



UMC Utrecht



Spino-pelvic alignment and posture: Is child a miniature of adult?

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Disclosures

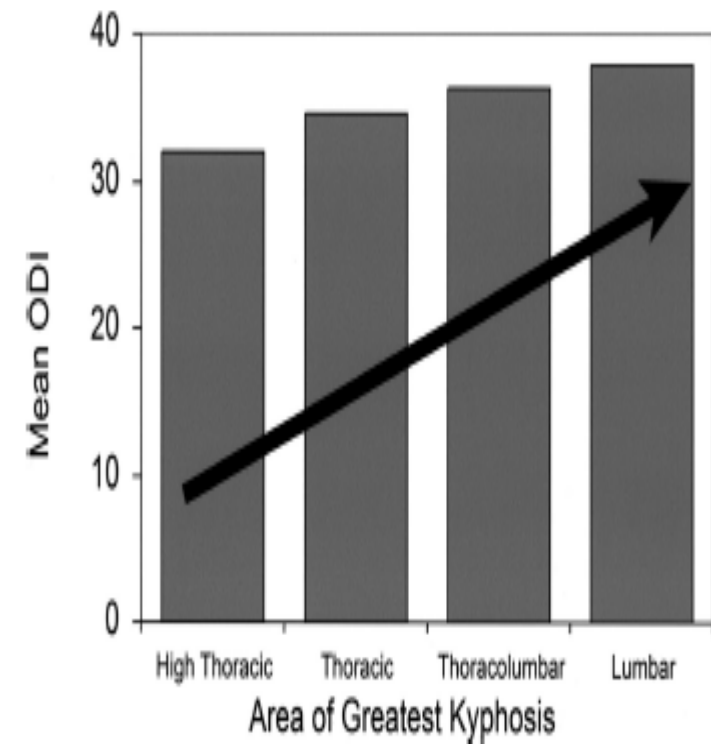
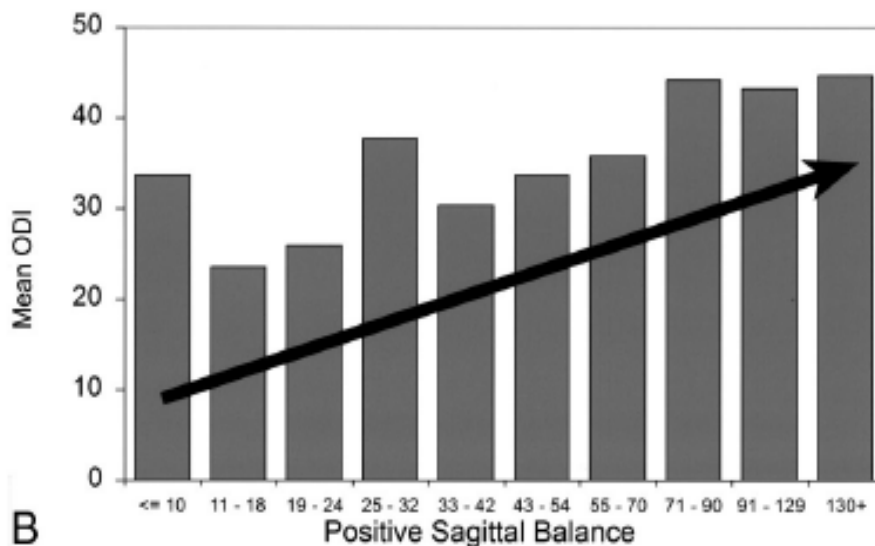
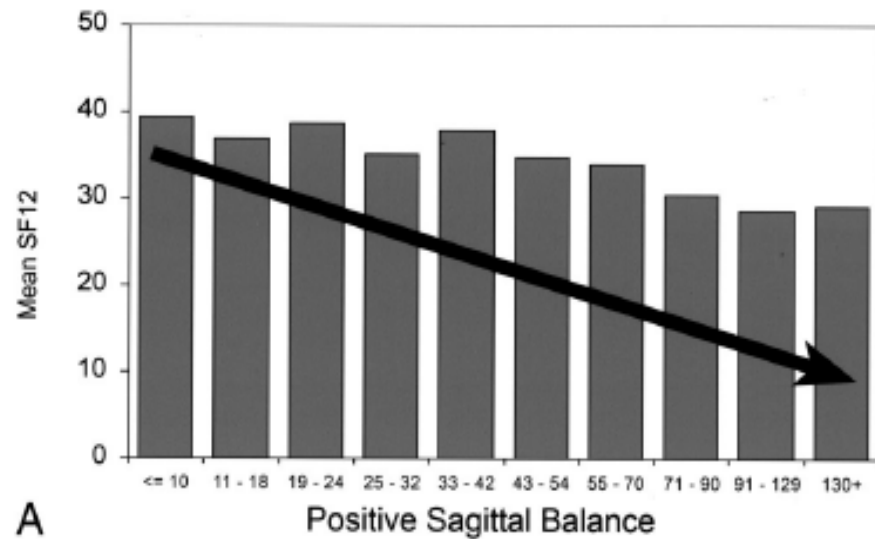
- Fondation Yves Cotrel start up grant
- Medtronic Research Grant (past)
- K2M Research Grant (ongoing)
- AO Start-Up grant - Research Support
- Alexandre Suermann MD PhD Stipendium, UMC Utrecht



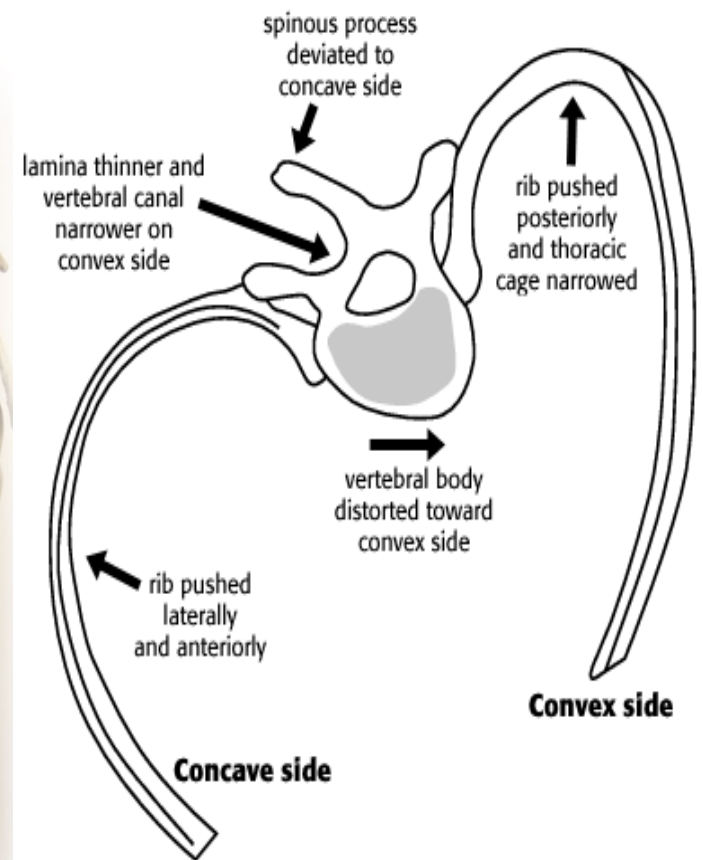
Why is sagittal alignment in a child important?



Certainly not for QoL!



Essence of scoliosis?



Anterior “overgrowth” ??

Spine

SPINE Volume 41, Number 00, pp 000–000
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Anterior Spinal Overgrowth Is the Result of the Scoliotic Mechanism and Is Located in the Disc

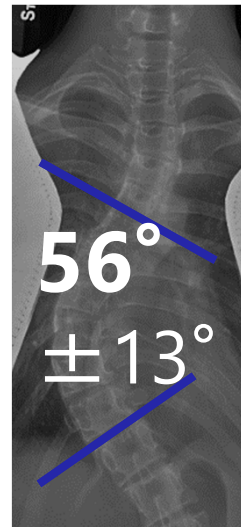
Rob C. Brink, MD,* Tom P.C. Schlösser, MD, PhD,* Dino Colo, MD,* Ludvig Vavruch, MD,[†]
Marijn van Stralen, PhD,[‡] Koen L. Vincken, PhD,[§] Marcus Malmqvist, BSc,[†] Moyo C. Kruyt, MD, PhD,*
Hans Tropp, MD, PhD,[†] and René M. Castelein, MD, PhD*

CT scans of:

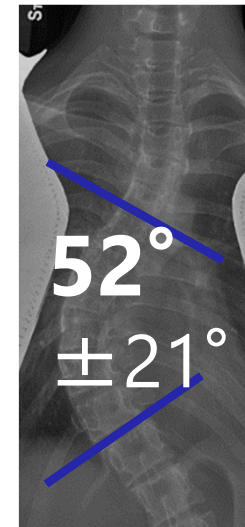
- **30** NM patients
- **30** AIS patients
- **30** Non-scoliotic controls

10-18 years of age

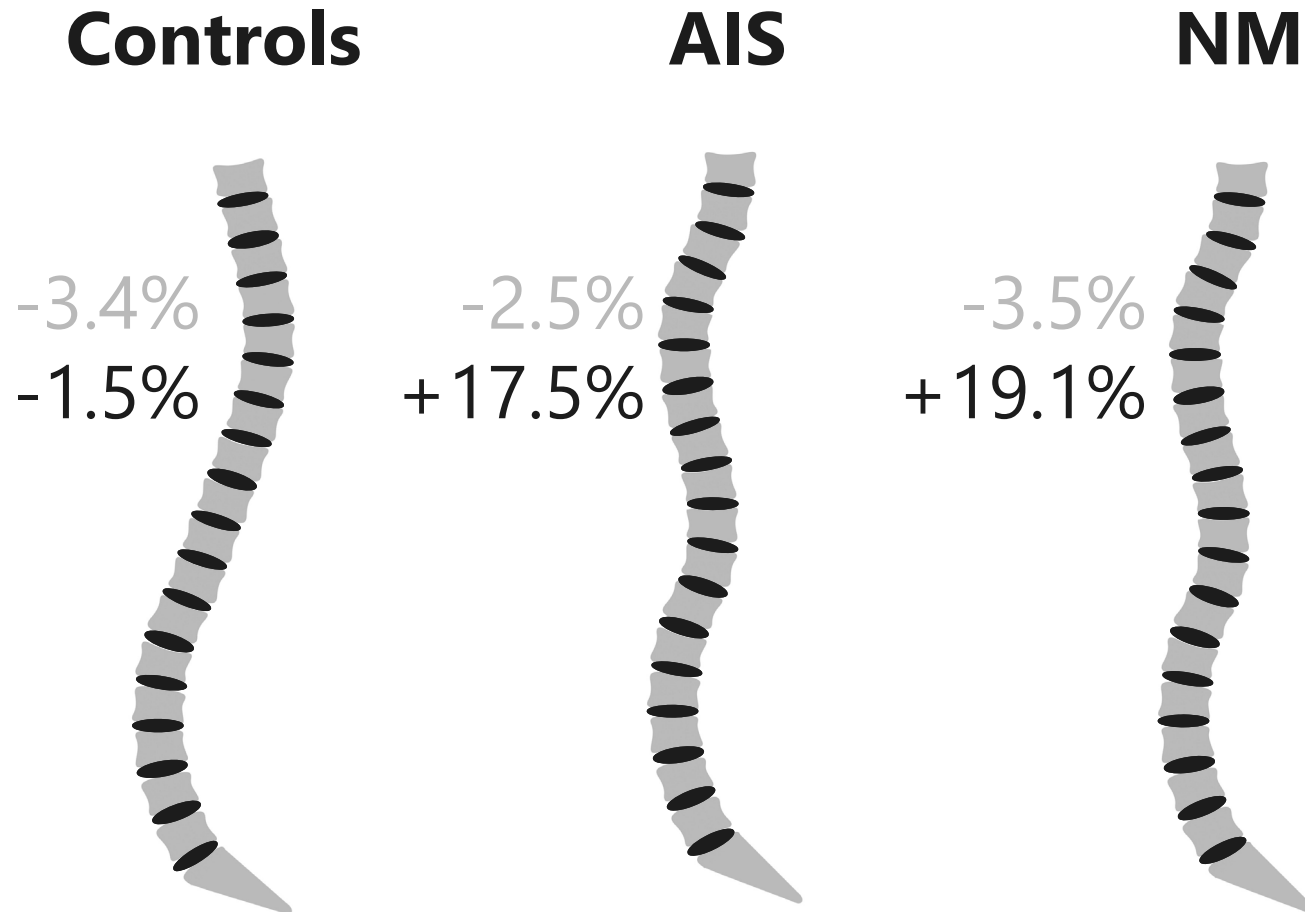
AIS



NM



Bony anatomy in scoliosis is the same as in controls, the discs are different!



AIS/NM vs. controls: body: $P > 0.05$, disc: $P < 0.01$
AIS vs NM: $P > 0.05$



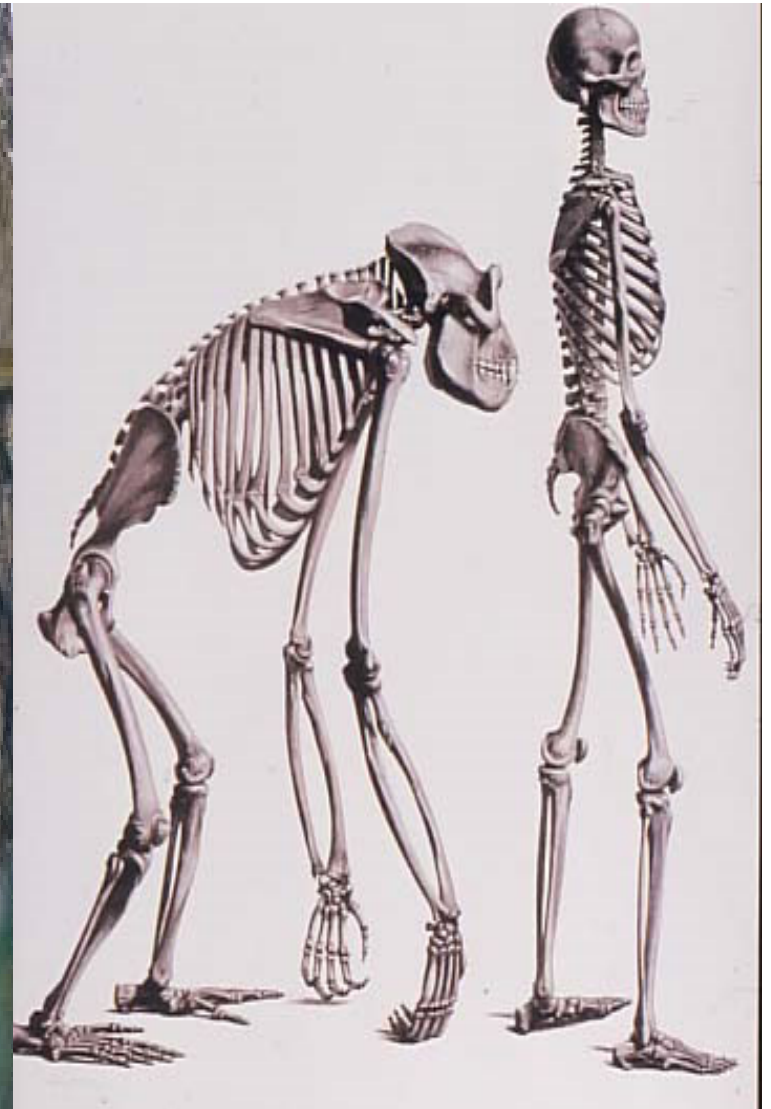
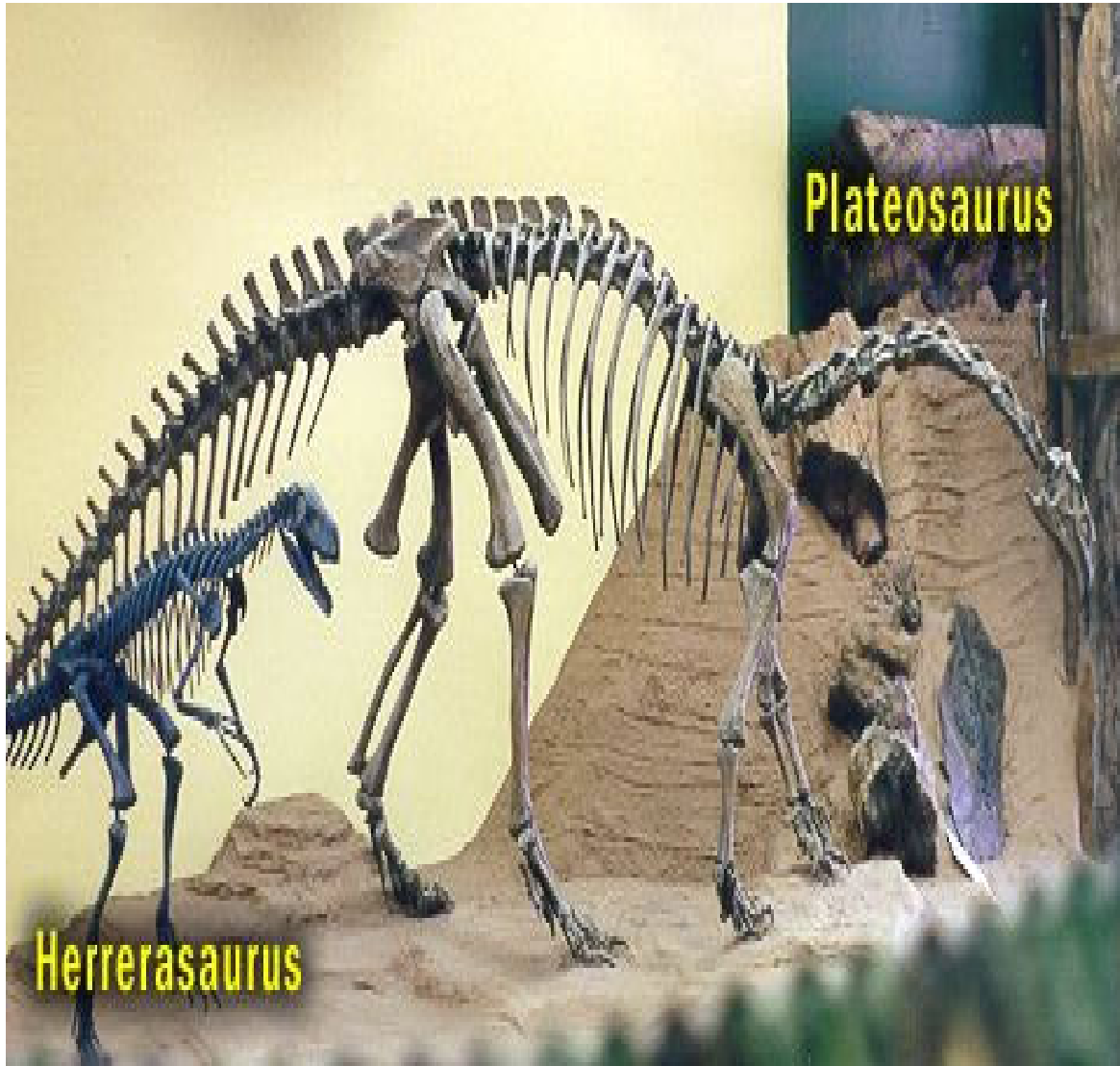


Essence of scoliosis:



Rotation!

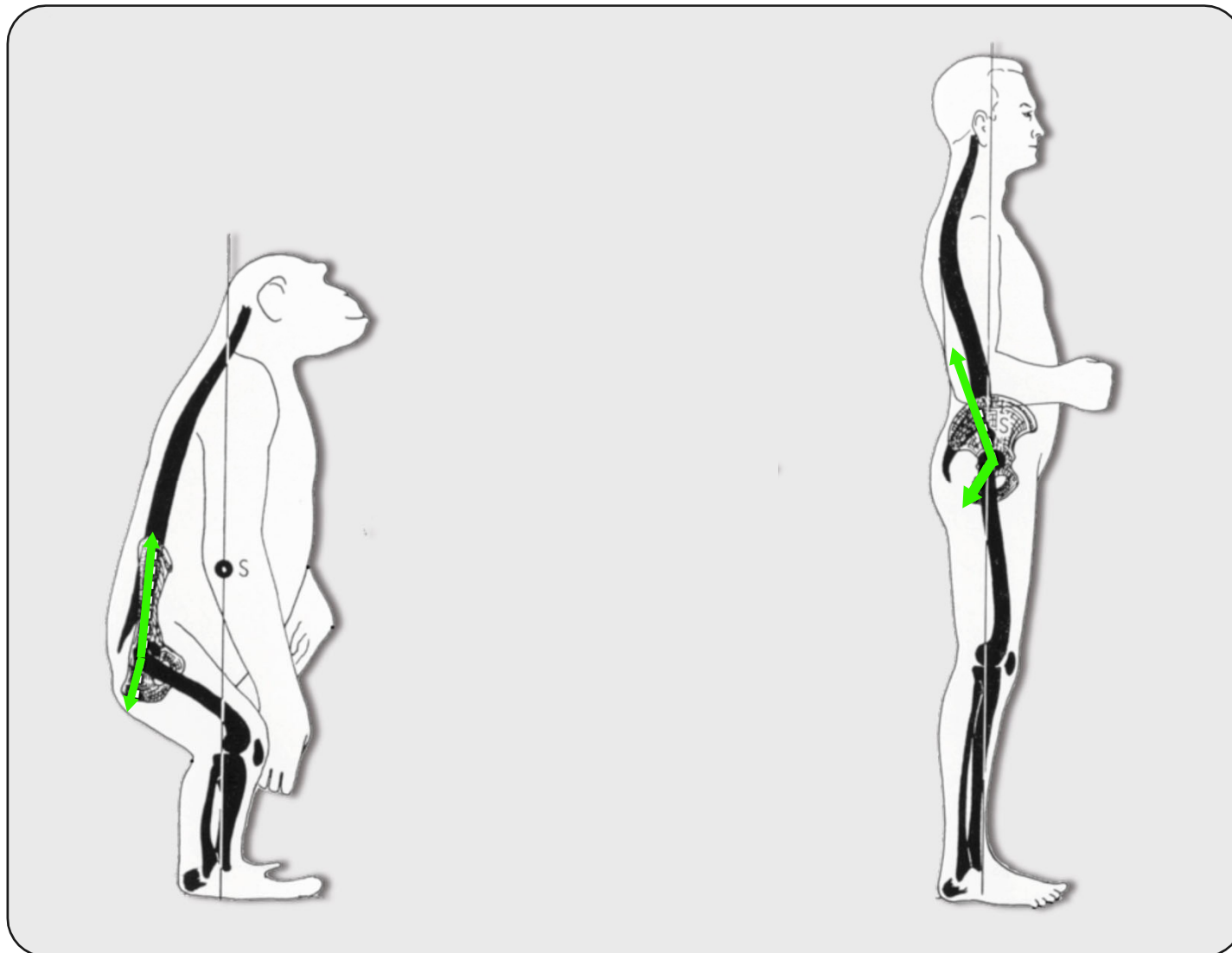
The spine has been a very successful and stable mechanical construct for more than 200 000 000 years....



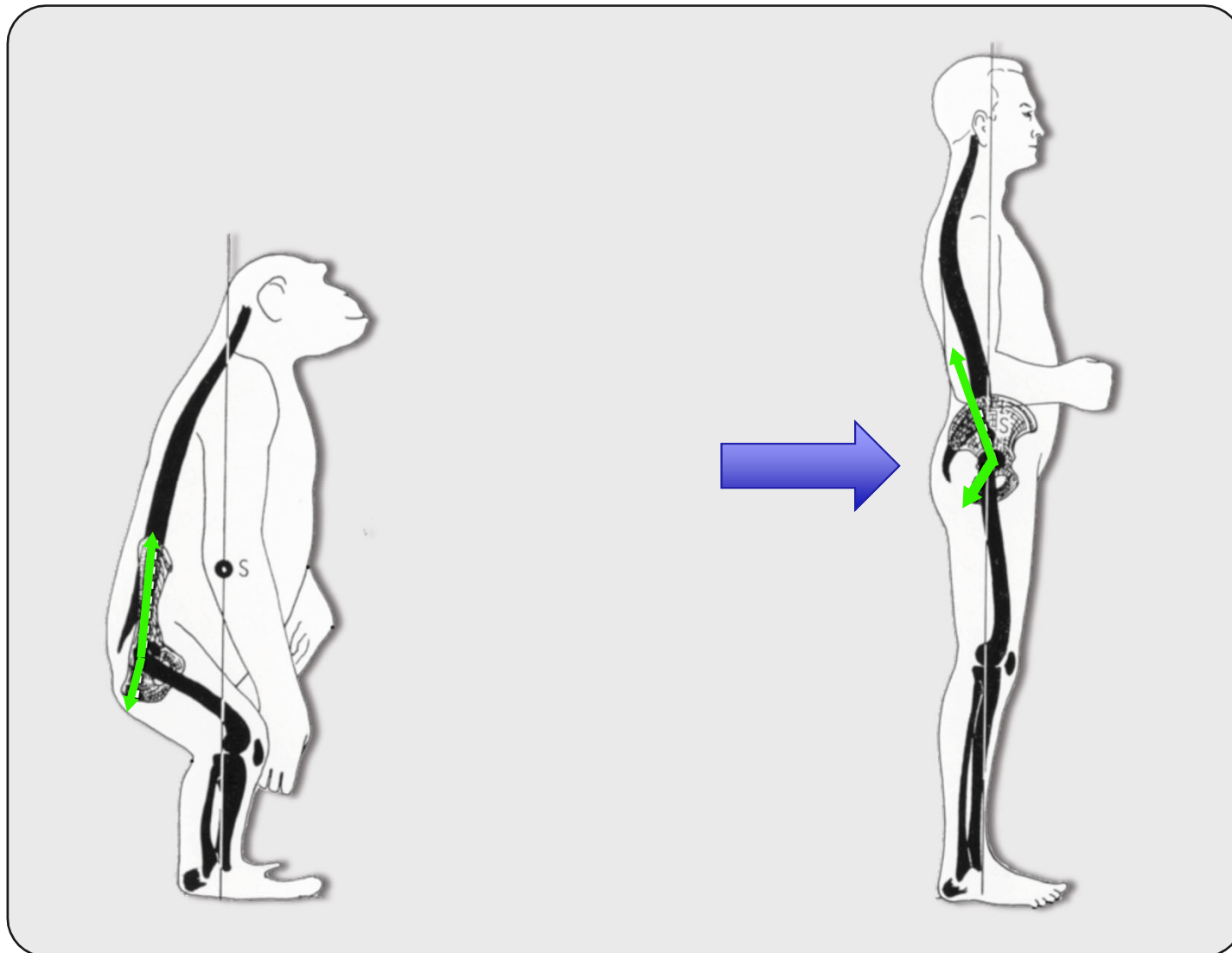
Why would it start to rotate??

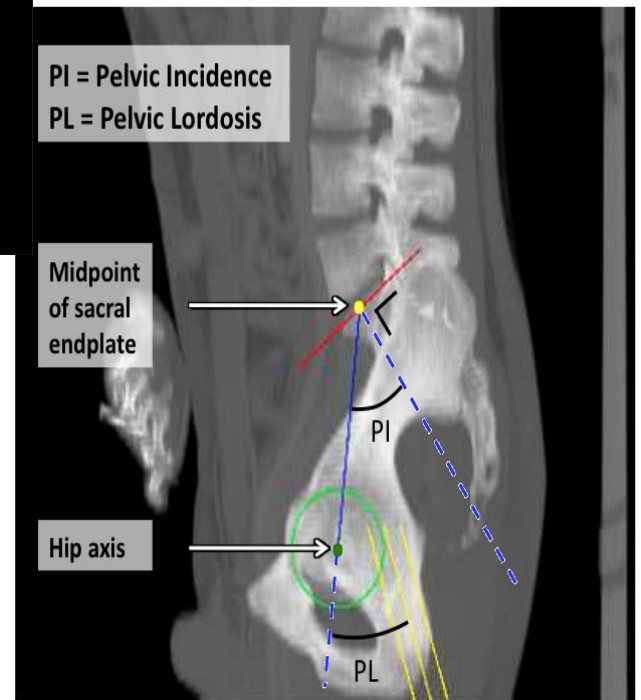
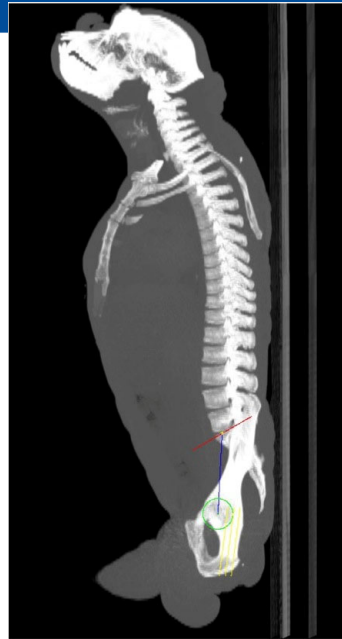


Because of the *unique* human spino-pelvic alignment with a *triple* lordosis



Because of the *unique* human spino-pelvic alignment with a *triple* lordosis

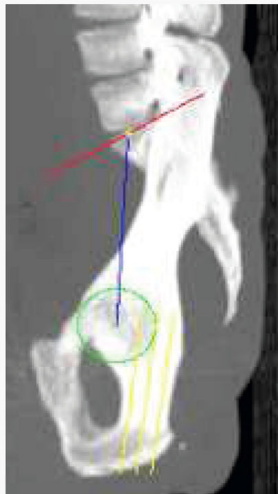




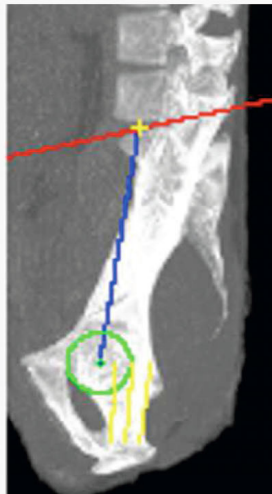
Bonobo
PL: 12°
PI: 28°



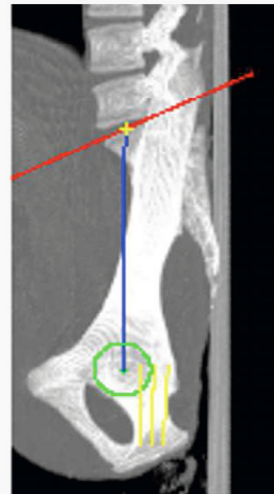
Chimpanzee
PL: -5°
PI: 32°



Gibbon
PL: 2°
PI: 22°

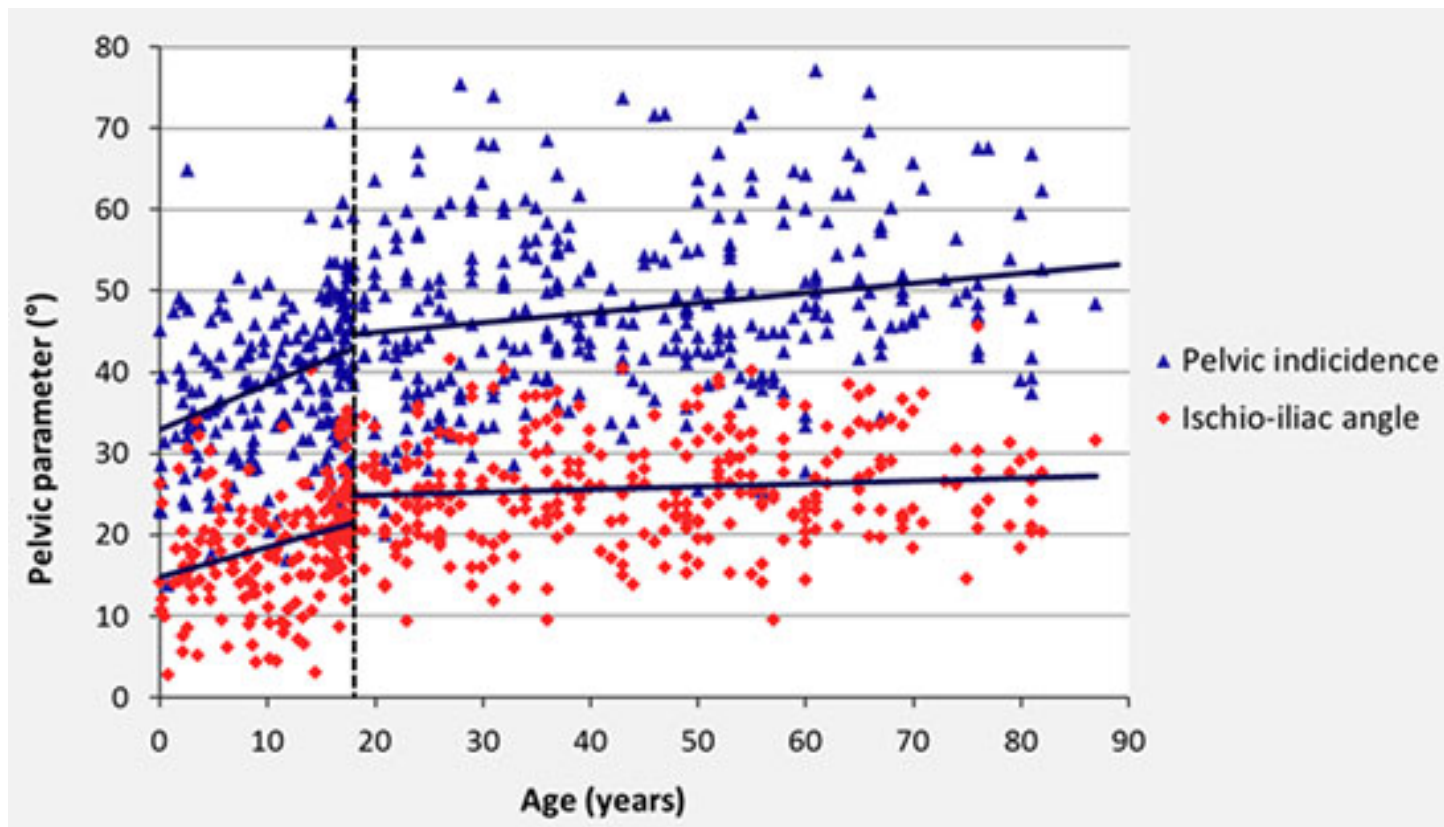


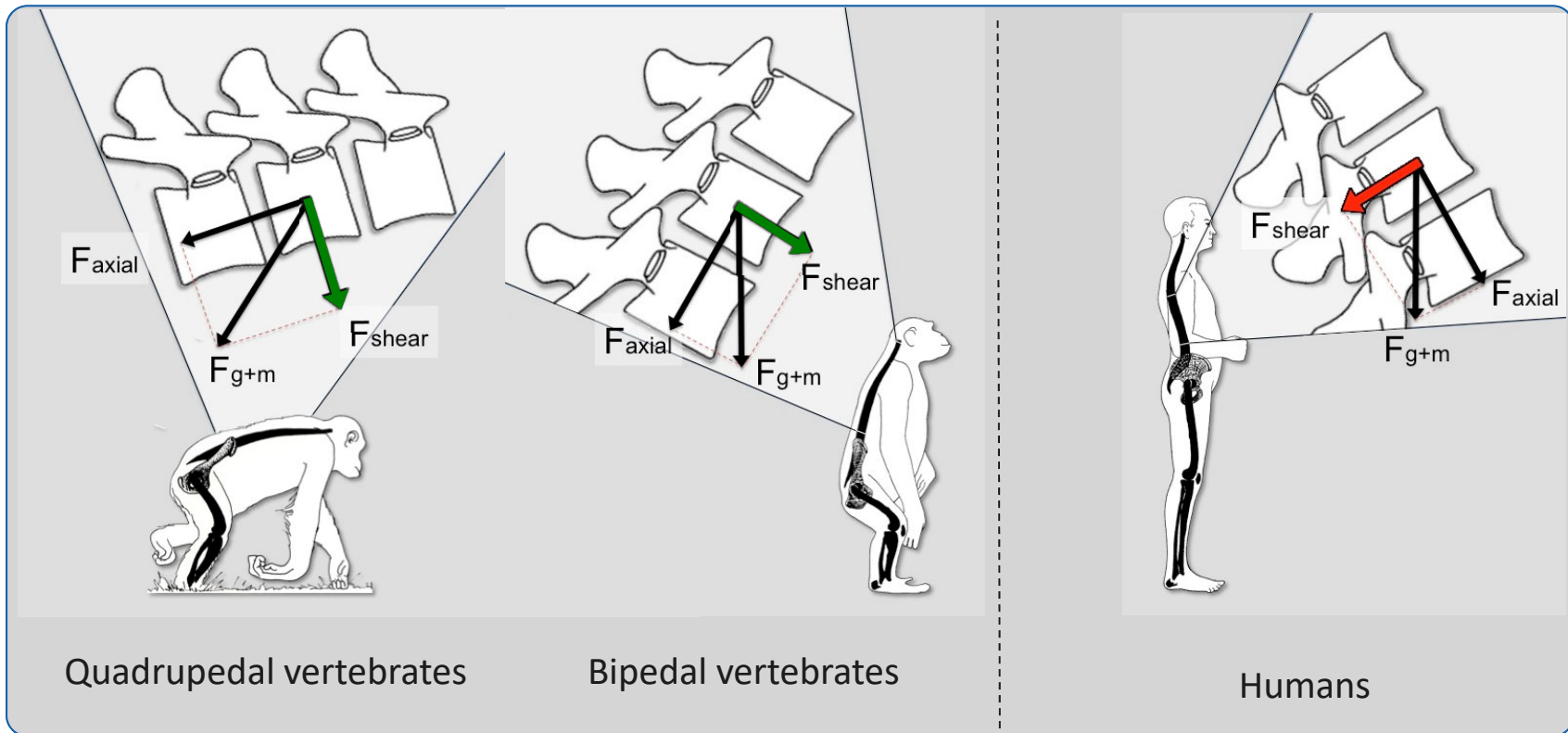
Siamang
PL: -4°
PI: 26°



Evolution of the ischio-iliac lordosis during natural growth and its relation with the pelvic incidence

Tom P. C. Schlösser · Michiel M. A. Janssen · Tomaž Vrtovec ·
Franjo Pernuš · F. Cumhur Öner · Max A. Viergever ·
Koen L. Vincken · René M. Castelein



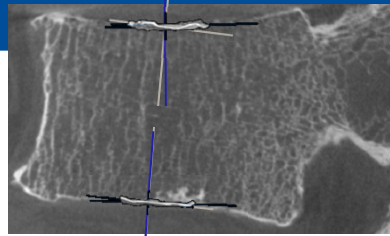


- Axial compression
- **Ventral** shear

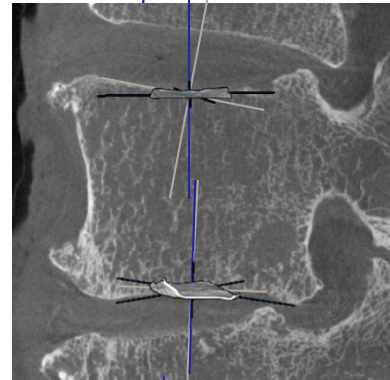
- Axial compression
- **Ventral** shear
- **Dorsal** shear¹



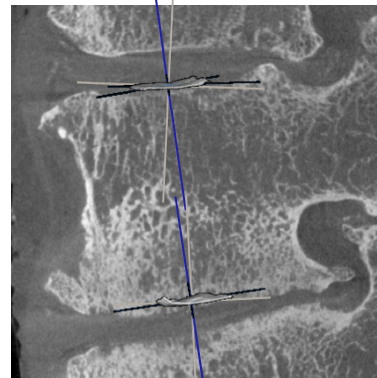
— Normal
— Trab. Orient.



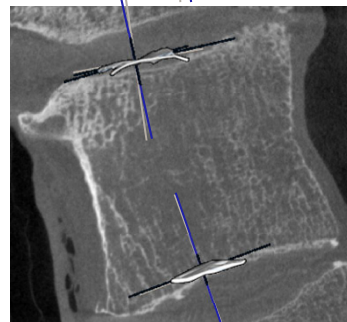
T11



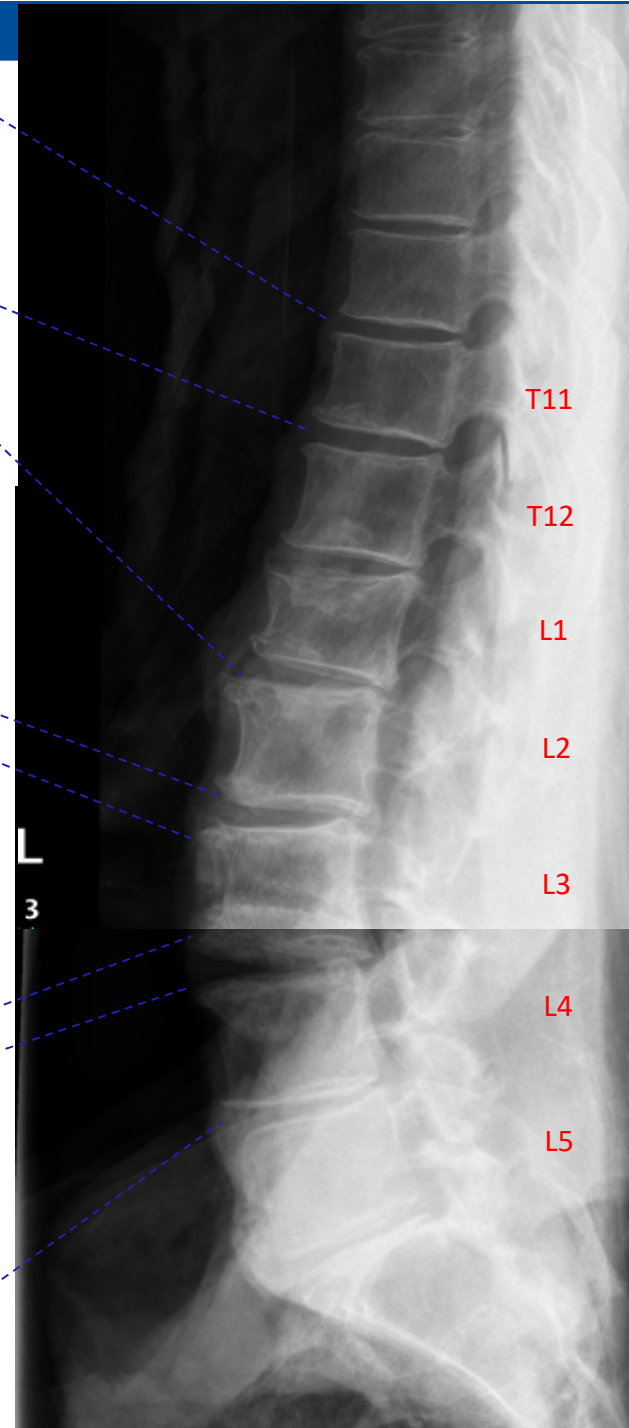
L2



L3



L4



T11

T12

L1

L2

L3

L4

L5



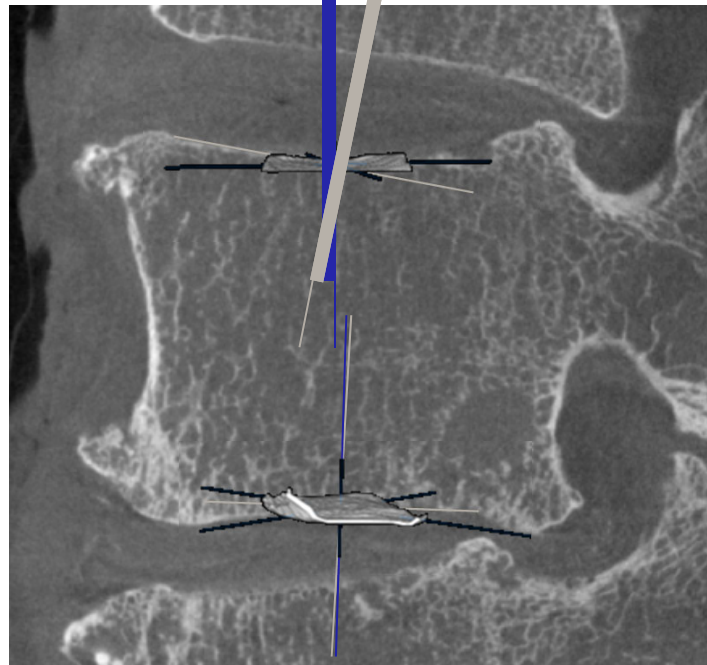
Backwardly tilted vertebrae



Dorsal Shear

Normal on surface

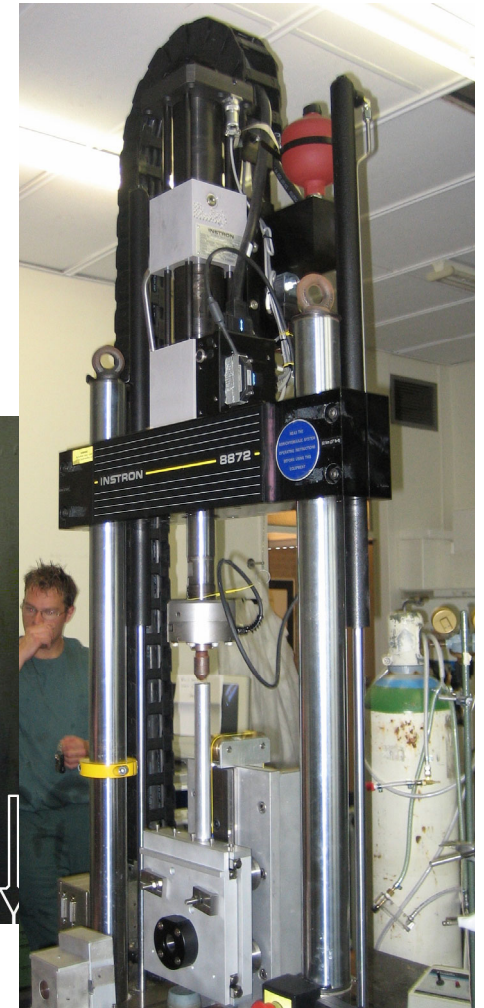
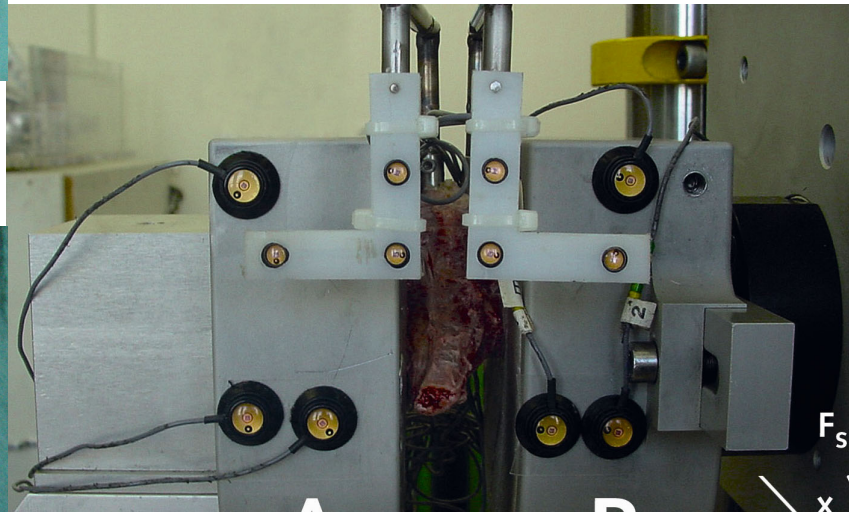
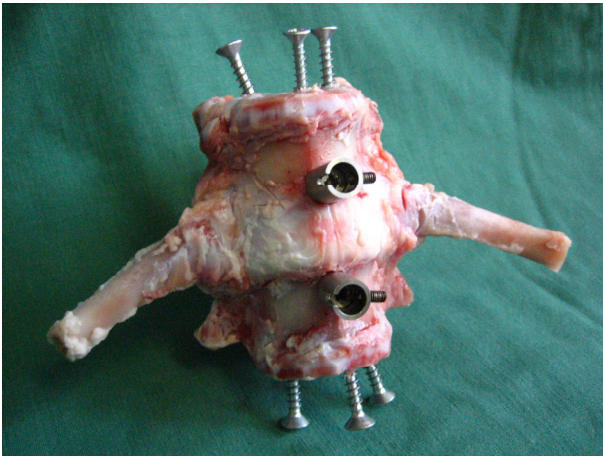
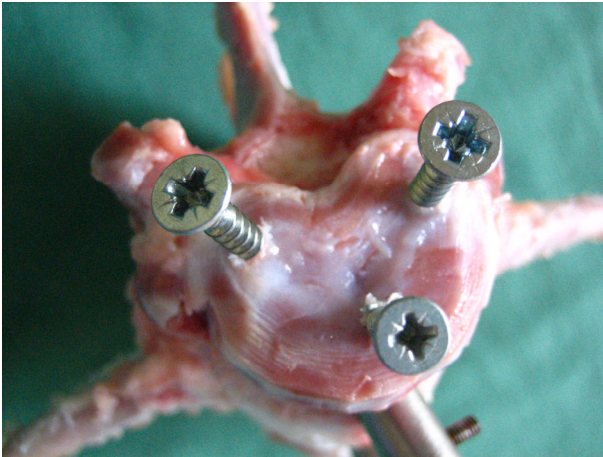
Trabecular orientation



L2



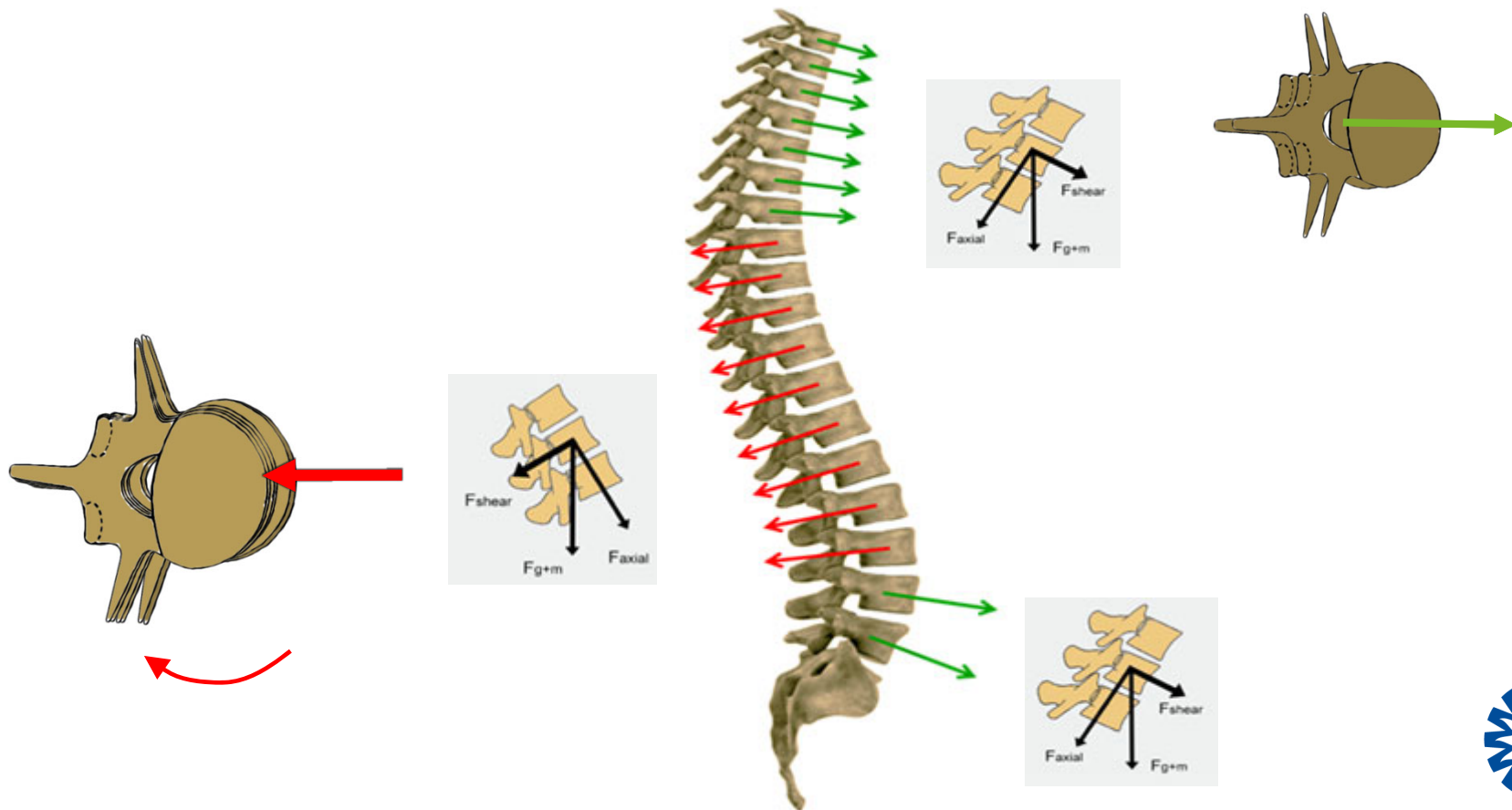
What is the effect of dorsal shear on the spine?



Effects of Dorsal *Versus* Ventral Shear Loads on the Rotational Stability of the Thoracic Spine

A Biomechanical Porcine and Human Cadaveric Study

Jan-Willem M. Kouwenhoven, MD,* Theo H. Smit, PhD,† Albert J. van der Veen, MSc,†
 Idsart Kingma, PhD,‡ Jaap H. van Dieën, PhD,‡ and René M. Castelein, MD, PhD*



Development of scoliosis: Rotated segments correspond to backwardly inclined segments



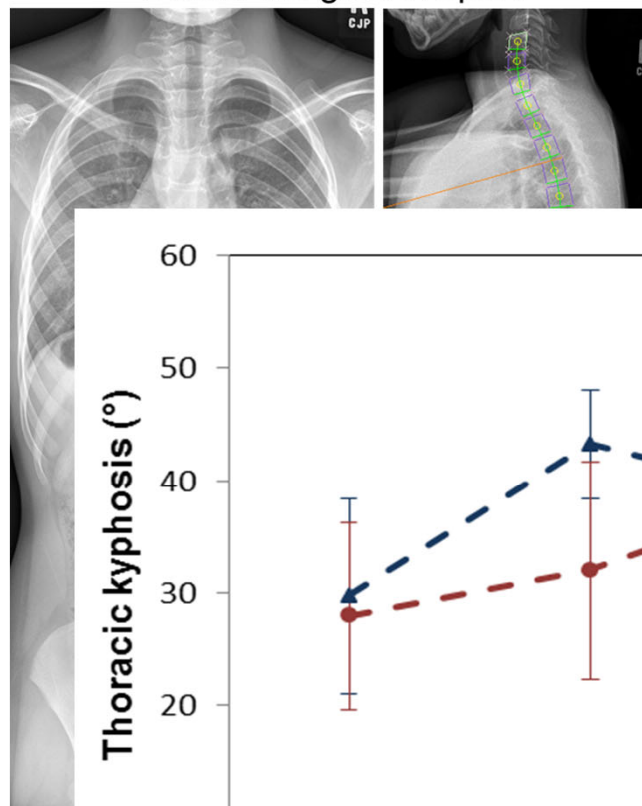
Natural sagittal spino-pelvic alignment in boys and girls before, at and after the adolescent growth spurt

Tom P. C. Schlösser · Koen L. Vincken ·

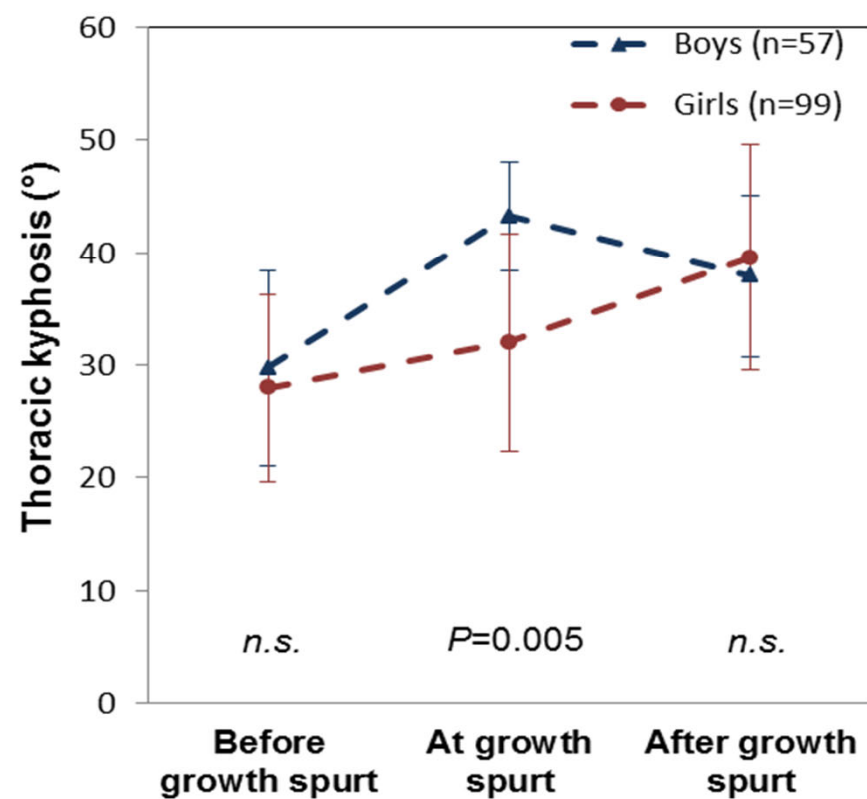
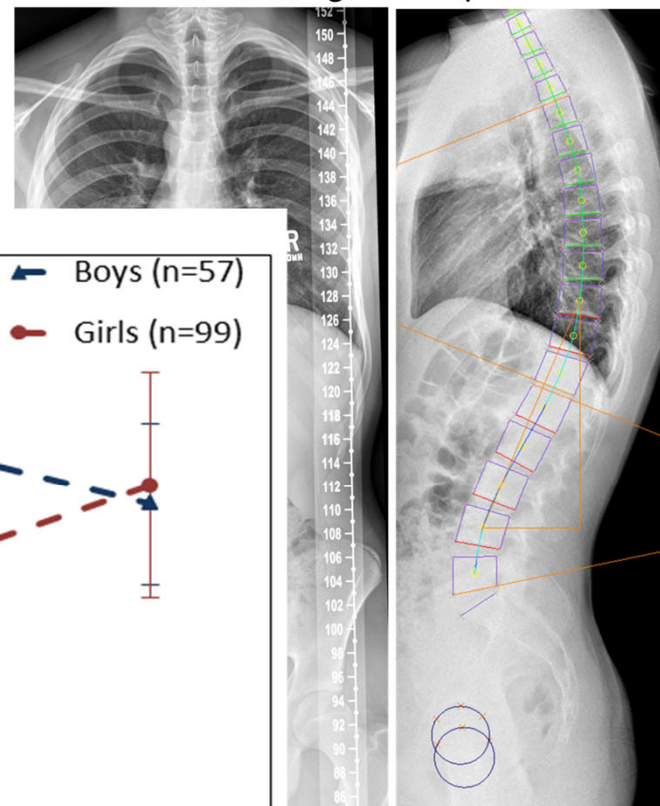
Kenneth Rogers · René M. Castelein ·

Suken A. Shah

Girl, 9 years old
Before the growth spurt



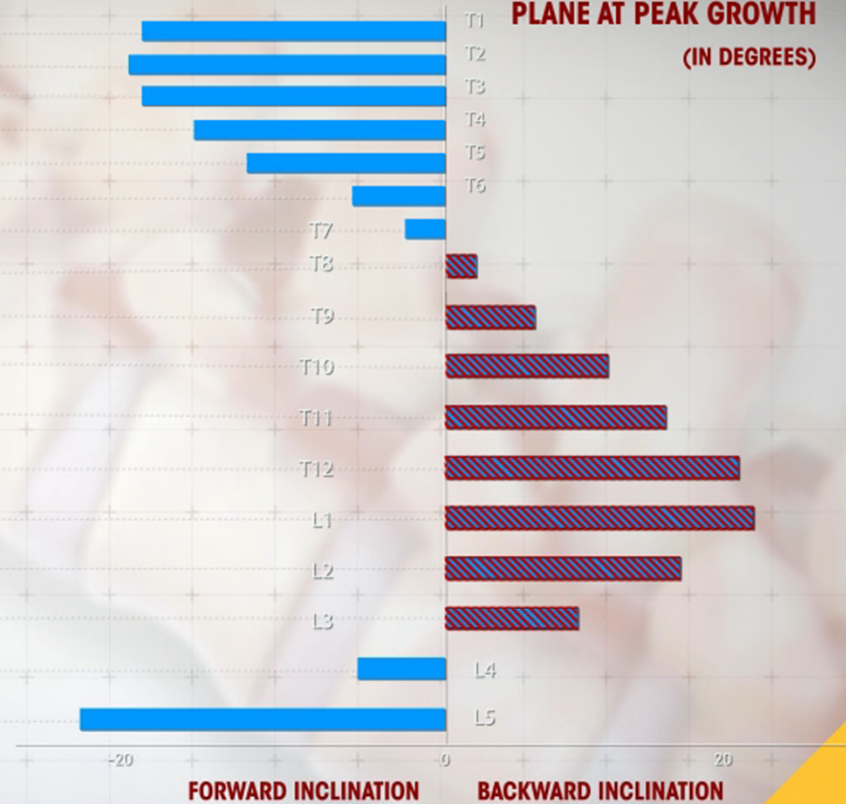
Boy, 14 years old
After the growth spurt





AVERAGE MALE SPINE

VERTEBRAL INCLINATION IN THE SAGITTAL PLANE AT PEAK GROWTH (IN DEGREES)



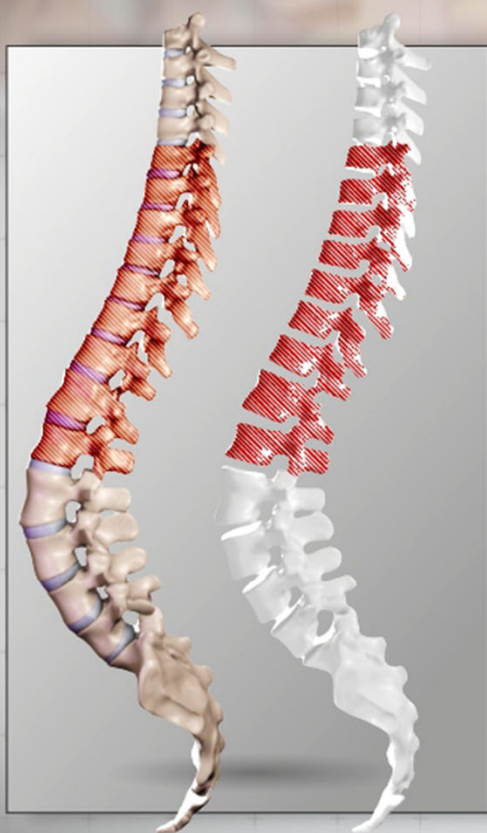
DEVELOPMENT BY GENDER



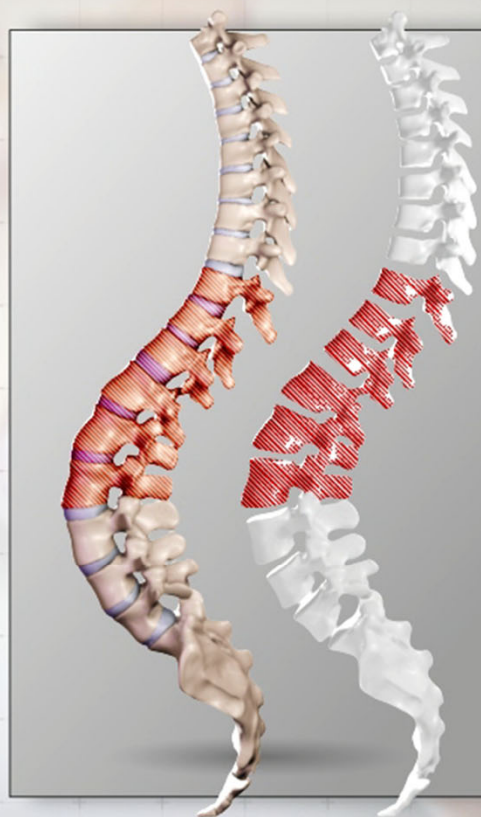
Differences in early sagittal plane alignment between thoracic and lumbar adolescent idiopathic scoliosis

Tom P.C. Schlösser, MD^a, Suken A. Shah, MD^b, Samantha J. Reichard^b,
Kenneth Rogers, PhD, ATC^b, Koen L. Vincken, PhD^c, René M. Castelein, MD, PhD^{a,*}

DEVELOPMENT BY SAGITTAL PROFILE



THORACIC SCOLIOSIS



(THORACO)LUMBAR SCOLIOSIS

Conclusion



Spino-pelvic morphology and alignment evolves during growth

Significant differences between genders during peak growth velocity

Spino-pelvic alignment determines spinal biomechanics and rotational stability of the spine

