

# THORACIC VOLUME PREDICTS PULMONARY FUNCTION RECOVERY IN SCOLIOSIS PATIENTS

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# DISCLOSURES

## ✘ The authors have no financial disclosures

- ✘ Presenter: David W. Polly, Jr., MD
  - (a) SRS, POSNA, SRF, OREF, DOD
  - (b) Medtronic Spine & Navigation ended 10/1/09 & 6/28/10
  
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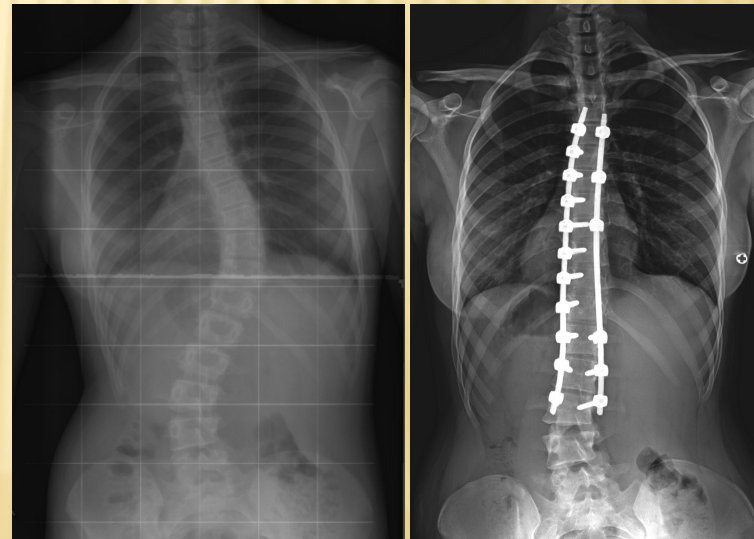
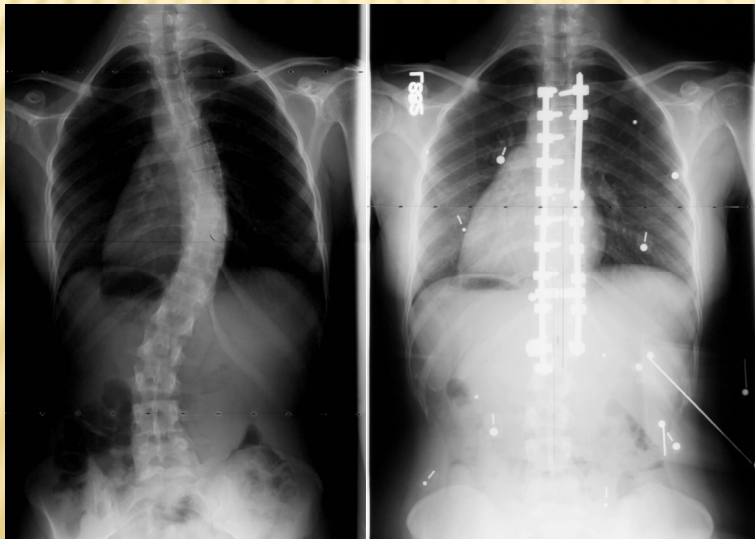
# BACKGROUND

- ✘ While moderate scoliosis is present in 1 in 300 children its effects on pulmonary compromise is not well understood.
- ✘ Scoliosis deformity has long been linked with deleterious effects on pulmonary function.
- ✘ The causal relationship between spine/chest wall deformity and pulmonary function has yet to be fully defined.
- ✘ It has been hypothesized that deformity correction improves pulmonary function by restoring both respiratory muscle efficiency and increasing the space available to the lungs.



# OBJECTIVE

The objective of this research was to define the relationship between pulmonary function and the thoracic volume for adolescents before and after AIS deformity correction.



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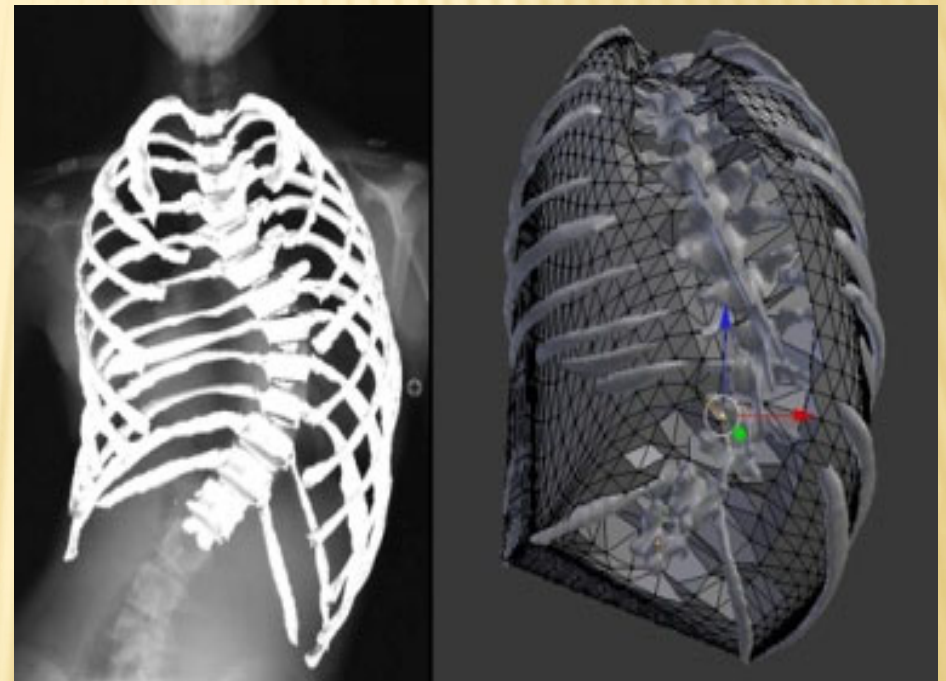
# METHODS

- ✘ Study Design. Retrospective case control correlational analysis of pulmonary function test (PFT) data and modeling reconstructions of thoracic volumes from plain x-rays.
- ✘ AIS patients from a multicenter database (PPSS) were sorted by presurgery PFT as a % predicted value.
- ✘ 10 patients with the highest and 10 with the lowest PFT values were analyzed.
- ✘ Thoracic volume was modeled and correlated with PFT values before and after surgery (2 year follow-up)

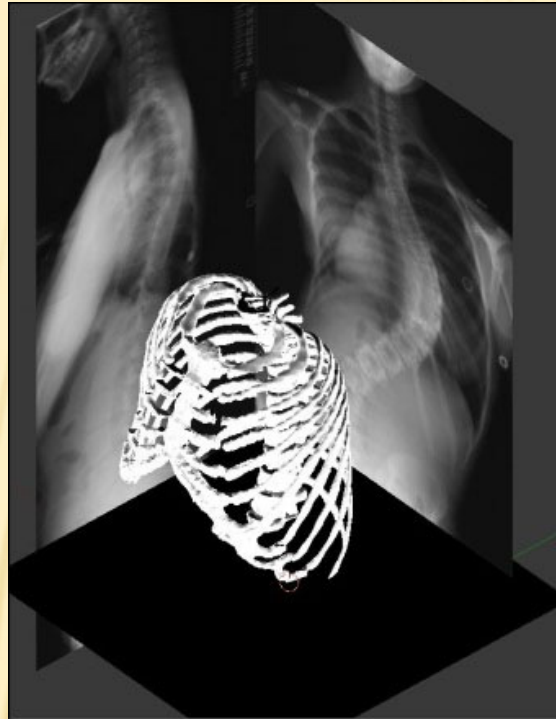
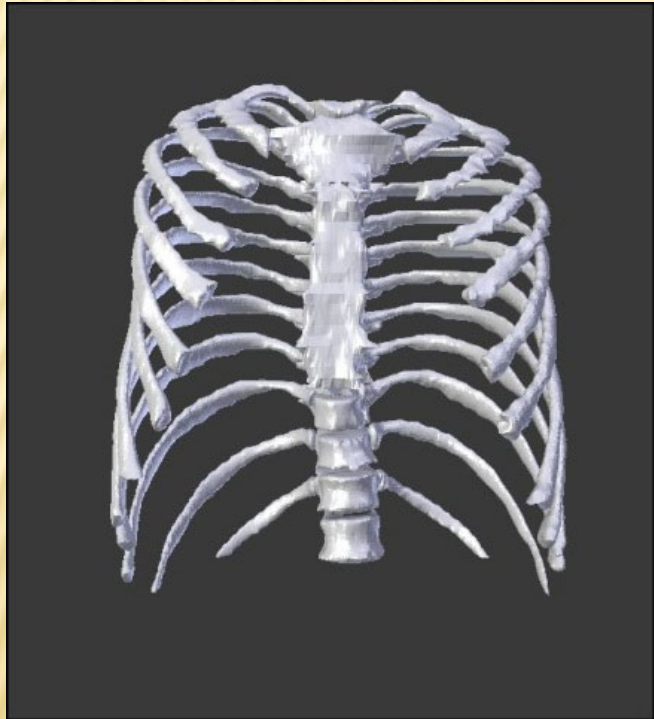


# METHODS

- ✘ Scoliosis films (AP and Lateral) were utilized to deform an existing thorax model to produce a patient specific thorax model and then measure the mediastinal volume.
- ✘ Blender 2.63a™ software used to construct computational model of the spine and thorax and perform deformation



# THORACIC VOLUME MODELING



The initial model is placed in a virtual x-ray where calibrated patient x-rays are placed orthogonal within the space. An x-ray projection of the 3D torso is overlaid on the x-rays and the bones are then deformed to match the x-rays.



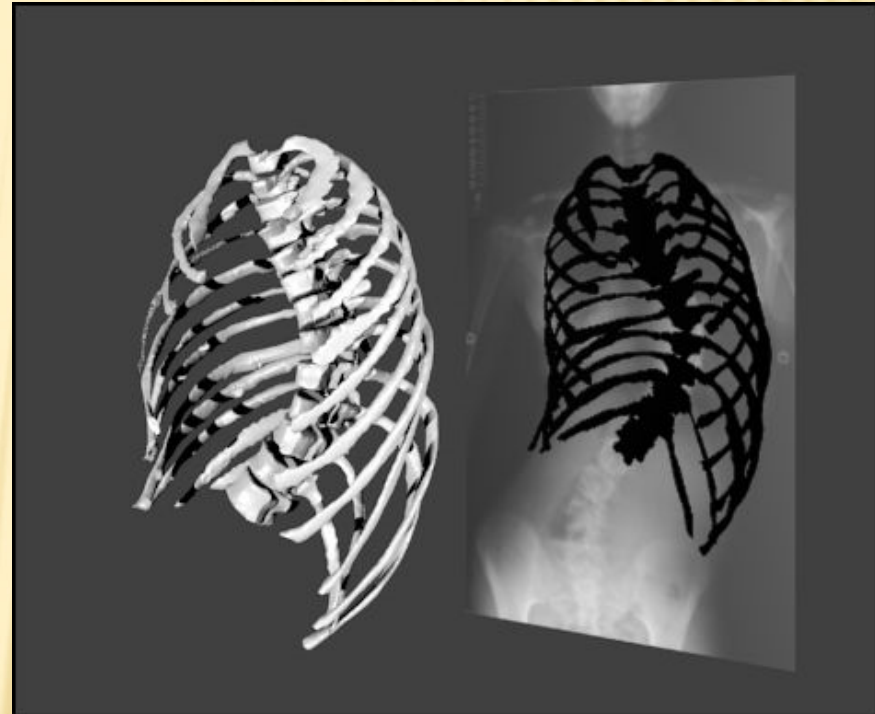
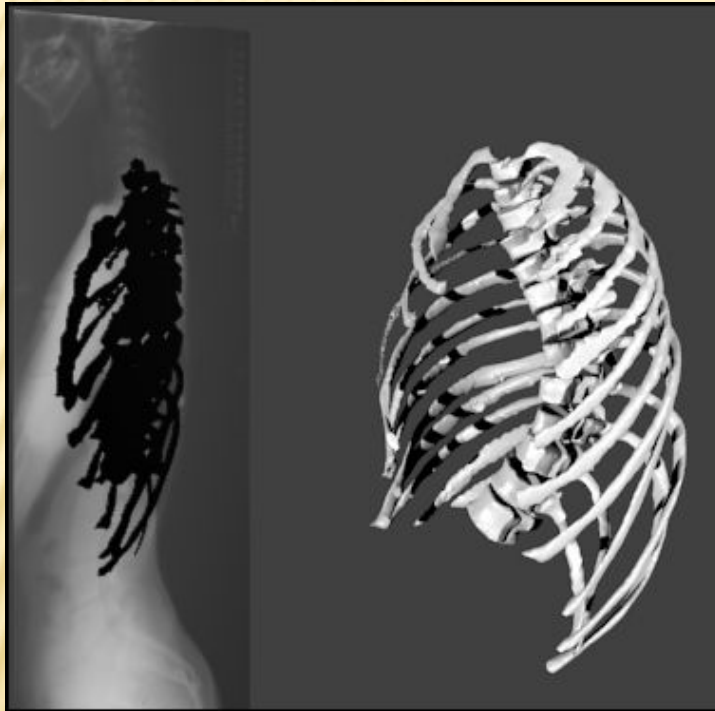
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# THORACIC VOLUME MODELING



The deformed spine and ribs are projected in the virtual x-ray to evaluate how well they match the patient films.



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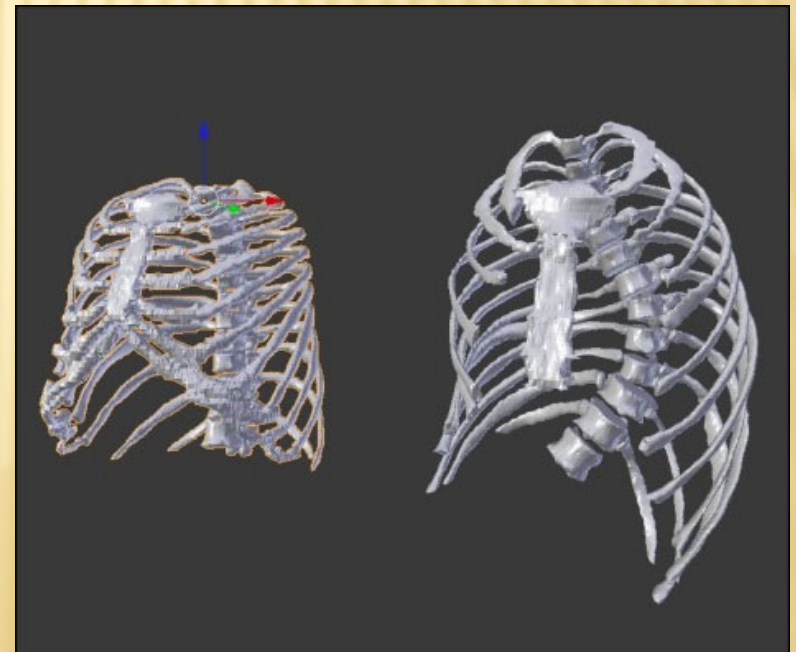




# THORACIC VOLUME MODELING



After deforming the spine and ribs and altering their orientation, the thoracic volume was computed above the diaphragm.



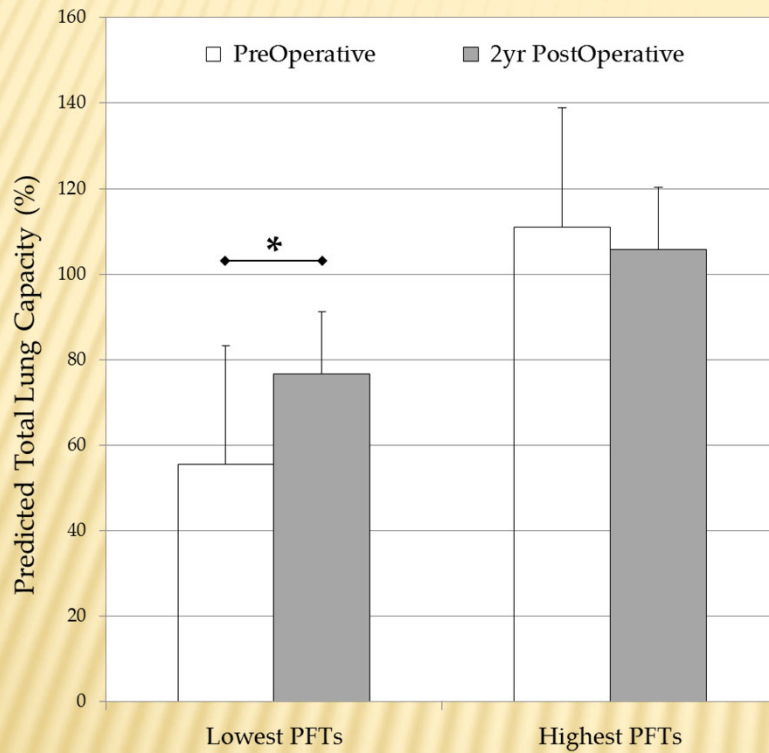
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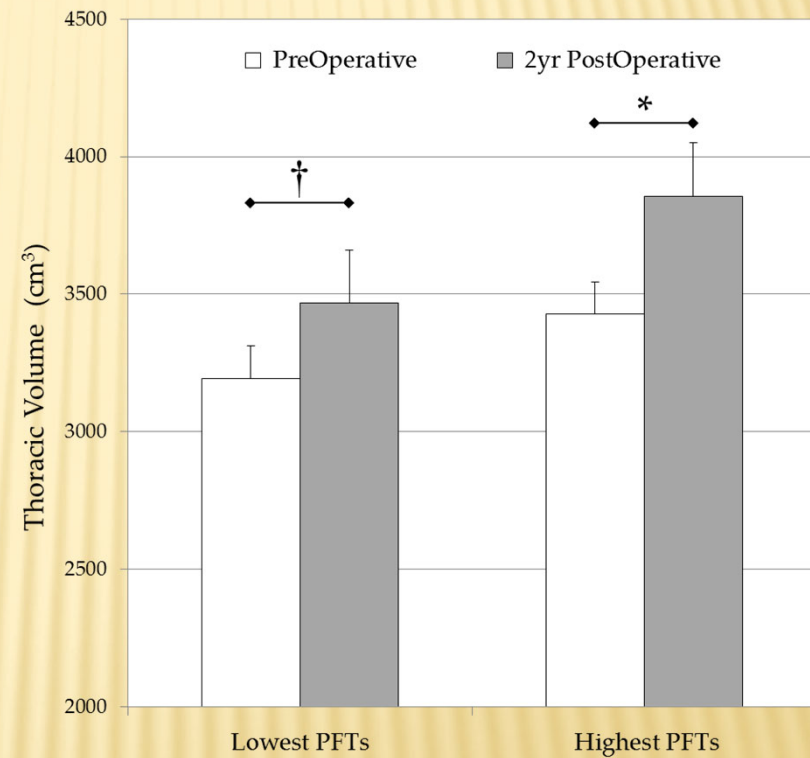
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# RESULTS



Pulmonary Function



Thoracic Volume



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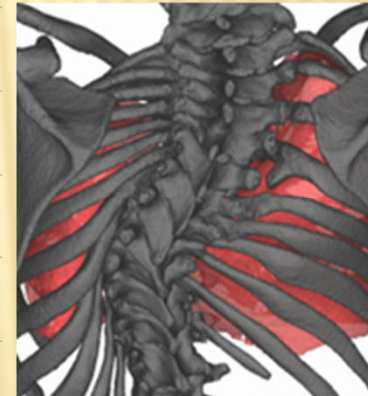
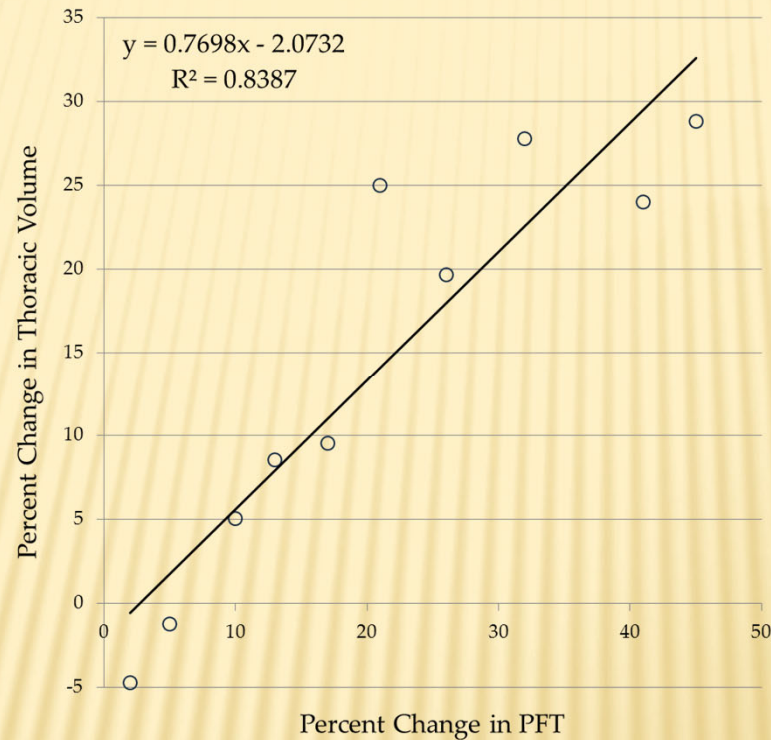
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† p=0.065; \* p<0.001

# CORRELATION OF PFTS WITH VOLUME



AIS Patients with the Pre-Surgical Lowest PFT Values



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# CONCLUSION

- ✘ Pre-operative thoracic volume was diminished in patients with the lowest PFT values ( $3194 \pm 1358 \text{ cm}^3$ ) compared with with the highest PFT values ( $3427 \pm 874 \text{ cm}^3$ ) although the groups were not height matched ( $p=0.085$ ).
- ✘ The adolescents with the most severe pulmonary compromise prior to surgery exhibited a strong positive relationship between post-operative change in PFT and thoracic volume ( $r^2 = 0.839$ ;  $p < 0.001$ ).
- ✘ The mean increase in thoracic volume (space available to the lungs) in this group was  $373.1 \text{ cm}^3$  (11.7%) which corresponded to a 21.2% improvement in PFTs.
- ✘ AIS surgical intervention was found to increase thoracic volume which was strongly correlated with improved pulmonary function in severe cases.

