Have We Improved Functional Outcomes?

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Michael Glotzbecker MD
Disclosures

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Member : CSSG, GSSG, HSG
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Challenges unique to EOS

Outcomes:

- Pulmonary (previous talk)
- Radiographic
- Quality of life
- Surrogates for above?
- **Functional**
Why is it so Challenging?
Goals in EOS

What do we think is important?

– Maximum spine length, residual mobility
– Maximum chest size/function
– Minimum surgeries, hospitalizations
– Minimum complications
Obstacles to Measuring Outcomes in EOS
Why is it So Hard?

Diverse population
Various etiologies
Co-morbidities
Obstacles To Measuring Outcomes In EOS
Why Is It So Hard?

Treatment occurs during growth
– Especially rapid spine growth
Obstacles To Measuring Outcomes In EOS
Why Is It So Hard?

Different skeletal structures

Abnormal growth rates
Obstacles To Measuring Outcomes In EOS
Why Is It So Hard?

Surgeon variability
- Indications
- Timing
- Technique
- Execution
How Can We Measure Outcomes?
Gold standard?

PFTs difficult in EOS
- Cooperation
- Effort
- Techniques
Radiographic-Traditional Measurements

Traditional study group measurements
– 2D measurements
– T1-T12, T1-S1 length, Cobb, etc.

Advantages
– Easily available

Disadvantages
– 2D, static, not normalized to growth
Do 2D Measurements Correlate With Pulmonary Function?

2D measurements correlate poorly w/ PFTs

– Not surprising!
– Chest is a dynamic 3D structure
Radiographic-Better Measurements?

True spine length?
- Growth friendly constructs pro-kyphtotic
- Growth out of coronal plane
- 3D techniques

More accurate…but better?
- Still a static measure
Is 3D Better?

Advantages
- 3D volumes quantifies
  - Chest volume
  - Effect of treatment

Disadvantages
- Relationship to PFTs?
  - You can make the box bigger…
  - Still a static measure
Dynamic 3D MRI

Advantages
- Dynamic
  - Chest wall
  - Diaphragm

Disadvantages
- Unproven in EOS
- Sedation concerns
QOL (EOSQ-24)

Early Onset Scoliosis Questionnaire

Advantages:
- Good to excellent agreement w/ test and re-test
- Correlated with PFTs

Disadvantages:
- Early experience
- Parent vs patient reported outcomes
- Others: SRS, PODCI, CHQ

Domains Tested

- General health
- Pain/Fatigue
- Pulmonary function
- Transfer
- Physical function
- Daily living
- Fatigue/Energy level
- Emotion
- Parental Burden
- Financial Burden
Emans et al 2009:
Retrospective review EOS
- 23% prevalence elevated Hgb
- Significant treatment effect w/ rib based growing construct (n=85)
- No treatment effect for GR patients (n=53)

Skaggs JPO 2016:
Retrospective review GR patients (n=66)
- 15% elevated Hgb prevalence (z>2)
- Improved with surgery
Other Surrogates…Hemoglobin

Prospective study of growth friendly implants

48/268 (18%) elevated Hemoglobin
Elevated Hgb preop:  
- Hgb decreases over time

Normal Hgb preop:  
- No change in Hgb
Elevated Hgb in small percentage (18%) of EOS

Respond to treatment when elevated

Useful in subset of younger, sicker patients?

*Are there better surrogates?*
Functional Outcomes: EOSQ

EOSQ has functional domains

Early experience

Hidden within larger scale
Growing rods vs Brace

EOIS

ASKp (Activities Scale for Kids performance)

GR reduction in activity and participation

Brace no change in activity and participation
Functional Outcomes...Graduates

Oxygen consumption testing
Submaximal graded exercise test

12 EOS Graduates
- PFTs showed compromise
- Keep up with peers with daily exercise

Can’t use in young kids....
EOS Outcomes: ICEOS 2017

Still searching for better outcome measures!

Classification of Early Onset Scoliosis (C-EOS) and Pulmonary Function
Outcomes
Summary
Etiology of early onset scoliosis as described by C-EOS does not predict pulmonary function. Further study is required to provide granularity with regard to specific C-EOS classifications.

Pre-operative Six Minute Walk Performance in Children with Congenital Scoliosis
Summary
The 6 minute walk (6MW) correlates with age and inversely with the Cobb angle for patients with congenital scoliosis prior to spine surgical intervention. All had low 6MW values compared to age-matched norms. 6MW is useful as a serial measure of functional status for each patient over time.
Conclusions
Conclusions

How do we define outcome?
- At best we have a bunch of surrogates
- Probably involves some combination
- May be different for different populations

We make children different (taller, straighter)
.......but better?

We are still searching!
Thank you!