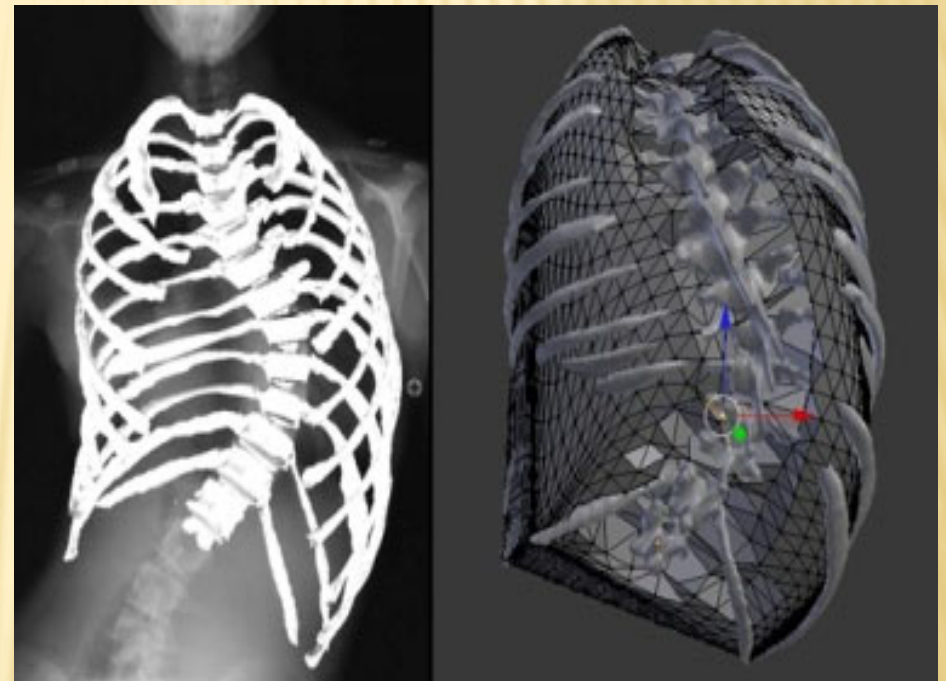# MODELING THORACIC VOLUME TO PREDICT PULMONARY FUNCTION IN SCOLIOSIS

David Polly Jr. MD[1], Benjamin Rosenstein[2], Charles Ledonio, MD[1], A. Noelle Larson, MD3, and David J Nuckley, PhD[2]

[1]Department of Orthopaedic Surgery and [2]Department of Physical Medicine and Rehabilitation; University of Minnesota, Minneapolis, MN. [3]Mayo Clinic, Rochester, MN.

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 &
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✖ Co-Authors:
  + Benjamin E. Rosenstein   No relationship
  + Charles Gerald T. Ledonio, MD   (a) SRS, POSNA, SRF, OREF, DOD, Medtronic
  + A. Noelle Larson, MD   (a) SRS, POSNA, OREF
  + David J. Nuckley, PhD   (a) Medtronic

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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 develop and validate a computational model to measure thoracic volume for scoliosis, pectus excavatum and combined deformity in order to predict cardiopulmonary function.
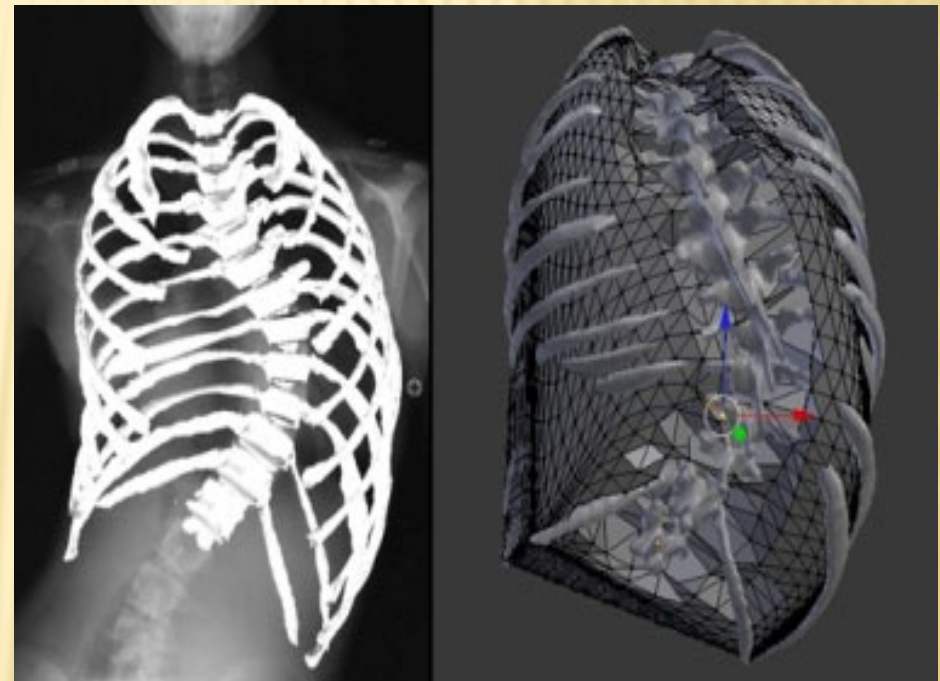
METHODS

- Utilizing Blender software we constructed a computational model of the spine and thorax which may be 'computationally deformed' to match chest X-rays and compute the resulting thoracic volume

- Size and orientation of the individual bones of the spine and thorax are altered until they fit the x-ray projections of the patient, creating a patient-specific model.

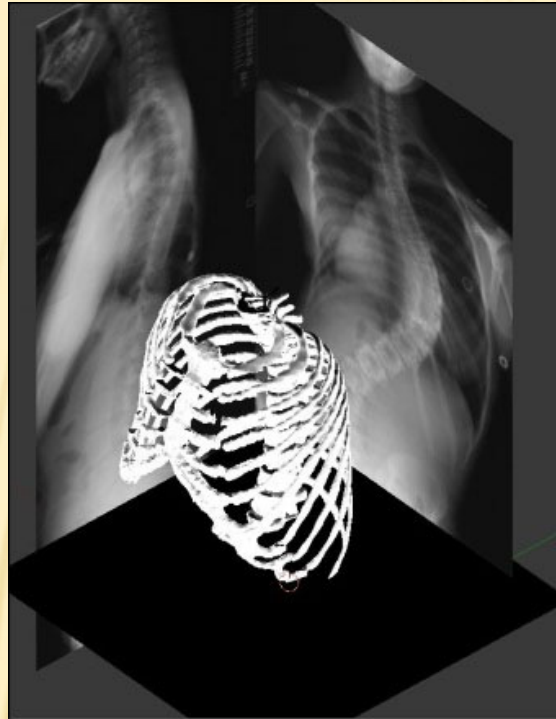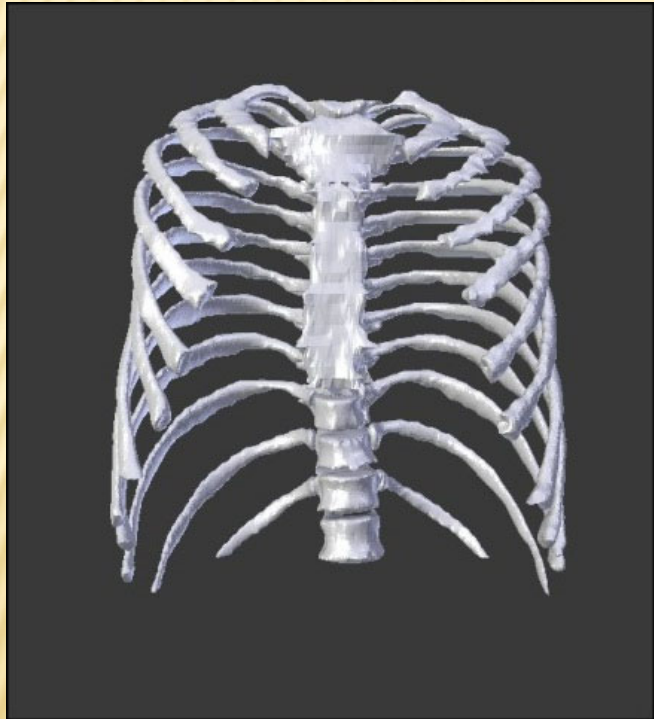- Thoracic volume was then computed by meshing the space within the thoracic cavity.

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 overlayed on the x-rays and the bones are then deformed to match the x-rays.
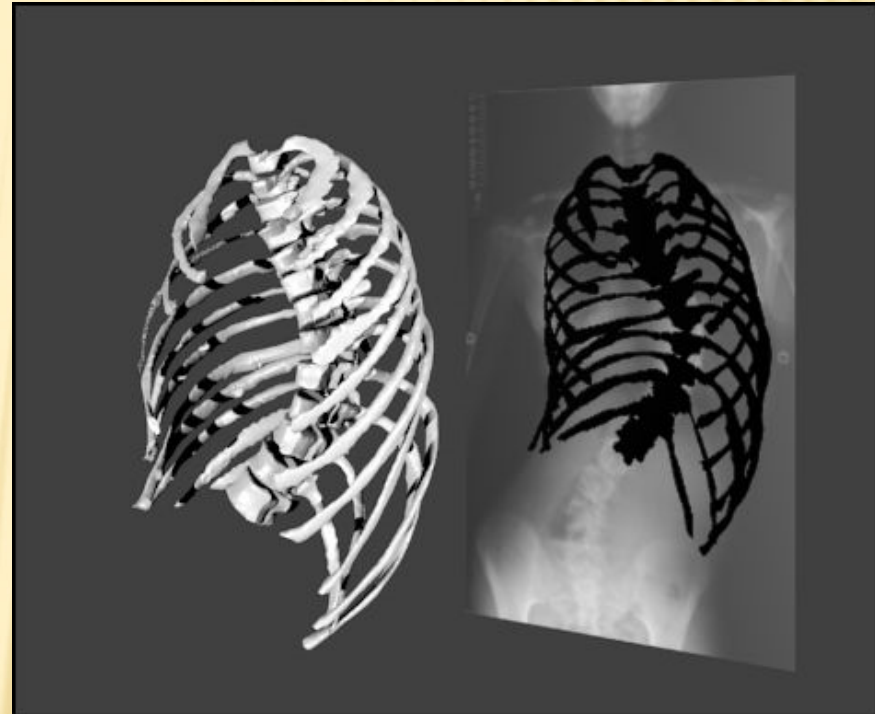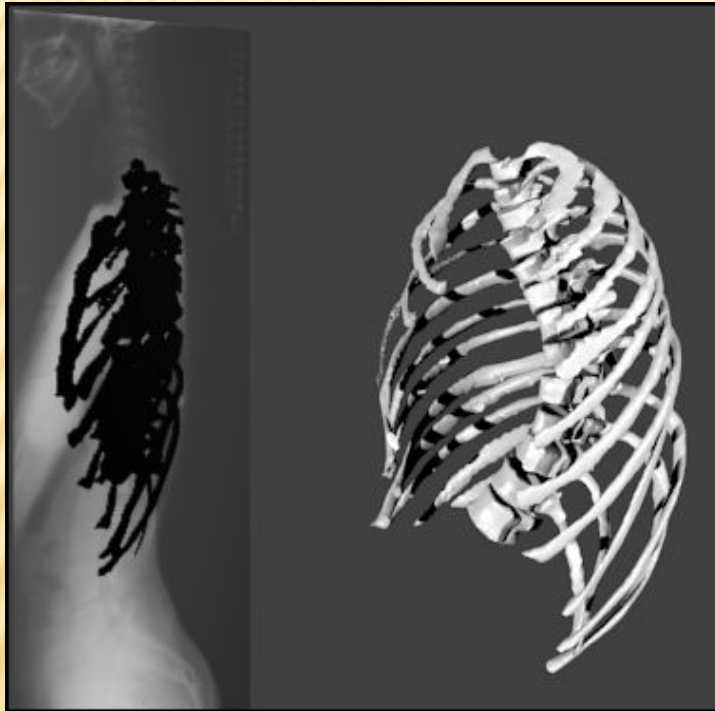
THORACIC VOLUME MODELING

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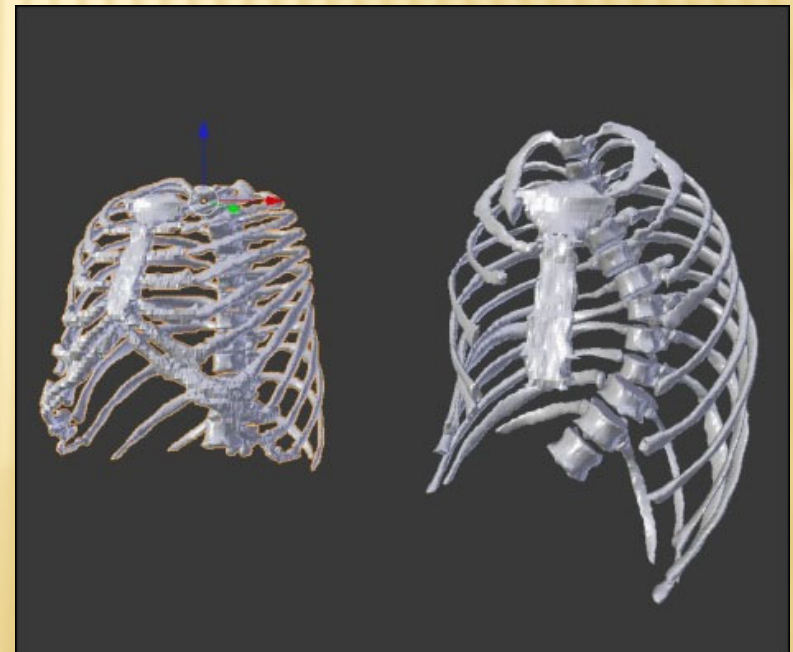
THORACIC VOLUME MODELING

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

METHODS

- Model development was performed using 4 healthy adult CTs of the thorax and then tested on eight scoliosis cases for model validity. The thoracic volumes measured for the scoliosis cases were on average 8.4 cm^3 different between the methods with a maximum error of 3.8% and a mean error of 2.4%.

CORRELATION OF PFTS WITH VOLUME

AIS Patients with the Pre-Surgical Lowest PFT Values
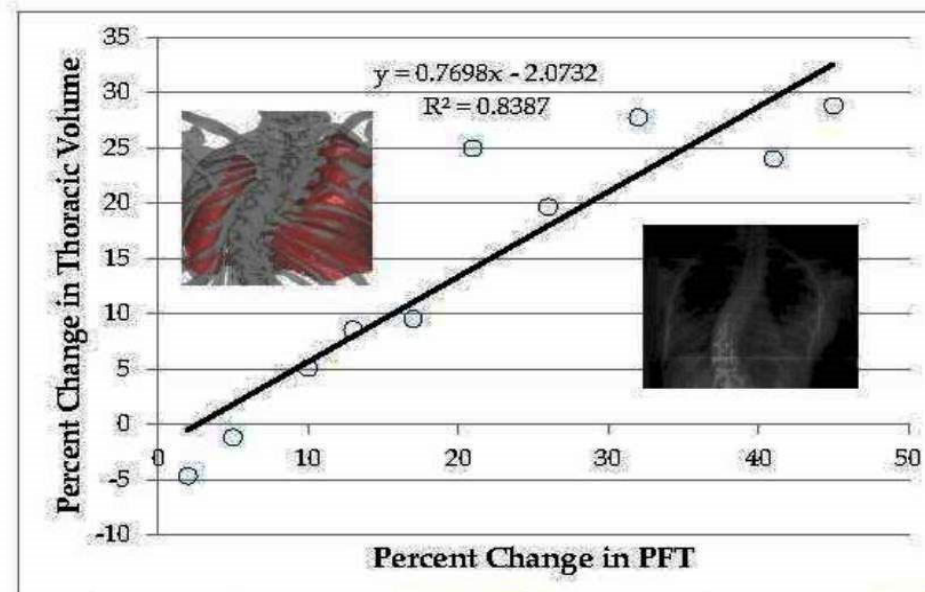
PFT Group	% Pred Preop	% Pred F/u	ΔPFT	Thx Vol Pre	Thx Vol F/u	ΔVol
Worst	55.5 ±5.5%	76.7 ±13.5%	21.2%	3253 ±425cm³	3836 ±398cm³	17.9%
Best	111.1 ±4.1%	105.8 ±9.7%	-5.3%	3526 ±702 cm³	3856 ±619cm³	9.4%

CONCLUSION

- We have developed a methodology for deforming a computational model to create a patient-specific skeletal thorax which can be used to measure thoracic volume. This model has been validated using scoliosis cases to reveal a maximal error of 3.8%. Using this model we aim to apply it to different types and severities of scoliosis and combined deformity patients to develop a prediction model wherein thoracic volume and functional outcomes may be predicted based upon the type and severity of deformity.

- Also see e poster 11

- Thanks!