

Degenerative Spondylolisthesis and Scoliosis

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Disclosures / Acknowledgements

- Consultant – Medtronic
- Royalties - R90 – Medtronic
- Research assistance – Medtronic

Spinal stenosis and degenerative spondylolisthesis

Female 56 yrs



**Health-Related Quality of Life:
Comparison following
Fusion for Lumbar Degenerative Spondylolisthesis
with Hip & Knee Joint Replacement Surgery
& with Population norms**

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& Gavin White[¥]**

Macquarie University Sydney^{*}, Royal Brisbane Hospital[†], Monash University[‡], Medtronic[¥]
Australia

SSA & NASS
Adelaide & Toronto,

- Certain surgical procedures are well regarded:
 - in the community
 - by health regulators
- Comparisons to other surgeries:
 - Rampersuad YR et al. *NASS 2007 Best Paper*
 - Polly DW et al. *Spine 2007*

Objectives

1. Measure the Quality of Life of patients (HRQL) :
 - common & specific spinal disorder,
 - specific decompression and fusion technique,
 - generic measurement instrument
2. Compare these HRQL measurements with:
 - hip or knee surgery
 - total joint arthroplasty,
 - population norms
 - published, age-matched.

SF12

- Generic HRQoL measure
 - Physical (PCS-12) & Mental (MCS-12) components
 - Allows comparison of health status of different conditions
- MCID \geq 5 points*

* Bozic KJ et al. *J Bone Joint Surg Am* 2003

Copay AG et al. *Spine J*, *In press*

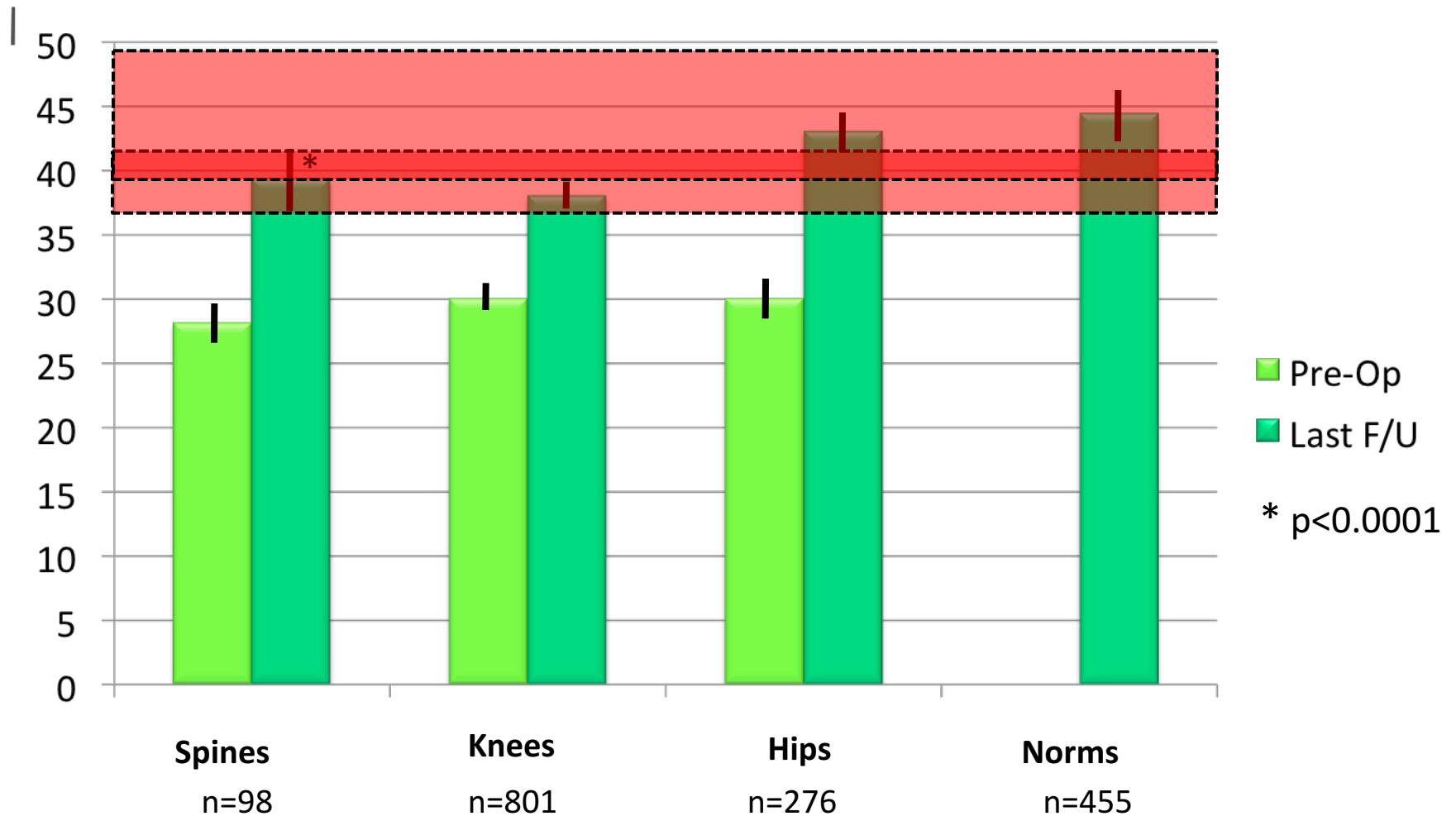
Methods

- Study design:
 - Prospective
 - Consecutive case series
 - 2 independent surgeons
 - Comparison with published literature (Hips, Knees, Norms)
- Inclusion Criteria:
 - Clinical:
 - neurogenic claudication
 - no previous surgery
 - failed conservative management
 - Radiological:
 - single level, lumbar spinal stenosis
 - ‘unstable’ degenerative spondylolisthesis



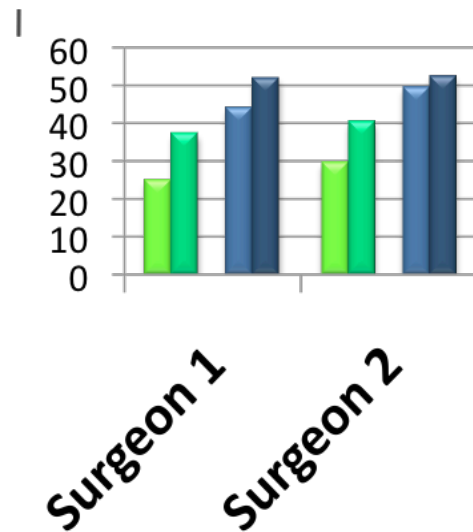
Results

PCS-12 (means \pm MCID (detectable difference))



Discussion

- PCS-12 change scores:
 - No difference between spine surgeons: +12 vs. +11



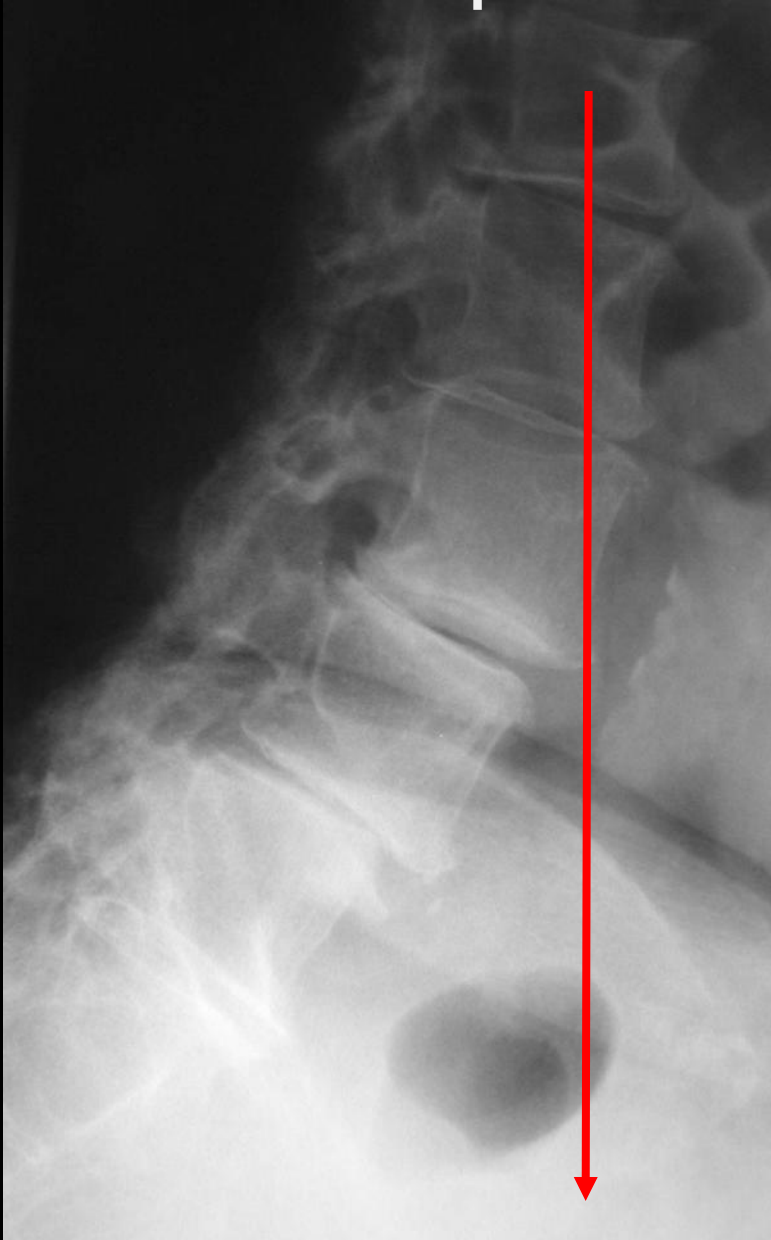
Discussion

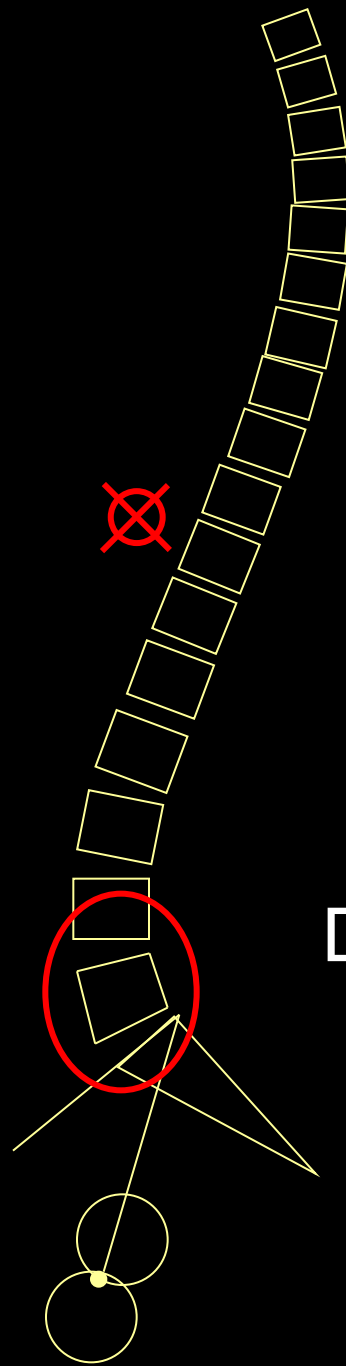
- PCS-12 change scores:
 - No difference between spine surgeons: +12 vs. +11
 - Similar between spinal fusions and large joint arthroplasties
 - Spines: +11 (95%CI: 9-14)
 - Hips: +11 (95%CI: 9-13)
 - Knees: +8 (95%CI: 7-9)

Conclusion

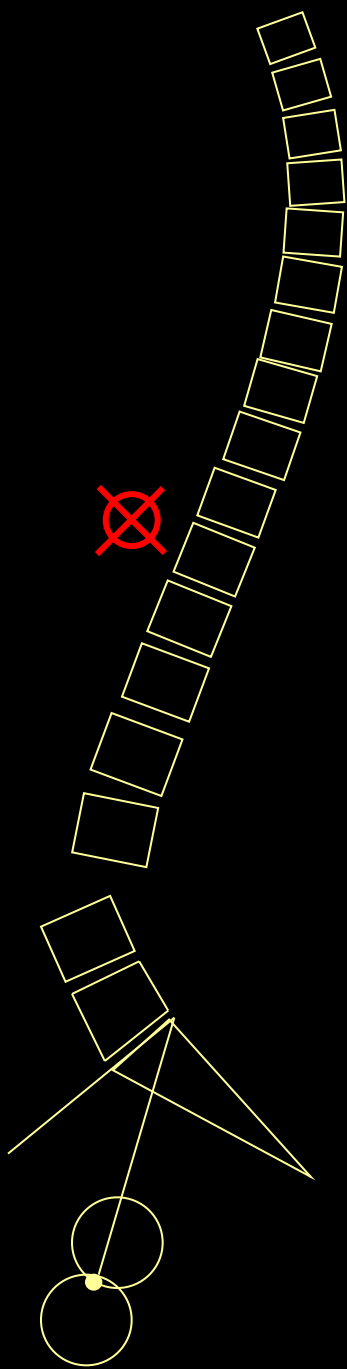
- \uparrow Quality of Life ***Spine*** = \uparrow Quality of Life ***Knee & Hips***
- \uparrow Quality of Life ***Spine*** \approx Quality of Life ***Norms***

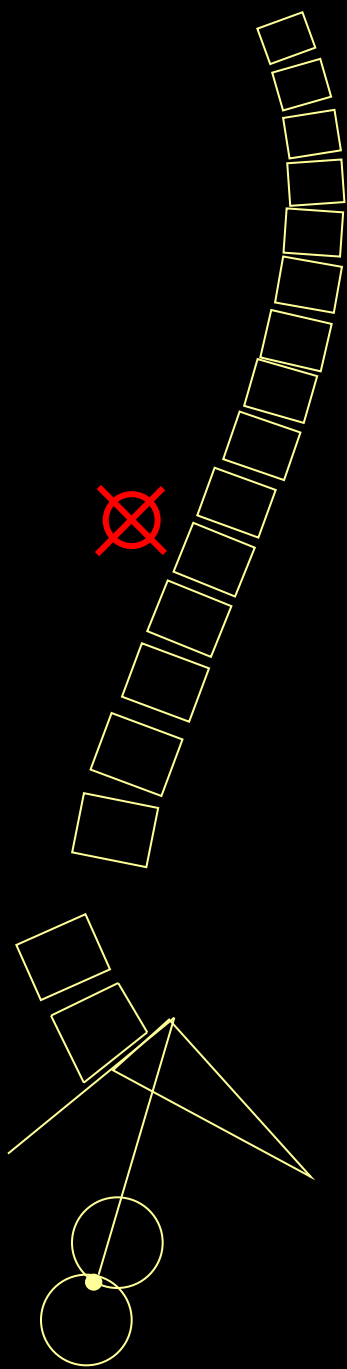
Spinal sagittal balance



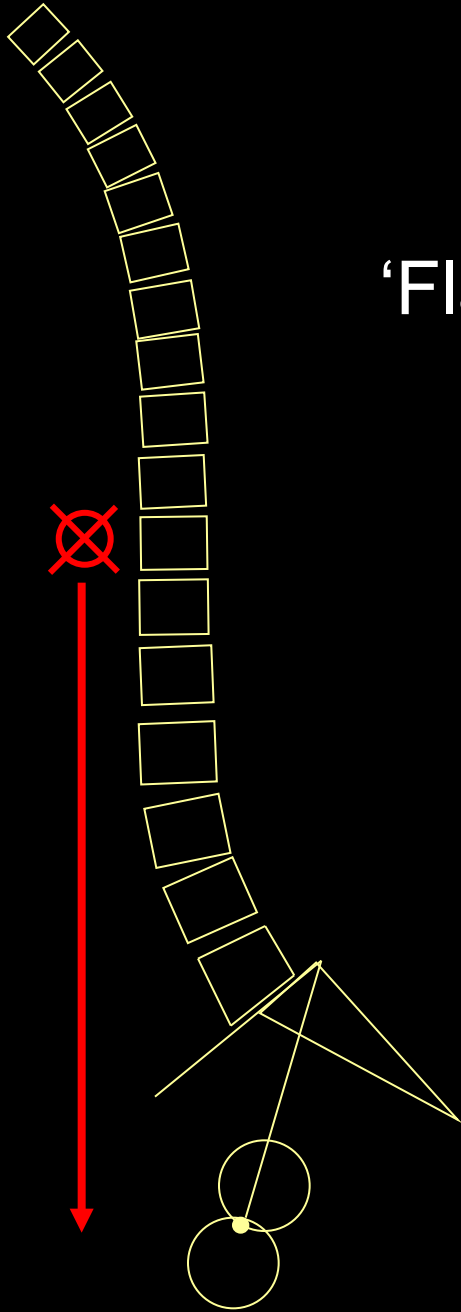


Degeneration

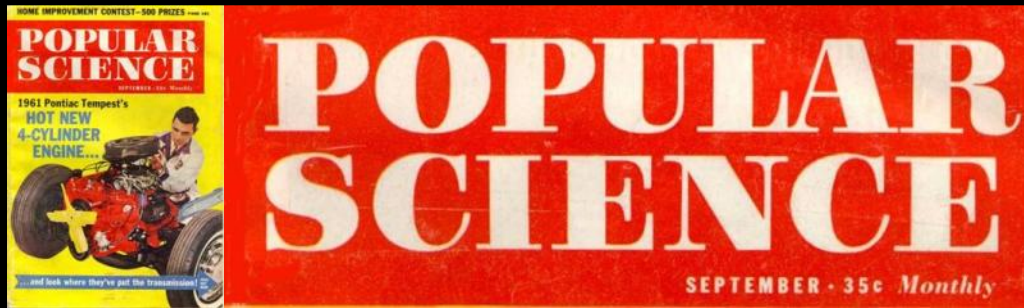




'Flat-back' deformity



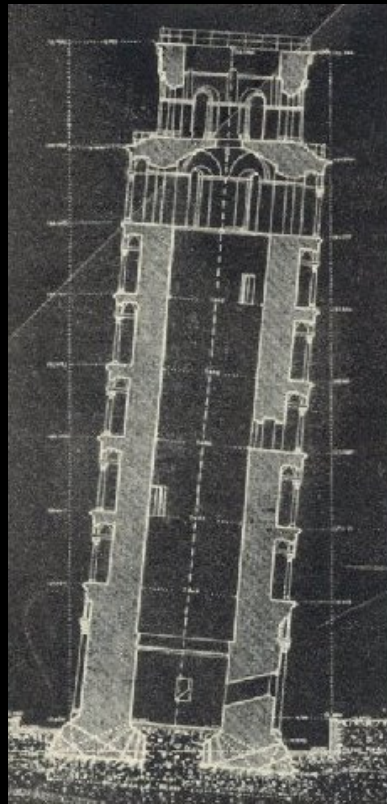
The Leaning Tower Is Falling Down



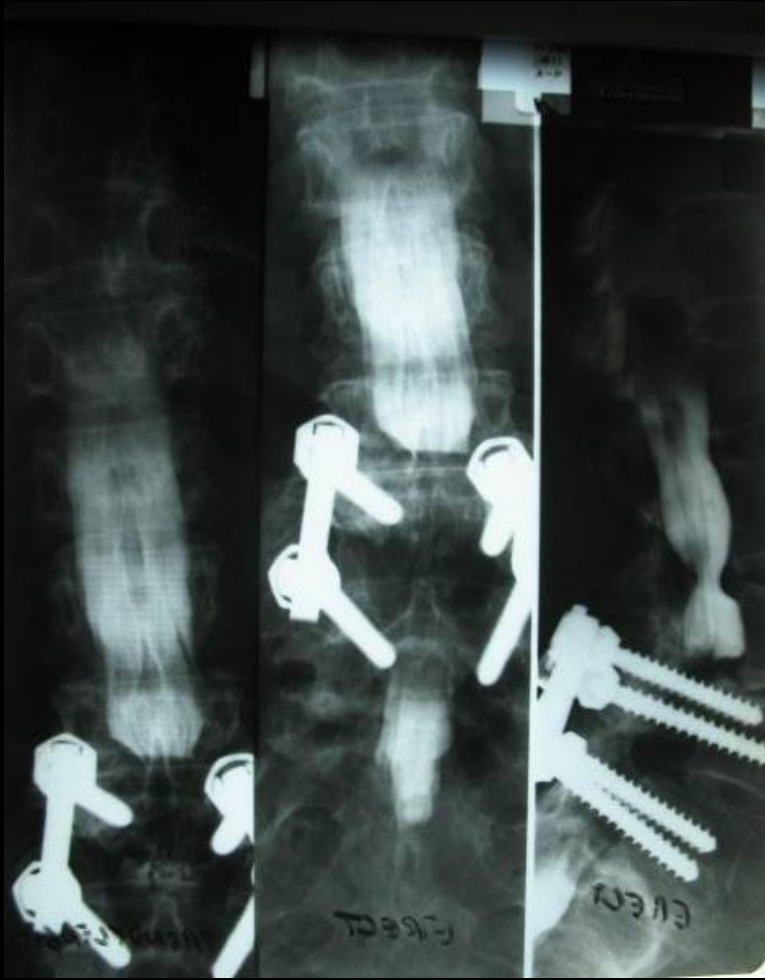
September 1960

Now 17 feet out of line, the 800-year-old wonder may collapse before long

Ways to save a sagging tower: jack it up, shore it up, gird it 'round with iron bands - then cross your fingers



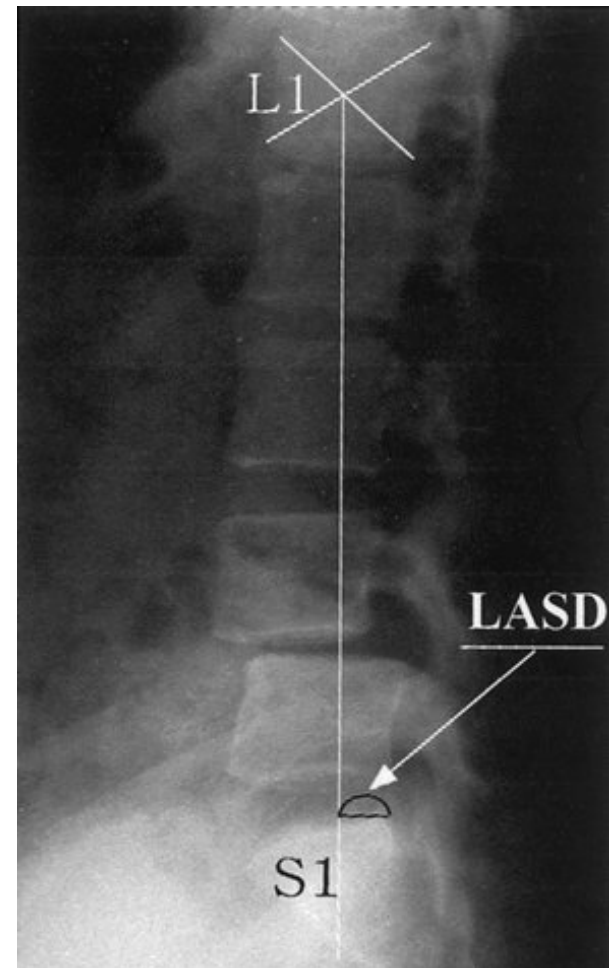
Sagittal balance & adjacent segment degeneration



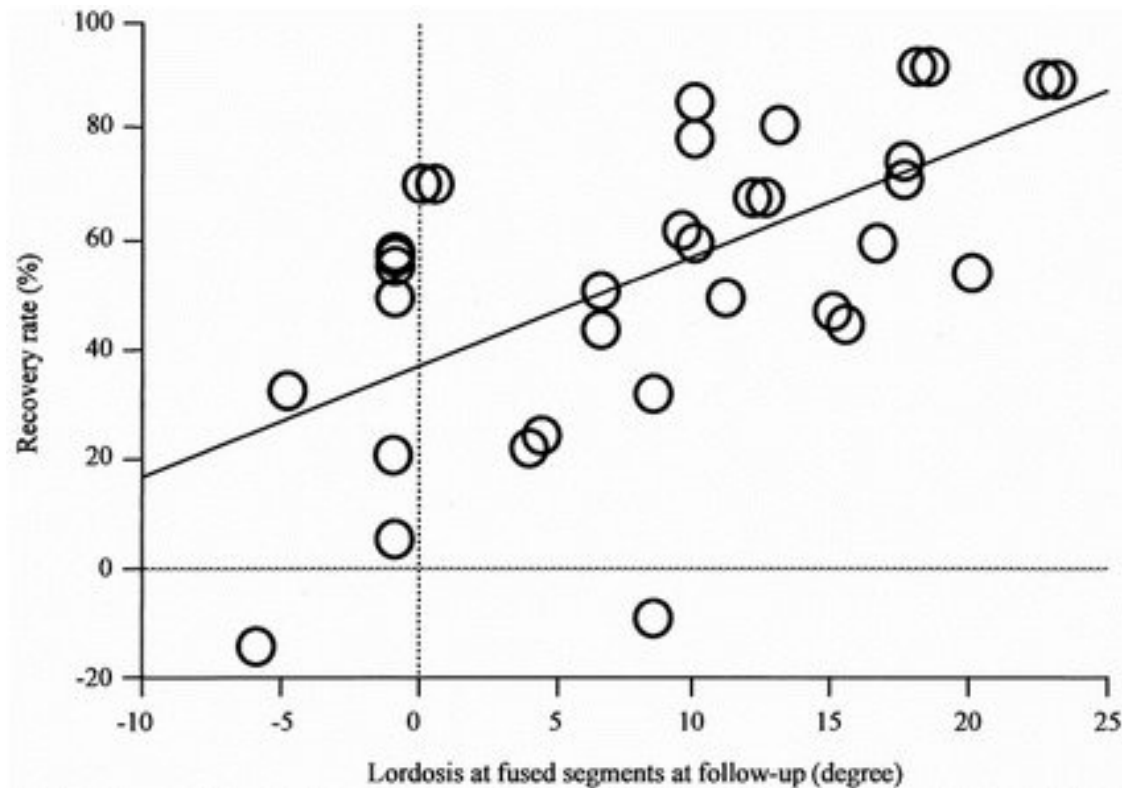
Fusion & the importance of maintaining lordosis: Clinical

Kawakami et al. *Spine* 2002

Lumbar Sagittal Balance
Influences the Clinical
Outcome After
Decompression and
Posterolateral Spinal Fusion
for Degenerative Lumbar
Spondylolisthesis.

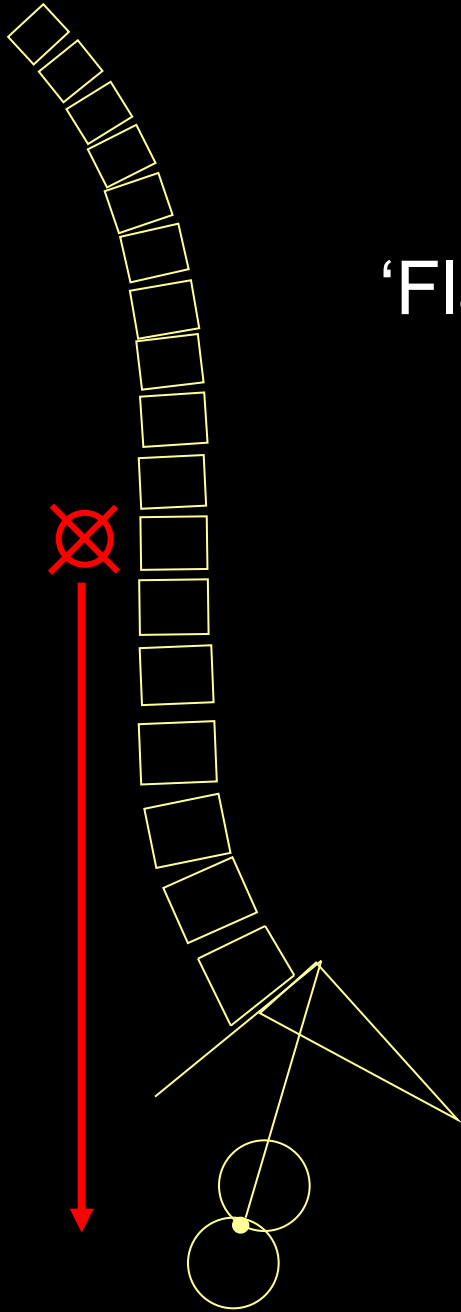


Fusion & the importance of maintaining lordosis: Clinical

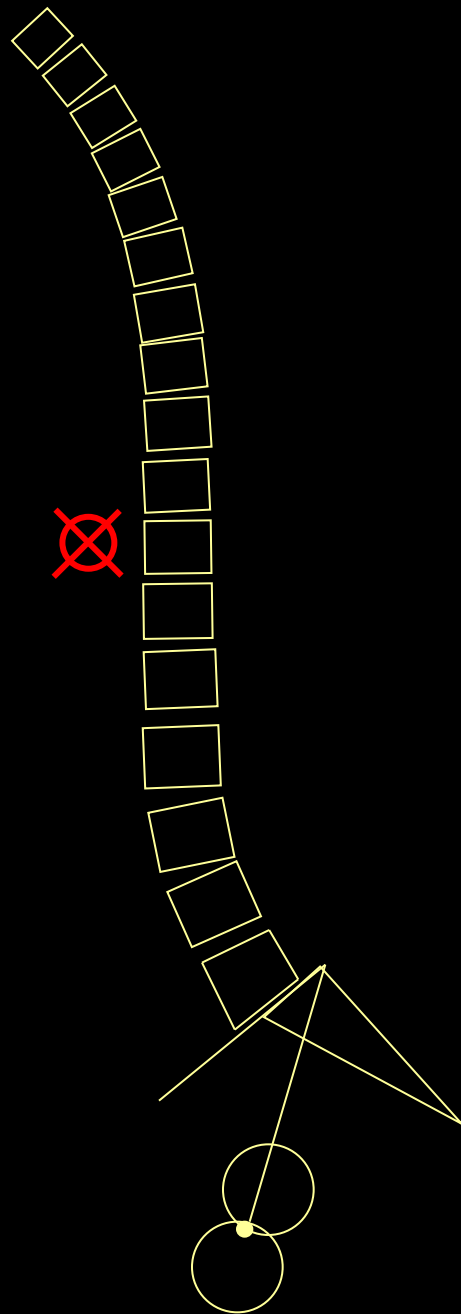


Mamoru Kawakami et al. Spine 2002

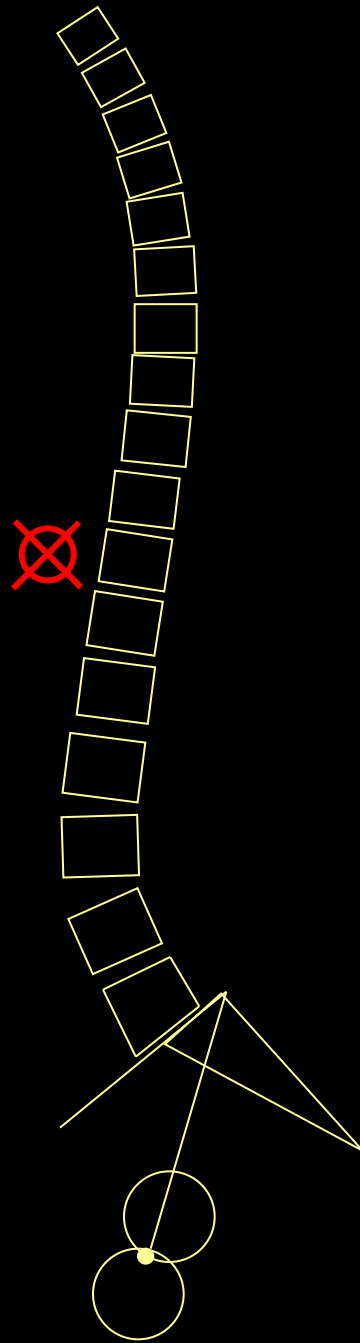
'Flat-back' deformity



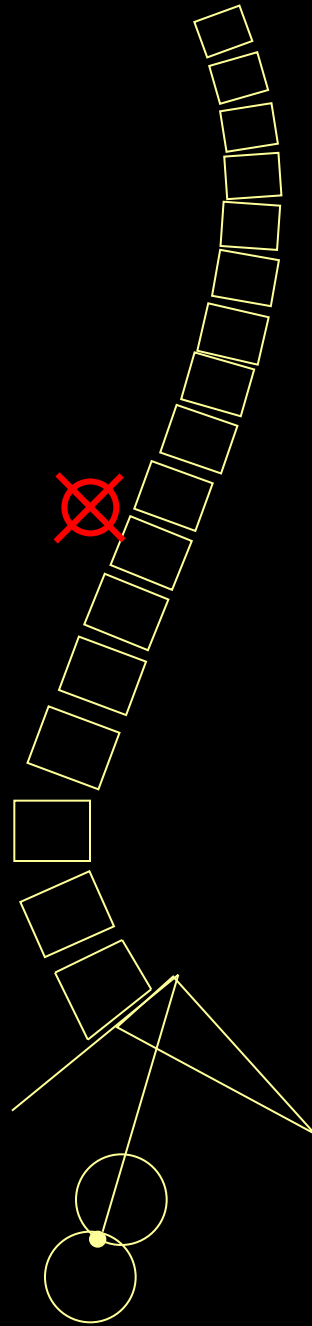
Compensation Mechanisms (1)



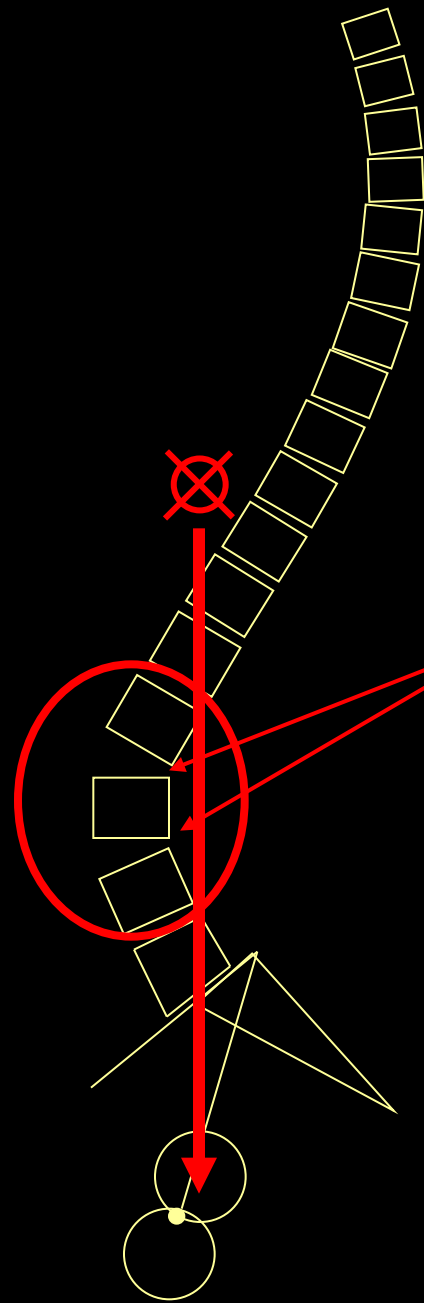
Compensation Mechanisms (1)



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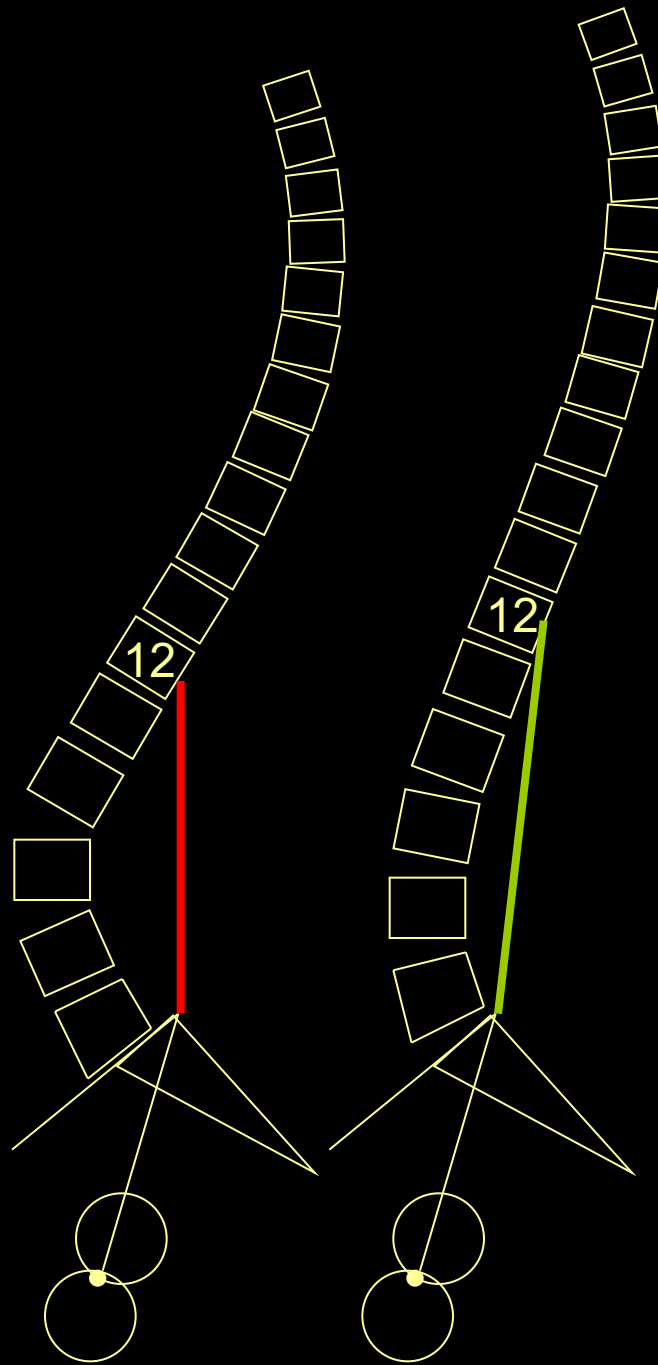


Compensation Mechanisms (1)



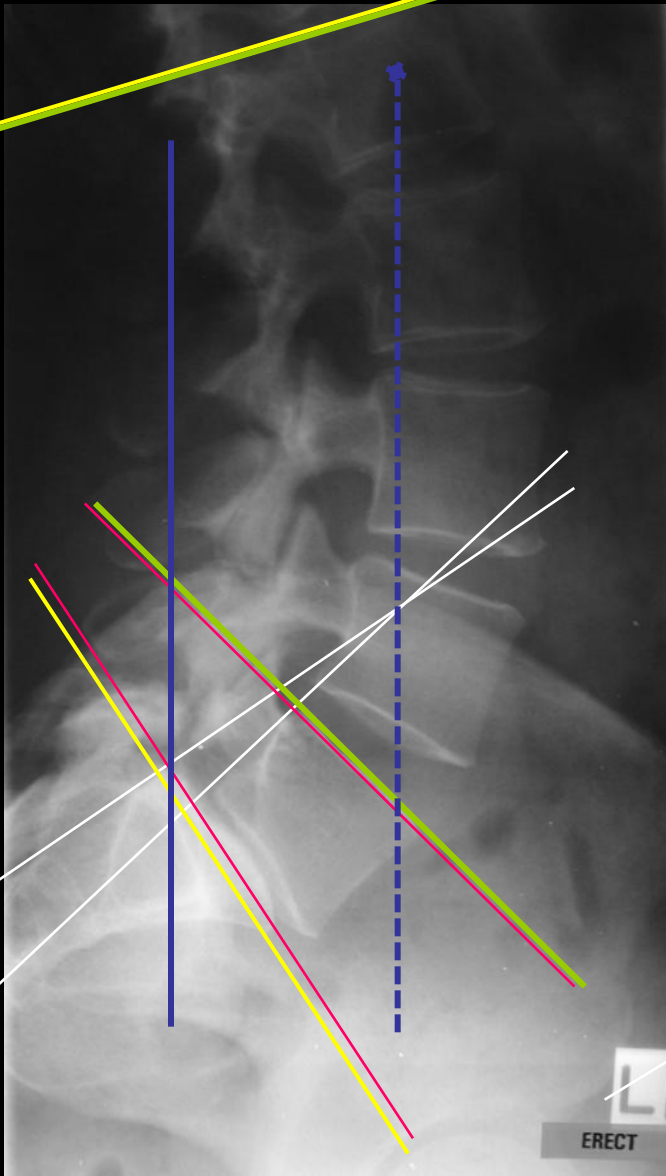
1. Increase lordosis above

→ Muscle fatigue
Facet joint overload
Canal stenosis
...Pain



Can we correct sagittal imbalance???

Female, 53 yrs

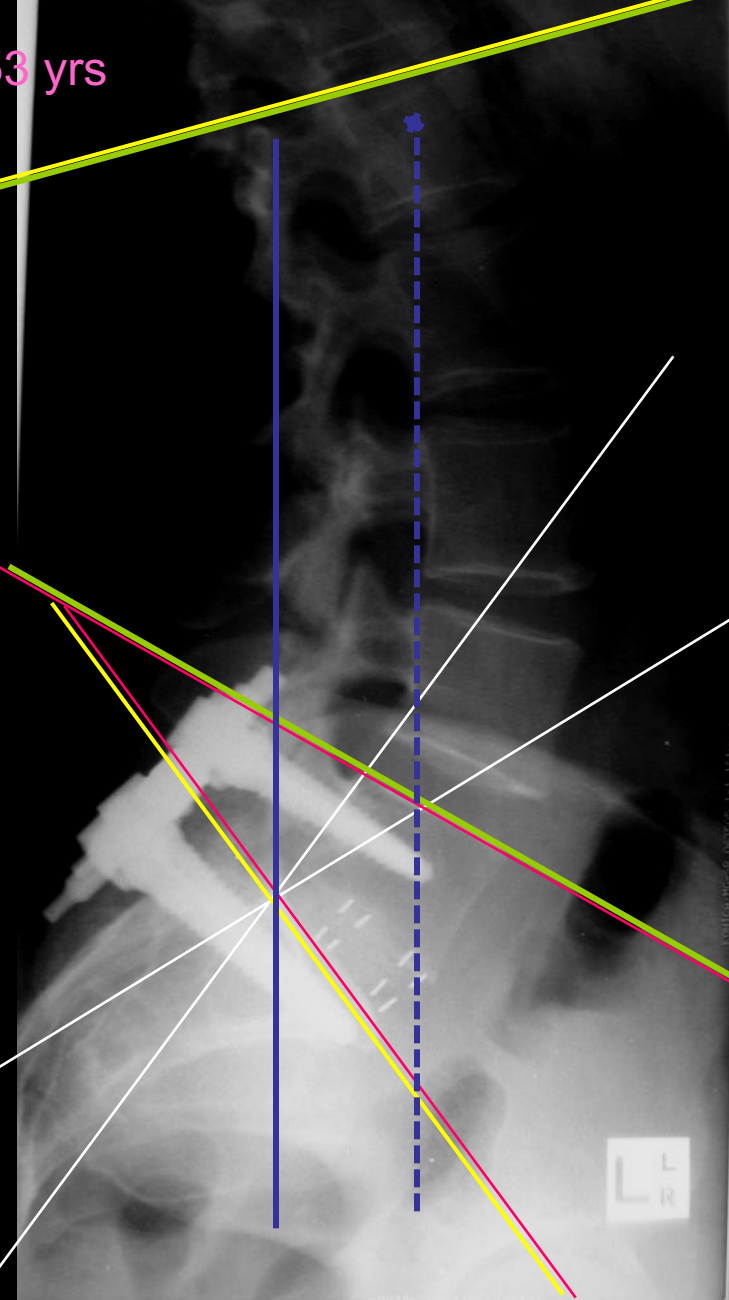


9 degrees

73 degrees

12 degrees

61 degrees



22 degrees

70 degrees

24 degrees

46 degrees



The Spine Journal 5 (2005) 161–169

THE
SPINE
JOURNAL

Posterior lumbar interbody fusion for lytic spondylolisthesis: restoration of sagittal balance using insert-and-rotate interbody spacers

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Received 9 May 2003; accepted 13 May 2004



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Change in mean Alignment (n = 13)

- Slip: 30% → 6% ($p < 0.001$)

Change in mean Alignment (n = 13)

- Slip: 30% → 6% (p<0.001)
- Focal lordosis: 10.5° → 18° (p=0.02)

Sagittal Balance Correction

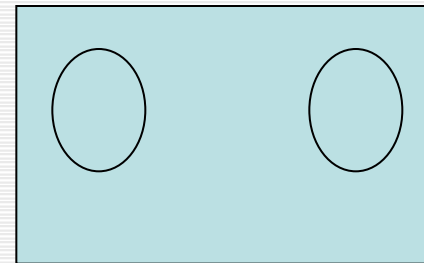
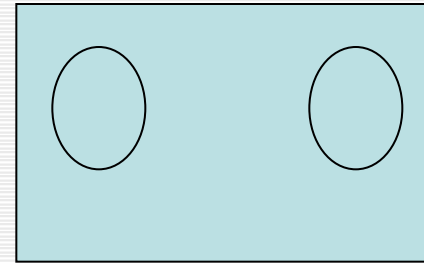
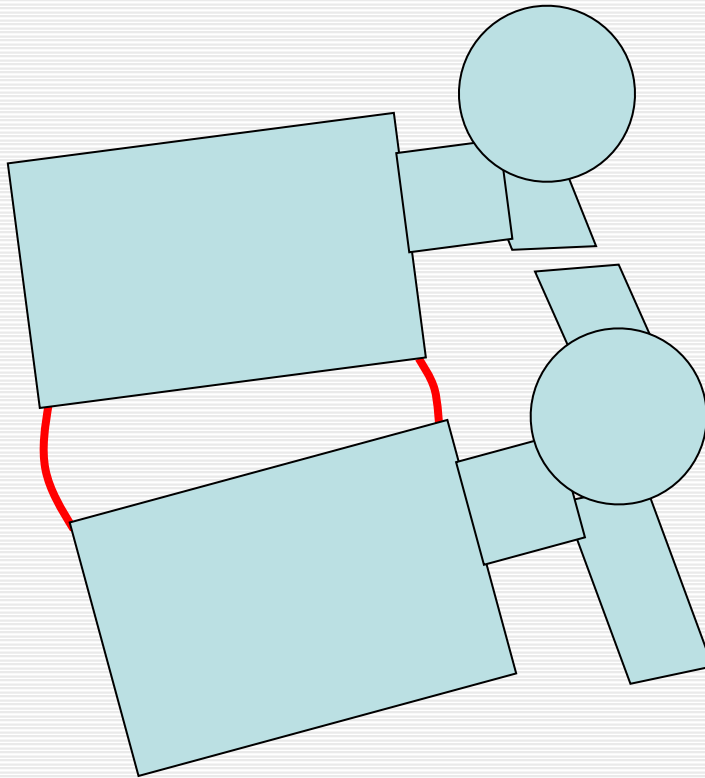
PLIF for Lytic Spondylolisthesis Series (n=13)

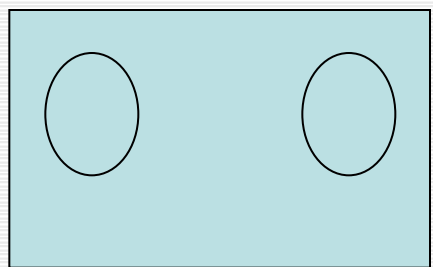
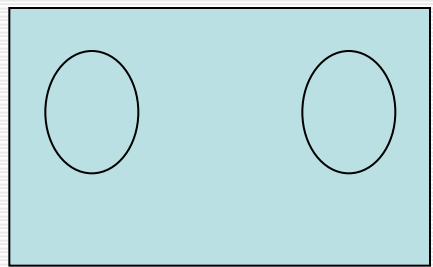
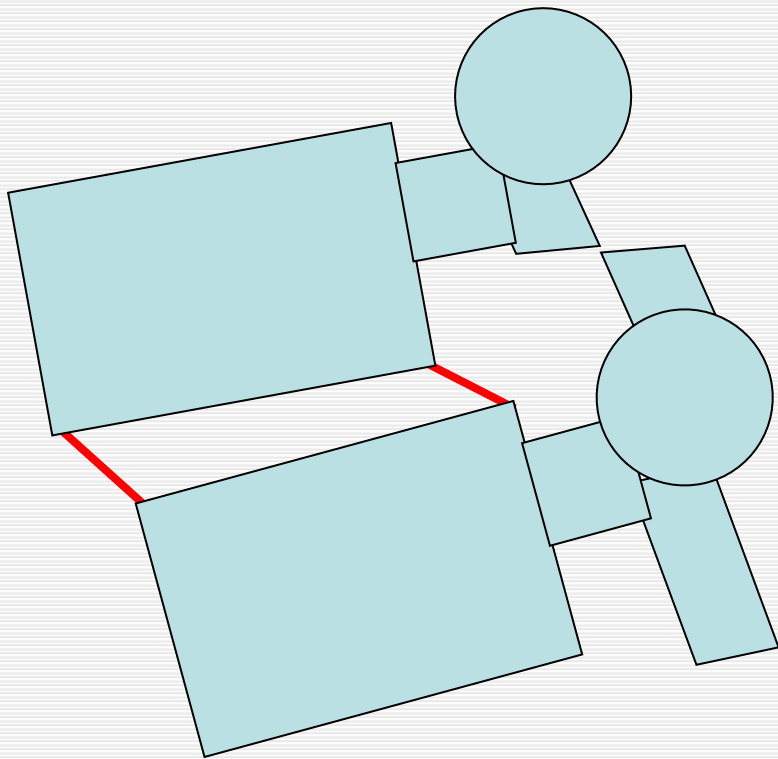
	Slip	Focal lordosis	Lumbar lordosis	Lumbar lordosis above fusion	L1axisS1 interval (ref. 28)
Pre Operative	30.2% (range: 9–78%)	10.6° (range:-12–33°)	59.3° (range:46-78°)	46.8° (range:29-76°)	38.9mm (range:2-83mm)
Post Operative	6.2% (range: 0–18%)	18.1° (range:5-32°)	56.7° (range:35-77°)	34.9° (range:15-62°)	24.3mm (range:-28-94mm)
Correction	79% (p=0.001)	71% (p=0.02)	Unchanged	25% (p=0.02)	38% (P=0.09)

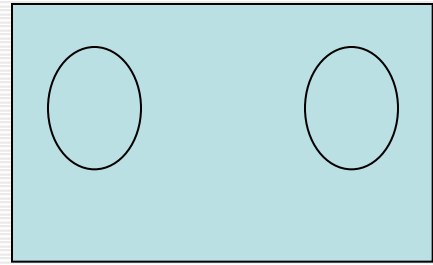
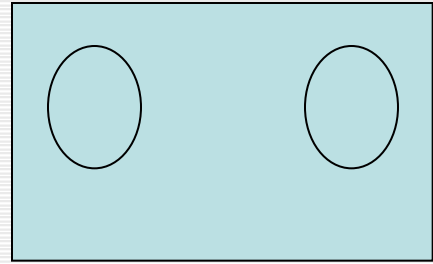
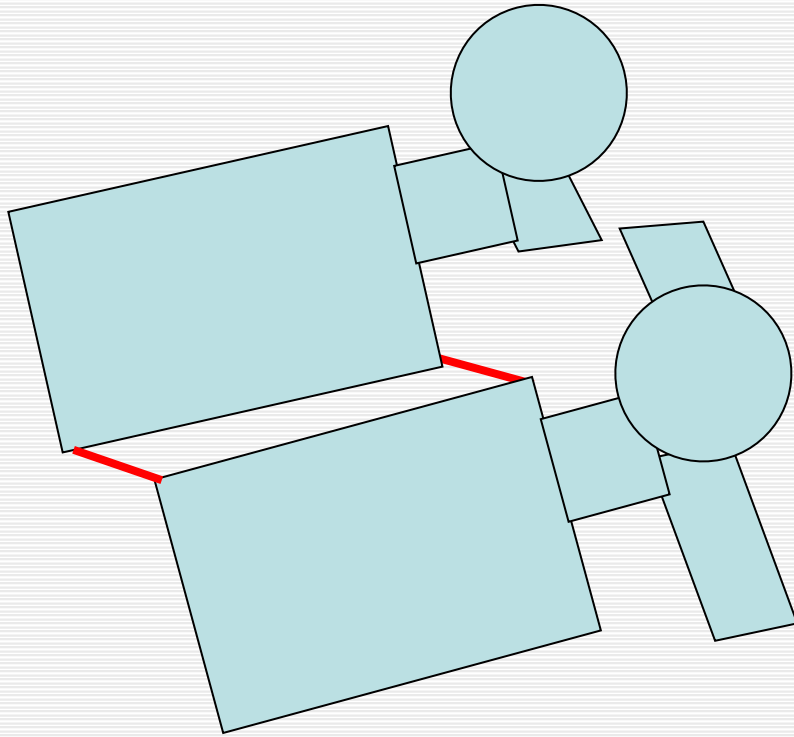
Change in mean Alignment (n = 13)

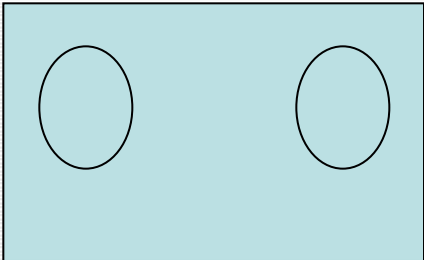
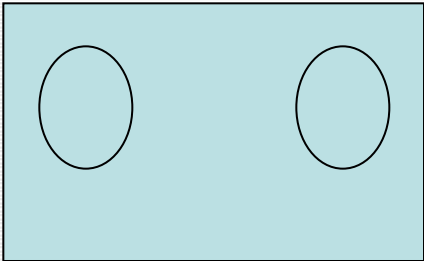
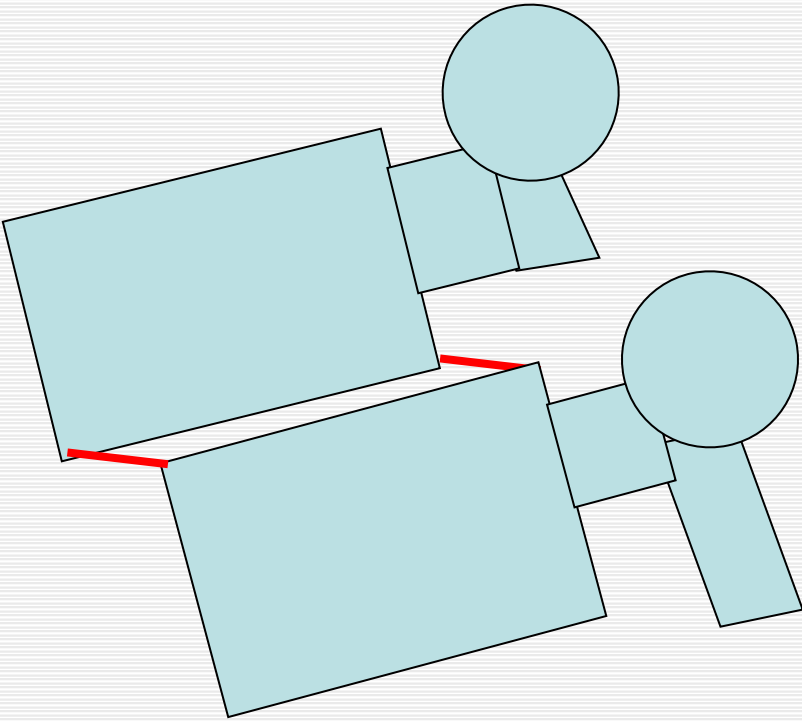
- Slip: 30% → 6% post-
op (p<0.001)
- Focal lordosis: 10.5° → 18° (p=0.02)
- Lumbar lordosis above the fusion:
47° → 35° (p = 0.02)

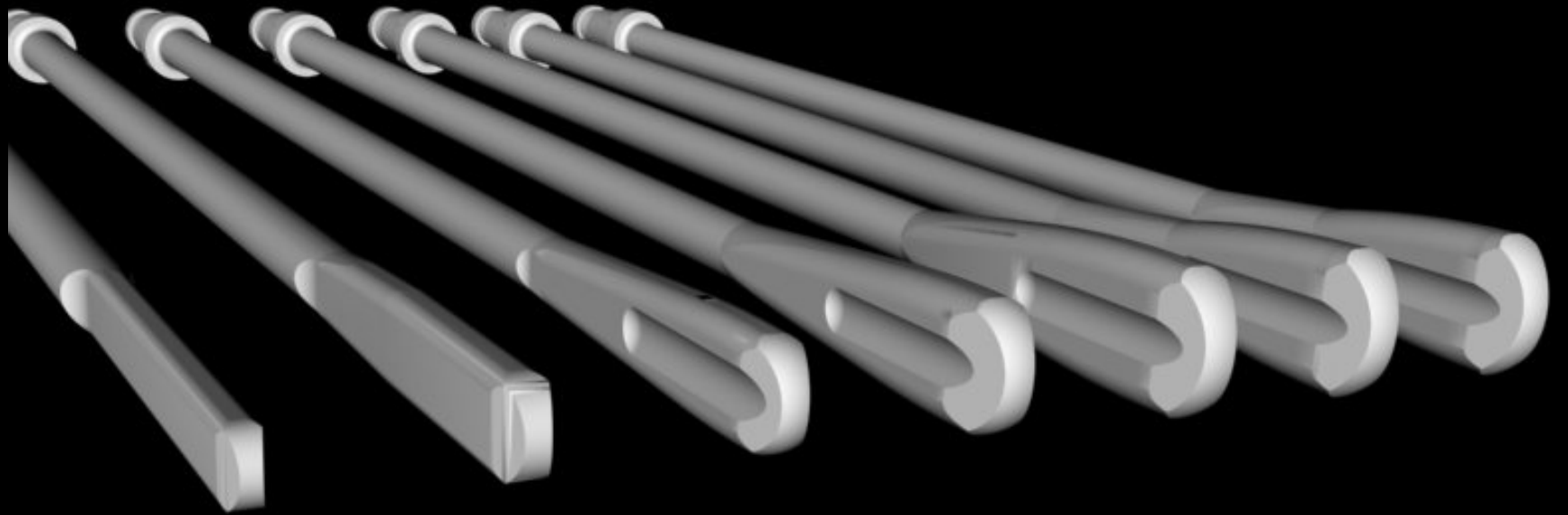
Correction of Spondylolisthesis



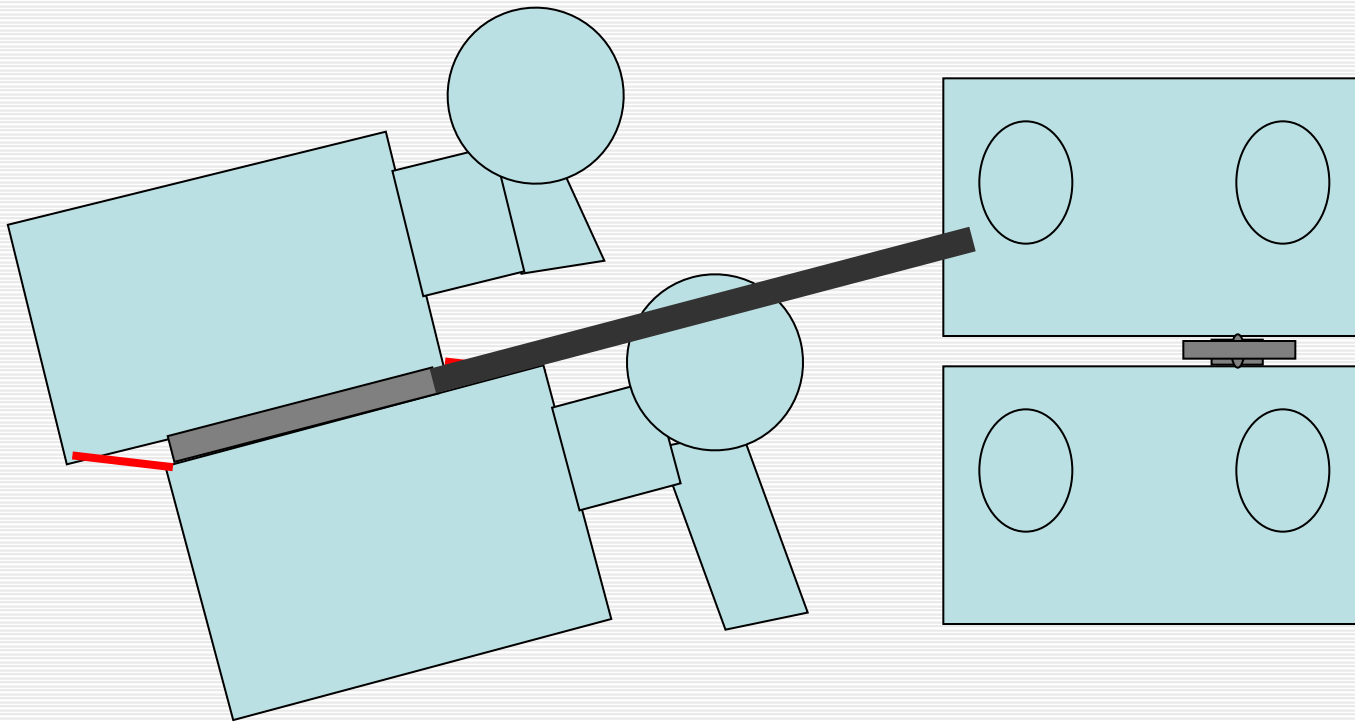


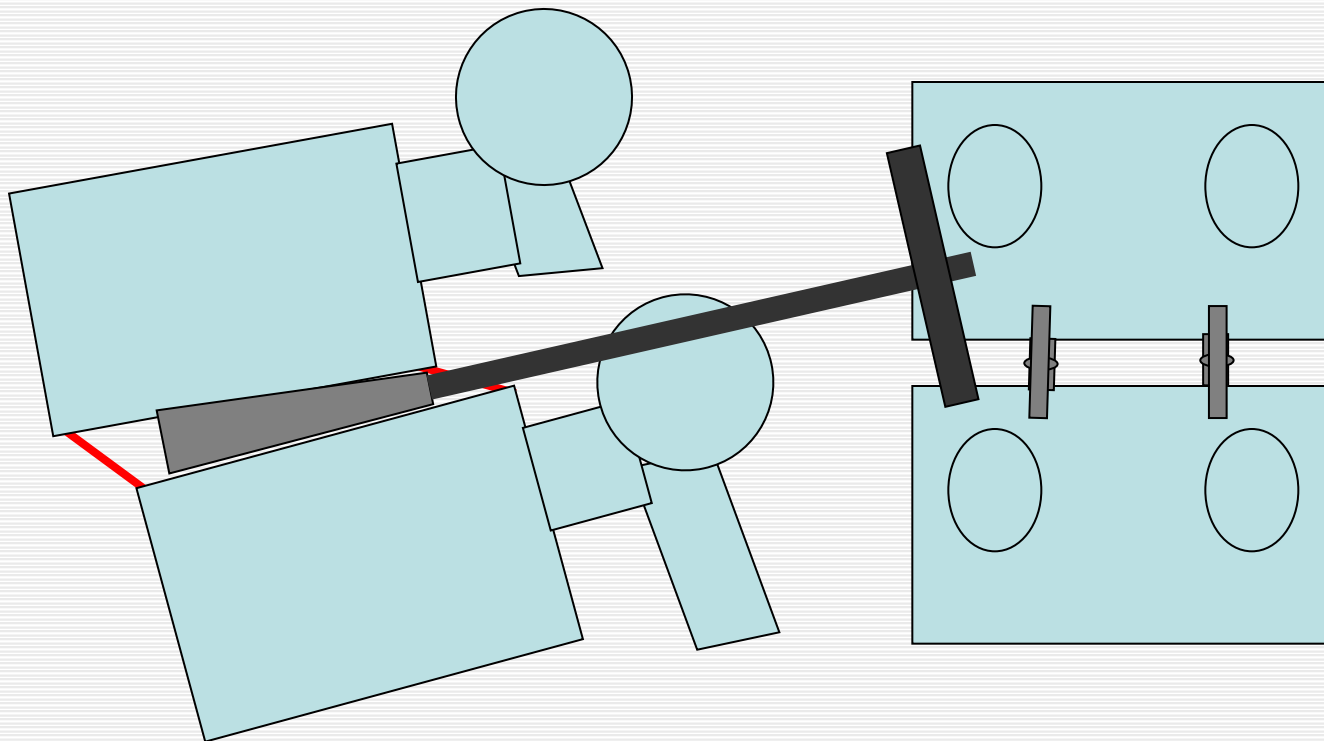


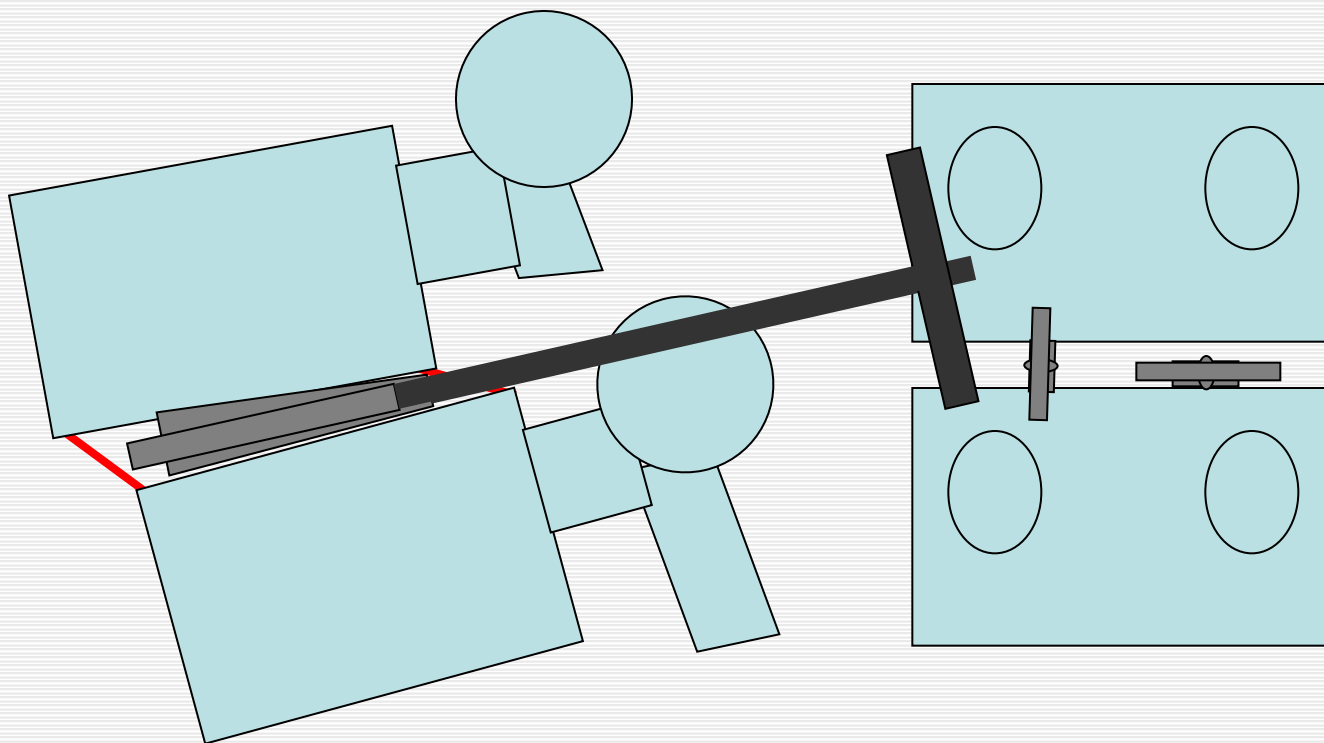


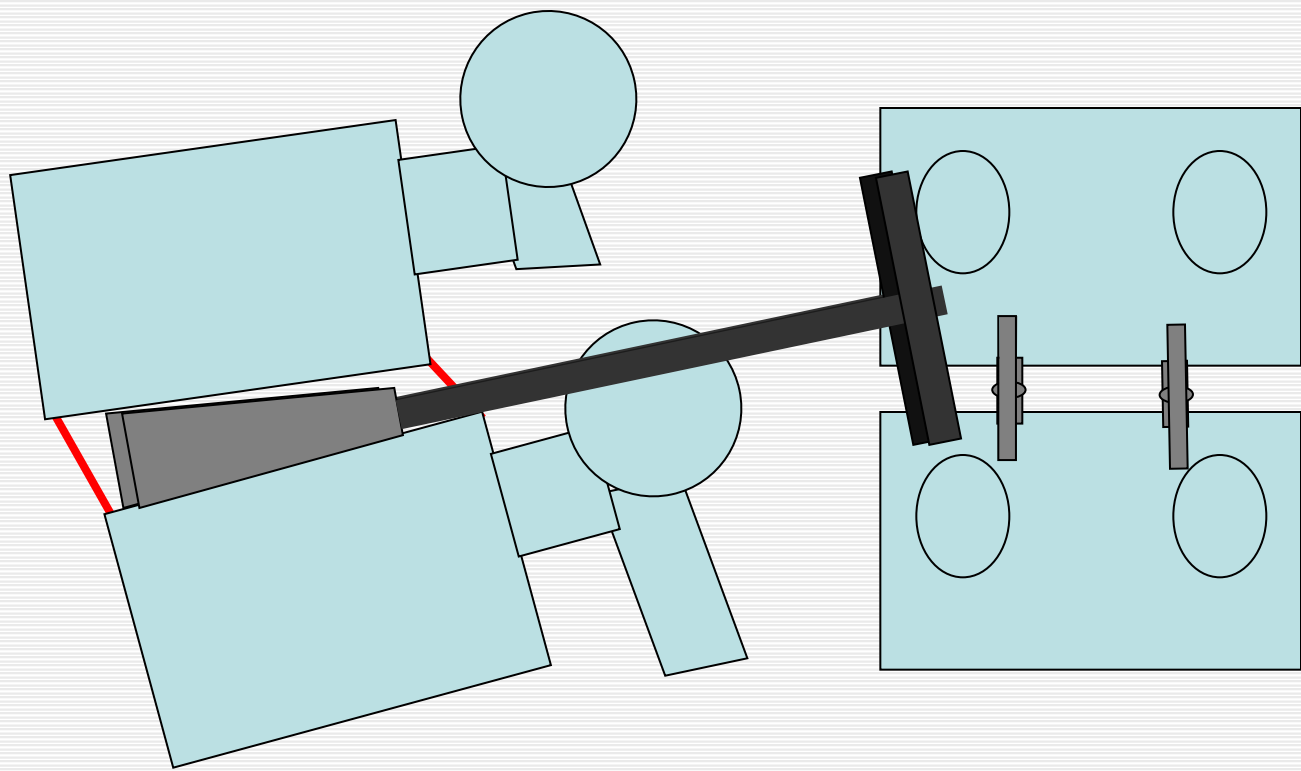


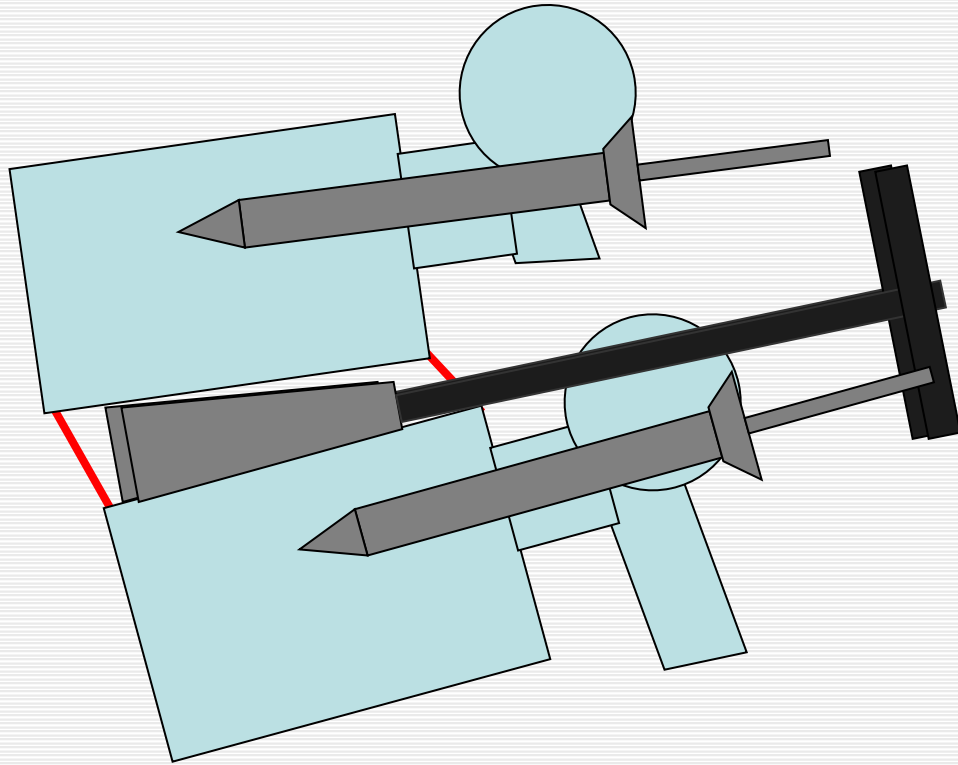
Correction:

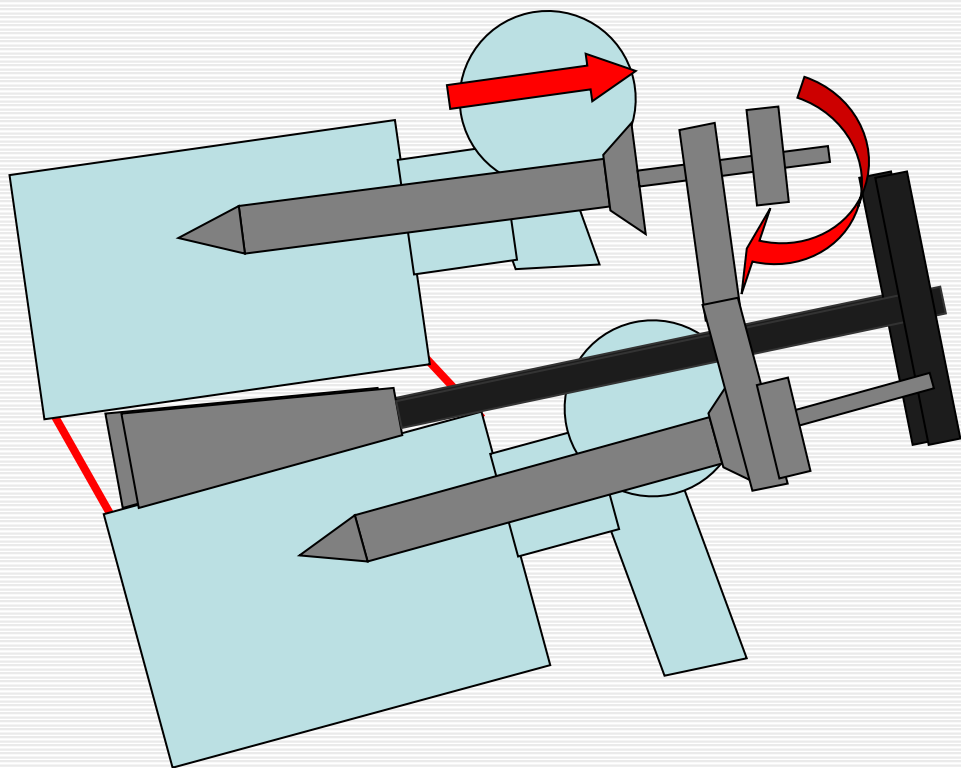


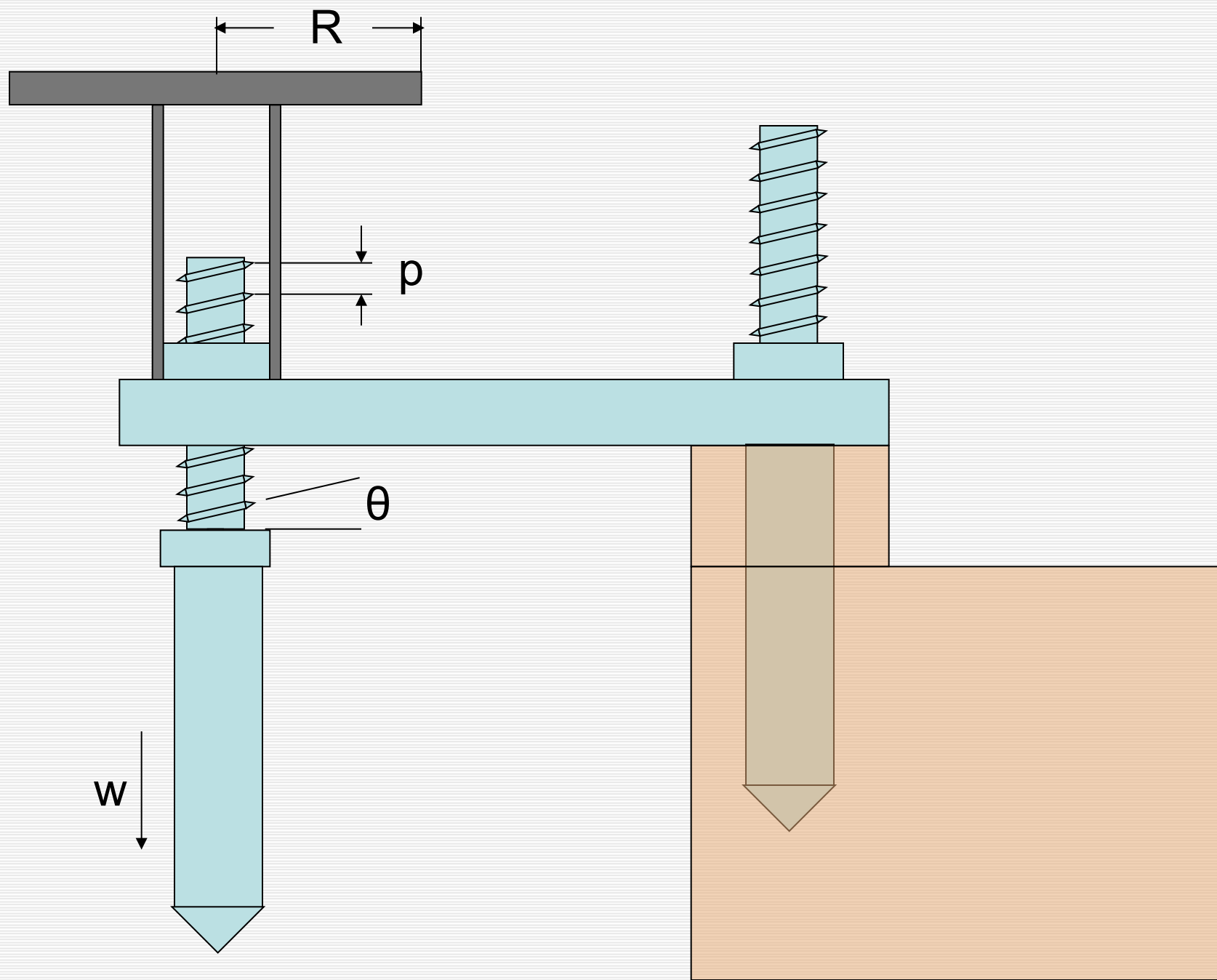


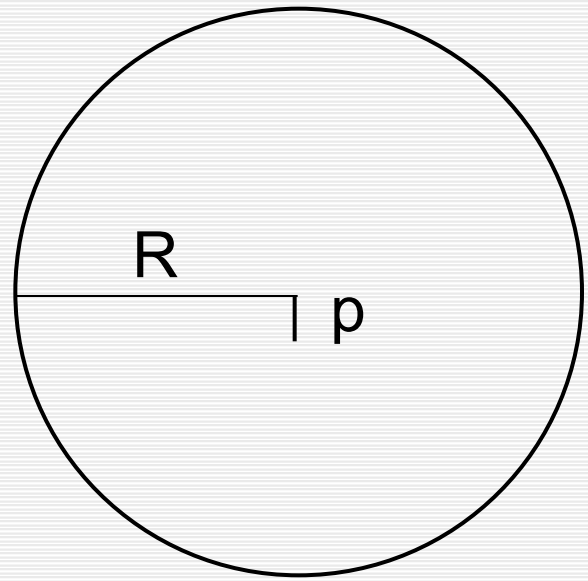
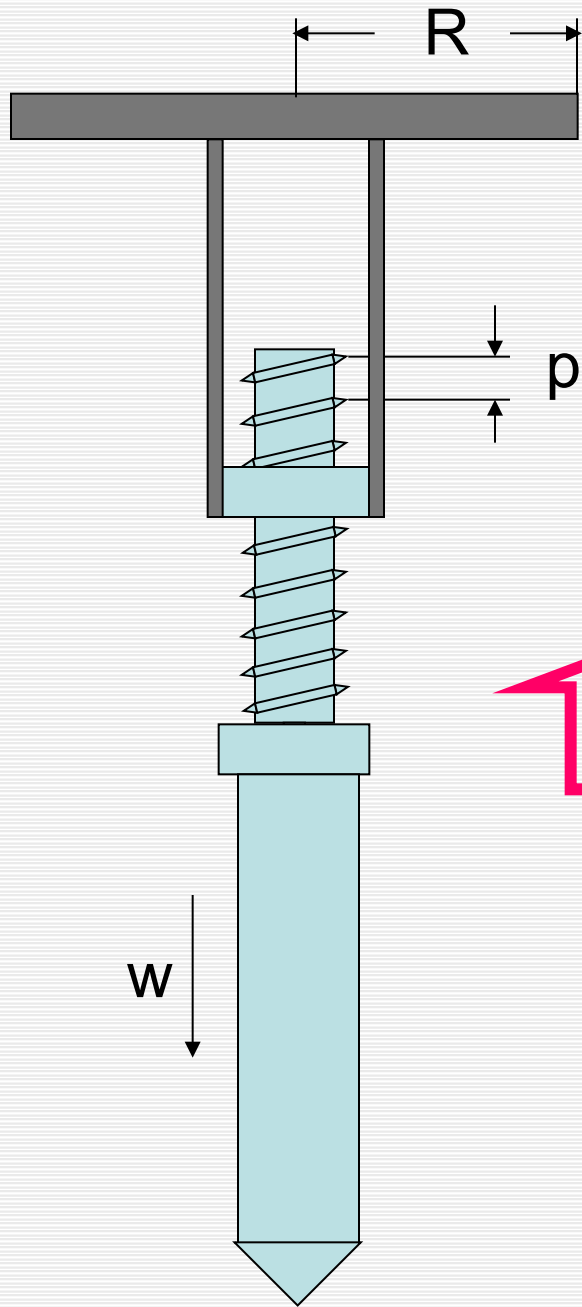






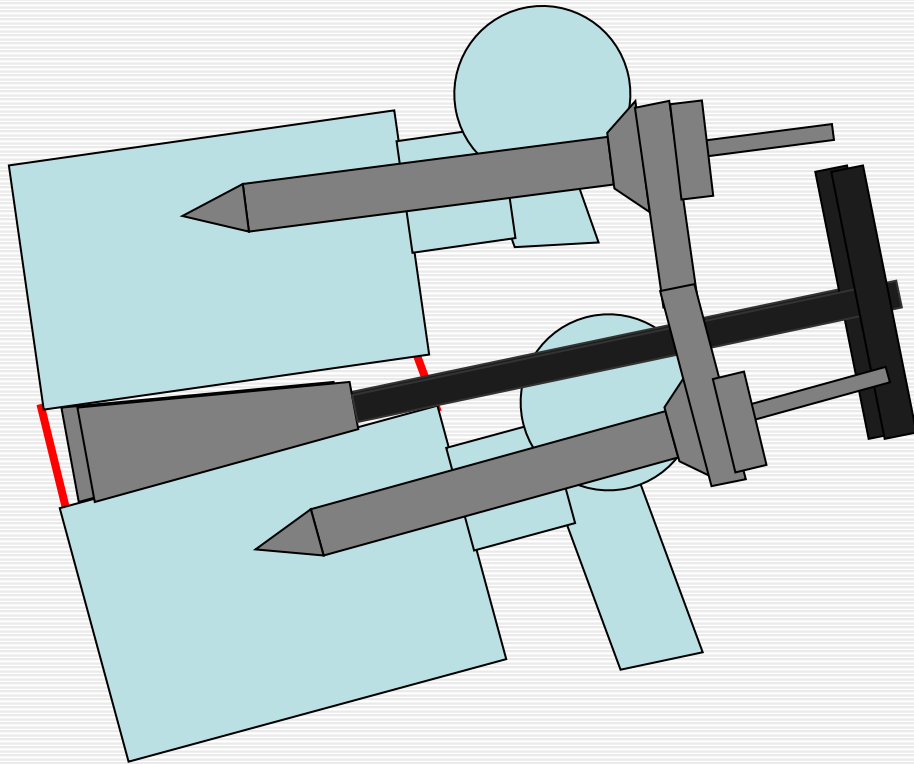


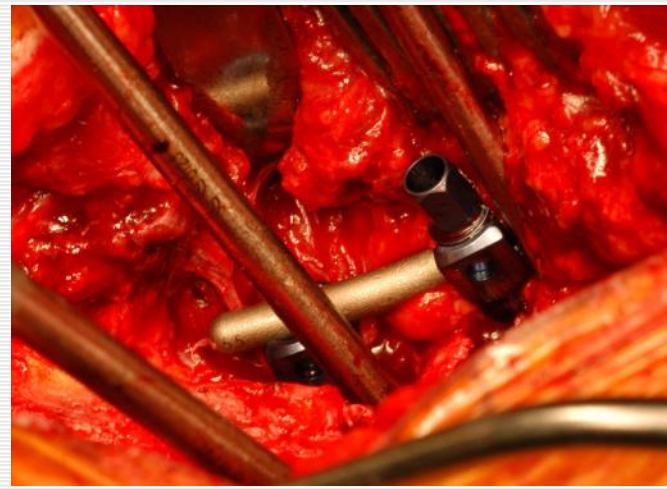
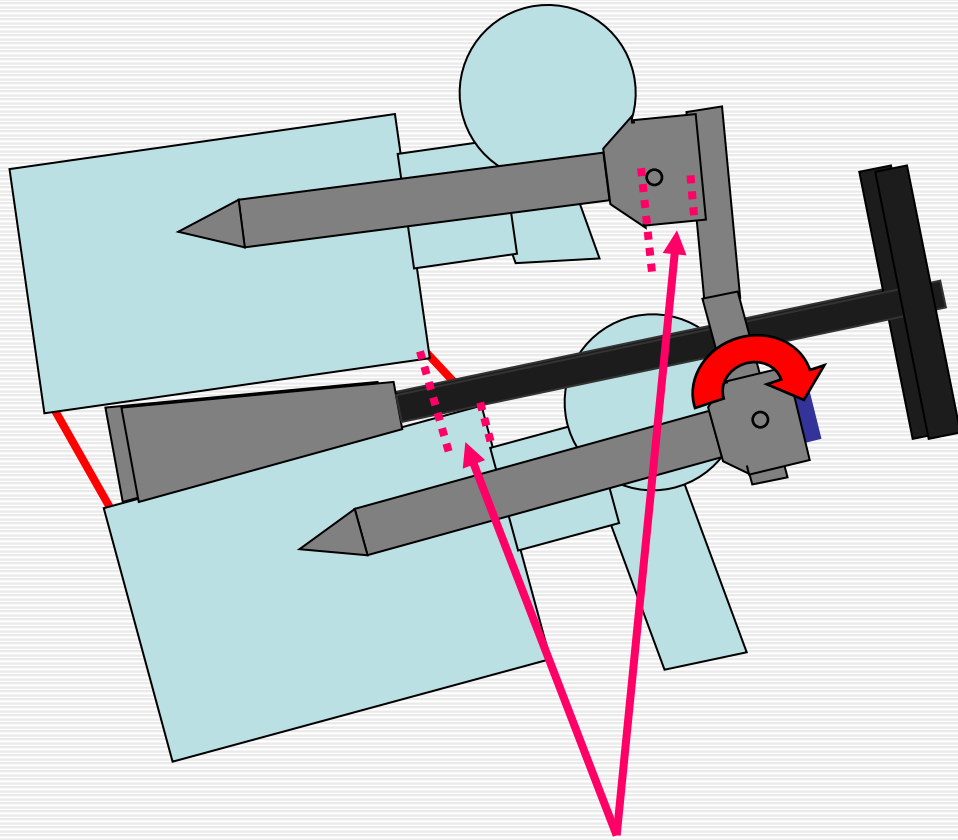


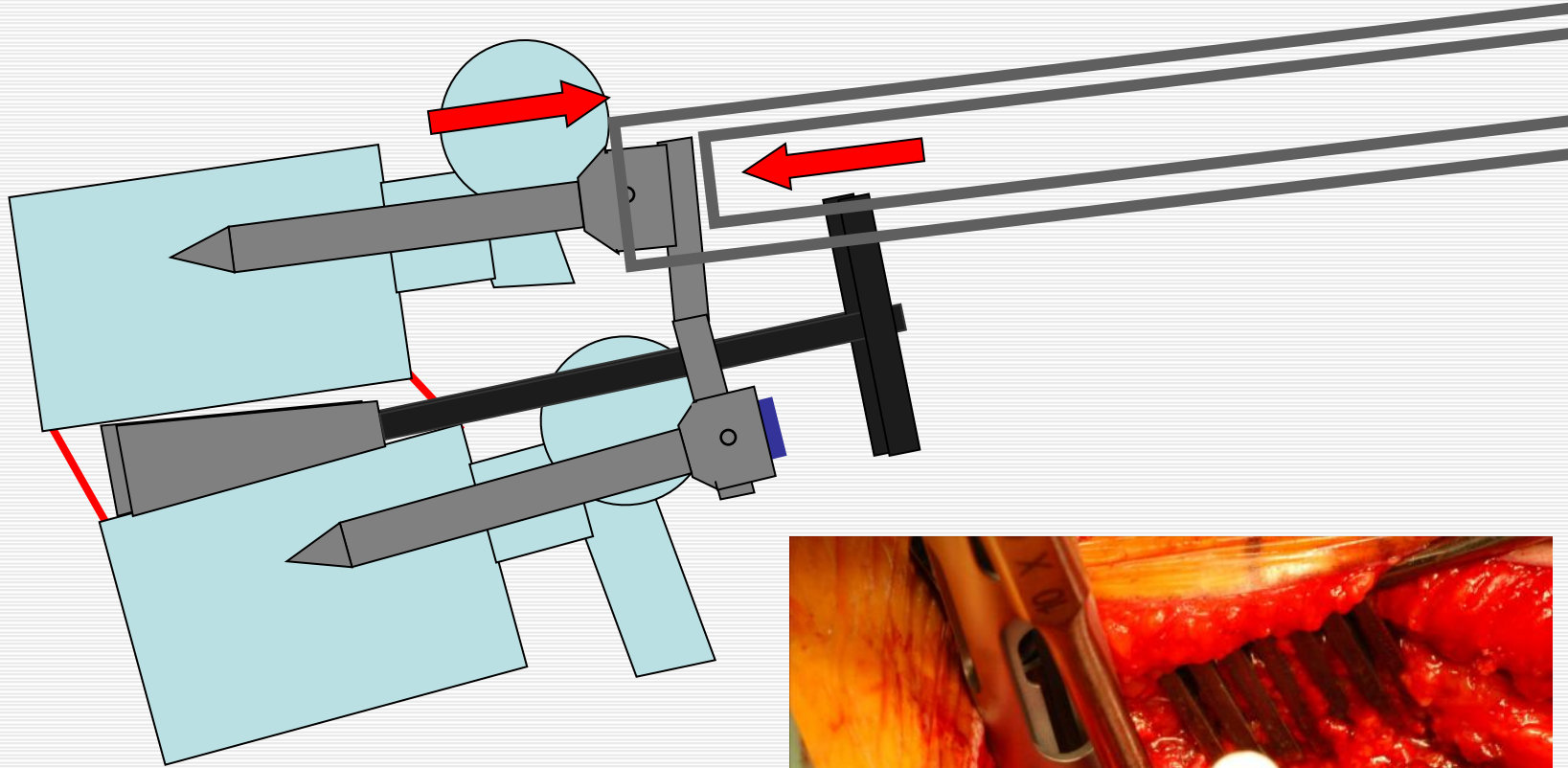


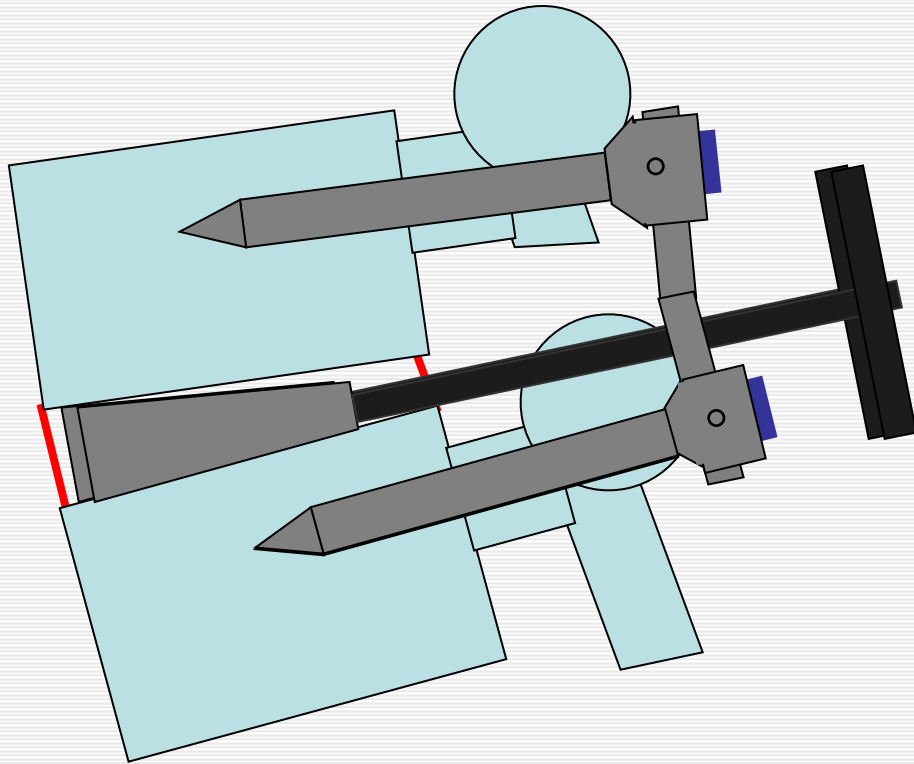
$$\text{Advantage} = \frac{2\pi R}{p}$$

$\approx 270 \text{ times}$

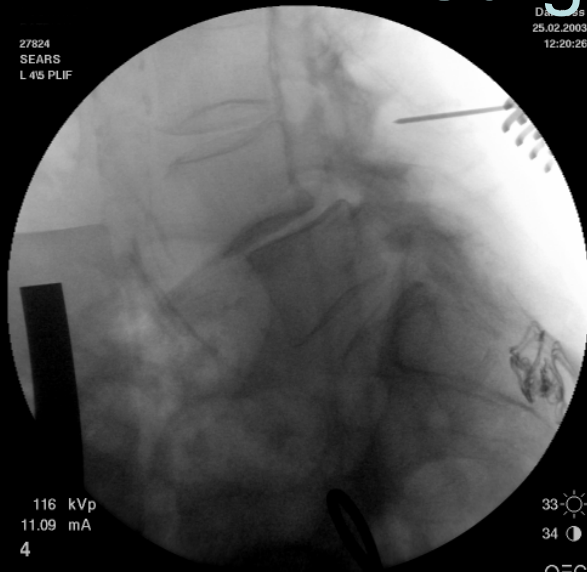








Surgical Technique



27824
SEARS
L 4/5 PLIF

Dalcross
25.02.2003
12:20:26

116 kVp
11.09 mA
4

33 ☀
34 ●

OEC



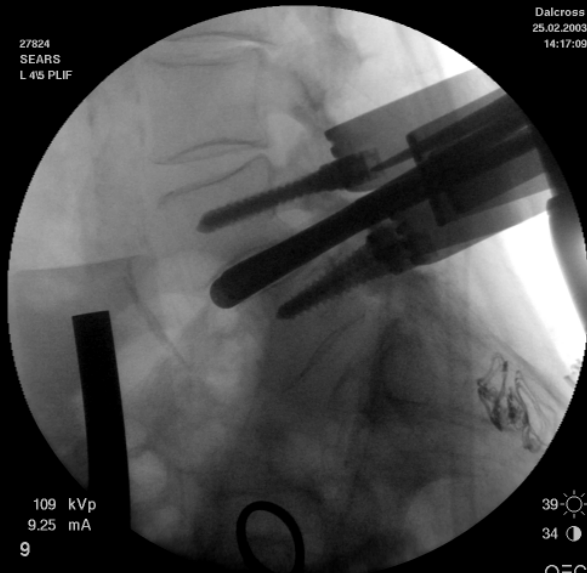
27824
SEARS
L 4/5 PLIF

Dalcross
25.02.2003
13:35:19

120 kVp
8.92 mA
8

33 ☀
34 ●

OEC



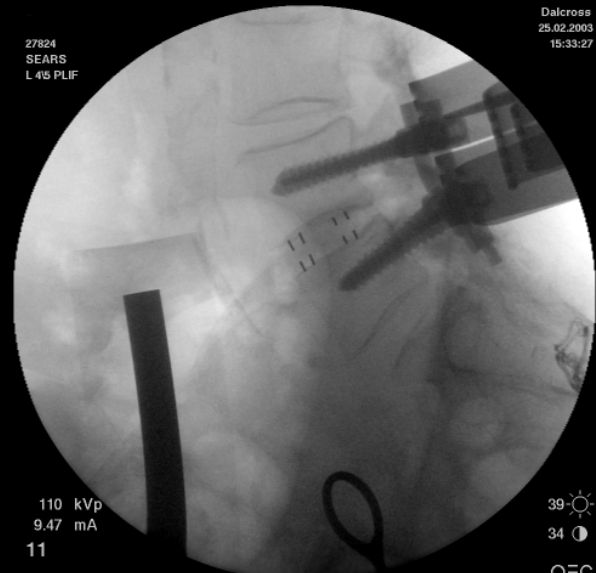
27824
SEARS
L 4/5 PLIF

Dalcross
25.02.2003
14:17:09

109 kVp
9.25 mA
9

39 ☀
34 ●

OEC



27824
SEARS
L 4/5 PLIF

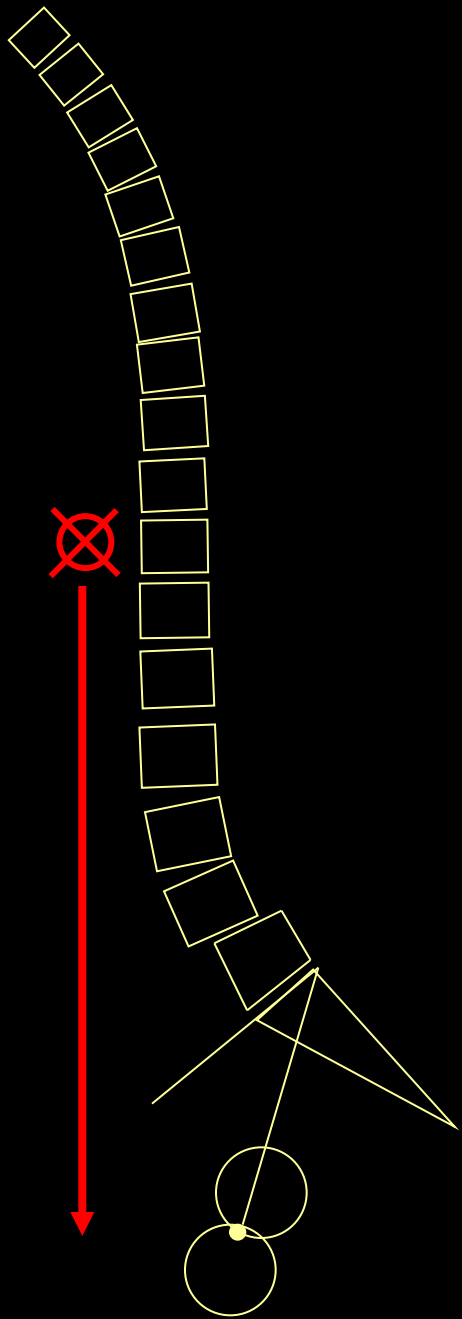
Dalcross
25.02.2003
15:33:27

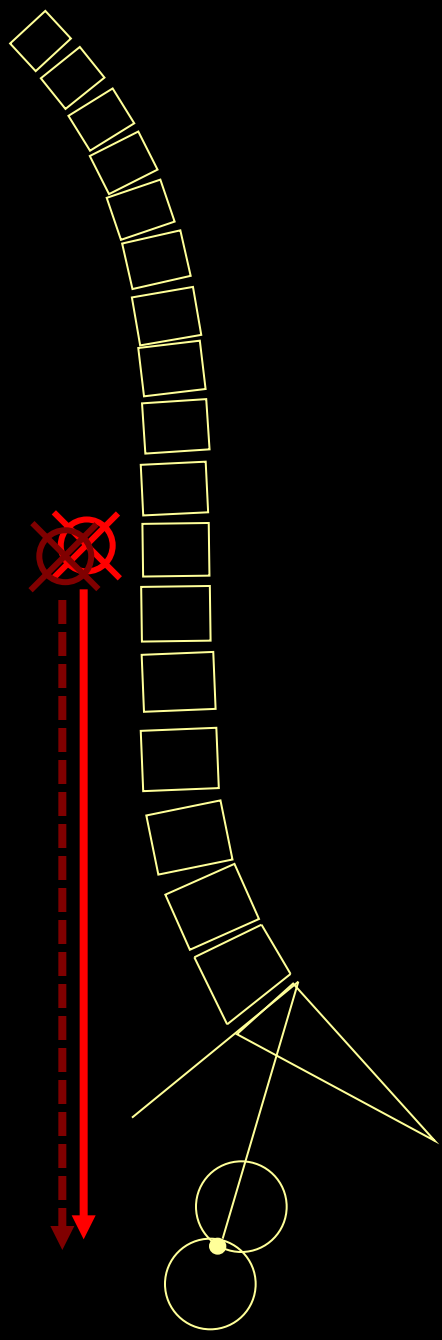
110 kVp
9.47 mA
11

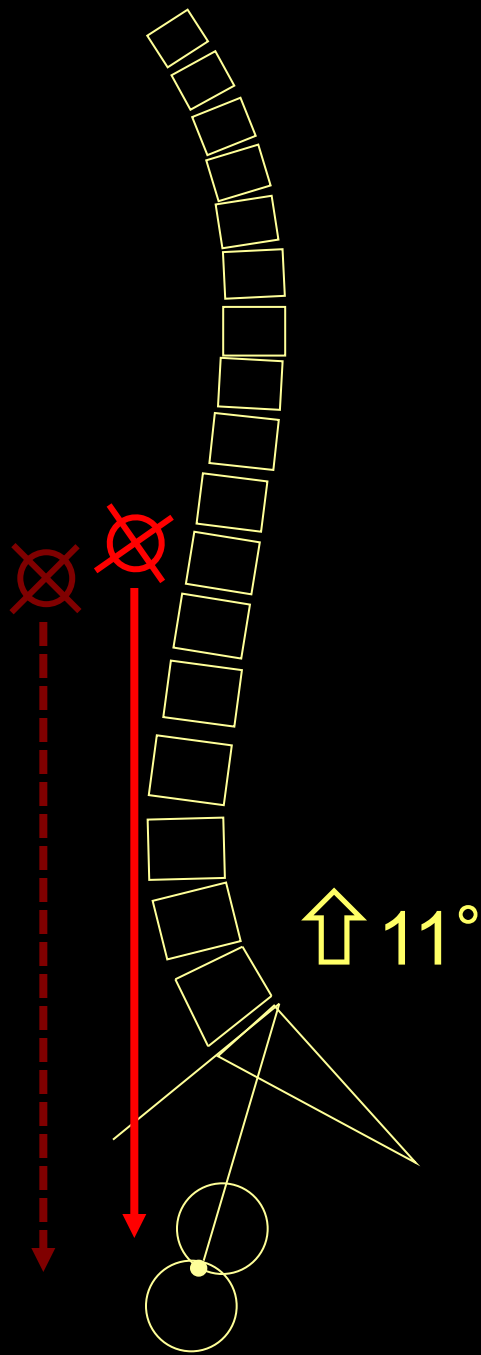
39 ☀
34 ●

OEC

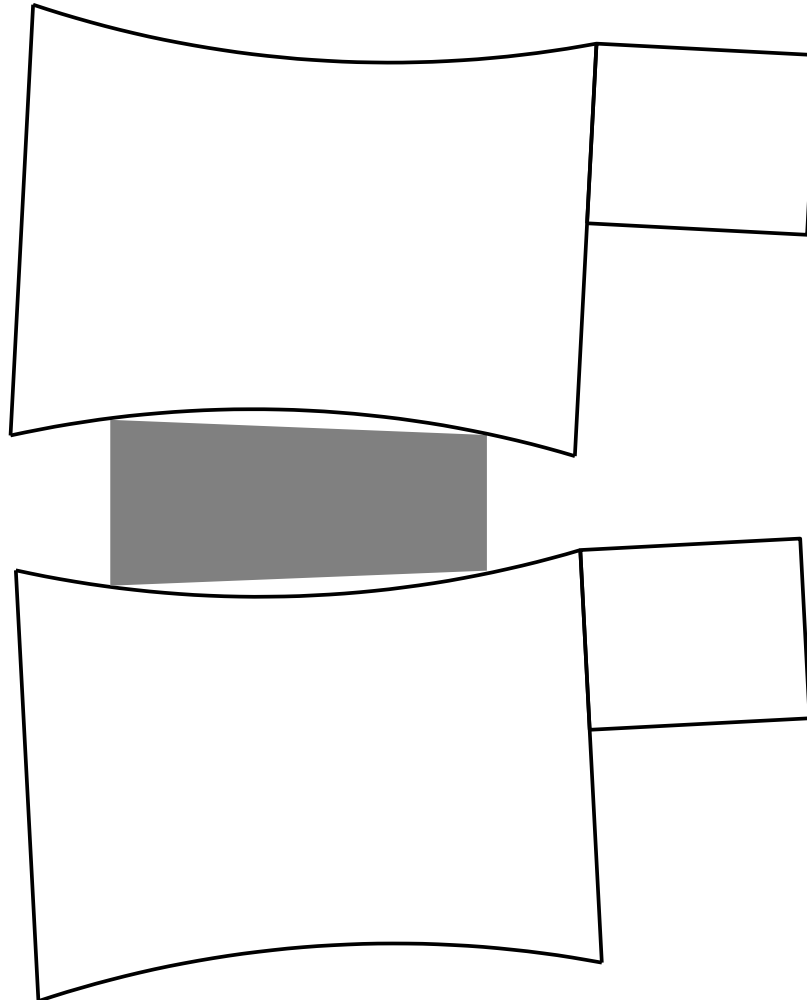
Is it all about slip correction?



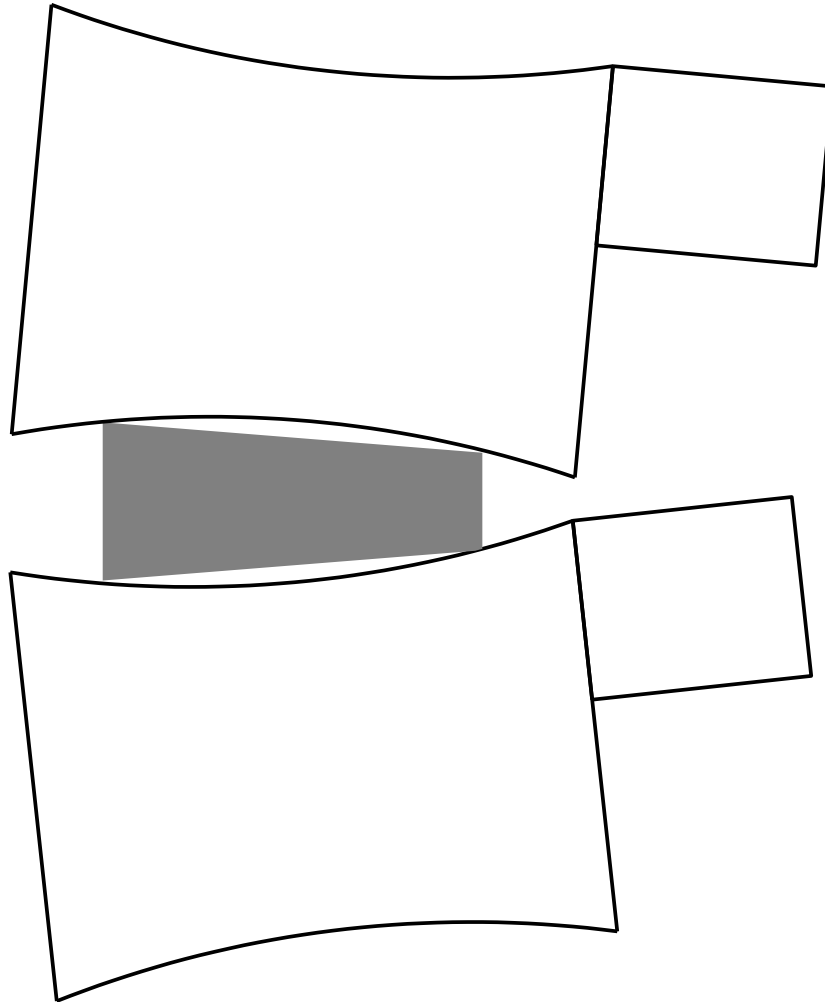




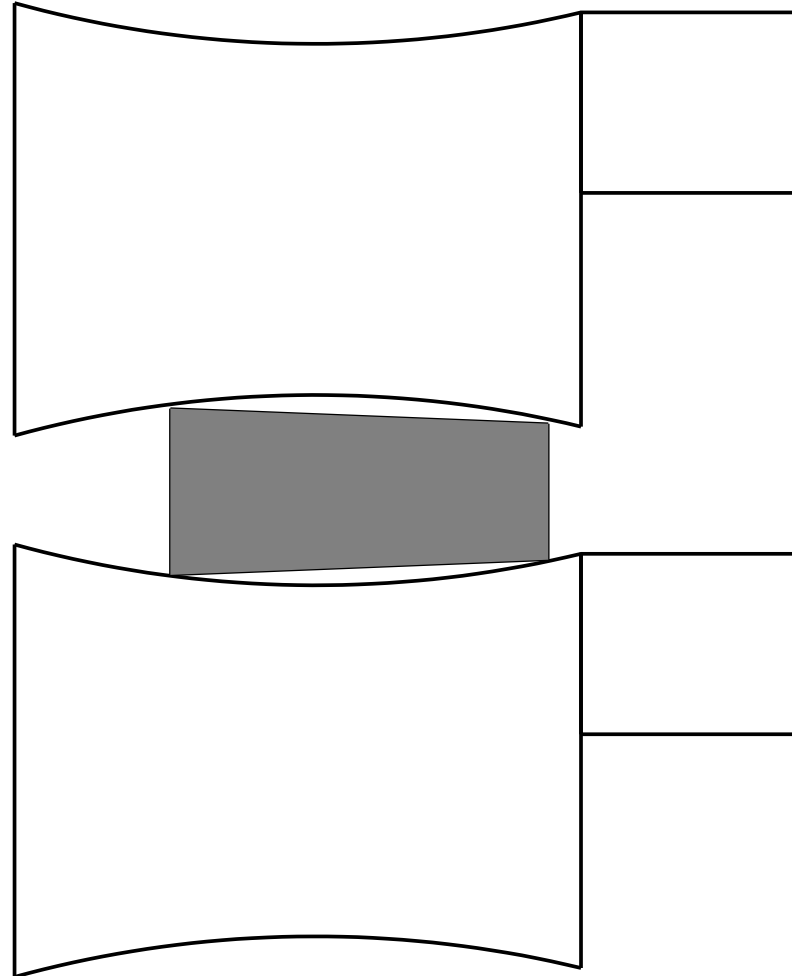
Setting the Lordosis



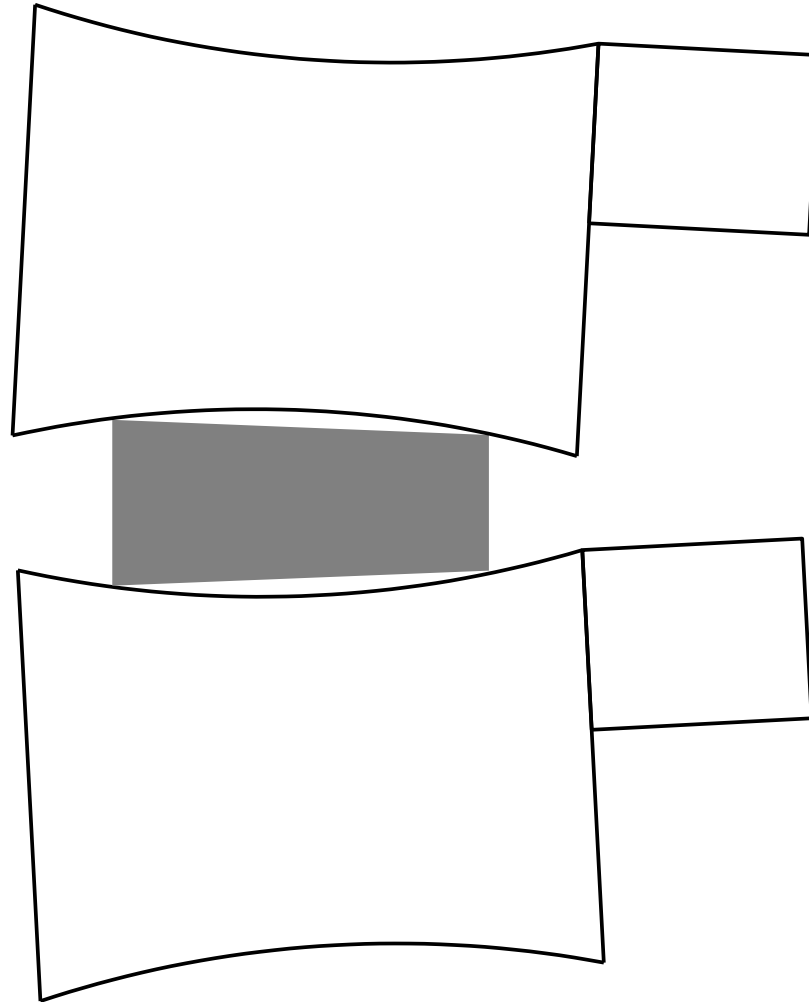
1. Alter the Implant Lordosis

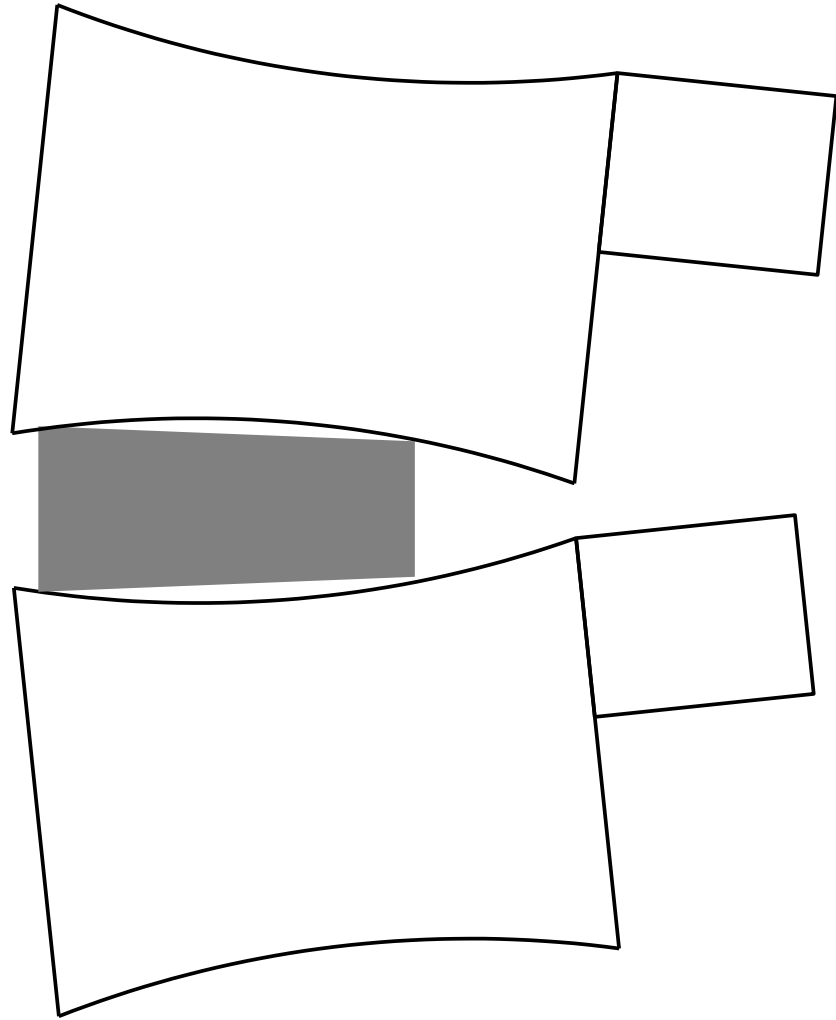


2. Alter the implant position

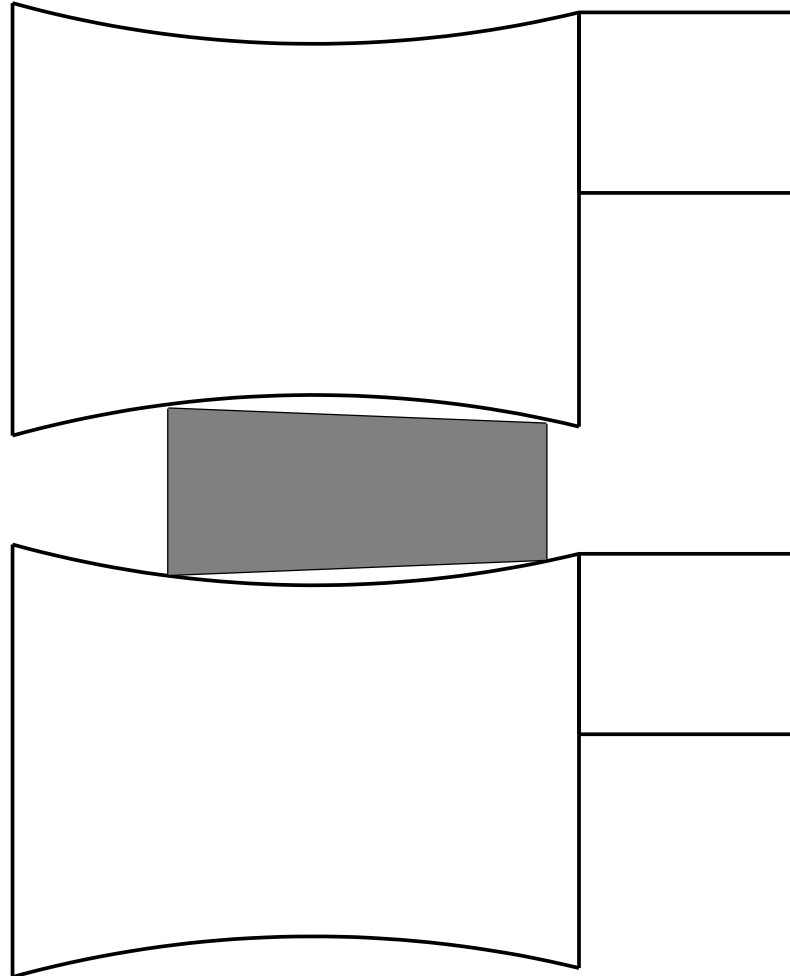


Move the implant forwards

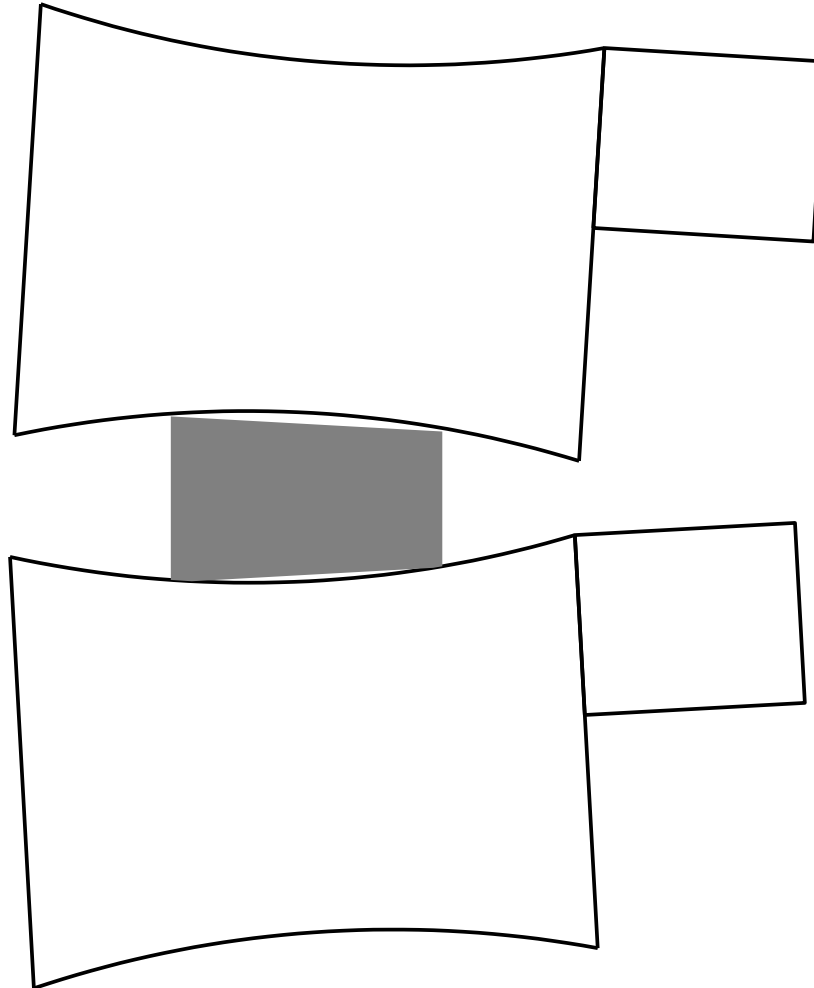




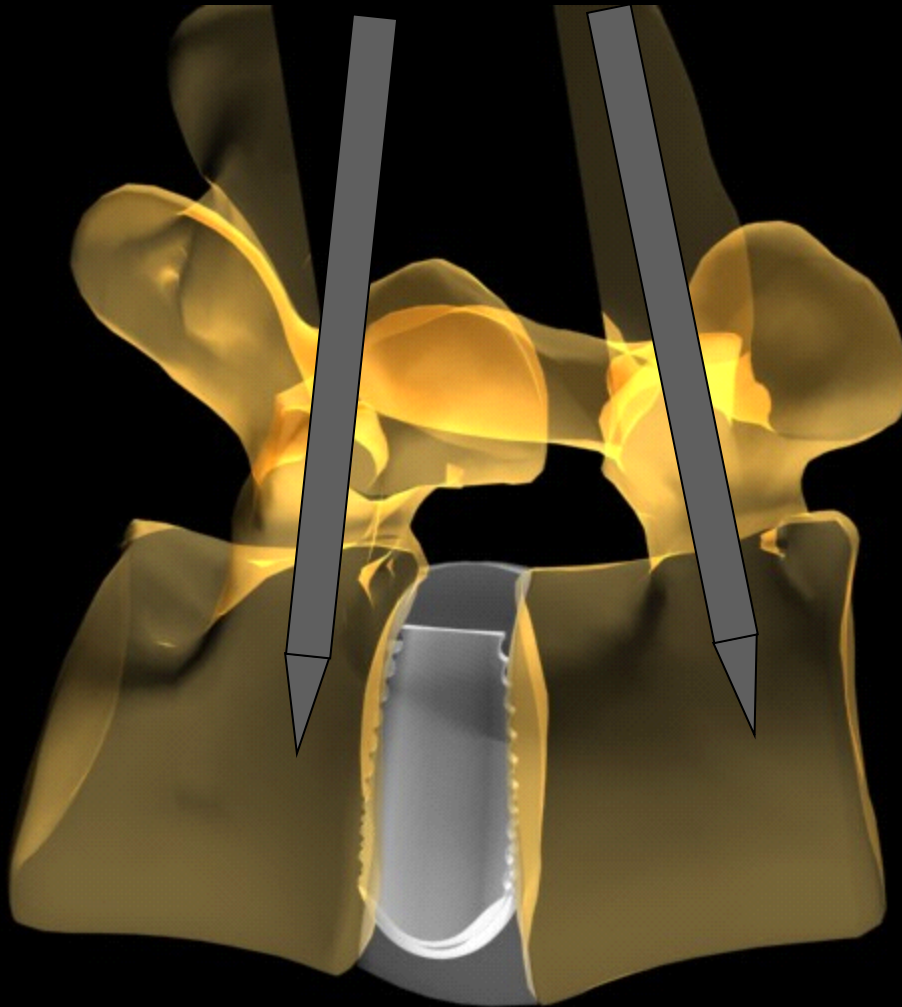
3. Alter the implant length

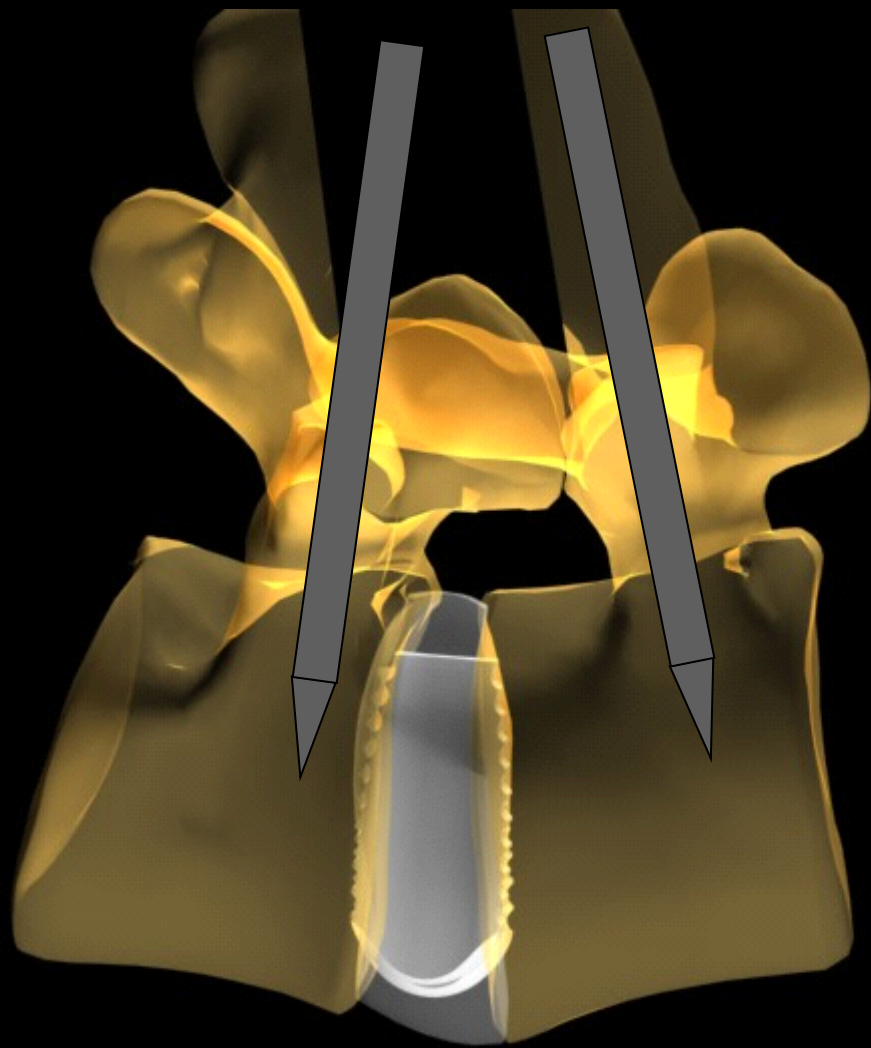


Shorten the implant



Final Restoration of Lordosis





27824
SEARS
L 4/5 PLIF

110 kVp
9.47 mA
11

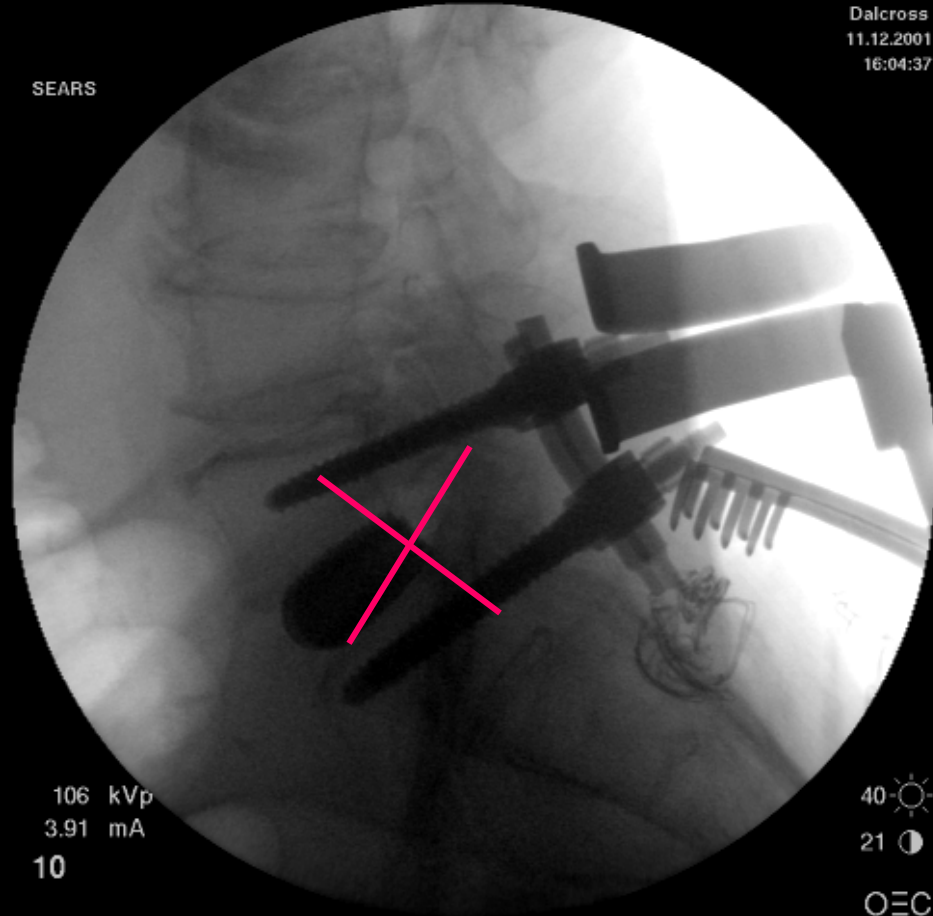
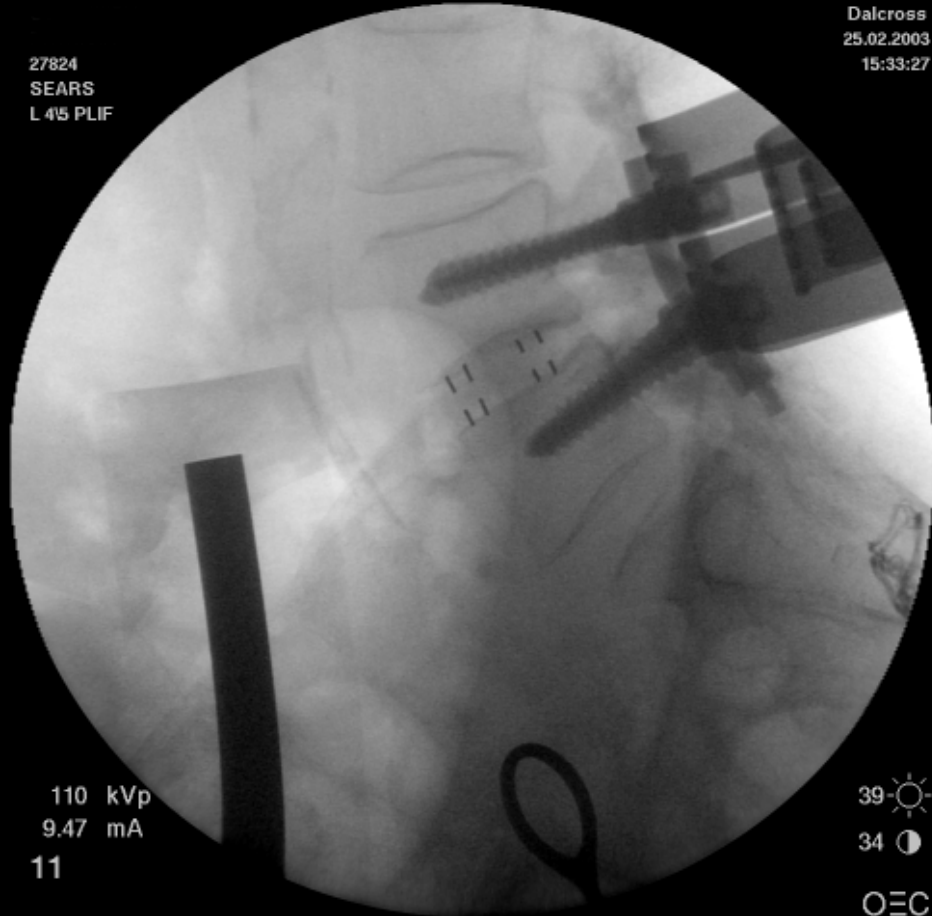
Dalcross
25.02.2003
15:33:27

SEARS

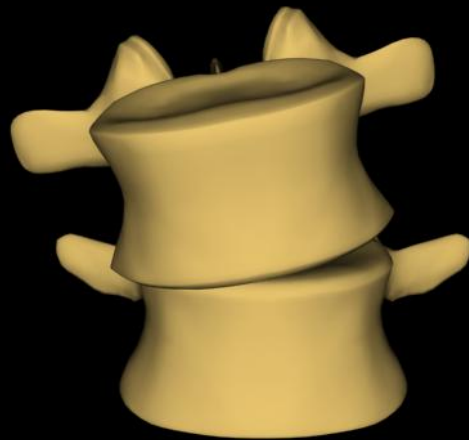
106 kVp
3.91 mA
10

Dalcross
11.12.2001
16:04:37

40 kVp
21 mA
OEC

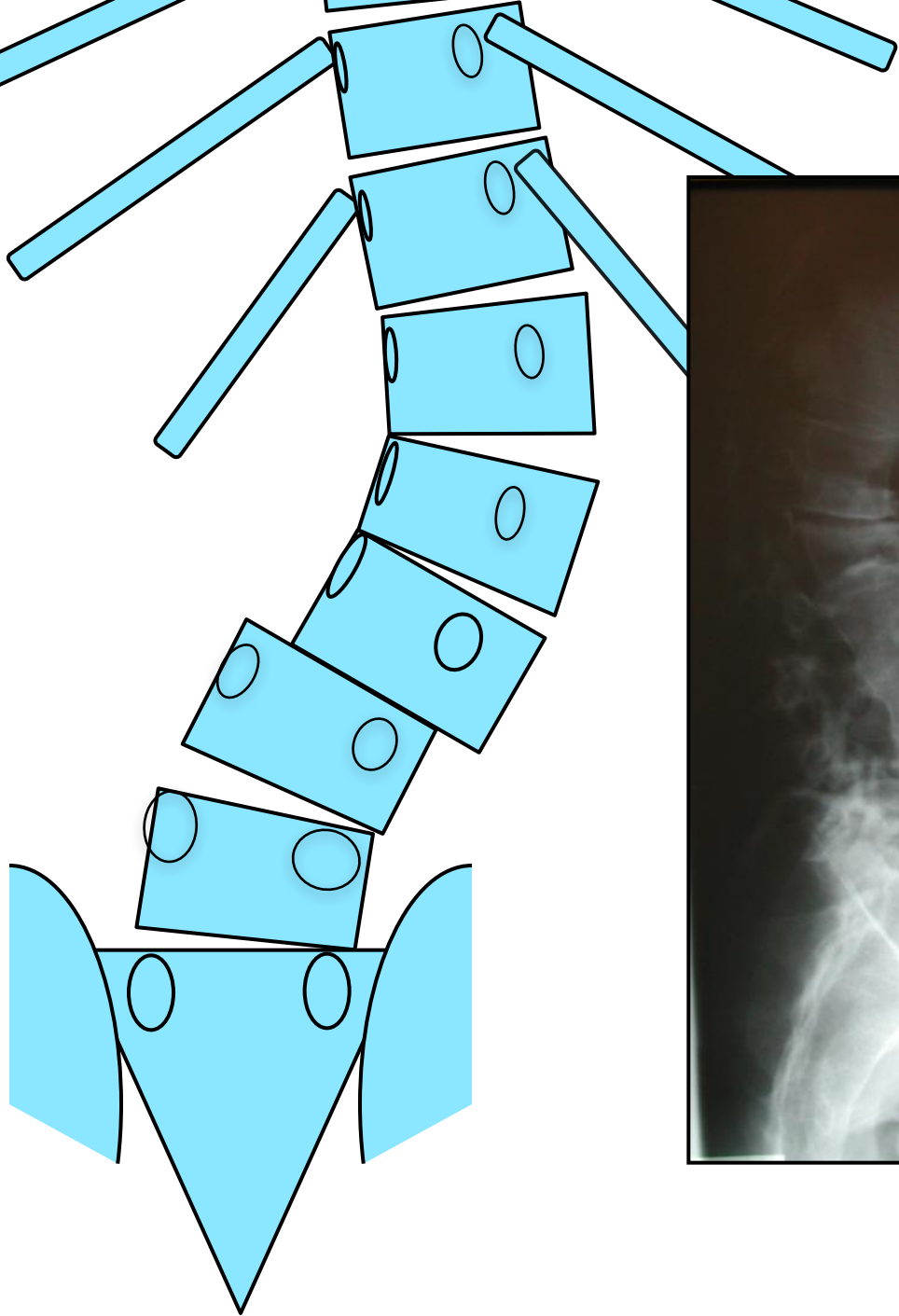


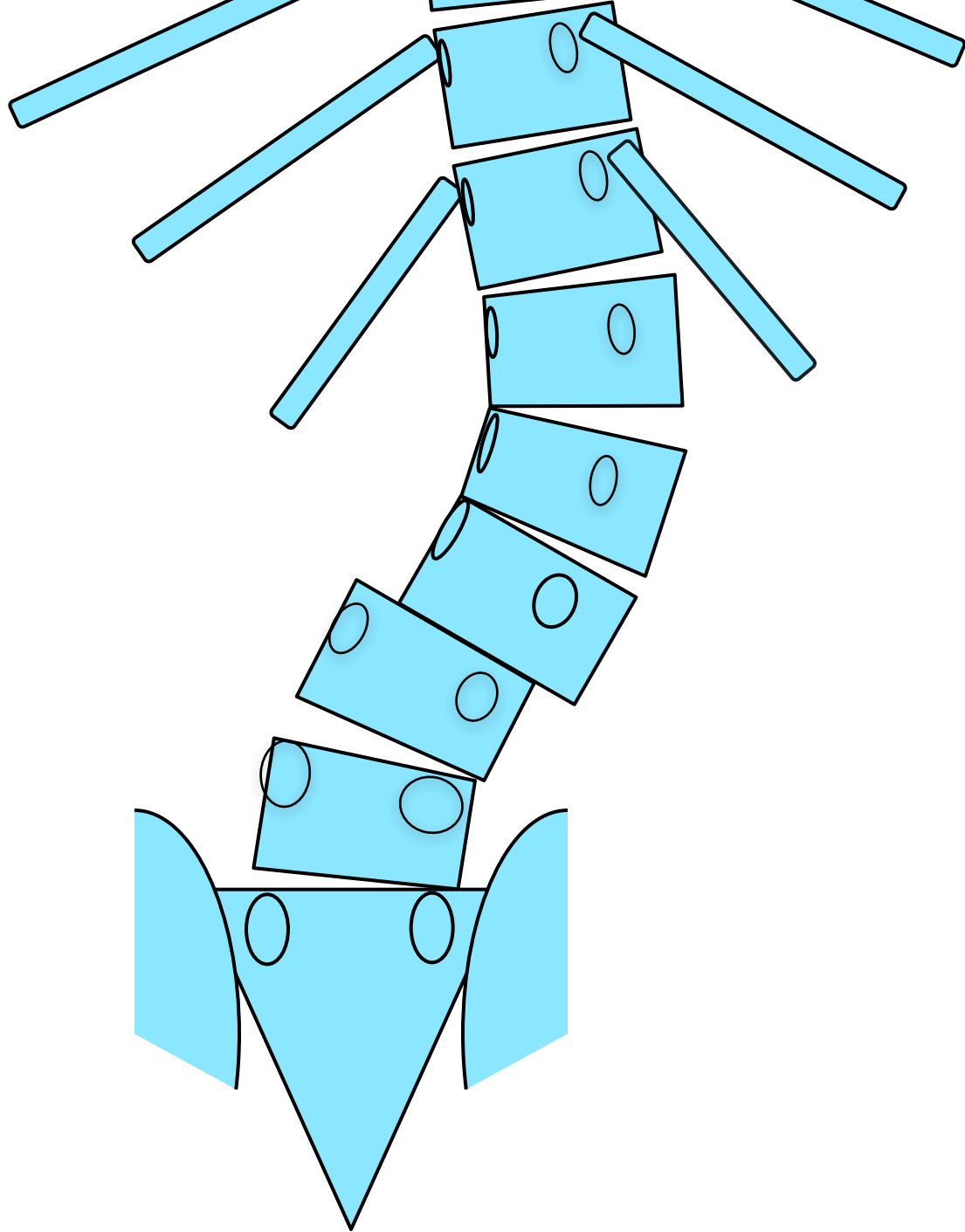
3-dimensional deformity

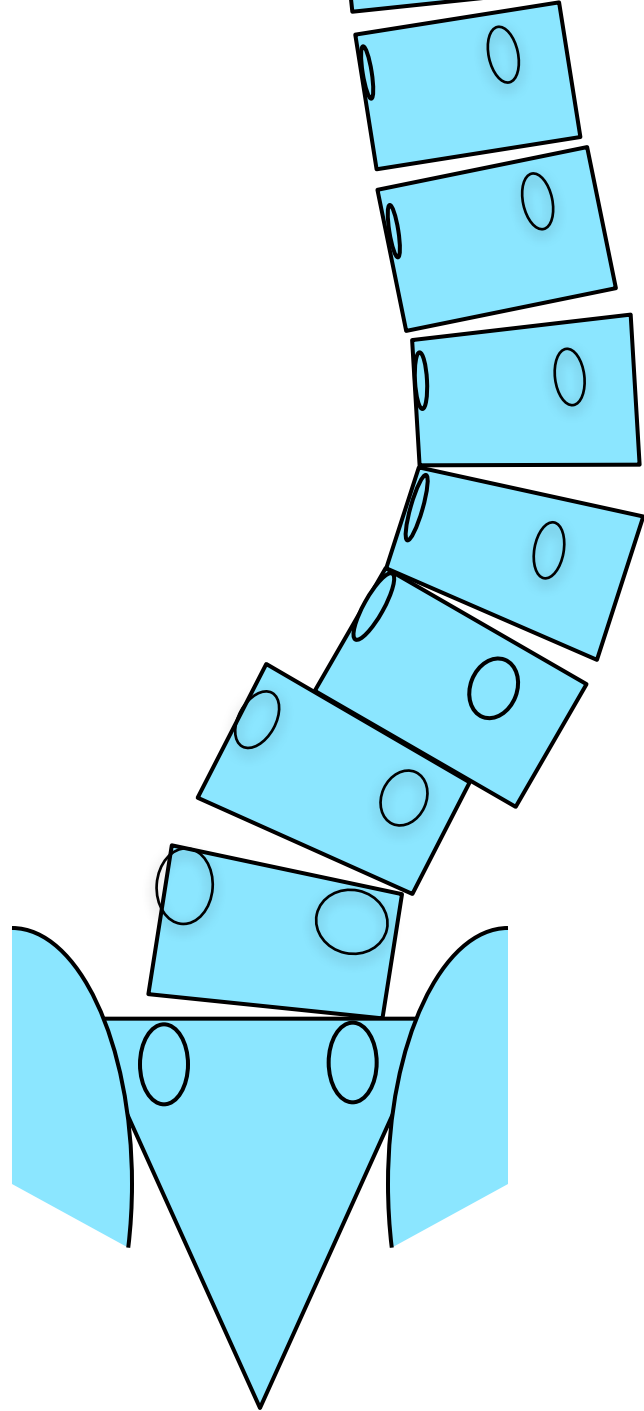


NM, Female, 76yrs



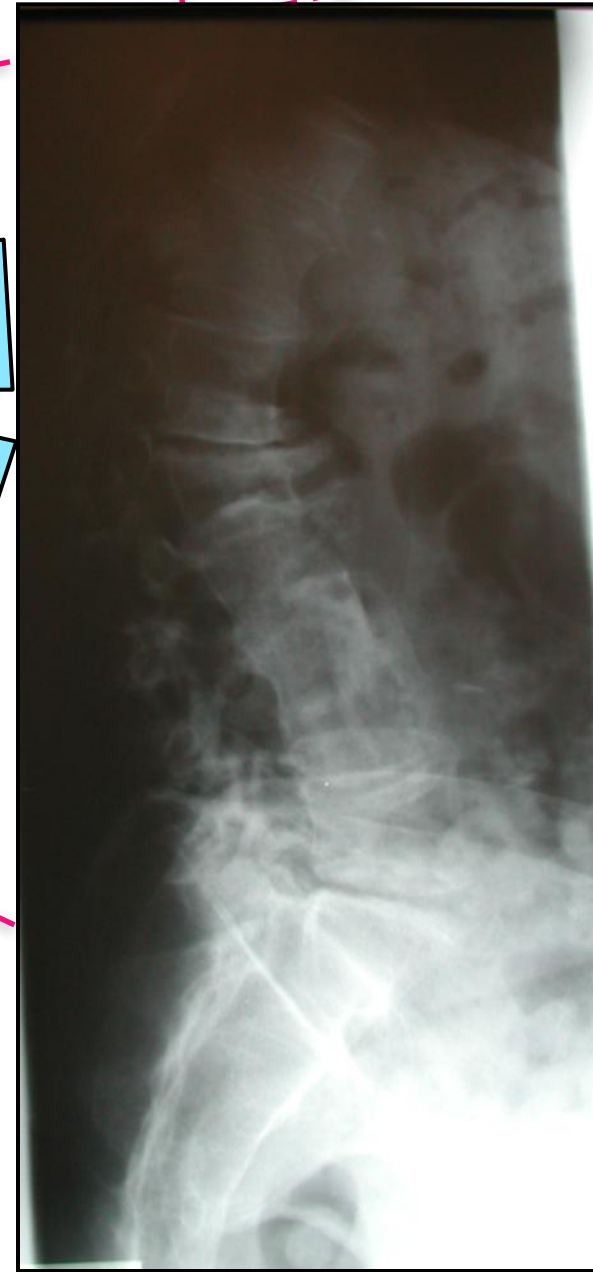
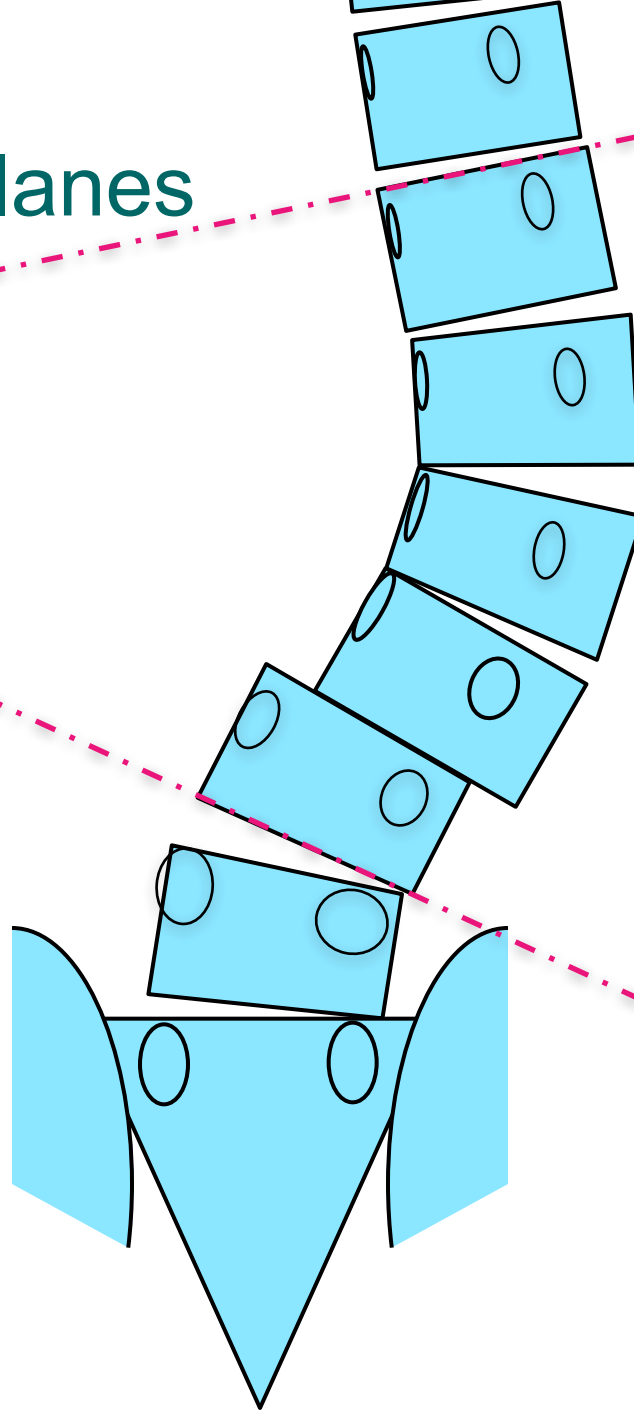
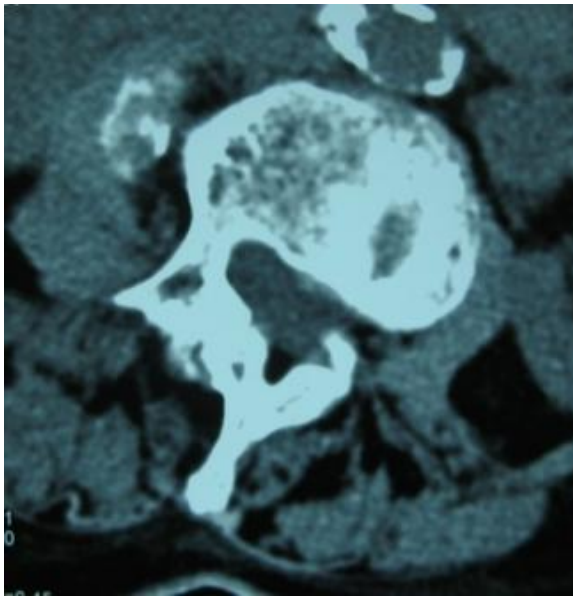






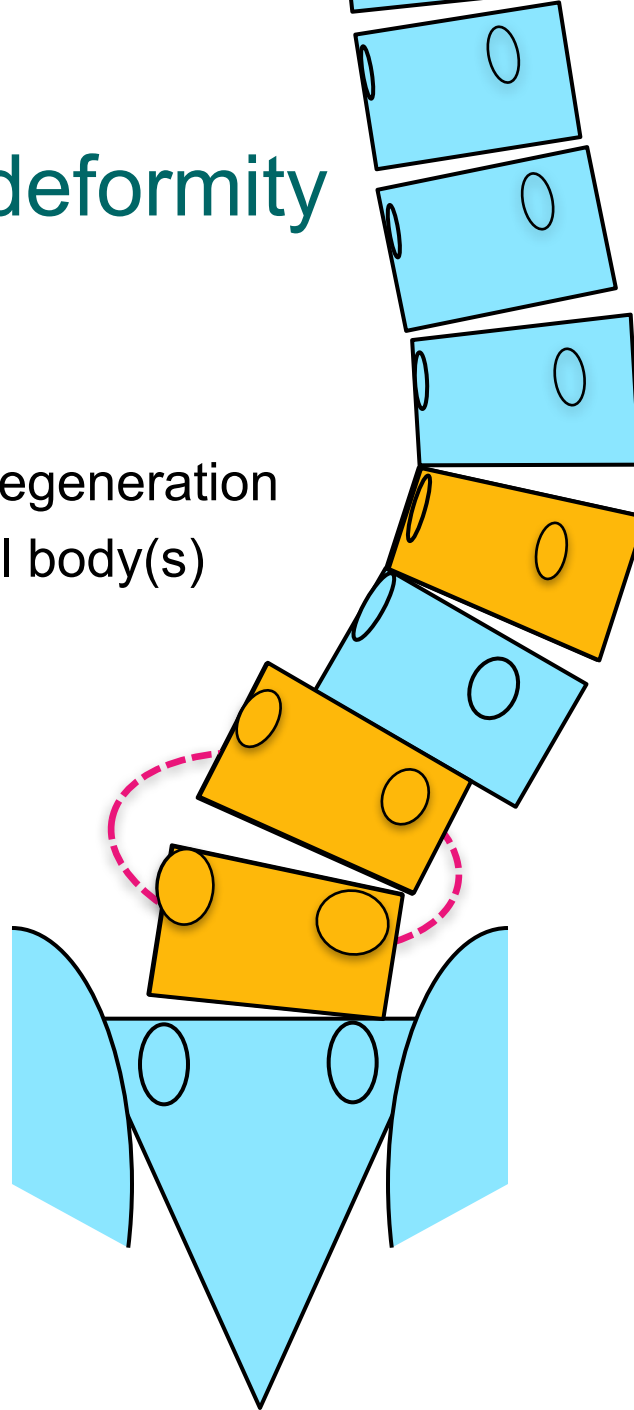
Deformity planes

- Coronal
- Sagittal
- Axial



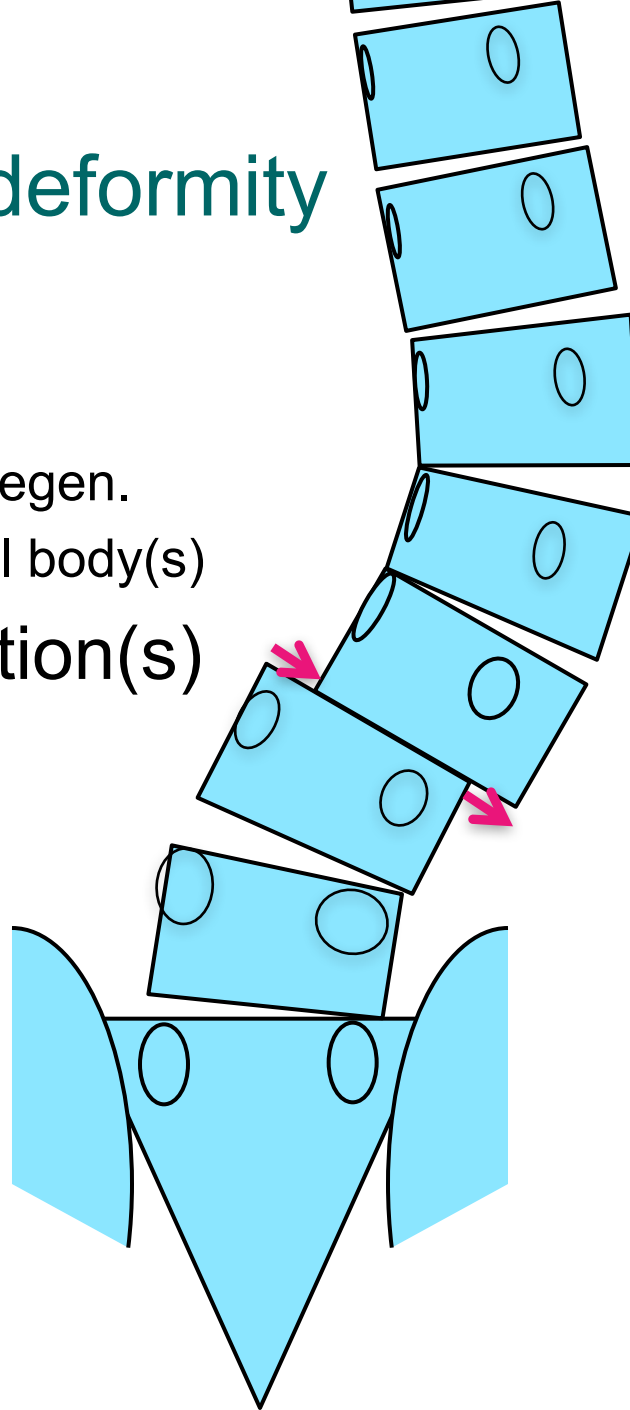
Coronal plane deformity

- **Scoliosis**
 - asymmetric disc degeneration
 - trapezoid vertebral body(s)

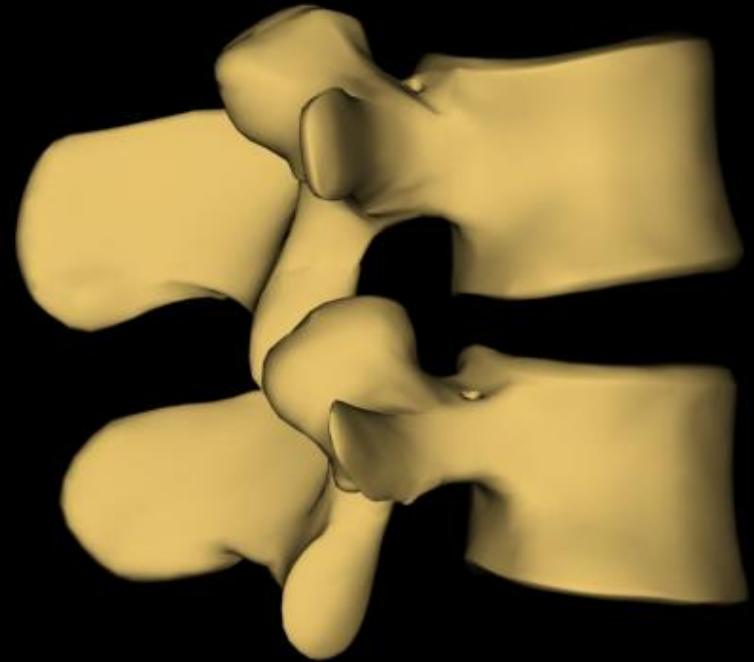
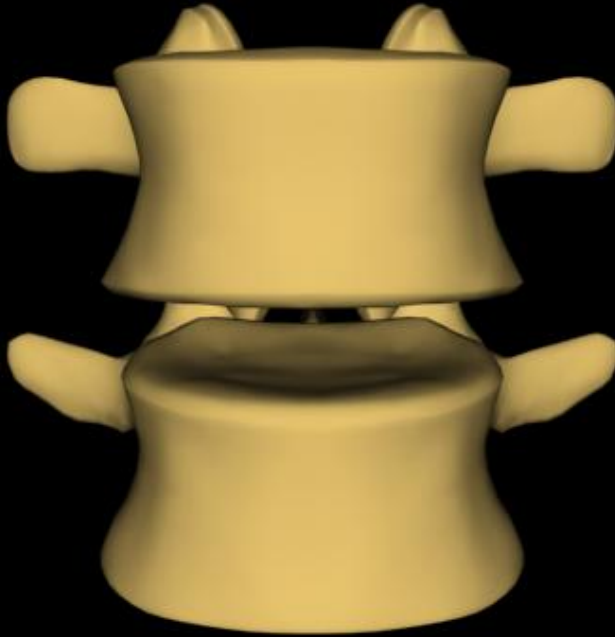


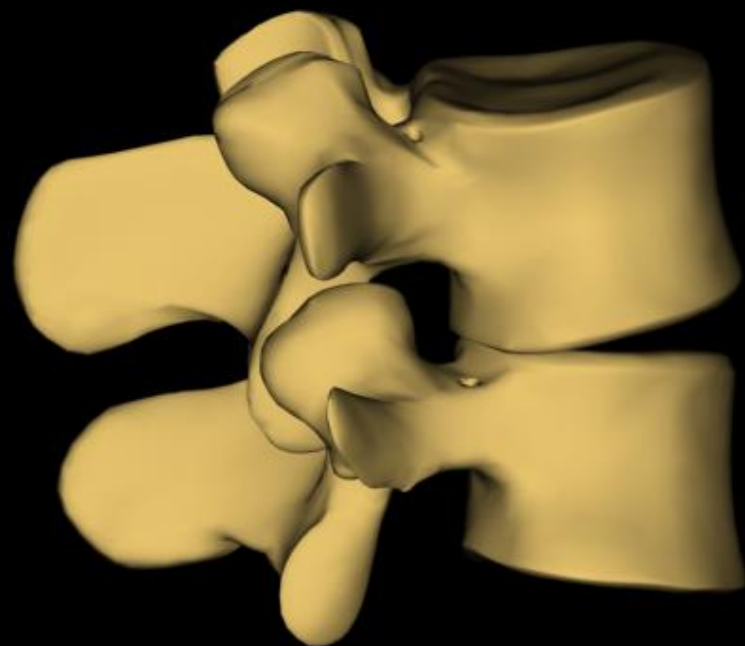
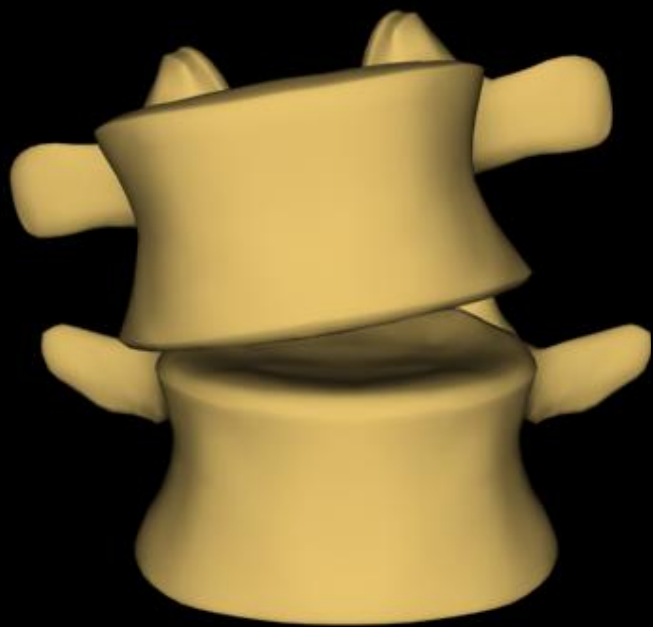
Coronal plane deformity

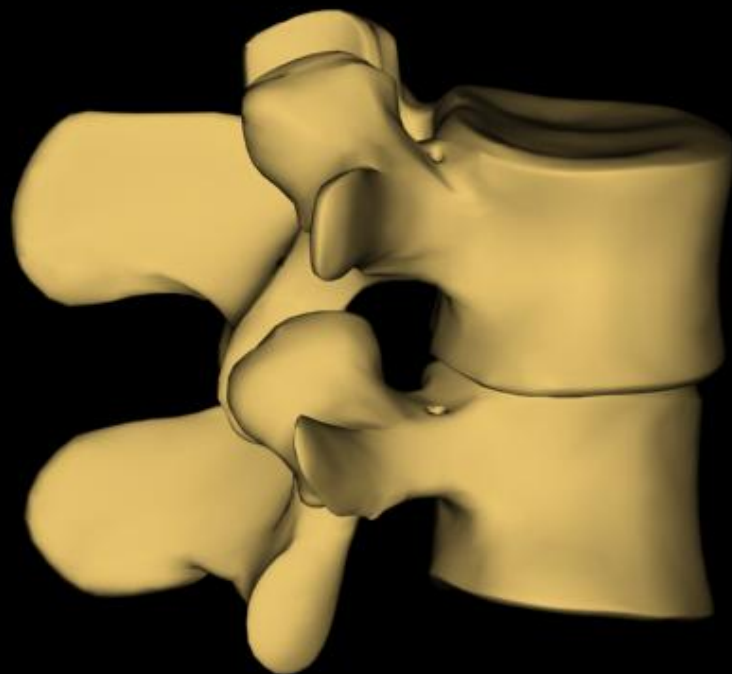
- **Scoliosis**
 - asymmetric disc degen.
 - trapezoid vertebral body(s)
- **Lateral subluxation(s)**
 - Often L3/4

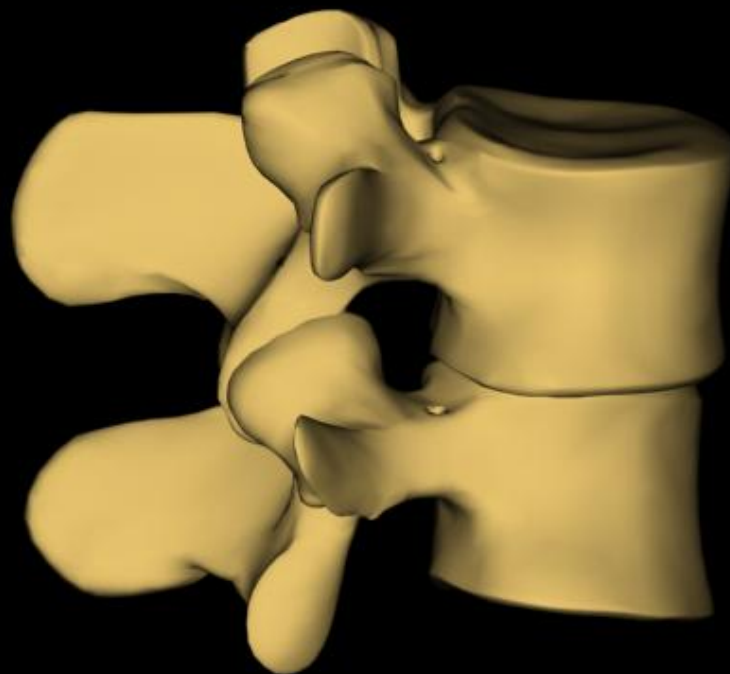
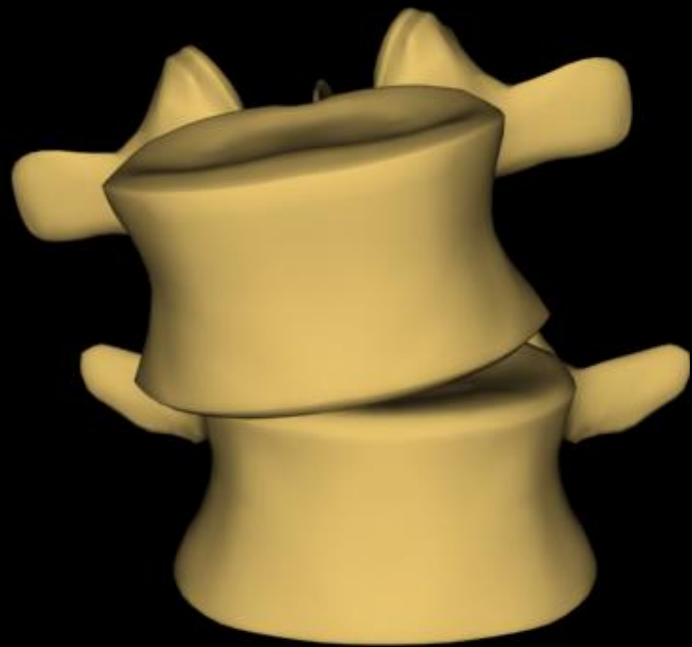


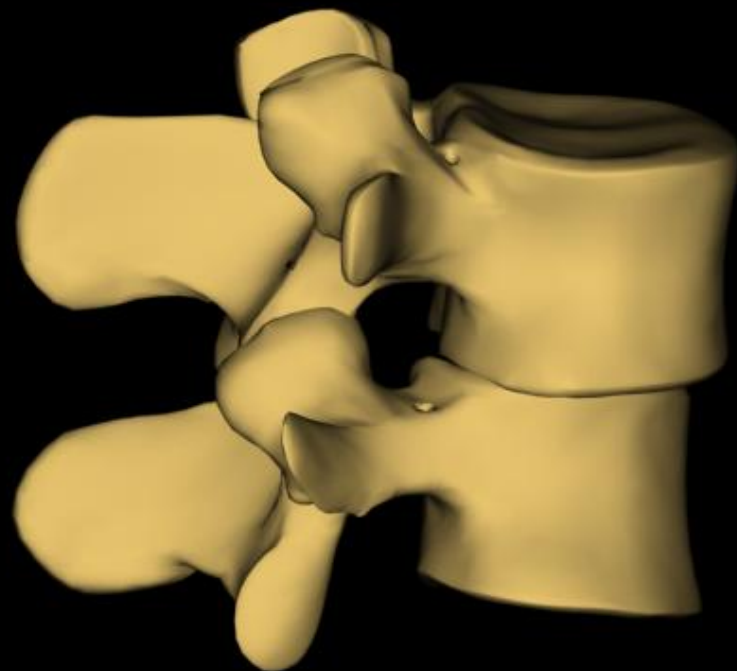
Correction of 3-D deformity

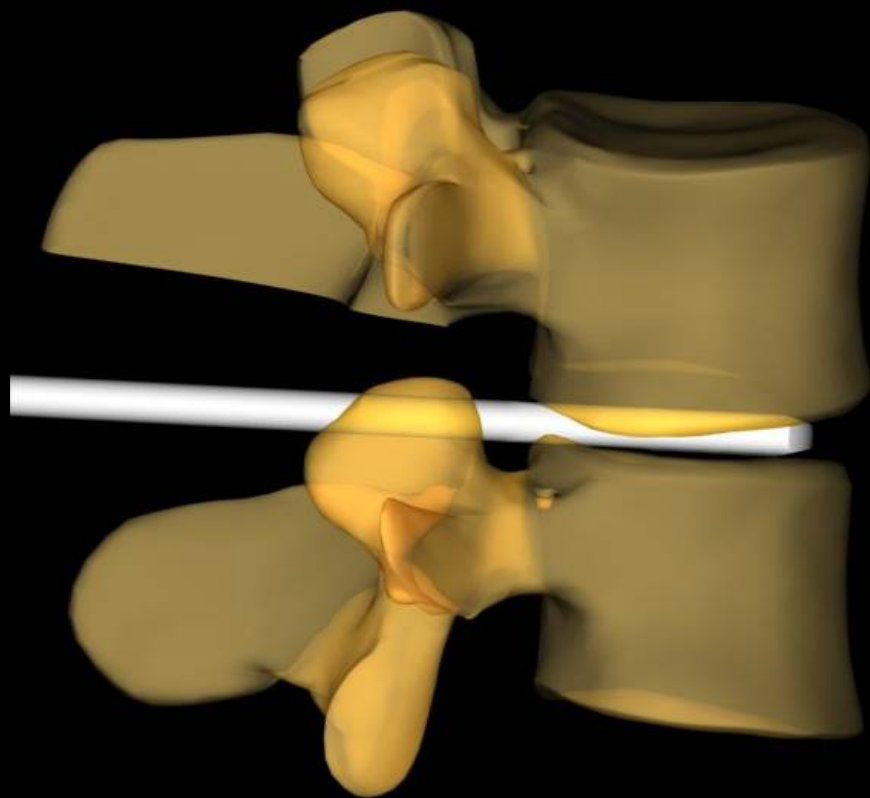
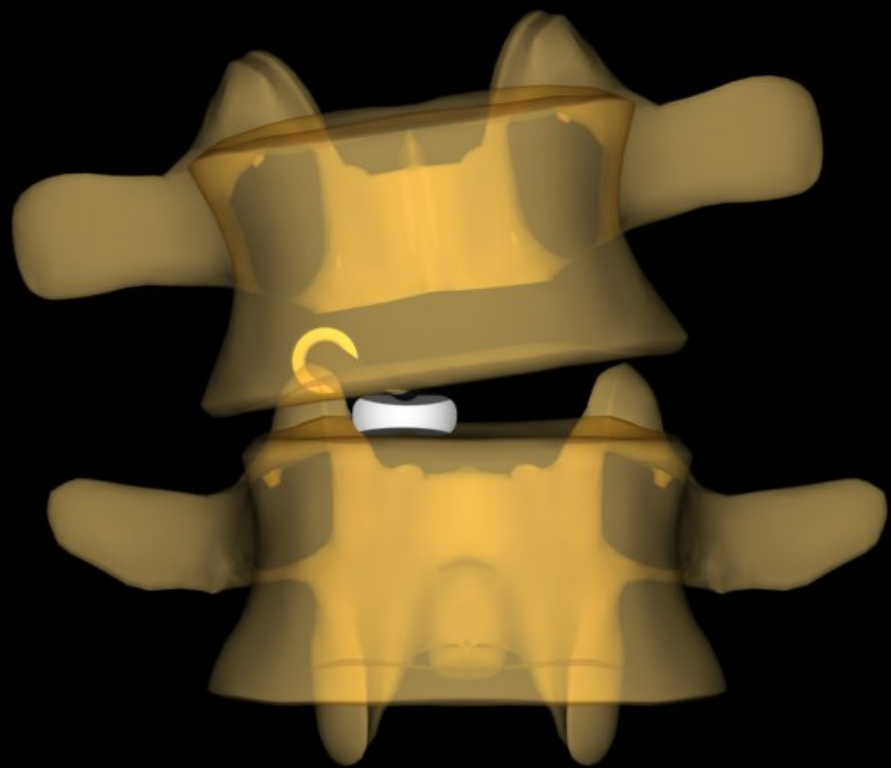


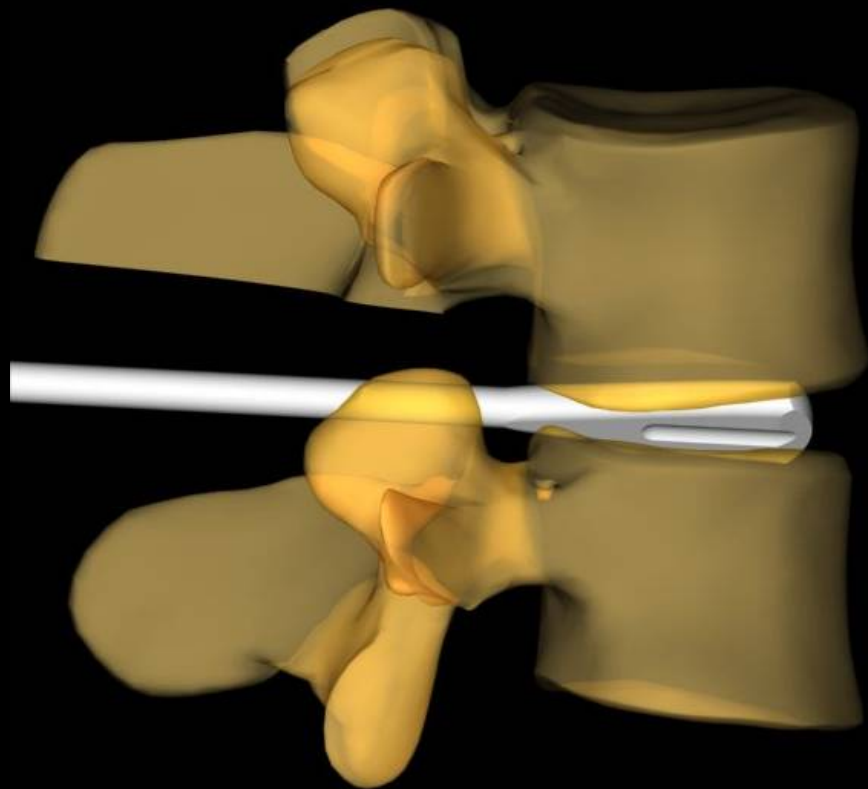
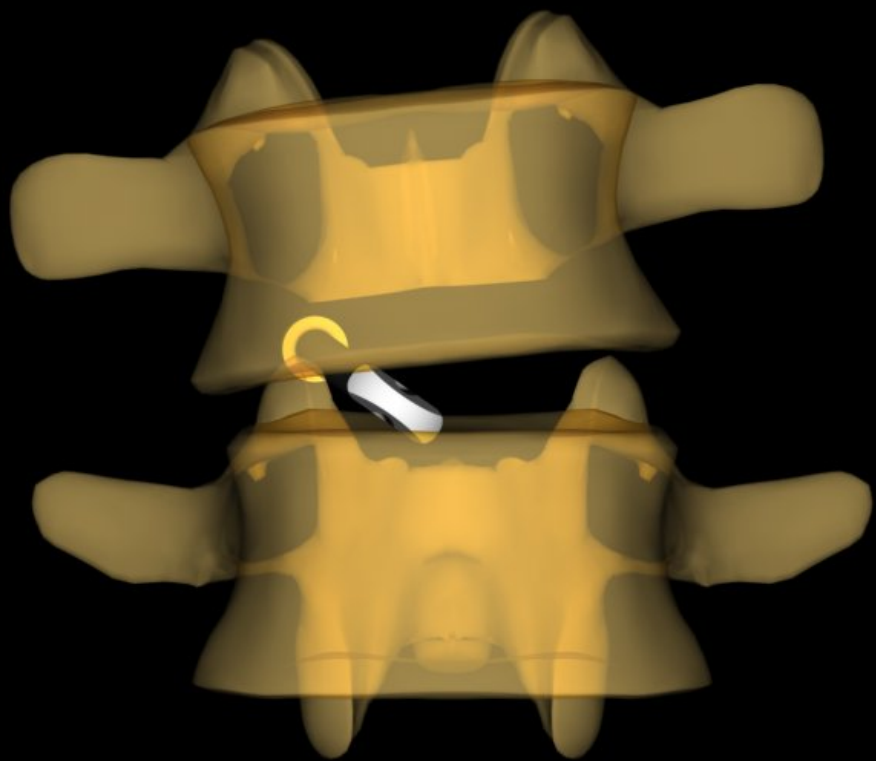


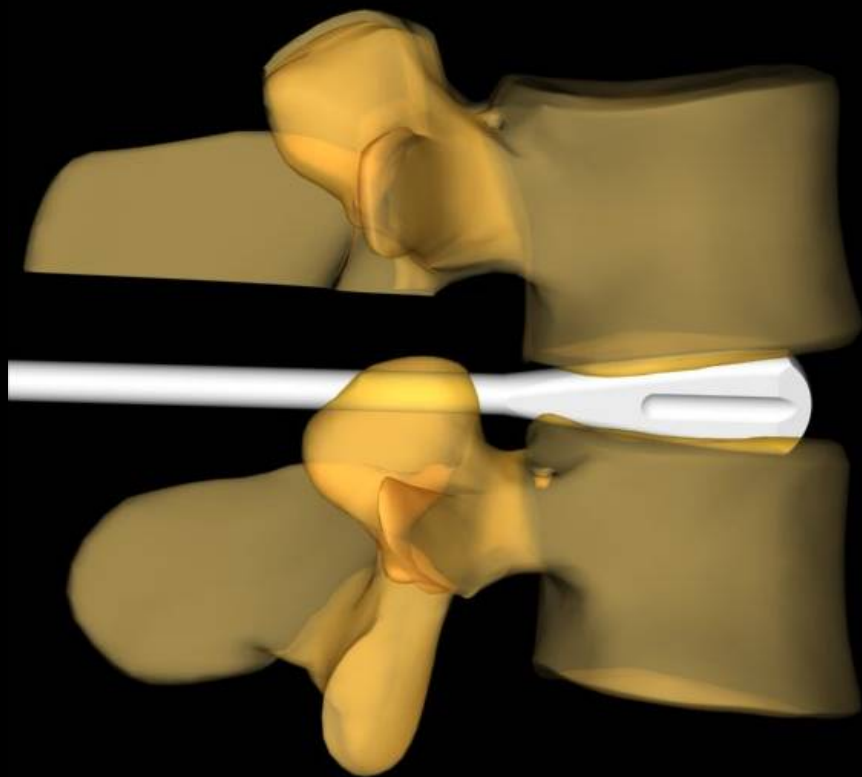
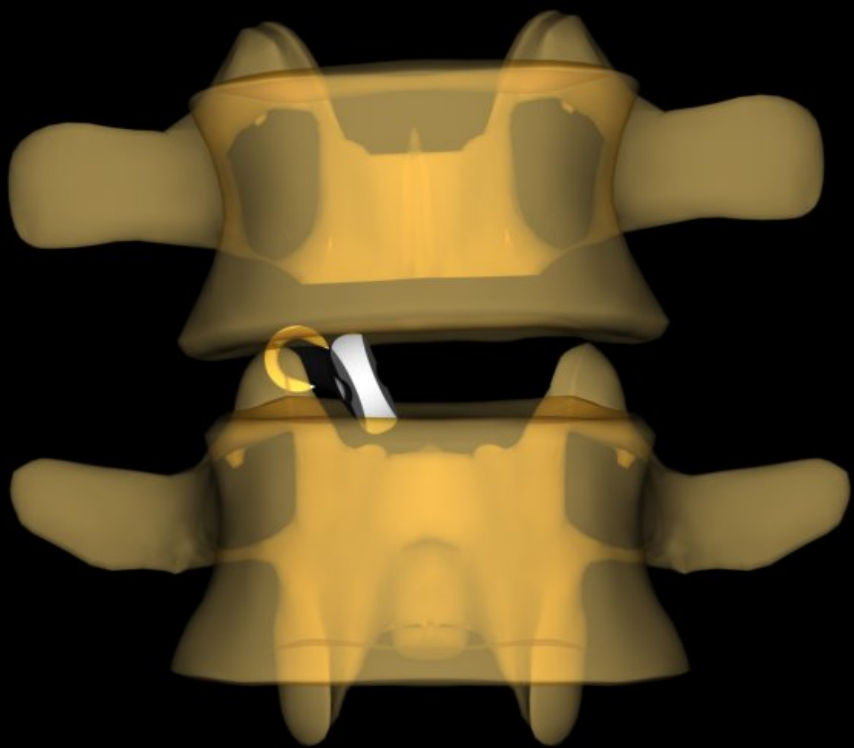


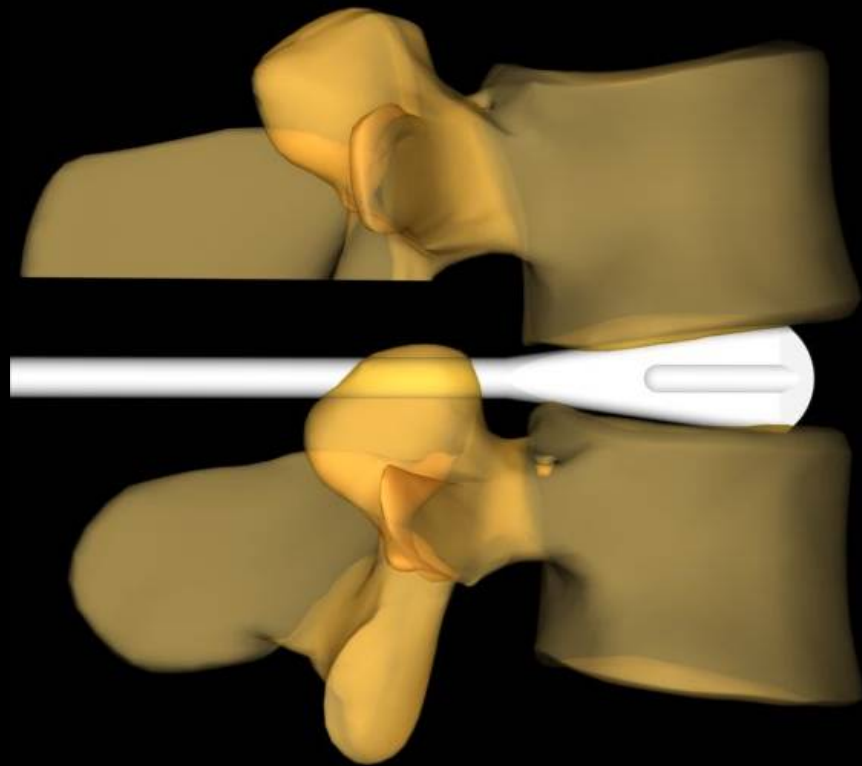
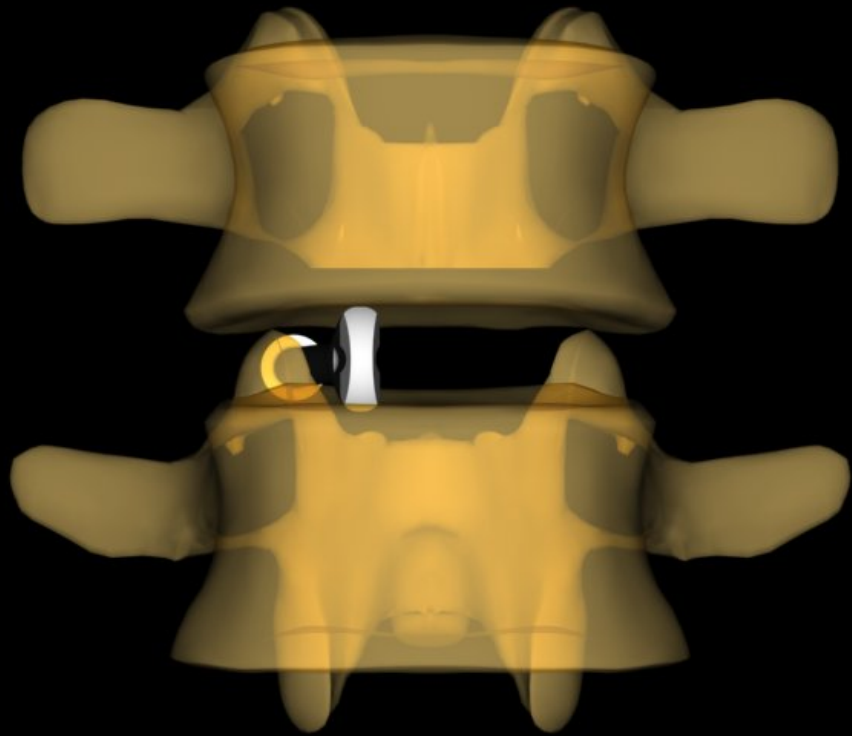


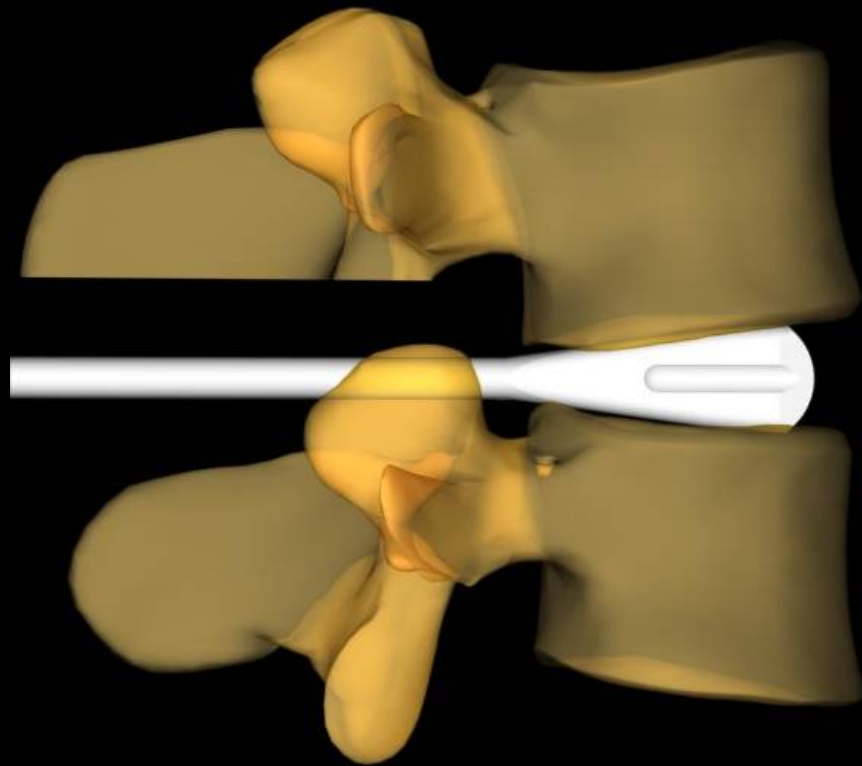
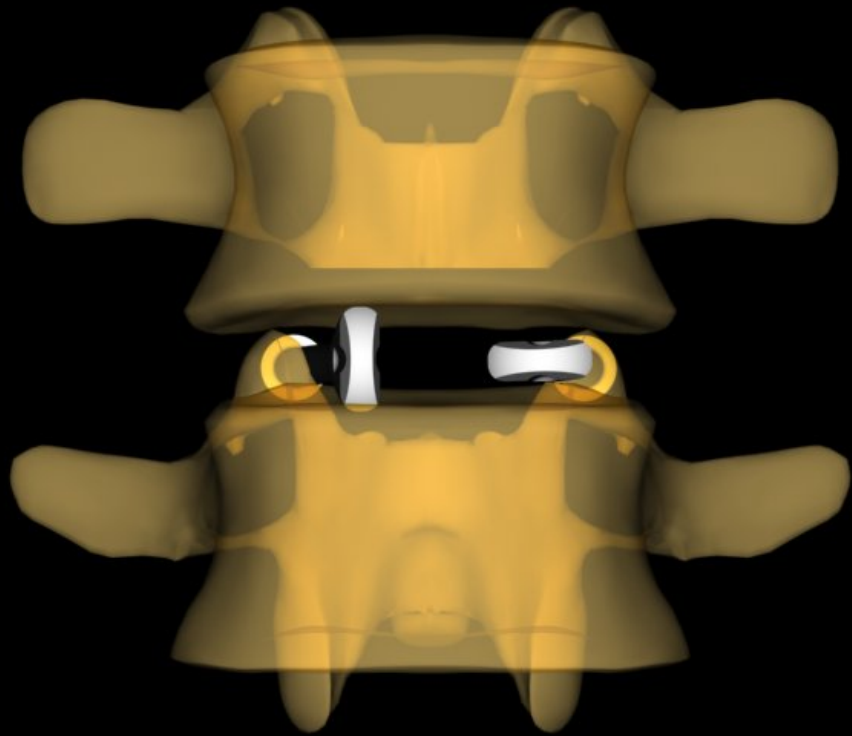


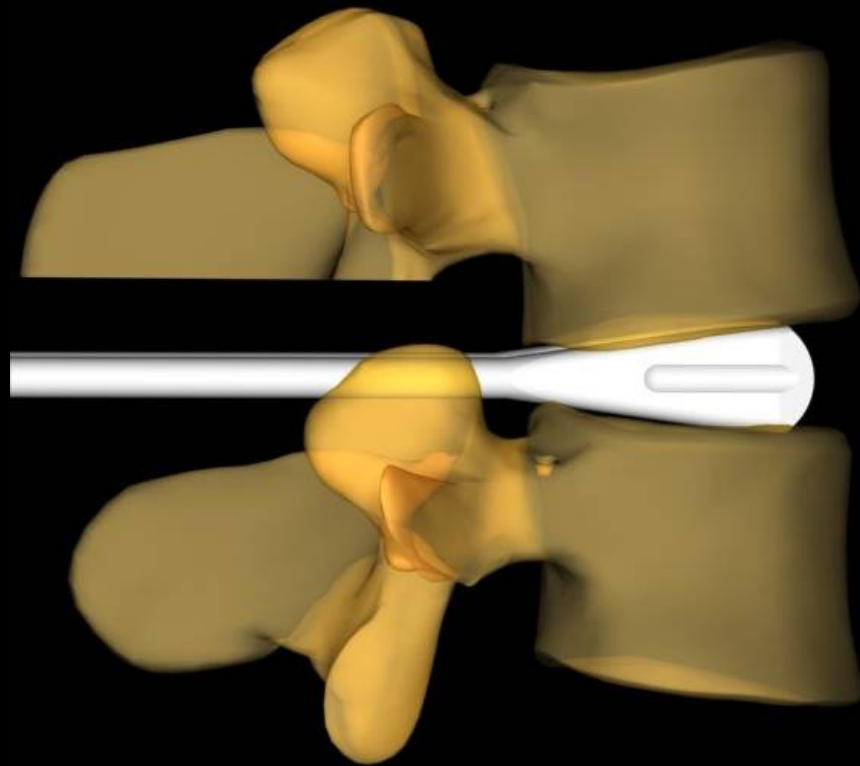
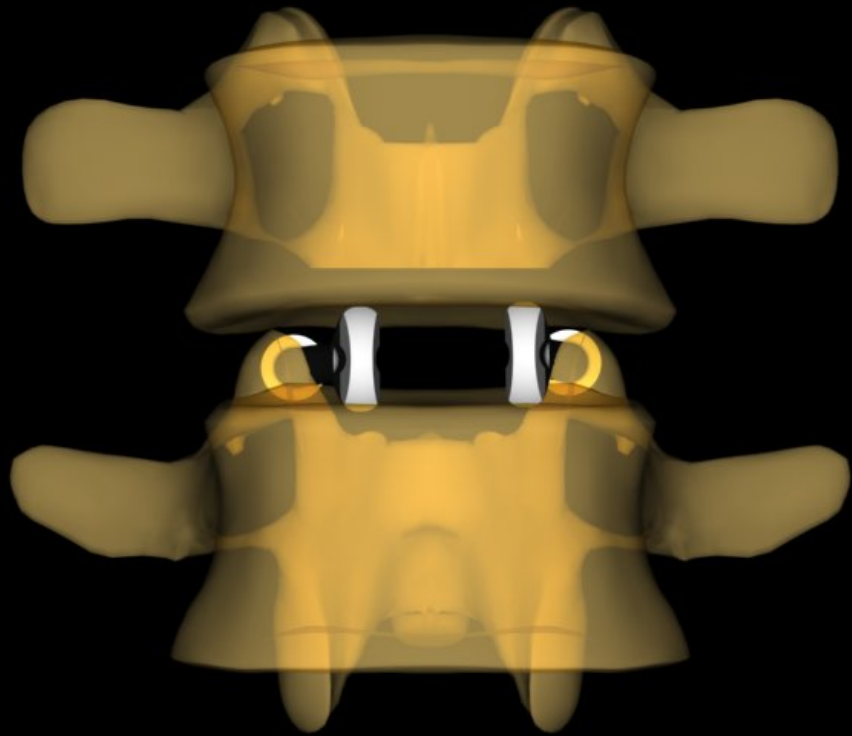


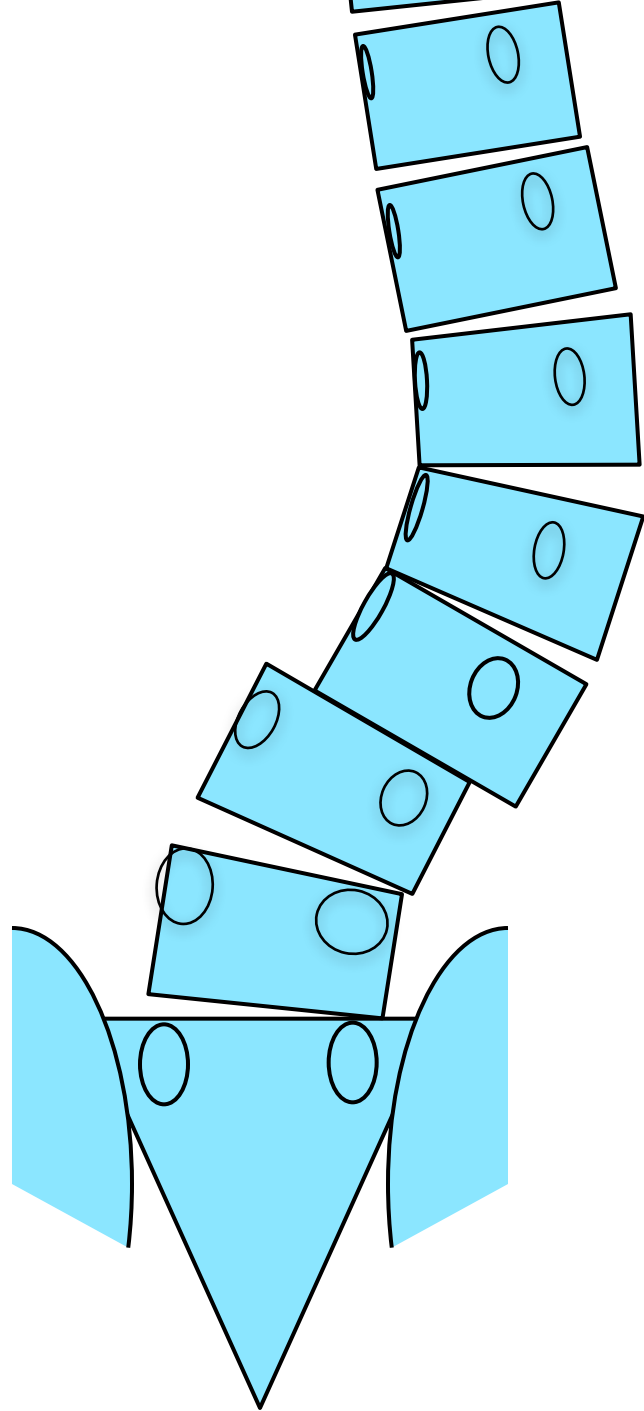


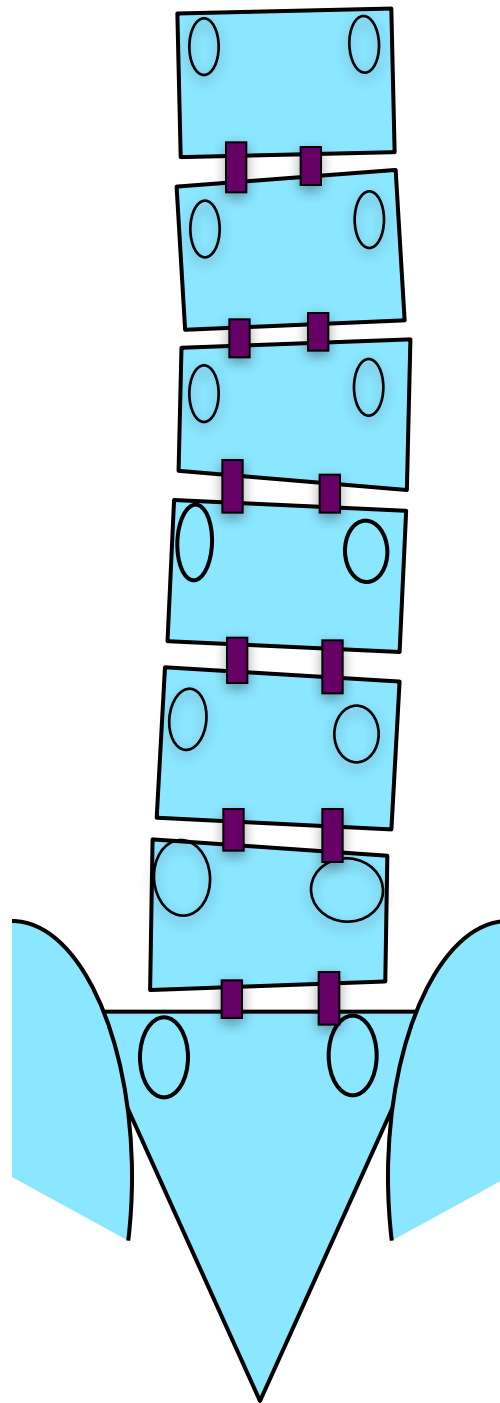


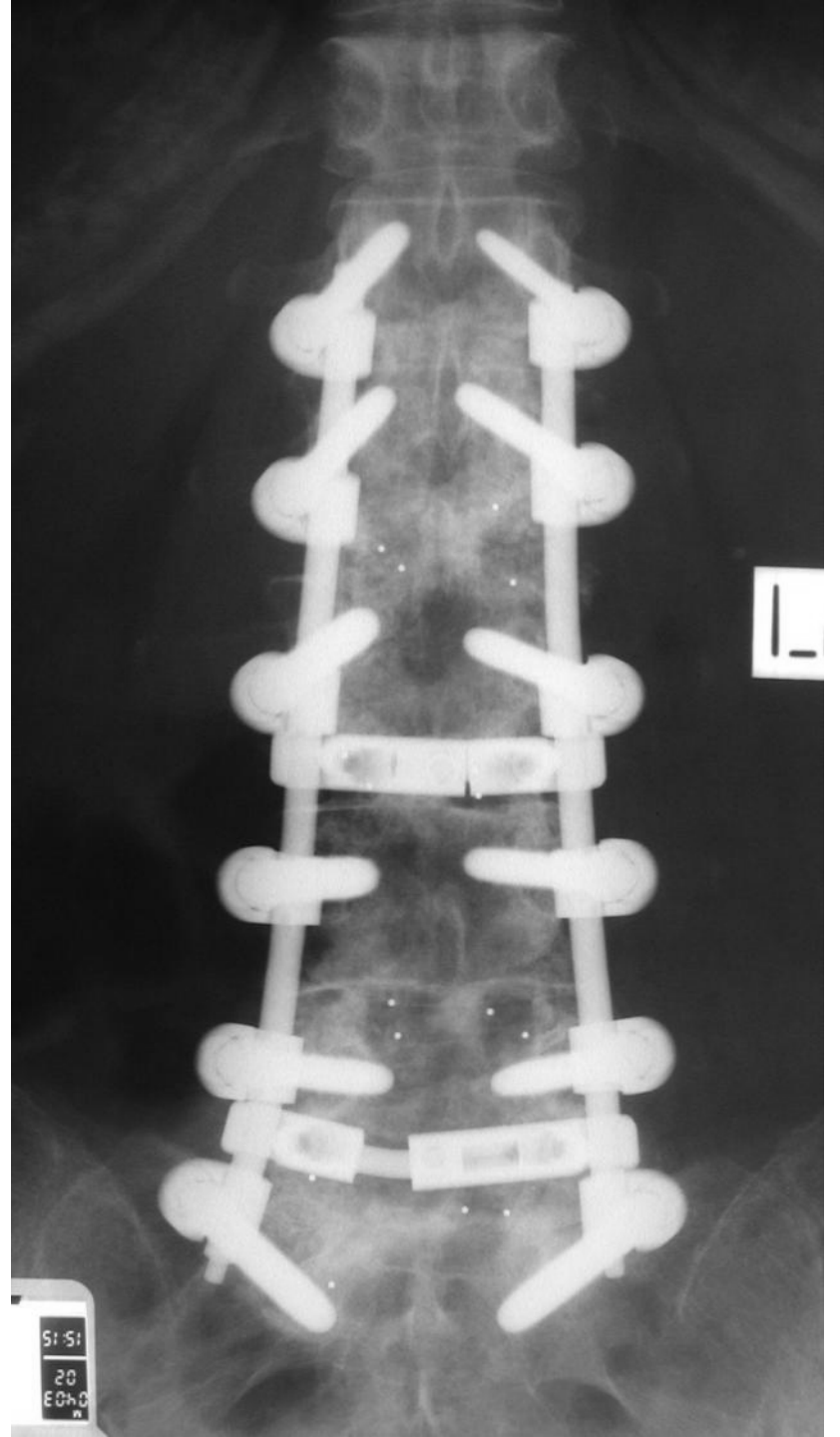
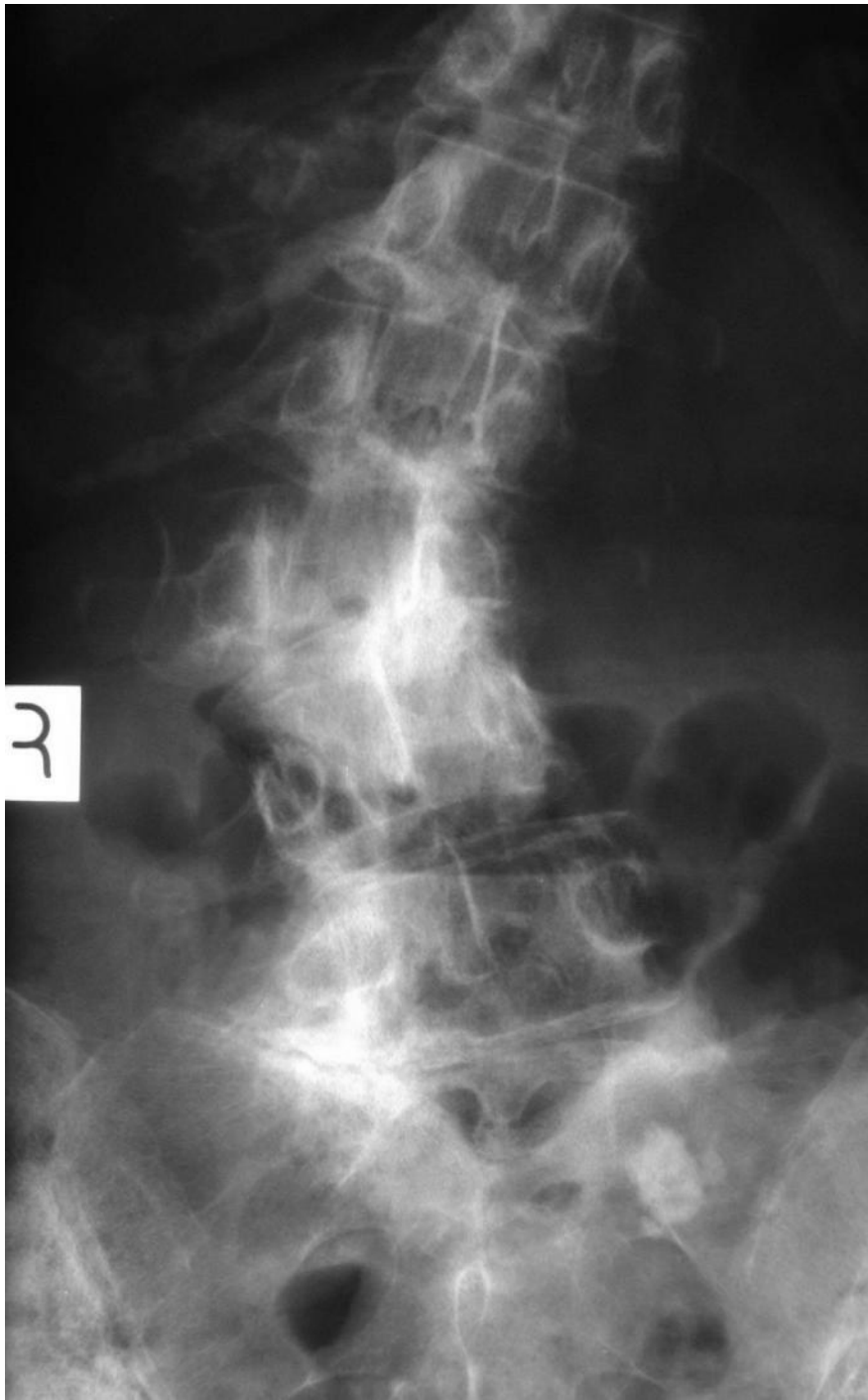


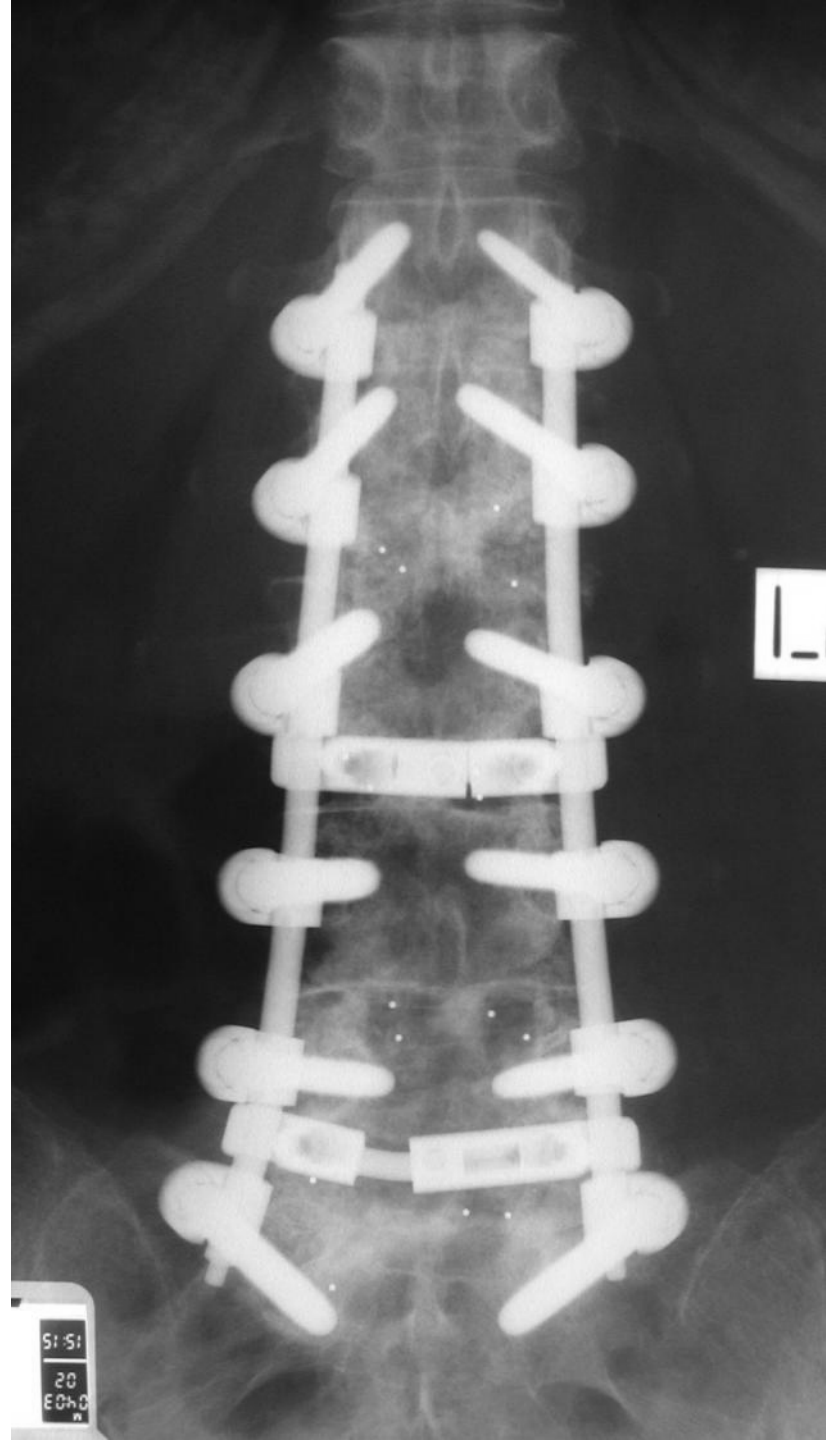
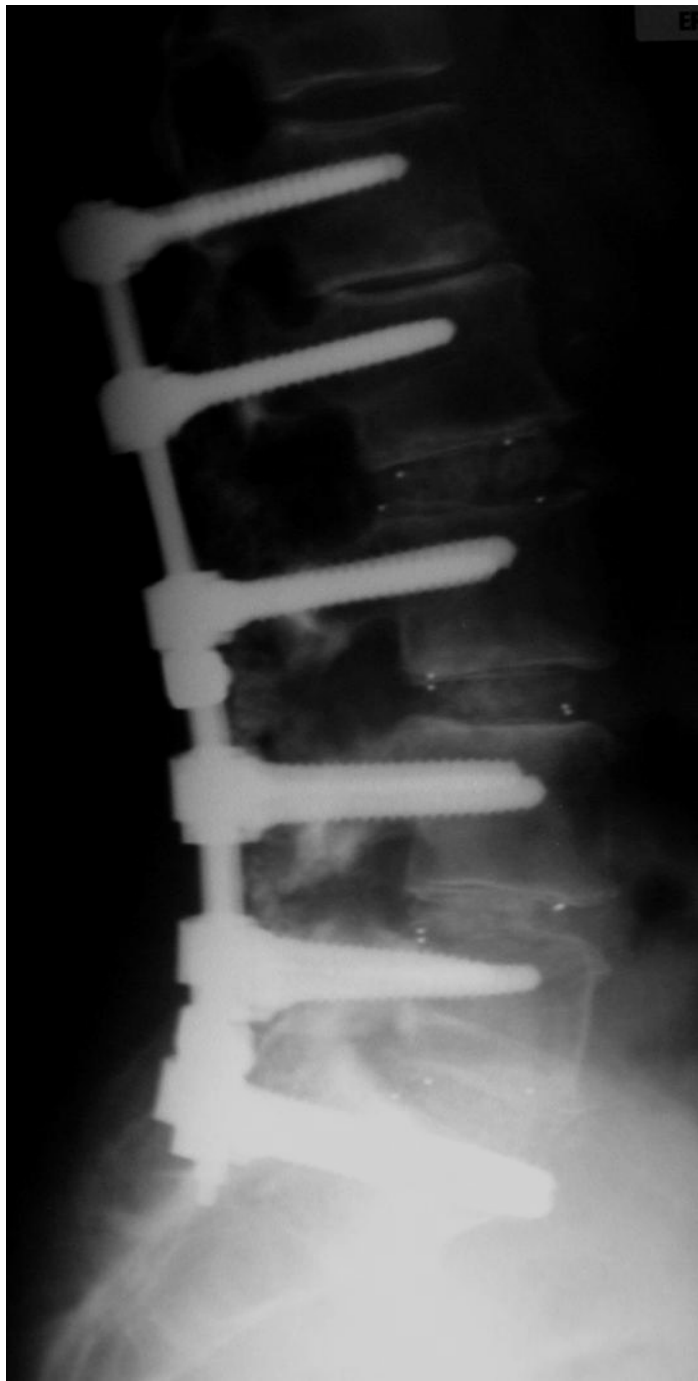


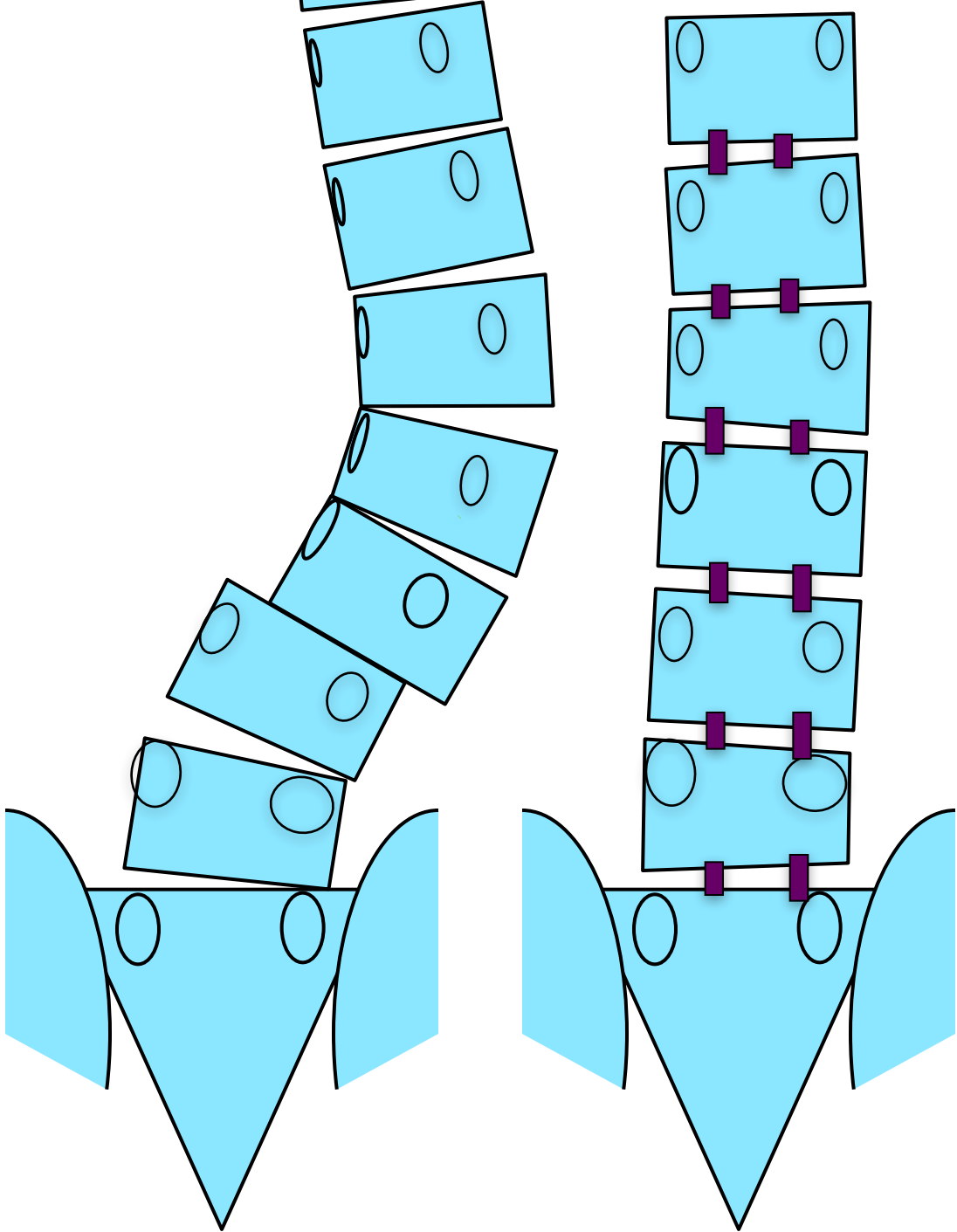


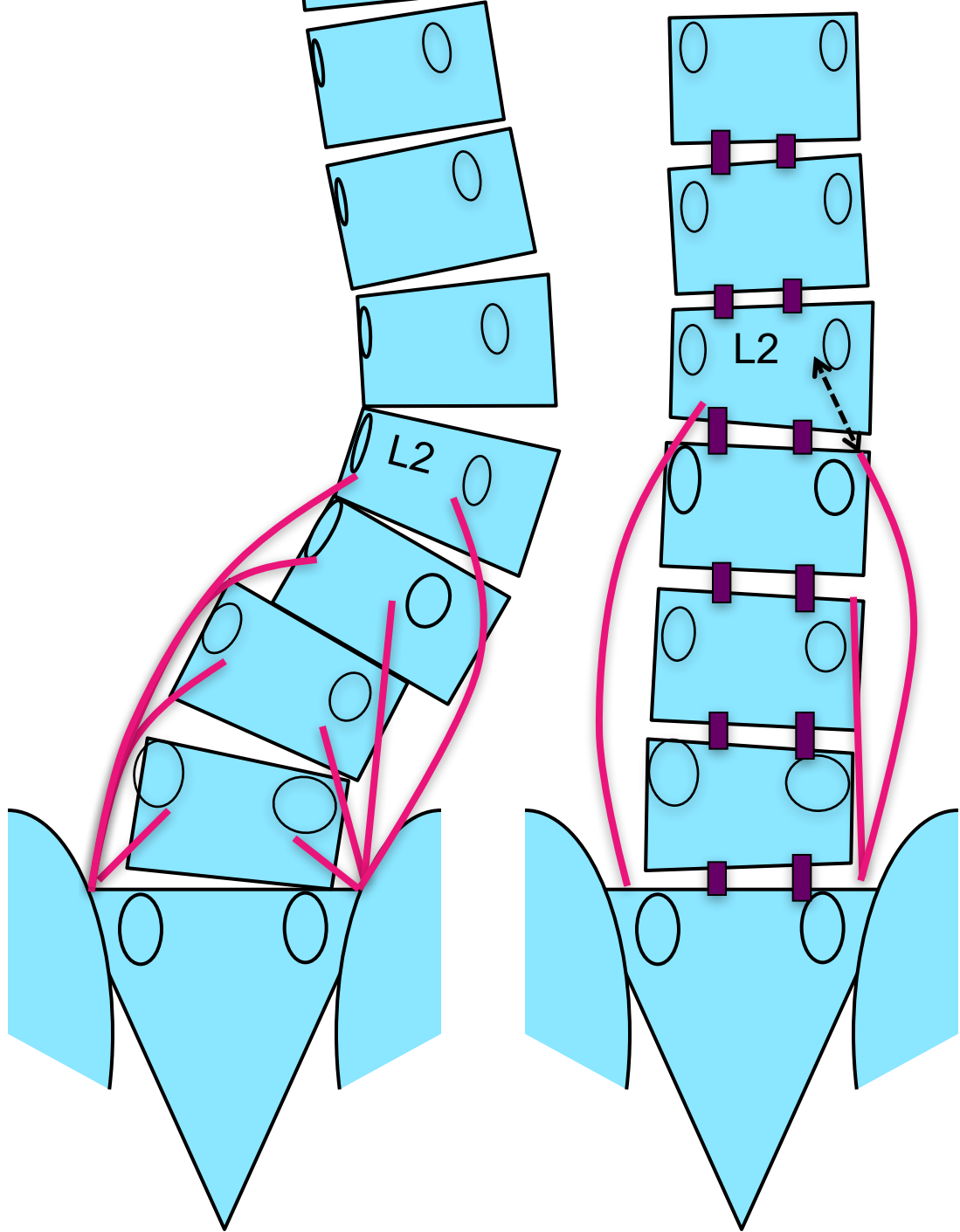


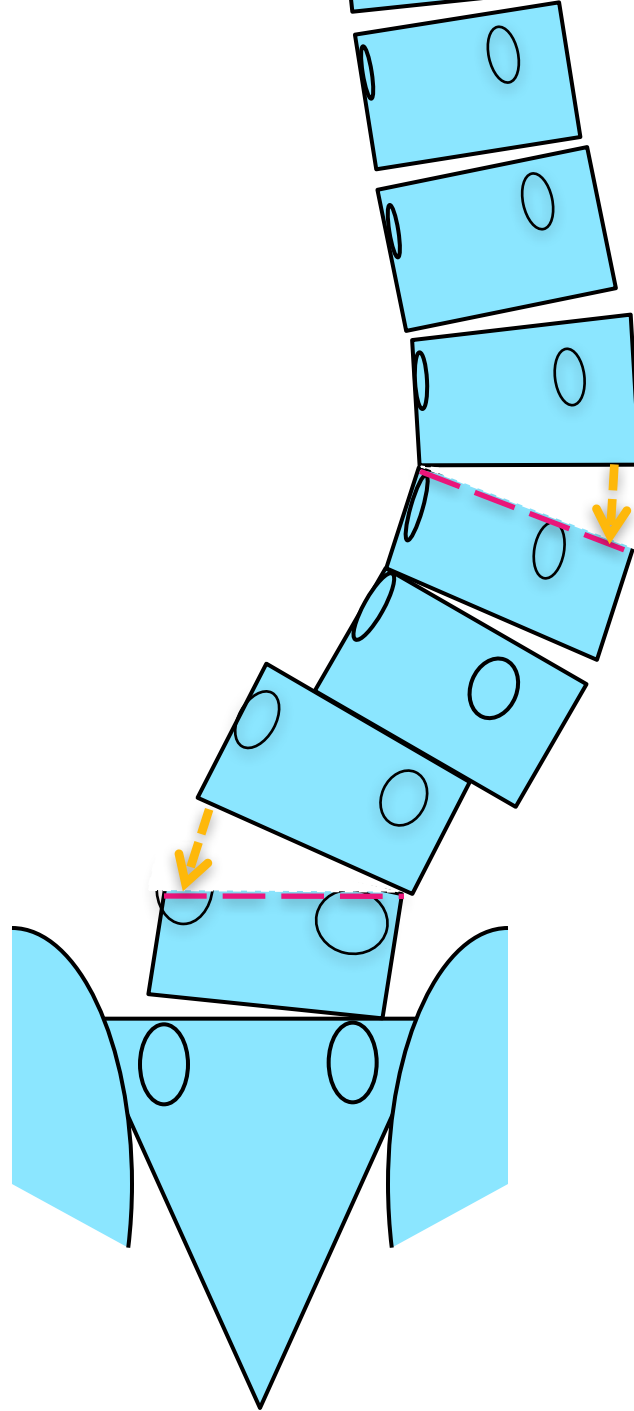


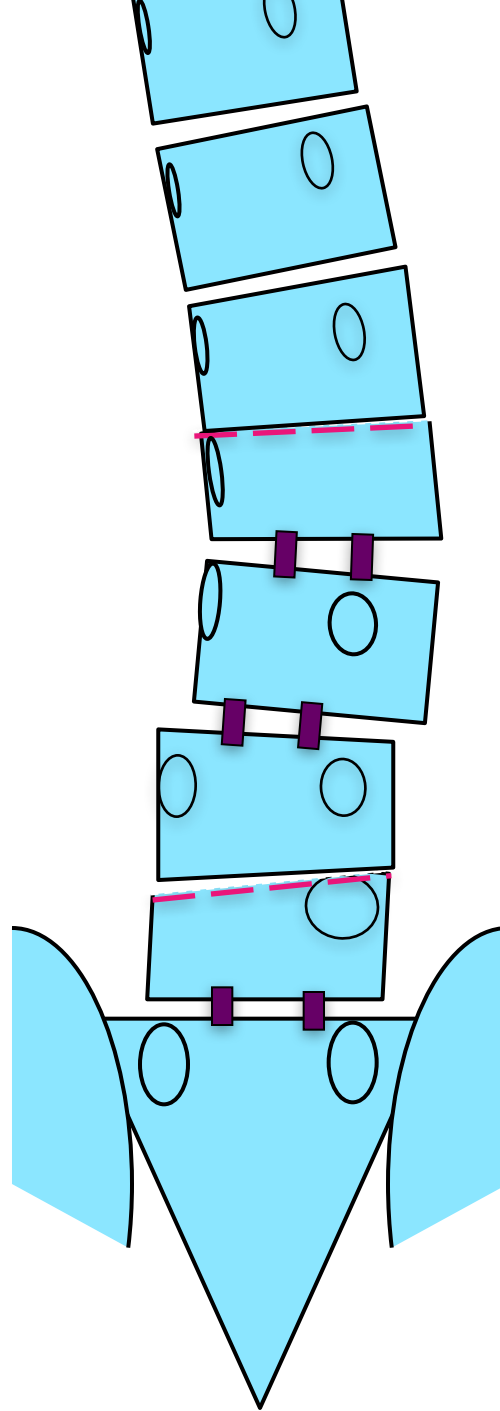


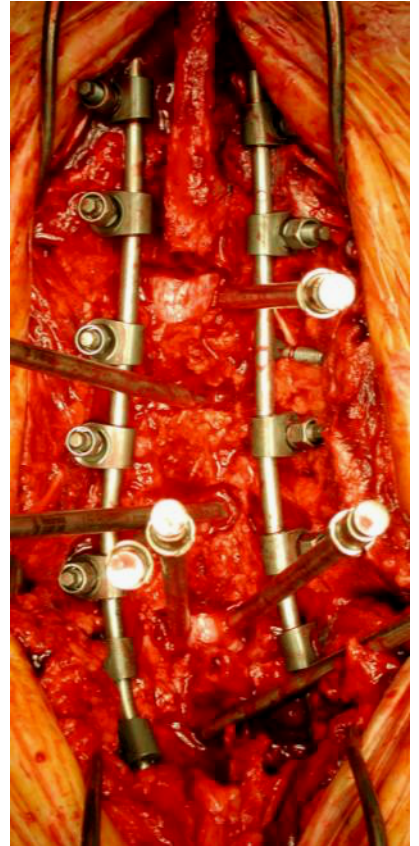
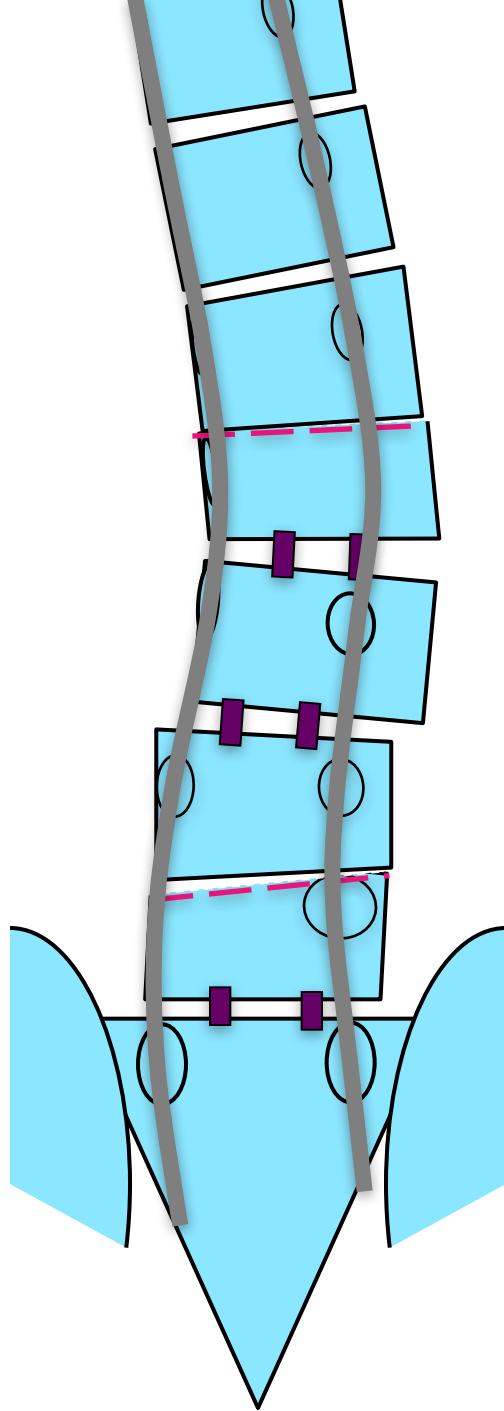


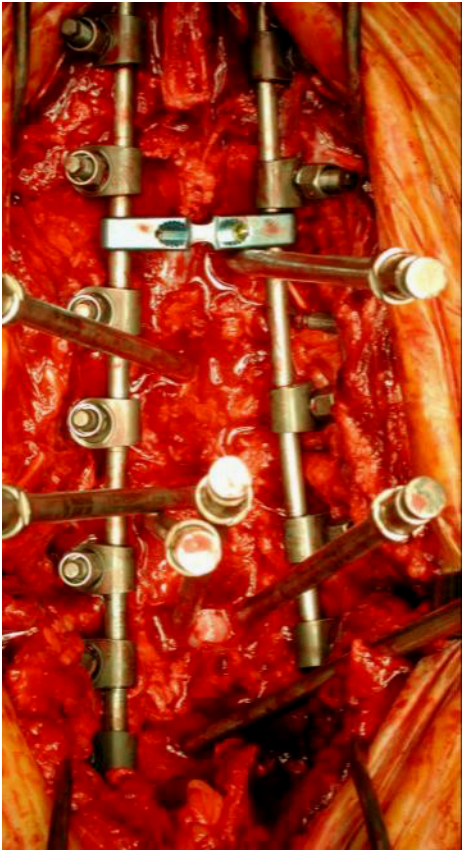
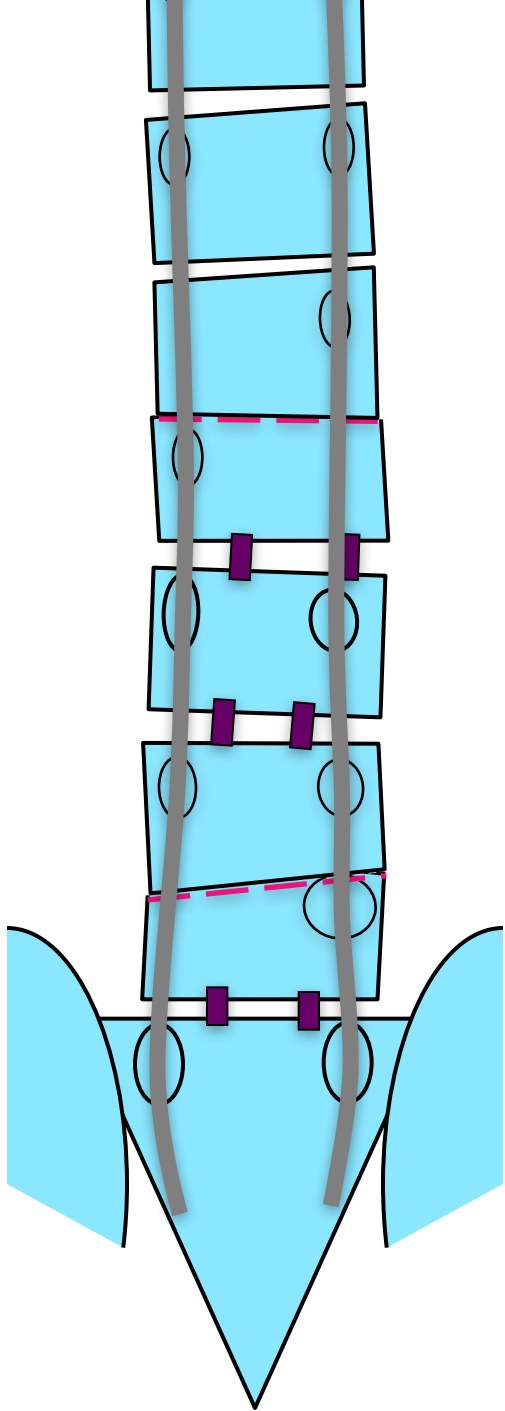


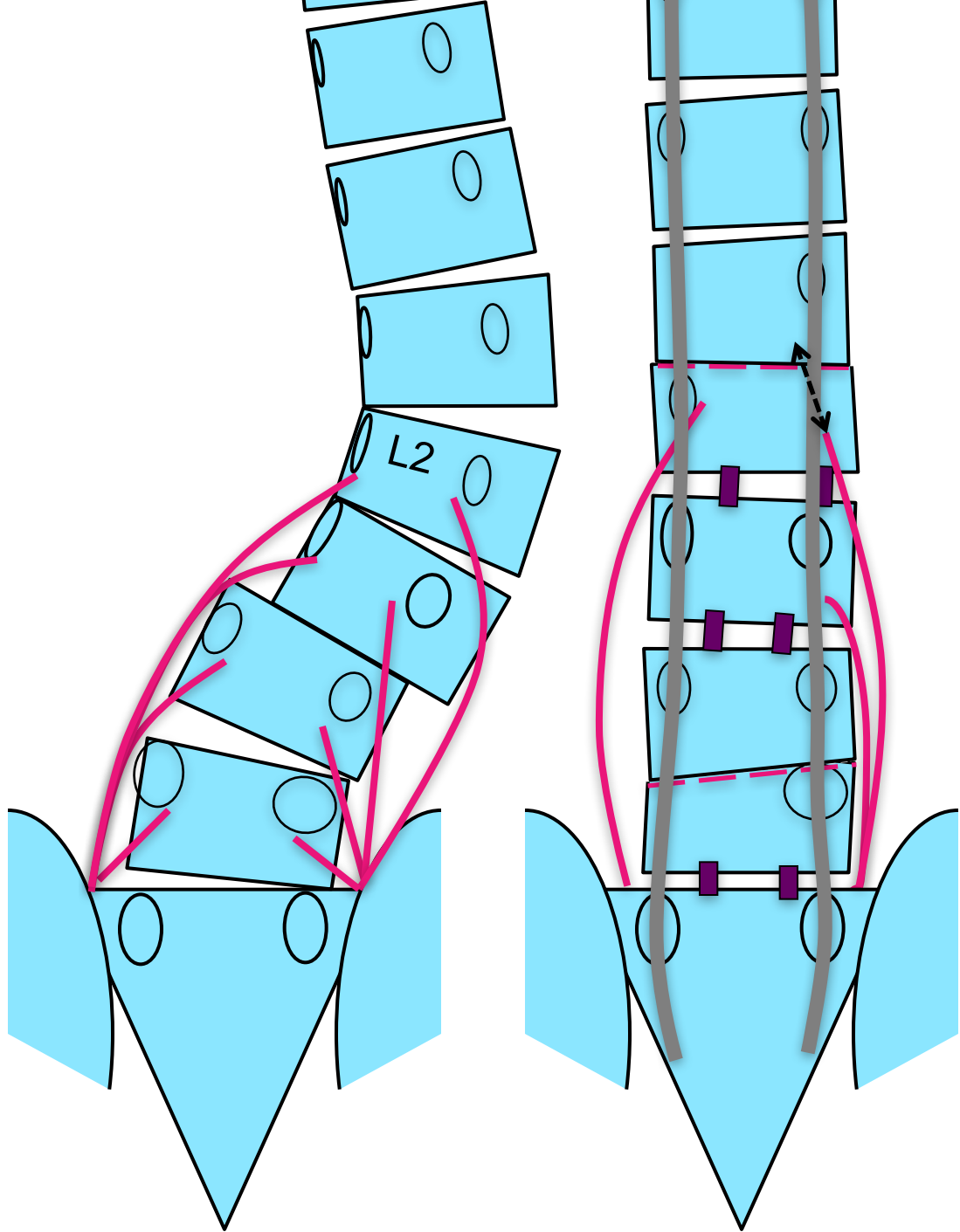












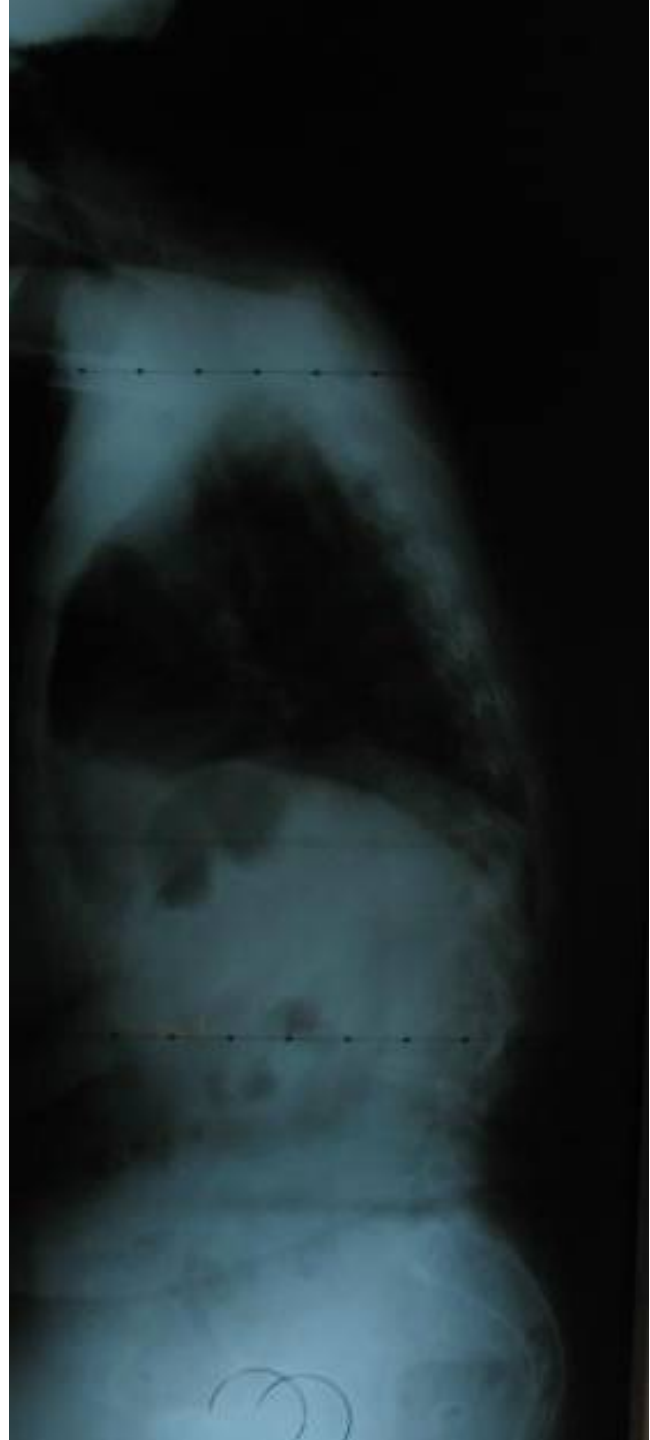
62yrs female



62yrs female

BMI – 35

- One previous laminectomy
- 69° scoliotic curve
- VAS pain
 - Back: 10/10
 - Leg: 10/10
- Oswestry – 74
- SF-36
 - PCS – 19
 - MCS – 45





PRT12=55°

T10 – Iliac fusion with L3 & L5 unilateral osteotomies



3 month f/u

- VAS pain
 - Back: 0.3/10
 - Leg: 0/10
- Oswestry – 24
- SF-36
 - PCS – 39
 - MCS – 63

SSA 2006

Prospective scoliosis patient series

- 11 consecutive patients
- May 2001 – Feb 2005
- 20° + adult scoliosis (Range 20-65°)
- 4+ levels PLIF
- Outcome measures:
 - Coronal and sagittal plane deformity
 - VAS
 - SF12
 - LBOS (Oswestry)
 - Patient satisfaction

Demographics

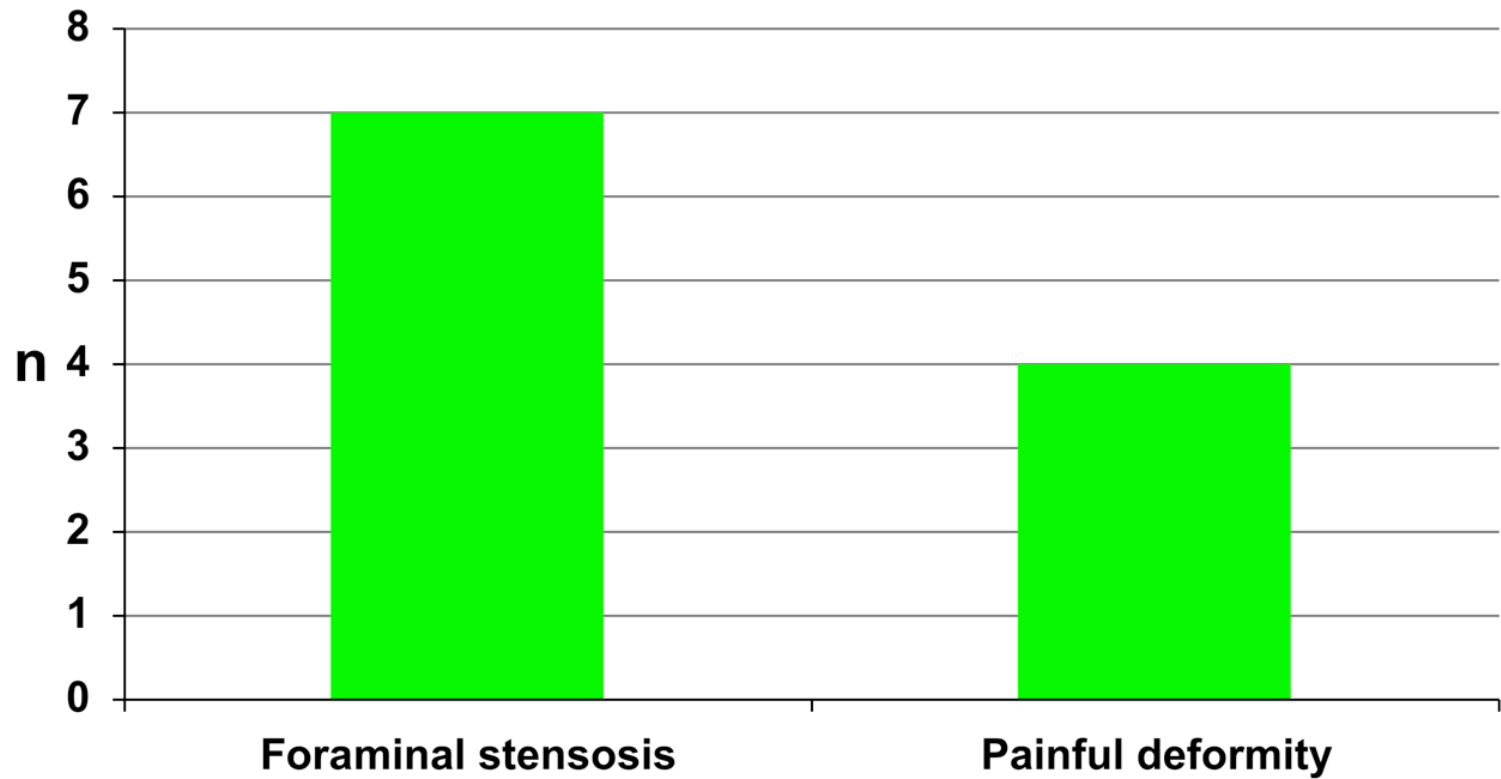
- Median age: 71yrs (range: 56-81)
- Male:Female - 1:10



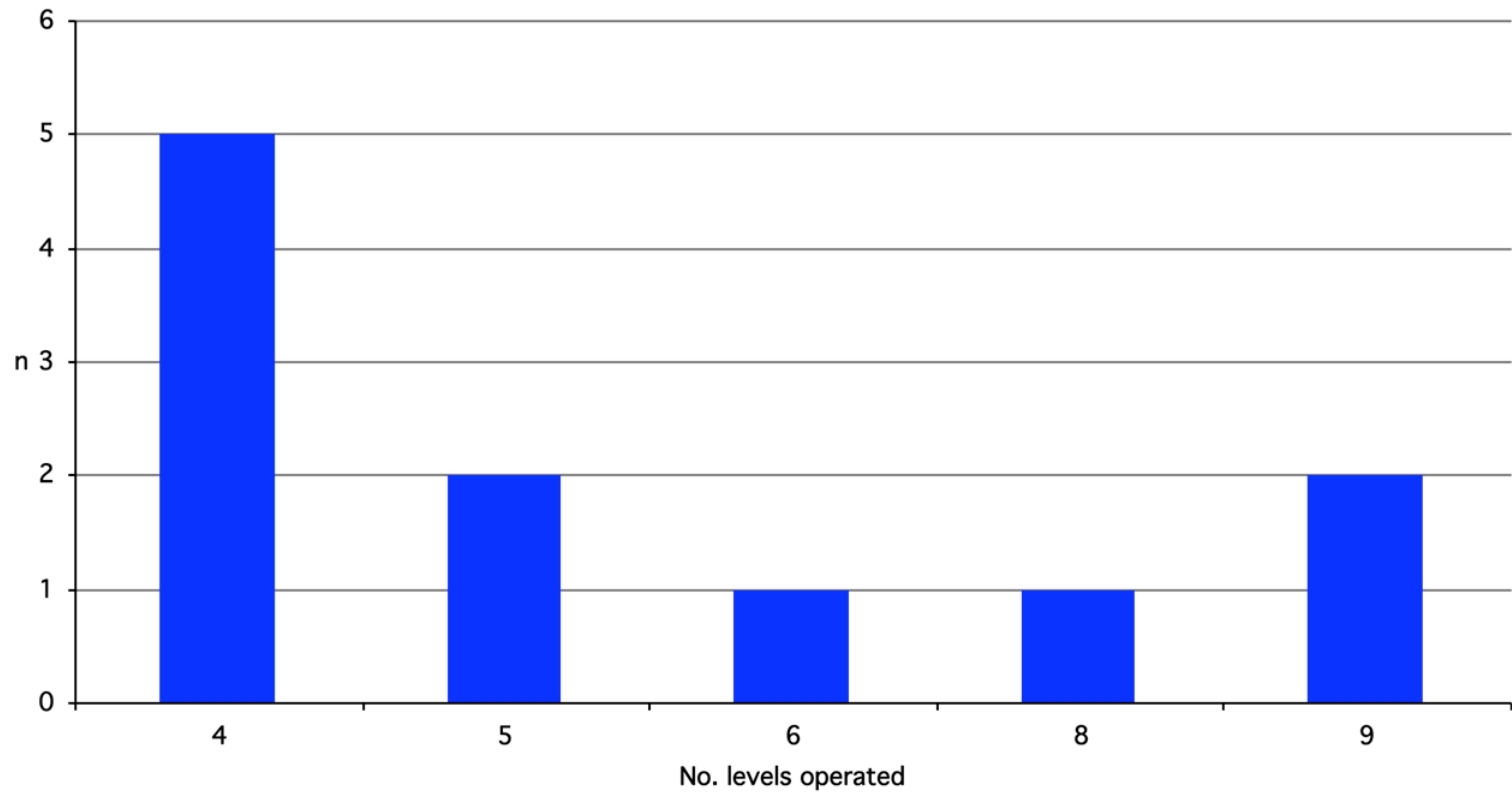
Demographics

- Median age: 71yrs (range: 56-81)
- Male:Female - 1:10
- Median follow-up: 27mnths (range: 14-57)

Primary Indication

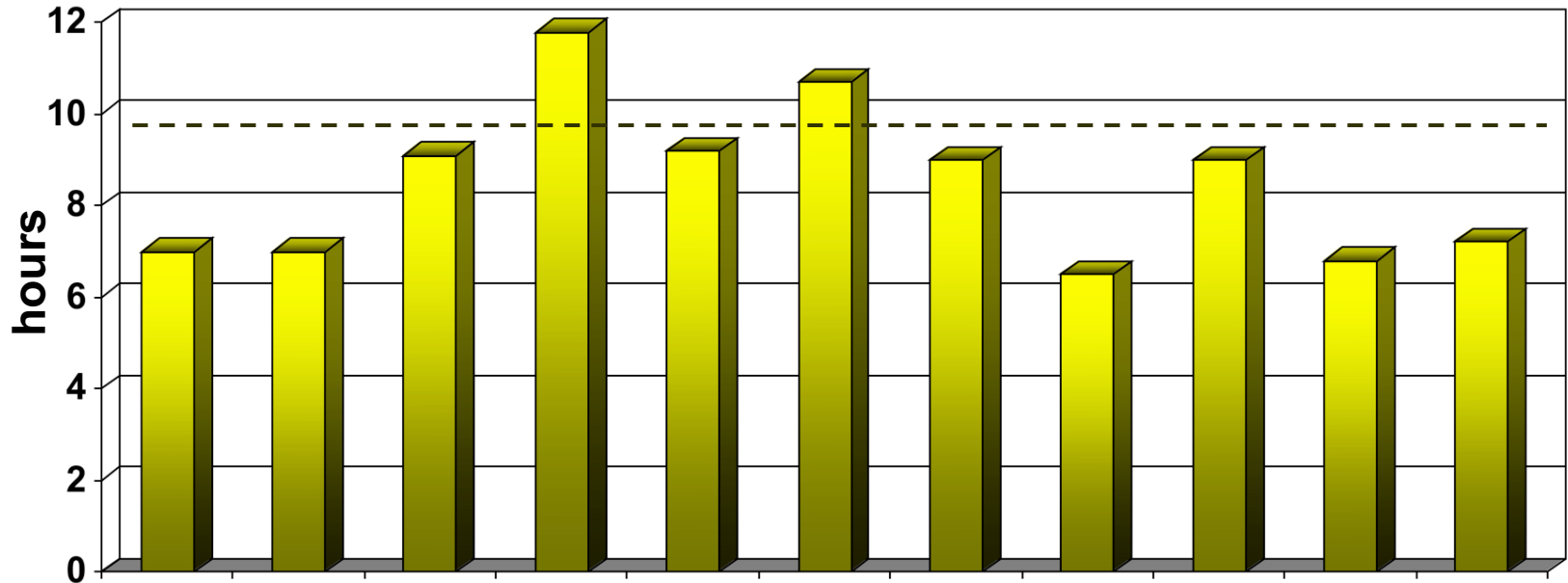


Levels operated



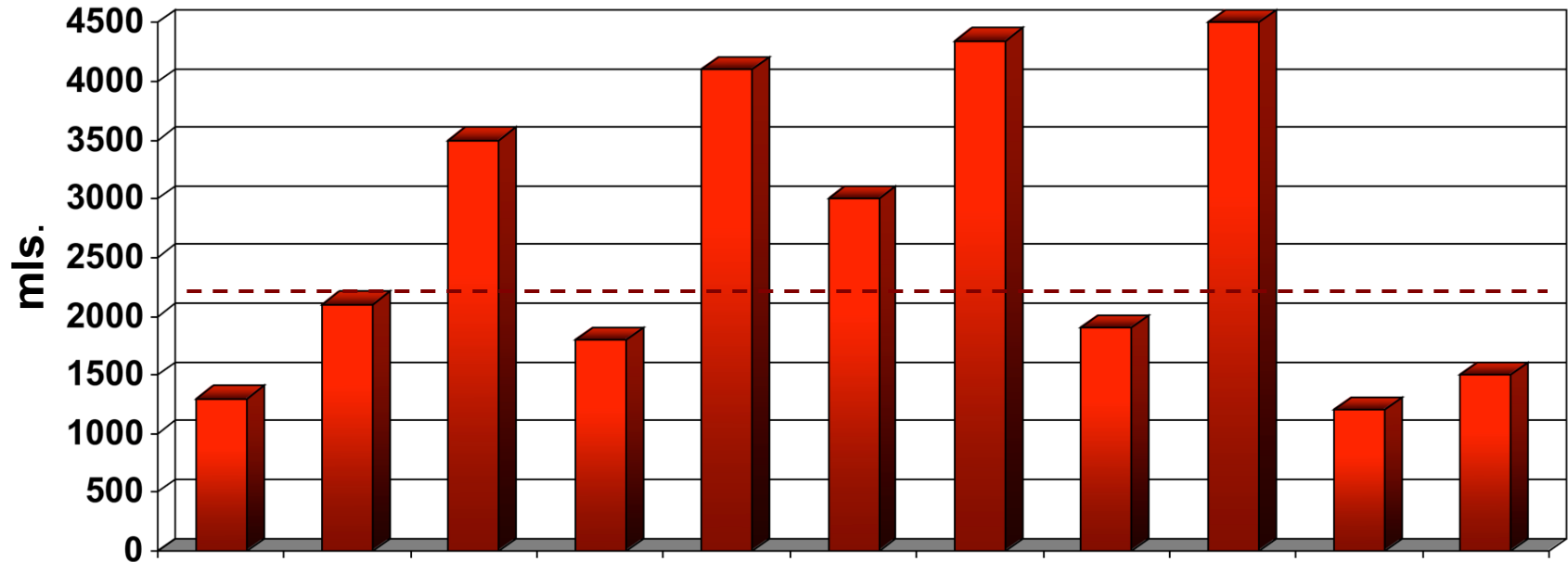
Operating time

(median = 9 hours)



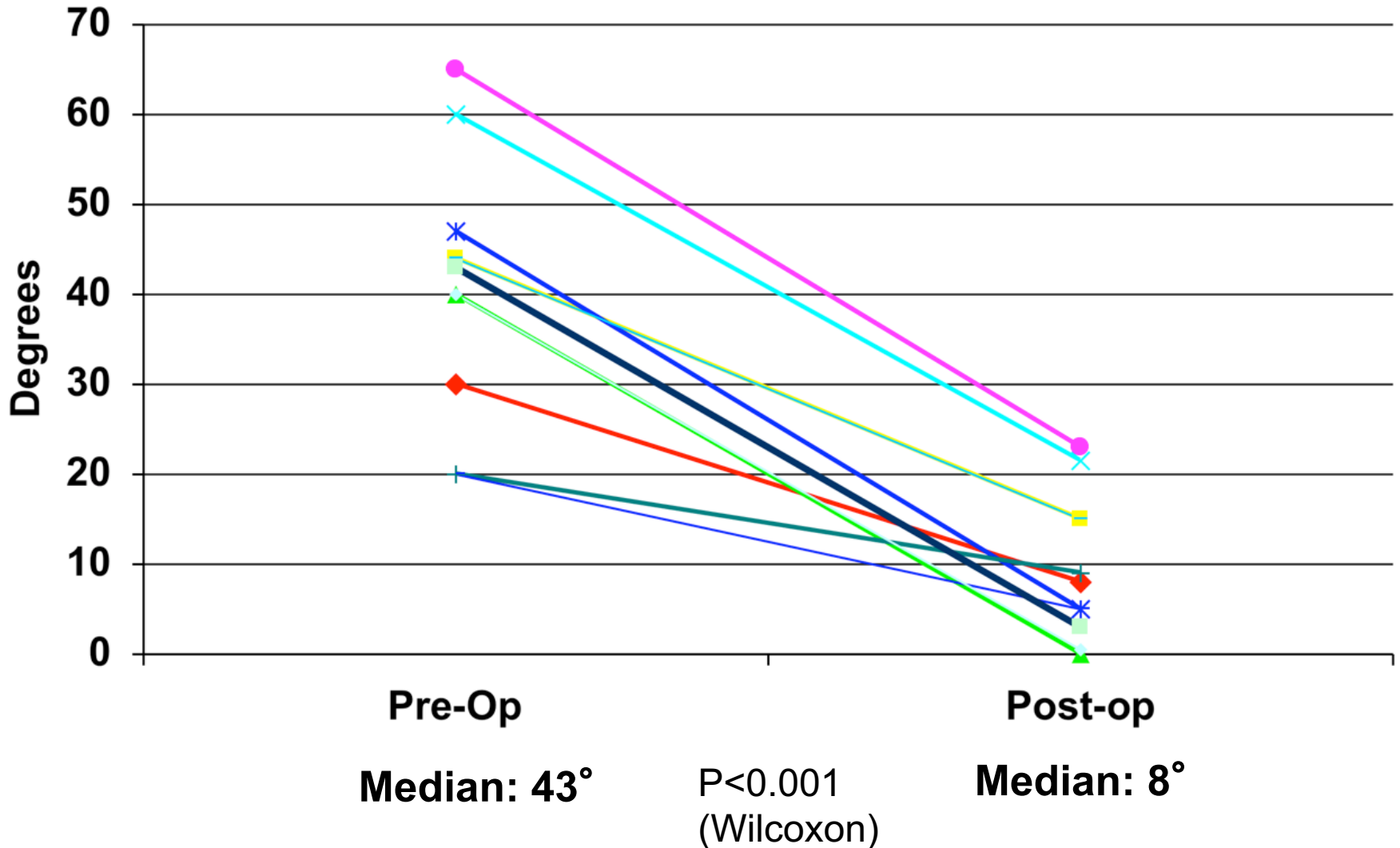
Blood loss

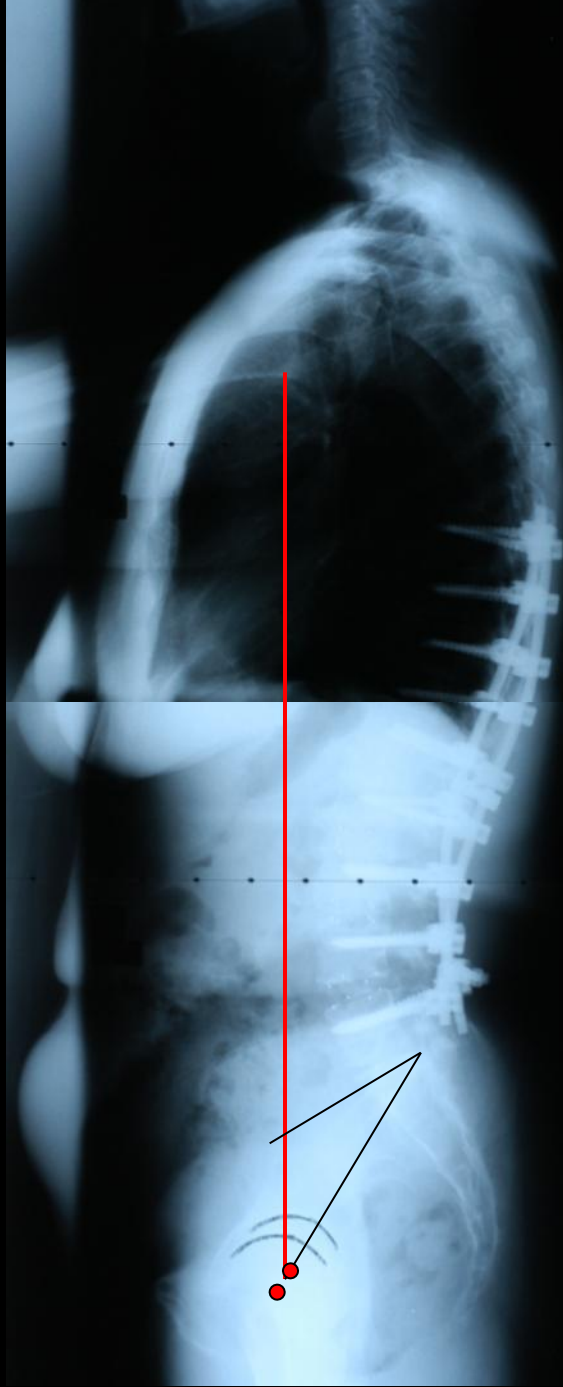
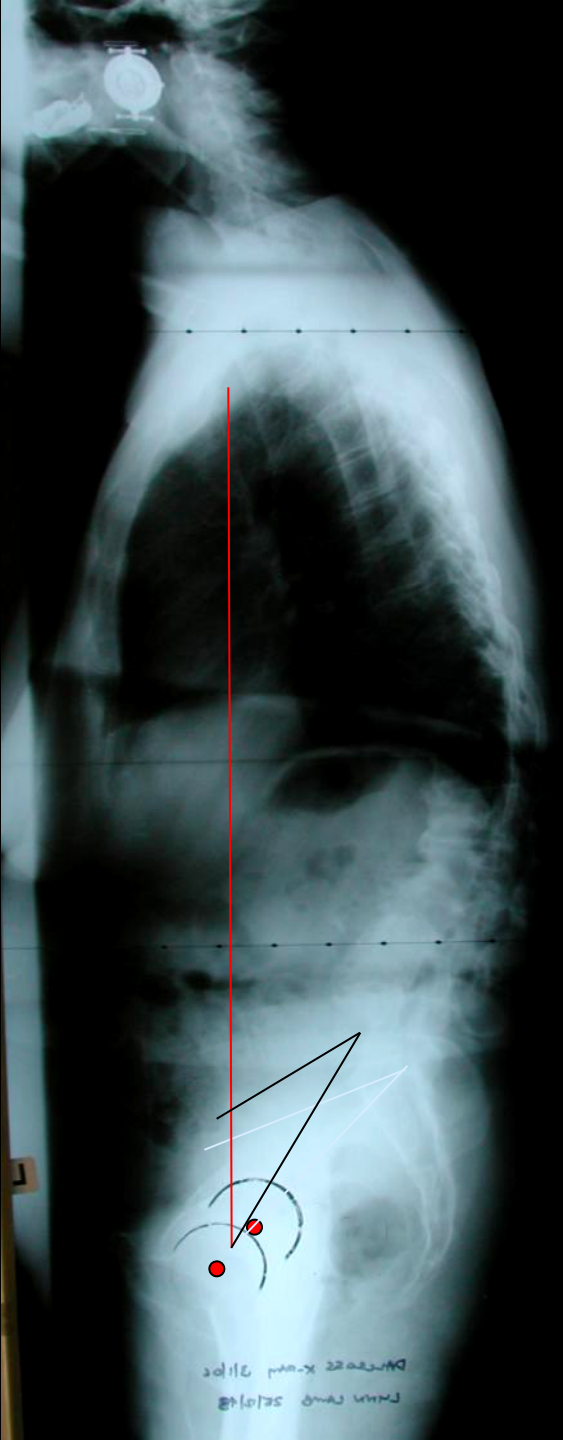
(median = 2100 mls.)



Scoliosis (degrees)

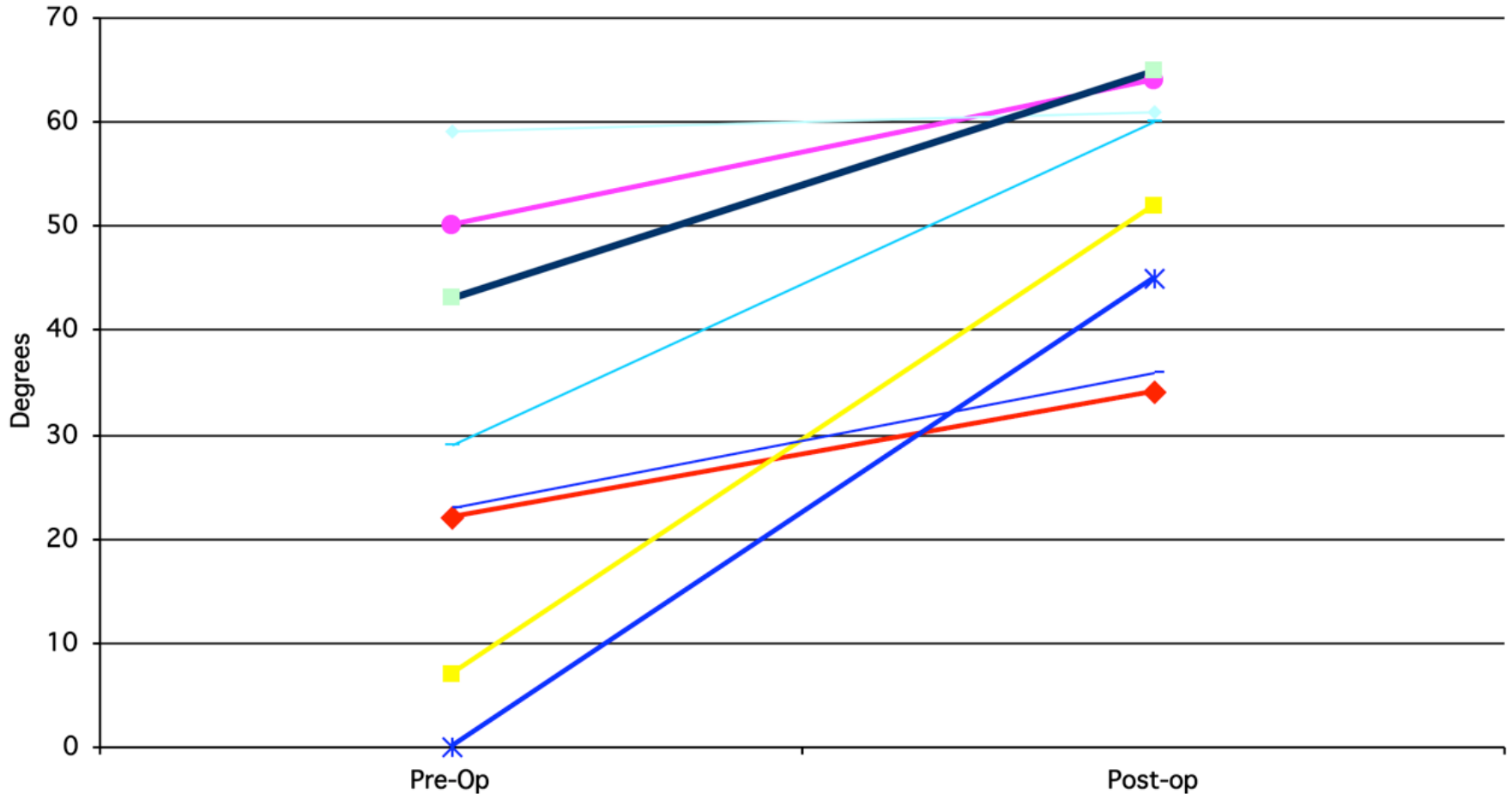
Pre- vs. Post-op





Lumbar lordosis (degrees)

Pre- vs. Post-op

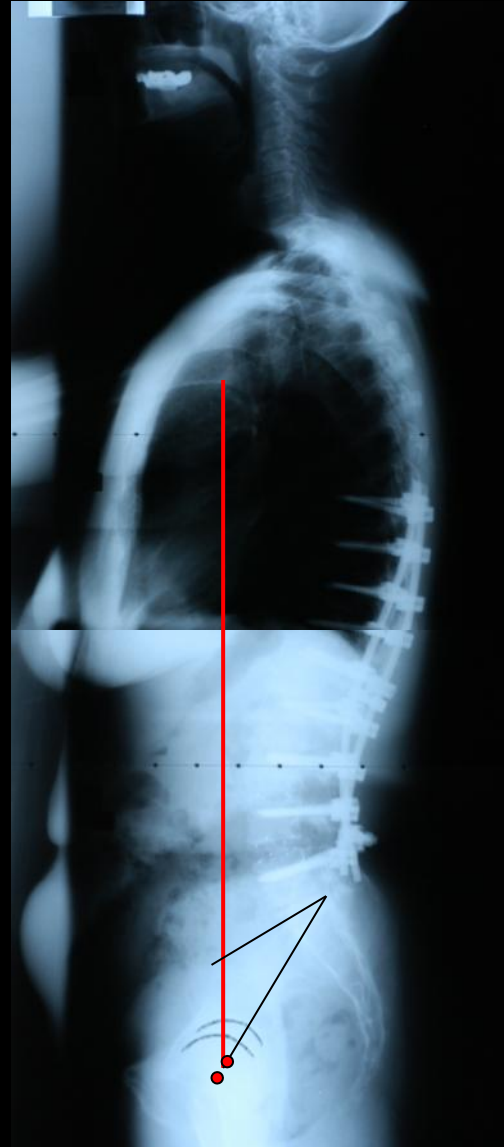
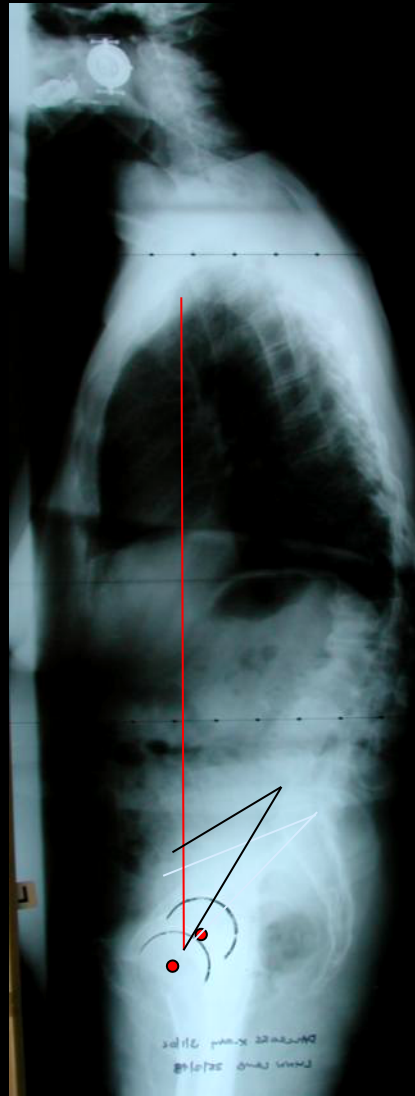


Median: 26°

P<0.001
(Wilcoxon)

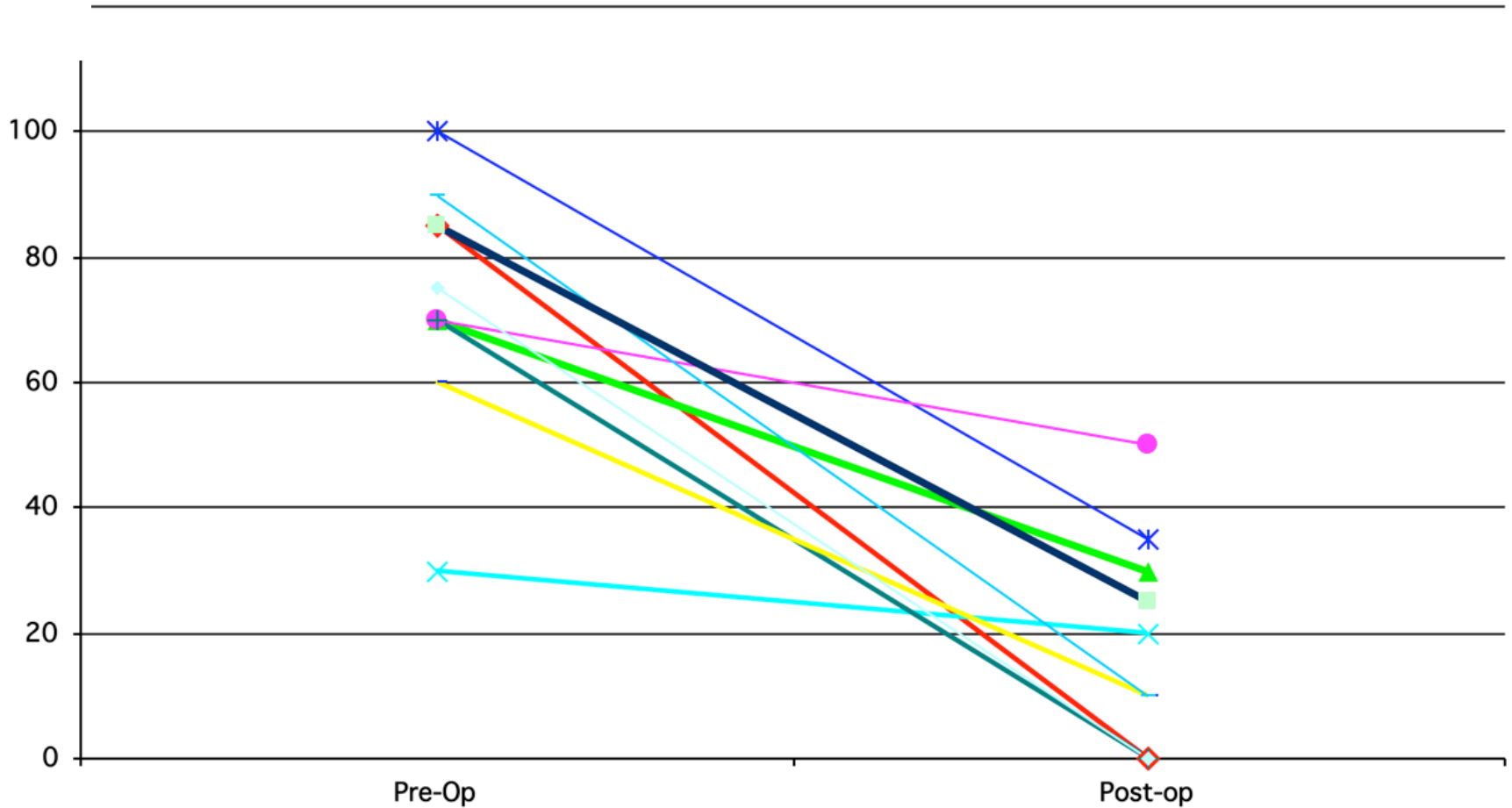
Median: 56° (↑55%)

Median change in pelvic angulation = -13°
(range: $0^\circ \rightarrow -19^\circ$)



VAS

Pre- vs. Post-op



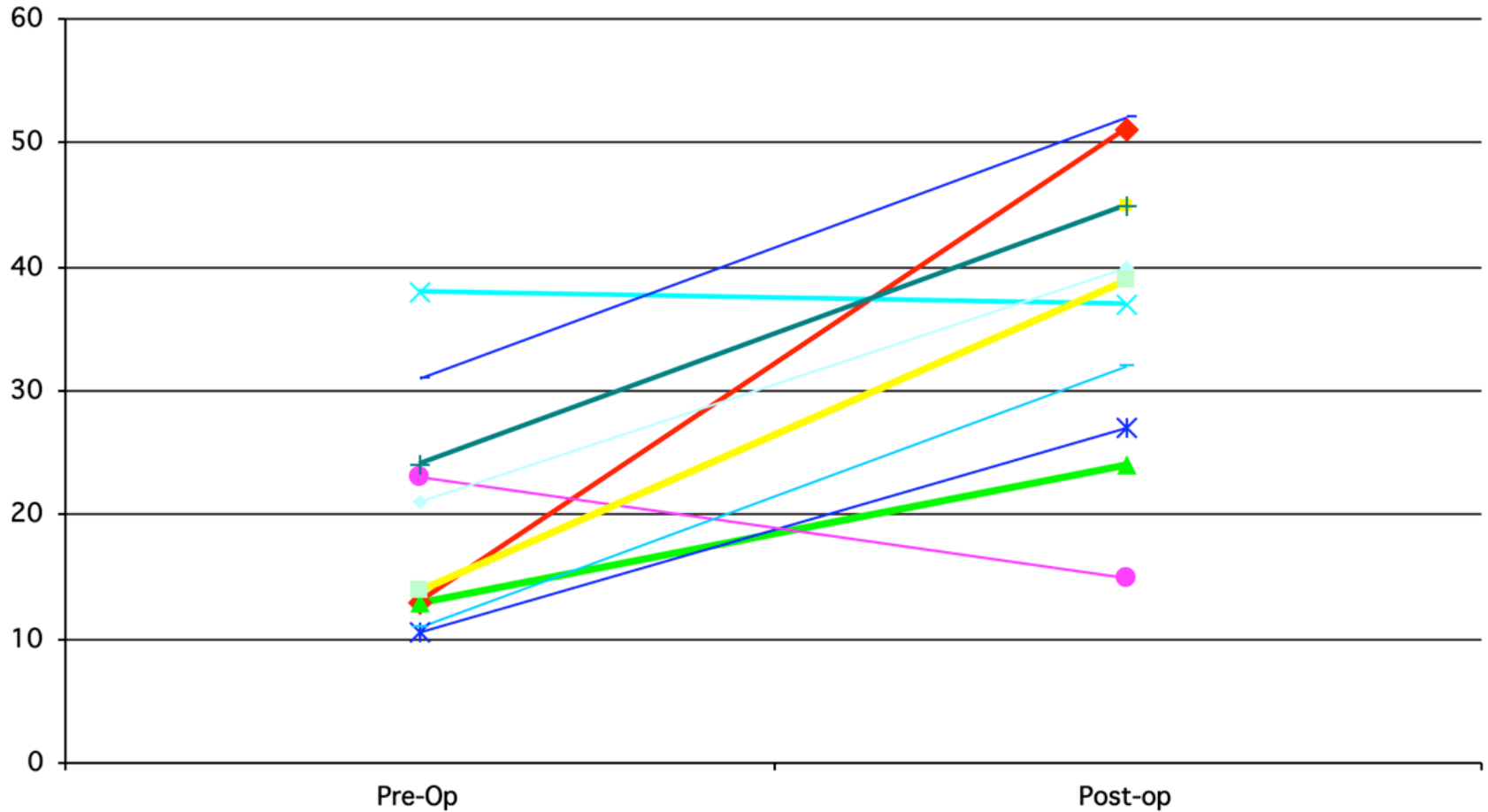
Median: 73

P<0.001
(Wilcoxon)

Median: 20

LBOS

Pre- vs. Post-op



Median: 18

P=0.01
(Wilcoxon)

Median: 39

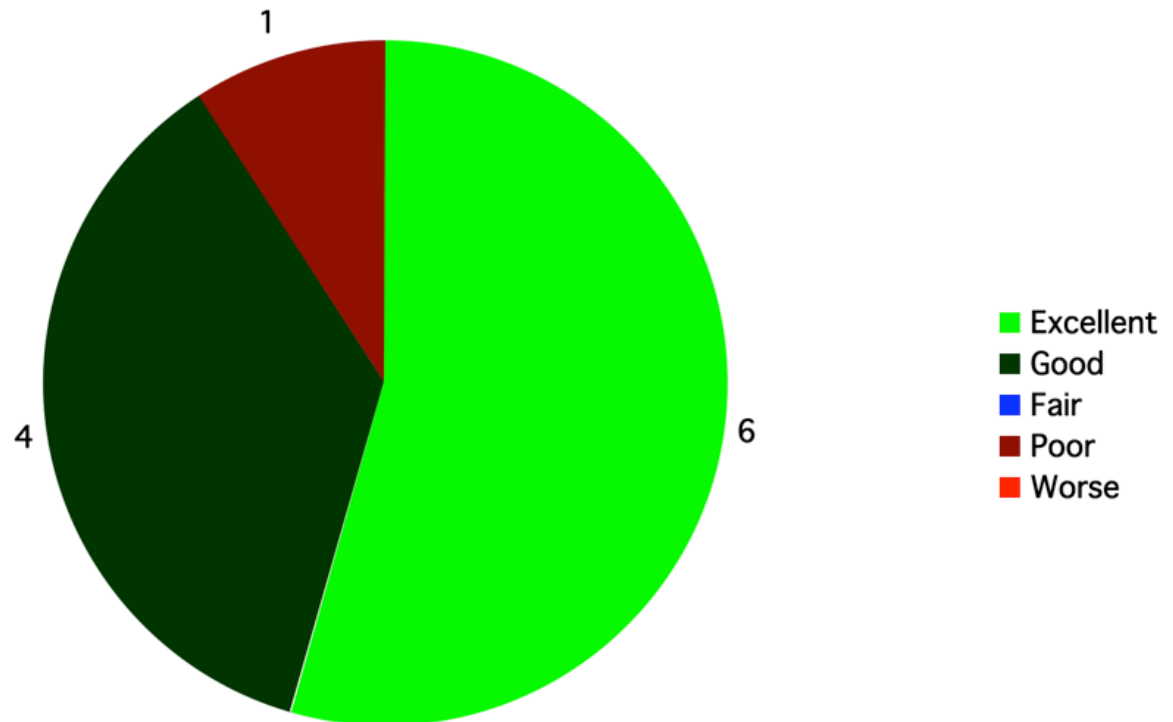
Complications (Early)

- Intra-op:
 - 4 dural tears
- Early Post-op:
 - 2 major fluid/electrolyte disturbance
 - 2 cardiac arrhythmias
 - 1 P.E. / DVT
 - 1 acute confusional state
 - 1 return to O.R (misplaced screw)
 - 2 Radicular pain - ? Concave side stretch
 - One resolved, one didn't

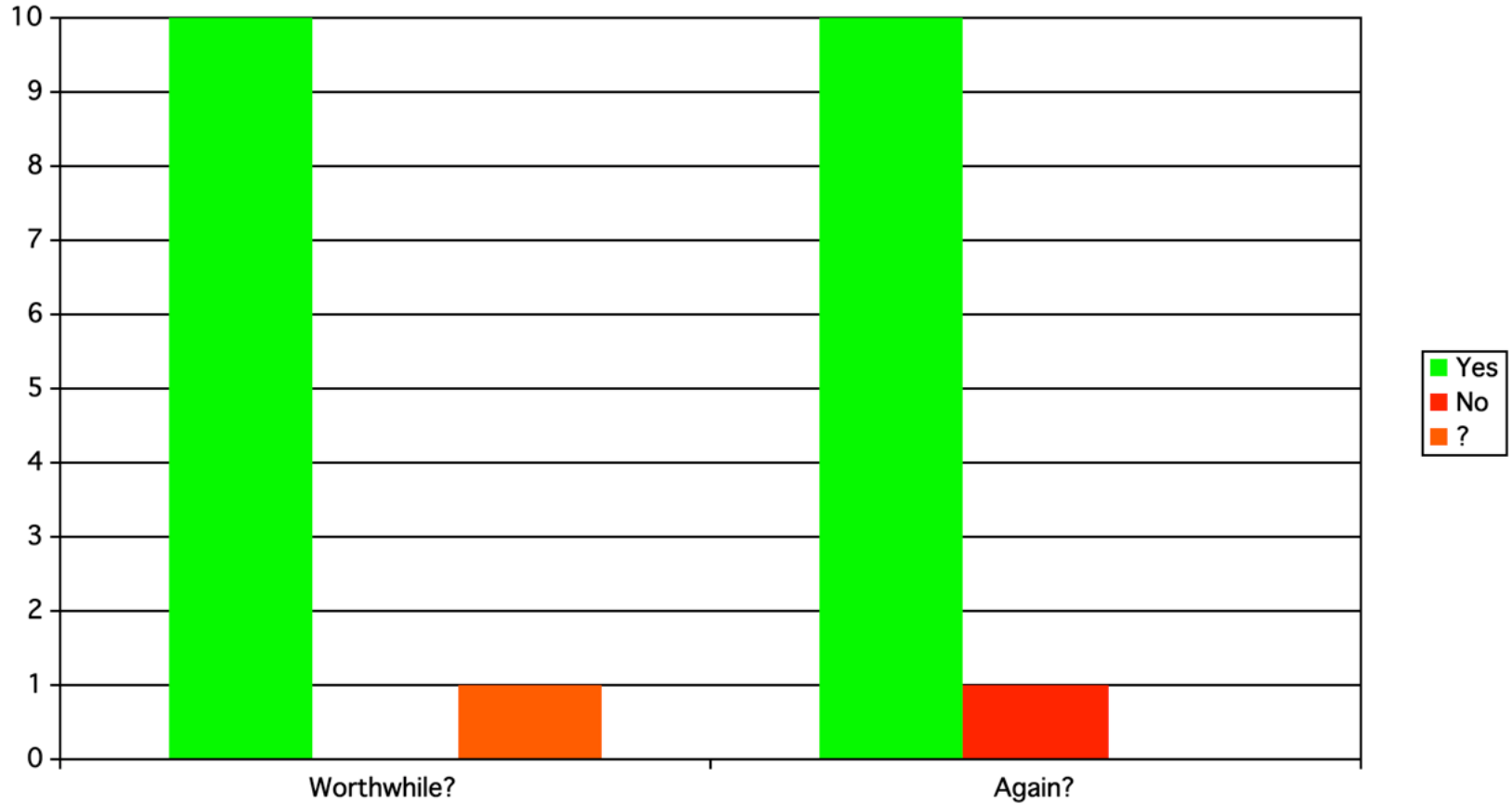
Complications (Late)

- Deformity above
 - Scoliosis
 - Path # T12
- Further surgery
 - 1 x extend up for progressive scoliosis
 - 1 x reposition L5 screw
 - 3 x L5/S1 for foraminal stenosis (all within 8mnths)

Patient Satisfaction



Patient Satisfaction



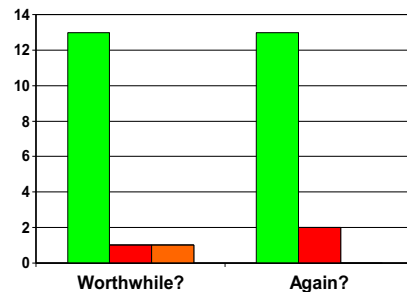
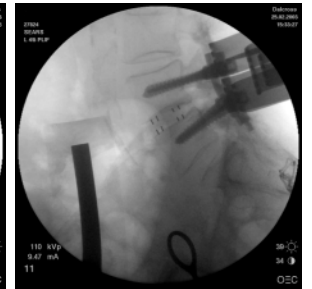
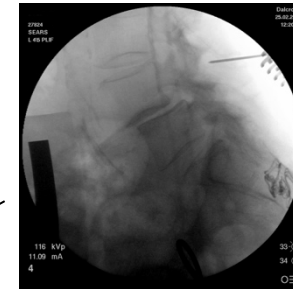
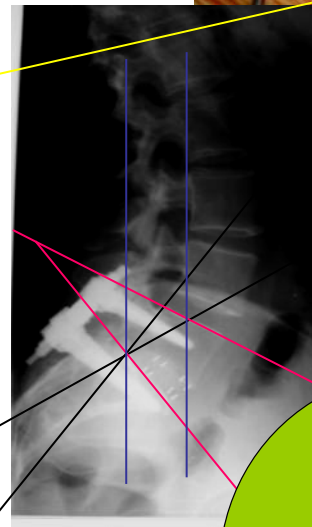
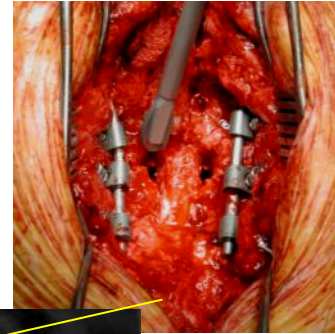
Conclusions

- Difficult, dangerous and demanding surgery
- Steep learning curve
- Coronal and sagittal plane deformity can be substantially corrected
- Take great care in selecting patients
- Satisfactory intermediate clinical results

Conclusions

Current PLIF techniques for Degenerative Deformity

- Atraumatic / minimal neural retraction
- Powerful restoration of spinal balance
- Satisfactory clinical results



■ Yes
■ No
■ ?

