



# Benefits of preoperative planning in degenerative indications

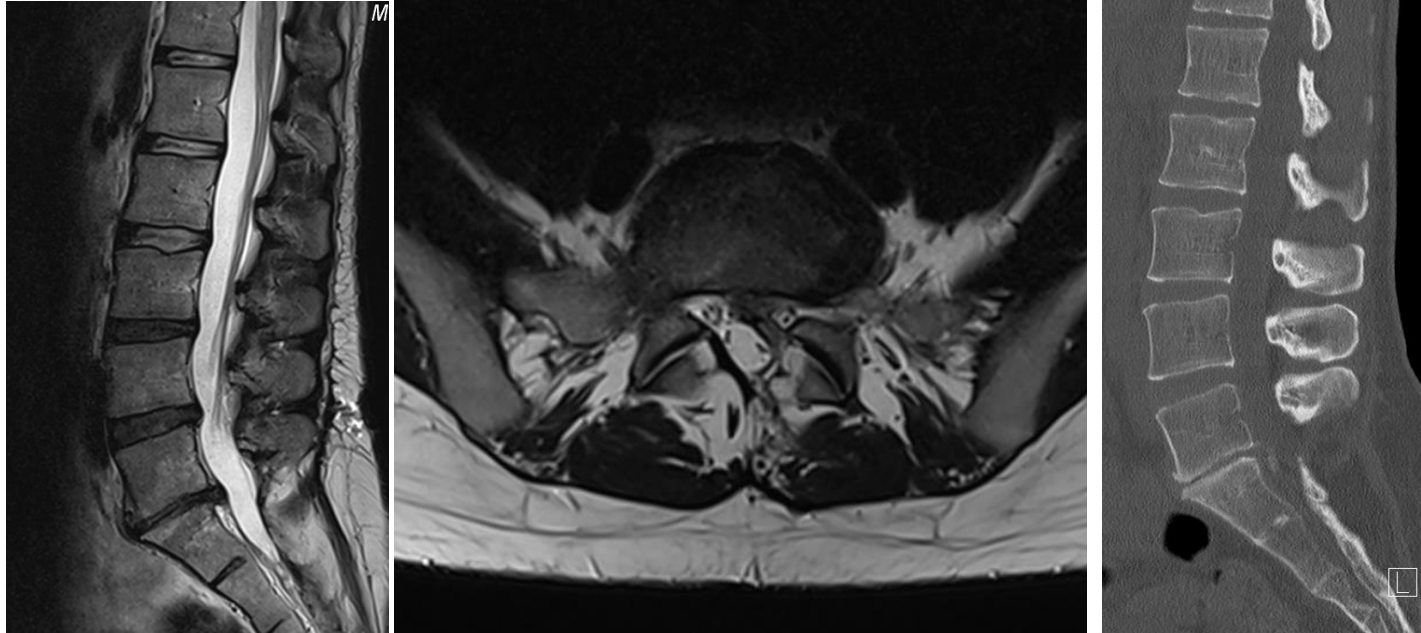
Matti Scholz  
Head – Spine Unit

**ATOS** ORTHOPÄDISCHE KLINIK  
BRAUNFELS

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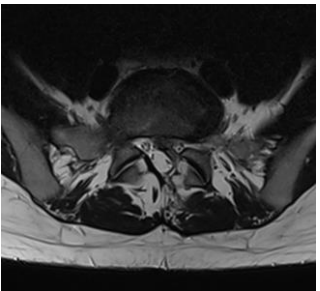
# Case

- female, 35 years old, police officer, micro-discectomy 3 years ago
- severe load depended back pain (70%) and left leg pain -S1- (30%)
- Injections: Facet joint L4/5 + L5/S1 (+), SI joint (+), S1 left (+)
- Denervation: L5/S1 + SI joint left + right (+/-)



03/2021

# Surgical Aim?



- **Primary from patients perspective:**
  - Pain improvement but „avoid fusion“
- **Primary from surgeons perspective:**
  - adequate nerve root decompression
  - stability with perfect implant positioning
  - (Deformity correction)
- **secondary from patients perspective:**
  - no recurring pain / no secondary surgery
- **secondary from surgeons perspective:**
  - solid fusion, avoid revision for ASD



# Problem of fusion

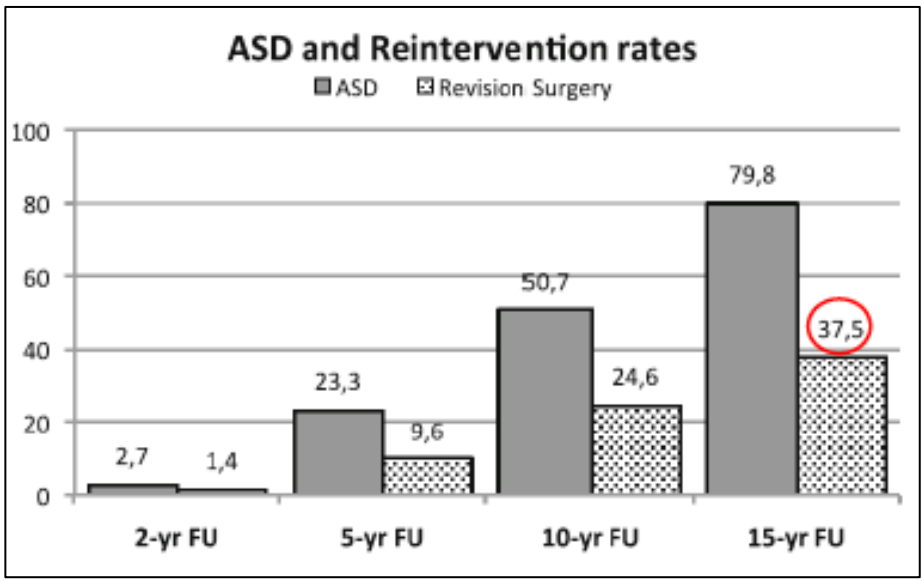
- Several possible complications
  - Implant related: Screw-misplacement, Pseudoarthrosis, Screw-loosening
  - Biomechanics related: ASD

Eur Spine J (2016) 25:1550–1557  
DOI 10.1007/s00586-016-4469-5

ORIGINAL ARTICLE

Adjacent segment degeneration and revision surgery after circumferential lumbar fusion: outcomes throughout 15 years of follow-up

José L. Maruenda<sup>1</sup> · Carlos Barrios<sup>2</sup> · Felipe Caribó<sup>1</sup> · Borja Maruenda<sup>3</sup>



„natural progression of a degenerative disease“  
- always a „good“ excuse -



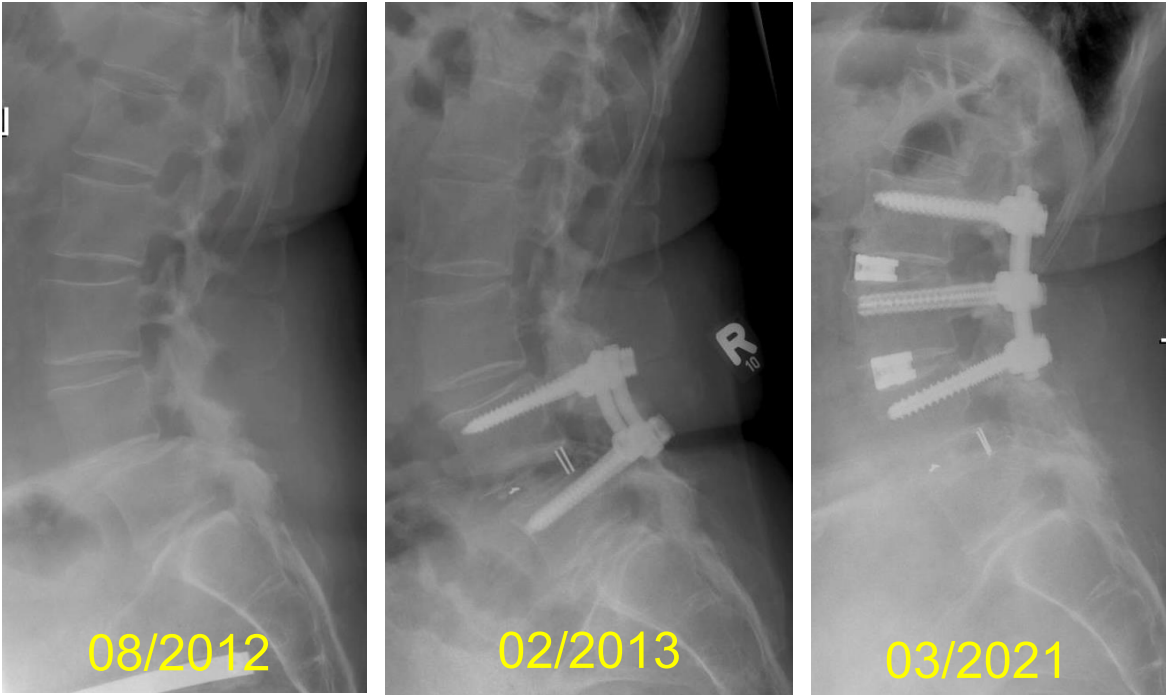
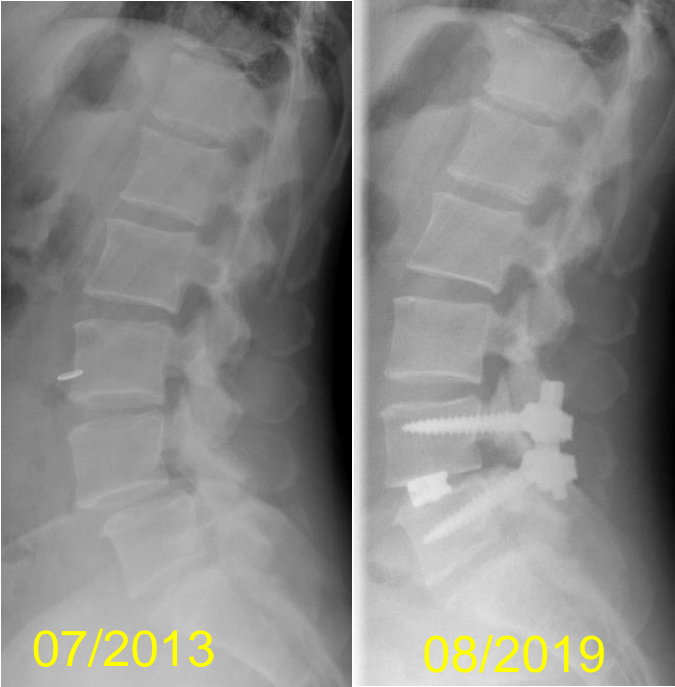
# „Good“ Fusion vs. „Bad“ Fusion

2 patients – same primary problem

Patient 1: 49 years old

Back pain + Claudicatio spinalis,  
Pseudospondylolisthesis L4/5 MI

Patient 2: 51 years old

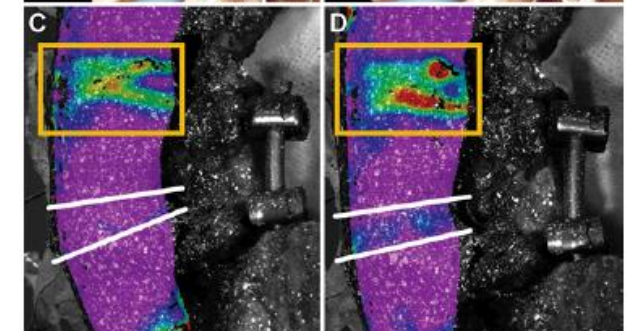
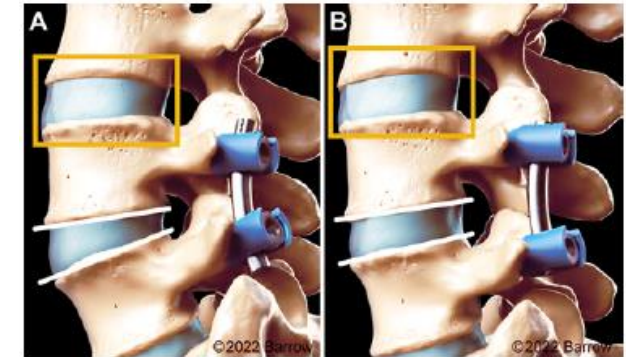
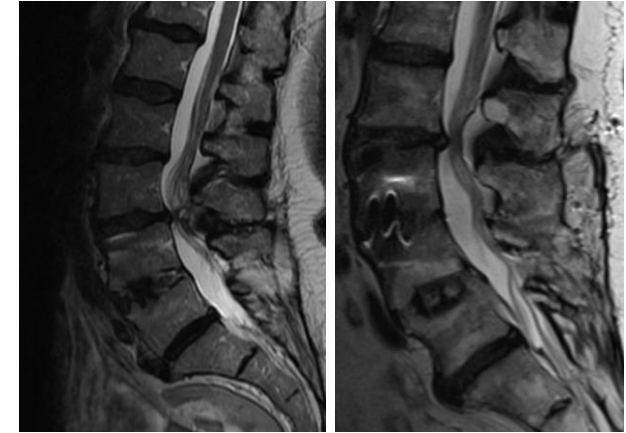


**2 x revision for ASD within 8 years**



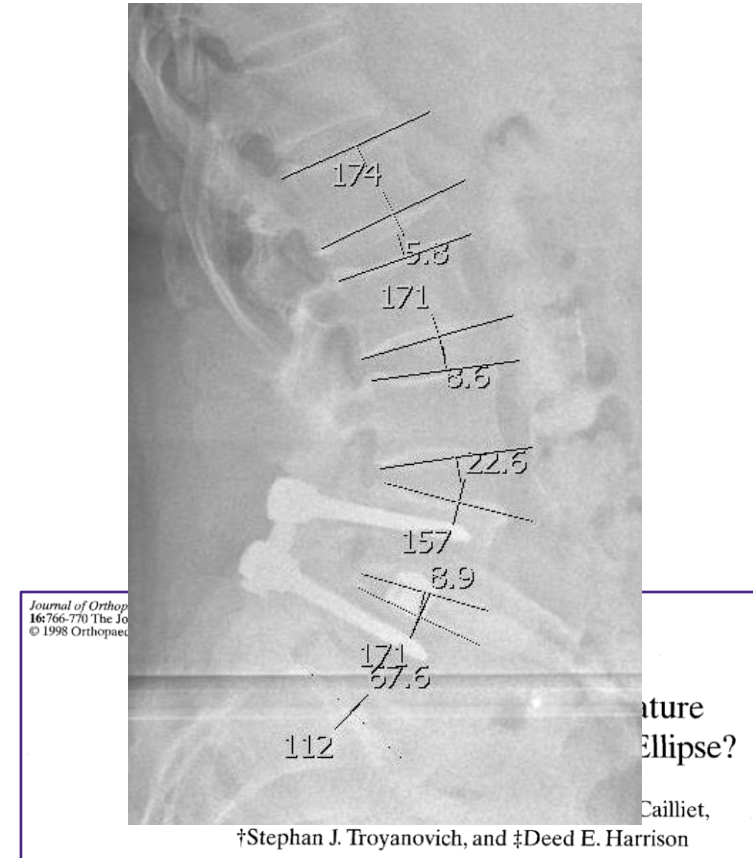
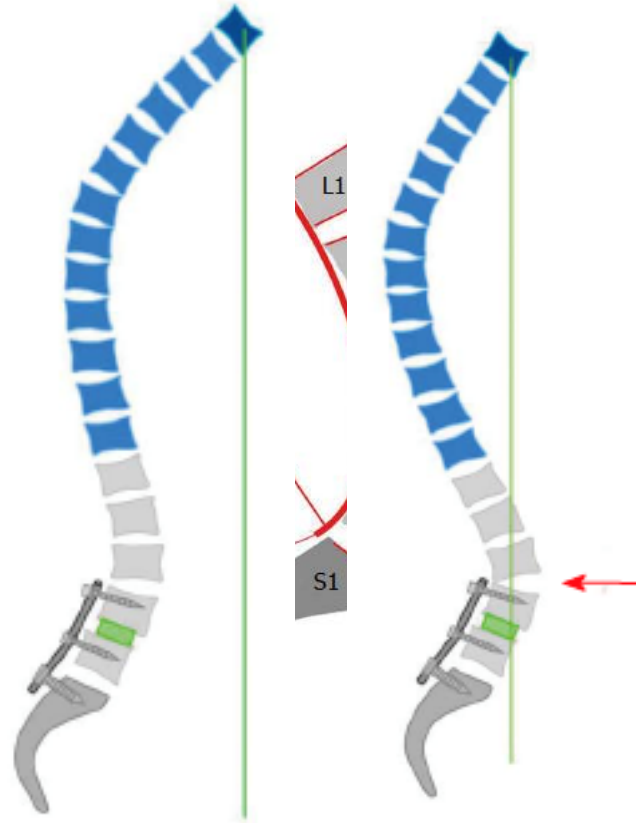
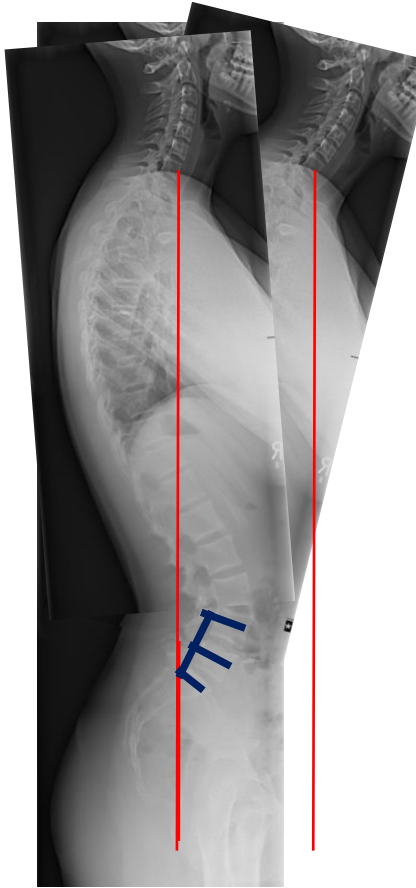
# Major driver for ASD?

- age > 60 years & PLIF: risk x 3,4  
(Lee J.C. et al. Spine 2014)
- Mismatch of LL and PI without correction  
→ ASD risk x10  
(Rothenfluh D.A. et al. ESJ 2016)
- High stress in adjacent disc if fusion in unphysiological kyphosis/lordosis  
(Pereira BA et al. JNS 2022)



# ASD - potential mechanism

Image source: C. Barrey et al.  
World Orthop 2015



**Healthy lumbar segments (L3-S1) are always lordotic!**  
**Lordosis decrease from caudal to cranial!**

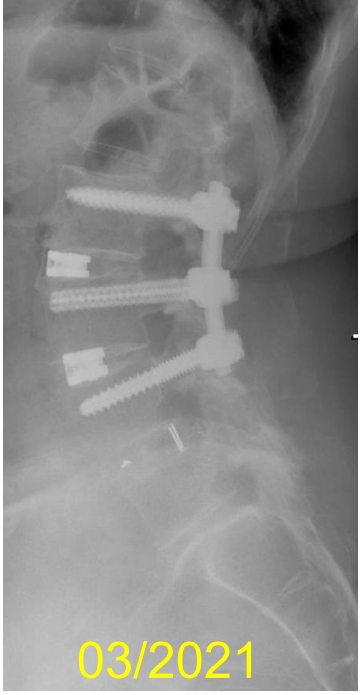
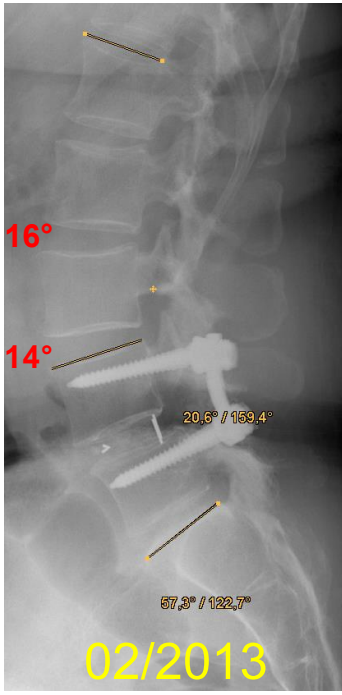
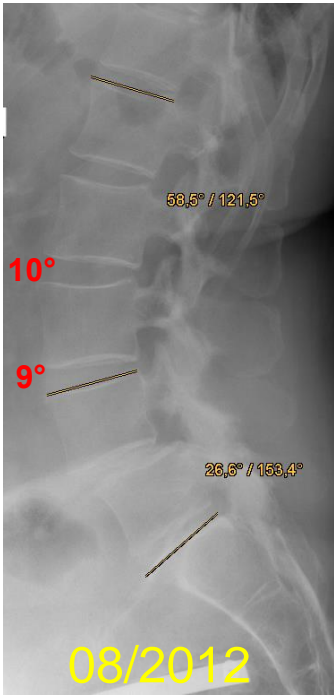
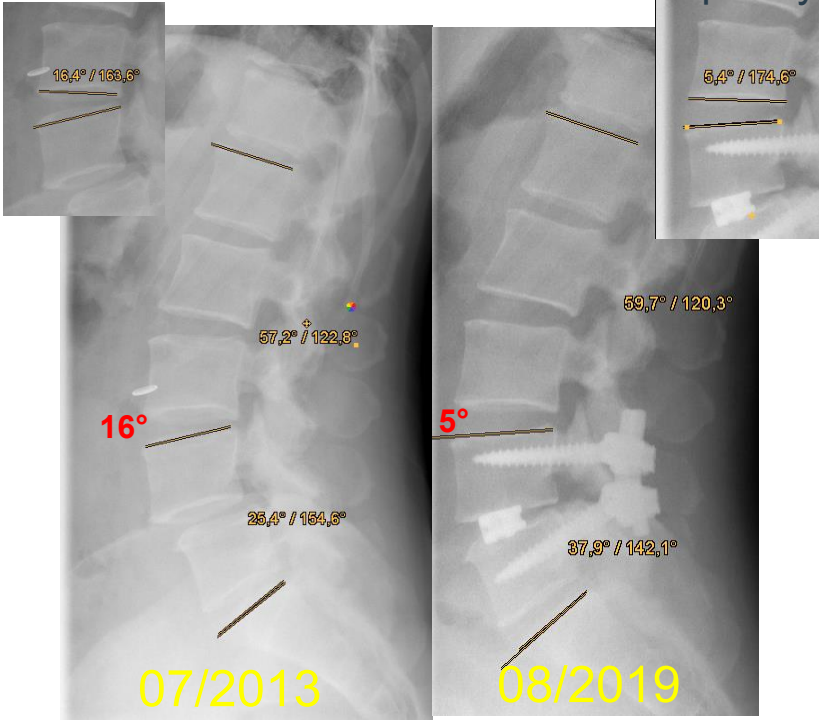
# „Good“ Fusion vs. „Bad“ Fusion

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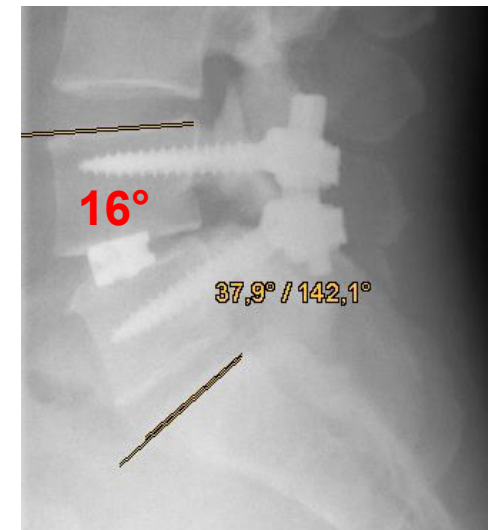
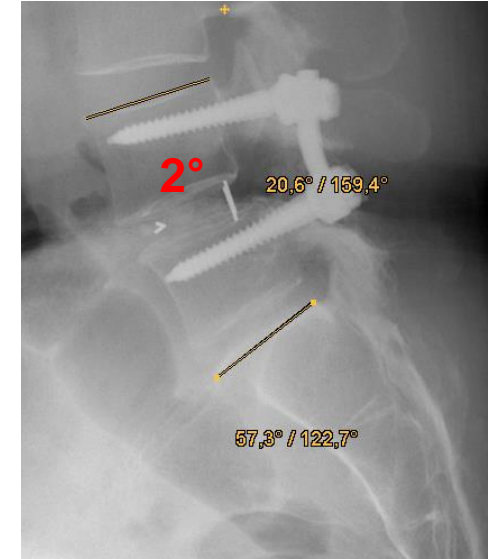
Patient 2: 51 years old





# How to prevent ASD?

- Avoid old patients and PLIF  
(Lee J.C. et al. Spine 2014)
- Match LL and PI  
(Rothenfluh D.A. et al. ESJ 2016)
- Avoid stress in adjacent discs due to fusion in anatomical lordosis  
(Pereira BA et al. JNS 2022)
- **FSLA > 15° significant less ASD (p=0,009)**  
(Soh J. et al. Asian Spine J. 2013)



# Case



## Surgical aim:

- Decompression (left S1 root)
- Stability (short fusion)
- Anatomical Deformity correction (kyphosis)

# What do we need to plan a short lumbar fusion?

## Images:

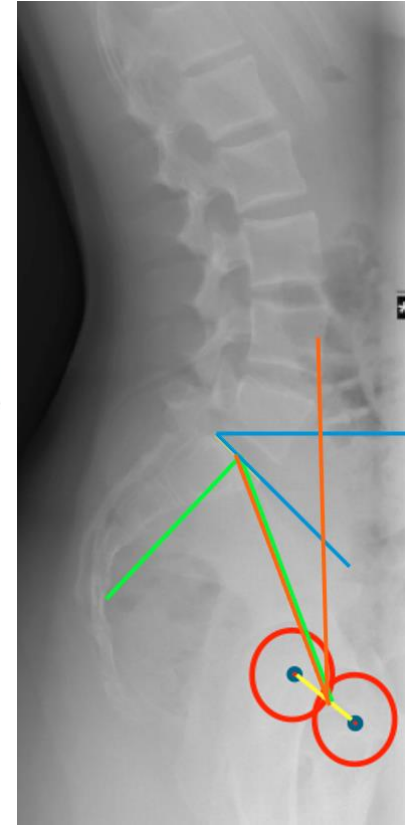
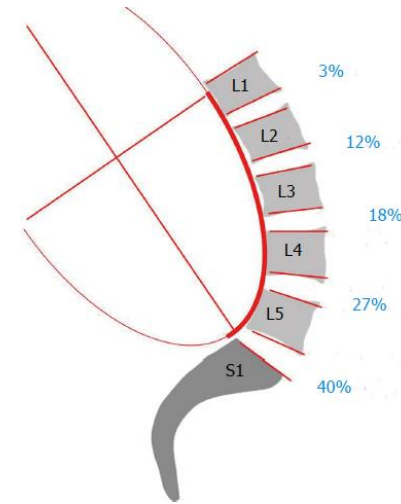
- upright x-ray lumbar spine incl. femoral heads
- Full spine x-ray??

## Measurement

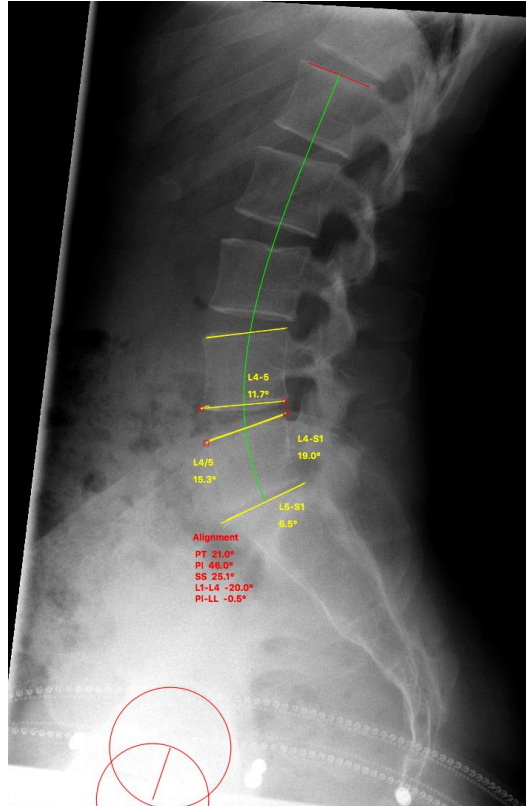
- **PI = SS + PT**
- LL, L4-S1, segmental angulation

## Calculation

- LL (PI matched) =  $0.54 \times \text{PI} + 27.6$  (Le Huec)
- L4-S1  $\rightarrow$  2/3 of LL
- L5/S1  $\rightarrow$  40%; L4/5 27%; L3/4 18% of LL



# Case – planning

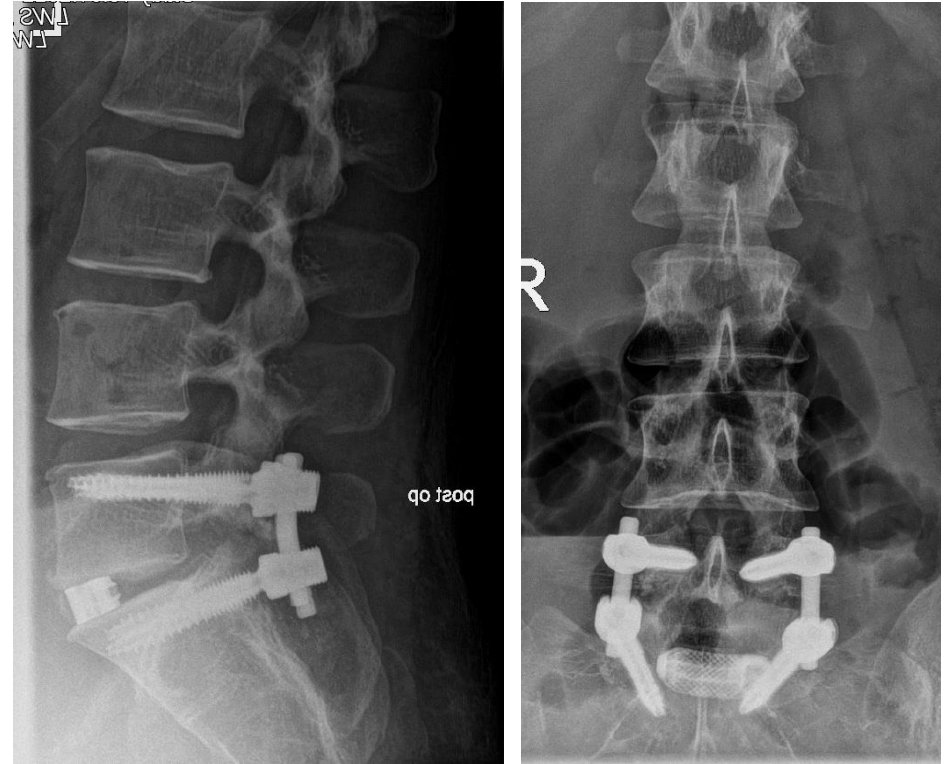
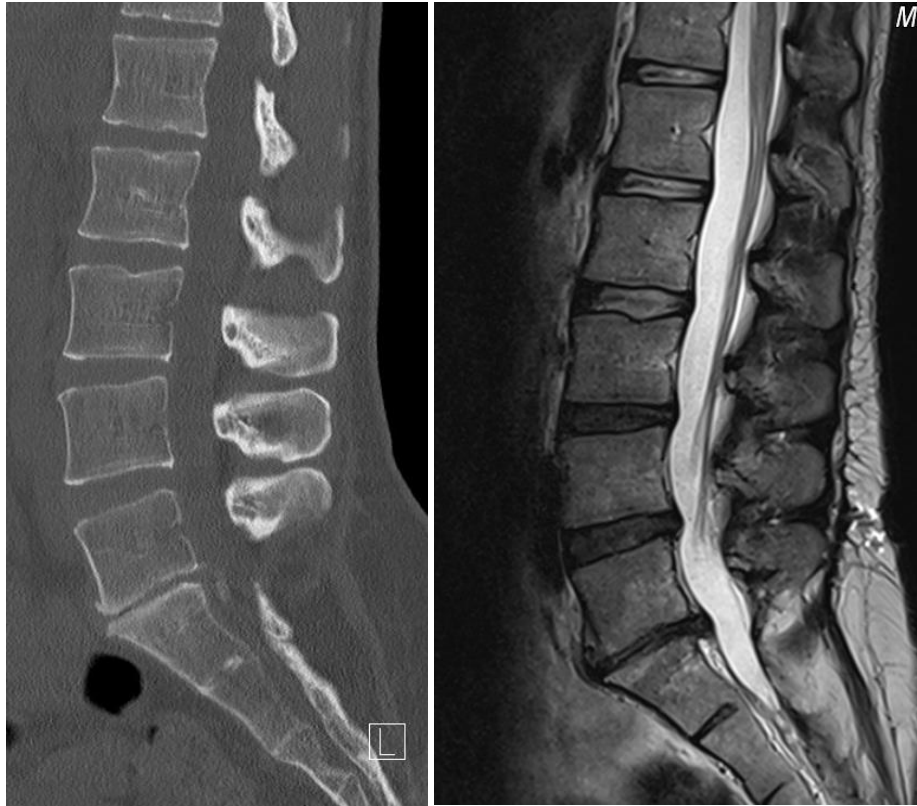


pre OP

PI: 46°  
 PT: 21° (↑)  
 SS: 25° (↓)  
  
 LL: 46° (52°)  
 L4-S1: 21° (34°)  
  
 L5/S1: -3° (21°)  
 L4/L5: 18° (14°)

Measures Table		
MEASURE	PRE-OP	NORM
Orient...	Ant  Post	
PT	21.0°	4.7 to 15.5
PI	46.0°	46.0°
SS	25.1°	29.4 to 42.6
LL	-46.5°	-60.2 to -42.4
L1-L4	-20.0°	-27.3 to -12.5
L4-S1	-37.0°	-41.2 to -29.2
PI-LL	-0.5°	-15.1 to 1.5
L1-S1	not calib...	
L4-S1	19.0°	
L4-5	11.7°	
L5-S1	6.5°	
L4/5	15.3°	

# Case – Solution



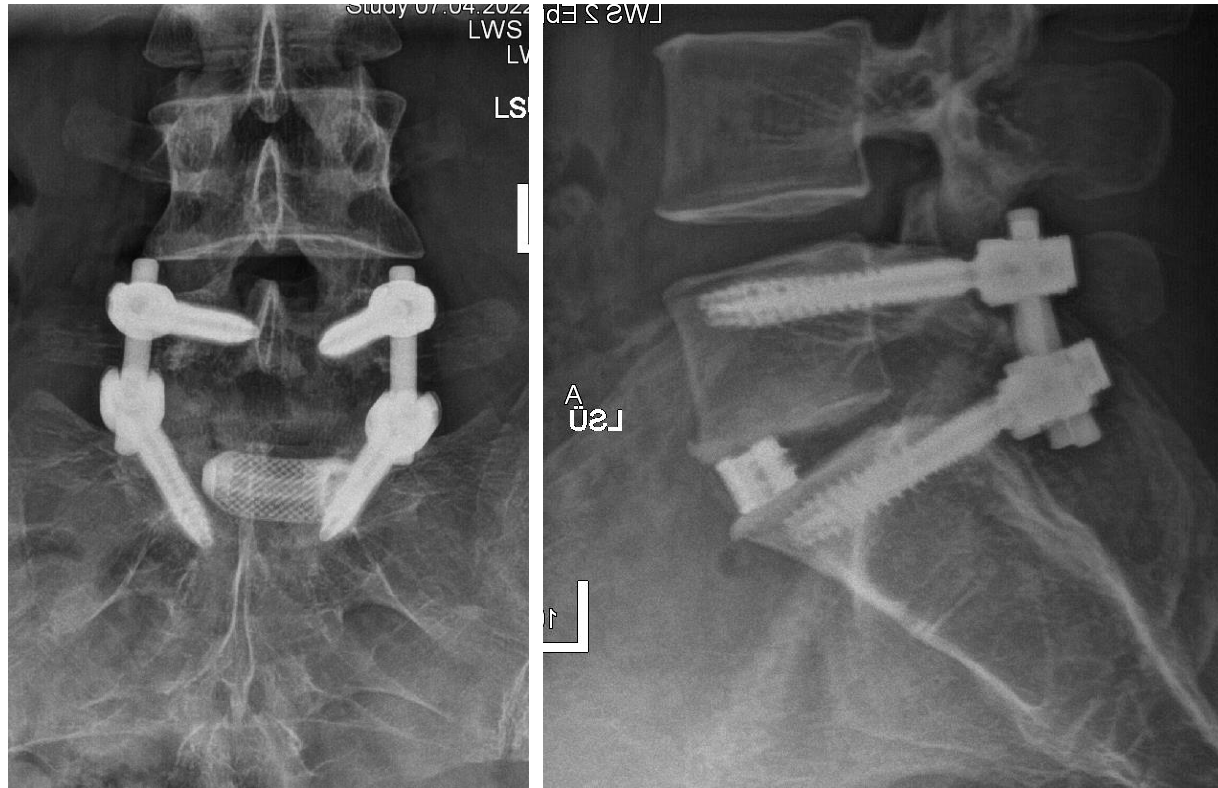
## OR-Strategy: rebalancing short TLIF

- adequate release
- anterior cage position
- perfect cage height
- intraoperative measurement of lordosis

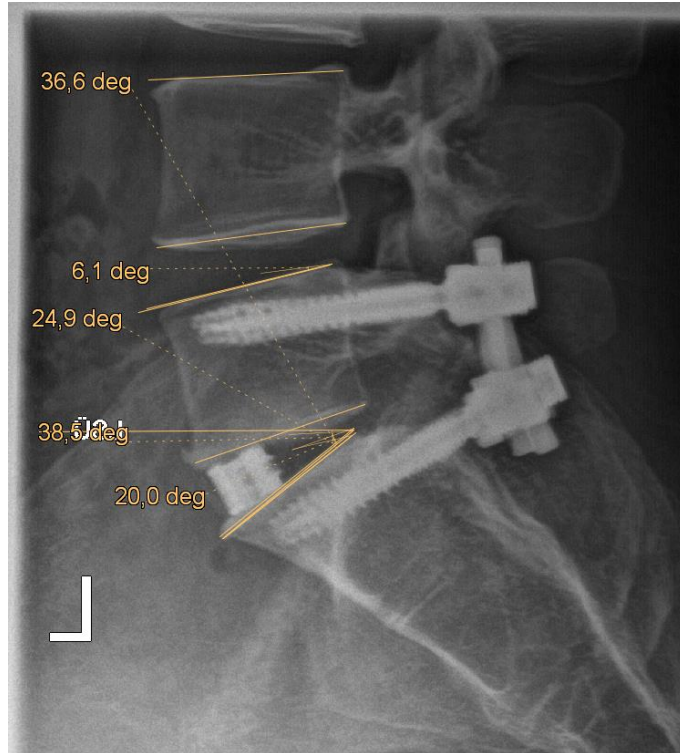
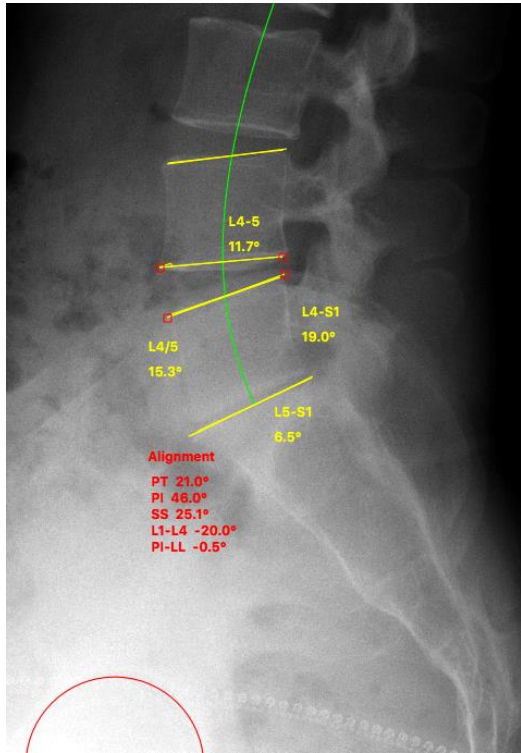


# Case – FU 6 months

- female, 35 years old, police officer, micro-discectomy 3 years ago
- back pain significantly decreased (VAS 1-2), SI-joint painfree
- some burning sensations left leg (part. neuropathic pain)



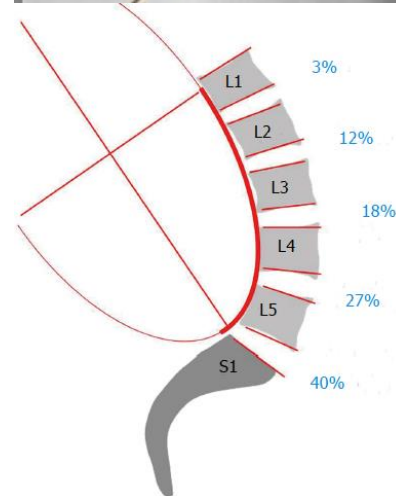
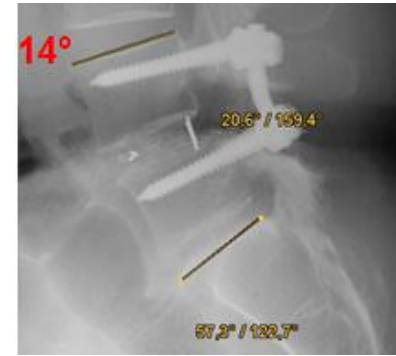
# Case – FU 6 months



	pre OP	post OP
PI:	46°	46°
PT:	21° (↑)	? (10°)
SS:	25° (↓)	38°
LL:	46° (51°)	?
L4-S1:	21° (34°)	37°
L5-S1:	-3° (21°)	25°
L4-L5:	18° (14°)	12°
Segment angle:	L4/L5 15° → 6°	L5/S1 -2° → 20°

# Take Home Message

- non anatomical fusion is a potential driver of ASD.
- restoration and anatomical distribution of LL is the potential key for long term success.
- planning is recommended for every fusion case:
  - upright lumbar x-ray (PI, LL, L4-S1, SA)
  - calculate  $LL = 0.54 \times PI + 27.6$
  - 2/3 of LL located between L4-S1







**ATOS** ORTHOPÄDISCHE KLINIK  
BRAUNFELS

ATOS Orthopädische Klinik Braunfels  
Hasselborring 5  
35619 Braunfels  
T +49 (0)64 42939-0  
[kontakt-braunfels@atos.de](mailto:kontakt-braunfels@atos.de)  
[www.atos-kliniken.de](http://www.atos-kliniken.de)

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