

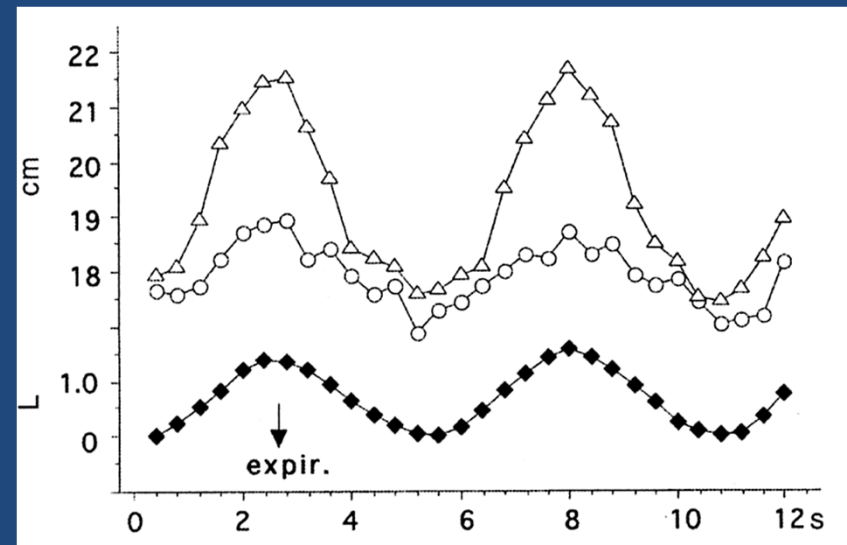
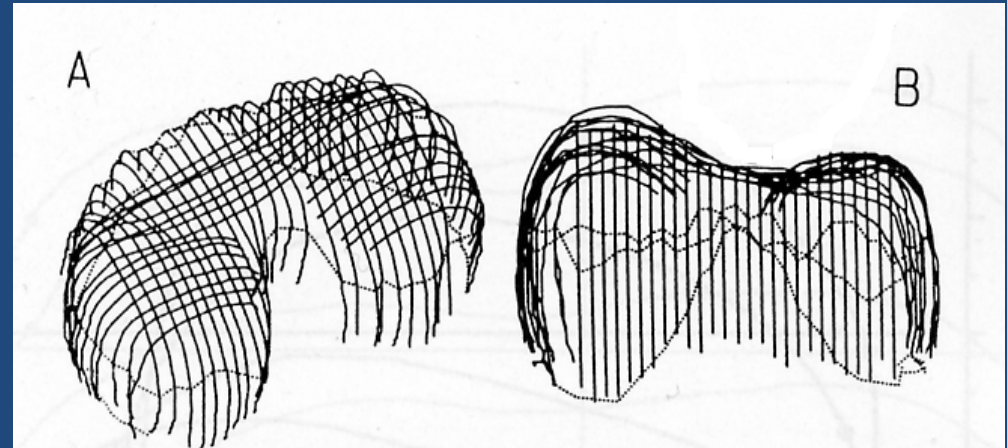
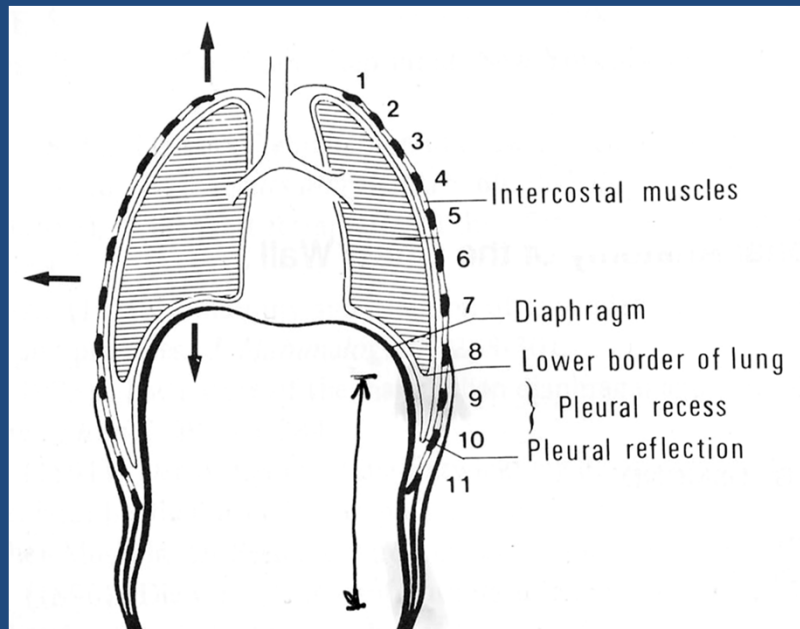
# **Diaphragm Mechanics and the Developing Chest**

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# Disclosures

- Section Editor, Pediatric Pulmonology, UpToDate

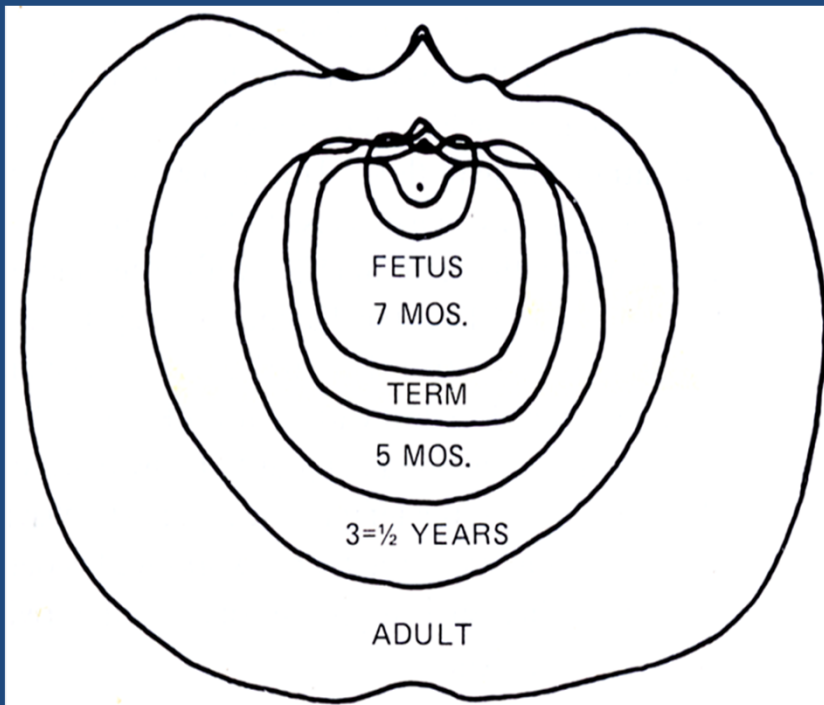
# Diaphragm Shape and Motion in Adults



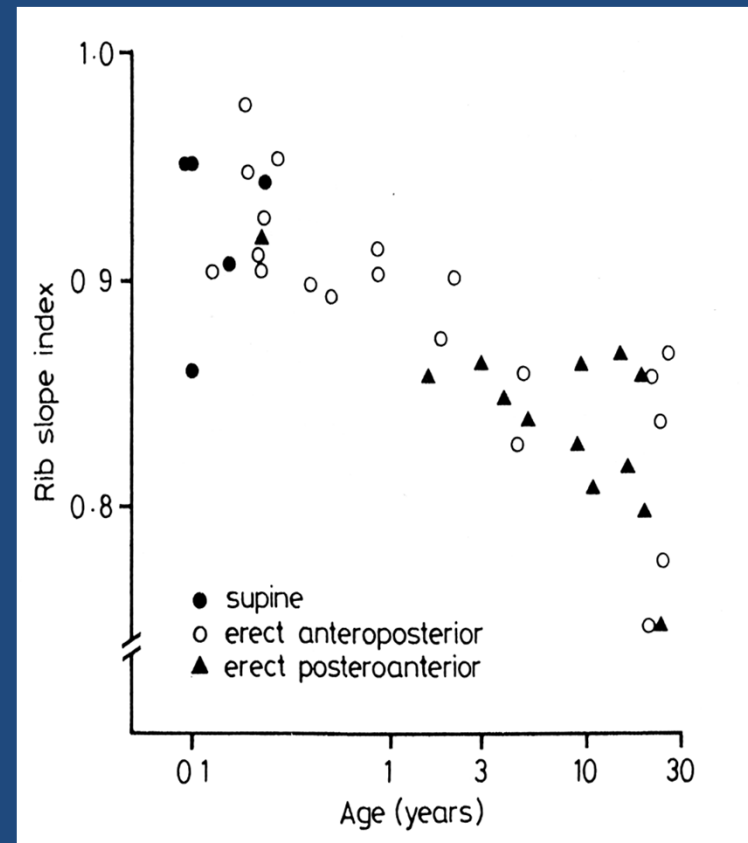
Kondo T, et al. *Respirology* 5:19-25, 2000.

Osmond DG. Functional Anatomy of the Chest Wall. In: *The Thorax. Lung Biology in Health and Disease*. Edited by Roussos C, Macklem PT. Maryland, pp.200-233, 1985.

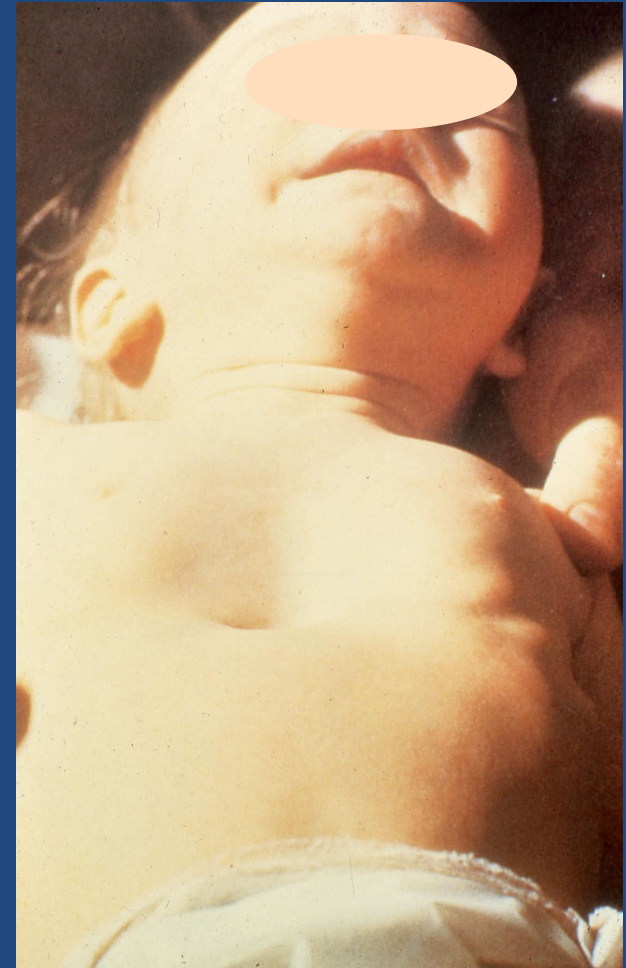
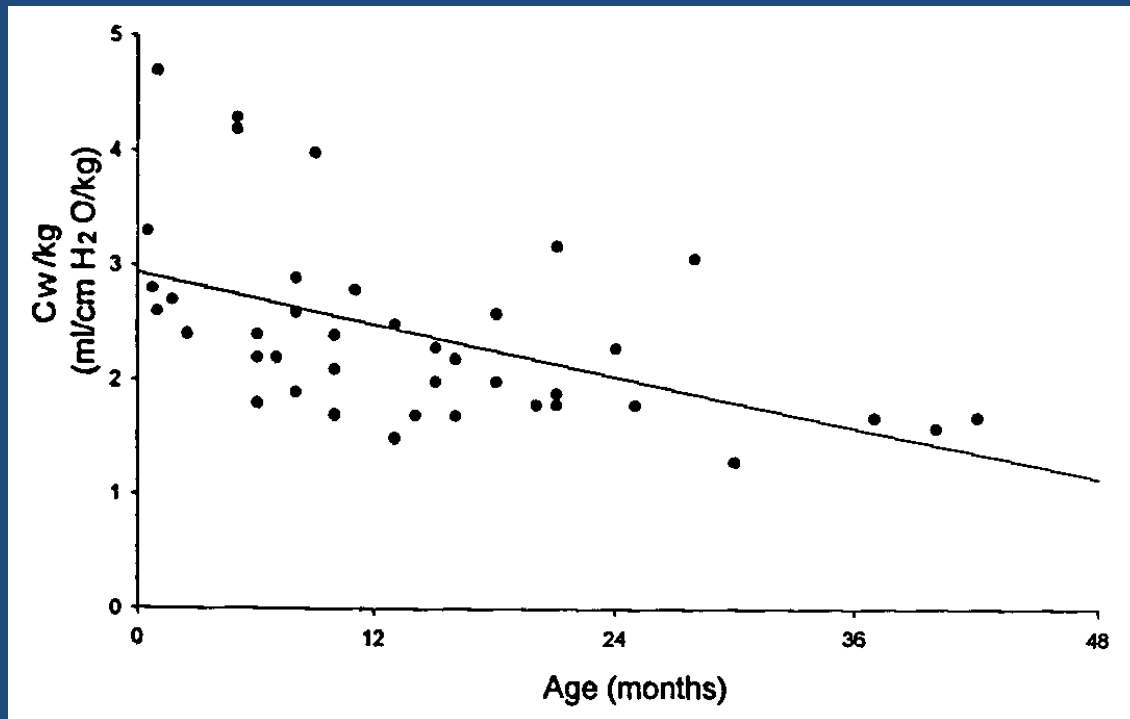
# Developmental Thoracic Features Impacting Respiratory Muscle Function



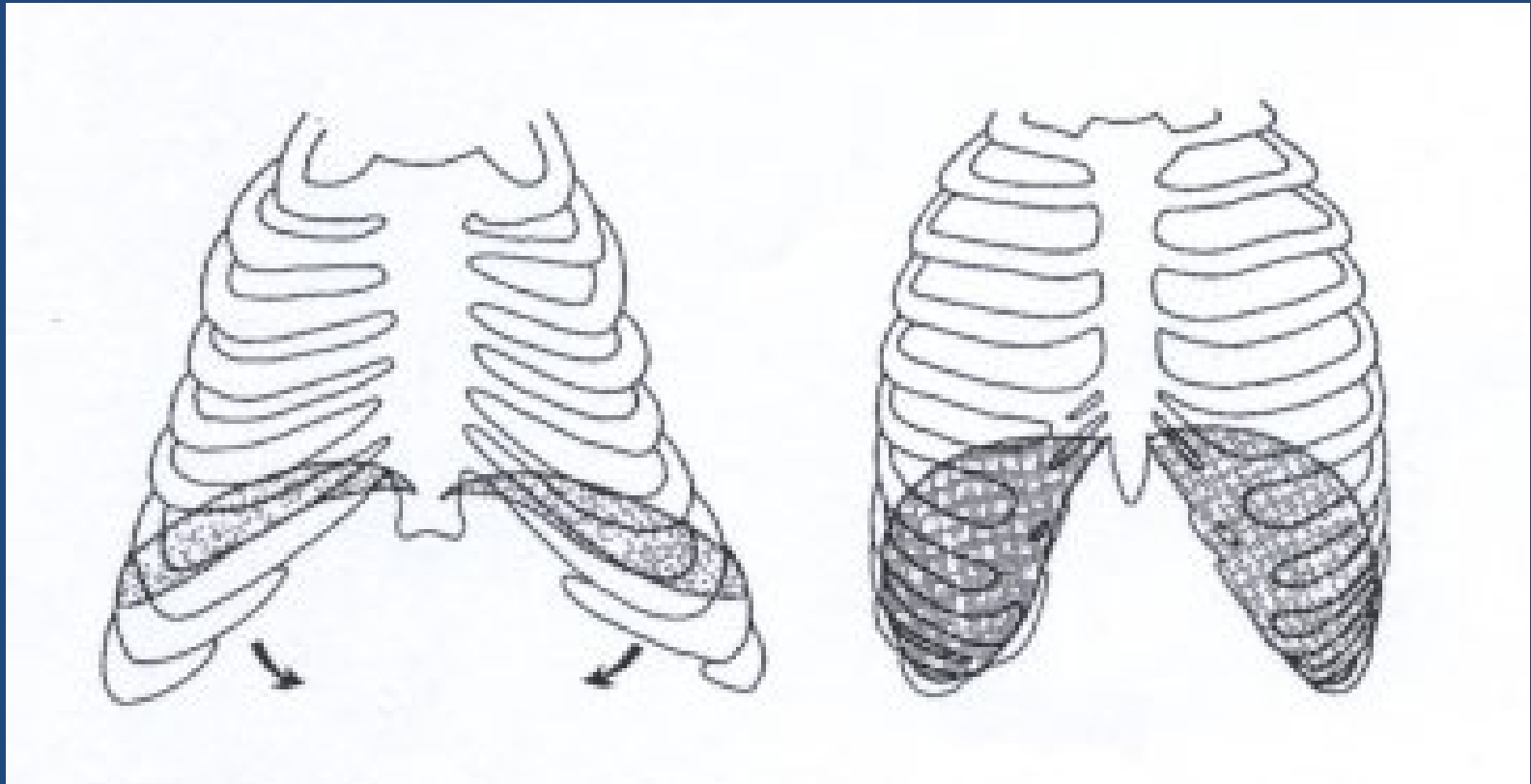
\* Slope of 1=horizontal alignment



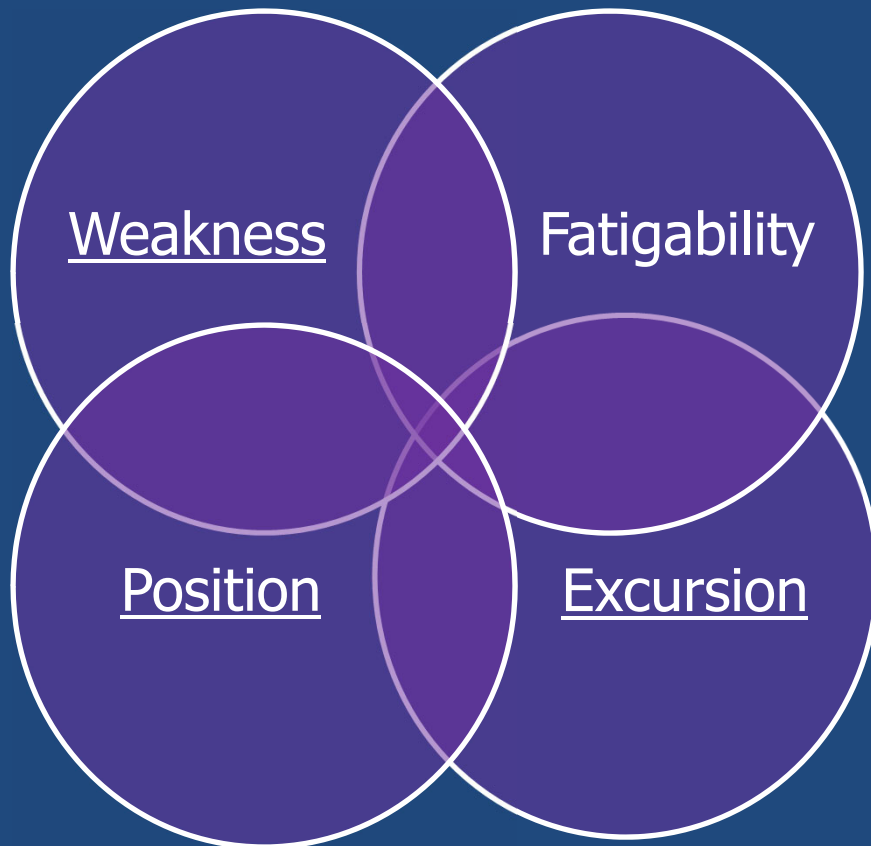
# Chest Wall Compliance in the First 3 Years of Life



# Developmental Diaphragm Features: Newborn vs Adult



# Features of Diaphragm Function



<http://www.healthcentral.com/acid-reflux/encyclopedia/diaphragm-4011519/>  
Roussos C, Macklem PT. In: The Thorax (vol 29):Marcel Dekker, Inc., 1984.

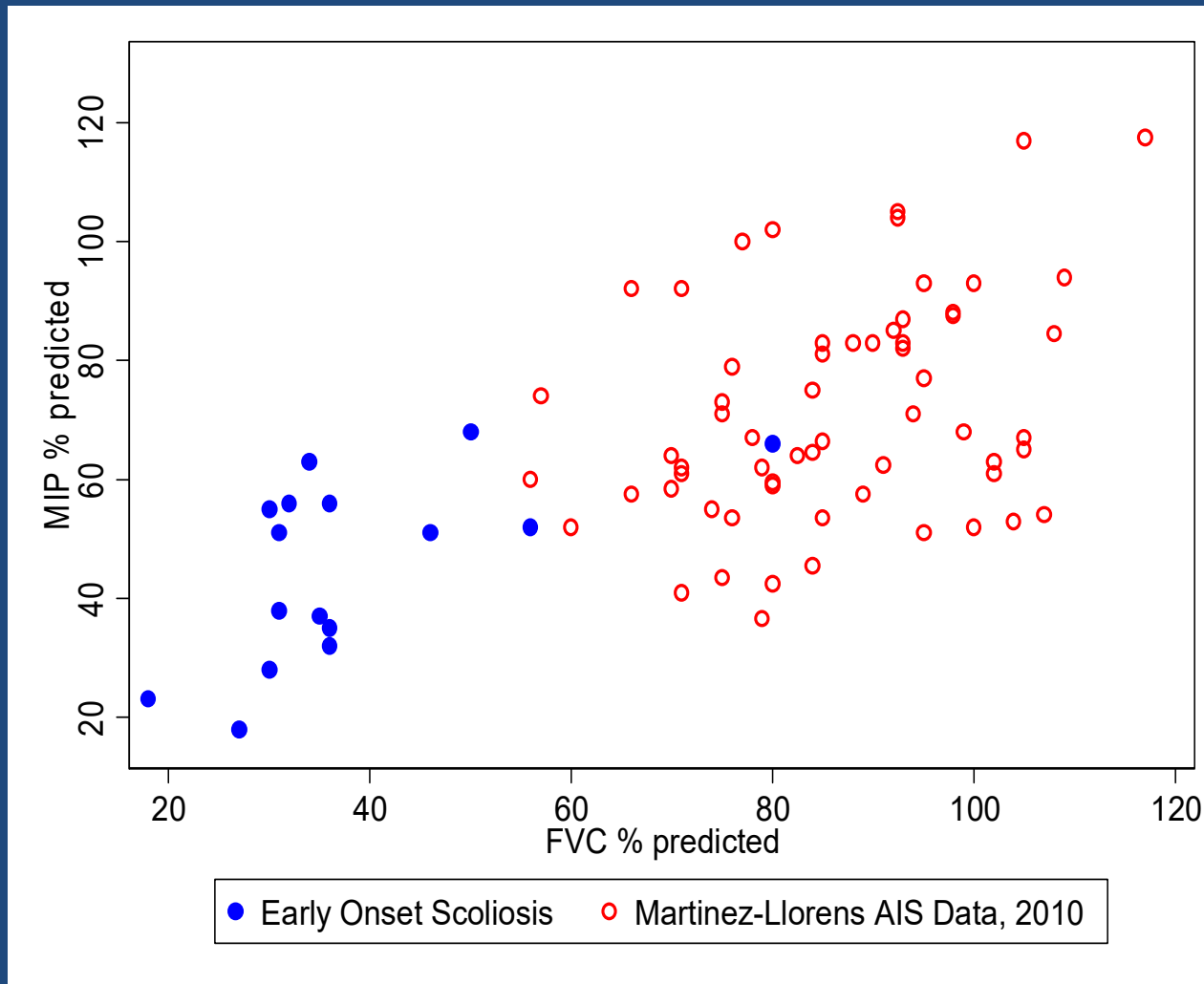
# Restrictive Respiratory Disease due to Scoliosis



- Loss of lung volume and lung distensibility
- Loss of rib mobility and chest wall excursion
- Increased reliance on diaphragm function as the primary muscle of inspiration
- Loss of respiratory muscle strength

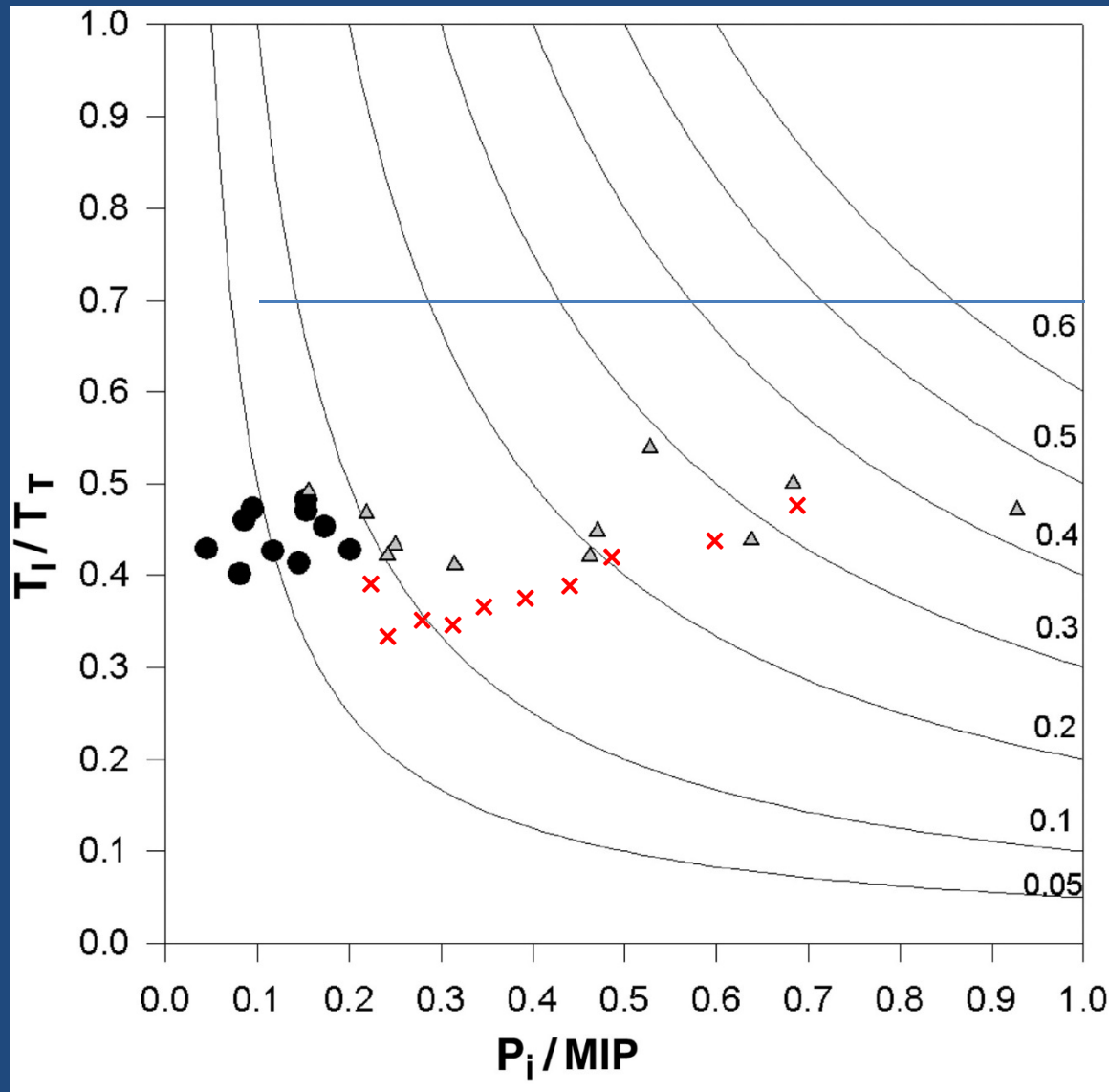


# MIP and FVC are Reduced more in EOS than AIS



Martinez-Llorens et al. *Eur Resp J* 36(2):393-400, 2010.  
Redding G, et al. ICEOS, 2012.

## Time Tension Index: Muscle Fatigability in EOS compared to normal children and those with neuromuscular weakness.

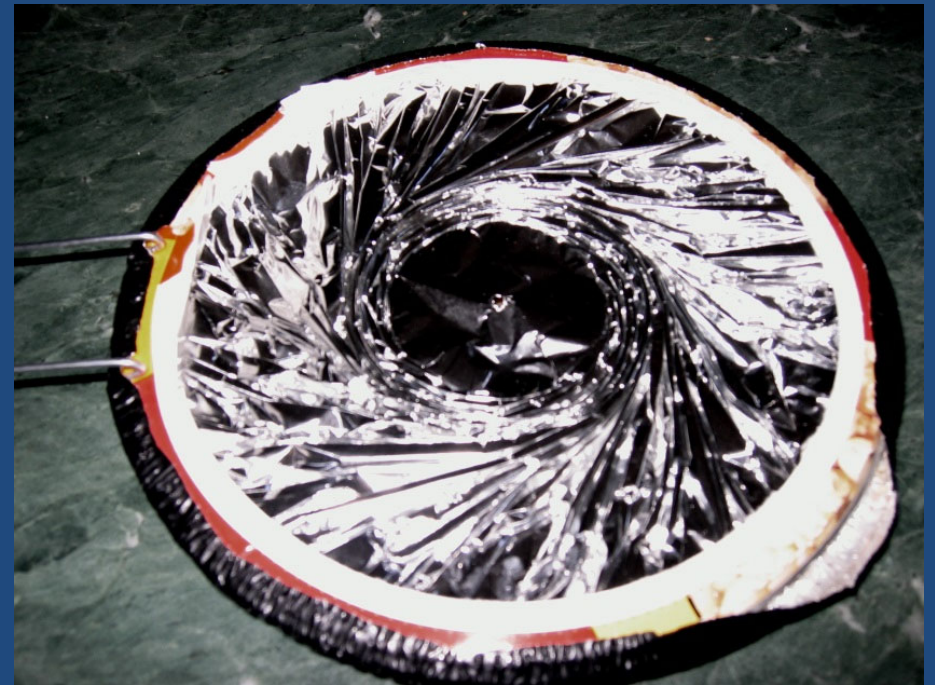
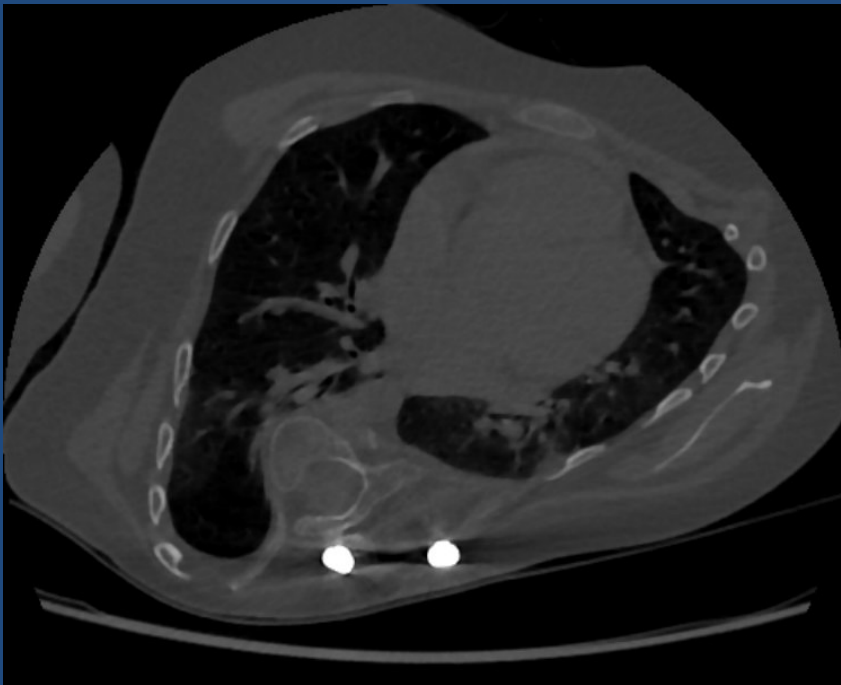


● = Normals

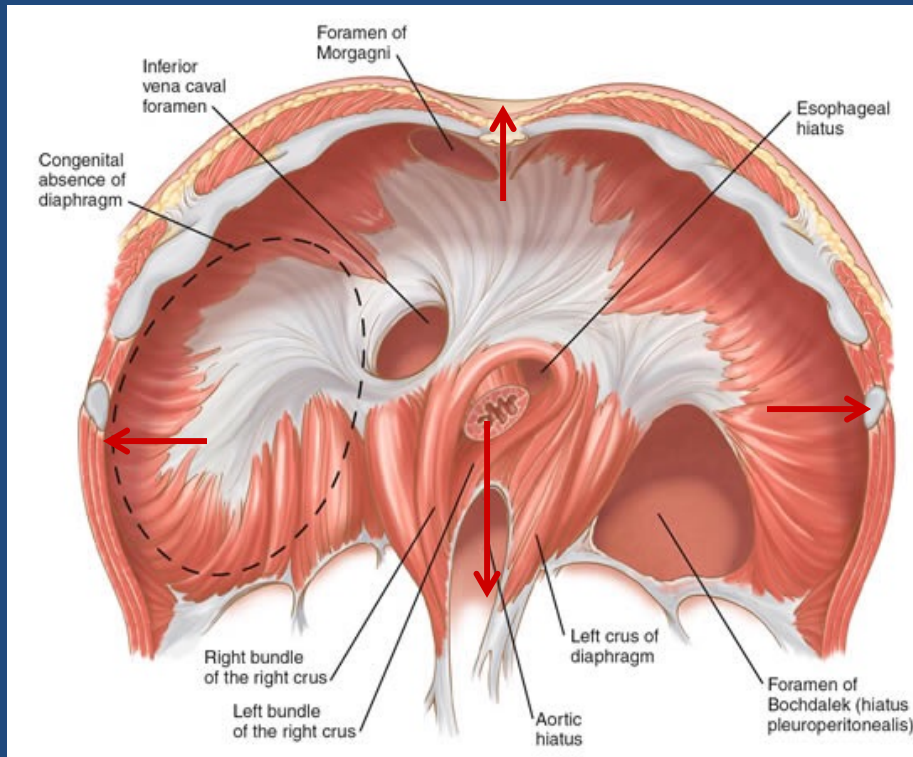
△ = Neuromuscular weakness

X = EOS without weakness

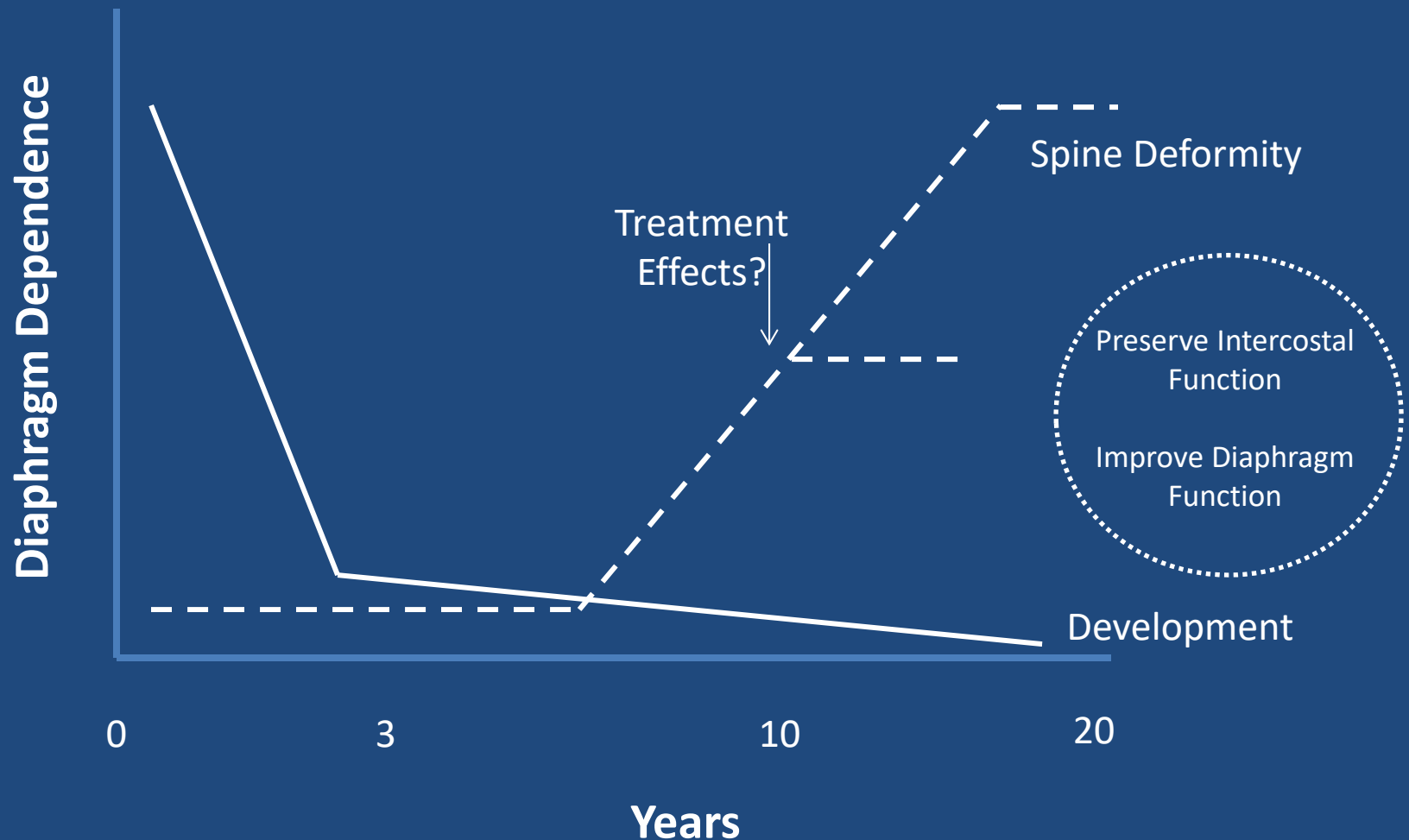
# Does Spine Rotation Influence Diaphragm Function in Infants?



# Role of The Central Tendon as a Tether in Older Children with EOS?



# Postnatal vs Deformity-related Diaphragm Dependence



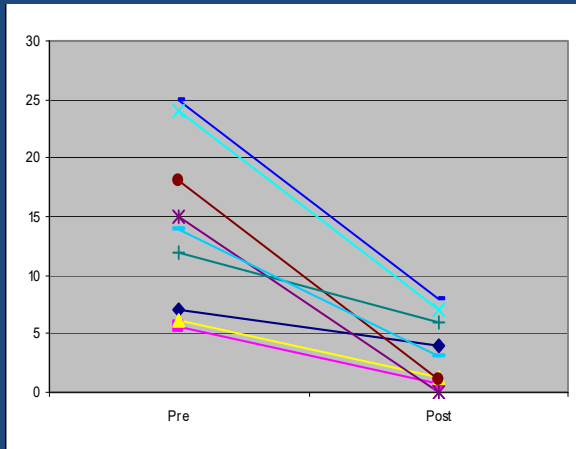
# Summary

- The diaphragm is critical to breathing for newborns and infants and in children with EOS.
- The intercostal and accessory muscles play a greater role after age 2-3 years until rendered less effective by limited rib motion due to EOS.
- Diaphragm dysfunction occurs in EOS at a time when there is no back up system to power ventilation.
- Future surgical strategies for EOS will target preservation of diaphragm function to improve long term outcomes.

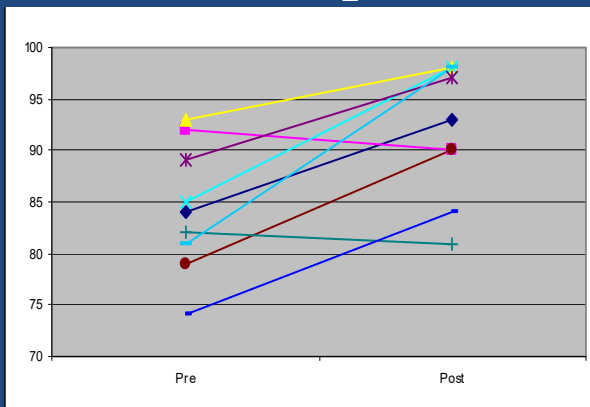


# Results: Changes in Sleep Indices After NPPV Use

AHI\*



SaO<sub>2</sub>\*



\*Significant  $p < .05$  by paired t-test