

3rd International Congress on Early Onset Scoliosis and Growing Spine

The Rib Vertebral Angle Difference – Is it reliable?

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Saturday November 21, 2009



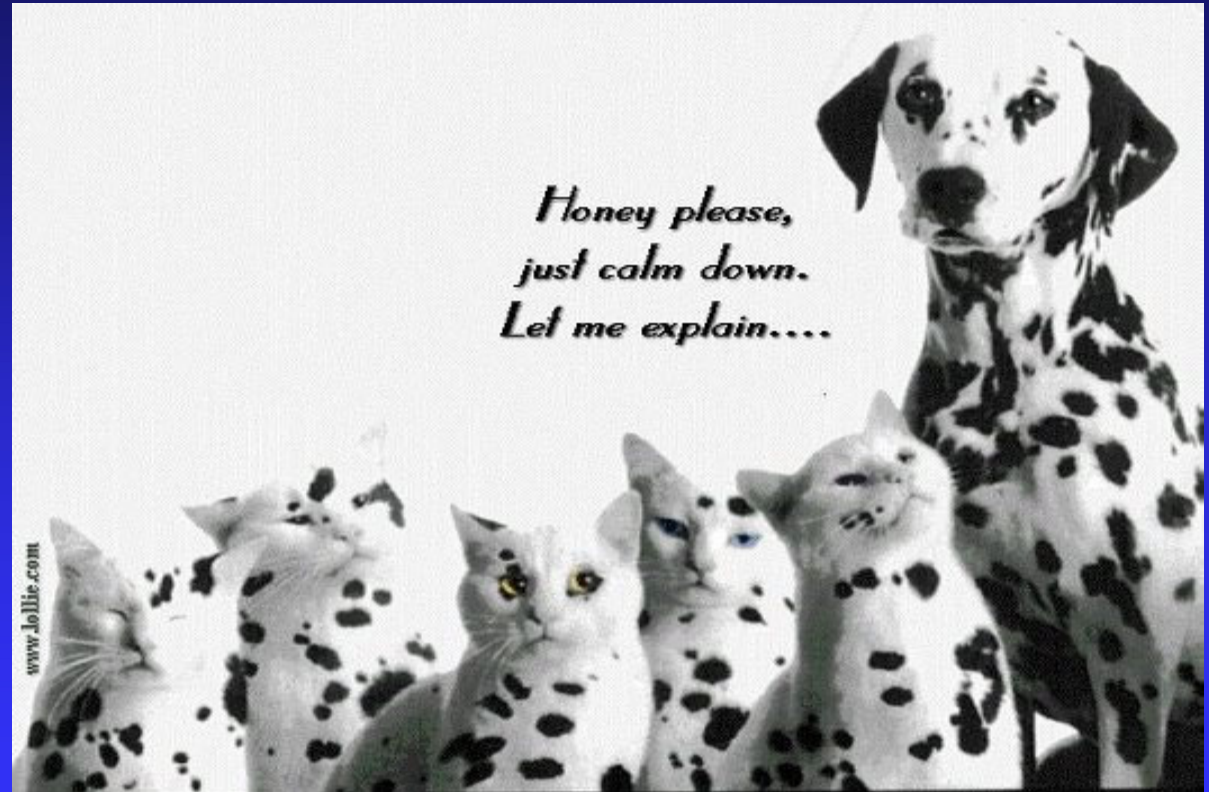
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Columbia Orthopaedics
Pediatric Orthopaedic Surgery

Disclosures

- I am a consultant for Stryker Spine and Biomet Spine
- Royalties from Biomet Spine
- Receive Divisional /Research support from Medtronic, Biomet, AO Spine



Mehta RVAD

- Described in 1972 by Mehta
- RVAD > 20 deg in IIS is associated with progression
- Cast
- Surgery
- Is this a reliable measure ?

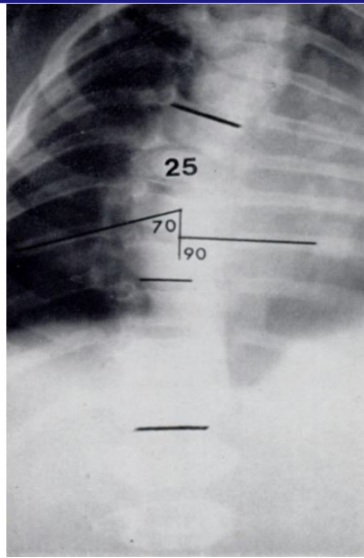


FIG. 5

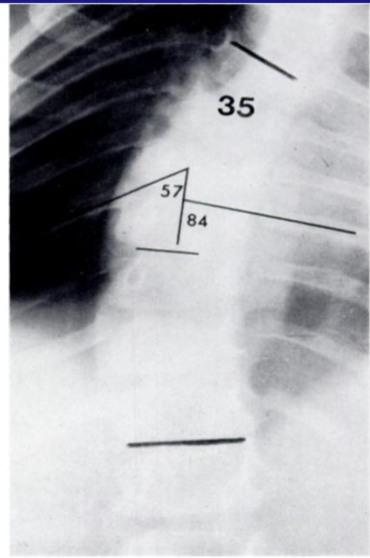


FIG. 6

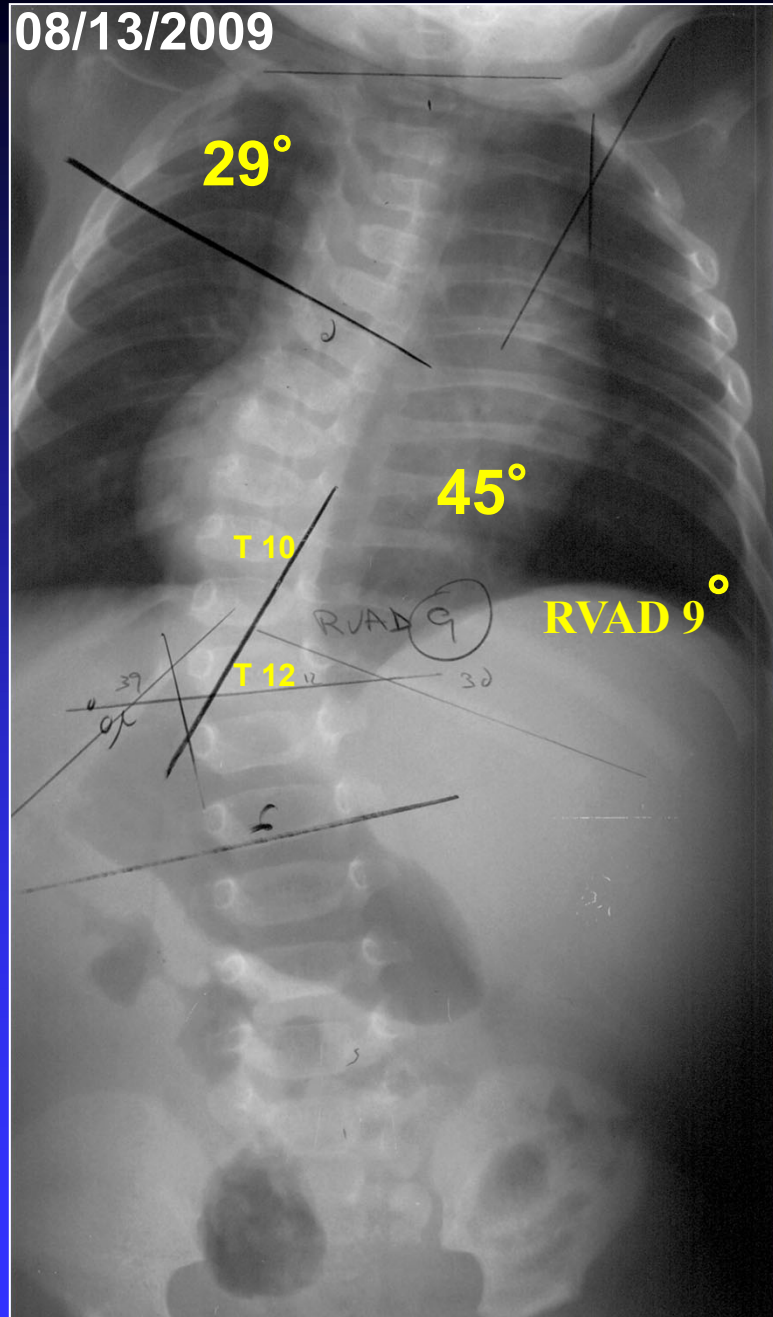
To illustrate the early stages of progressive infantile scoliosis. Figure 5—Radiograph of a mild curve in a boy of 5 months. The convex side apical rib head, the ninth, is in Phase 1. The rib-vertebra angle difference is 20 degrees. Figure 6—Radiograph of the same child at the age of 14 months showing the apical rib head in Phase 2, superimposed upon the upper corner of the vertebra. The rib-vertebra angle difference is now 27 degrees.

THE RIB-VERTEBRA ANGLE IN THE EARLY DIAGNOSIS BETWEEN RESOLVING AND PROGRESSIVE INFANTILE SCOLIOSIS*

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08/13/2009

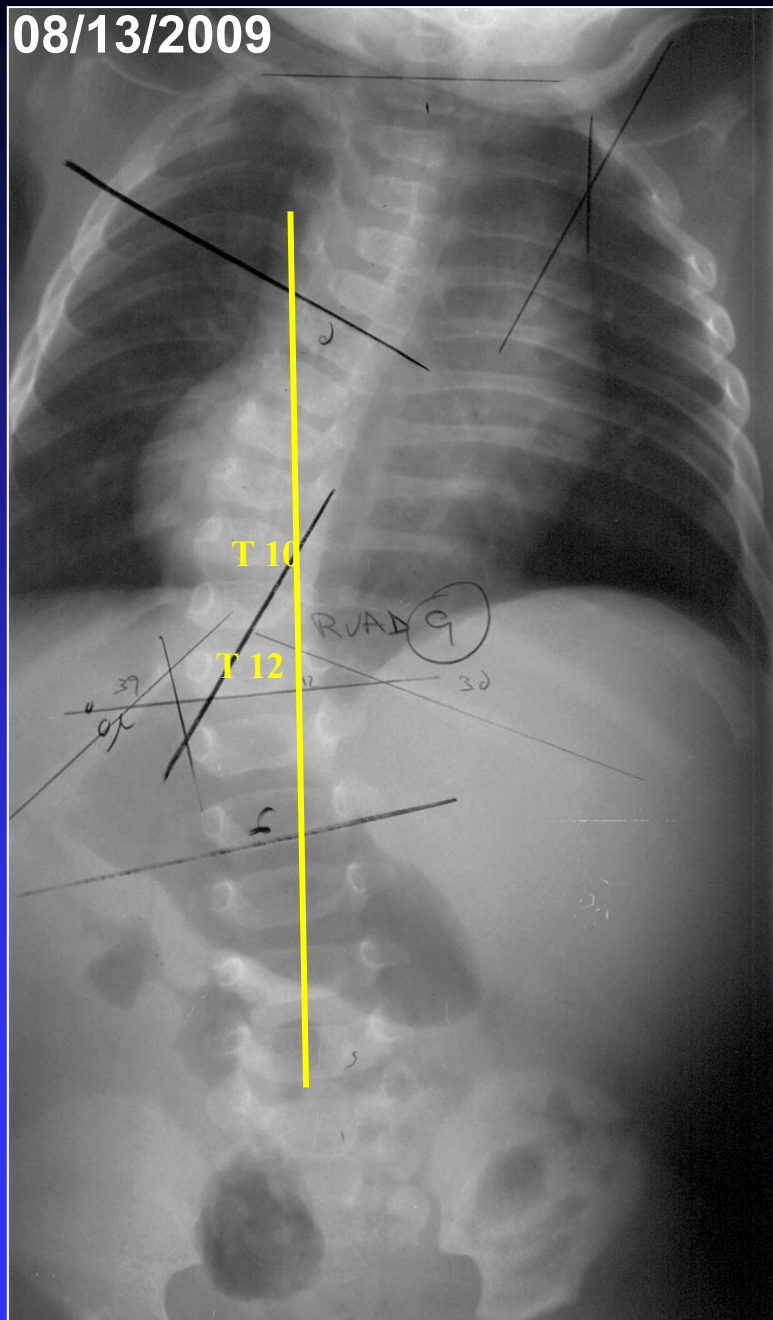


CASE MF: 5 month old male

- Laryngomalacia
- Development Appropriate
- A/P:
 - Likely IIS
 - f/u in 3 months with new films



08/13/2009



CASE MF: Other Opinions Demonstrating Variation in Interpretation of Xrays

Apex	Dr #1		
T 10			
T 11			
T 12	9		

Reliability of RVAD

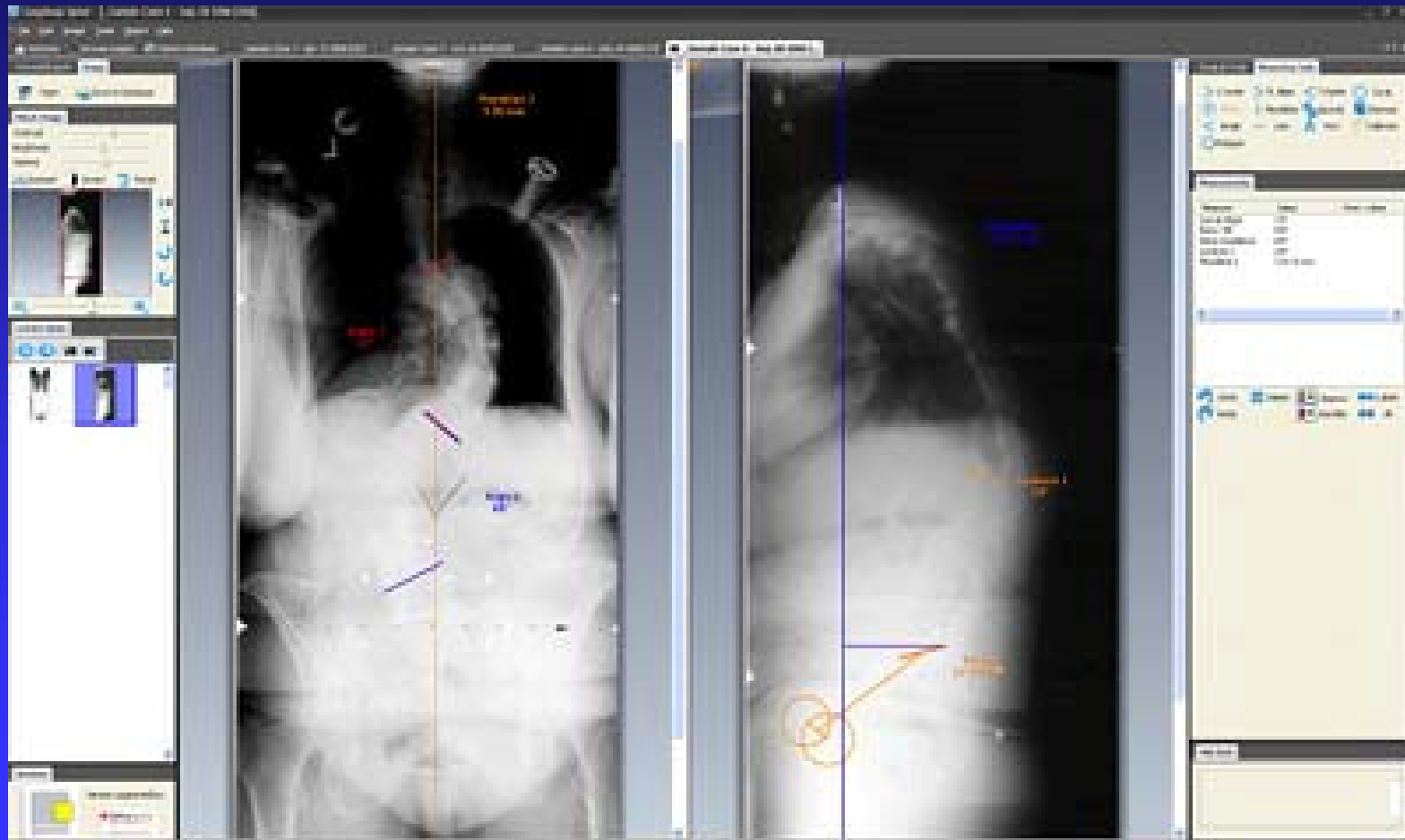
- **RVAD \pm 5 degrees**
- **Not pure Infantile population**
- **Apical vertebrae pre labeled**
- **Is RVAD truly this reliable?**

McAlindon and Kruse. Spine 1997

Methods

- 45 xrays from patients with IIS (age: 2 mo - 4 yr)
- Measured by 3 pediatric orthopaedic surgeons and a pediatric orthopaedic surgery fellow
- Surgimap Spine software
- Identified the major curve apex, rib-vertebra phase, Cobb, end vertebrae, number of vertebra
- Calculated the RVAD and the SAL
- Radiographs were measured at 2 separate time points – approximately 2 months apart
- “Will it Progress?”

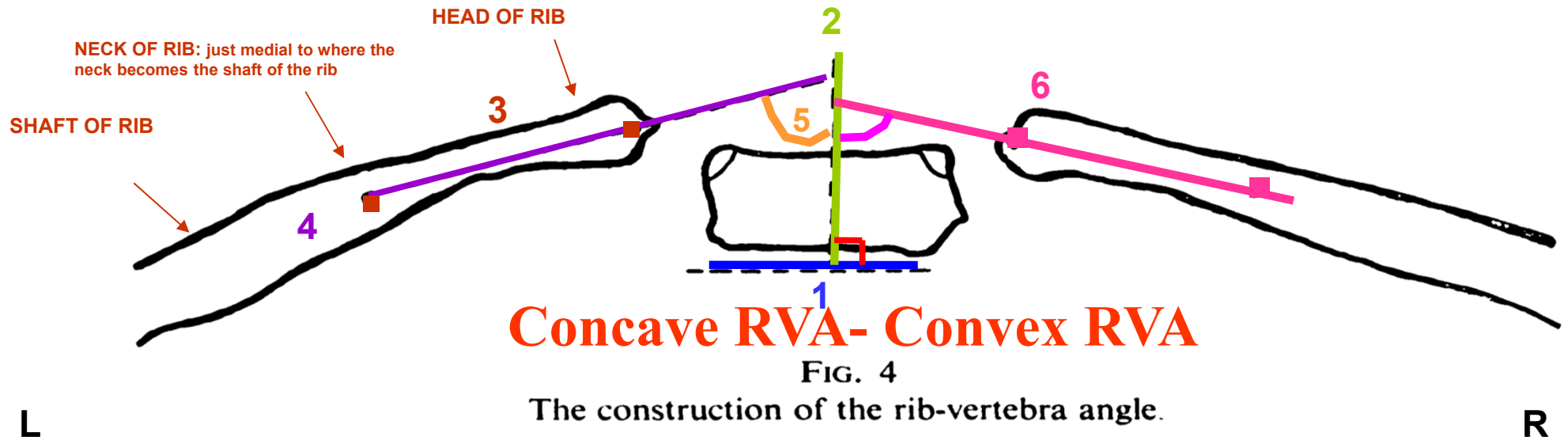
Surgimap Software



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RIB VERTEBRAL ANGLE (RVA=the angle made between a vertebrae and its rib)

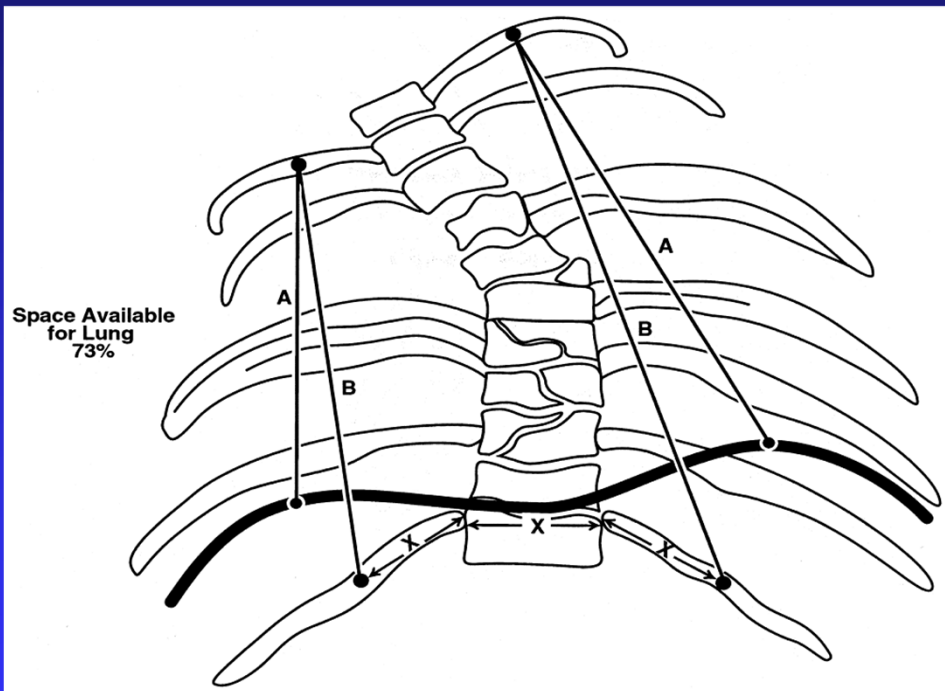
- 1) Draw a line parallel to the bottom of the apical vertebrae (apical vertebra endplate)
- 2) Draw a line perpendicular to the line drawn in STEP 1
- 3) Find the MIDPOINT of the head of the rib. Find the MIDPOINT of the neck of the rib. See dots. These markers are often just eyeballed and a mental note is taken. These landmarks are subjectively measured.
- 4) Draw a line from the MIDPOINT of the head of the rib to the MIDPOINT of the neck of the rib to the line from STEP 2
- 5) The resulting angle is the Rib-Vertebra Angle for one side.

RIB VERTEBRAL ANGLE DIFFERENCE (RVAD=the difference of the RVA on the concave side minus the RVA on the convex side)

- 6) In order to calculate the RVAD, the RVA for the Right side needs to be calculated. Use the lines created in STEP 1 and 2 above. Repeat STEPS 3-5 for the right side

Technique for measuring SAL as described in

Campbell RM J Bone Joint Surg Am. 2003; 85A: 399-408



- “The height of the hemithorax is defined as the distance from the middle of the most cephalad rib down to the center of the hemidiaphragm (A lines). A ratio, expressed as a percentage, is derived by dividing the height of the concave hemithorax by the height of the convex hemithorax.”

$$\frac{\text{A concave}}{\text{A convex}} \times 100 = \text{SAL}$$

Intra-class correlation coefficients

- Intra-class correlation coefficients (ICC's) for **continuous** variables
 - assess the inter- and intra-rater reliability
- Interpretation of the strength of reliability values
 - 0.00–0.20 slight agreement
 - 0.21–0.40 fair agreement
 - 0.41–0.60 moderate agreement
 - 0.61–0.80 substantial agreement
 - 0.81–1.00 almost perfect agreement
- Variables of interest analyzed with this method:
 - Cobb, RVAD, SAL

Fleiss' Kappa of Coefficient

- Statistical measure of inter-rater agreement **categorical** items
- Fleiss coefficient was chosen as it allows analysis for more than 2 raters
- Interpretation:
 - < 0 No agreement
 - 0.00 - 0.20 Slight agreement
 - 0.21 - 0.40 Fair agreement
 - 0.41 - 0.60 Moderate agreement
 - 0.61 - 0.80 Substantial agreement
 - 0.81 - 1.00 Almost perfect agreement
- **Variables of interest**
 - # of thoracic and lumbar vertebrae
 - Superior, inferior and apical vertebra
 - Phase (1,2)
 - Concave / Convex
 - Resolve / Progress

Descriptive

	Minimum	Maximum	Mean	Std. Deviation
Number of Thoracic Vertebrae	11	13	12.03	0.18
Number of Lumbar Vertebrae	4	6	4.99	0.26
Cobb Angle	0	82	33.26	17.77
Superior end vertebra	1	12	6.02	1.70
Inferior end vertebra	4	17	12.76	1.52
Apical vertebra	4	14	9.74	1.53
Phase	1	2	1.32	0.47
Concave / Convex	0	1	0.63	0.48
RVAD	-17	62	13.21	14.91
SAL	66	128.2974	90.11	8.73
Progress / Resolve	0	1	0.46	0.50

Intra-class coefficient – *Intra and Inter*

	Inter-rater	Intra-rater
Cobb Angle	0.99	0.99
RVAD	0.89	0.84
SAL	0.72	0.63

- Interpretation:

- < 0 No agreement
- 0.00 - 0.20 Slight agreement
- 0.21 - 0.40 Fair agreement
- 0.41 - 0.60 Moderate agreement
- 0.61 - 0.80 Substantial agreement
- 0.81 - 1.00 Almost perfect agreement

- Cobb angle = Almost perfect agreement for both
- RVAD = Good agreement for both
- SAL:
 - Moderate agreement for Intra-rater
 - Substantial agreement for inter-rater

Kappa - Group

	Inter-rater		Intra-rater	
	kappa	% agree	kappa	% agree
Number of Thoracic Vertebrae	0.08	88.64	0.39	95.94
Number of Lumbar Vertebrae	0.00	72.73	0.13	90.74
Superior end vertebra	0.16	13.64	0.25	39.29
Inferior end vertebra	0.26	11.36	0.36	49.44
Apical vertebra	0.47	31.82	0.54	63.32
Phase	0.67	75.00	0.71	87.78
Concave / Convex	0.82	84.09	0.90	95.12
Progress / Resolve	0.59	61.90	0.72	85.94

The % of agreement does not necessarily match the kappa, because the latter takes into account the risk of a rating being done “by chance” (ex: 12 thoracic vertebrae)

- Substantial agreement for Phase and Progress/Resolve (inter and intra)
- Excellent agreement Concave/Convex
- Substantial agreement for phase
- Moderate agreement for Apical vertebral or “will it progress?”

Correlations: Summary

- Cobb angle correlated with
 - Phase ($r=0.62$)
 - Curve classified as “progress” ($r=0.69$)
- RVAD correlated with
 - Cobb angle ($r=0.57$)
 - Phase ($r=0.4$)
 - Curve classified as “progress” ($r=0.57$)
- Phase
 - Curve classified as “progress” ($r=0.7$)

Summary

Surprisingly,

- Moderate/ Good Agreement for Cobb and RVAD
- Moderate agreement for choice of Apical vertebra
- Wide standard deviations for measurements
- Careful with decision making based on single numbers in gray area

Follow Up: MF at 7 months



Parents decide to
initiate casting on
10/8/2009

	8/2009	10/2009
T11 RVAD	16	19
Prox. Cobb	29	28
Distal Cobb	45	39

Thank You



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