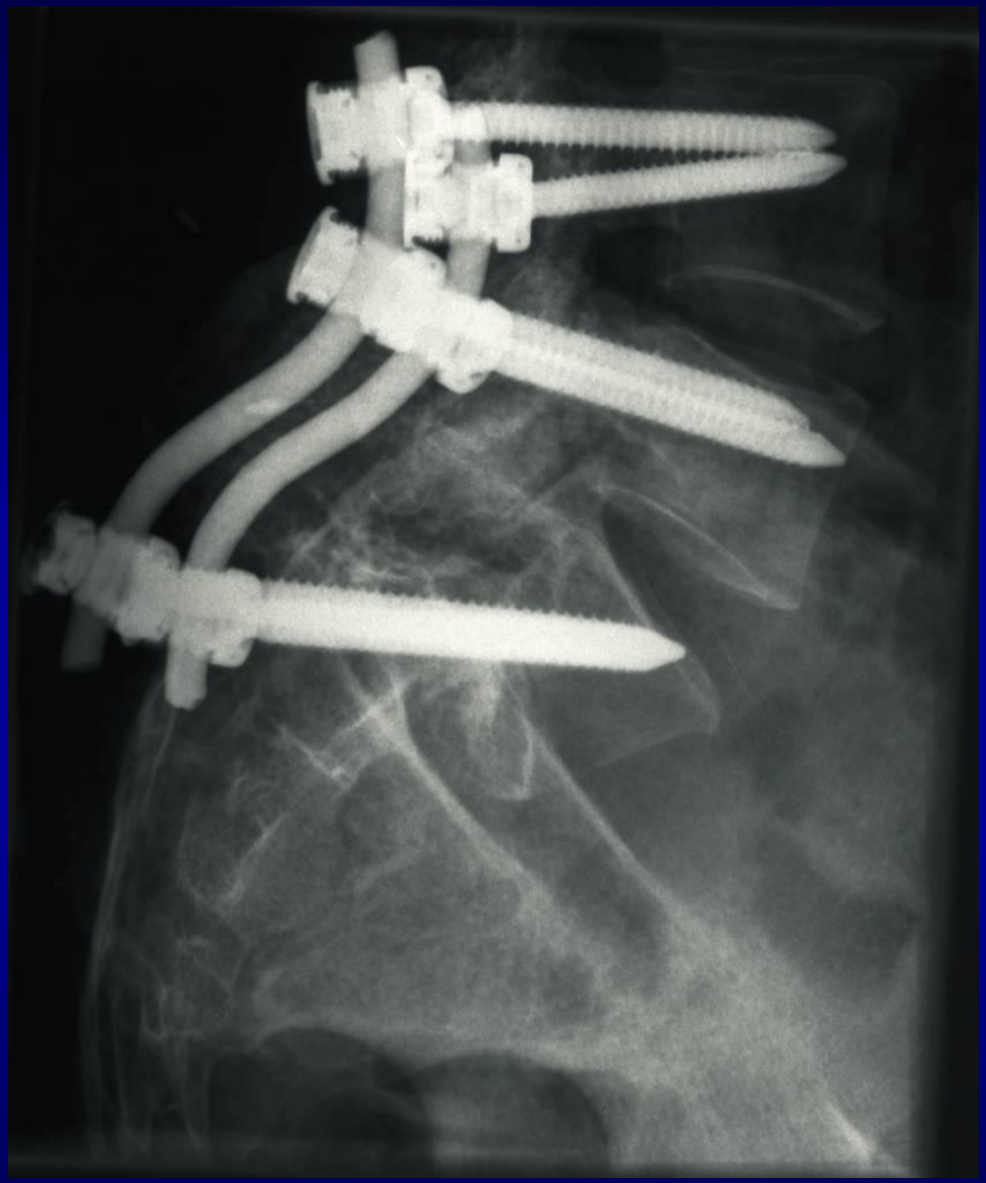

NEUROSURGERY
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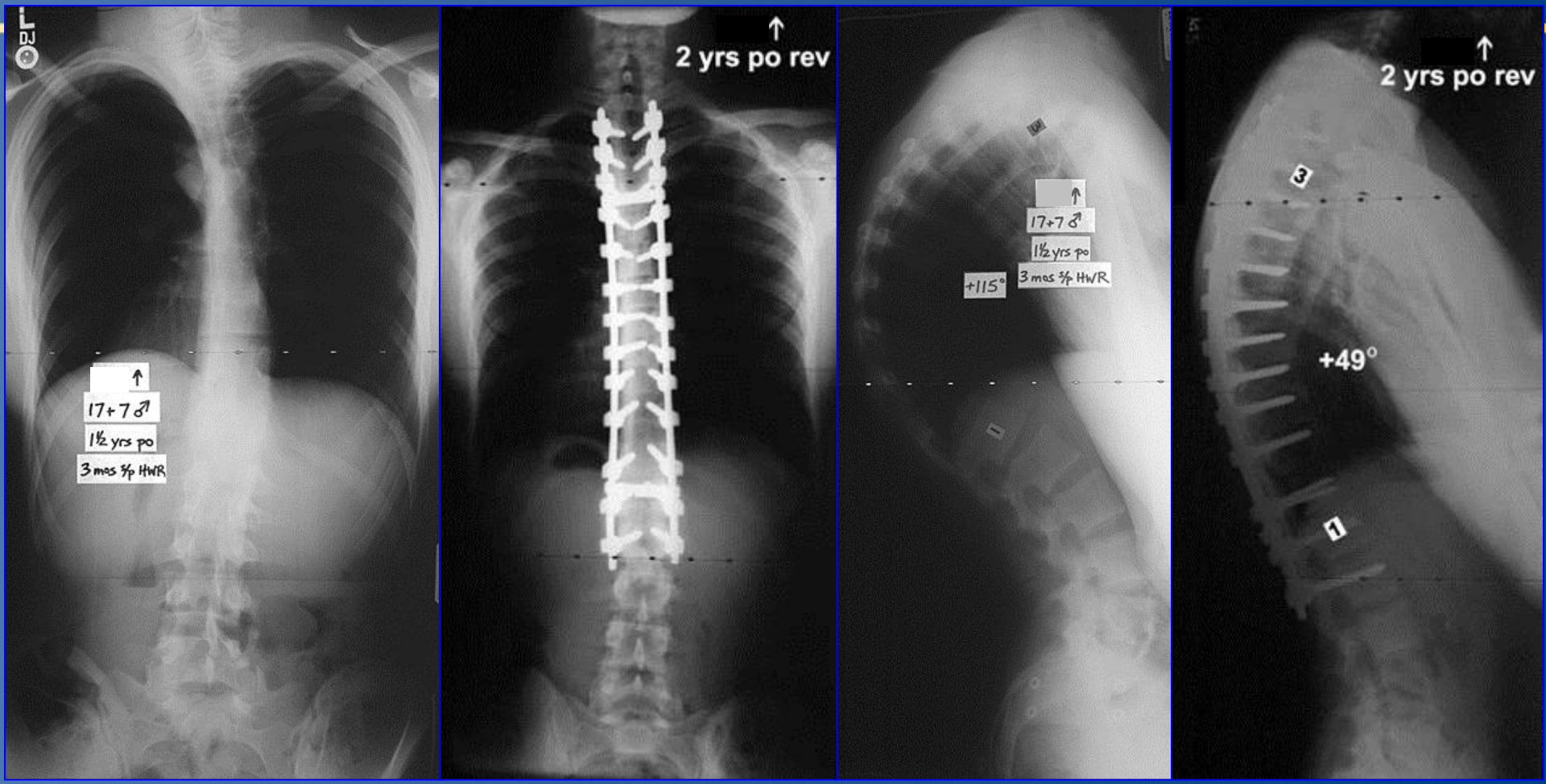
JOHNS HOPKINS

Posterior: T_2-L_2 and 9 SPO



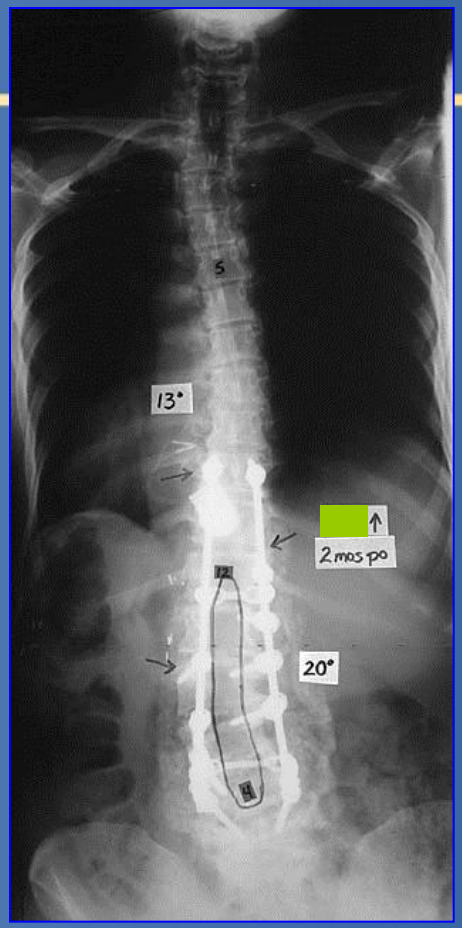
Lenke

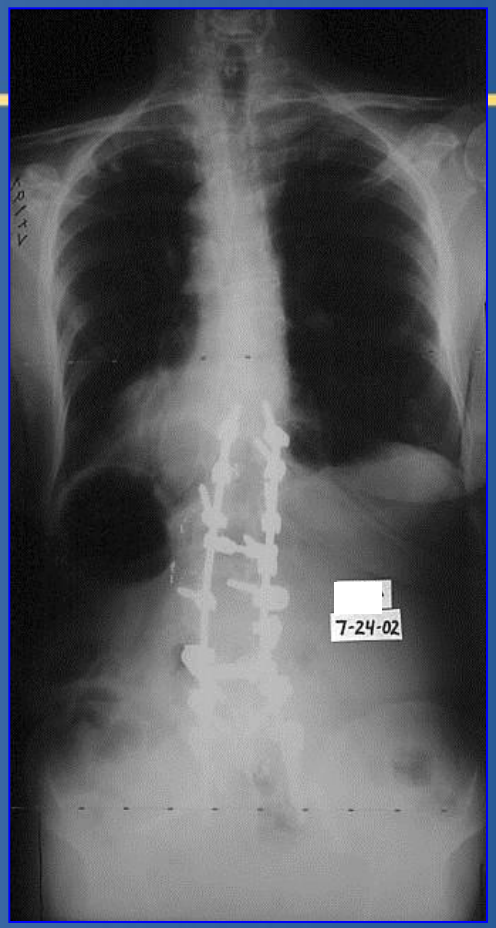
Preop

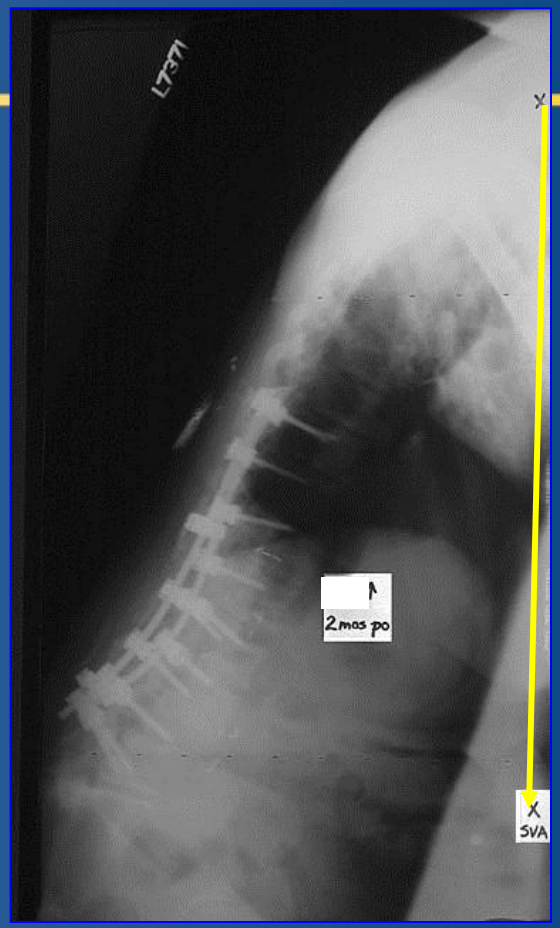
Postop

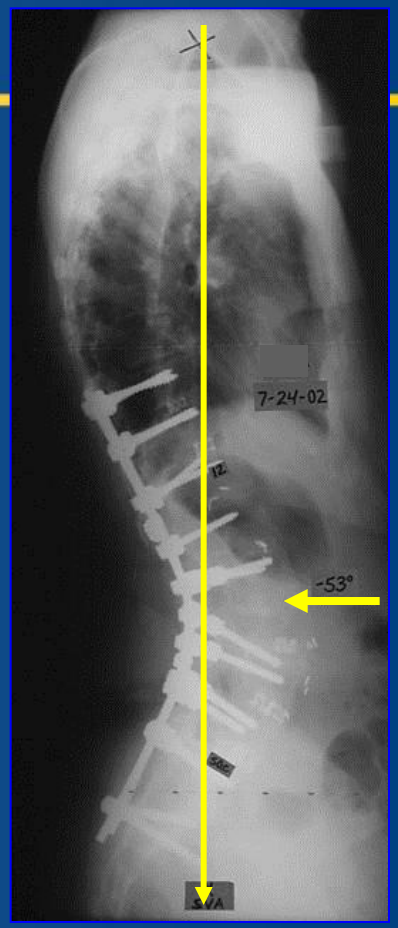
S/P REV-PSF/PSO-L3/ASF

JOHNS HOPKINS MEDICINE









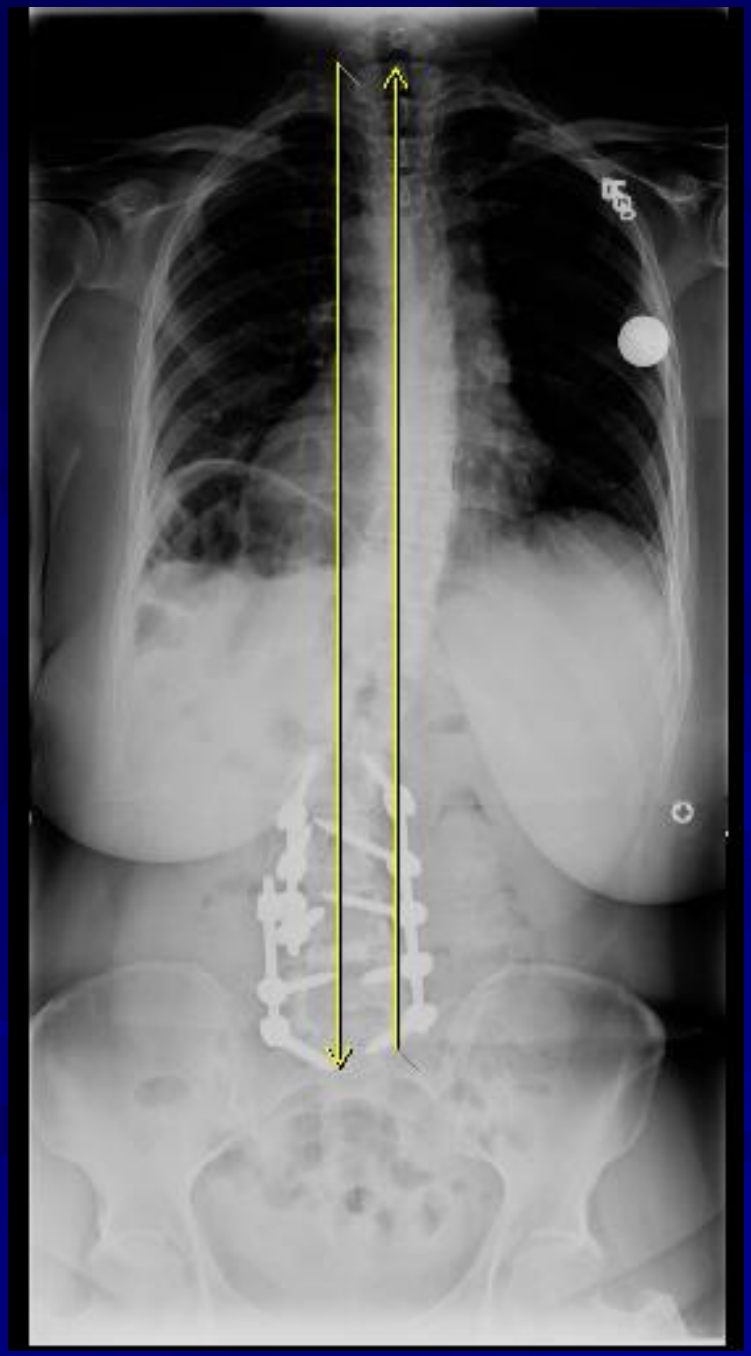
Achieve Balance!

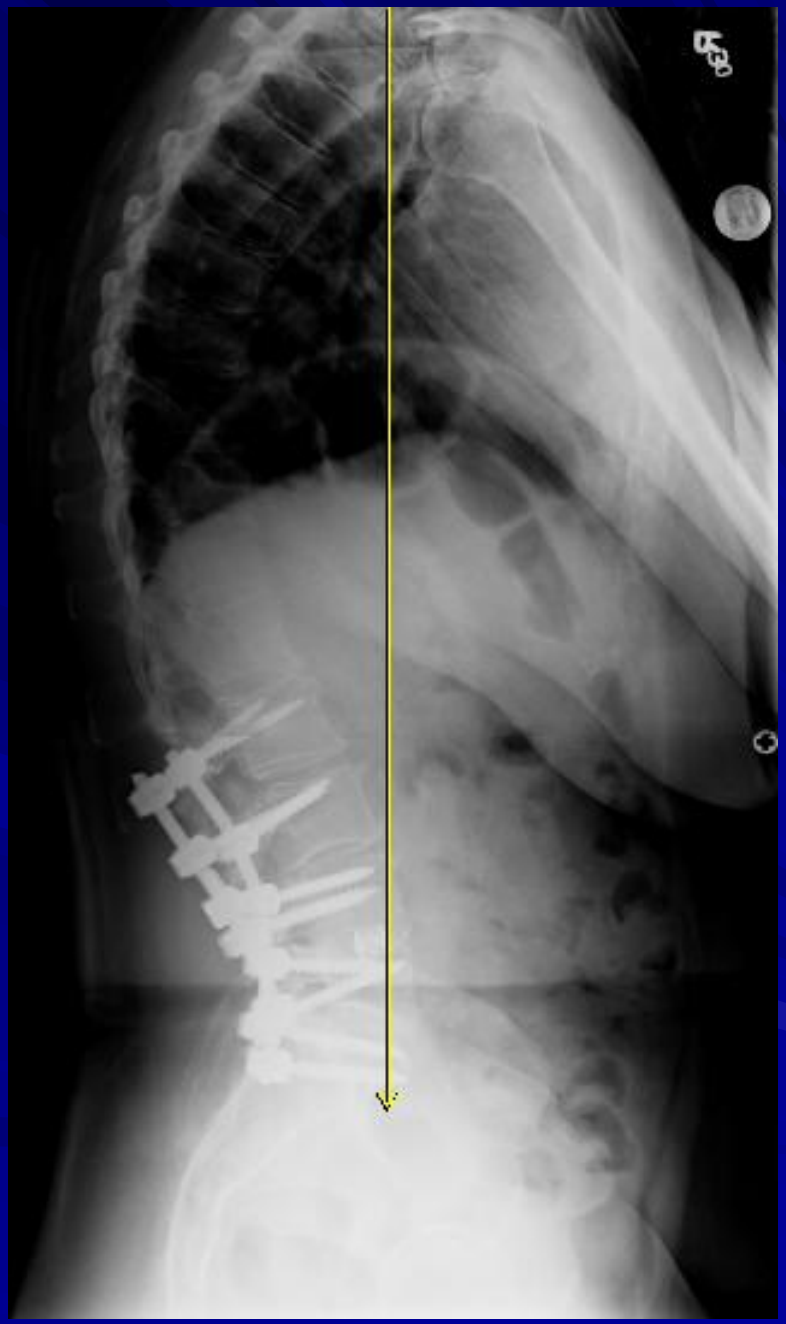
Preop

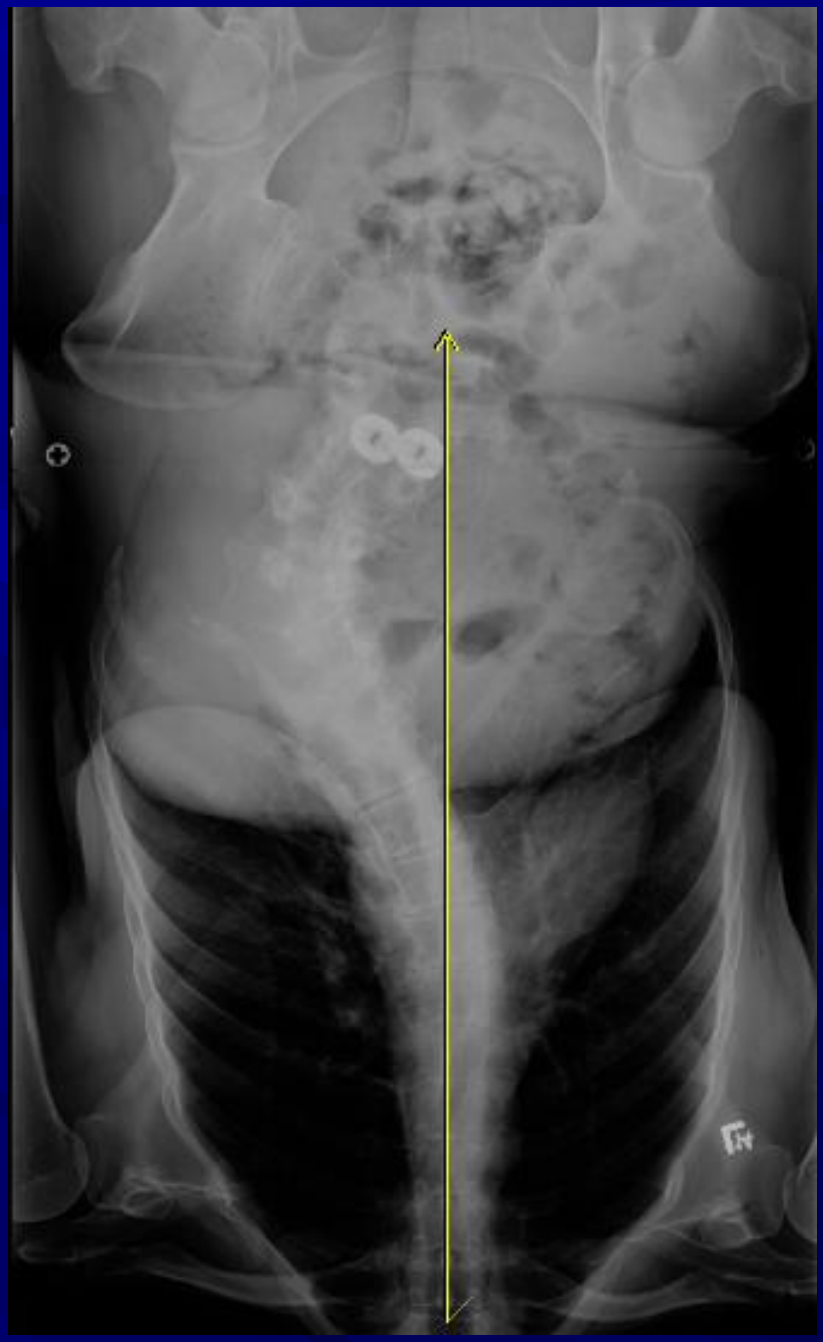
Postop

JOHNS HOPKINS
MEDICINE


1040HRS





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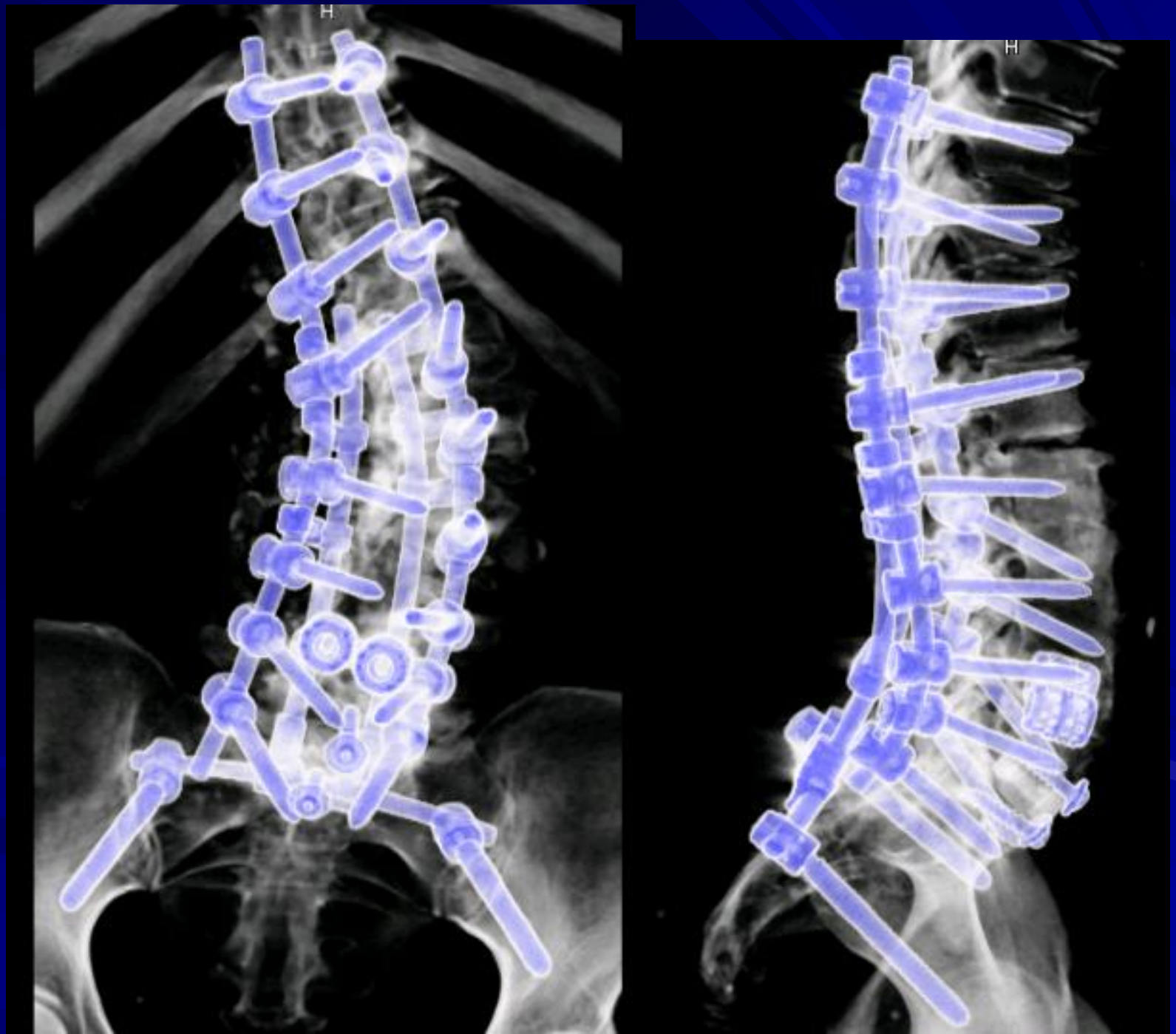

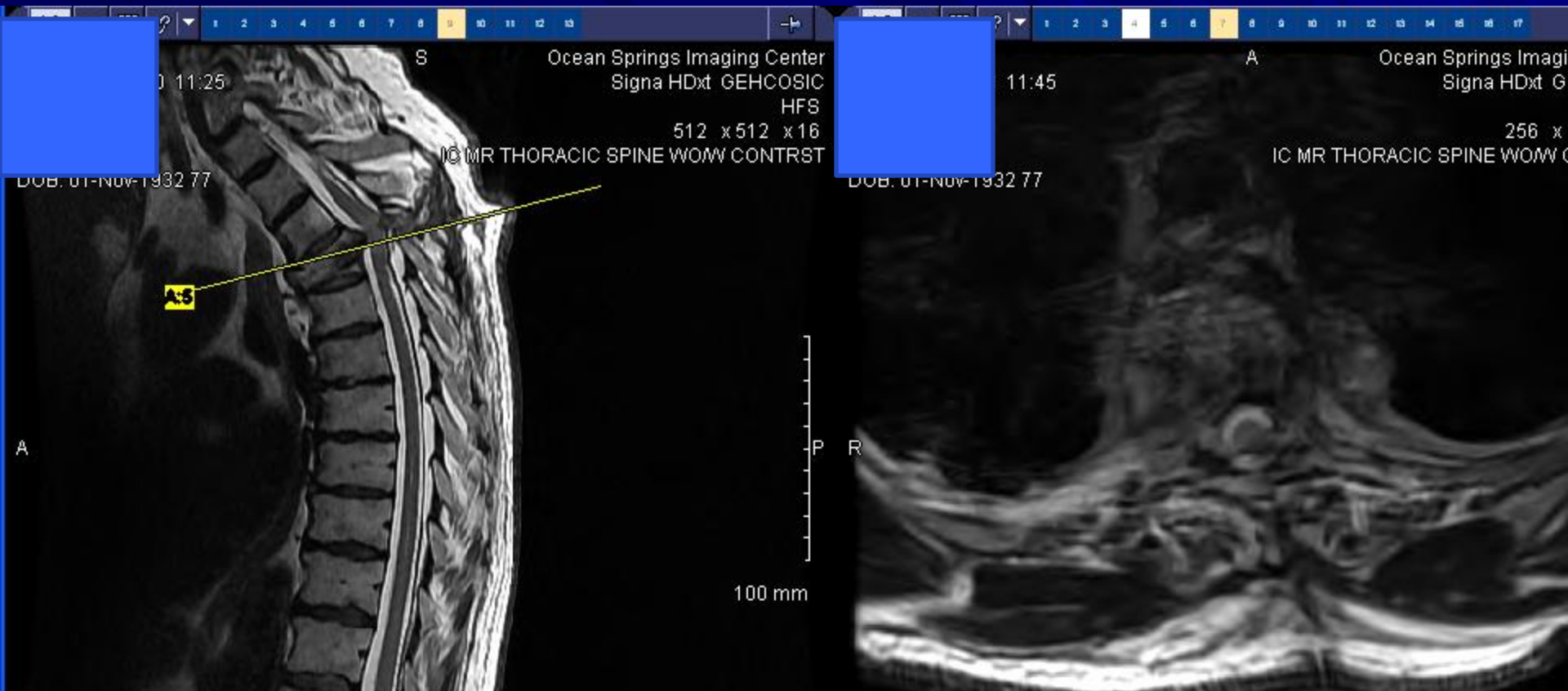
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Ocean Springs Imaging Center
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IC MR THORACIC SPINE WO/W CONTRST
11:25
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A
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TR: 2050.00
TE: 107.1
Slice:3.00 Loc:-22.73
Lossy: 20:1
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TE: 113.0
Slice:3.00 Loc:28.83
Lossy: 20:1
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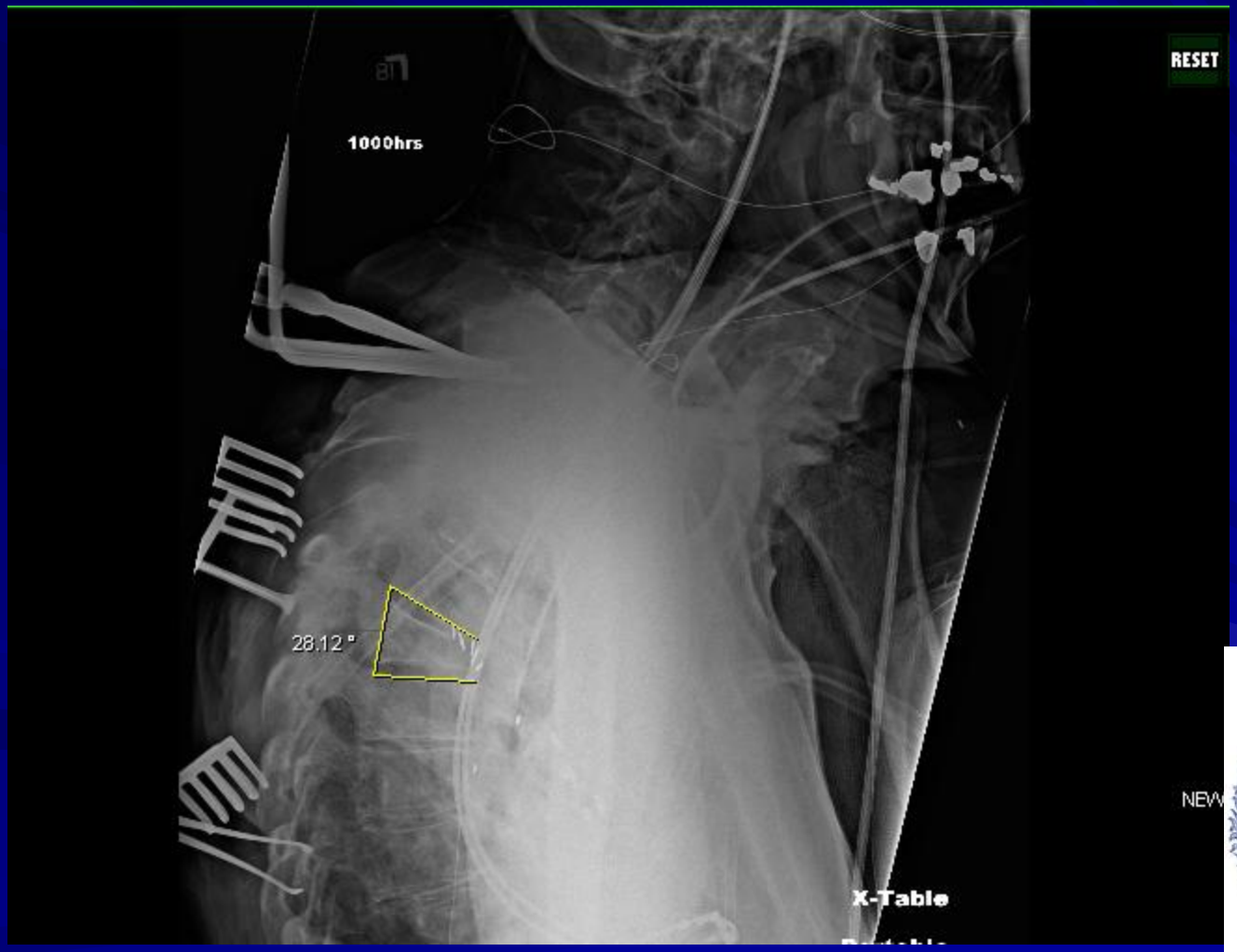
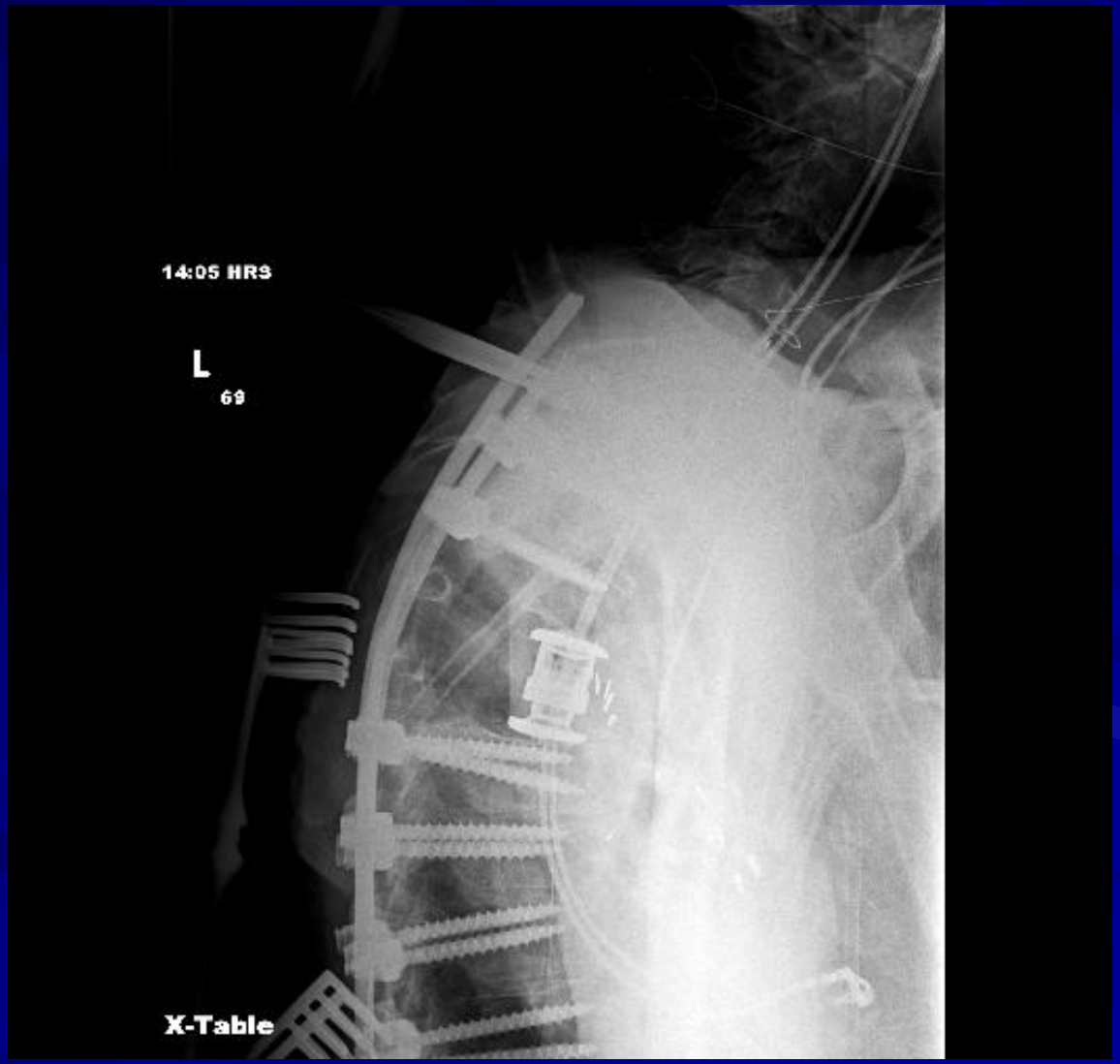
W:
Filter:No

PPre-Op 27.7 degrees of Focal Kyphosis

First Intra-Op Film, About 28 degrees of Focal KyphosisFi



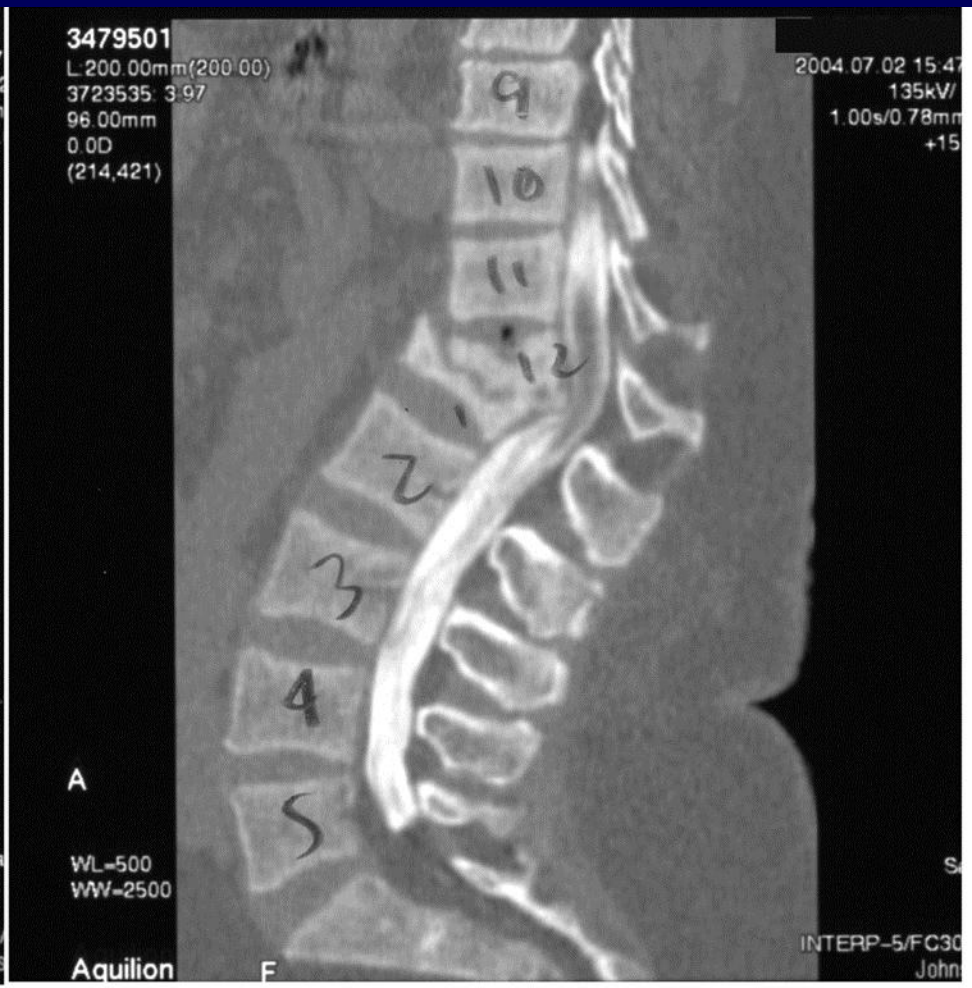
After Cage Placement Prior to Final Correction With the Rods



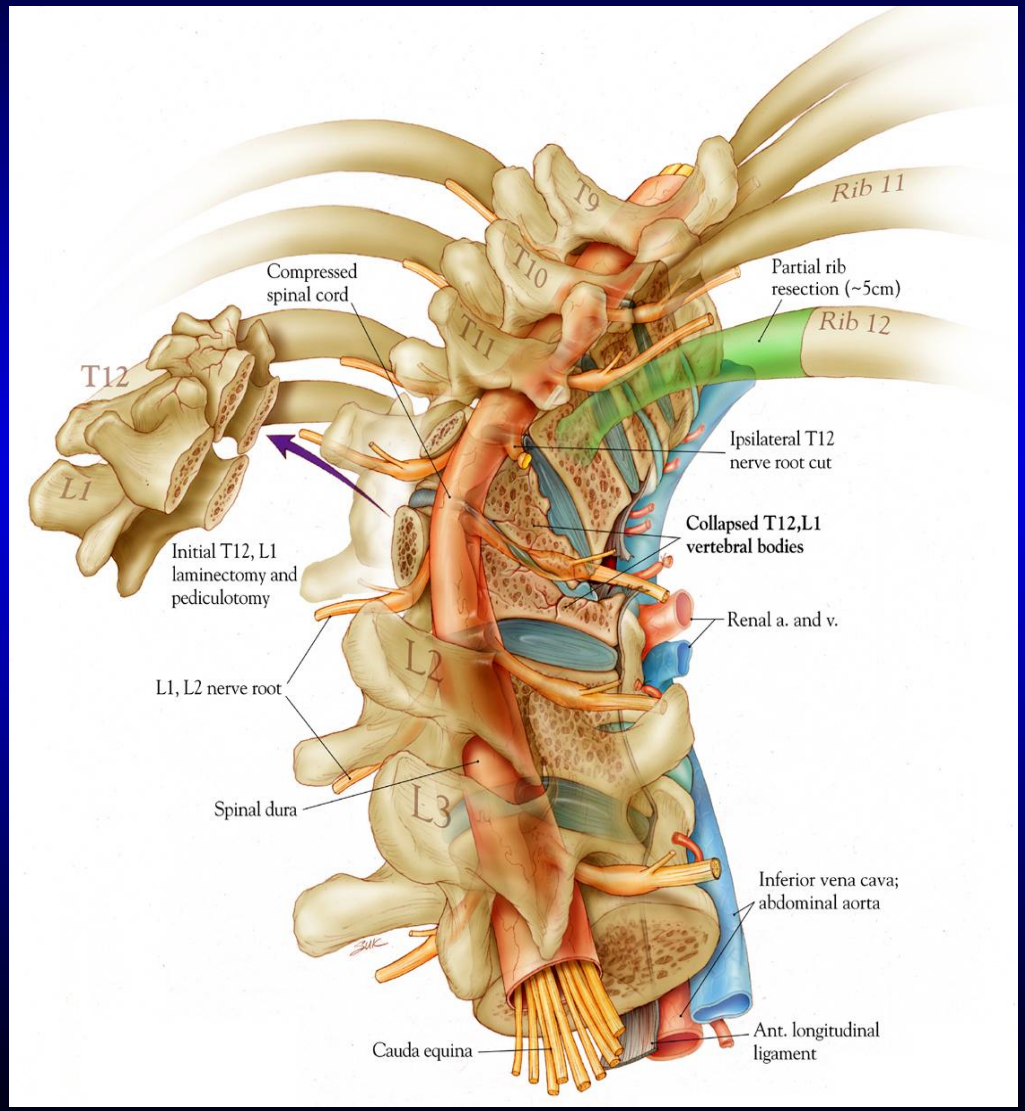
Final Correction with about 11 Degrees of Focal KyphosisF


51.20 cm
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
L1
L2
L3
L4
L5
S1
S2
9.82 °

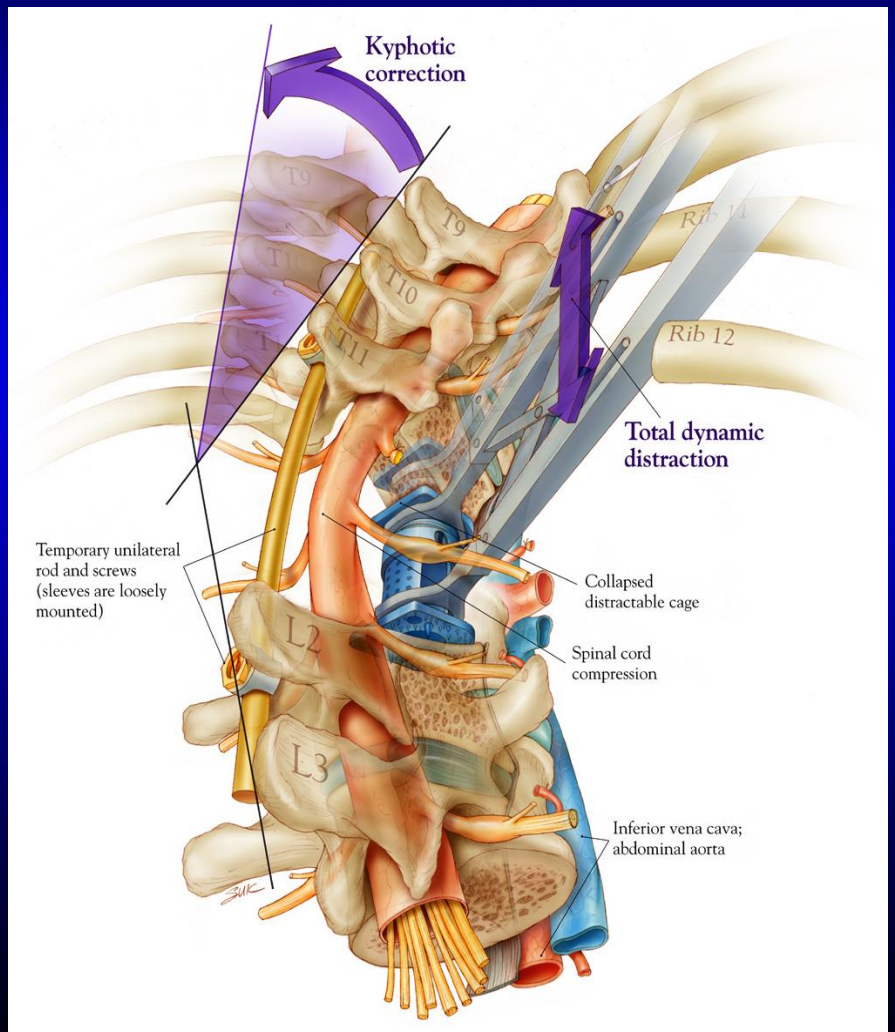
360° Kyphotic Deformity Correction Managed Through a Posterior Approach

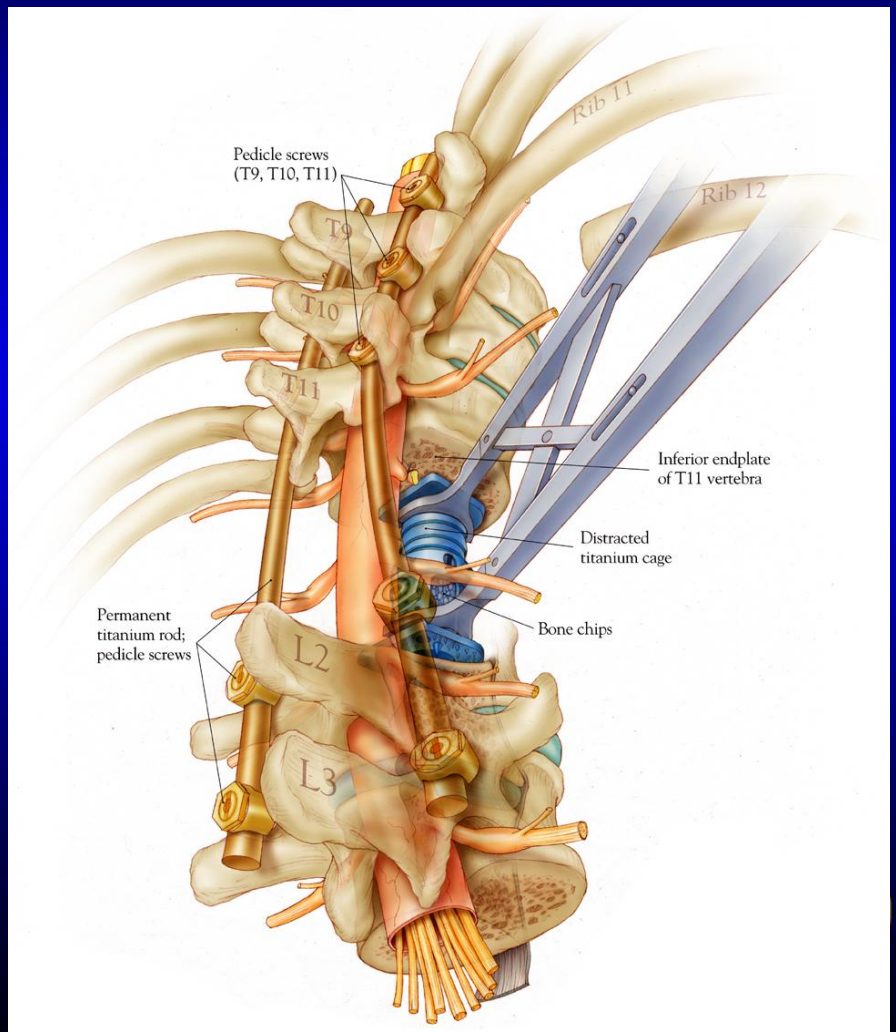


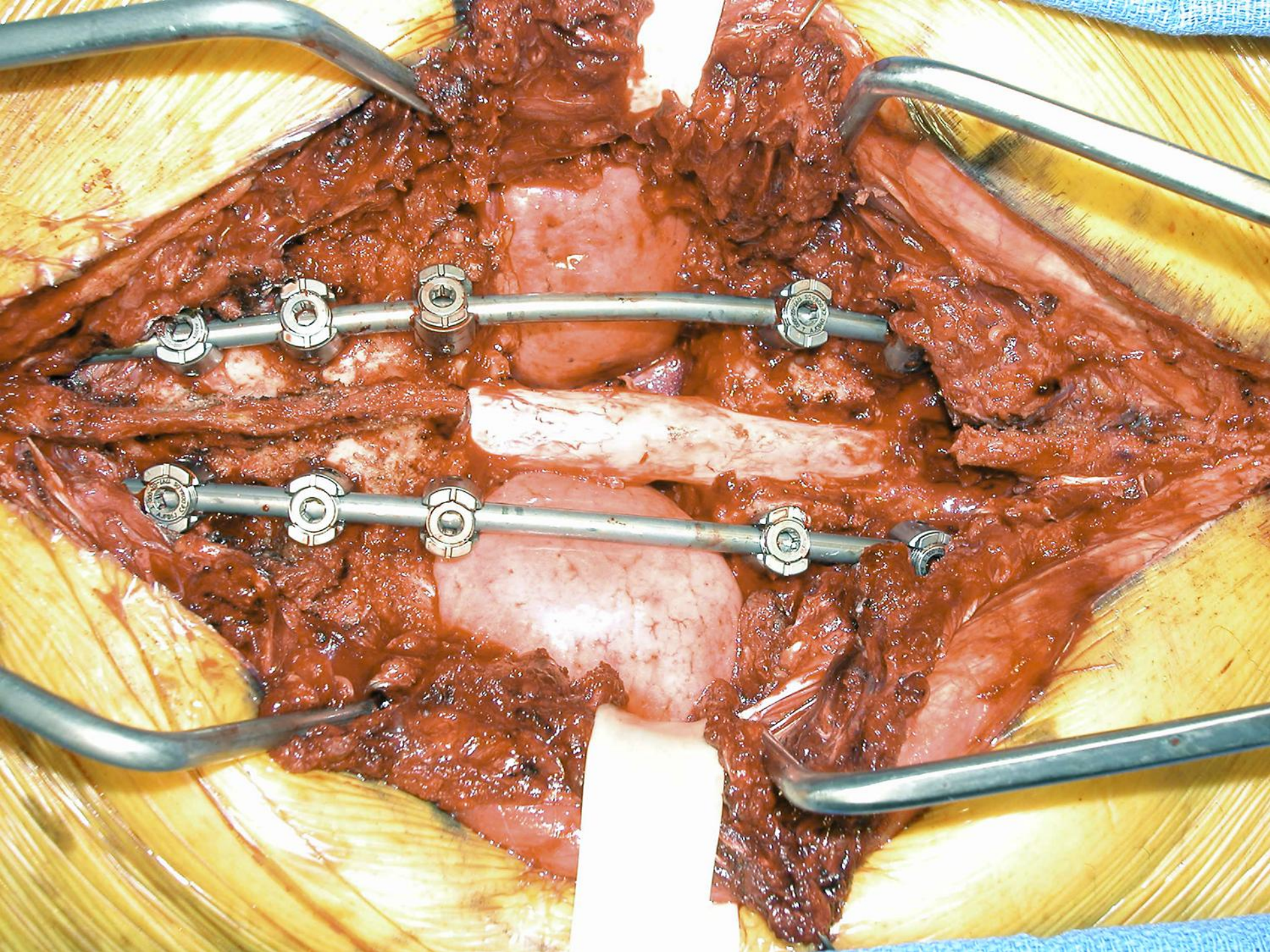
360º Kyphotic Deformity Correction Managed Through a Posterior Approach

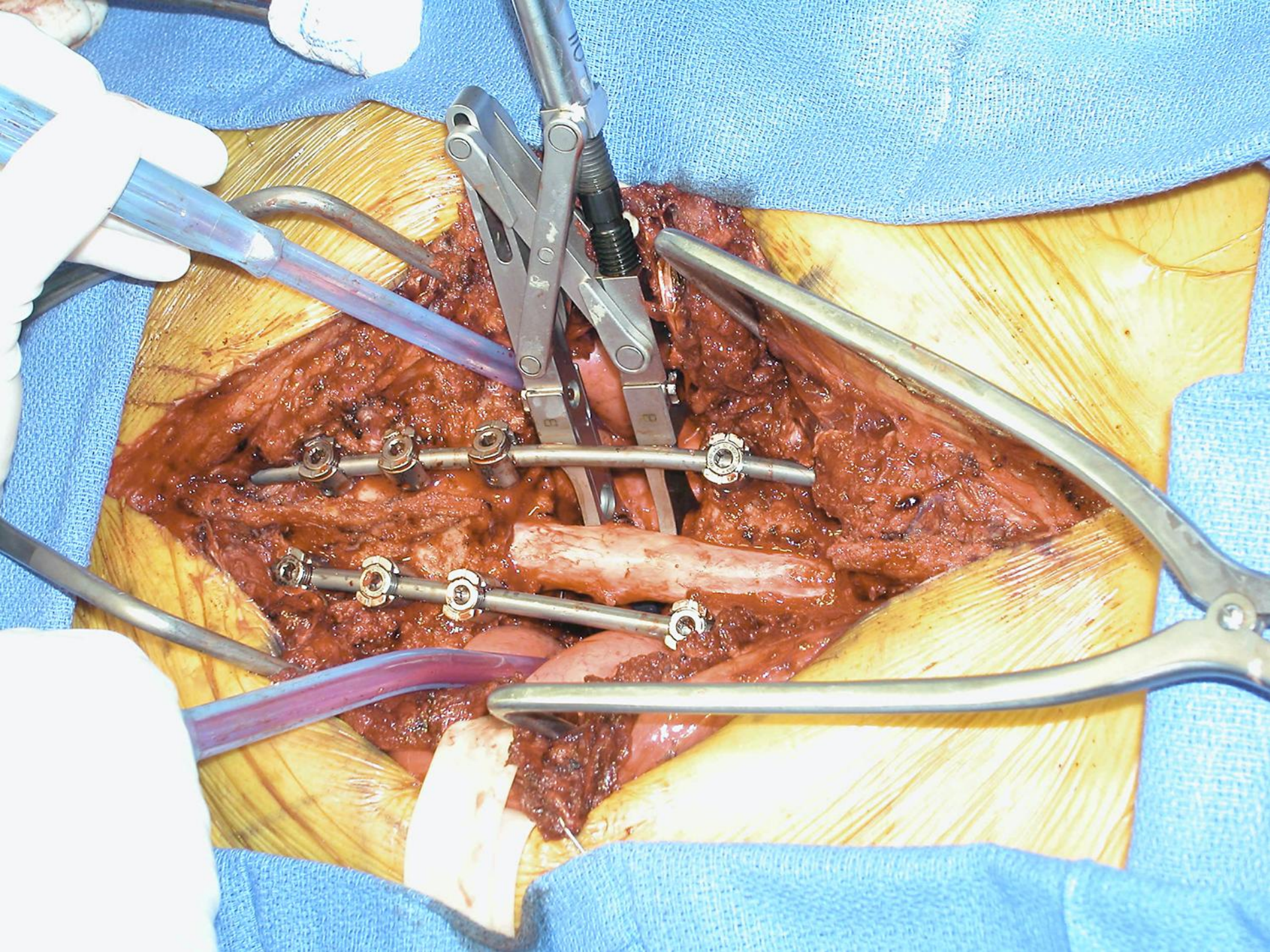


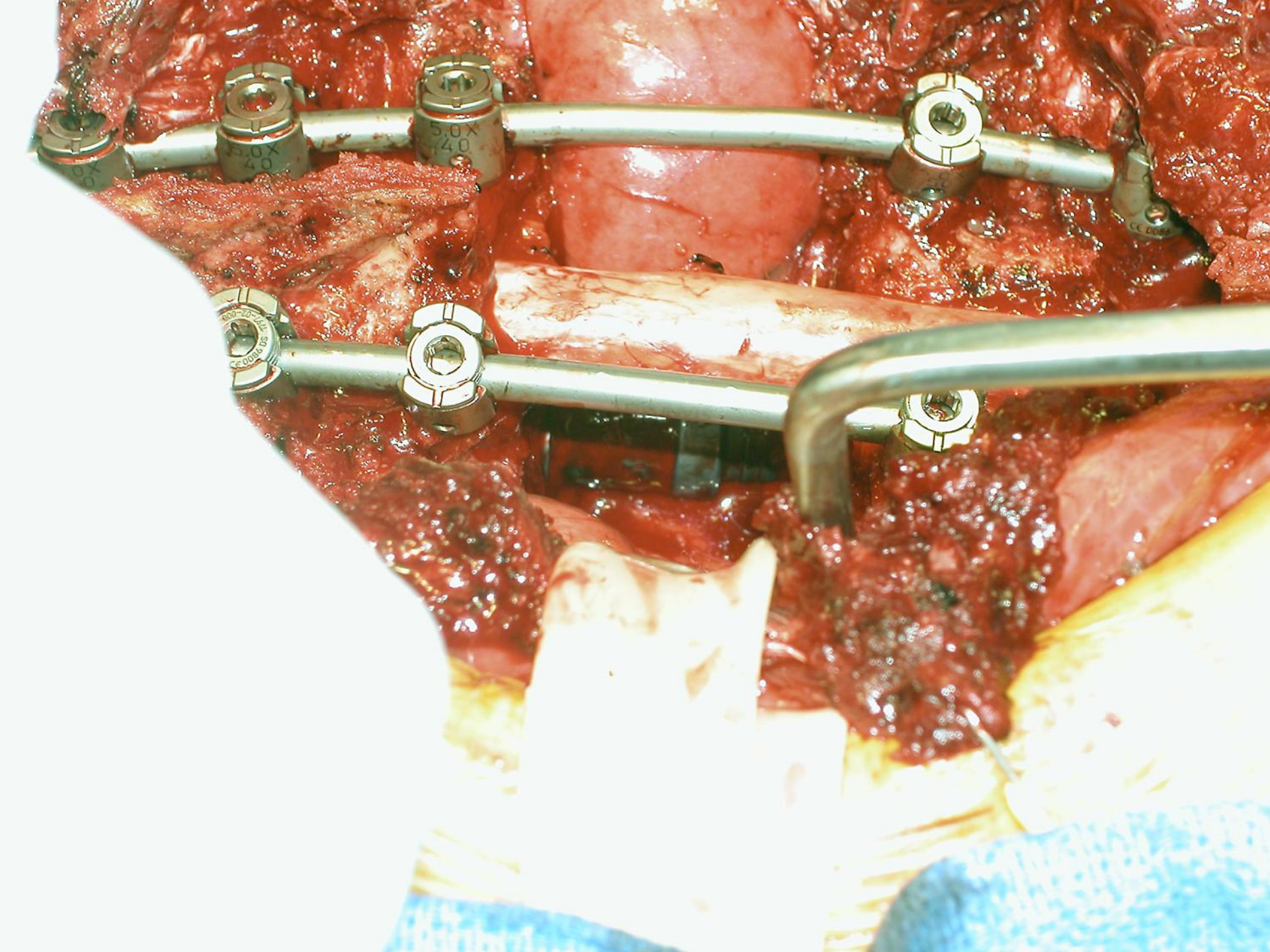
360° Kyphotic Deformity Correction Managed Through a Posterior Approach



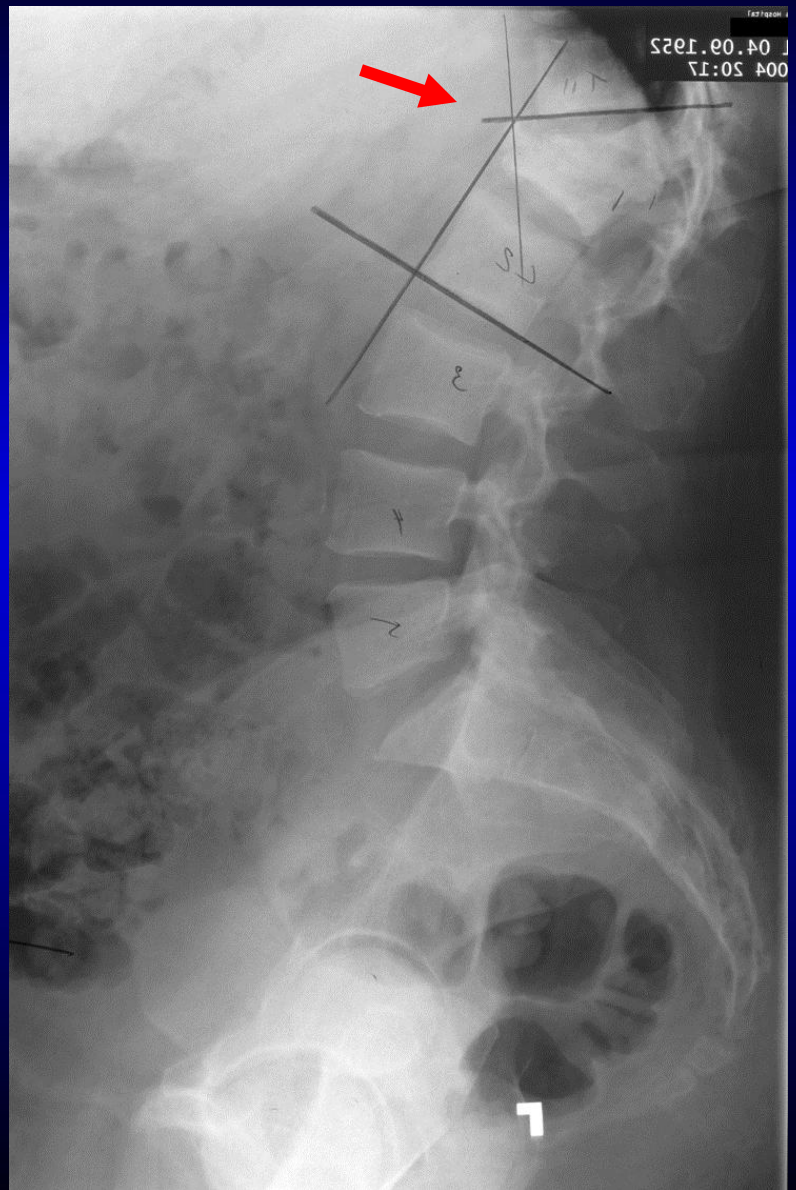


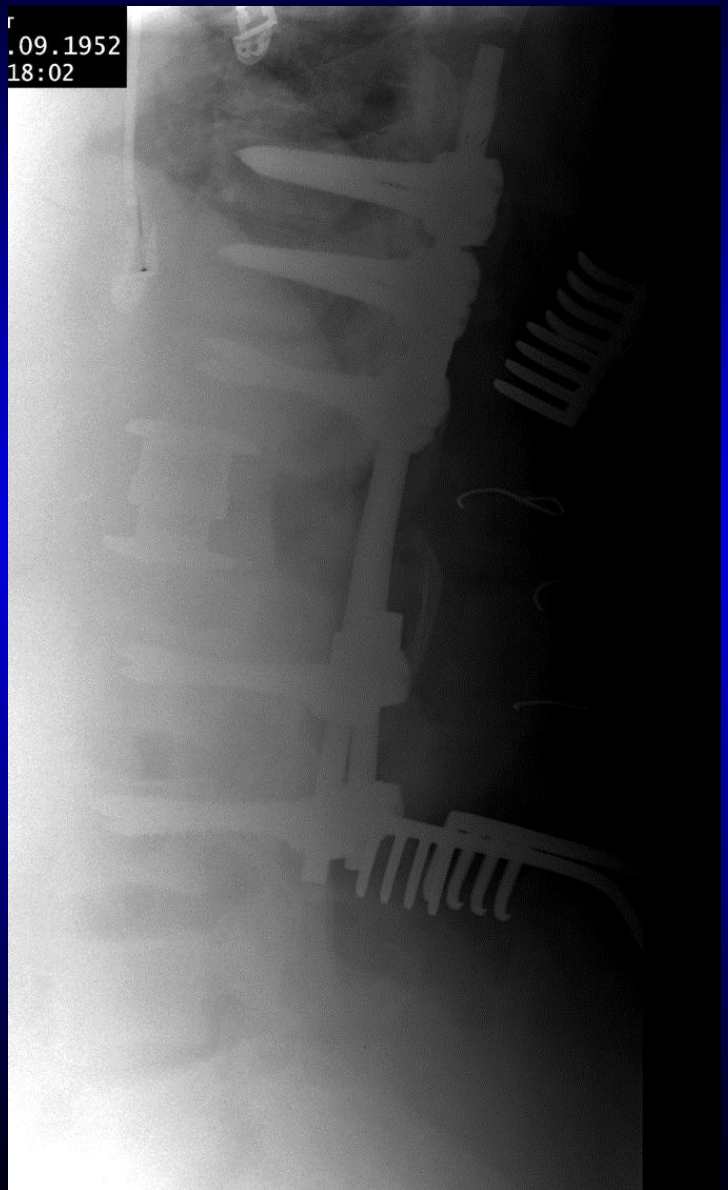




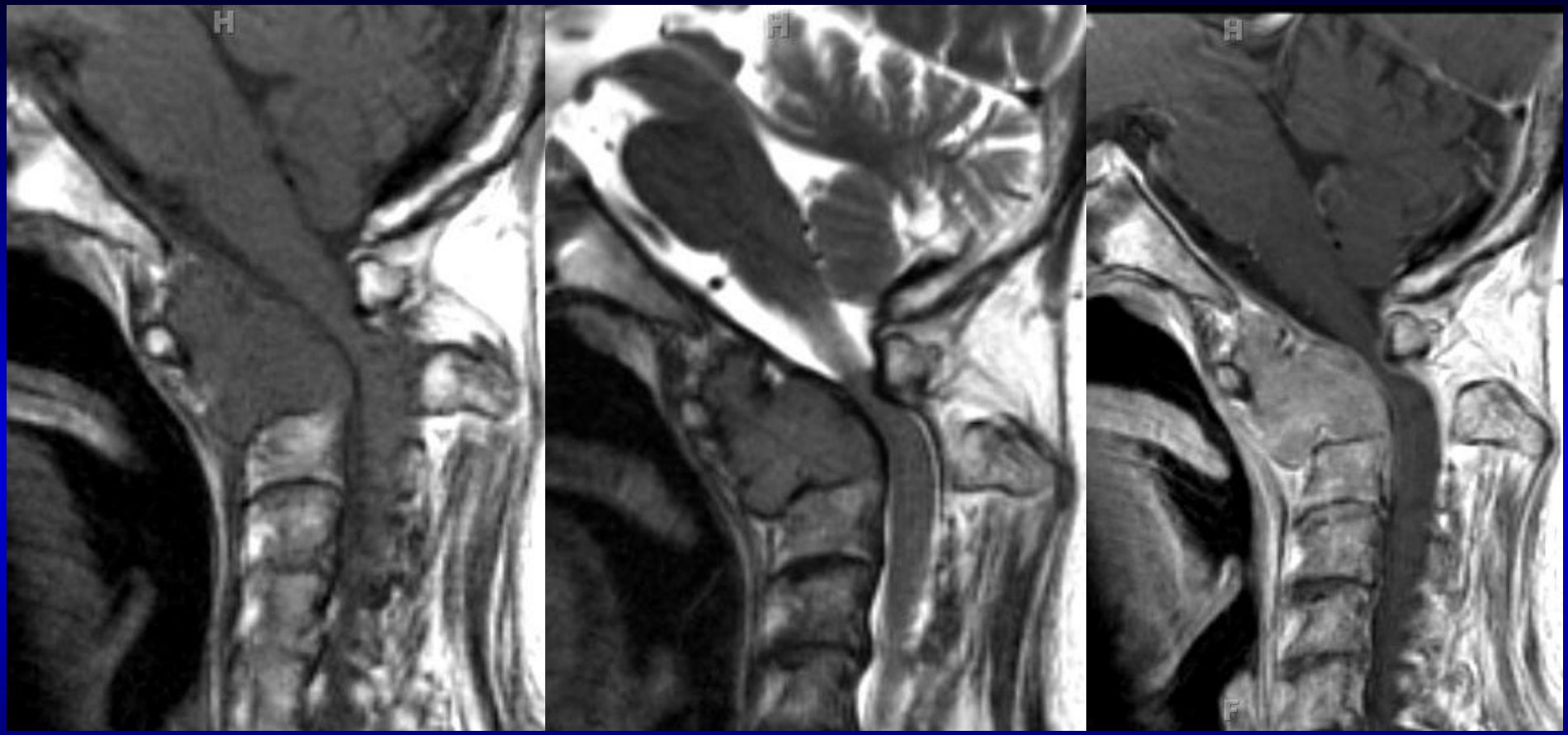


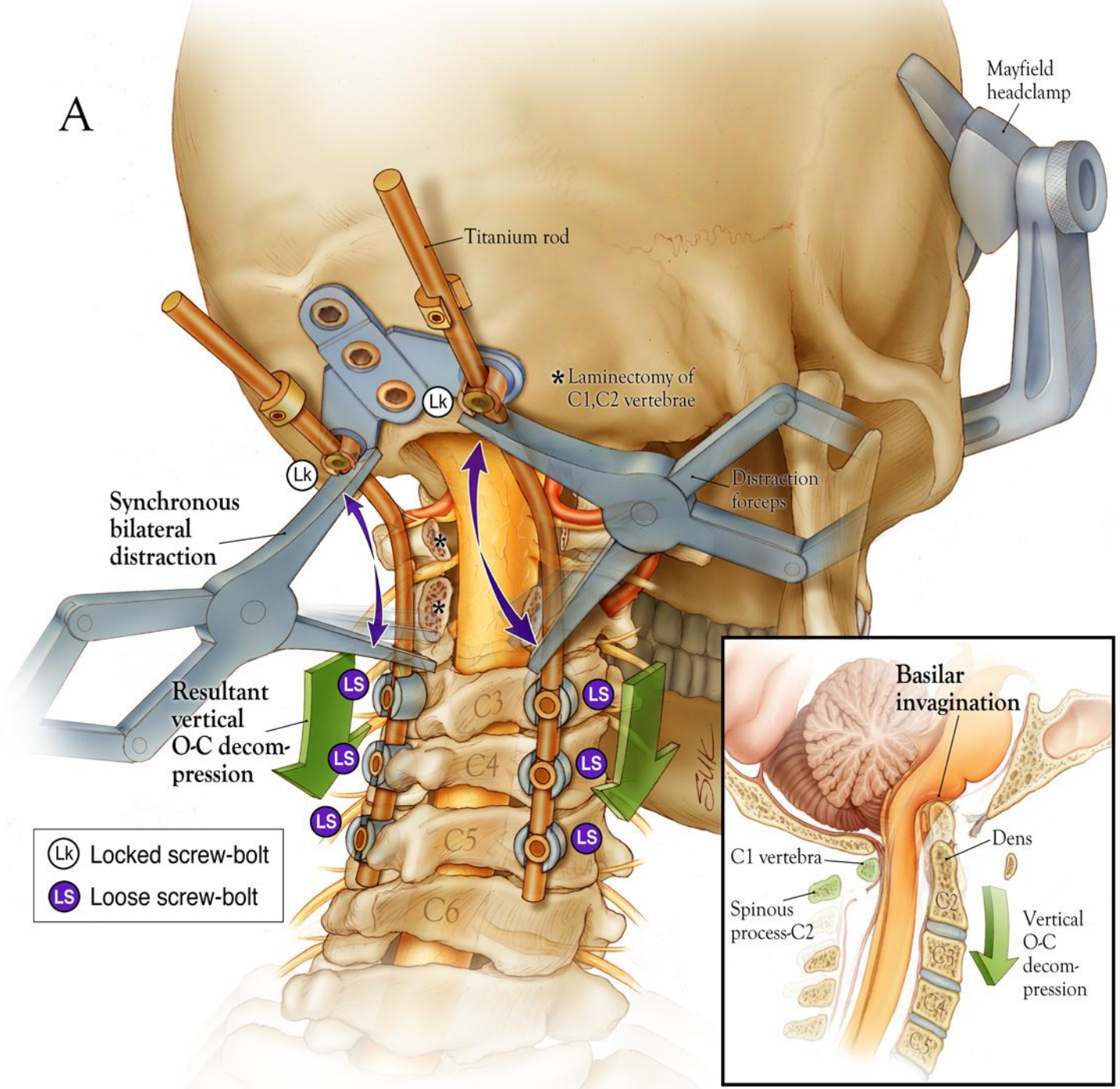
360º Kyphotic Deformity Correction Managed Through a Posterior Approach

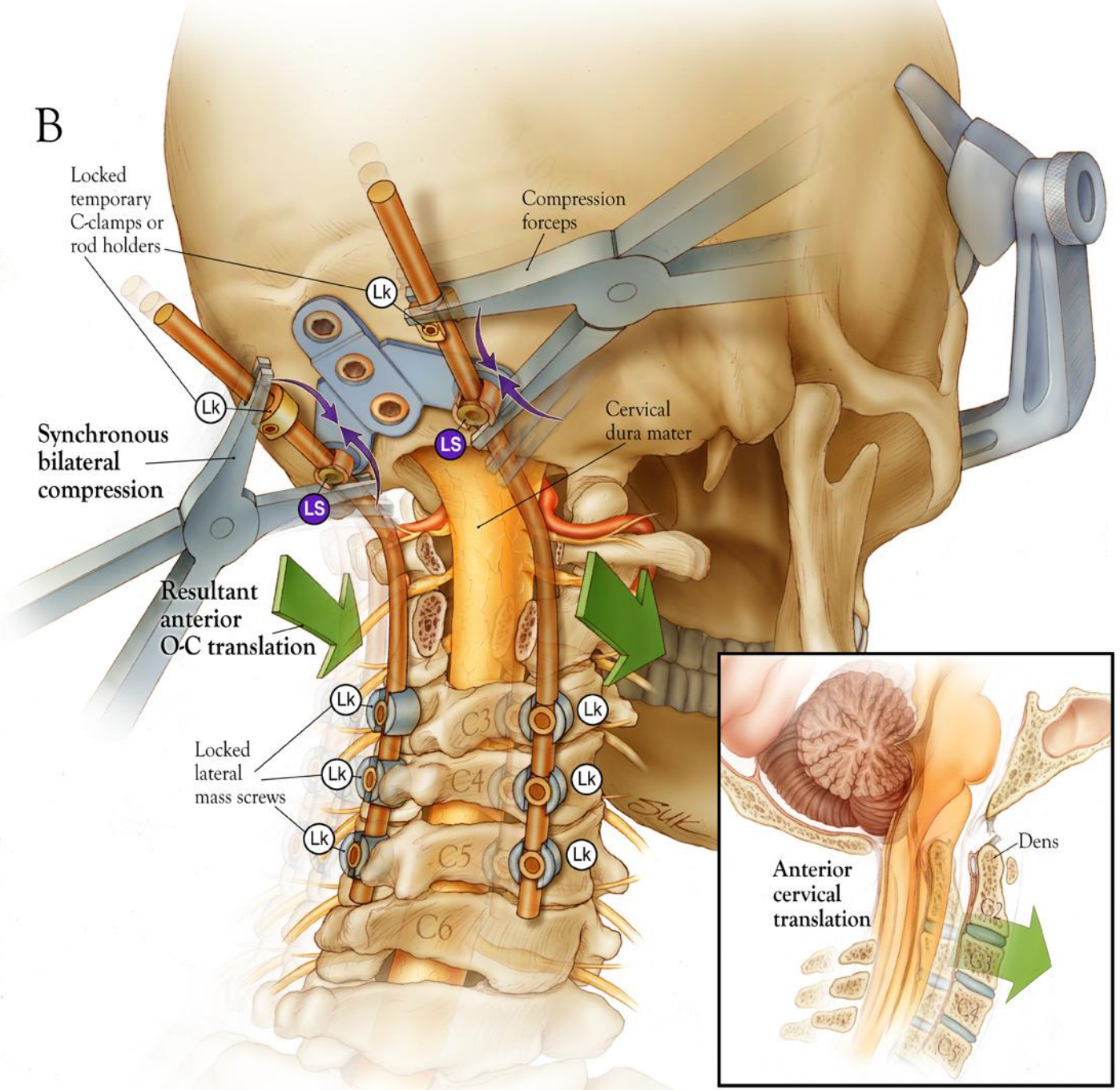


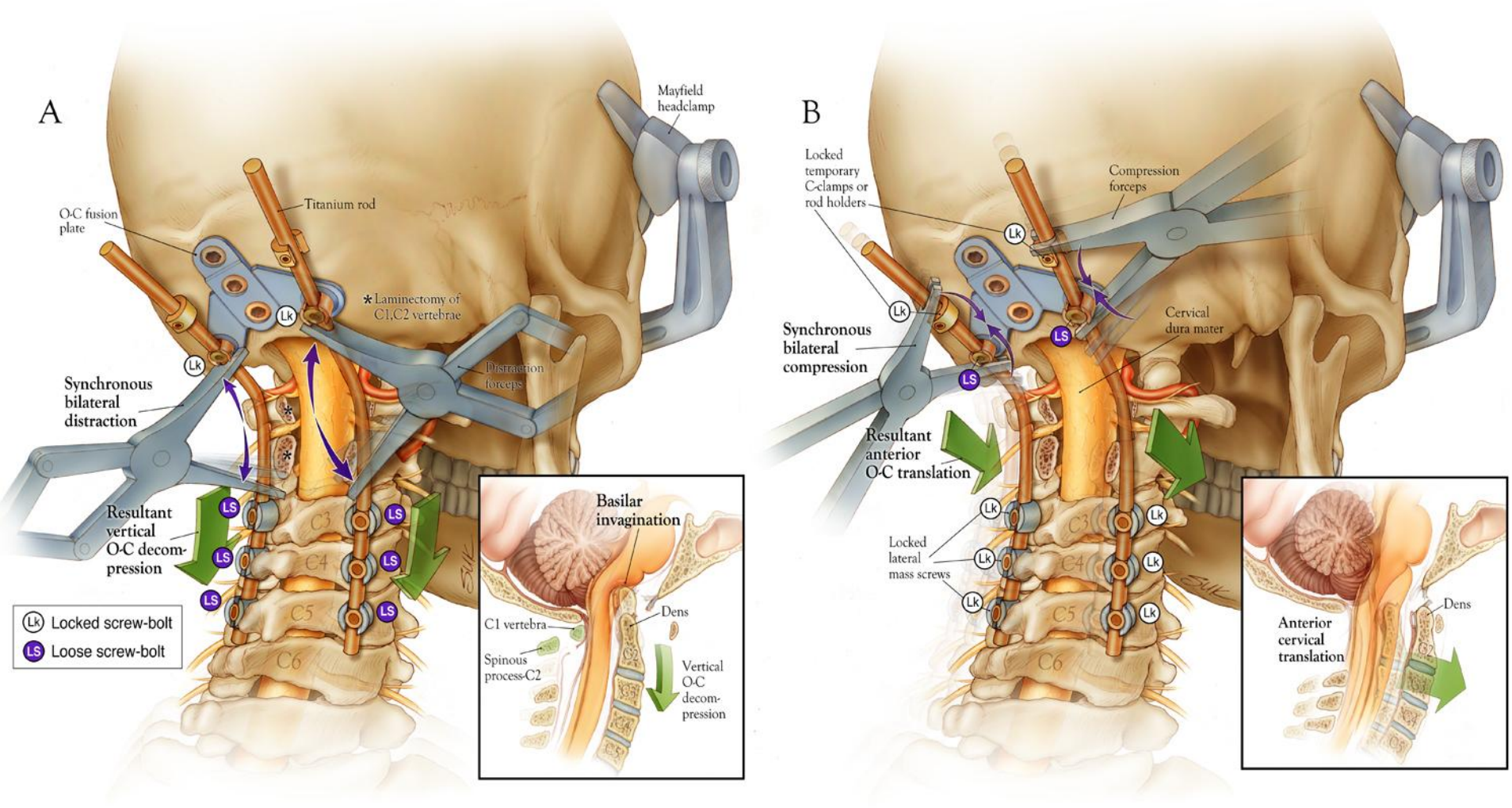



H
Spin: -9
Tilt: 0
L
F


H
H
A
F


A
Mayfield headclamp
Titanium rod
* Laminectomy of C1,C2 vertebrae
Lk
Lk
Distraction forceps
Synchronous bilateral distraction
Resultant vertical O-C decom-pression
LS
LS
LS
LS
LS
LS
C3
C4
C5
C6
Lk Locked screw-bolt
LS Loose screw-bolt
Basilar invagination
Dens
C1 vertebra
Spinous process-C2
Vertical O-C decom-pression
C2
C3
C4
C5


B
Locked temporary C-clamps or rod holders
Compression forceps
Lk
Lk
LS
LS
Synchronous bilateral compression
Cervical dura mater
Resultant anterior O-C translation
Lk
Lk
Lk
Lk
Lk
Lk
Locked lateral mass screws
C3
C4
C5
C6
Anterior cervical translation
Dens
C2
C3
C4
C5

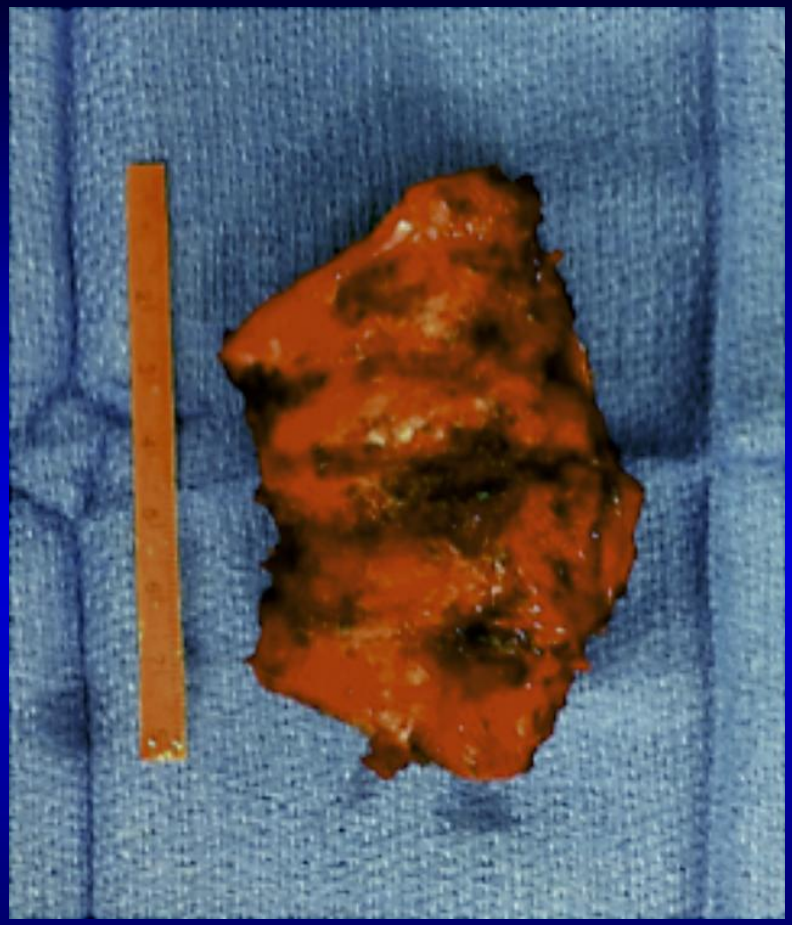

A
Mayfield headclamp
Titanium rod
O-C fusion plate
*Laminectomy of C1,C2 vertebrae
Distraction forceps
Synchronous bilateral distraction
Resultant vertical O-C decompression
Lk Locked screw-bolt
LS Loose screw-bolt
Basilar invagination
Dens
C1 vertebra
Spinous process-C2
Vertical O-C decompression
B
Locked temporary C-clamps or rod holders
Compression forceps
Cervical dura mater
Synchronous bilateral compression
Resultant anterior O-C translation
Locked lateral mass screws
Anterior cervical translation
Dens


H


H

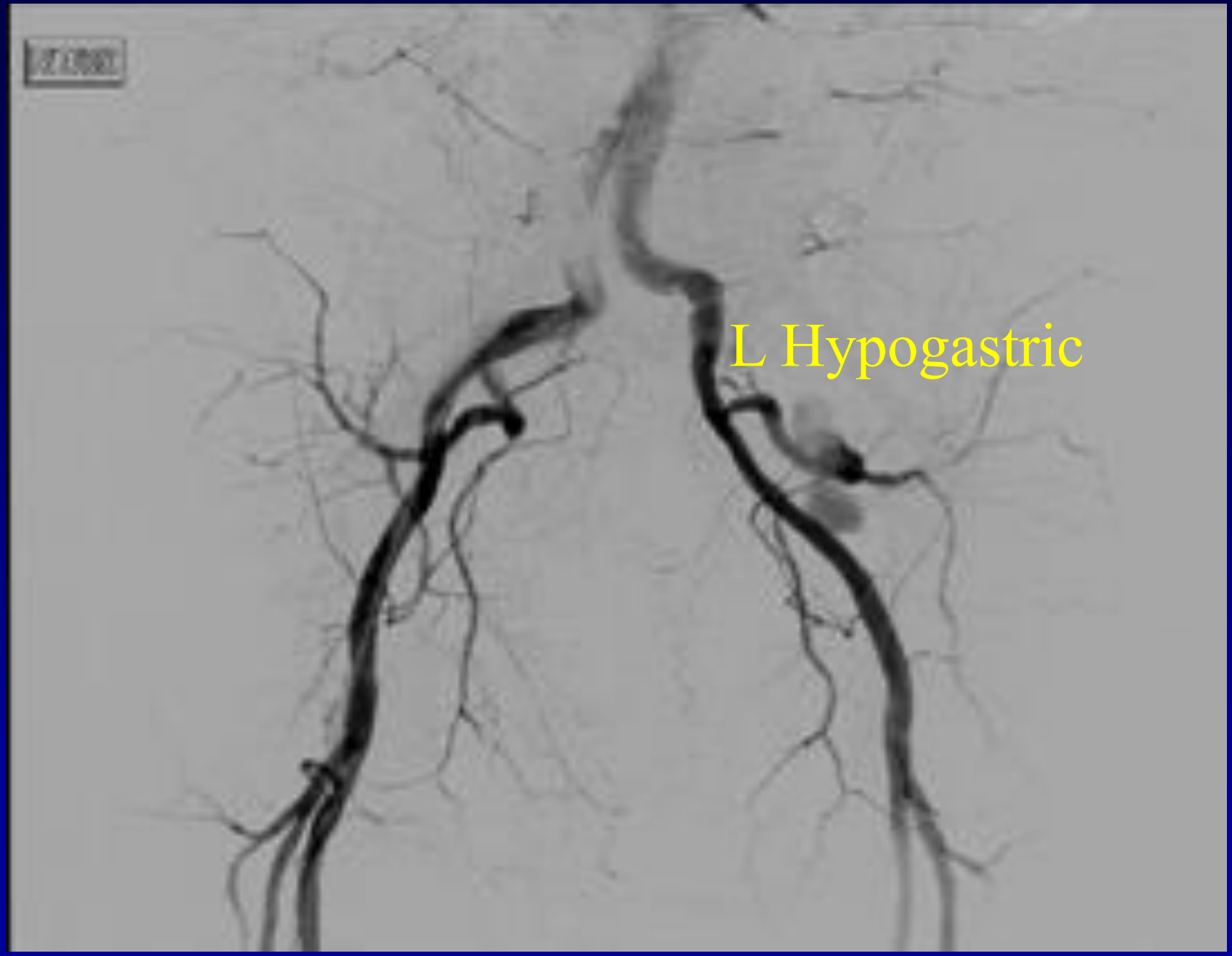

H
SERIES: #603A
sagittal
IV CONTRAST ONLY
IV CONTRAST ONLY

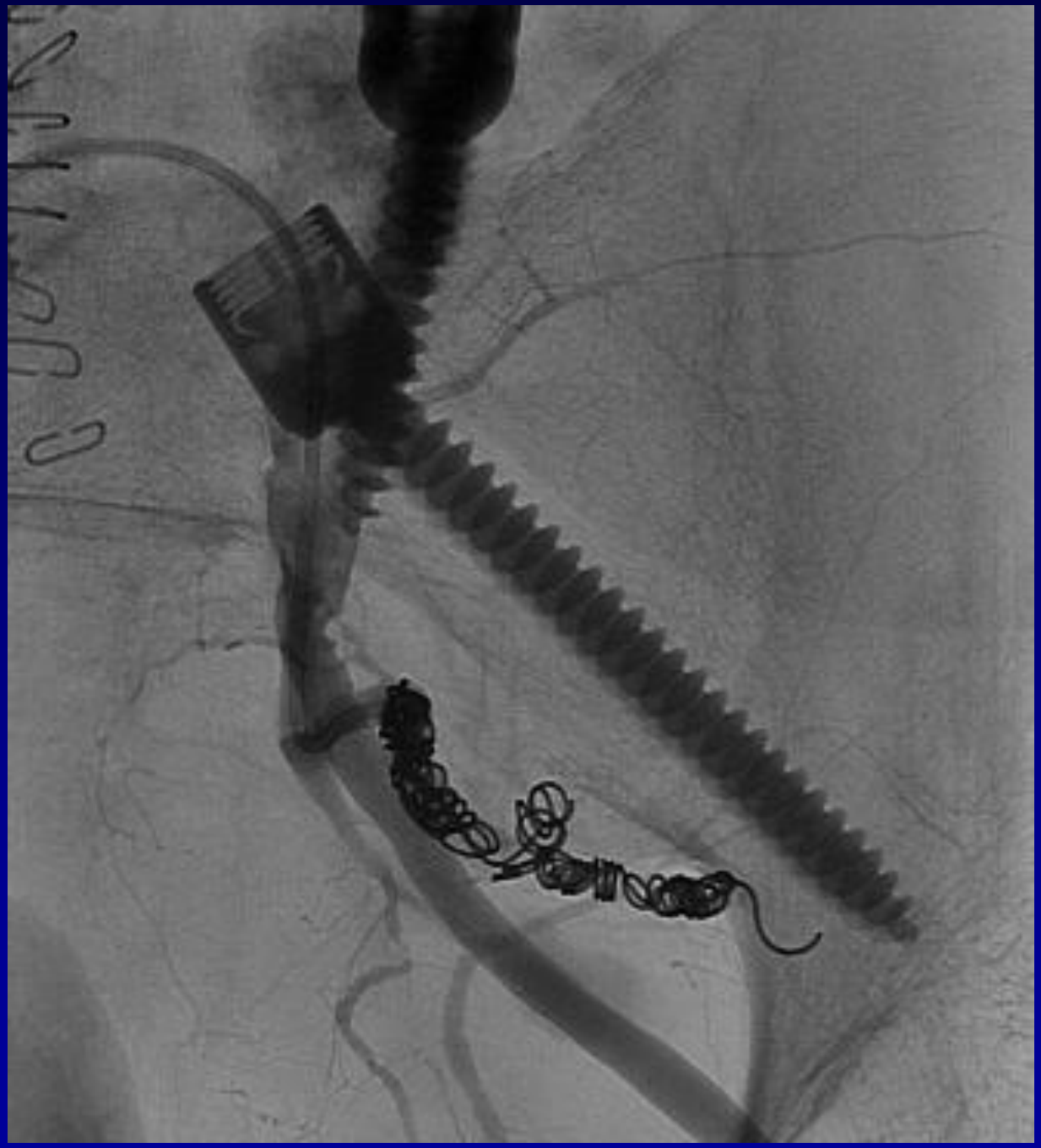

H
SERIES: #603A
sagittal
IV CONTRAST ONLY
IV CONTRAST ONLY



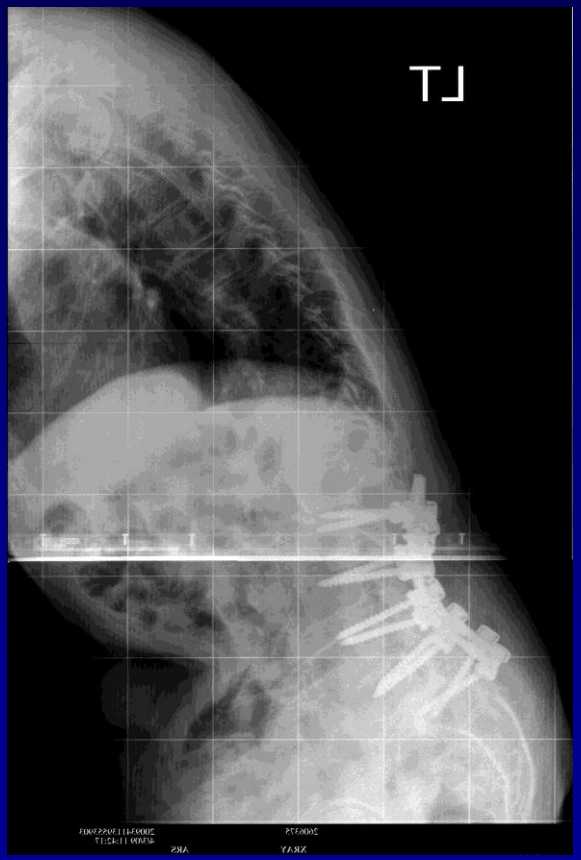

H
SERIES: #603A
sagittal
IV CONTRAST ONLY
IV CONTRAST ONLY
H
T8
T9
T10
T11
SERIES: #604A
sag
NON CONTRAST
NON CONTRAST


SERES: #1


L Hypogastric



Pre/Postoperative Radiographs



Sagittal imbalance surgical goals

- Completely correct the decompensation
- Correct as close to apex as possible
- fix the entire kyphosis
- instrument equal moment arms
- Achieve global balance