The Classification for Early-Onset Scoliosis (C-EOS) Predicts Timing of VEPTR Anchor Failure

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Disclosures

- I am a consultant for Stryker Spine and Biomet Spine
- Royalties from Biomet Spine
- Receive Divisional support from Medtronic, Biomet, AO Spine
- Almost nothing I am discussing is approved for the indications that I am using it

Improving the Evidence Base in EOS

Development of a Research Infrastructure
Via four parallel efforts

Endpoints	Development and Validation of a Disease Specific QoL Measure
Equipoise	Evaluating clinical equipoise in the field of EOS
Classification	Developing an EOS Subgroup Classification Schema to facilitate collaboration and communication
Consensus Trial Structure	Determining inclusion criteria, treatment options and outcome measures for future research efforts

Statement of Purpose

To classify EOS patients in order to:

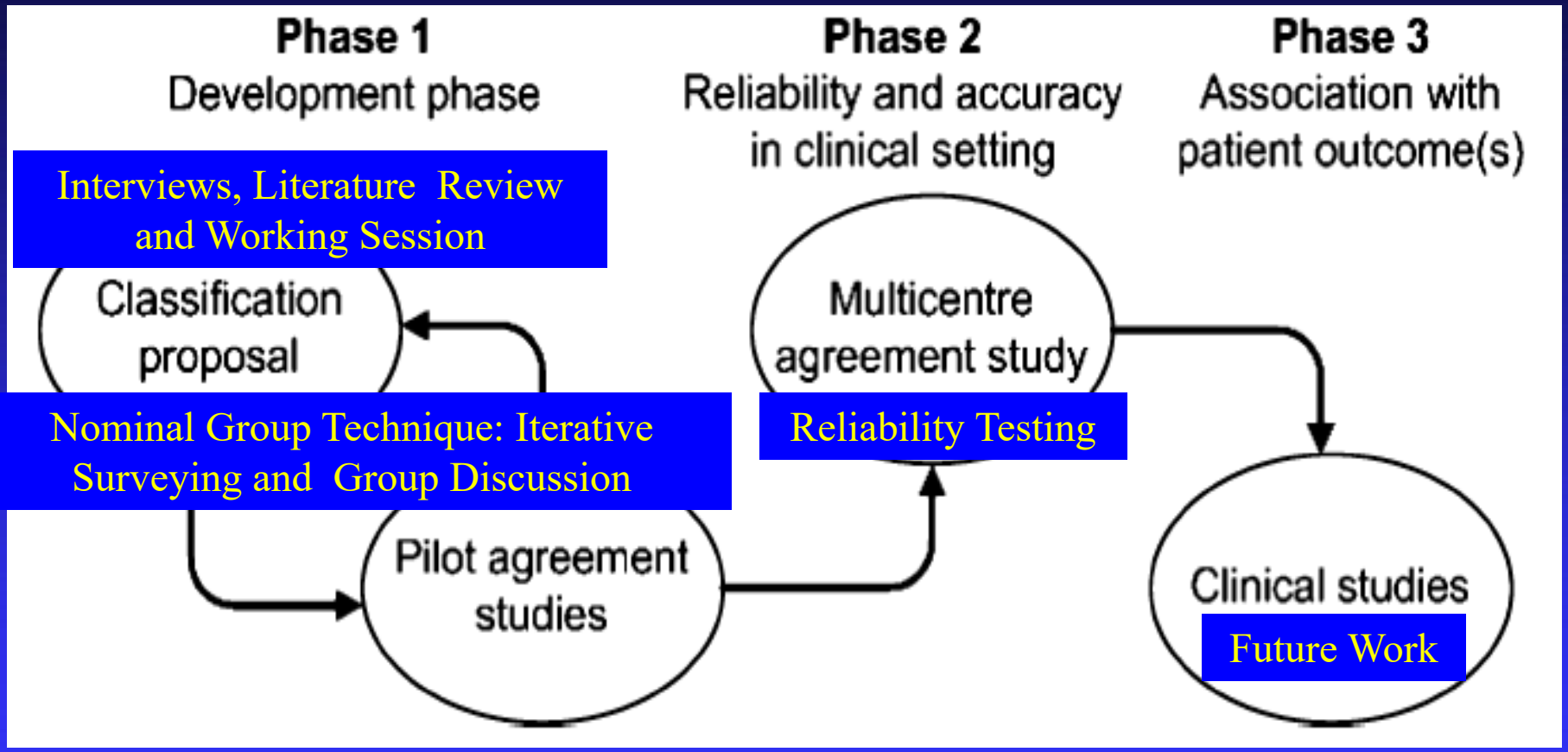
- Predict the disease course of individual patients
- Prognosticate and determine beneficiaries of differing treatment modalities
- Improve communication among EOS providers and facilitate research

Important 'Philosophical' Characteristics

- **Comprehensive:** Applicable to all EOS pts
- **Practical**: Utilized in daily practice
- **Prognostic**: Predictive of course
- **Guide**: Informs treatment decisions

An Early Onset Scoliosis 'One Liner'

Methods: Validation Pathway



Audige L et al. (2005). A concept for the validation of fracture classifications. J Orthop Trauma. 19:404-409

Development of the C-EOS

Group Discussion

Proposing Variables

- POSNA – May 2011

Iterative Survey

Assessing Variables

- May-July 2011

Group Discussion

Finalizing Variables

- ICEOS – November 2011

Validation:
Testing the Classification
2011-Present

hp2

Highest

Lowest Priority

Etiology	Cobb Angle (Major Curve)	Maximum Total Kyphosis	Progression Modifier (optional)
Congenital/Structural	1: <20º	(-) <20º	P0: <10º/yr
Neuromuscular	2: 21-50º	N: 21-50º	P1:10-20º/ yr
Syndromic	3: 51-90º	(+): >50º	P2: >20º/yr
Idiopathic	4: >90º		

Etiology (In order of priority):

***Congenital/Structural*: Curves developing due to a structural abnormality/asymmetry of the spine and/or thoracic cavity; includes hemivertebrae, fused ribs, post-thoracotomy, or CDH.**

- ***Neuromuscular*: Patients with CP, spinal dysraphism, SMA, myopathies, and dystrophies**
- ***Syndromic*: Patients with possible association with scoliosis (including spinal dysraphism)**
- ***Idiopathic*: No clear causal agent (can include children with a significant co-morbidity that has no defined association with scoliosis)**

Cobb Angle: Measurement of major spinal curve in position of most gravity

Maximum measurable Kyphosis: between any 2 levels

Annual Progression Ratio Modifier *(optional)*:

Progression per year;
min. 6 months between observation

$$\frac{(\text{Cobb @ } t_2) - (\text{Cobb @ } t_1) \times 12 \text{ months}}{[t_2 - t_1]}$$

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Early Validation of the C-EOS

Utilized Dr. Jack Flynn's (CHOP) data on time to VEPTR Anchor Failure

- patients from CWSDSG registry who had identified failure of proximal rib anchors

Hypothesis

The C-EOS will differentiate patients at high vs low risk of early proximal anchor failure

Data Characteristics by C-EOS Variable

N=105

Etiology
Congenital: 56 (53.3%)
Neuromuscular: 33 (31.4%)
Syndromic: 8 (7.6%)
Idiopathic: 8 (7.6%)

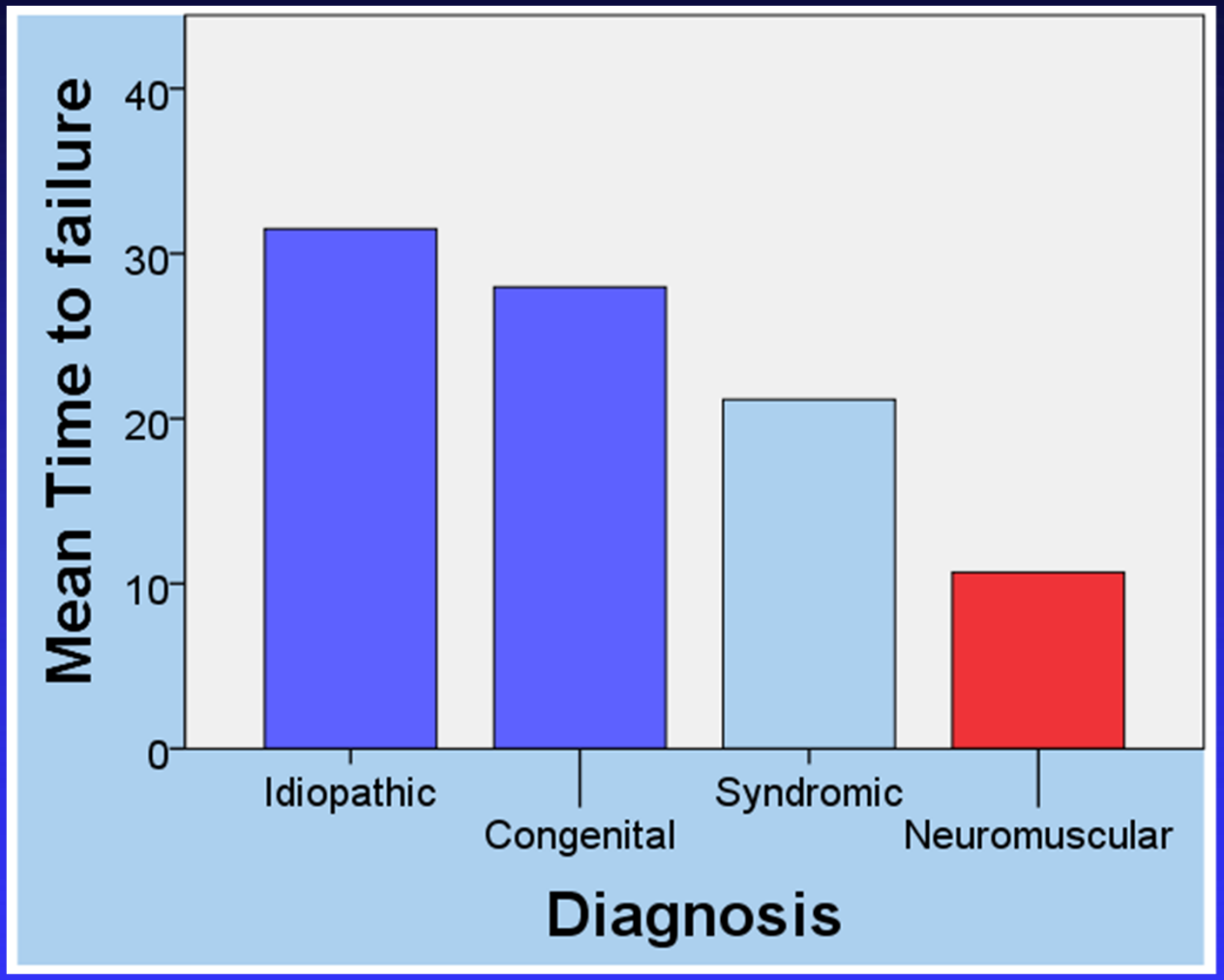
Cobb Angle
0-20°: n = 0
21-50°: n = 17
51-90°: n = 71
>91°: n = 17

Kyphosis***
<50°: 61
>50°: 26

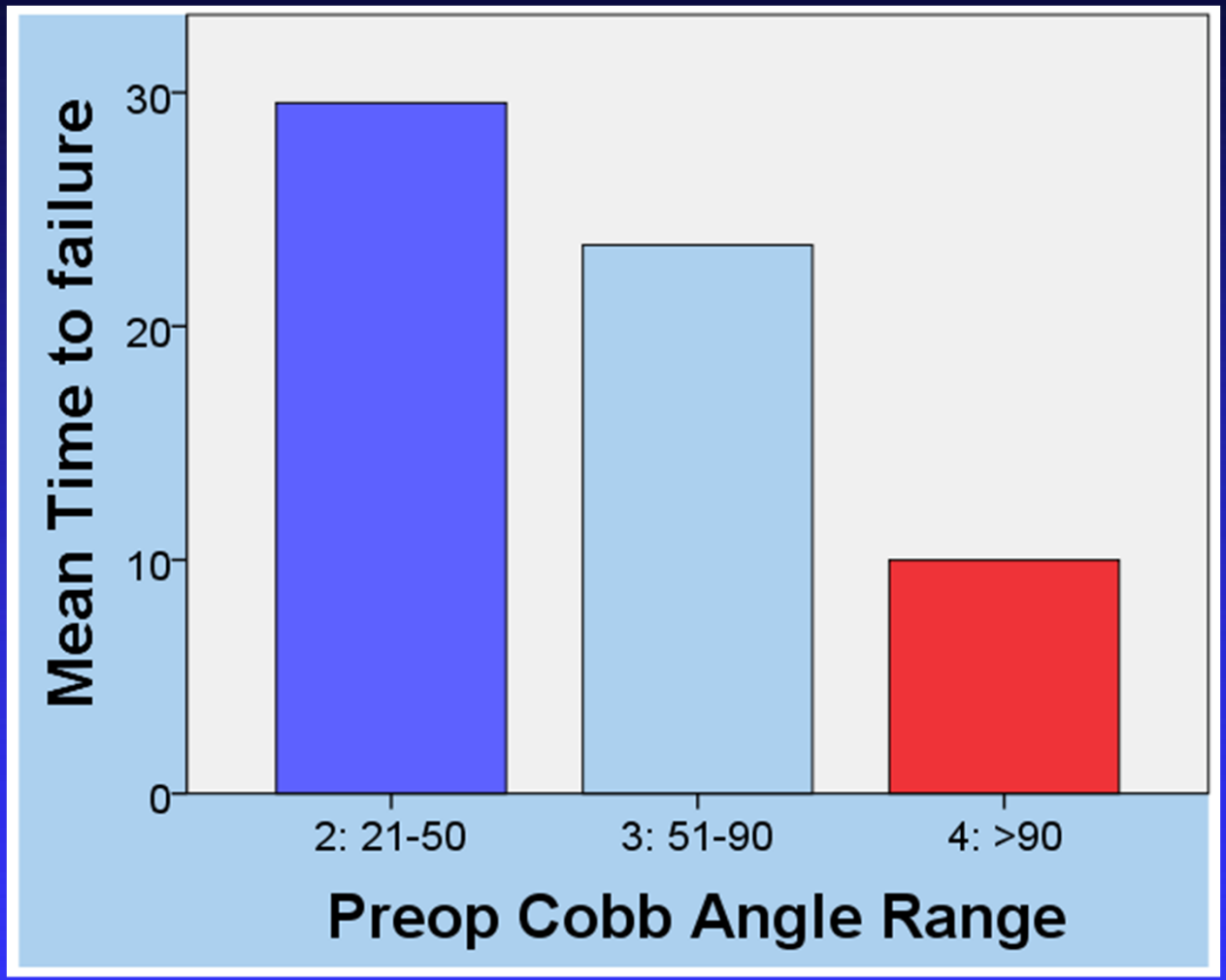
***Data Limitations

- Kyphosis only recorded as < or >50 degrees
  - Classification necessitates <20, 21-50, >50
- 18 missing kyphosis

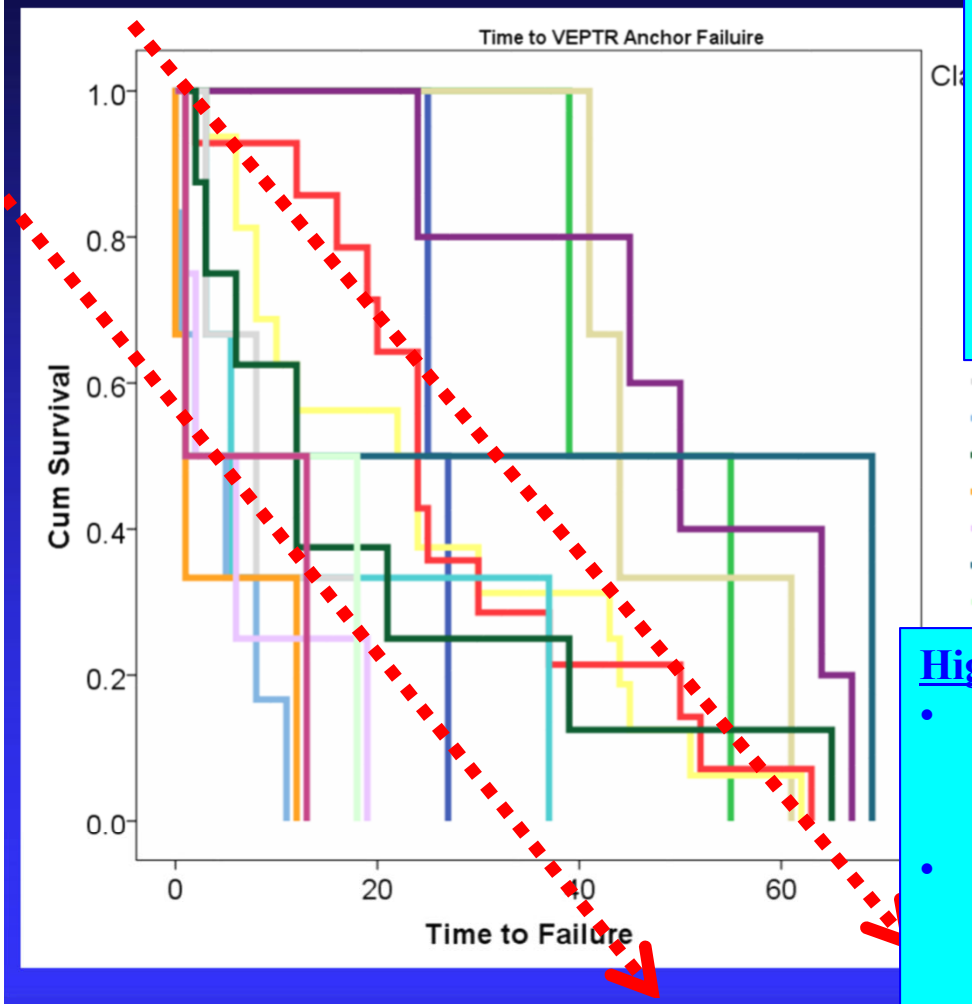
Neuromuscular Pts Exhibit Rapid Failure



Curves >90° Pts Exhibit Rapid Failure



Reliability and Validation



Low Risk

- Congenital with Cobb 21-50° & 51-90° with all kyphoses represented
  - C2N, C2+, C3-
- Syndromic with Cobb 21-50° and kyphosis 21-50°
  - S2N

Medium Risk:

- Congenital with Cobb 21-50°, 51-90°, & >90 with all kyphoses represented
  - C2-, C3N, C3+, C4+
- Neuromuscular with Cobb 51-90° and kyphosis >50°
  - N3+

High Risk:

- Neuromuscular with Cobb 51-90° & >90° with all kyphoses represented
  - N3-, N3N, N4N, N4+
- Syndromic with Cobb 51-90° and kyphosis >50 °
  - S3+
- Idiopathic with Cobb 51-90° and kyphosis >50 °
  - I3+

Flynn et al.

Conclusions

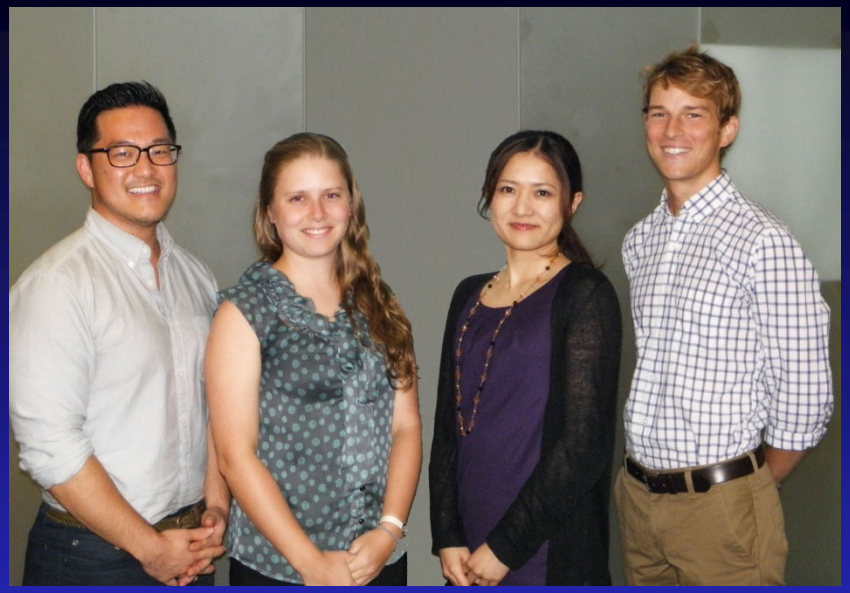
- C-EOS is able to stratify risk of rapid VEPTR anchor failure
  - Supports validity of C-EOS instrument
  - Potential for use in clinical setting

- Neuromuscular etiology and curves > 90° as individual variables at high risk of rapid anchor failure

Next: 5 Year Out C-EOS Study

C-EOS applied to min. 5 Yr follow up pts:

- **Purpose:** Apply C-EOS to identify trends
- **Methods:**
  - Retrospective review of CWSDSG & GSSG database
  - Min 5 year follow-up
- **Endpoints:**
  - Treatment course
  - Complications per Dr. Smith's Growing Spine Complications Classification
  - Change in coronal and sagittal curve over time
- **Status:** Pending data collection from CWSDSG and GSSG Registry



Thank You

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