

# Three-Dimensional High-Resolution Image Analysis of the Segmental Reduction Effect Obtained with Lateral Lumbar Interbody Fusion for Lumbar Intervertebral Deformity

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# Back ground

- Increase in elderly population  
→ Increase of treatment opportunities for degenerative lumbar scoliosis (DLS) cases
- There is no unified view on therapy for DLS



- In recent years, eXtreme lateral interbody fusion (XLIF) has been performed and its utility is being studied
  - The detailed correction mechanism of XLIF is not clear



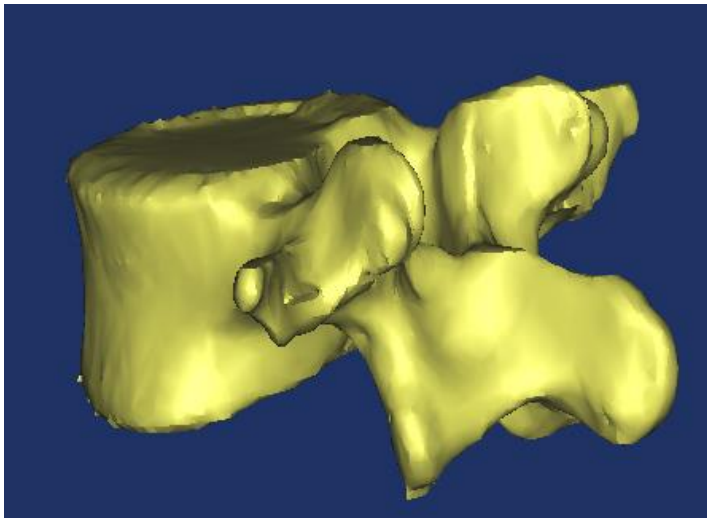
# Purpose & Subjects

- Evaluating the effect of correcting intervertebral deformity by inserting an XLIF cage
  - Measuring spinal morphology during XLIF
- 

- 28 subjects with lumbar degenerative disease (14 subjects with L3/4 and 14 with L4/5, respectively)
- XLIF was performed to relieve the neuropathy (e.g., pain, gait disturbance) at our institution from June 2014 to July 2016
- Patients with intentional correction from the posterior side and adult spinal deformity cases were excluded

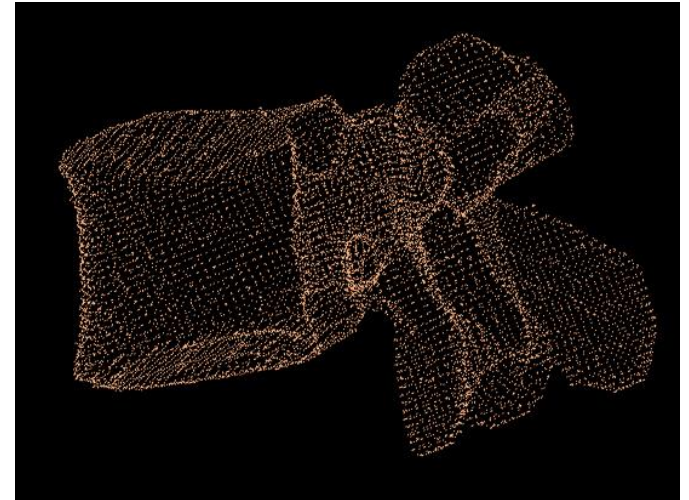
# Methods

CT DICOM data ( preoperatively and 3 months after surgery )



Segmentation  
using Mimics® software

Export



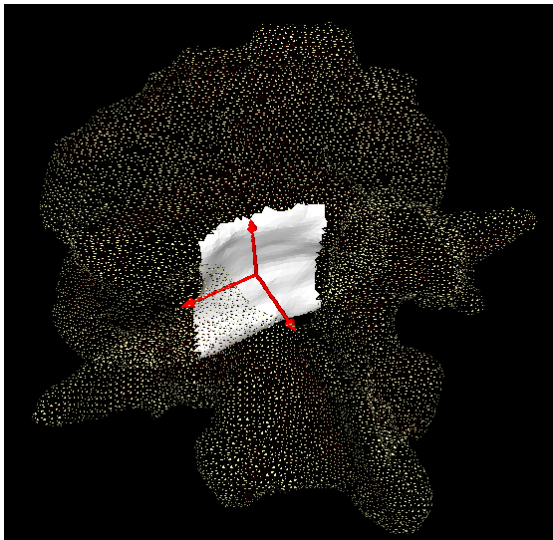
Point cloud data



In-house developed  
analysis routines

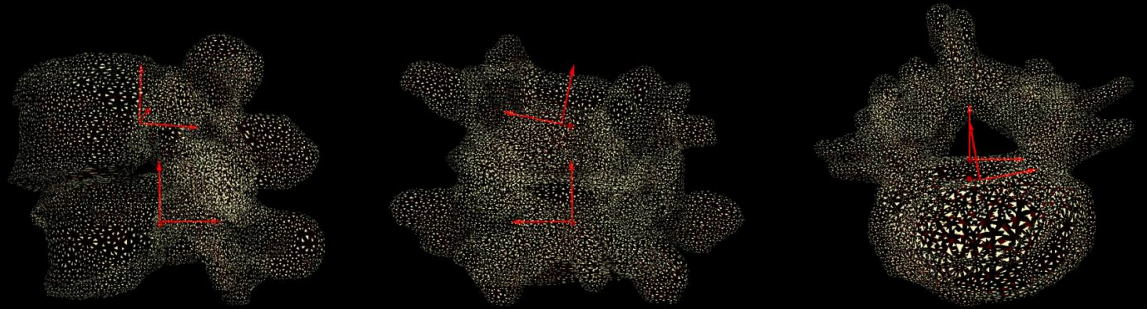
# Consideration item

## ① Euler angle

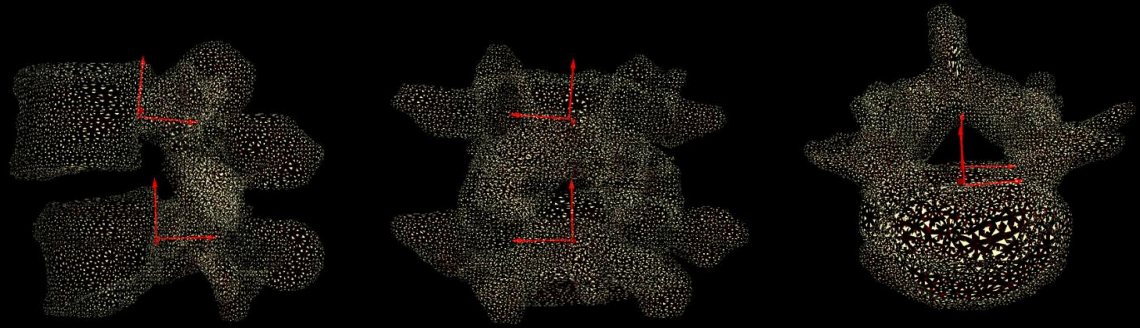


Local coordinates were set for each posterior wall of the vertebral body not affected by vertebral degeneration

## Preoperative alignment

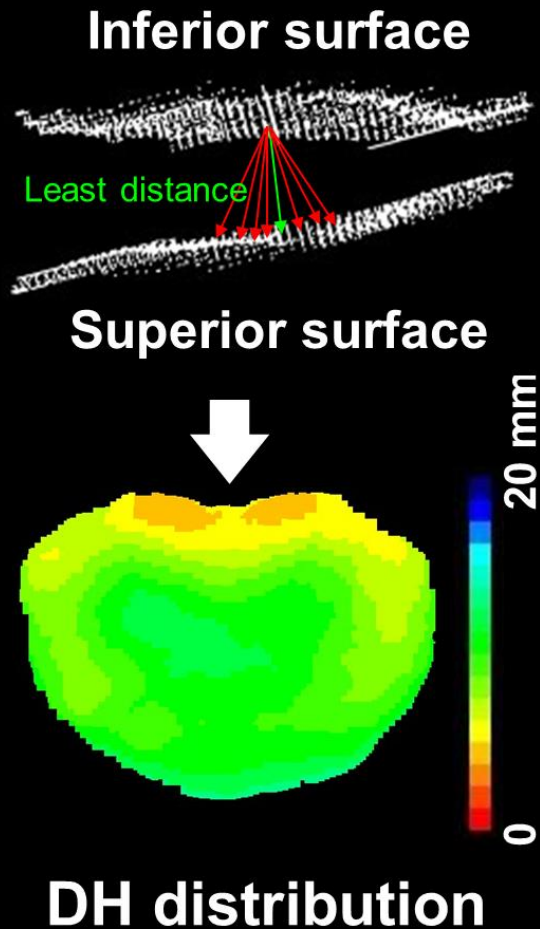


## Postoperative alignment



# Consideration item

## ② Disc height



① Each Euler angle  
Wedge angle, Axial rotation angle  
(not be distinguished from each other)

Kyphosis angle  
(+ : kyphosis, - : lordosis)

② Disc height (mm)

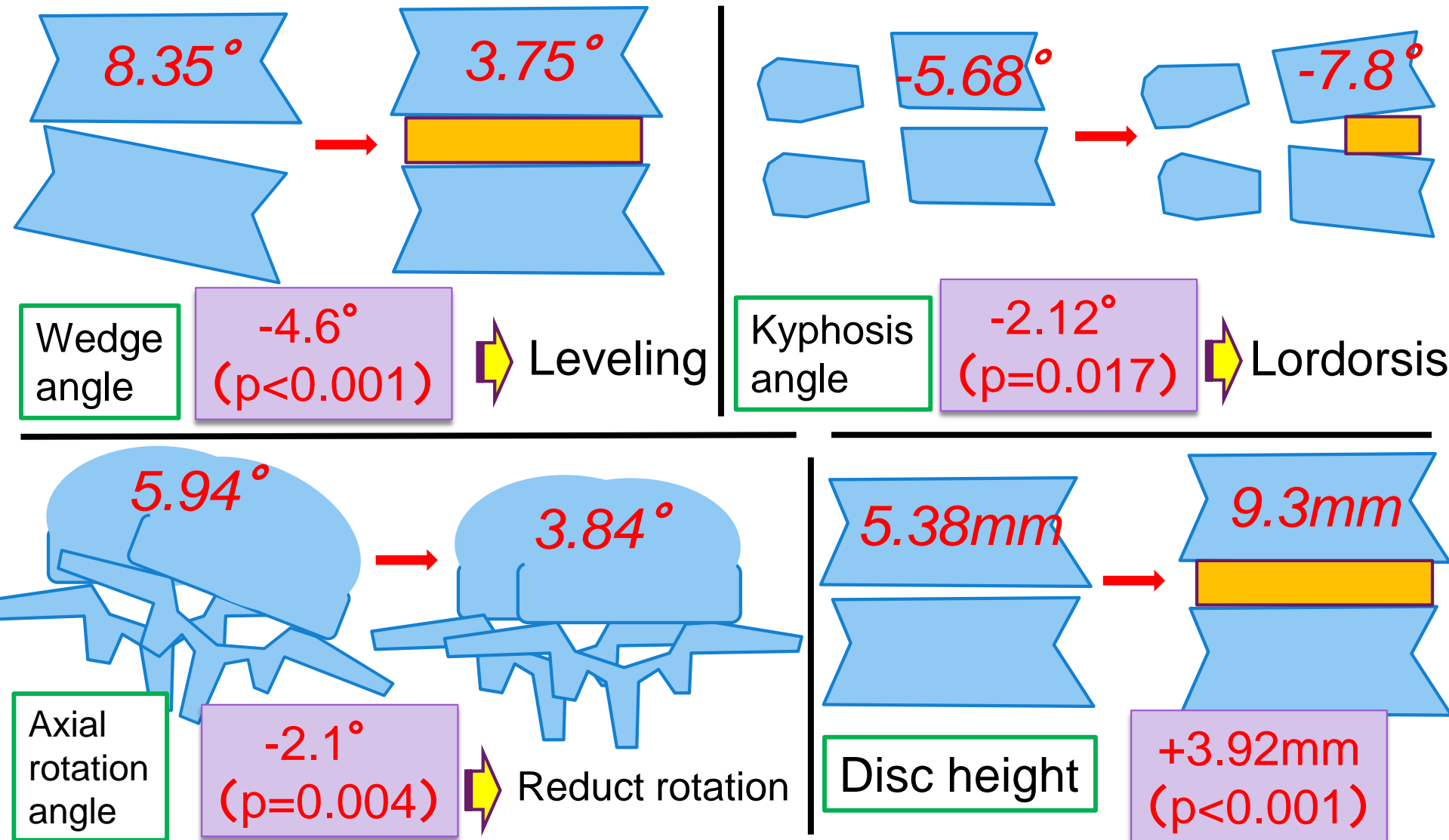


Measurement

- Values of preoperatively and postoperatively
- The perioperative amount of change
- The perioperative correction rate
- Their correlation

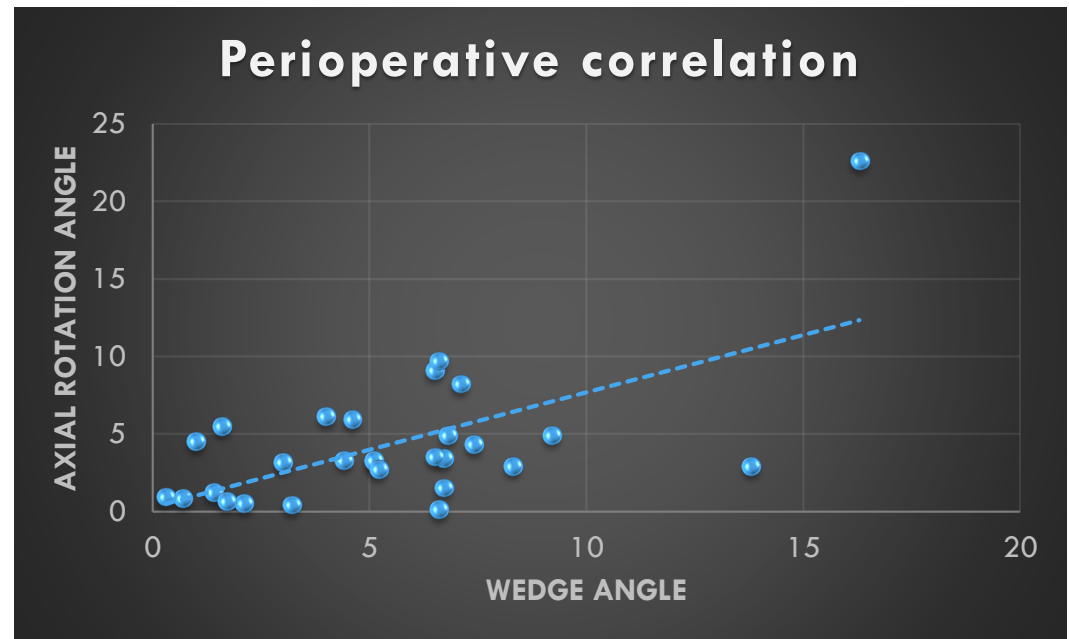
# Results

The mean values of the targeted 28 vertebrae



# Results correlation

- A positive correlation was found between wedge angles and axial rotation angles ( $r = 0.62, P < 0.001$ )

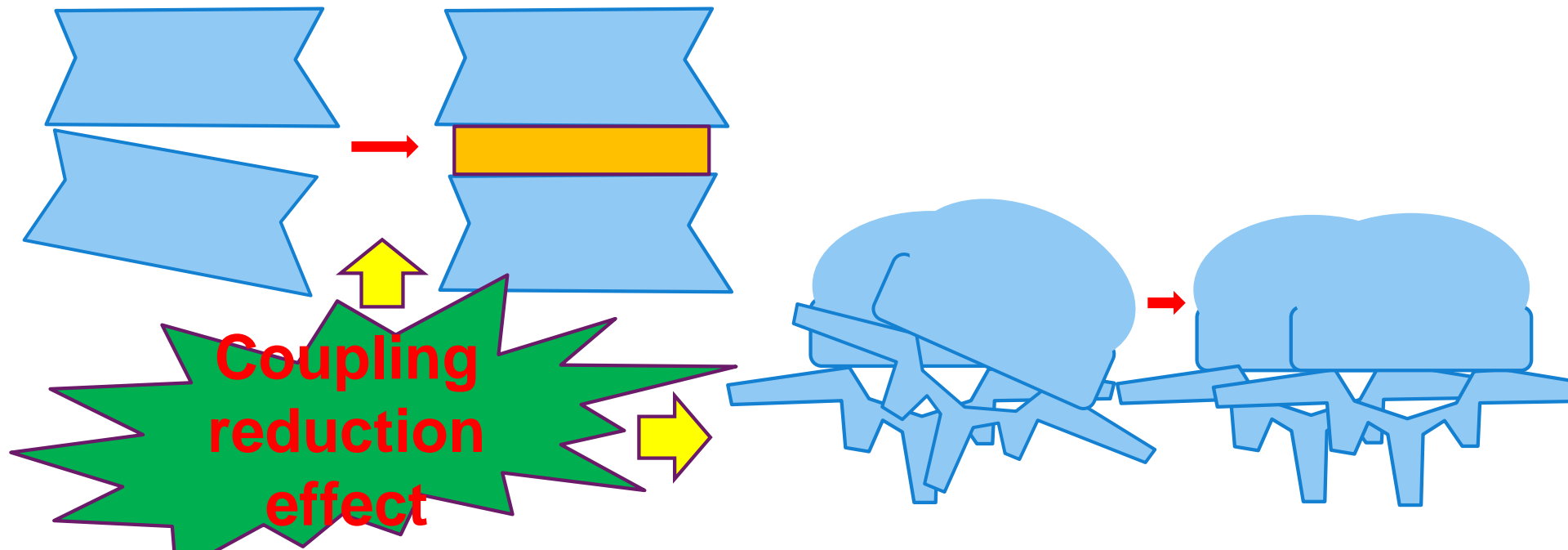


- No significant correlation was found between wedge / kyphosis / axial rotation angles and disc height



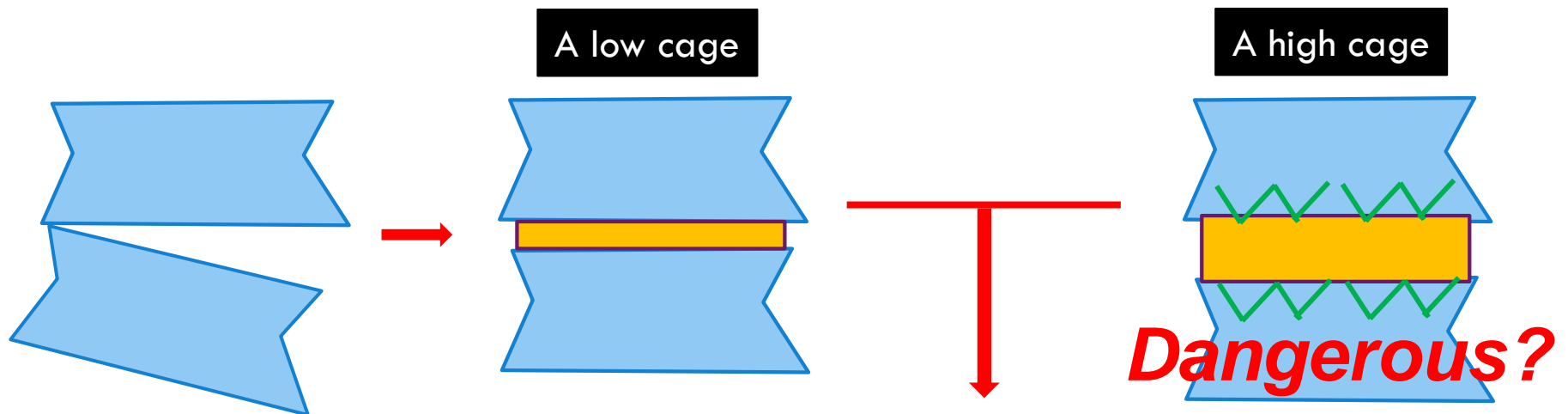
# Discussion

- A significant correlation was found between wedge angles and axial rotation angles regarding the perioperative amount of change ( $P < 0.001$ )
  - Indicating that correction of the intervertebral wedge deformity by cage insertion also corrected the rotational deformity



# Discussion

- There was no significant correlation between the disc height and the wedge/axial rotation angle
  - The amount of correction of the wedge/axial rotation angle did not depend on the amount of change in the disc height
  - It is not necessary to forcibly insert an implant with a high cage height, risking vertebral body end-plate damage

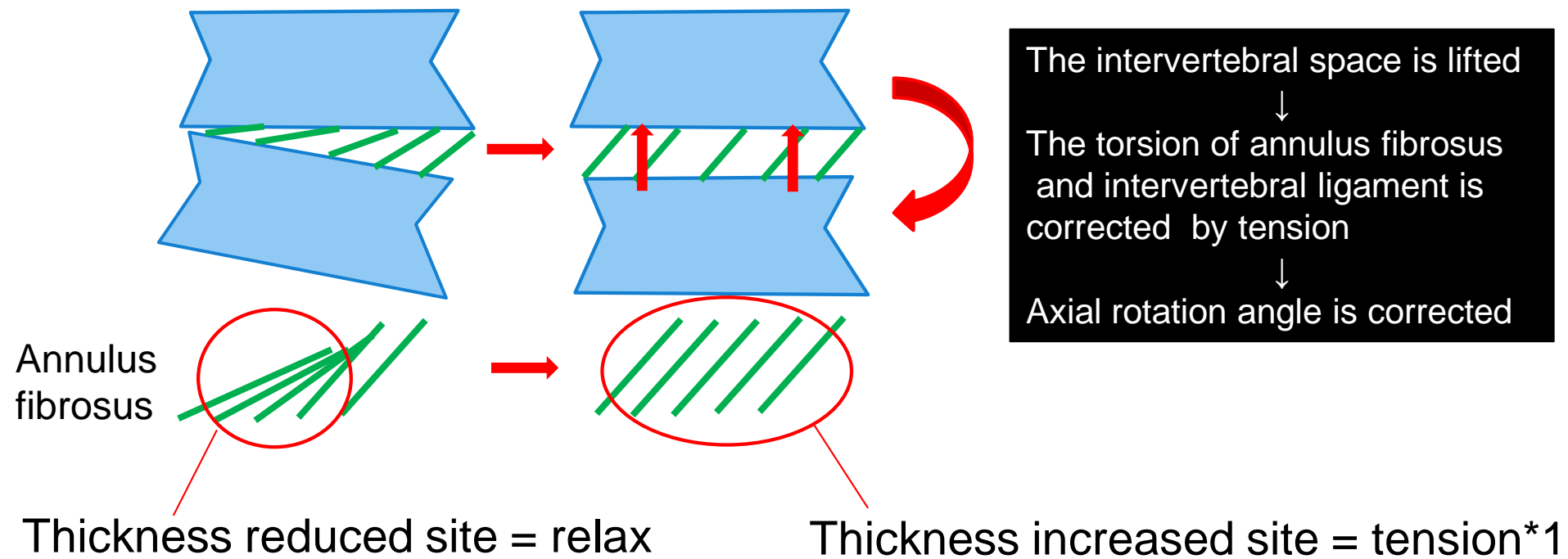


There is no difference in the amount of correction.  
It depended solely on the leveling of the intervertebral space?

# Discussion

▪ *correction effect of LLIF*

→ Ligamentotaxis effect of both the intervertebral ligament such as ALL, PLL and the remaining annulus fibrosus



# Conclusion

- The effect of correcting intervertebral deformity by quantifying 3D-CT images using a means to measure accurately the perioperative form during LLIF was validated.
- Leveling the intervertebral wedge deformity by cage insertion also corrected rotational deformity.
- Ligamentotaxis could partially achieve intervertebral correction of both wedge and rotation deformities without forcibly inserting a large cage during LLIF.

*Authors' disclosure statement:*

*The authors report no actual or potential conflict of interest in relation to this article.*