San Diego Growing Spine Tutorial 2001

(We've come a long way)

R Campbe

Disclosures: RMC

- Royalties from Synthes Spine for the VEPTR device
- Non-compensated volunteer member Medical Advisory Board SpineForm Co.
- Medical Advisory Committee member National Organization of Rare Disorders (NORD)
- Grants
  - NORD and FDA Office Orphan Product development
- Provide advocacy for companies or inventors trying to develop safe and effective devices for children

Thoracic Insufficiency: History, Physiology and Mechanics

ICEOS 2009
CHEST vrs SPINE Debate

Chest deformity has to be primarily corrected

This argument is silly

Robert M. Campbell, Jr., MD ,

Division of Orthopaedics,

The Center for
Thoracic Insufficiency Syndrome

The Children's Hospital of Philadelphia

CTIS

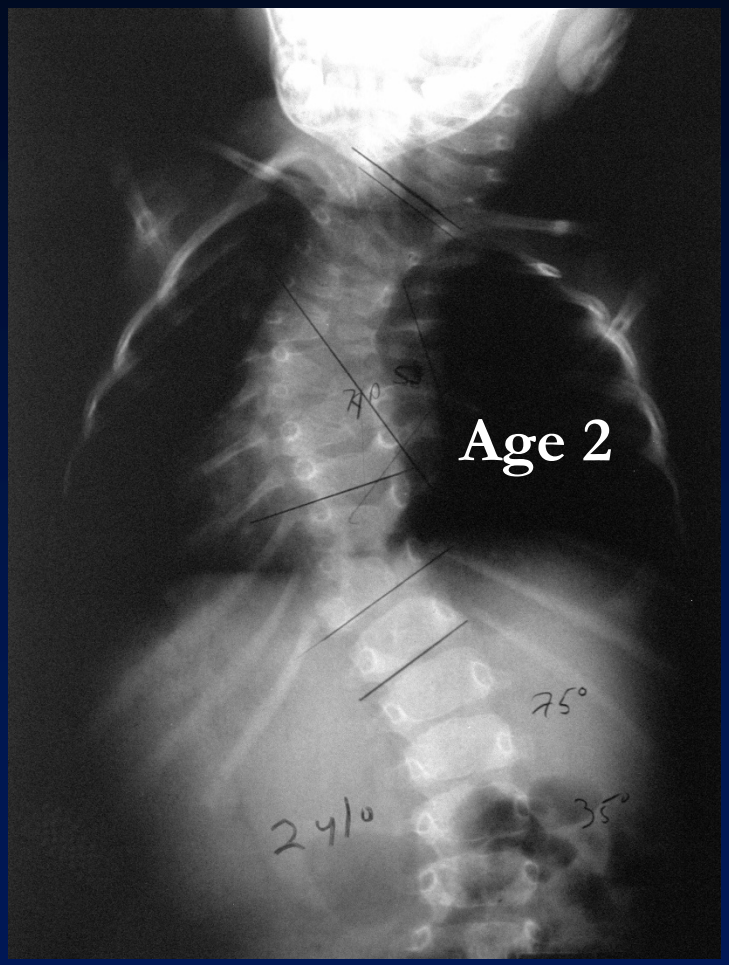
A Radical Hypothesis

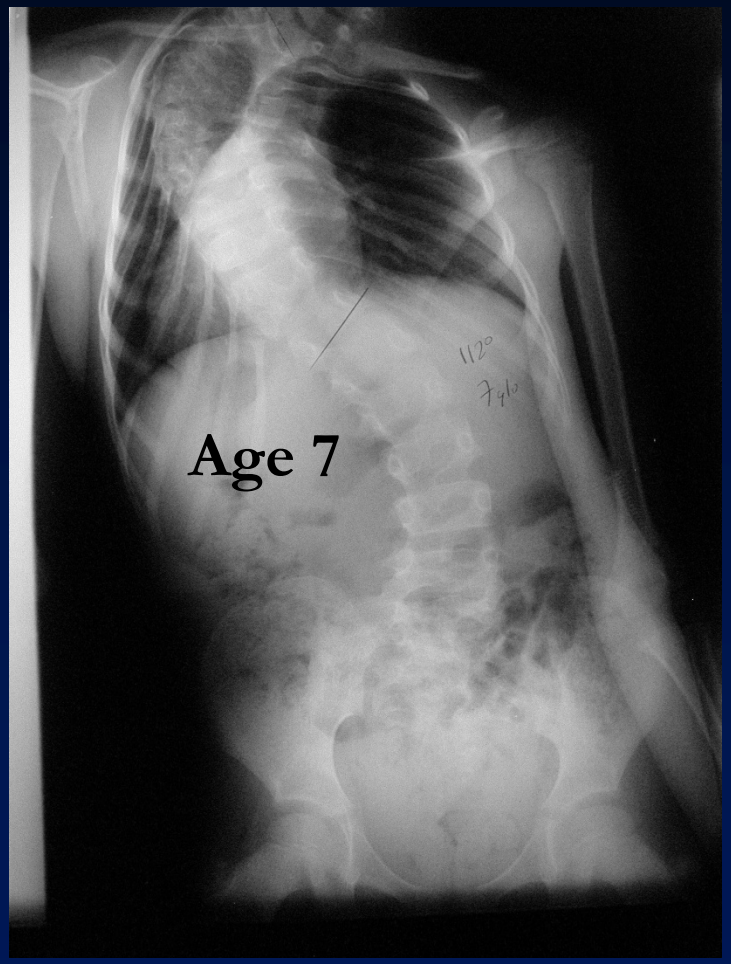
- The Chest is connected to the Spine

2-Dimensional radiograph

2-Dimensional progression

2-Dimensional thinking





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BB&T
2-Dimensional Thinker's Club

We are all guilty of operating on x-rays,

not on patients

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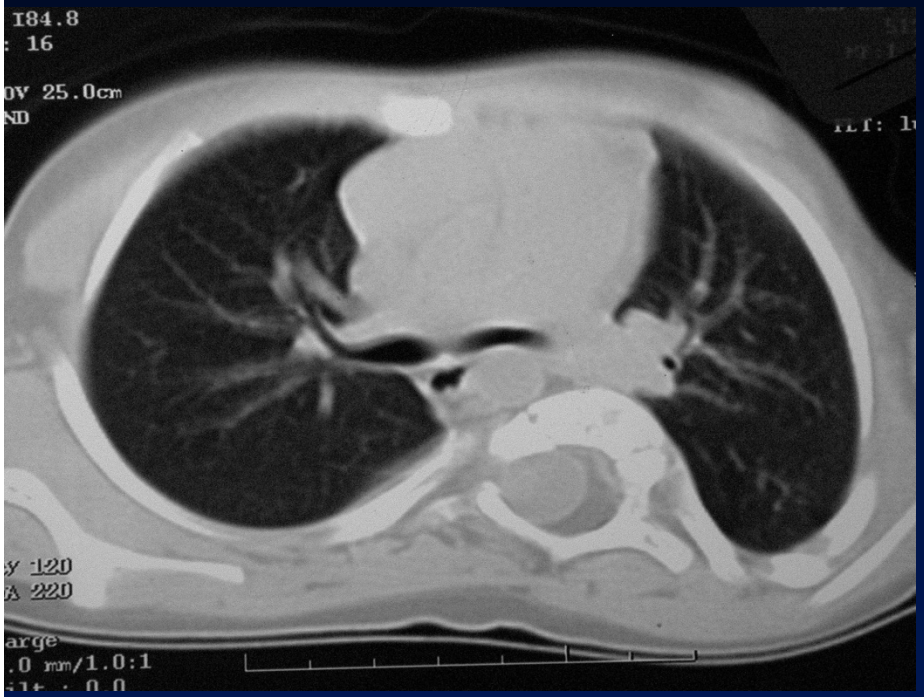
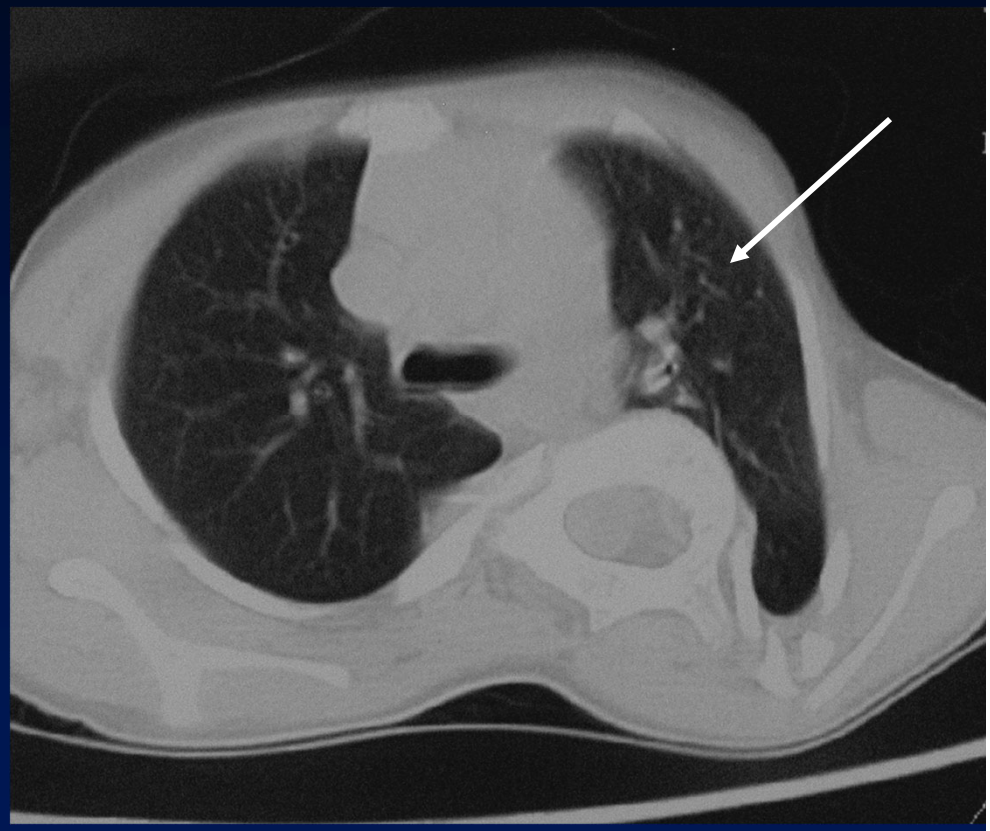
The problem really is 3-Dimensional



Age 2



Age 7

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“Spine” or “Chest” approach ?

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Is the spine the only problem in this patient ?

R Campbell

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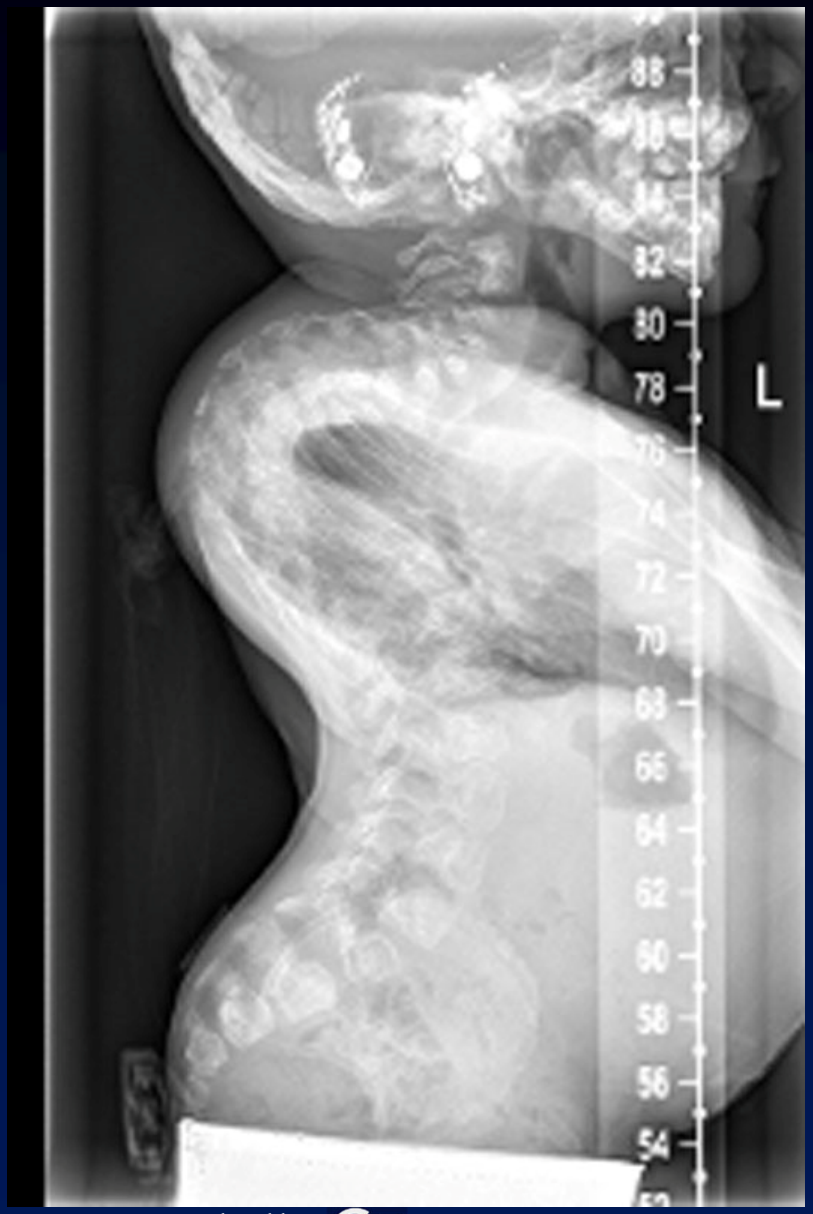
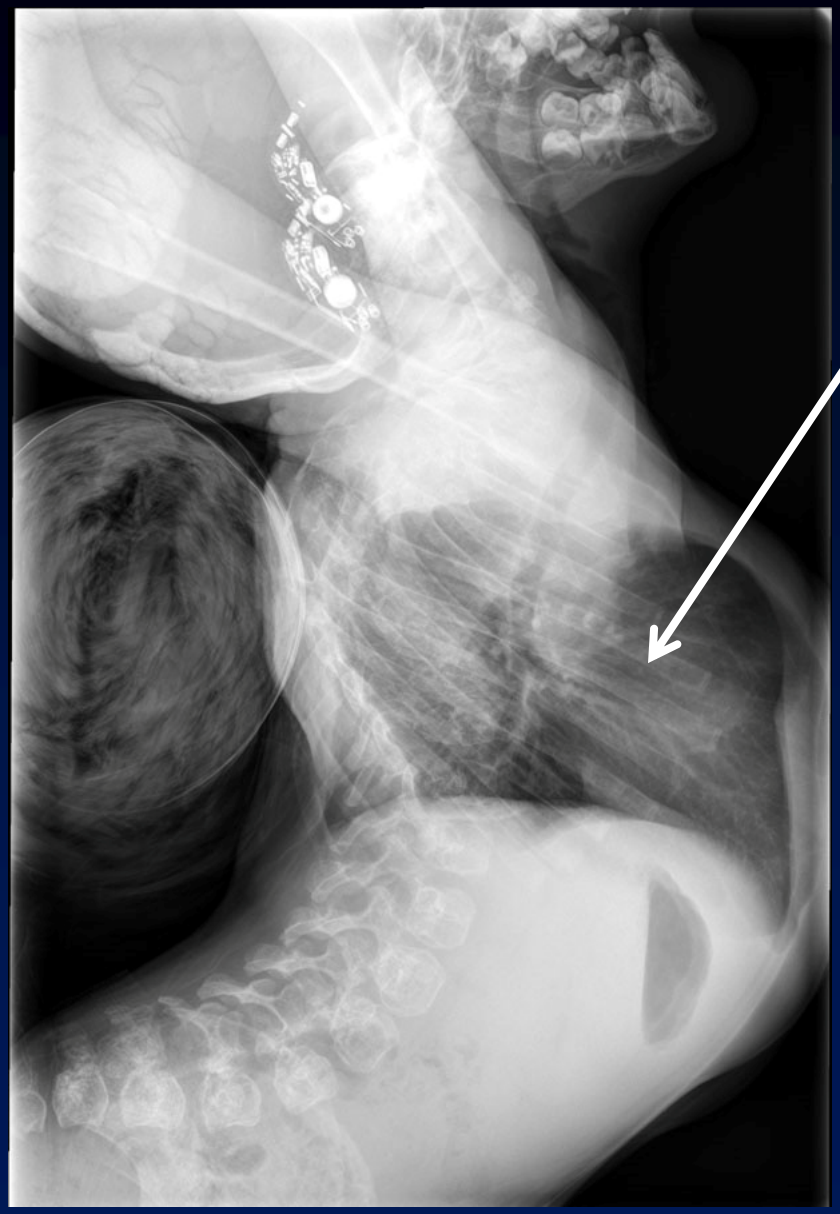
Isn’t it a little crazy to consider the spine and chest separate ?





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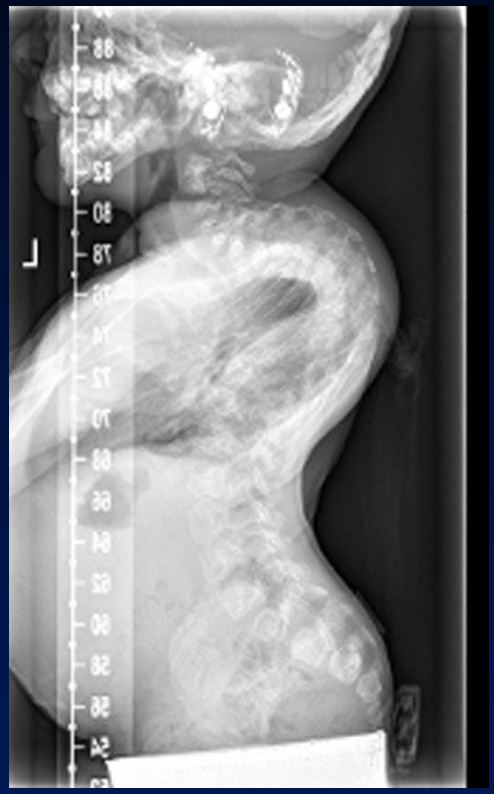
When all else fails, examine the patient



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I would be glad to just use " spine deformity correction" if:

- It increases thoracic volume and symmetry
- It increases rib cage and diaphragm function This is the real basis for pulmonary function
- It preserves spinal and rib cage growth
- It indirectly aids lung growth

Spine Deformity Correction Outcome Measures

- Lots of 2-Dimensional AP radiograph data
- Where's the 3 Dimensional data?
  - CT scans?
- Where's the Pulmonary data?

How do we choose between "chest" or "spine" approach?

- I would use Spine Correction

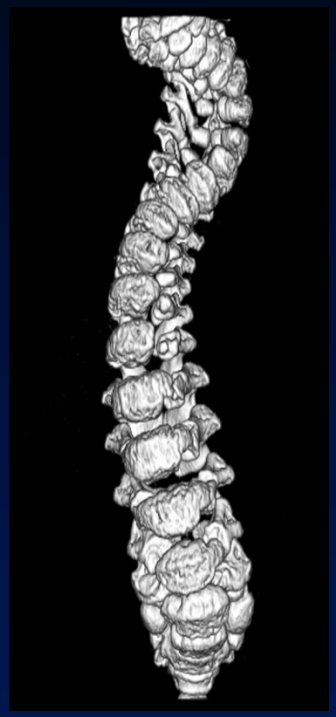
  " I like growing rods "
- I would use Chest Correction

  "I used to use growing rods, but

  I like VEPTR now"

What outcome measures do we use to make these choices?

Define the Outcome Measures



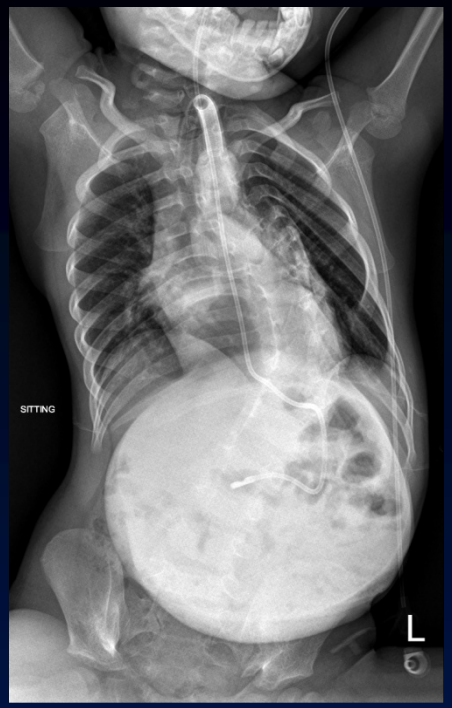
- (X) growth sparing technique is "better" than (Y) growth sparing technique
- (X) growth sparing technique "works" , but (Y) growth sparing technique "does not work" as well

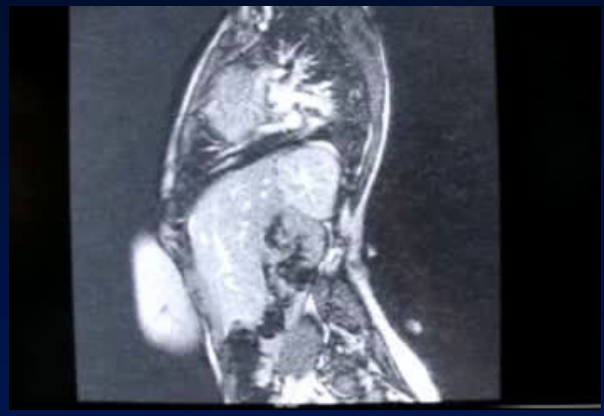
Every surgeon has their own interpretation of what "better" and "works" means

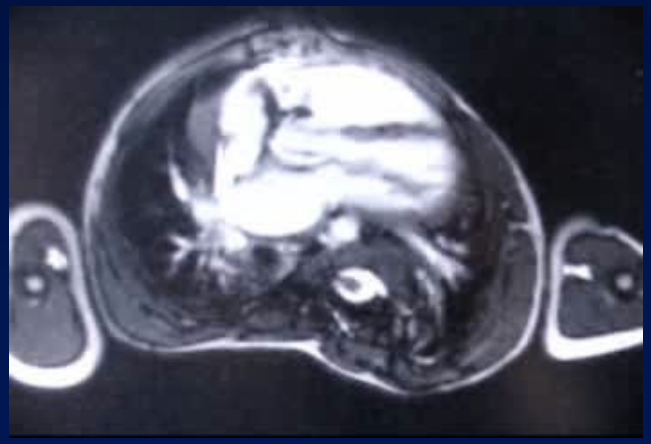
R Campbell

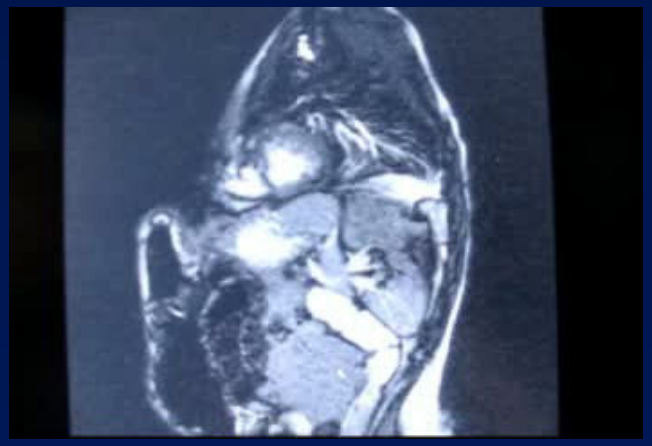
The ideal deformity system would:

- Reduce the Cobb angle
- Correct the cosmesis issue of scoliosis
- Re-orient the ribs for normal costo-vertebral movement and thoracic shape
- Maximize thoracic volume and symmetry
- Minimize grow inhibition
- Do this with minimal morbidity and cost









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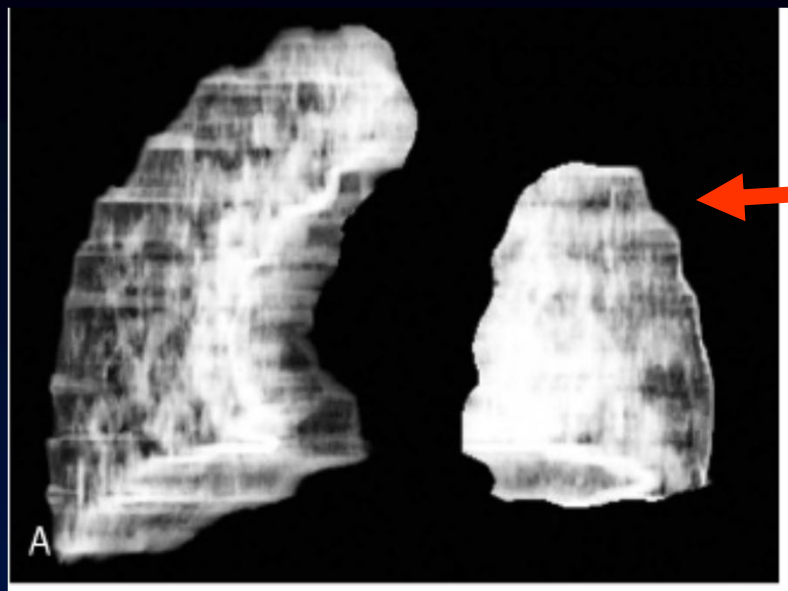
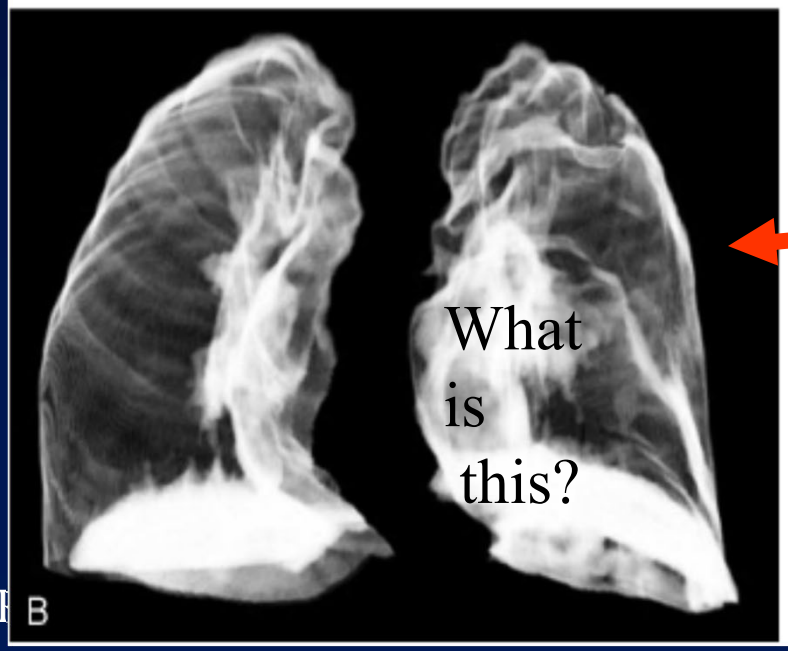
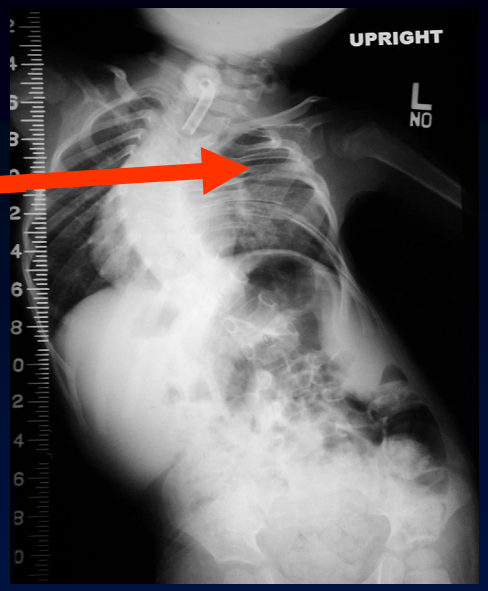
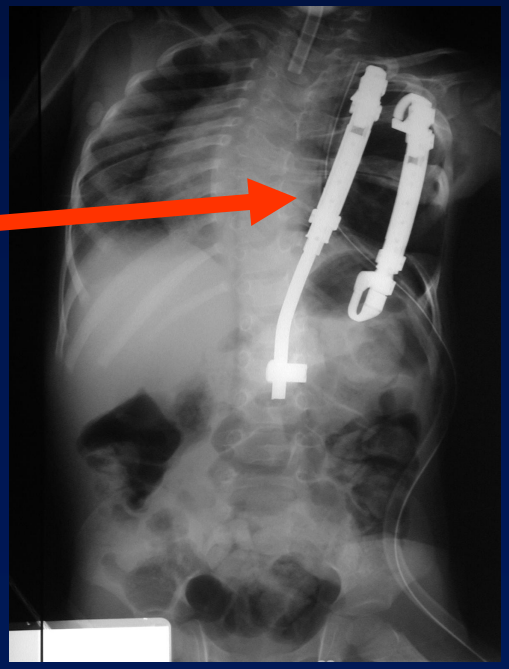
Normal Lung Growth? , “stretching” of tissue? , ????









-Emans, et al.,
SPINE, 2005

How Does Expansion Thoracoplasty Affect Pulmonary Growth and Function? *Pulmonary Cellular Response to Thoracic Insufficiency Syndrome Using Rabbit Model*

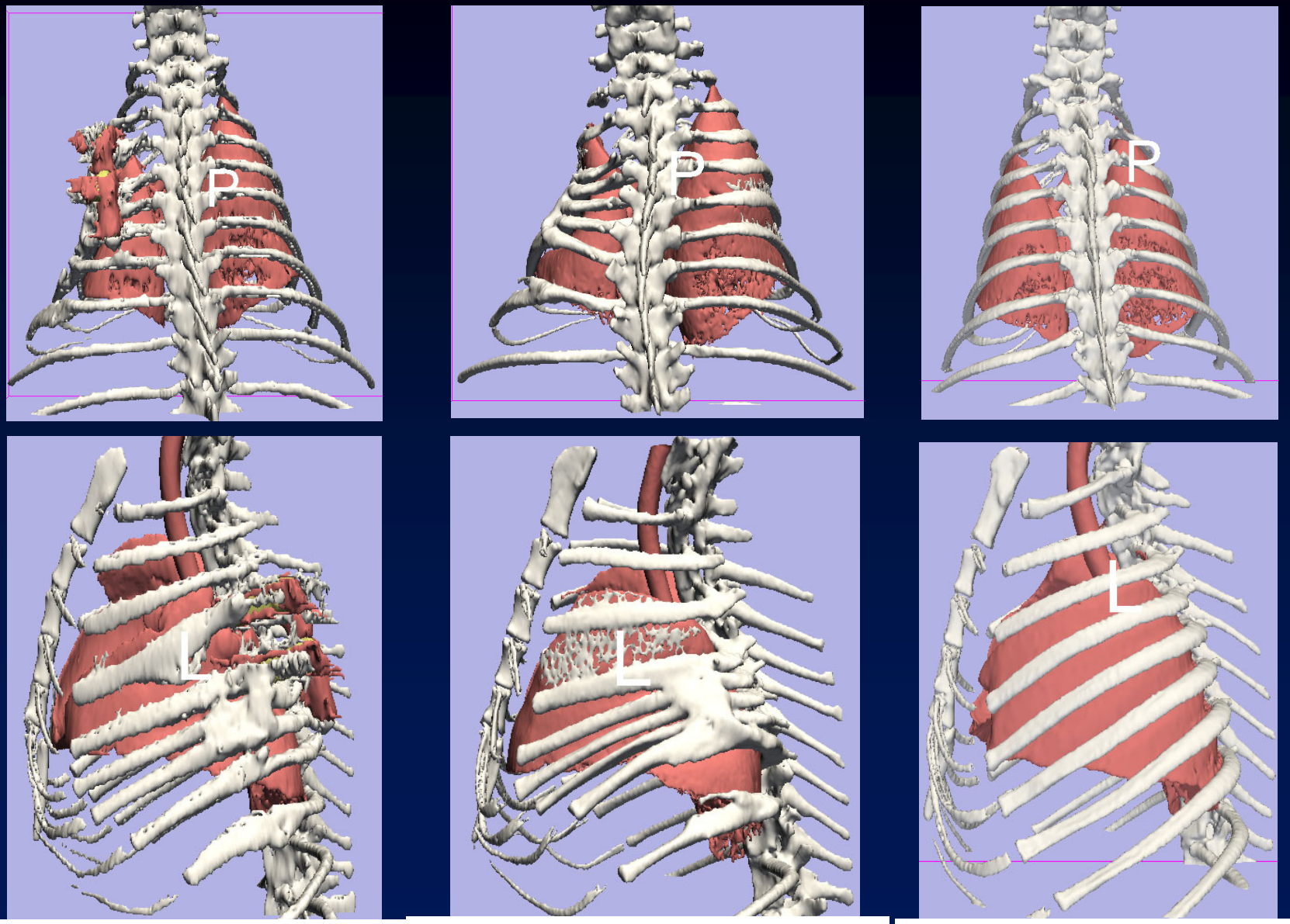
Olson J C, Kurek K C, Mehta H P, Warman M L, Snyder B D

Orthopedic Biomechanics Laboratory, Beth Israel Deaconess Medical Center

Department of Biomedical Engineering, Boston University

Department of Orthopaedic Surgery, Children's Hospital and Harvard Medical School, Boston, MA

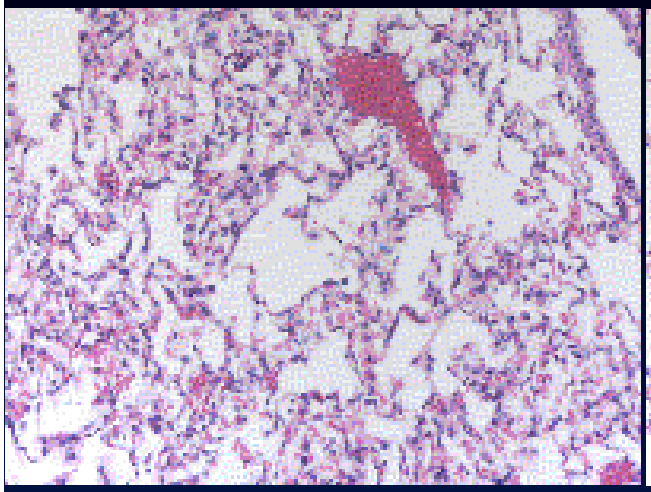
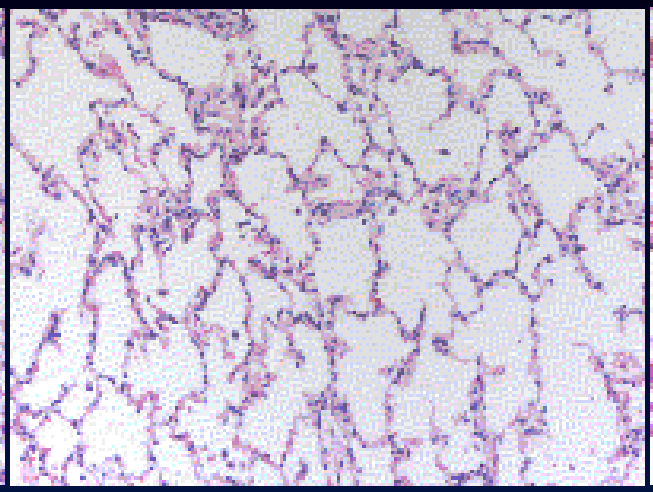
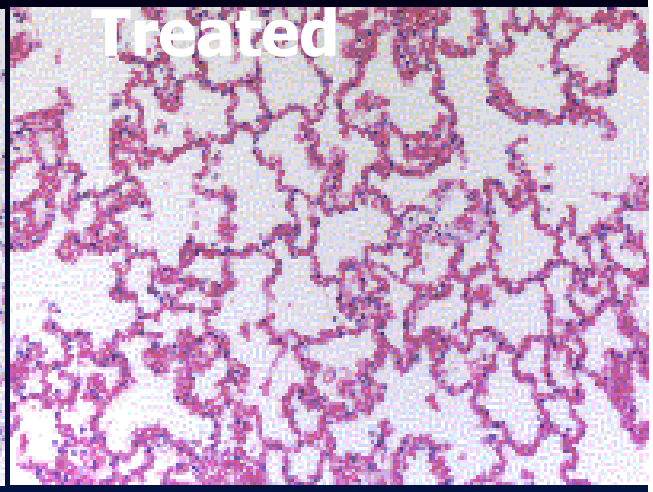
Comparison of Thoracic Cage at 18 wks



R

VEPTR Treated **+ Disease Control** **Normal Control**

Histology

+ Disease Control	Normal Control	"VEPTR" Treated
		
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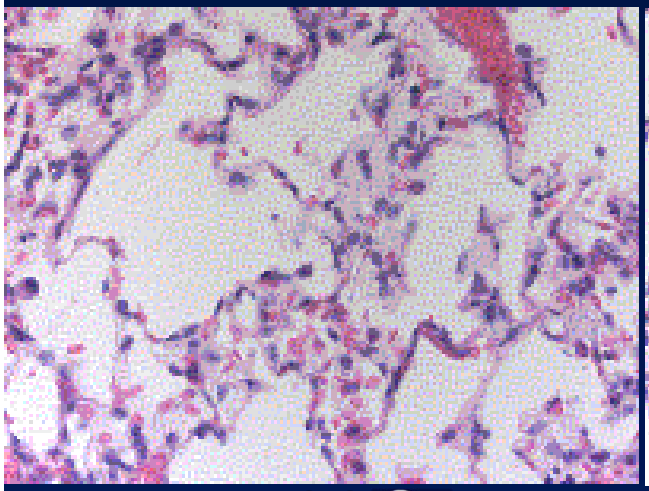
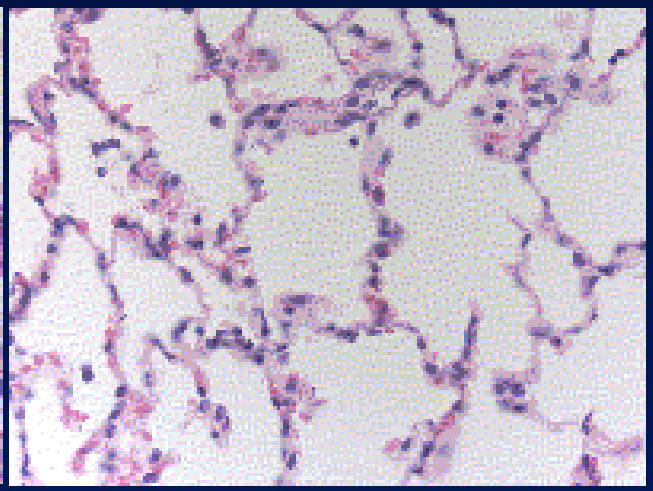
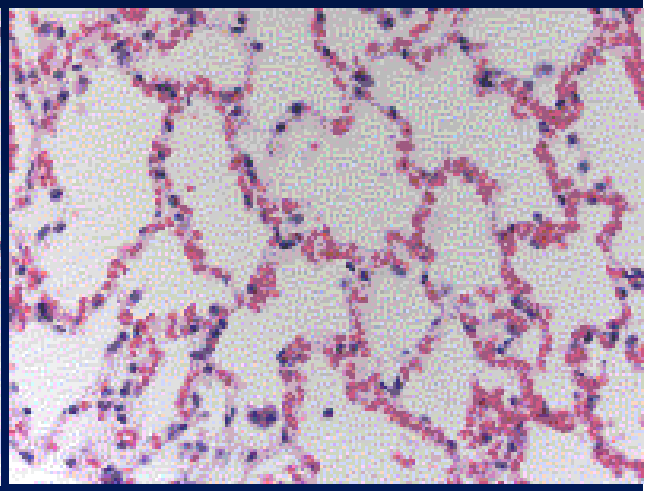
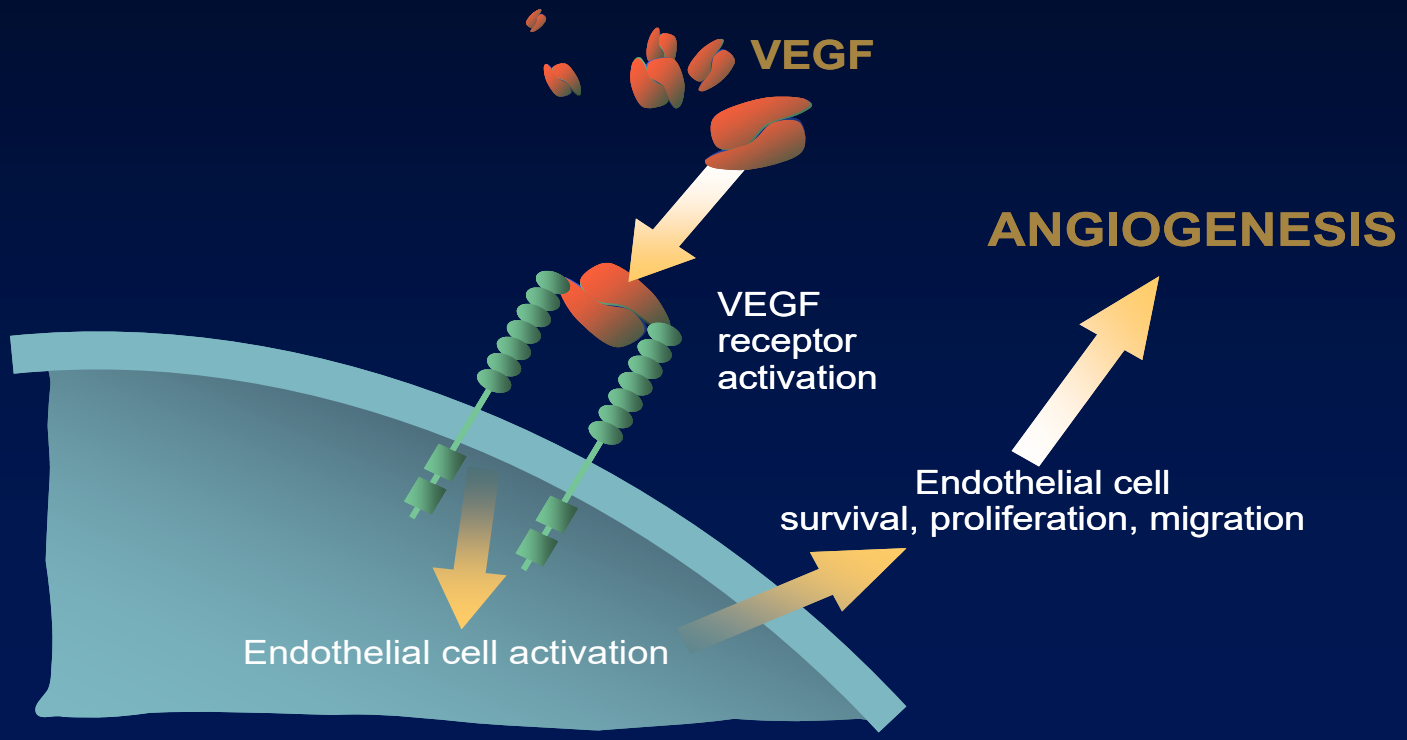
		
400x	400x	400x

VEGF & Alveolar Development

- The VEGF pathway induces vascular endothelial cell mitosis
- Capillary growth improves CO_2 and O_2 gas exchange
- Expression is induced by hypoxia and stretch



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Reference: researchVEGF.com

IHC – quantification
Preliminary Results

- Ki-67 and macrophage cell abundance was measured normalized by total cell abundance
  - DAB stain / Hematoxylin

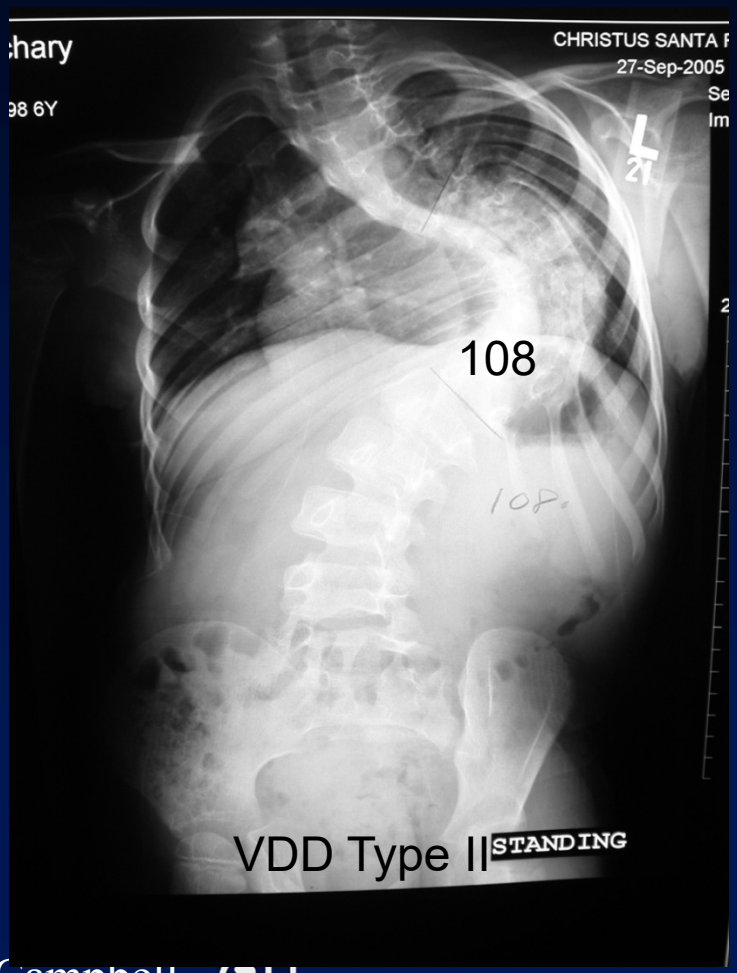
Antigen	Experimental Group		
	Healthy	Disease	VEPTR
Ki-67	3.73%	1.86%	3.37%
MIB-11	1.80%	6.46%	0.91%

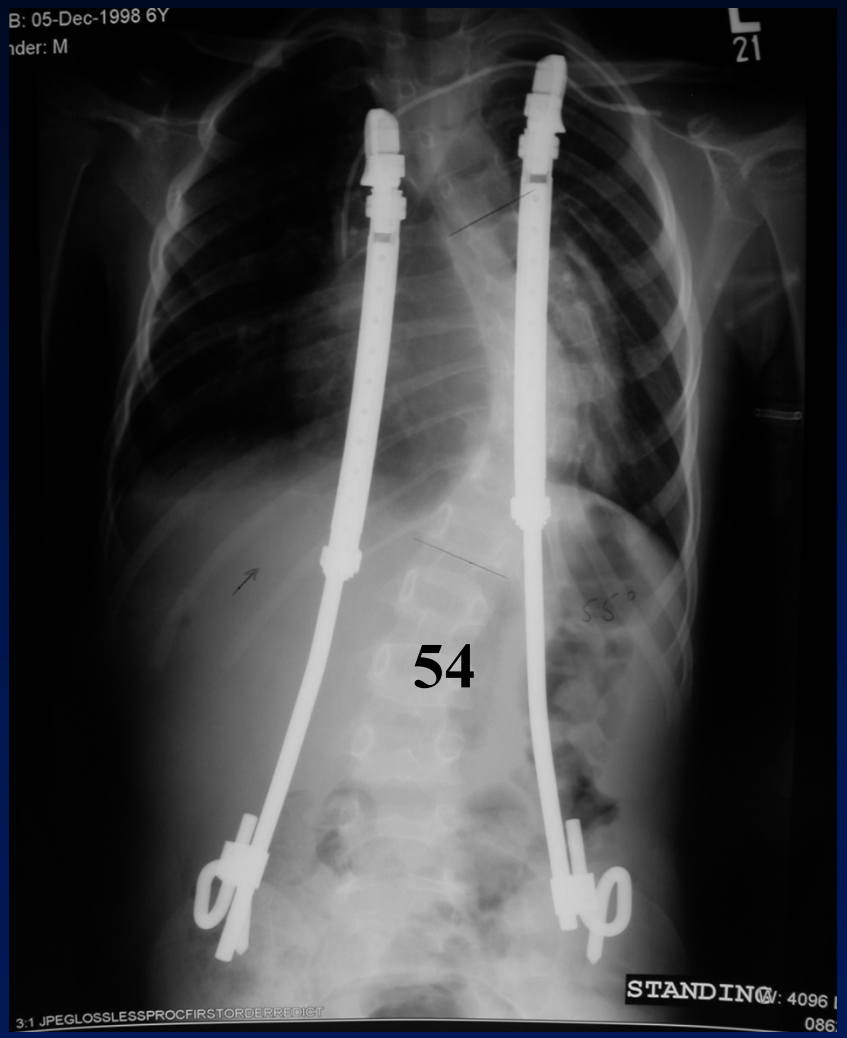
Total Percentage of cells expressing antigen

We need to stop operating on x-rays

R Campbell

Is VEPTR thoracoplasty the "solution" for everything?





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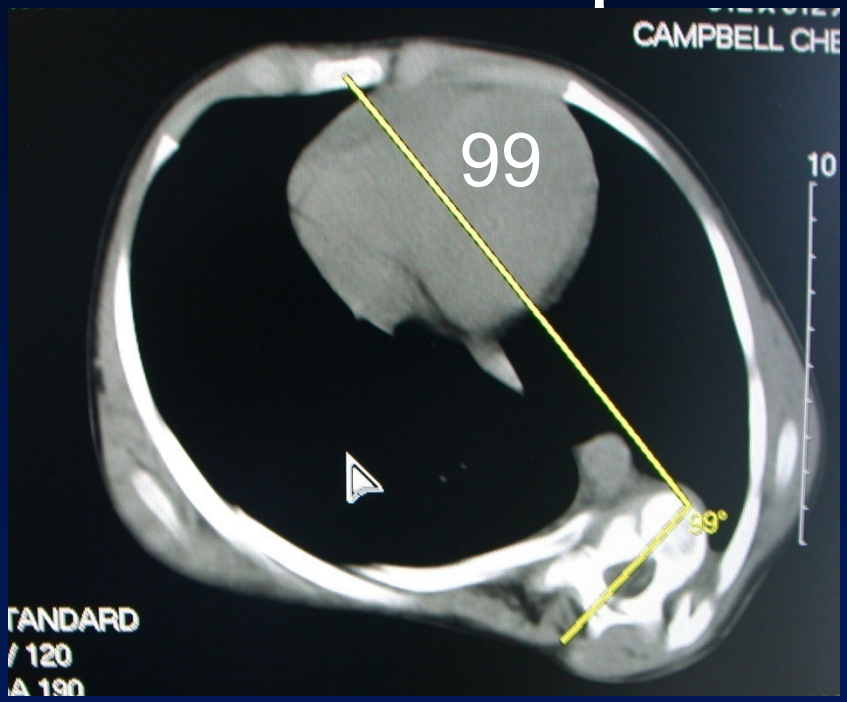
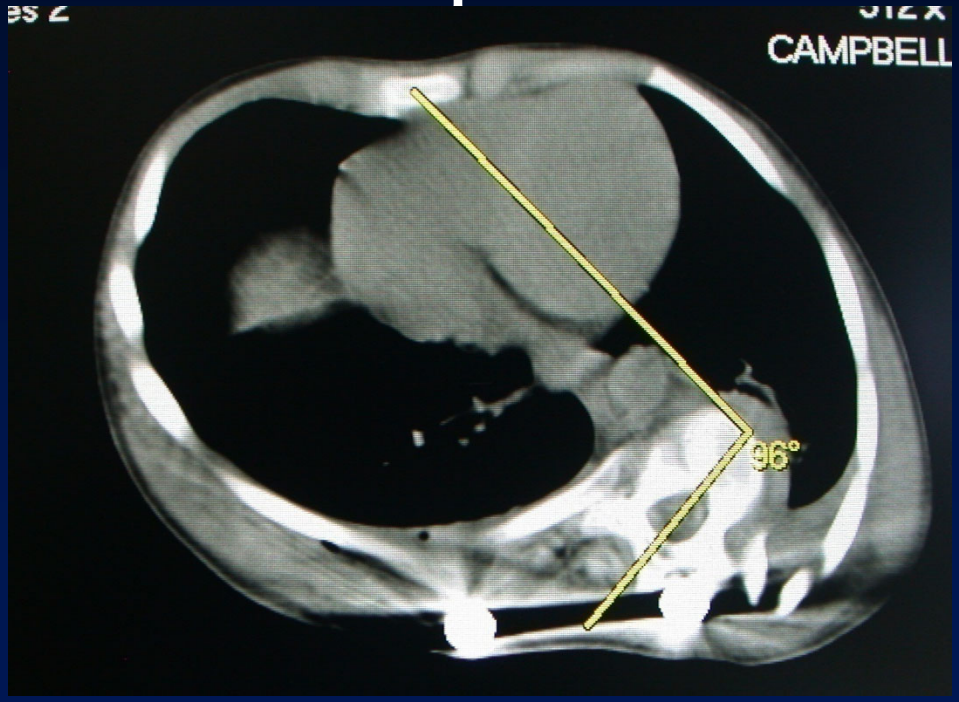
We have a lot to learn…..

Pre op



Post op



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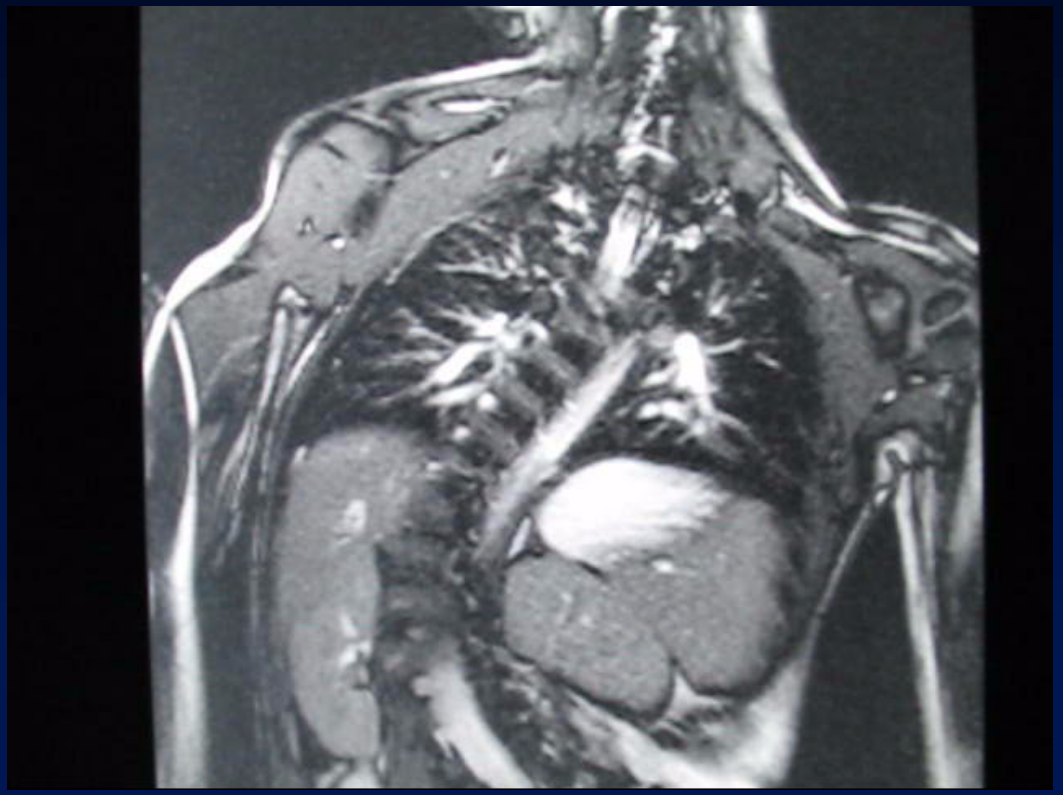
Neuromuscular scoliosis
Level II thorax, FVC 58% nl



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Scoliosis:

- "lateral curvature"
  - 2,500 years old
- The concept of "lateral curvature" of the spine is inadequate to describe the complex deformity and biomechanical disability of the thorax in spine / chest wall disorders

R Campbell

The Campbell-Marks $20 Bet

- Our current 2- dimensional "Scoliosis" concept will be replaced by a 3 dimensional dynamic thoracic deformity model by the time Campbell finally retires

Thank You!

R Campbell