Patterns of Progression in the Porcine Scoliosis Model

Frank Schwab MD, Ashish Patel MD,
Virginie Lafage PhD, Jean-Pierre Farcy MD

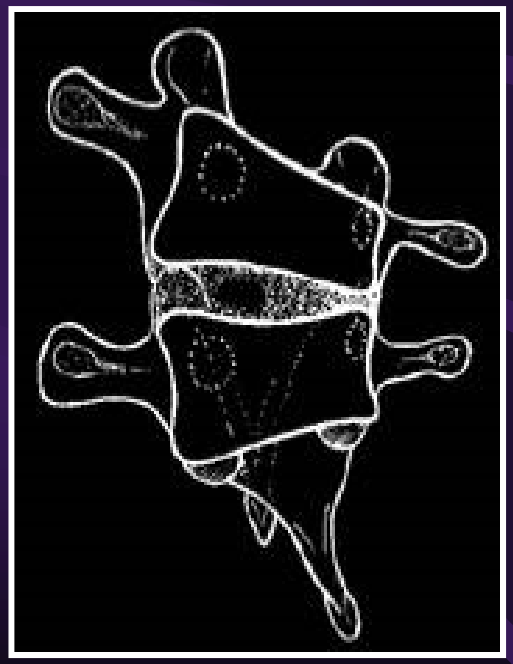
Disclosure Information

Schwab F	Medtronic (Consultant, Grants/Research Support) Depuy, (Consultant, Grants/Research Support) Nemaris (Stock Holder)
Patel A	NA
Lafage V	Nemaris (Stock Holder)
Farcy JP	NA

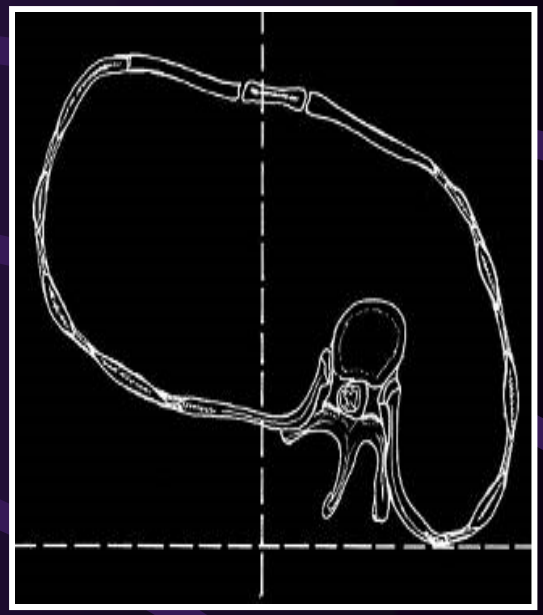
AIS Progressive 3D Deformity

Coronal Changes

Cuneiformisation



Rib hump



Significance

AIS = Limited Treatment Options

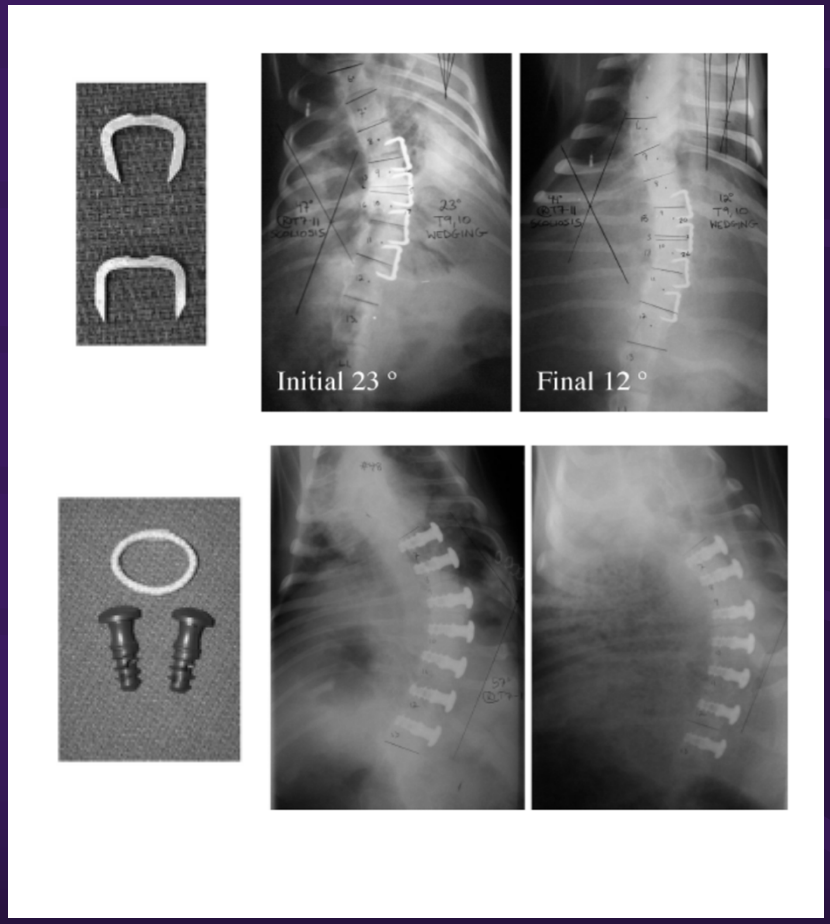
Bracing

1. Limited corrective ability
2. Compliance issue
3. Psychological impact on young children

Surgical

1. Loss of mobility
2. Fusion of growing segments
3. Long term sequelae of segmental instrumentation?

Non Fusion Technology



Optimal Development of Non-Fusion Requires a Large Animal Model

Braun & al, Spine 2005

Non Fusion Technology

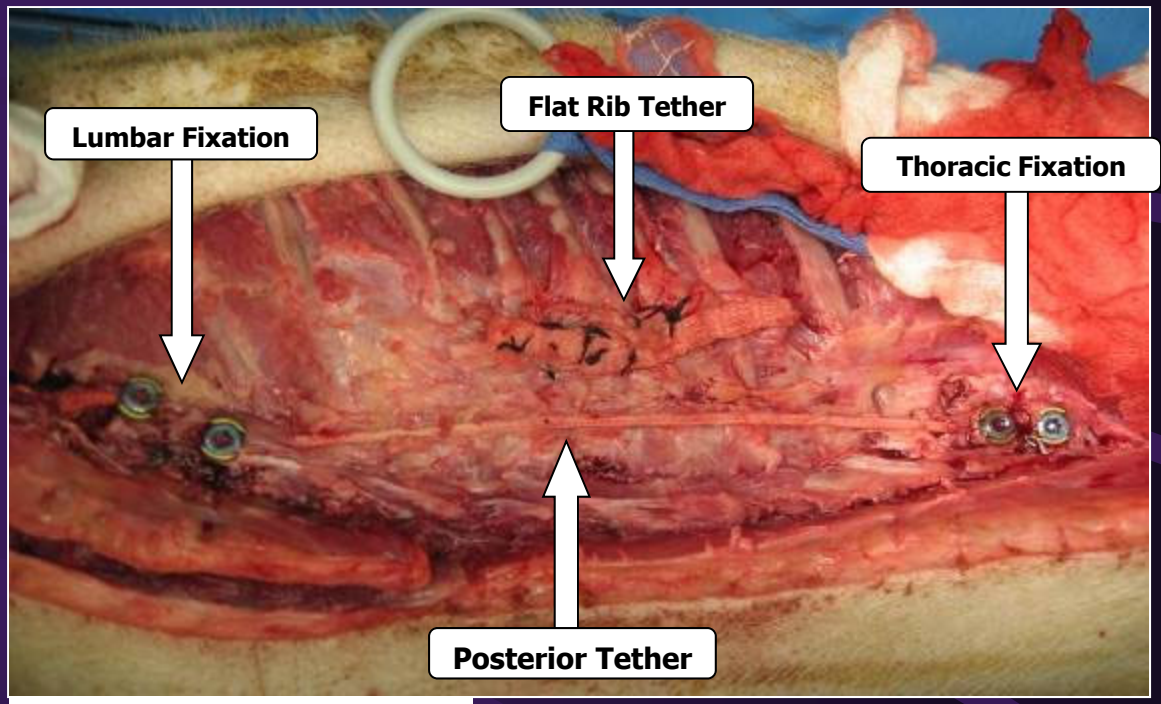
Optimal Development of Non-Fusion Requires a Large Animal Model

Yorkshire Pig

1. Significant Growth Potential
2. Round Thoracic Cage Similar to Humans
3. Similar Vertebral Morphology (Mclain et al 02)
4. Available All Year
    - No Cyclical Breeding (ex. Goats)

Methods: Surgical Technique

11 Yorkshire Pigs (11 wks old, 20Kg)



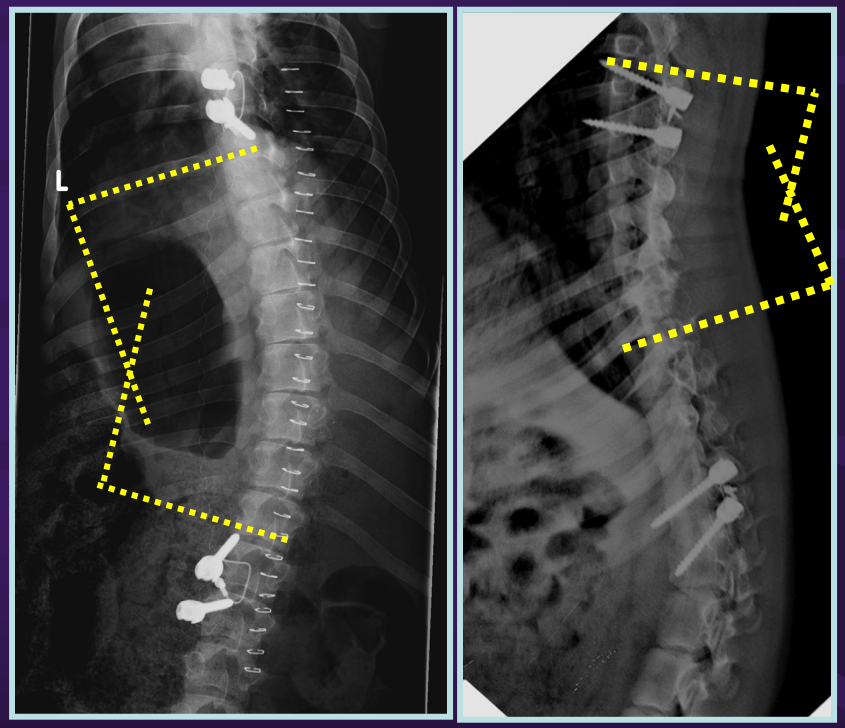
*Erector Spinae Removed

Creation of a mild intraoperative curve ~25°

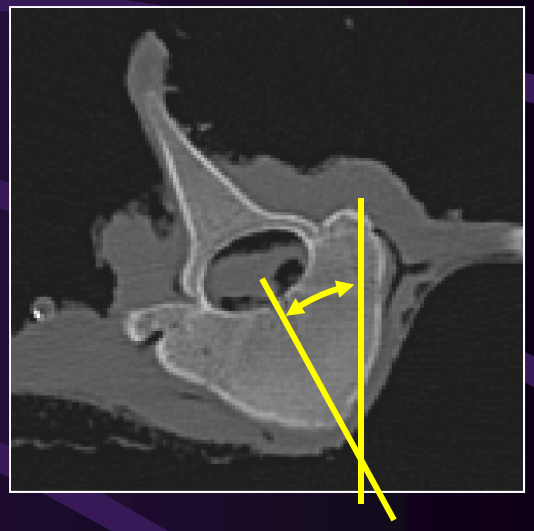
Analysis Protocol

Bi-Weekly Xrays → Severe Deformity >50 degs → Euthanized

Post Mortem CT



Coronal/Sagittal Cobb



Axial Rotation RAsag Method

Purpose of Current Investigation

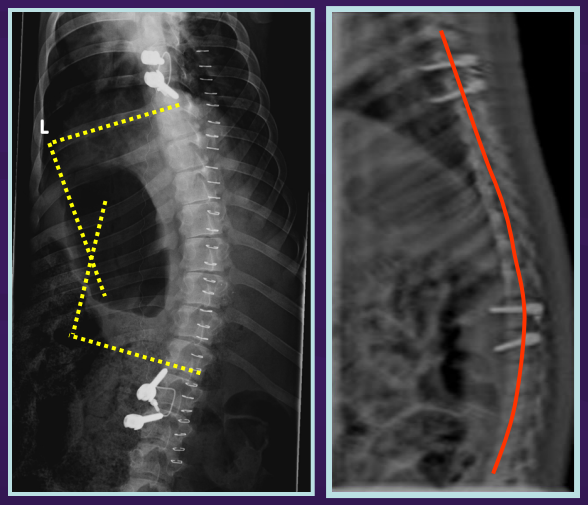
- Describe the Progressive Deformity in 3 Planes

- Establish the key parameters leading to Progressive deformity

General Results

Immediate Post-op

8.3 vertebrae within curve
[7-10]



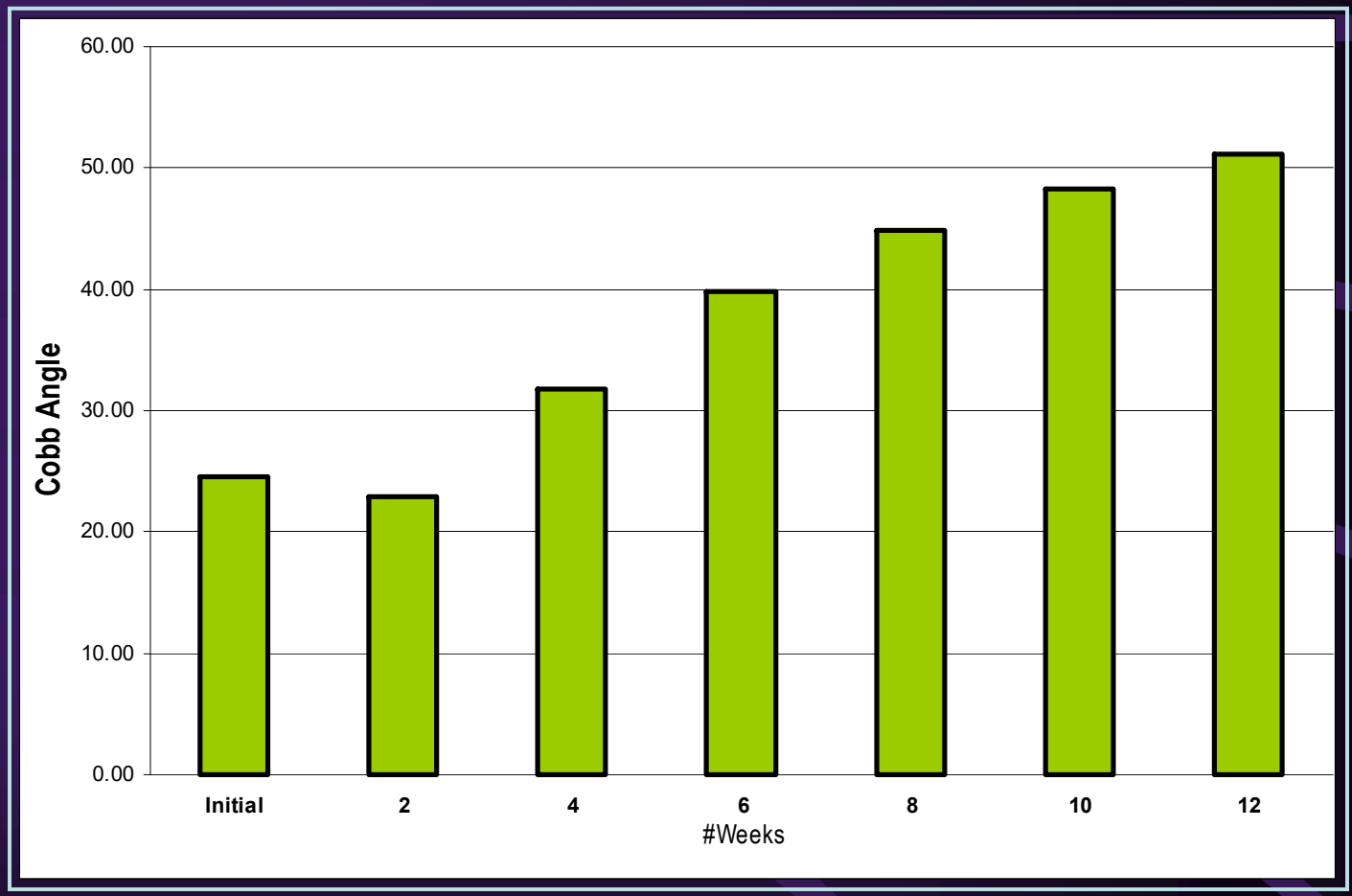
Cobb 24.6˚ [8-35]
Lordosis 3.6˚ [0-9]

Progression

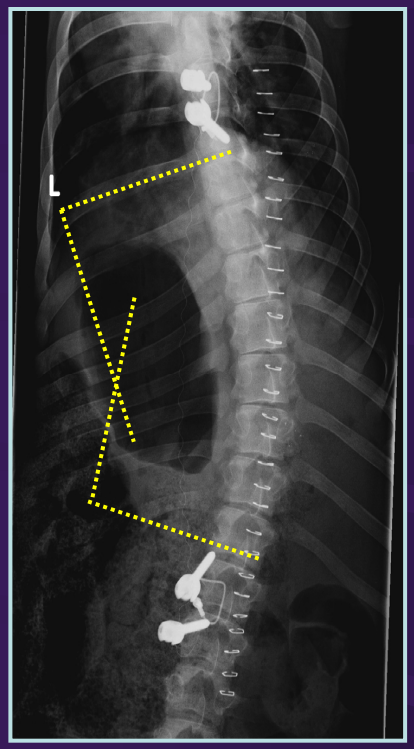
to > 50˚
- **Mean: 10.6 weeks**
- **Range: 6-14 weeks**

Mean Progression (deg)
- **Coronal 3/w** [2.2-5.7]
- **Lordosis 2/w** [0.8-3.3]

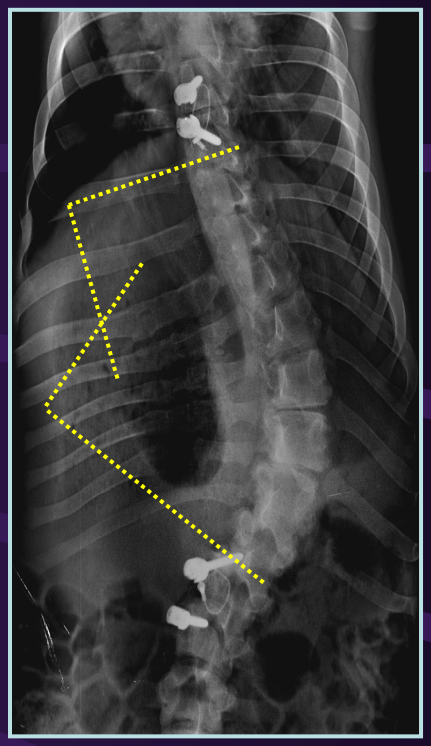
Coronal Curve Progression



Coronal Plane



Initial 27 degs



Final 59 degs

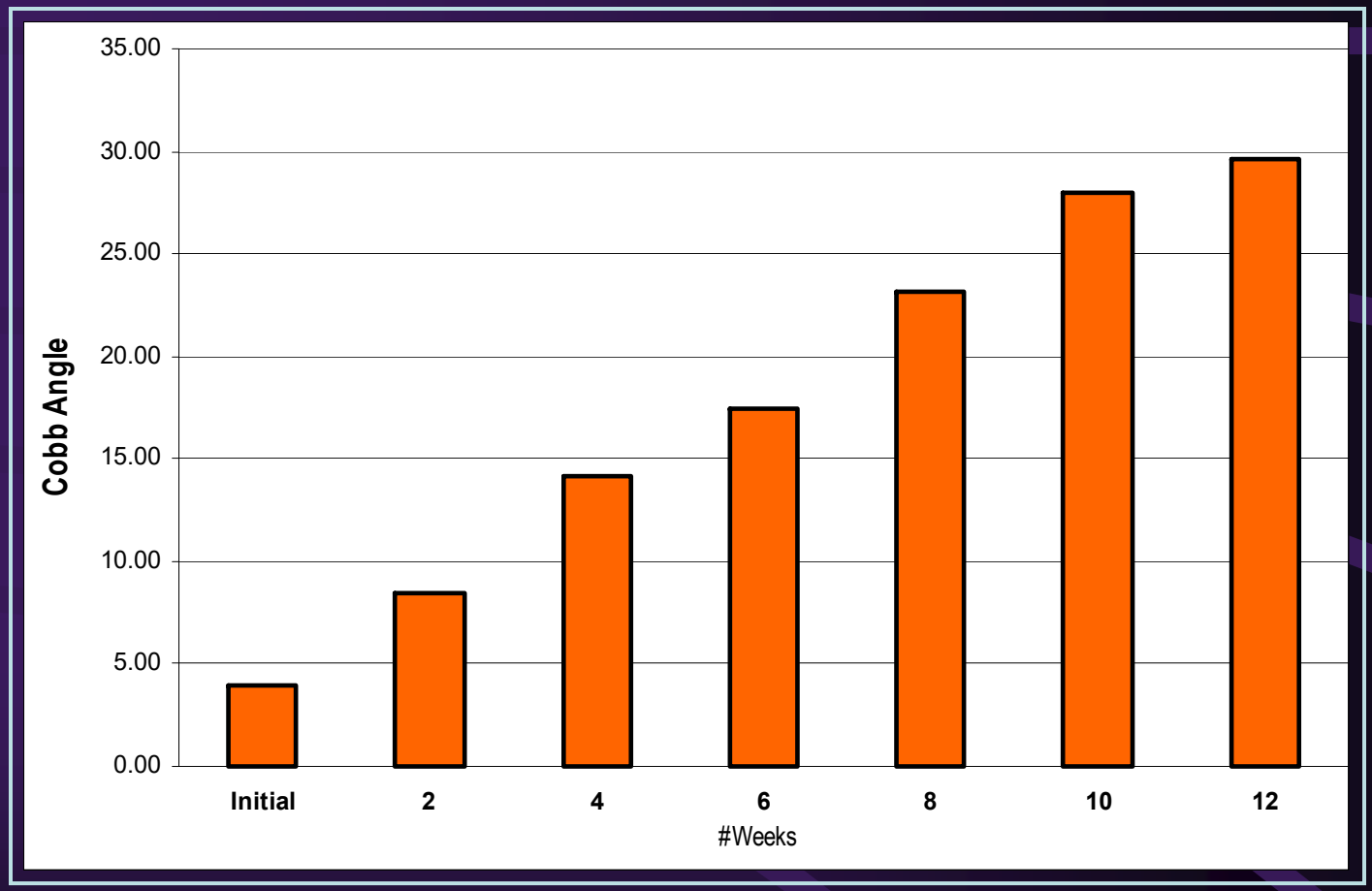
Cobb Index:

(Induced Cobb/# Vertebrae)

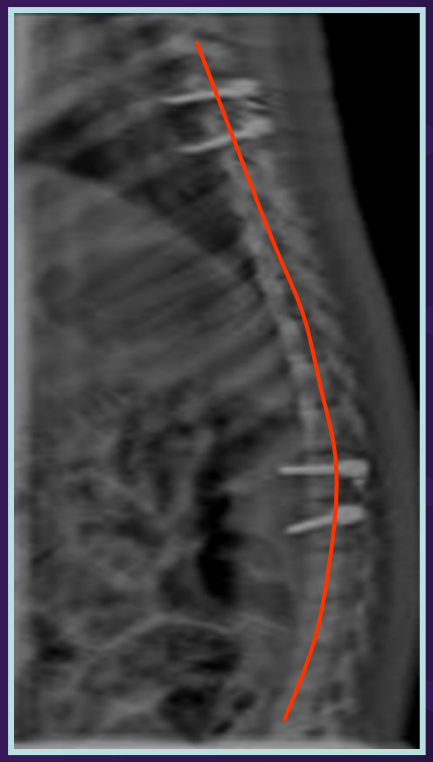
r = -0.678

Time for progression to >50°

Max Lordosis Progression



Sagittal Plane



Initial Kyphosis

Final Lordosis

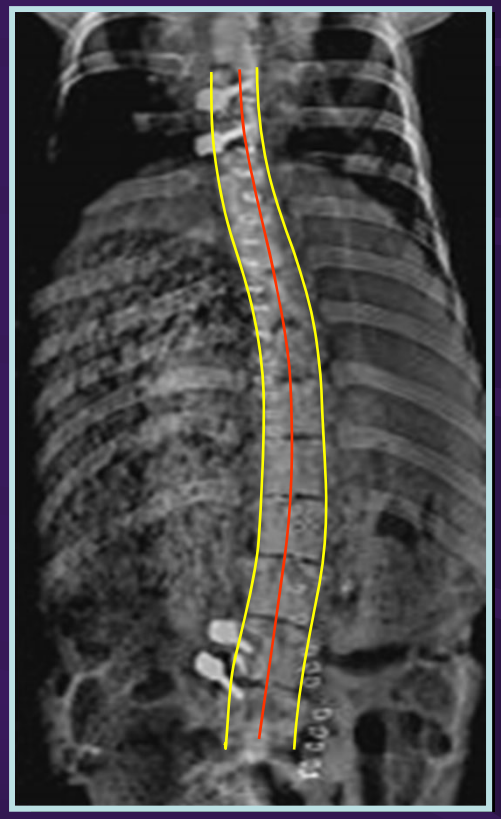
Lordosis Index:

(Induced Lordosis/# Vertebrae)

r = -0.01

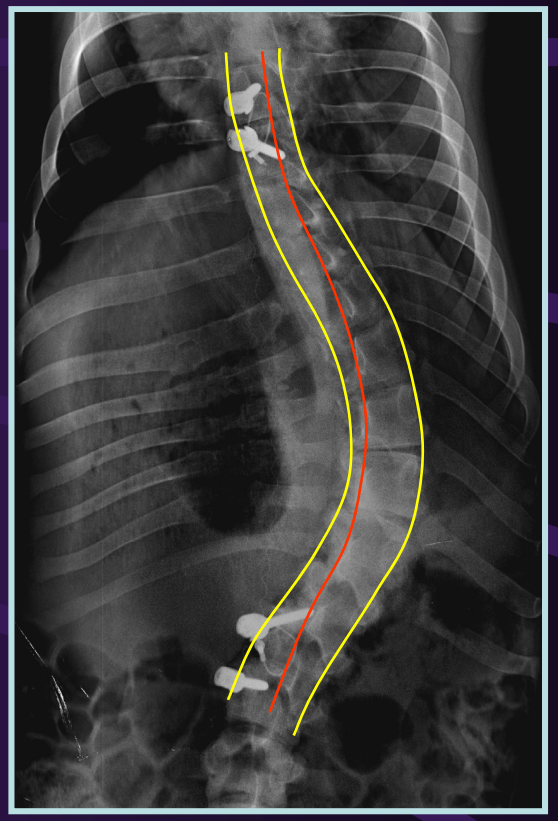
Final Lordosis

Axial Rotation Progression



Initial

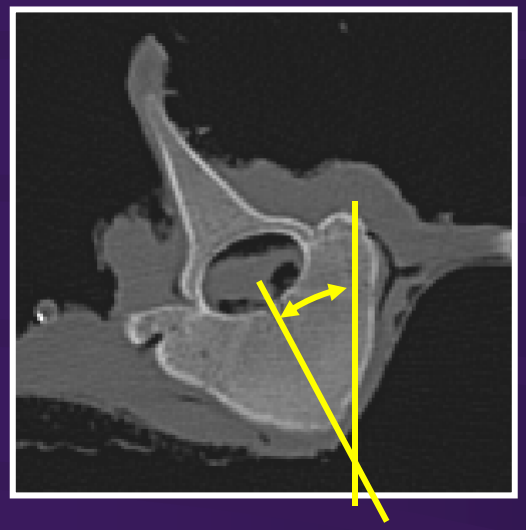
No Rotation



Final

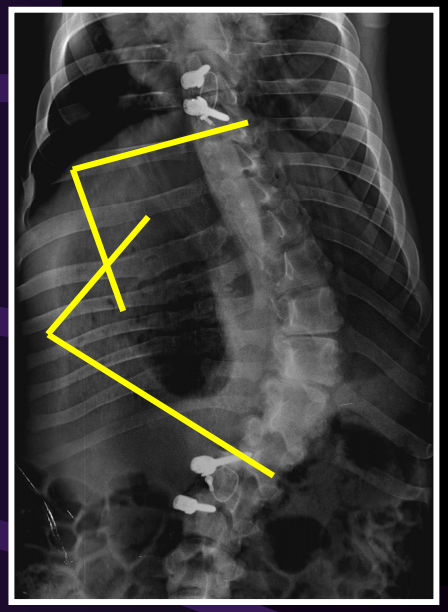
Into Concavity

Transverse Plane



Mean Axial Rotation

Apical Unit: 22º (SD 7º)



Mean Cobb angle

52º (SD 10º)

Highly Significant Correlation

r=0.86; p<0.001

Discussion

- **Porcine Scoliosis Model**
  - Highly reproducible mechanically induced deformity
  - 3D Progressive Radiographic Deformity
  - Provides evidence for Mechanical Vicious Cycle of Progression – Ian Stokes, Phd
- **Patterns of Progression**
  - Similar to AIS… Ideal Model
  - Large Cobb index → Higher risk of Progression
  - Variable Sagittal Plane
  - Axial Rotation Correlates w/ Curve Magnitude