Rib-based Growing Systems: Is There a Law of Diminishing Returns with Repeated Lengthening?

John A Heflin, MD
John T. Smith, MD

Department of Pediatric Orthopaedics

THE UNIVERSITY OF UTAH

Disclosures

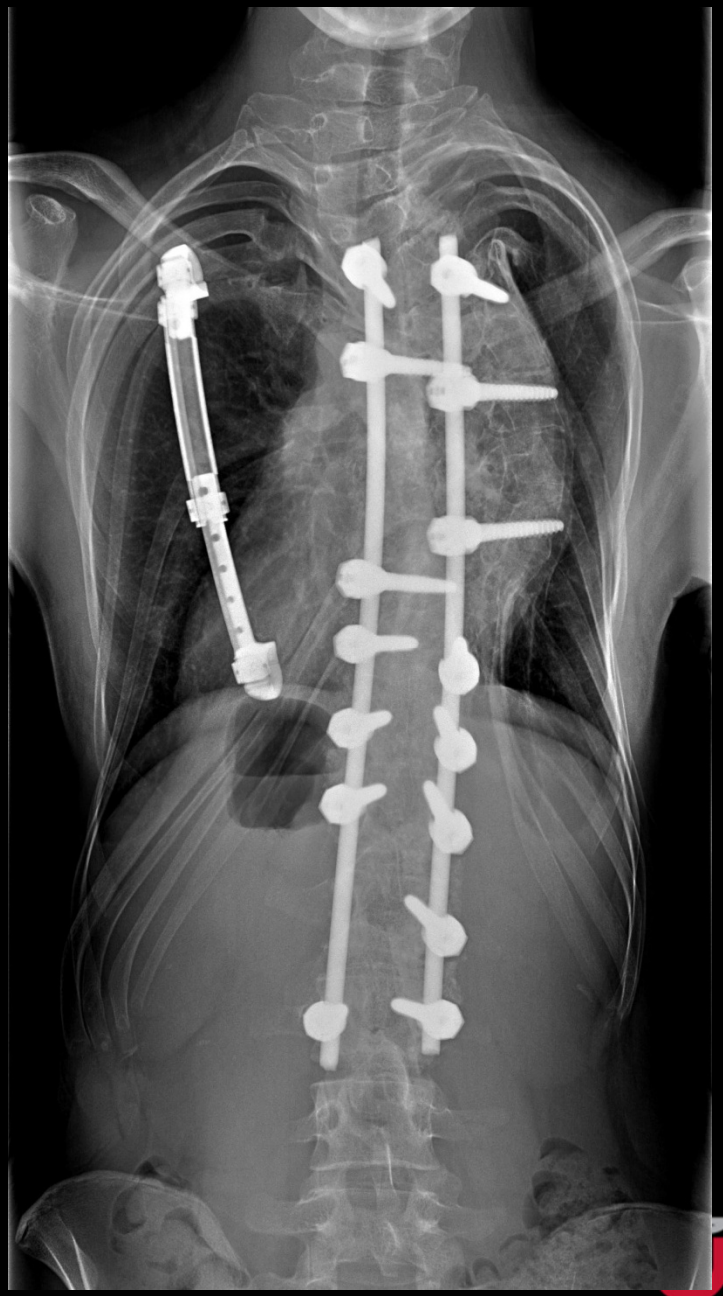
John A. Heflin, MD: Nothing to disclose
John T. Smith, MD:
Royalties, VEPTR 2
Research support: CWSDRF
Consultant, Synthes Spine

The Problem:

- Young child
- Progressive curve
- Not responsive to bracing or casting

The Solution: (eventually)

- Posterior and/or anterior spinal fusion
- Ideally around 13-15 years of age



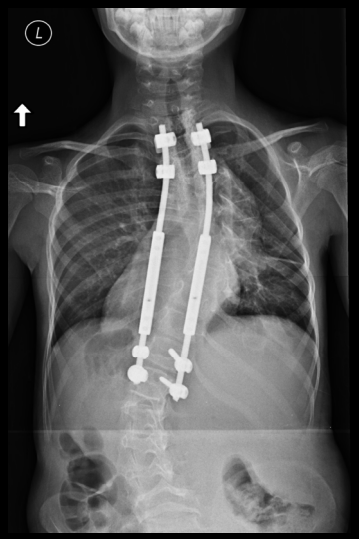
What to do in-between?

- Fusions generally not a good choice in young children
- Fusionless instrumentation: “growing rods”
- Several previous studies have established effectiveness of dual growing rods:
  - controlling spinal deformity
  - promoting spinal “growth”

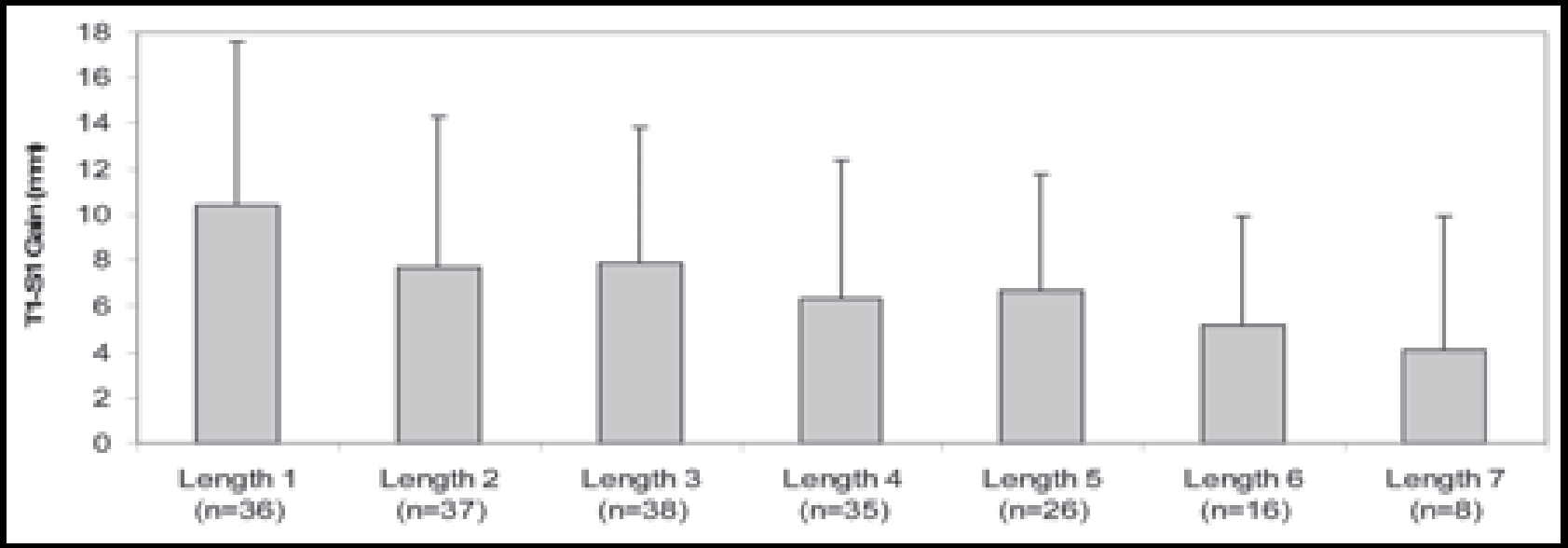
Spine
DEFORMITY
SPINE Volume 36, Number 10, pp 806–809

Lengthening of Dual Growing Rods and the Law of Diminishing Returns

Wudbhav N. Sankar, MD, David L. Skaggs, MD, Muharrem Yazici, MD, Charles E. Johnston II, MD, Suken A. Shah, MD, Pooya Javidan, MD, Rishi V. Kadakia, BS, Thomas F. Day, MD, and Behrooz A. Akbarnia, MD



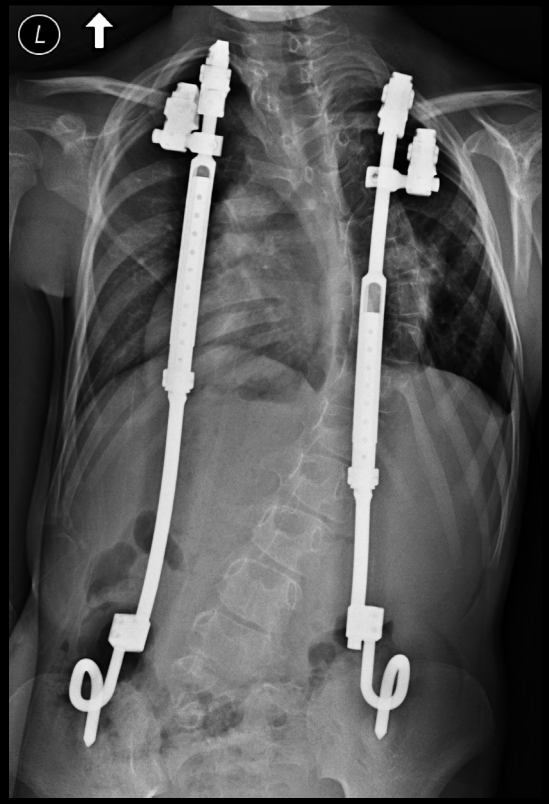
T1-S1 gain after initial lengthening decreased significantly with repeated lengthening



Rib-based Constructs

- Fusionless systems that avoid proximal spine attachments
- Thought to be associated with lower rate of spinal auto-fusion?
- No literature regarding the effect of repeated rib-based lengthenings on spinal growth

Question:



- Does the “Law of Diminishing Returns” for spine-to-spine growing constructs apply to rib-based growing constructs?

Purpose of Study

- Evaluate the effect of repeated lengthenings on spinal growth (T1-S1, T1-T12) for rib-based constructs

Study Design

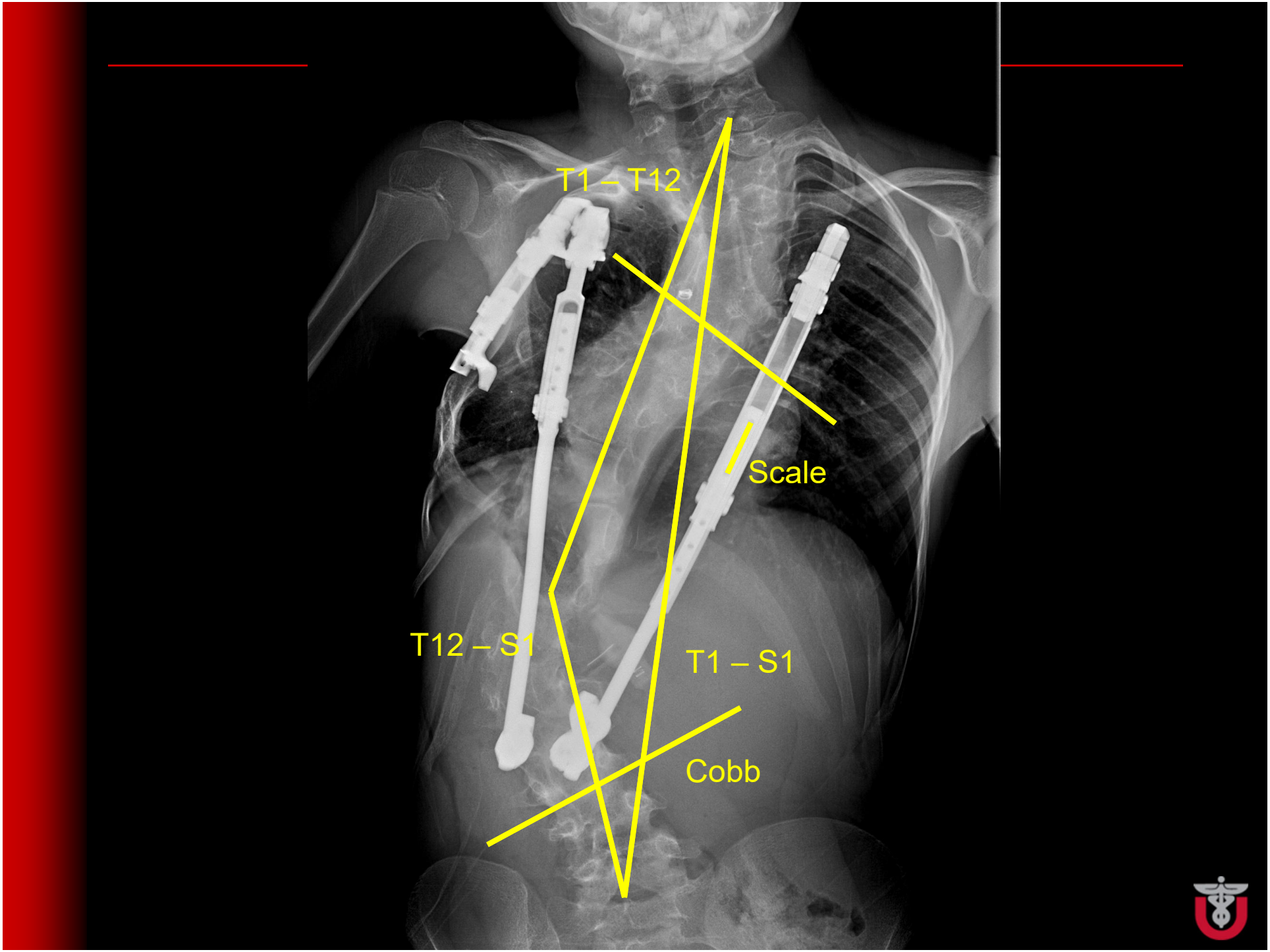
- Retrospective review of patients with early onset scoliosis treated with rib-based growing constructs
  - X-rays
  - Patient charts
- Single center, single surgeon (JTS)
- 24 subjects

Inclusion Criteria

- Early onset scoliosis
- All diagnoses
- Rib based growing rod system
  - Rib-spine
  - Rib-pelvis
- < 10 years old at initial implantation
- Minimum 2 year follow-up
- Minimum of 5 lengthenings

Review and Analysis

- Measurements
  - T1-S1 height
  - T1-T12 height
  - T12- S1 height
  - Coronal major curve Cobb angle
  - Sagital Cobb angle


T1 – T12
Scale
T12 – S1
T1 – S1
Cobb

Results

- 24 patients
- Age at surgery
  - 3.8 years ± 3.2 (0.8 - 9.4)
- Average follow-up
  - 6.3 years ± 1.9 (3.4 - 8.6)
- Average number of lengthenings or revisions
  - 9.2 (5 -18)
- Average time between lengthenings
  - 6.7 months (1 - 13)

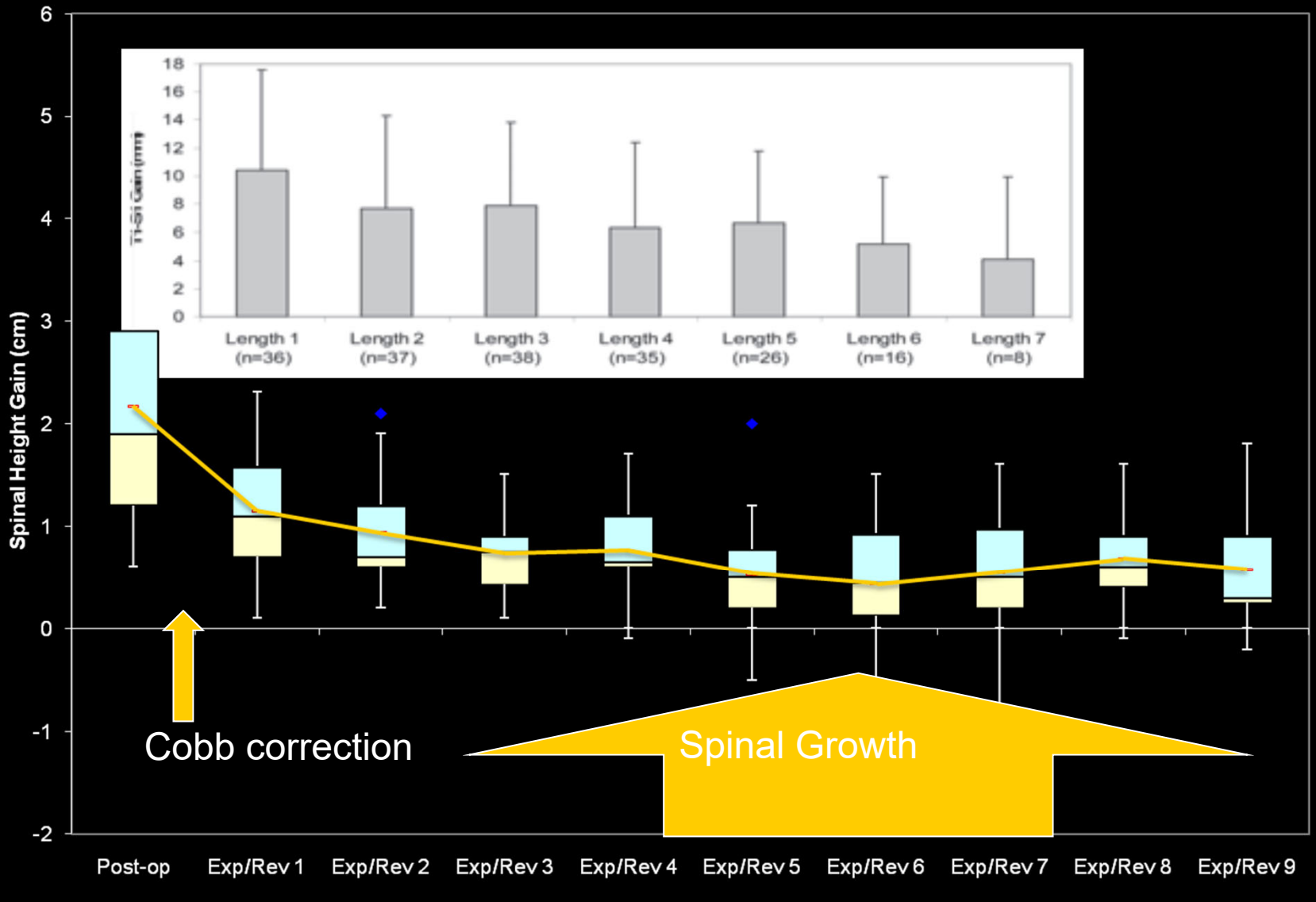
Spinal Height (T1-S1)

- Mean T1-S1 length prior to surgical intervention: 19.9 cm ±4.7
- Mean T1-S1 length following primary implantation: 22.0 cm ±5.2
  - Net gain: 2.2 cm ±1.3
- At final follow-up, the average T1-S1 length increased to: 29.2 cm ±5.0
  - Net gain: 7.3 cm ±1.7 following index procedure
  - Average growth per year: 1.3cm ± 0.6

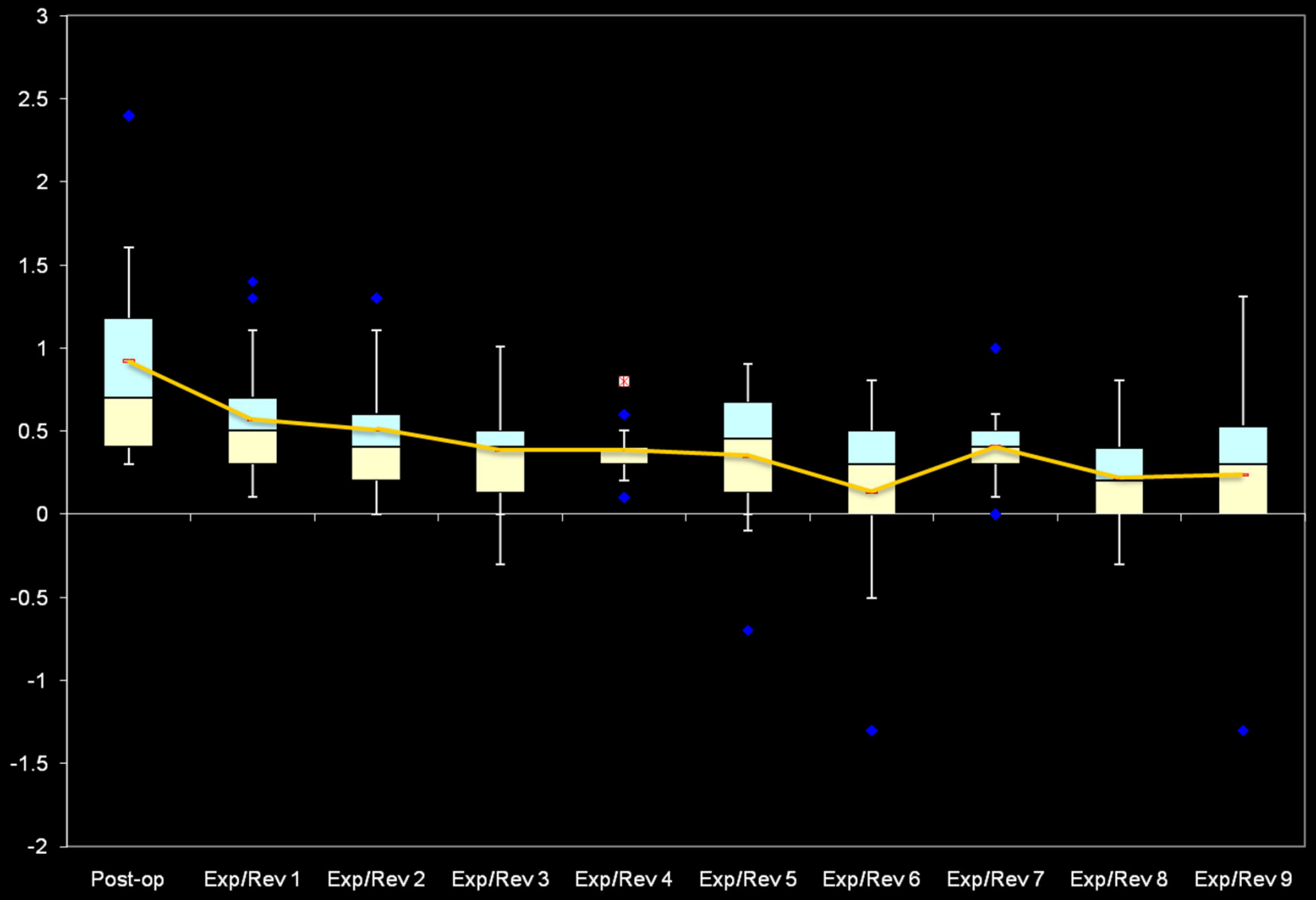
Spinal Height

- T1-S1 gain from the first lengthening:
  - 1.2 cm ±0.6
- T1-S1 gain from the ninth lengthening:
  - 0.6 cm ±0.6

T1 – S1 Gain (cm) versus Expansion / Revision Number



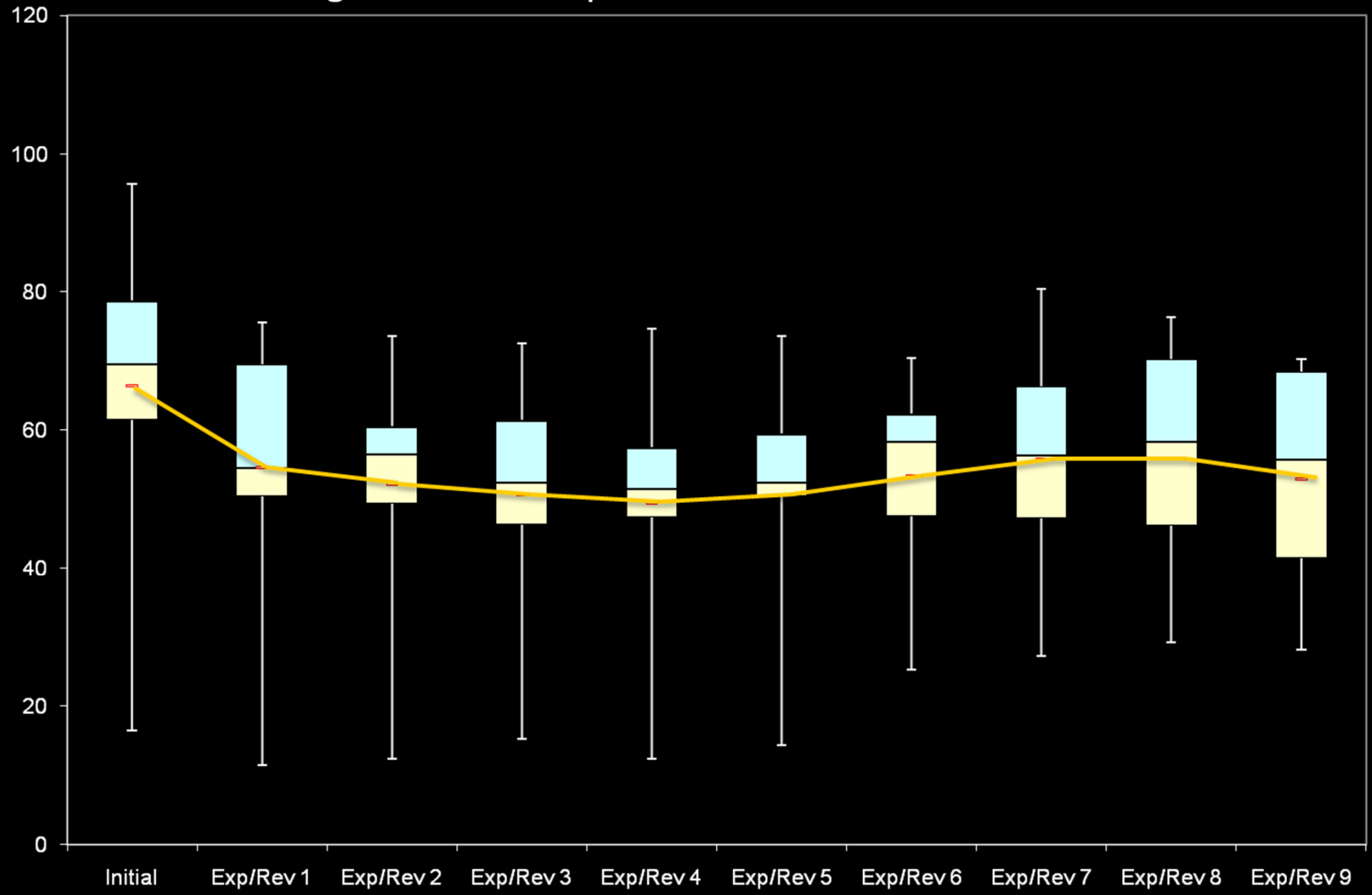
T1 – T12 Gain (cm) versus Expansion / Revision Number



Cobb Angle

- Average Coronal Starting Cobb (major curve)
  - 65.8° (16° – 95°)
- Most Recent Cobb (major curve)
  - 56.1° (37° – 75°) p = 0.084
- Sagittal Starting Cobb
  - 36° (26° – 54°)
  - Most recent 41° (23° -61°) p = 0.88

Cobb Angle versus Expansion / Revision Interval



Conclusions

- Rib Based distraction did not show a “law of diminishing returns” with multiple lengthenings
- The cobb angles improve initially but then tend to remain stable with multiple lengthenings.
- A multicenter study with more patients is in progress to confirm these findings.

Limitations

- Numbers small
  - Particularly at higher lengthening number
  - Variability of diagnosis
- Retrospective study
  - X-ray variability
  - Magnification
- Length increases in both sagittal and coronal plane
  - Variability may be too high with T1-S1 sagittal length

Thank You!