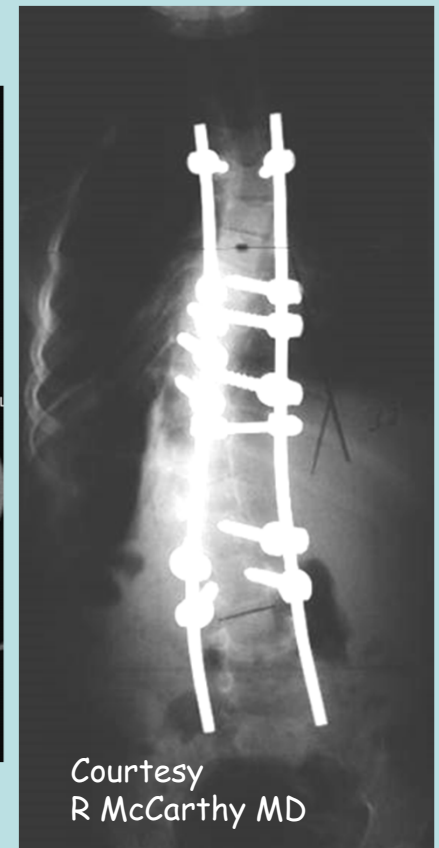
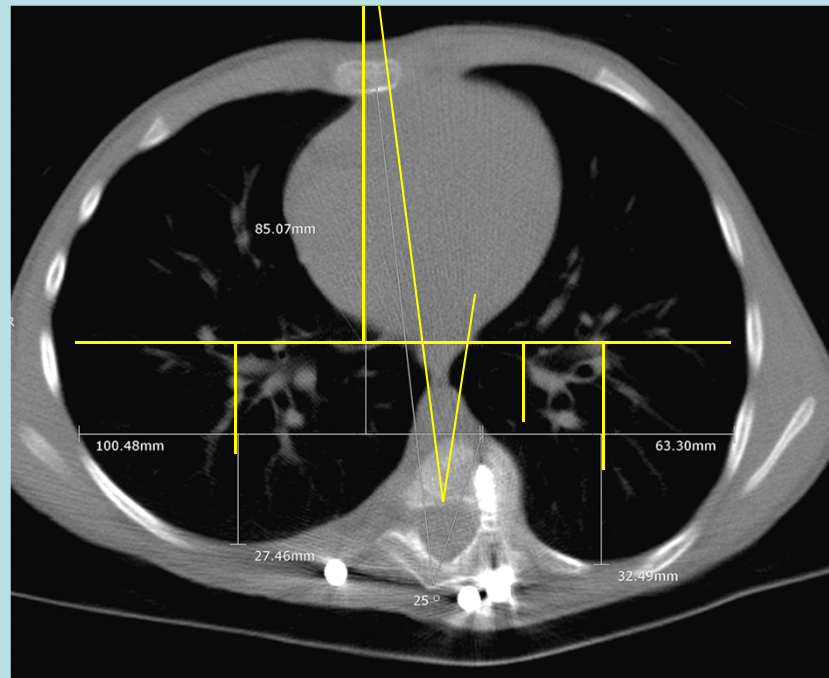
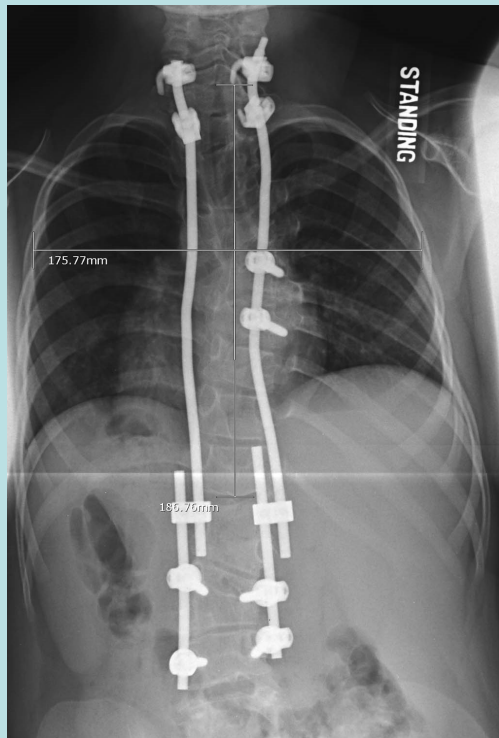


# Why Apical Control? What is Spinal Penetration?

Charles E Johnston MD

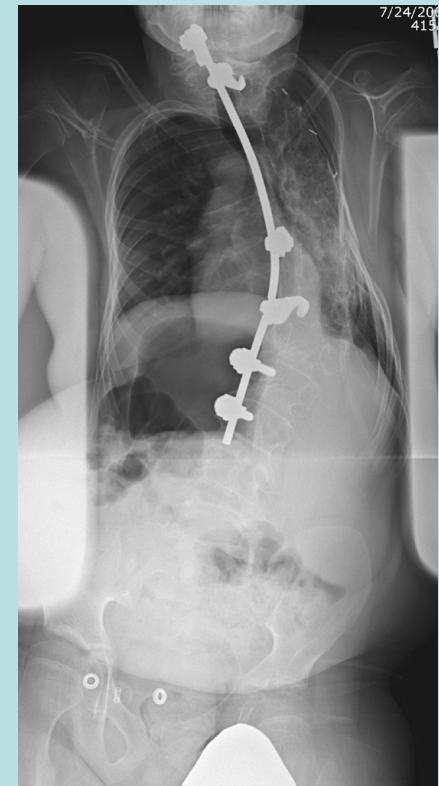
Disclosure: Medtronic a,b,e



# What Causes T.I.S.

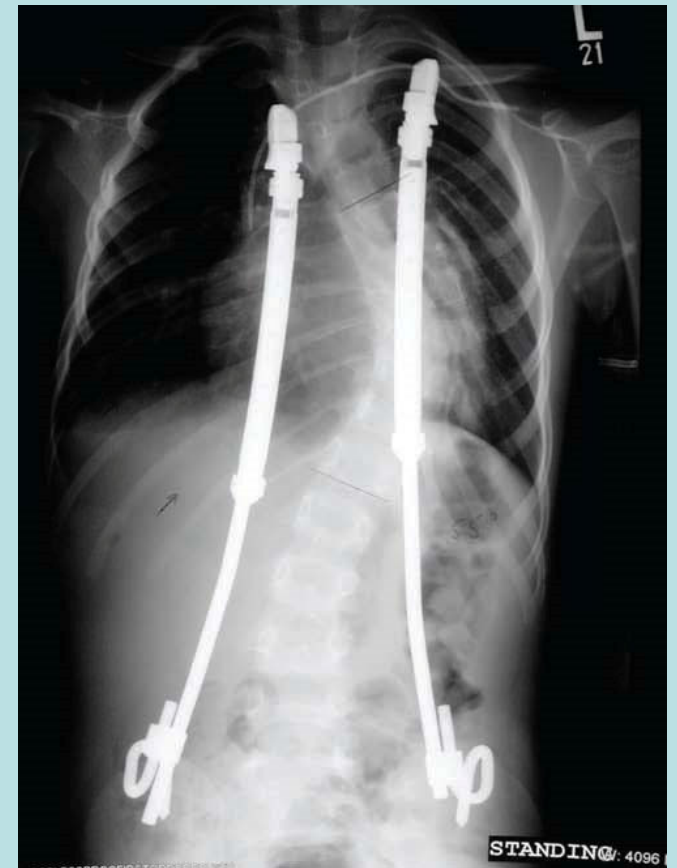
## → Respiratory morbidity ?

- Early onset - intrinsic lack of alveoli
- Deformity - extrinsic chest wall dysfunction - attention to apex



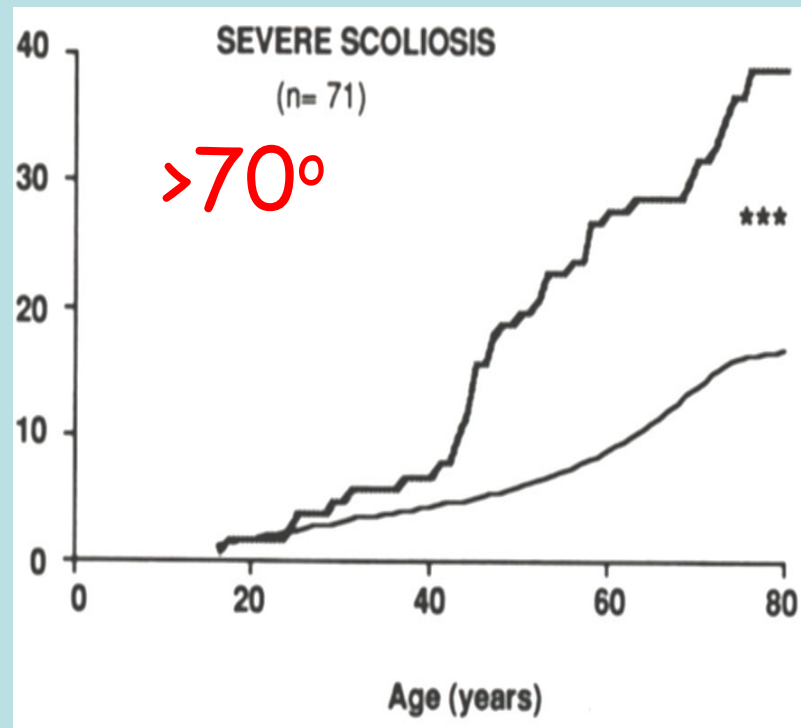
# Growing Instrumentation - mainstay

- Correction by Distraction
- Missing: Apical deformity control



# EOS RX - Prevention of T.I.S.

- Intrinsic - early thoracic enlargement
- Extrinsic - control/correct deformity w/o growth inhibition



•Pehrsson

•Branthwaite

•Bergofsky

Nat'l Hx Ominous  
for PFT's <45% pred

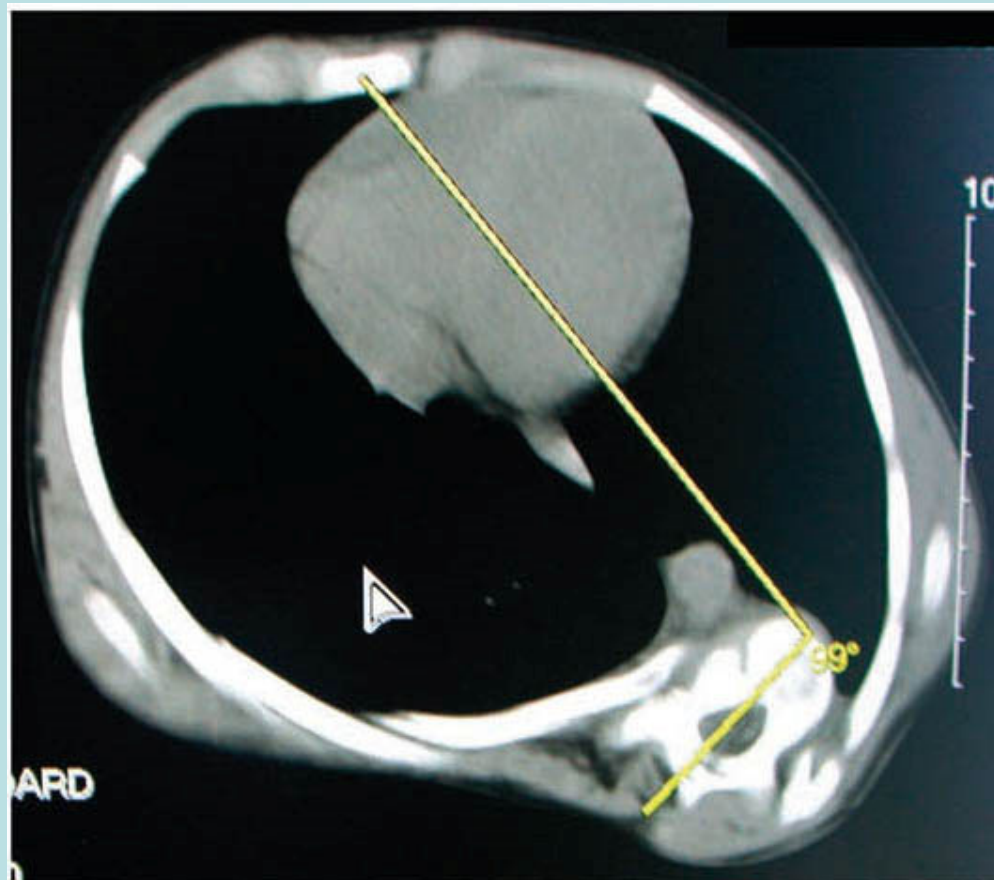


# What's Wrong with Distraction ?

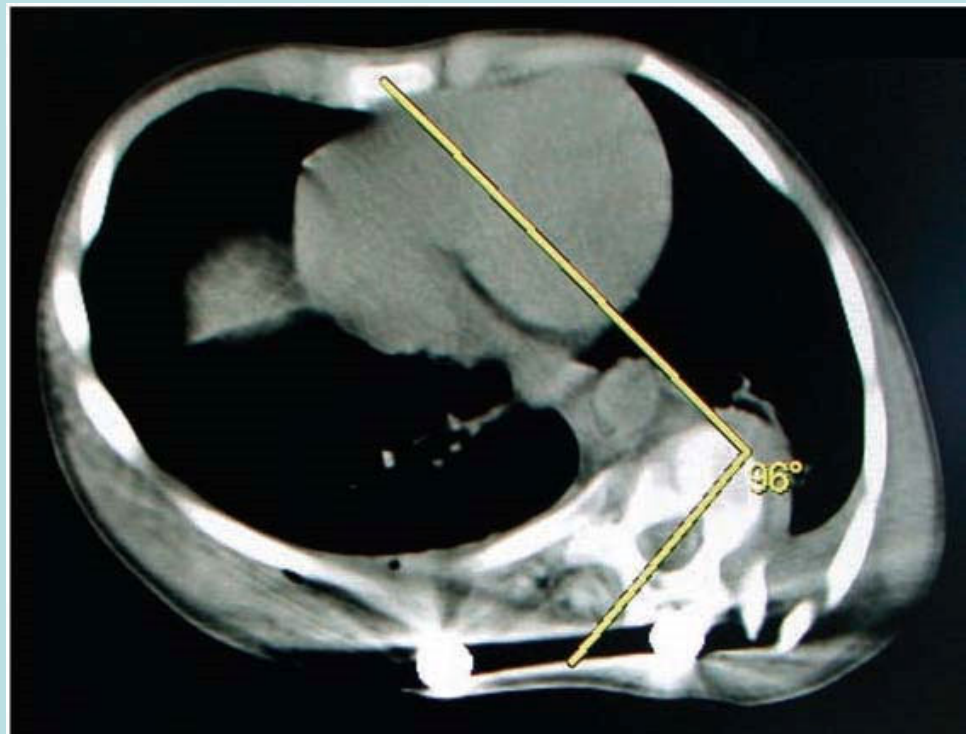
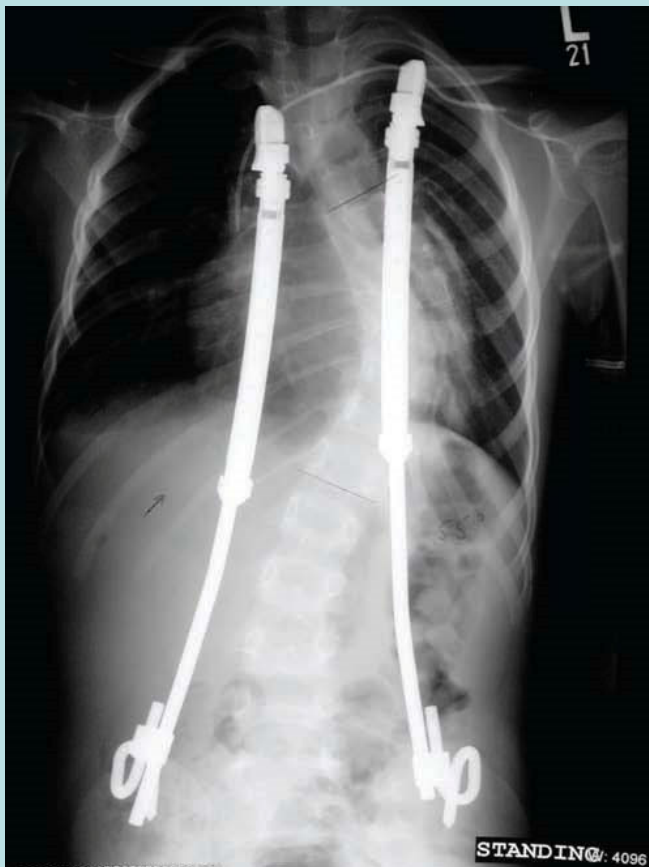
- Nothing - in some cases  
But consider.....
- Distraction directs corrective force at ends of curve, apex corrected only indirectly if at all
- Apex = most deformity, site of convex spine penetration, produces windswept constriction deformity

# Veptr and windswept correction

(Campbell/Smith JBJs '07 supp)

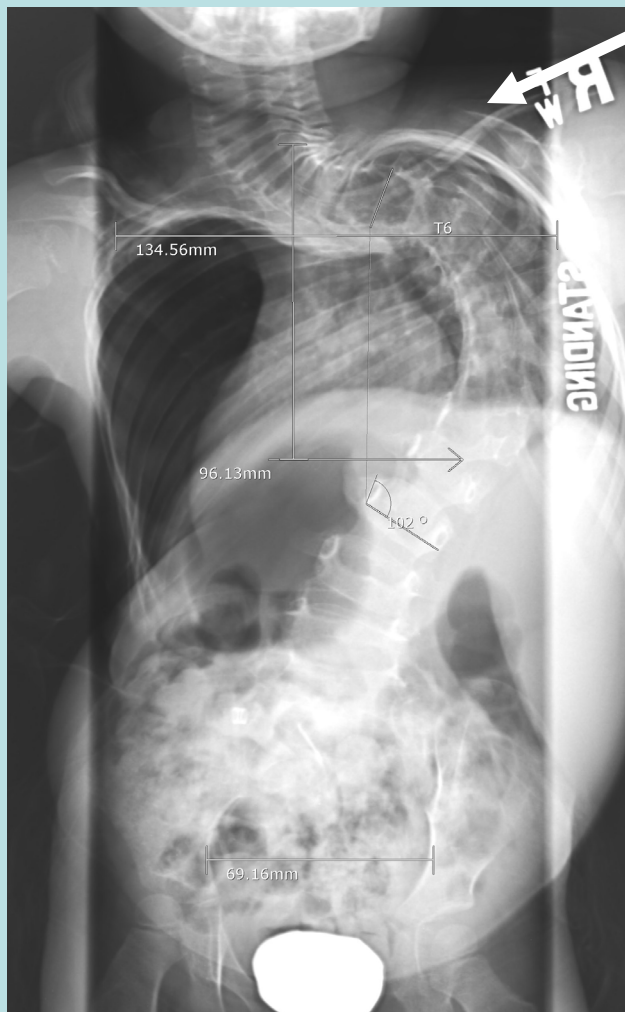


# Distraction inefficient to correct axial plane (windswept) deformity

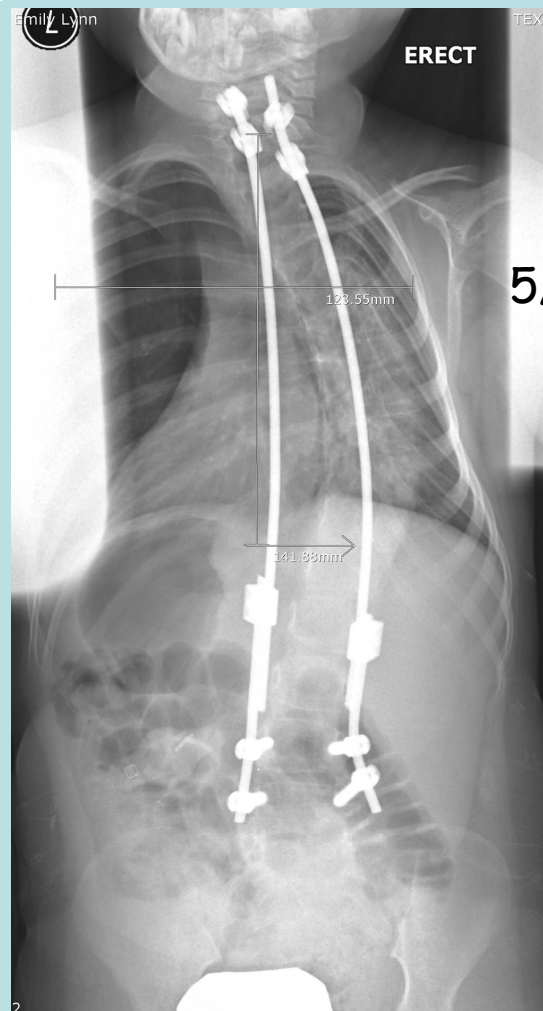


# "Traditional" double growing rod

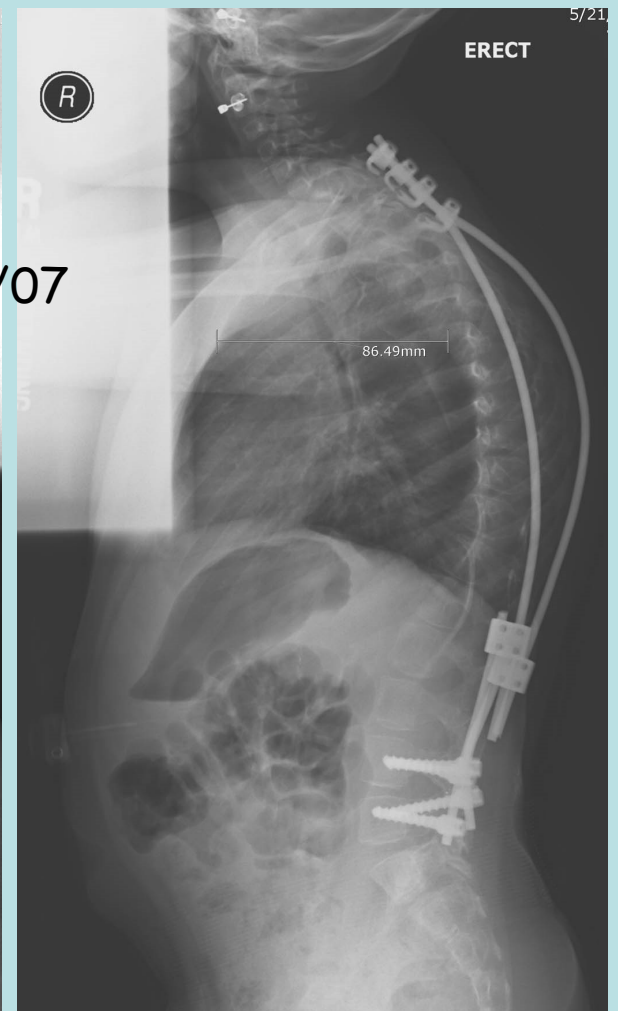
4 yo 102°



T1-12 9.6, T6 wd 13.5

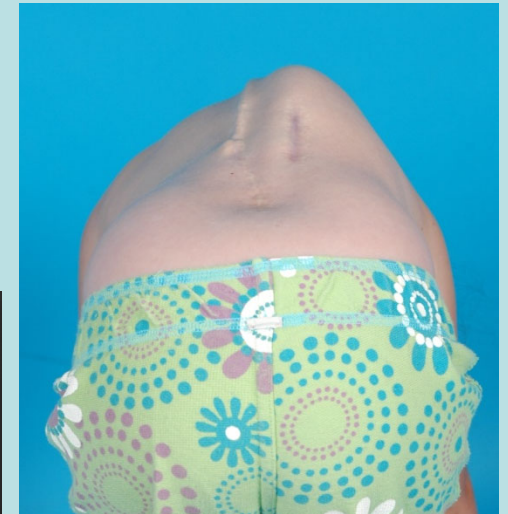
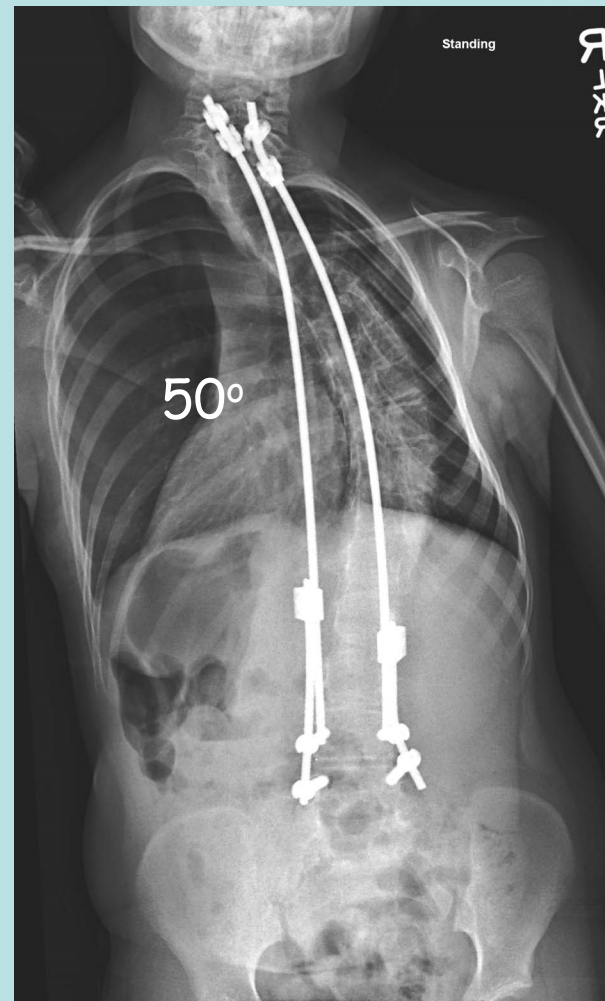
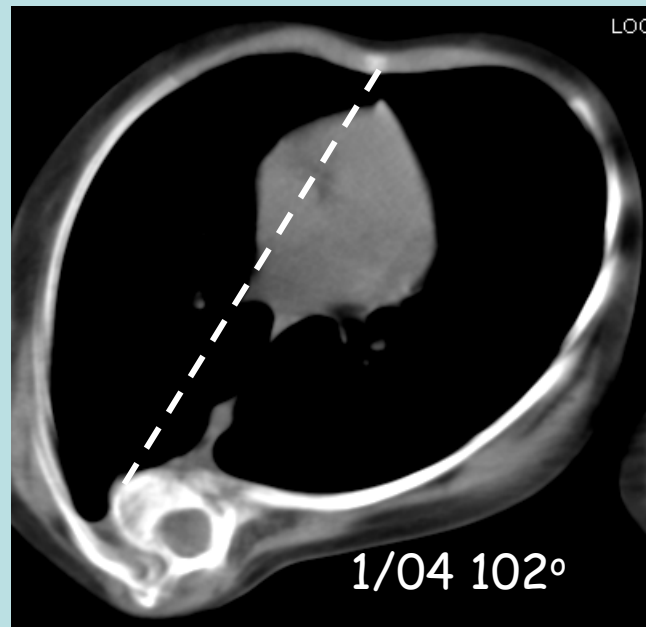
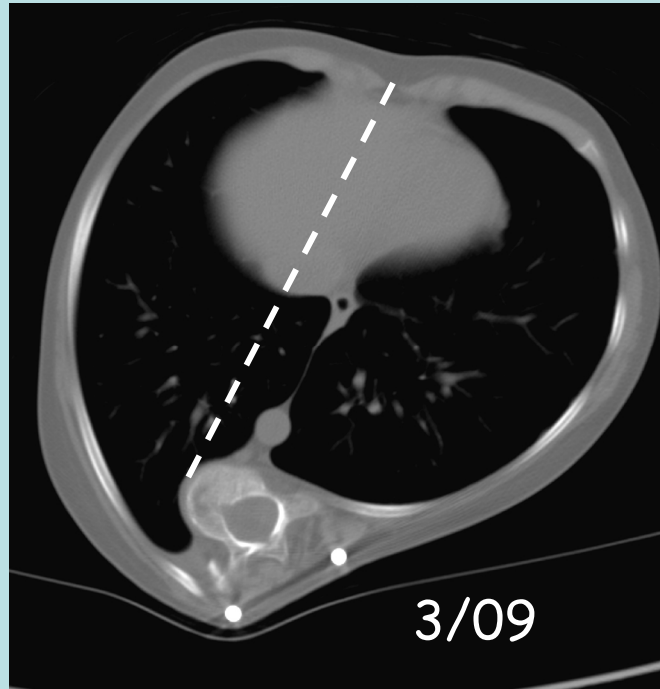


14.1 , 12.2



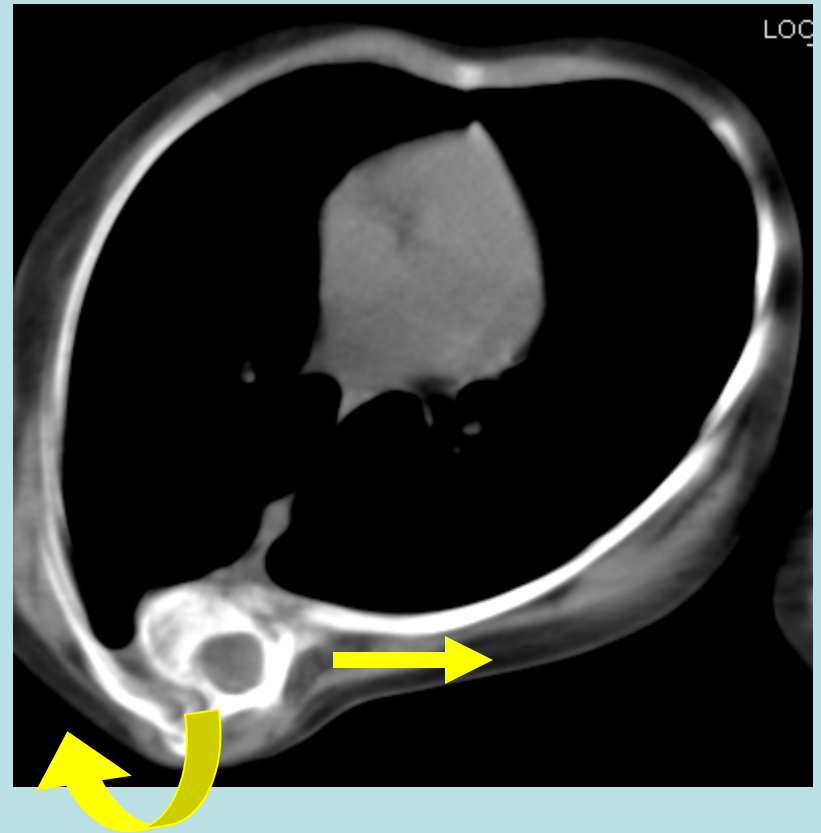


F/u 3/09



# GR's + apical fusion -> poor outcomes (Thompson, Akbarnia)

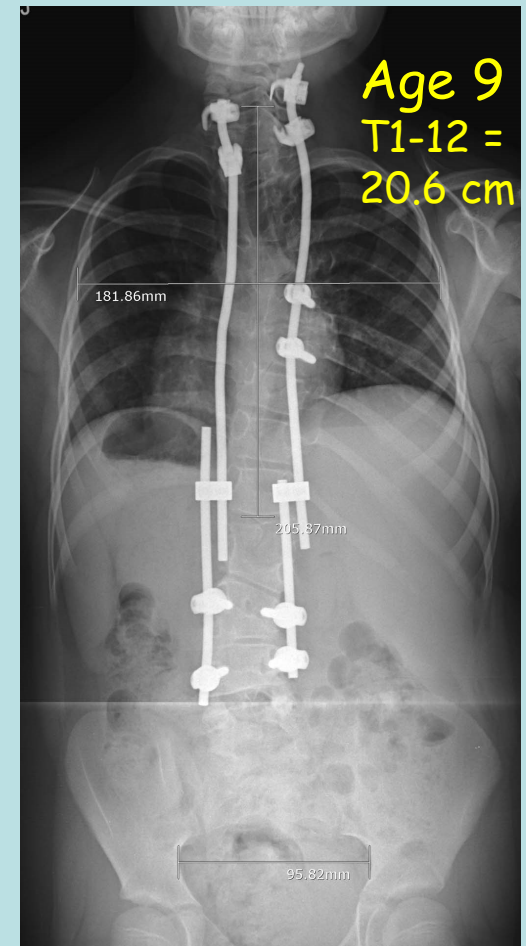
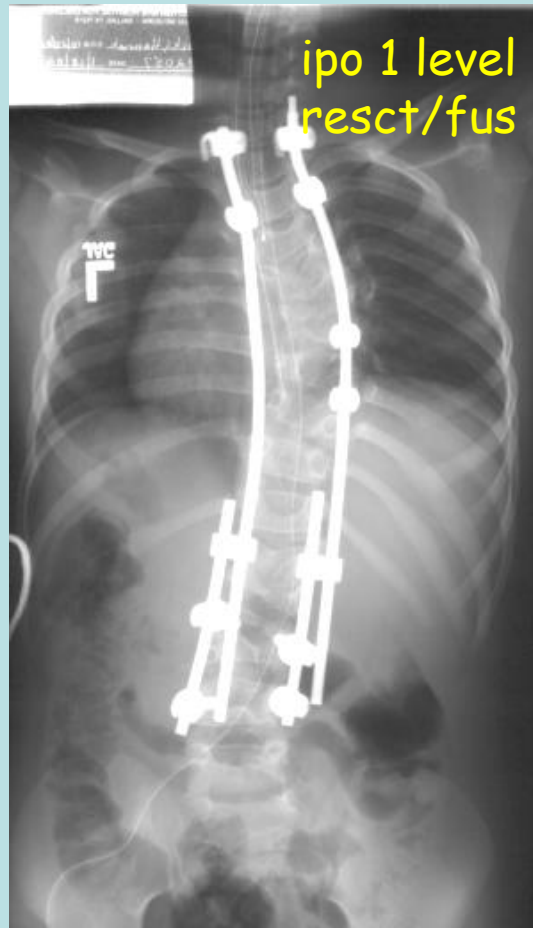
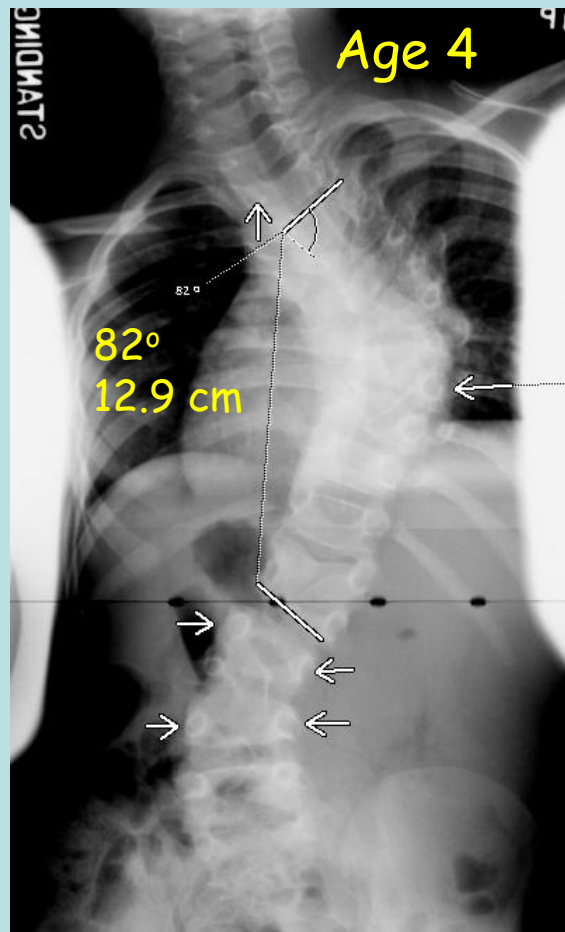
1. Lack of apical control by implants
2. "in situ" fusion of most deformed part -> ? ineffective to control deformity (= crankshaft)
3. Apical fusion is NOT apical control



APICAL CONTROL

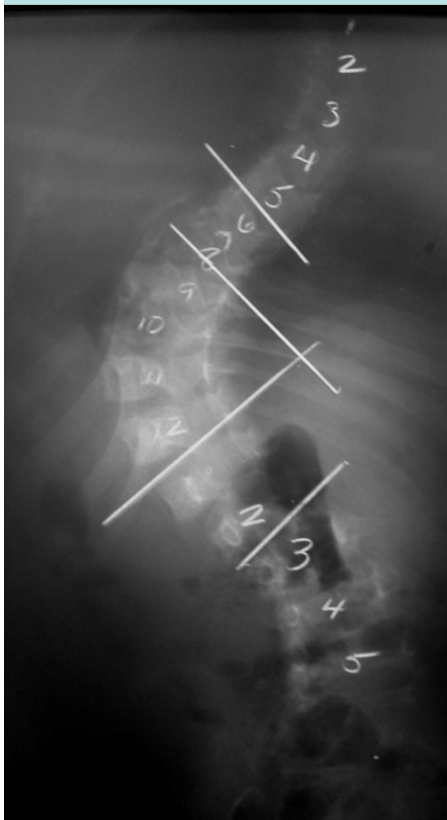


# 4. Early rx must correct or prevent progressive spinal deformity producing windswept thorax

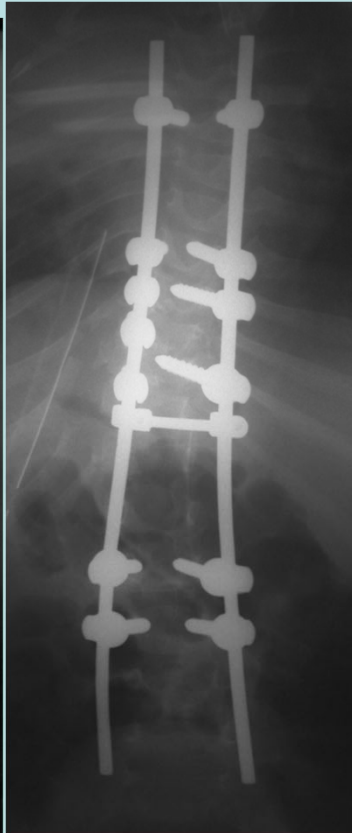


# Hypercorrection of apex (incl ant release) + growth guidance at EV's

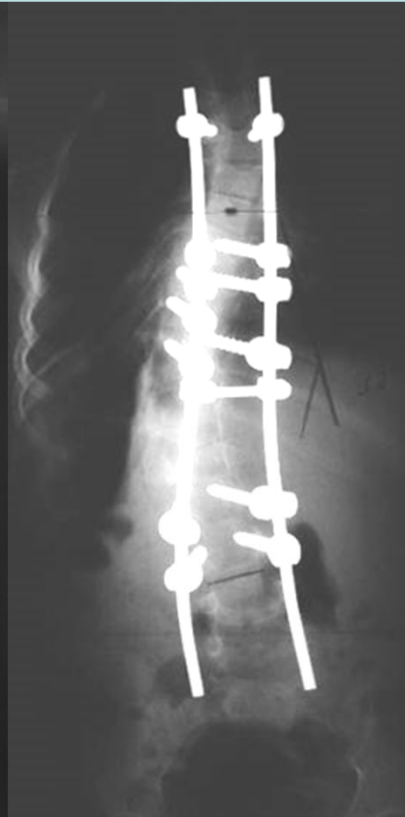
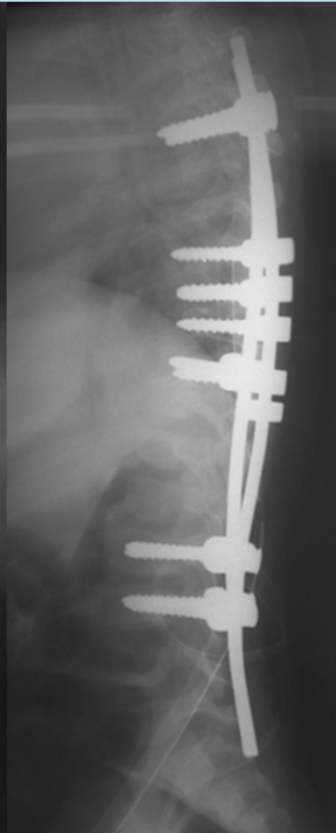
Courtesy RE McCarthy



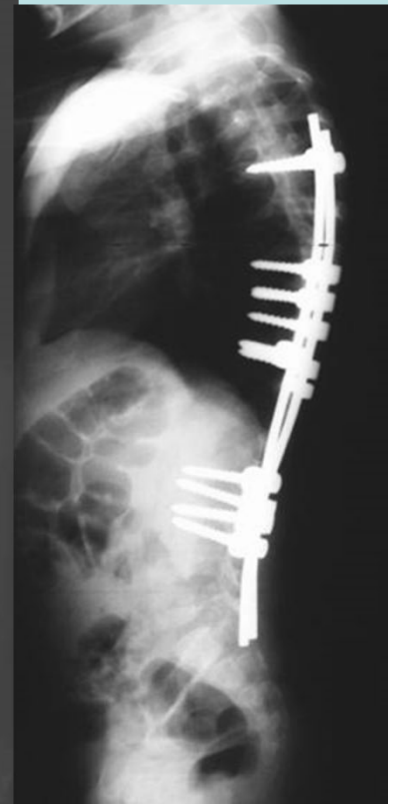
Preop



Postop

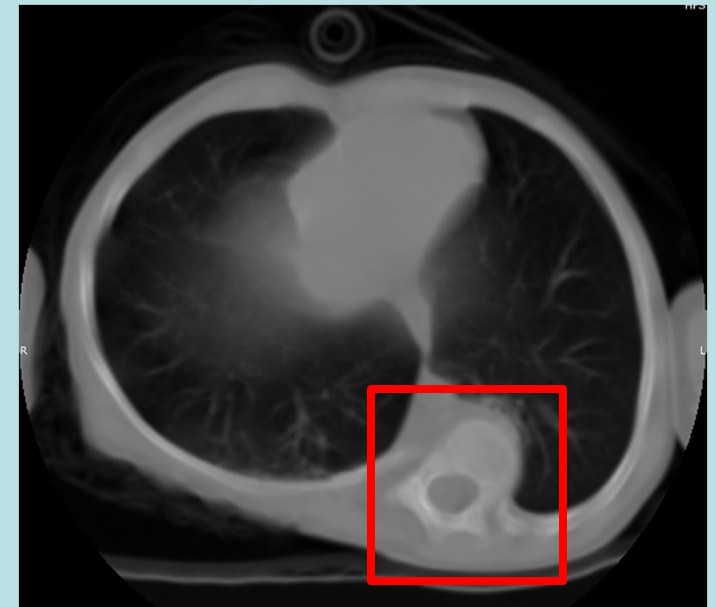


2 yr postop



# Chest Penetration Index

attempt to understand Dubousset





# Scolioses thoraciques : les gibbosités exo de pénétration rachidienne

*Thoracic lordoscoliosis: exothoracic and endothoracic and the spinal penetration index*

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## ABSTRACT

*Rev Chir Orthop 2002*

### **Purpose of the study**

We reviewed retrospectively our patients with thoracic lordoscoliosis with airway compression and atelectasia due to anterior protrusion. The pathological conditions involved and the management methods quantifying thoracic deformation. The individual cases discussed here are in analysis to date.

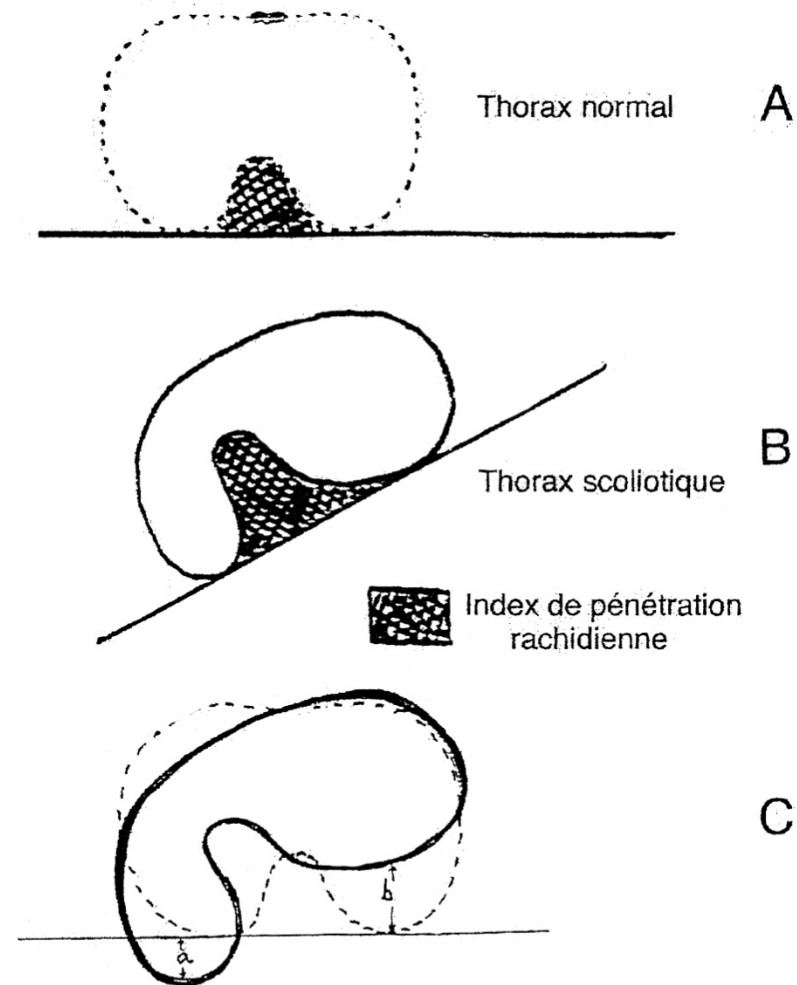
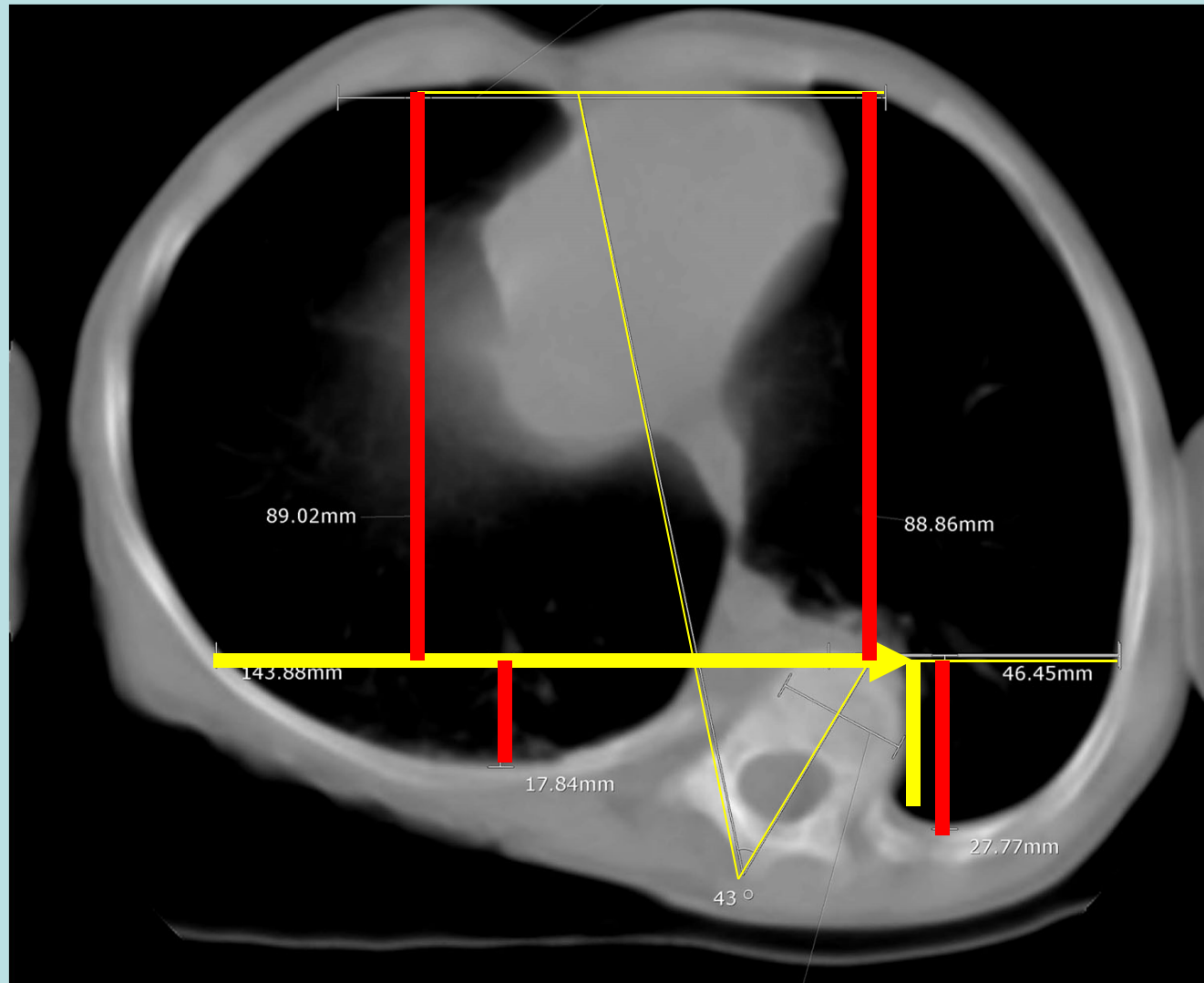


FIG. 1. – A. Thorax normal en pointillé. B. Thorax scoliotique en trait plein. L'index de pénétration rachidienne = % de surface ou volume occupé par la pénétration des corps vertébraux et des structures attenantes rapporté à surface ou volume théorique calculé à partir d'une tangente au bord postérieur des côtes droites et gauches. C. Comparaison entre le contour thoracique normal (pointillés) et un contour thoracique scoliotique où l'on peut constater : a) La gibbosité exo thoracique convexe (en plus). b) Le manque thoracique concave (en moins).

## CT penetration indices

$$Cv/Cx \sim L/R \text{ hemithorax} = 144/46.5 = 3.1$$

( Normal = 1 ??)



Rotation = 43°

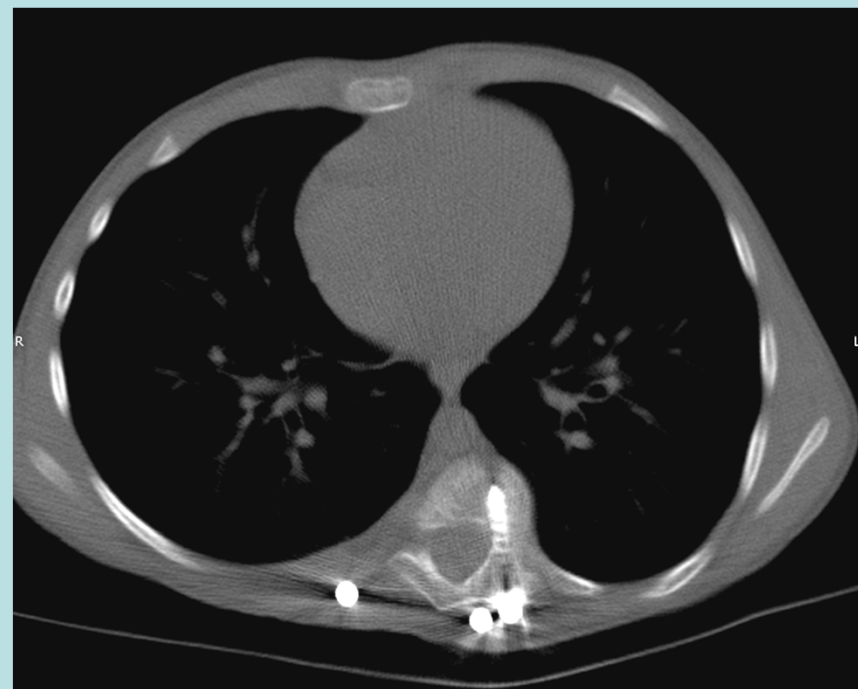
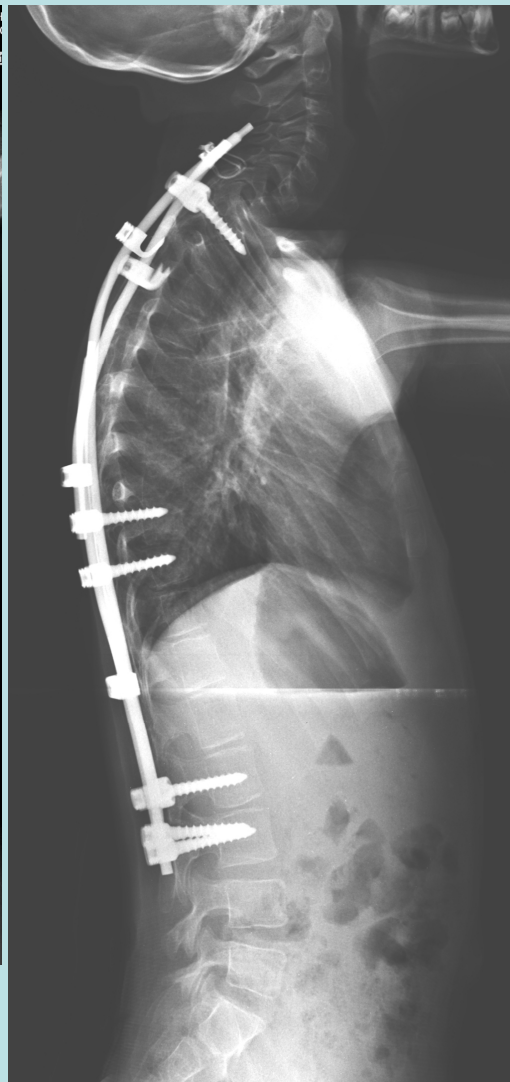
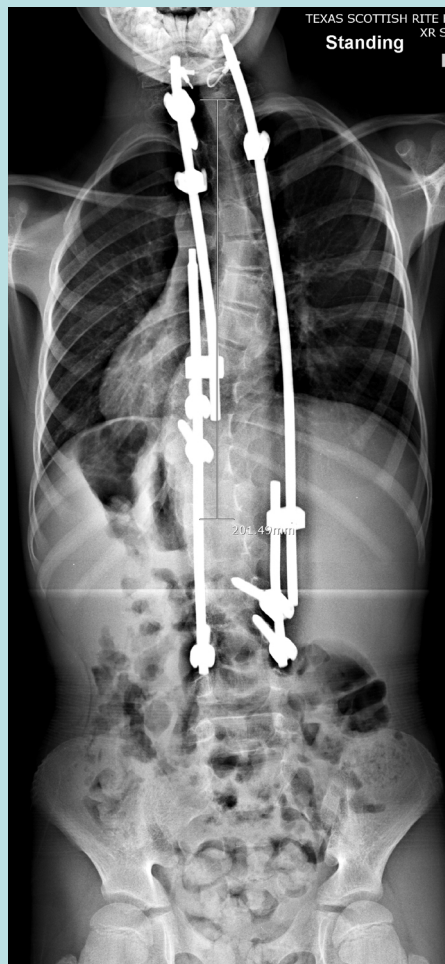
$$A/P_{pen} Cvx = 88.9/27.8 = 3.2$$

$$A/P_{pen} Ccv = 89.0/17.8 = 5$$

i.e. 3-5x  
more space in  
anterior chest  
(2° lordosis....  
normal ??)

# Postop correction ?

4 yr postop





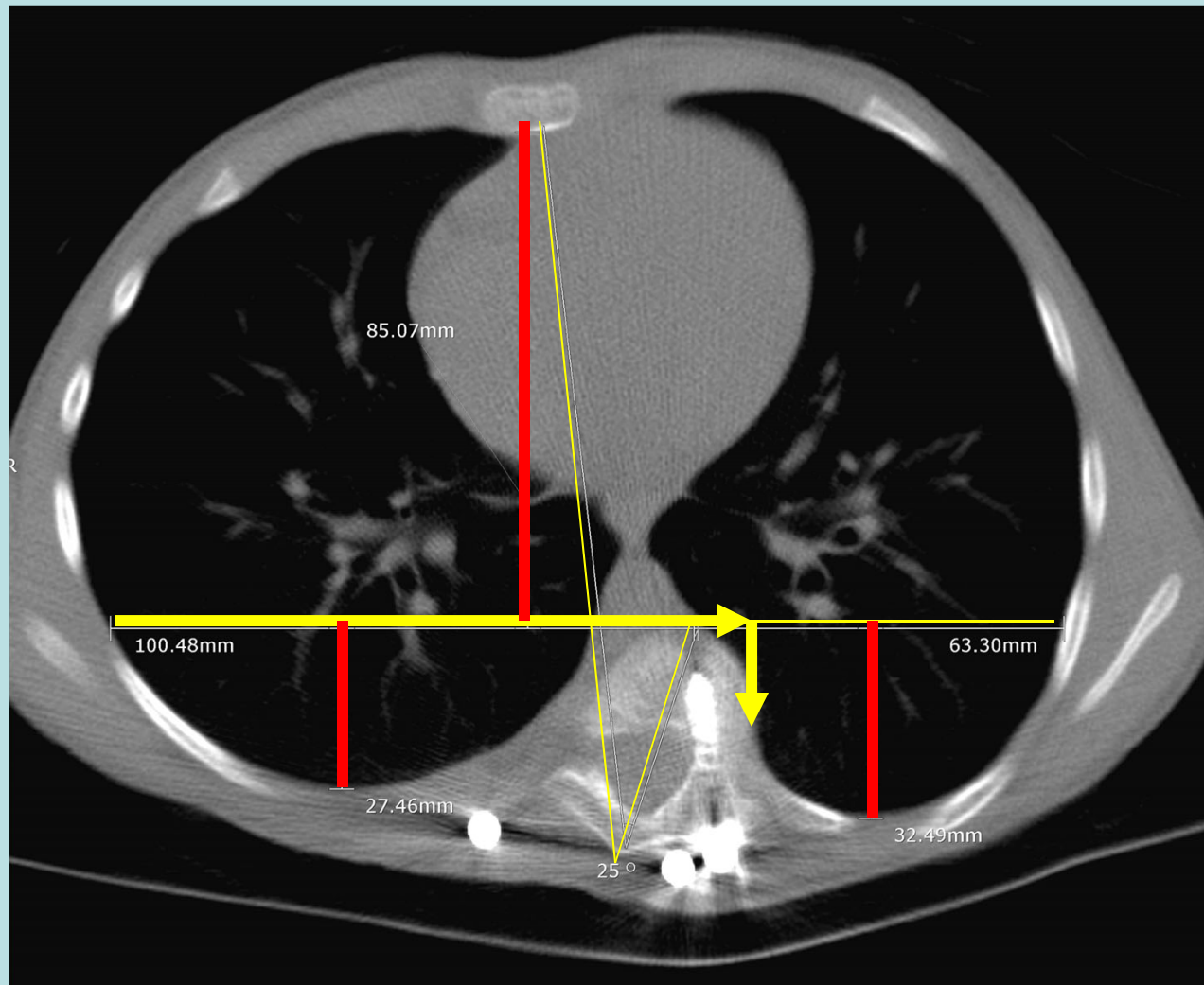
# Postop penetration indices

$$Cv/Cx_{pen} \quad 100.5/63.3 = 1.6$$

Rotation  $25^{\circ}$

$$A/P_{pen} \quad CVX = 85.1/32.5 = 2.6$$

$$A/P_{pen} \quad CCV = 85.1/27.5 = 3.1$$



## Compare

### preop

- Pen Cv/Cx = 3.1
- Rotation = 43°
- A/P pen Cx = 3.2
- A/P pen Cv = 5

### postop

- Pen Cv/Cx = 1.6
- Rotation 25°
- A/Ppen Cx = 2.6
- A/Ppen Cv = 3.1

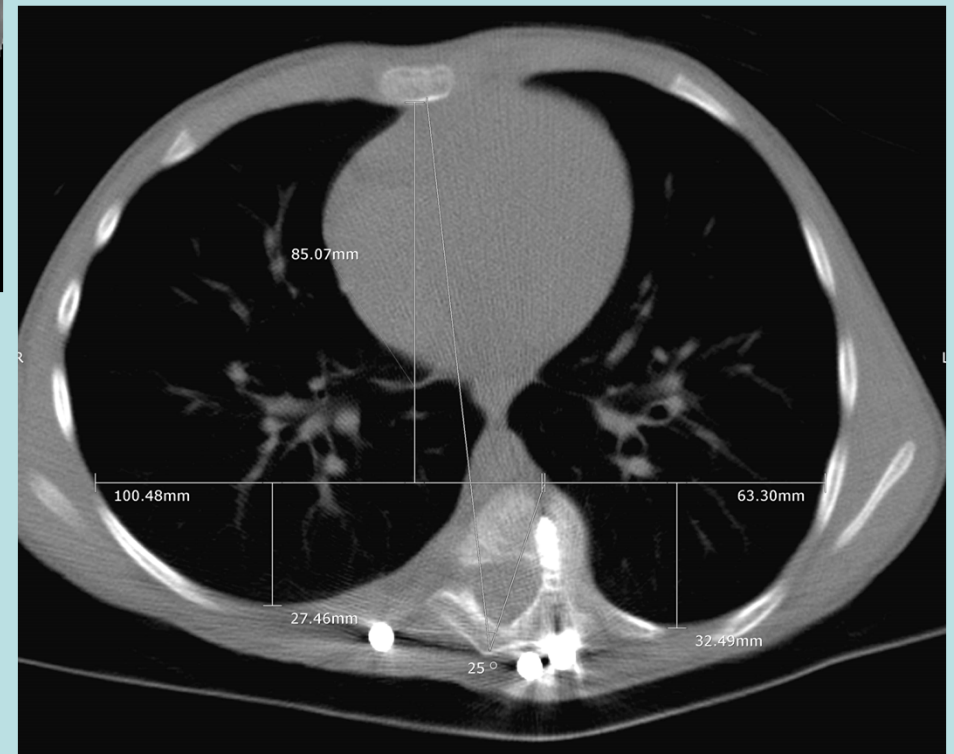
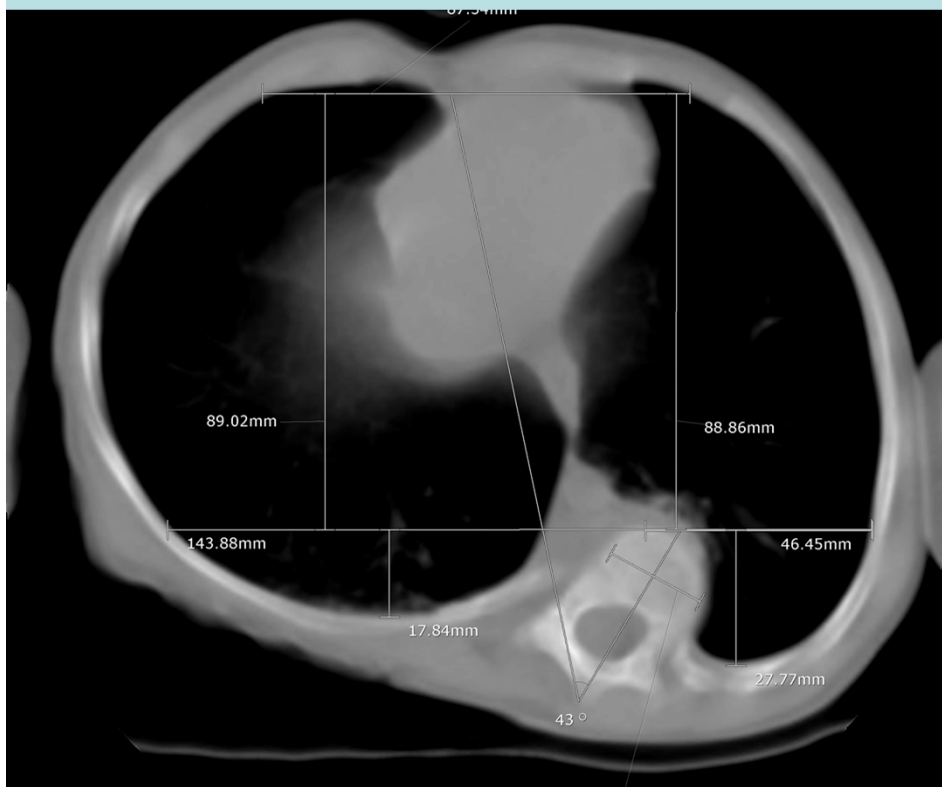
Result :

Cv/Cx hemithorax ratio closer to 1

Apical rotation less

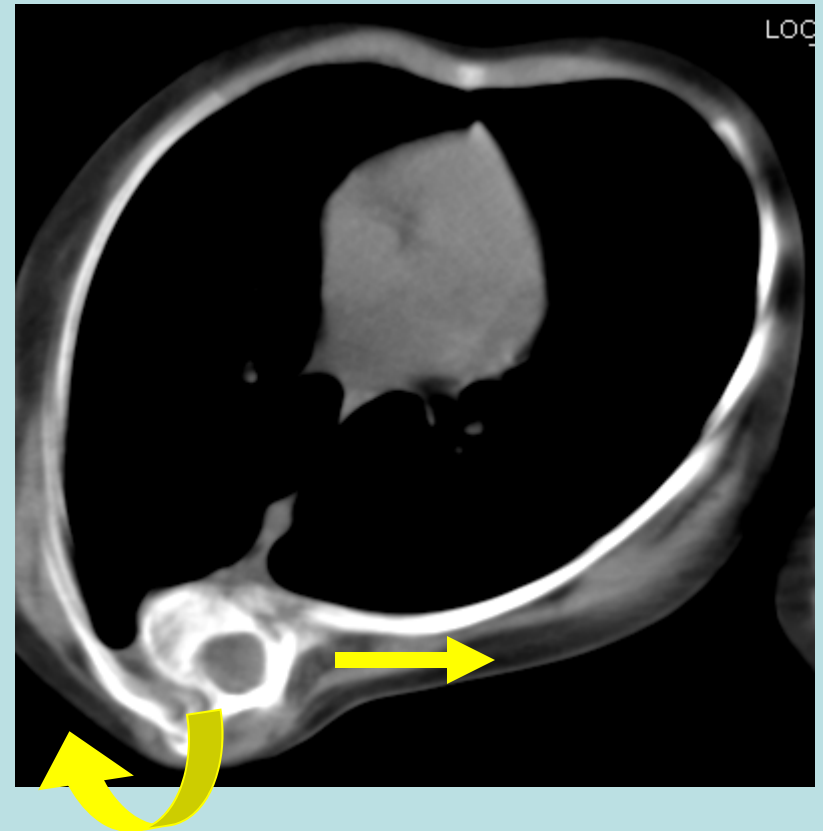
A/P pen smaller → more volume in  
post. hemithorax, ? Less lordosis

# Visual



# Apical Control

- Controls AVT/AVR
- Minimize spine penetration, windswept thorax  
(direct attack on extrinsic deformity)
- ? Better correction of any spine-mediated extrinsic chest wall deformity





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