The Classification for Early Onset Scoliosis (C-EOS) Identifies Patients at Higher Risk for Complications at 5 Years of Follow Up

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-Disclosures-

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Improving the Evidence Base in EOS

Development of a Research Infrastructure
Via five parallel efforts

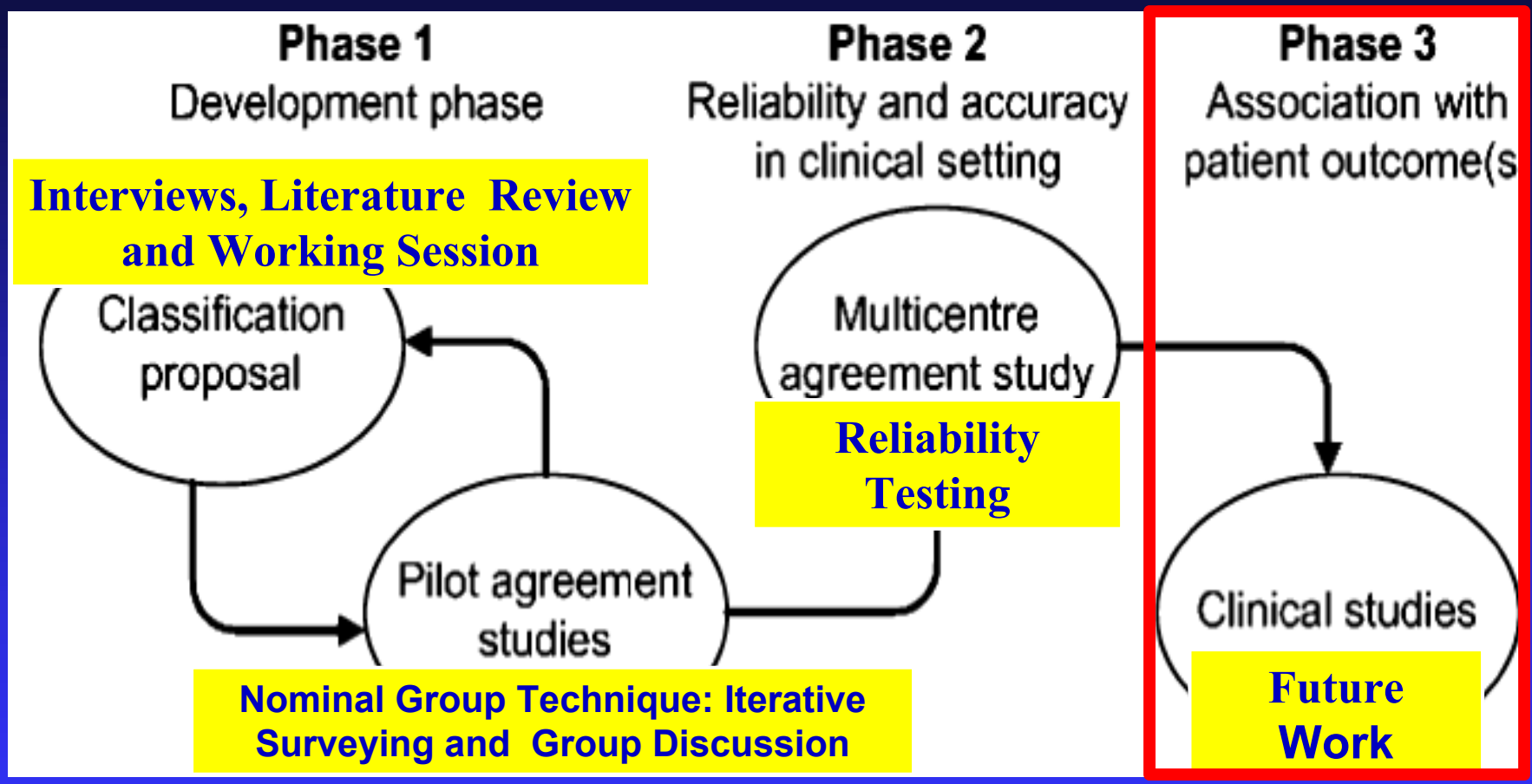
Endpoints	Development/Validation of a Disease-Specific QoL Measure
Equipoise	Identifying Clinical Equipoise in the Field of EOS
Classification-EOS	Development / Validation of Classification for EOS
Standardizing Complications	Standardize Way We Define and Report Complications
Clinical Trials	Proximal Anchors: Rib Vs Spine – Retrospective (Prospective Underway)

Background

Development of C-EOS

Age	Etiology	Cobb Angle (Major Curve)	Maximum Total Kyphosis	Progression Modifier (optional)
Continuous Prefix	Congenital/ Structural	1: <20°	(-) <20°	P0: <10°/ yr
	NeuroMuscular	2: 20-50°	N: 20-50°	P1:10-19°/ yr
	Syndromic	3: 51-90°	(+): >50°	P2: >20°/ yr
	Idiopathic	4: >90°		

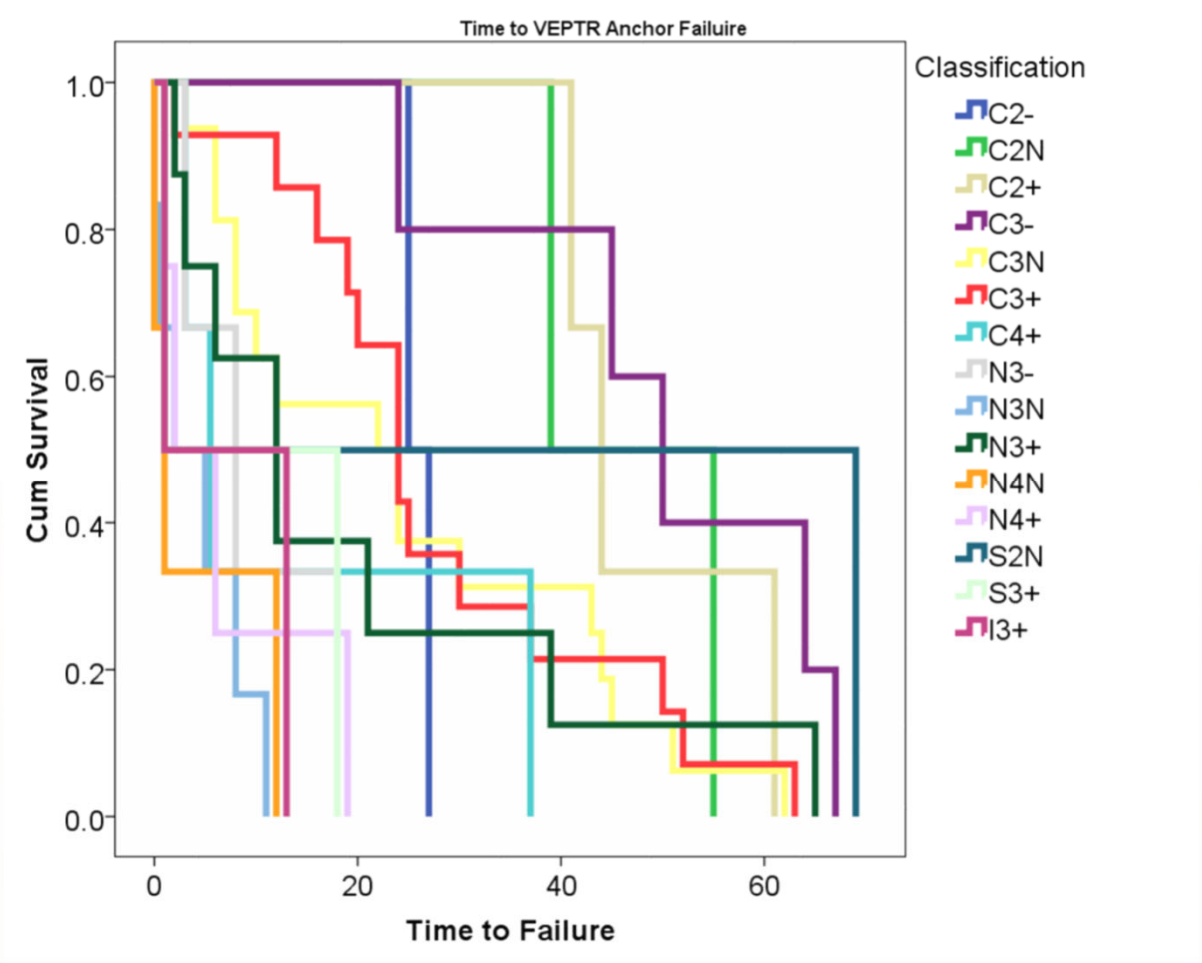
Methods: Validation Pathway



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

Initial Validation of C-EOS

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



Vitale, Flynn et al

Purpose: Further Validation of the C-EOS

To validate the prognostic potential of the C-EOS by examining the rate and severity of complications in surgical EOS patients

Age	Etiology	Cobb Angle (Major Curve)	Maximum Total Kyphosis	Progression Modifier (optional)
Continuous Prefix	Congenital/ Structural	1: <20°	(-) <20°	P0: <10°/ yr
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	Idiopathic	4: >90°		

Methods

- **Methods:**
  - Retrospective review of CSF & GSSG databases
  - Inclusion: EOS pts with *min 5 year follow-up* from index surgery
- **Outcomes:**
  - Complications
    - Rate
    - Severity

Classification of Complications in Growing Spine Surgery

JT Smith, D Skaggs, C Johnston, MG Vitale

- **Device Related Severity Grade**

1 – No unplanned surgery	**eg HWR prominence**
2A – 1 unplanned trip to OR	**eg rod fracture**
2B – Multiple trips to OR	**eg infection**
3 – Alteration in treatment plan	**eg fusion**

52 of 78 Patients Experiences Some Complication at 5 years

Complication Grade:

1 (resolved):	18
2a (1 unplanned trip to OR):	24
2b (multiple):	4
3 (change in outcome)	18

Etiology Alone Did not Predict Rate of Device Related Complications, N=161

Rate of Device Related Complications of *any Severity* per Etiology		
Etiology		**Percent**
Congenital	28/50	56.0%
Idiopathic	19/32	59.4%
Neuromuscular	30/45	66.7%
Syndromic	23/34	67.6%
		P = .629

Rate of Device Related Complications ≥ 2A per Etiology		
Etiology		**Percent**
Idiopathic	7/32	21.9%
Congenital	18/50	36%
Neuromuscular	19/45	42.2%
Syndromic	15/34	44.1
		P = .218

No Idiopathic Patient Experienced a Complication Which Required Return to OR or Change in Treatment

Irrespective of Cobb Angle, Kyphosis:

- **100% Idiopathic case complications ≤ 2A**

Cobb Angle Alone Did Not Predict Rate of Complications

Rate of Device Related Complications of *any Severity* per Cobb Angle		
Cobb Angle		Percent
≤20° (1)	2/2	100.0%
21-50° (2)	14/21	66.7%
51-90° (3)	70/112	62.5%
>90° (4)	13/24	54.2%
		P = .561

Rate of Device Related Complications ≥ 2A per Cobb Angle		
Cobb Angle		Percent
≤20° (1)	0/2	0.0%
21-50° (2)	9/21	42.9%
51-90° (3)	43/112	38.4%
>90° (4)	7/24	29.2%
		P = .531

Kyphosis Alone did not predict Rate of Complications

Rate of Device Related Complications of *any Severity* per Grade Kyphosis		
Kyphosis		Percent
≤ 20° (-)	4/5	80.0%
21-50° (N)	33/47	70.2%
>51° (+)	21/31	67.7%
		P = .855

Rate of Device Related Complications ≥ 2A per Grade Kyphosis		
Kyphosis		Percent
≤ 20° (-)	3/5	60.0%
21-50° (N)	23/47	48.9%
>51° (+)	11/31	35.5%
		P = .391

Rate of Device Related Complications by C-EOS, N=78

Numbers across cells too small for comparison

Rate of Device Related Complication of any Severity per C-EOS		
C-EOS		Percent
N4+	0/0	0.0%
N2N	1/2	50.0%
I2N	2/4	50.0%
I3N	3/5	60.0%
C3N	10/16	62.5%
S3+	2/3	66.7%
C3-	2/3	66.7%
I3+	2/3	66.7%
C3+	5/7	71.4%
C2N	3/4	75.0%
S2N	3/4	75.0%
N3+	4/5	80.0%
S3N	4/5	80.0%
S4+	1/1	100%
S3-	1/1	100%
C4+	1/1	100%
N3N	5/5	100%
C3+	2/2	100%
N2+	1/1	100%
N1+	1/1	100%
I4+	3/3	100%

Severe Complications (10) Occur in Patients with Large Cobb and in Hyperkyphotic Patients

C-EOS	Complication Severity				
	1	2A	2B	3	Total
C2N	2	0	1	0	3
C3-	1	1	0	0	1
C3N	2	8	0	0	10
C3+	1	2	0	2	5
C4+	0	0	0	1	1
N1+	1	0	0	0	1
N2N	0	1	1	0	2
N2+	0	0	1	0	1
N3N	1	4	0	0	5
N3+	2	0	1	1	4
N4+	0	0	0	0	1
S2N	1	1	0	1	3
S3-	0	1	0	0	2
S3+	2	0	0	0	2
S3N	1	2	0	1	4
S4+	0	0	0	1	1
I2N	1	1	0	0	2
I3N	1	2	0	0	3
I3+	2	0	0	0	2
I4+	0	1	0	0	1

Among the most severe complications (Class 3):

- **6/6 Cobb > 51°**
- **4/6 Hyperkyphotic**
- **0/6 Idiopathic**

Conclusions

- 67% of patients experience some complication within first 5 years, although only 18% affect outcome
- Non-idiopathic patients experience more, and more significant complications
- Severe complications occur in patients with large Cobb, hyperkyphosis and non-idiopathic etiology
- C-EOS can predict frequency and severity of complications

Thank You