Growing Rods

The Ideal Candidate and Unsuitable Candidate

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Thoughts On When to use a Treatment Method?

- When the treatment is effective
- When risks doesn't exceeds the benefits
- When it works better than the alternative methods

Who is the best candidate and who is not?

- OBM
- nique
- idence
- (EBM)

Comparison of Various Growing Rod Techniques for the Treatment of Early Onset Scoliosis.

Authors	Number of Patients	Average Initial Elongation Pre- to Post-Initial (cm)	Average Growth of Inst. area (cm)	Average T1-S1 Growth (cm)	# of Comp. Per Pt
Moe et al*	20	Not reported	2.9	Not reported	1.1
Luque et al§	50	Not reported	2.6	Not reported	.30
Klemme et al†	67	Not reported	3.1	Not reported	.81
Blakemore et al‡	29	Not reported	Not reported	Not reported	.31
Akbarnia et al#	23	5.0	4.67	9.64	.57

* Data from: Moe JH, Kharrat K, Winter RB, Cummine, JL. Harrington instrumentation without fusion plus external orthotic support for the treatment of difficult curvature problems in young children. Clin Orthop 1984;(185):35-45

§ Data from: Luque ER, Cardosa A. Segmental Spinal Instrumentation in Growing Children. Orthop Trans 1977;1:37

† Data from: Klemme WR, Denis F, Winter RB, Lonstein JW, Koop SE. Spinal instrumentation without fusion for progressive scoliosis in young children. J Pediatr Orthop 1997;17(6):734-42

‡ Data from: Blakemore LC, Scoles PV, Poe-Kochert C, Thompson GH. Submuscular Isola rod with or without limited apical fusion in the management of severe spinal deformities in young children: preliminary report. Spine 2001; 26(18):2044-8

Data from: Akbarnia BA, Marks DS, Boachie-Adjei O, Thompson A, Asher MA. Dual Growing Rod Technique for the Treatment of Progressive Early Onset Scoliosis: A Multicenter Study. Spine 2005; 30(17 Suppl): S46-S57

Evidence Basis for Management of Spine and Chest Wall Deformities in Children

Sponseller PD; Yazici M; Demetracopoulos C; Emans JB

The natural history and results of treatment of deformities of the spine and chest wall offer much opportunity for further evidence-based research

- **Spine 2007 Sep 1;32(19 Suppl):S81-90**

No good outcome tool to evaluate the results of the different treatment methods

Factors To Be Considered

- Patient
- Technique
- Surgeons experience

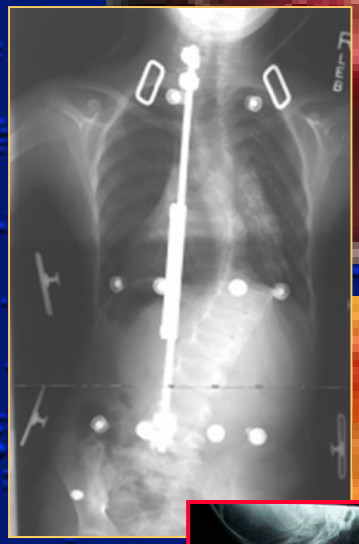
Definition

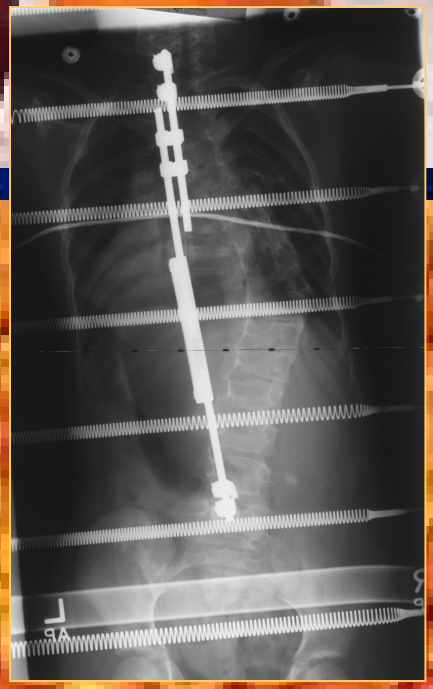
- Early Onset Scoliosis (EOS) due to all etiologies, appearing before the age of five.

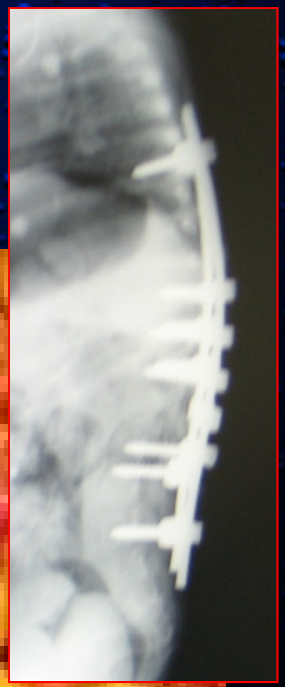
Etiology

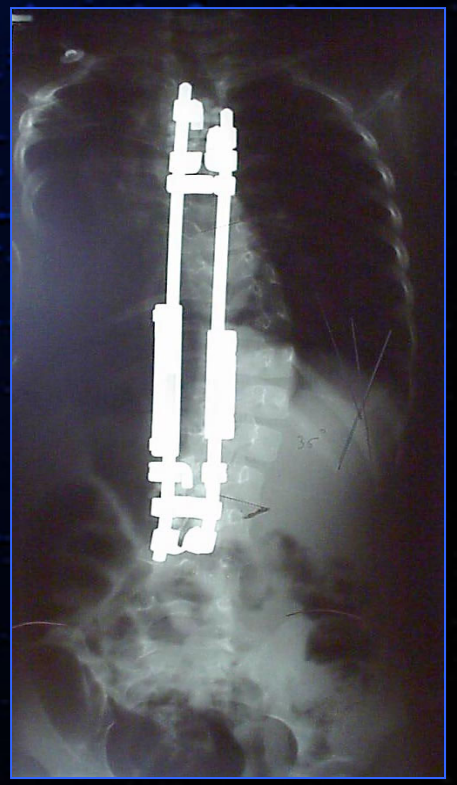
- Idiopathic
  - Infantile 0-3 years
  - Juvenile 4-10 years
  - Adolescent
  - Neuromuscular
  - Cerebral palsy
  - Myelodysplasia
  - Muscle diseases
- Others

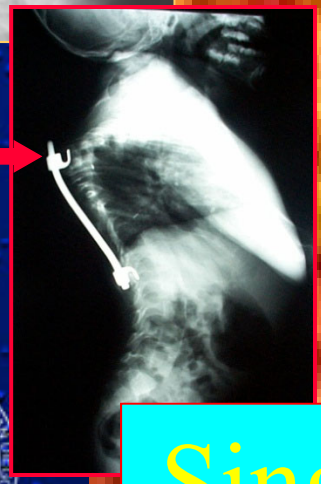
Not all GR are the same.











Single

Shilla

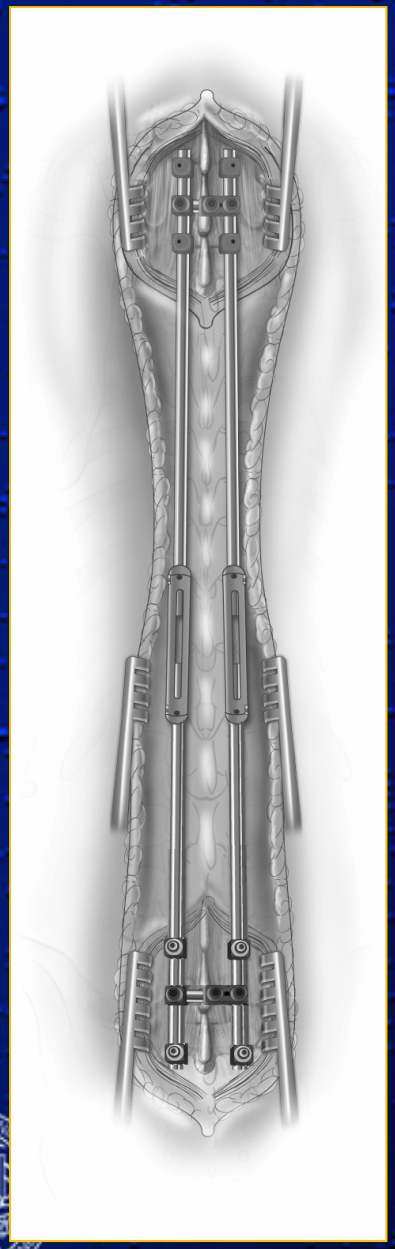
Dual

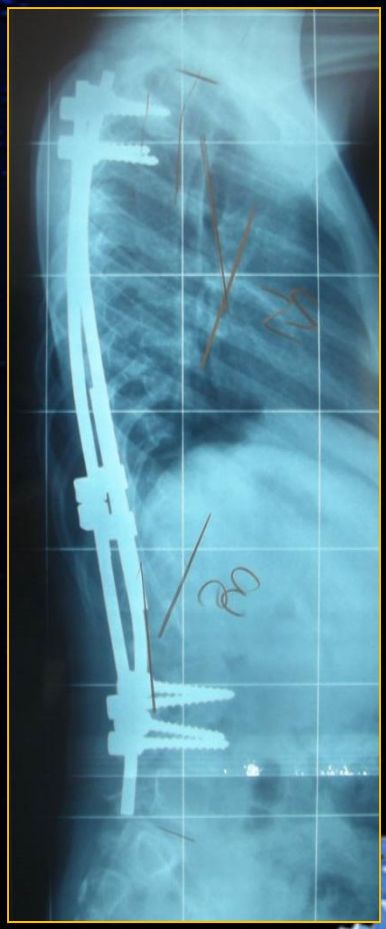
Growing Rod
Is Not
Another
VEPTR

RESULTS

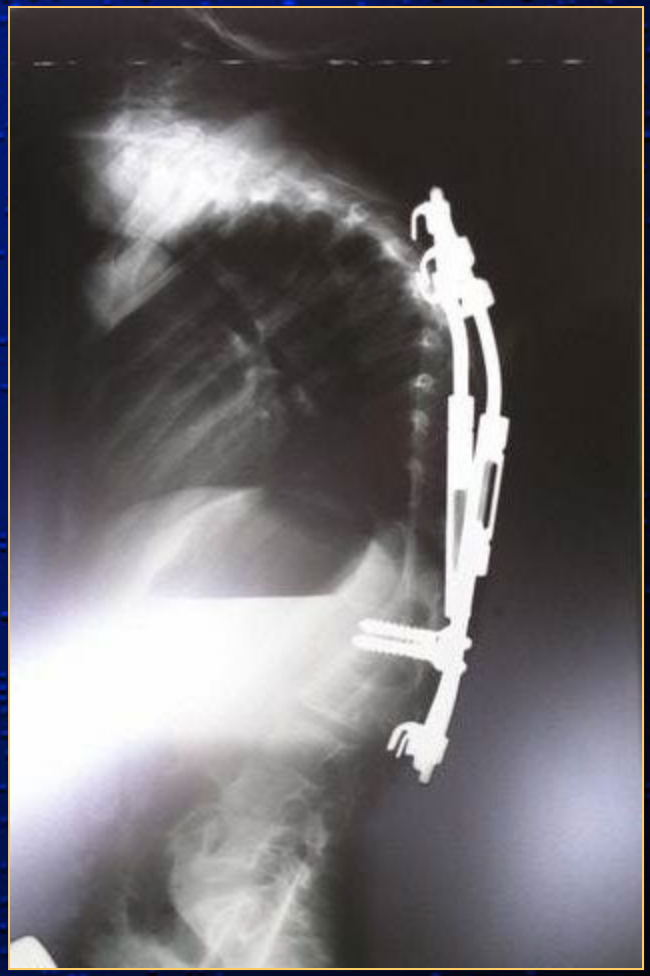
GROUP	Cobb Angle *(Pre-Initial to Post Final)*	% Correction	Increase in T1-S1 Length
Single with apical	85° → 65 °	23%	6.4cm
Single w/o apical	61° → 39 °	36%	7.6cm
Dual w/o apical	92° → 26°	71%	11.8cm

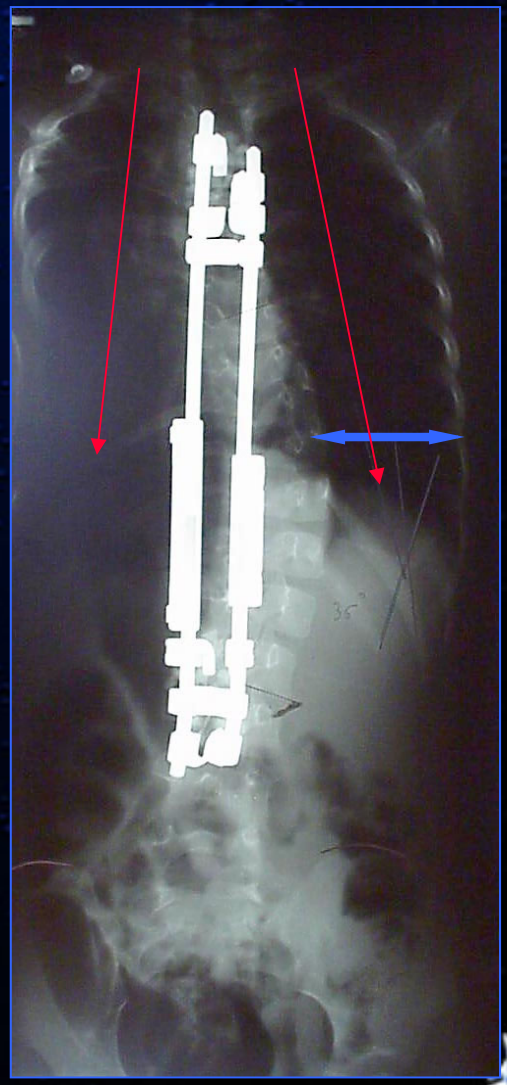
Dual growing rod technique

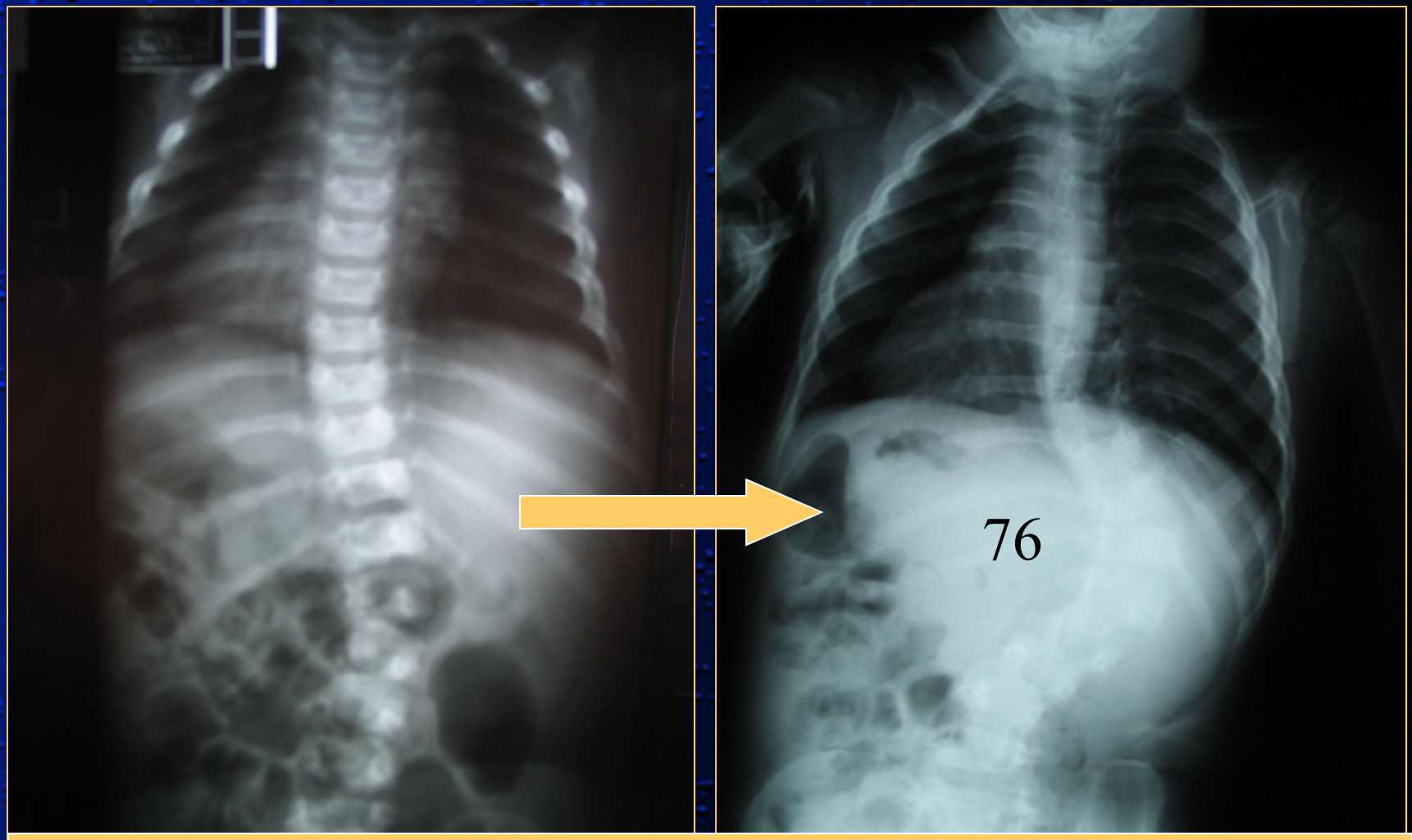




Short instrumentation



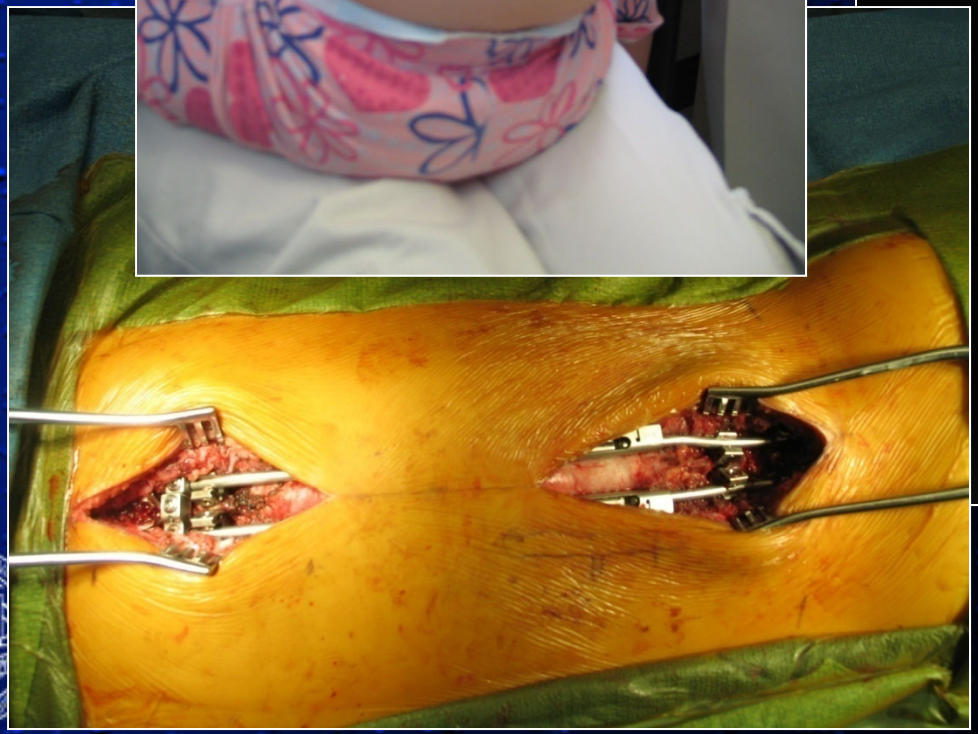


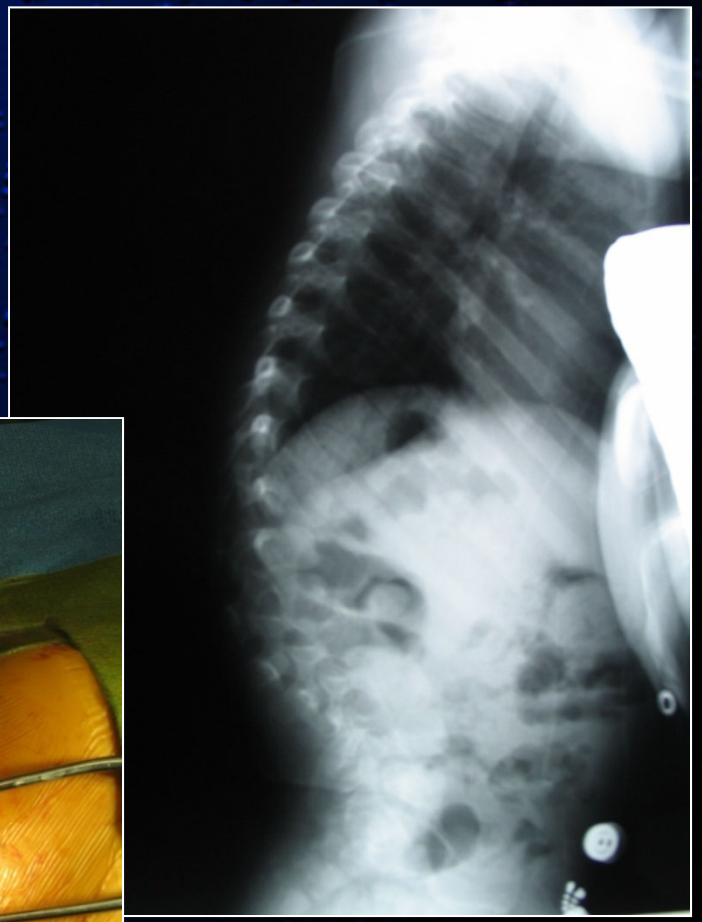


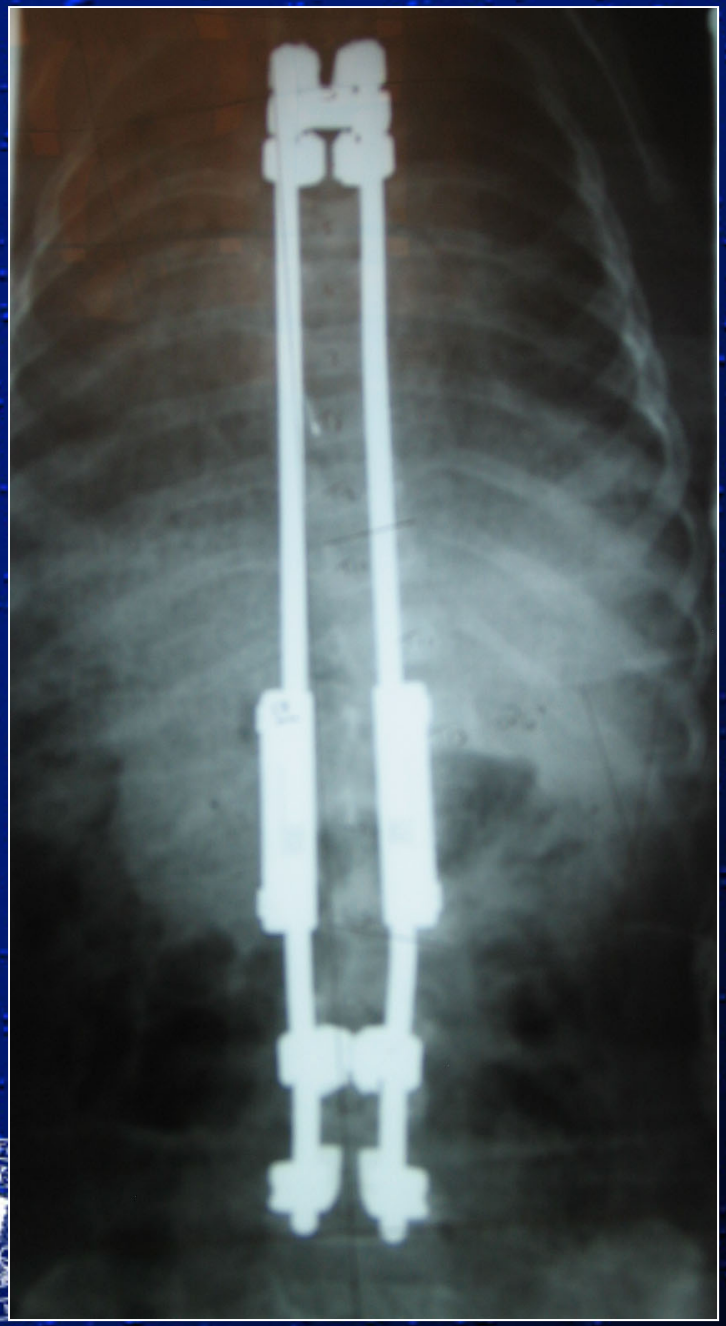
19 months old girl with curve progression in 6 months

MH

MH

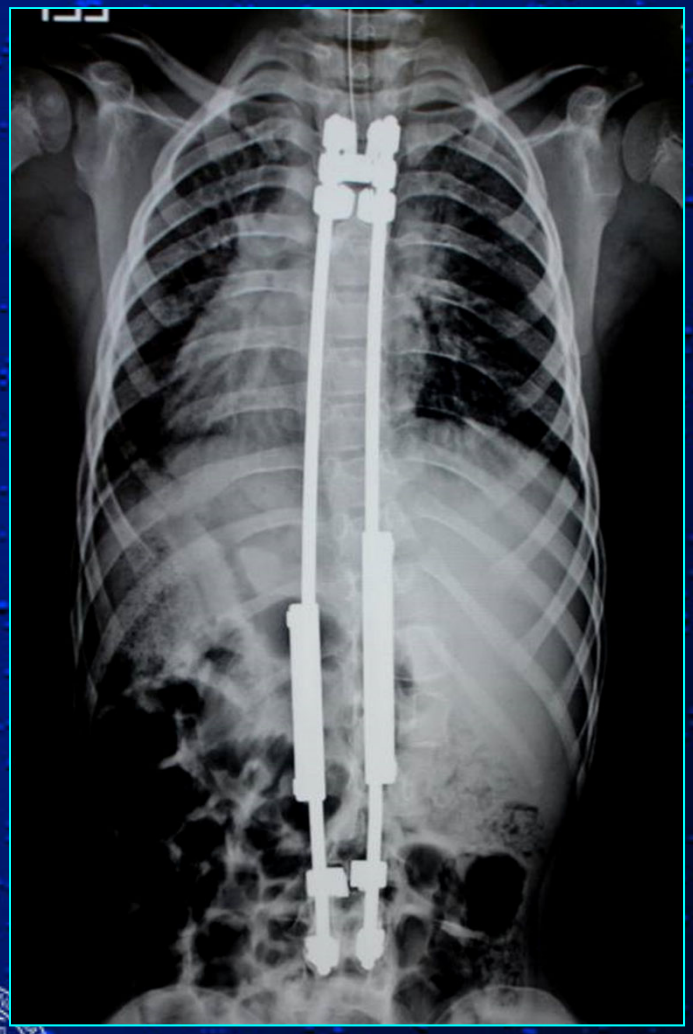


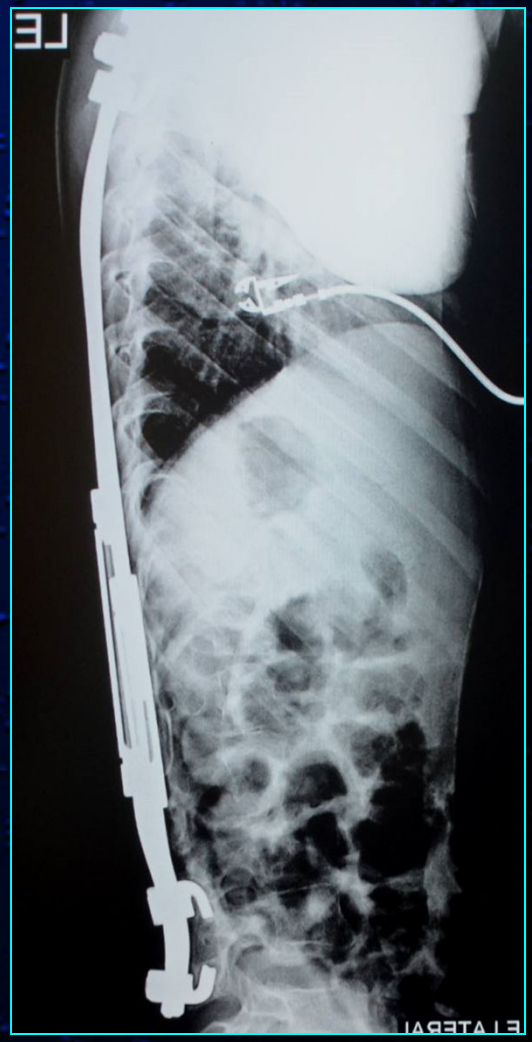




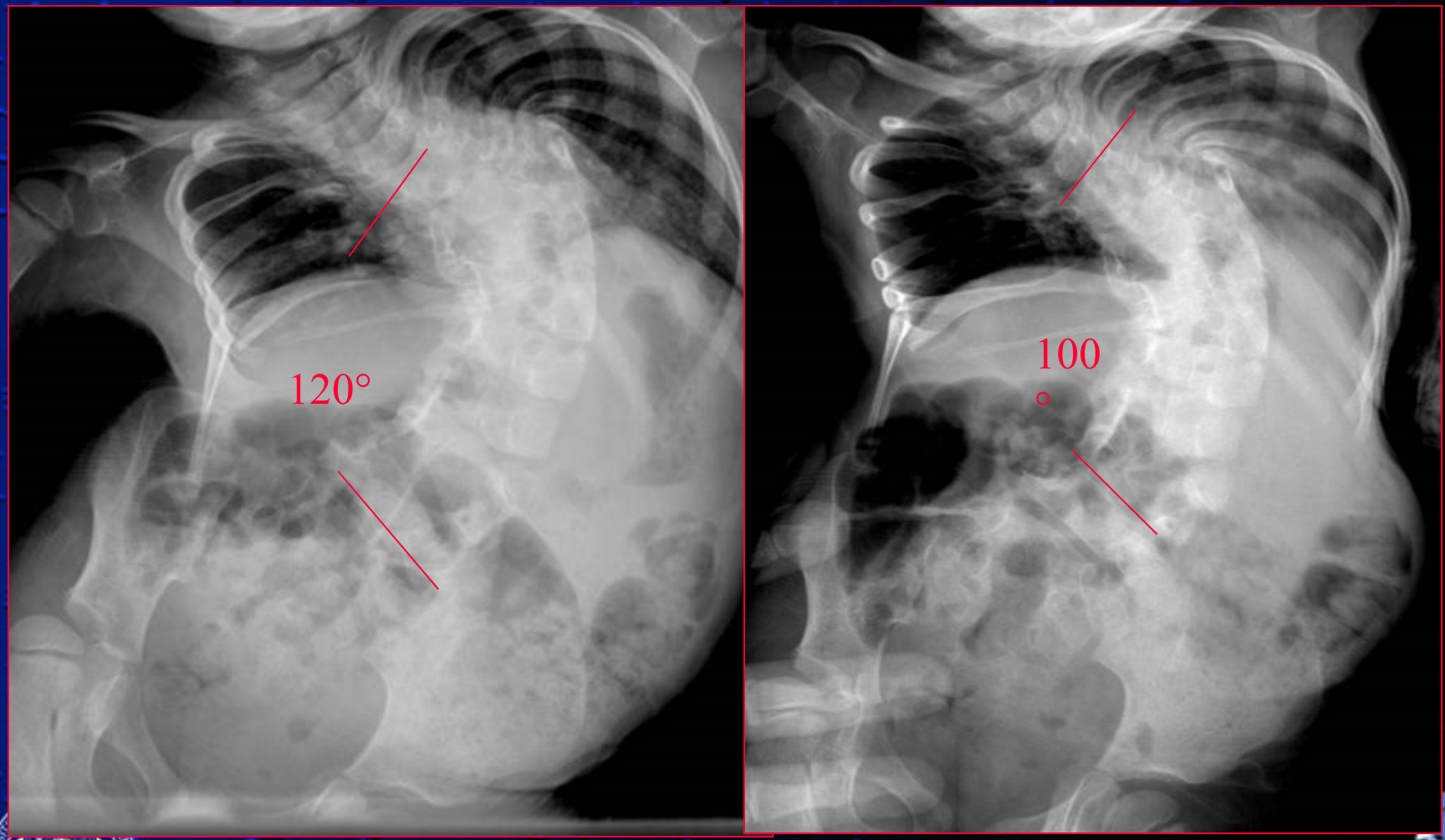
MH

M H 10-25-07 Post Length. 3 Yr FU

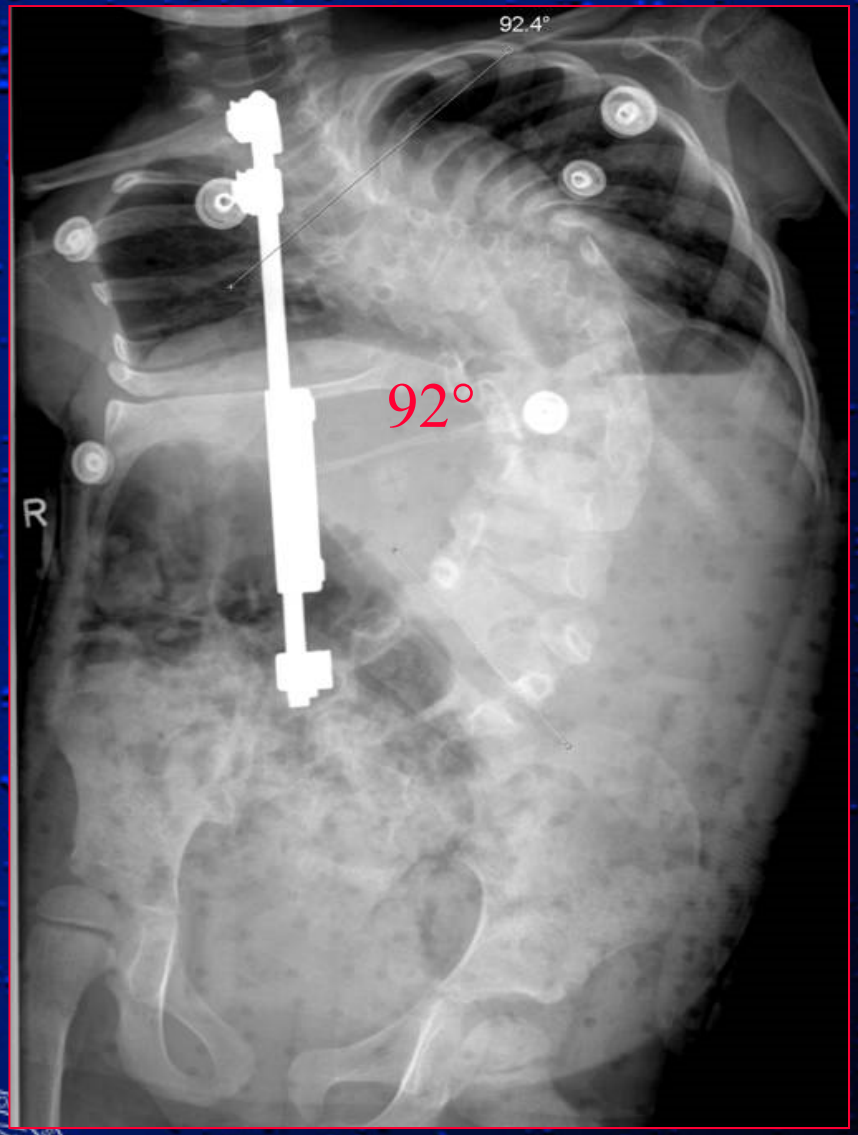


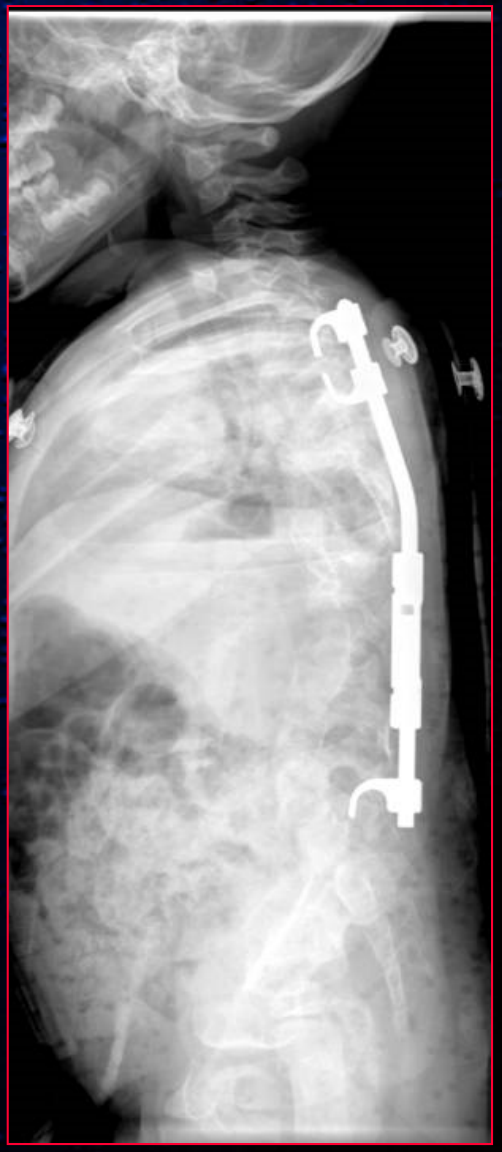


Jan 2003 - Age 3.5 years



Bending



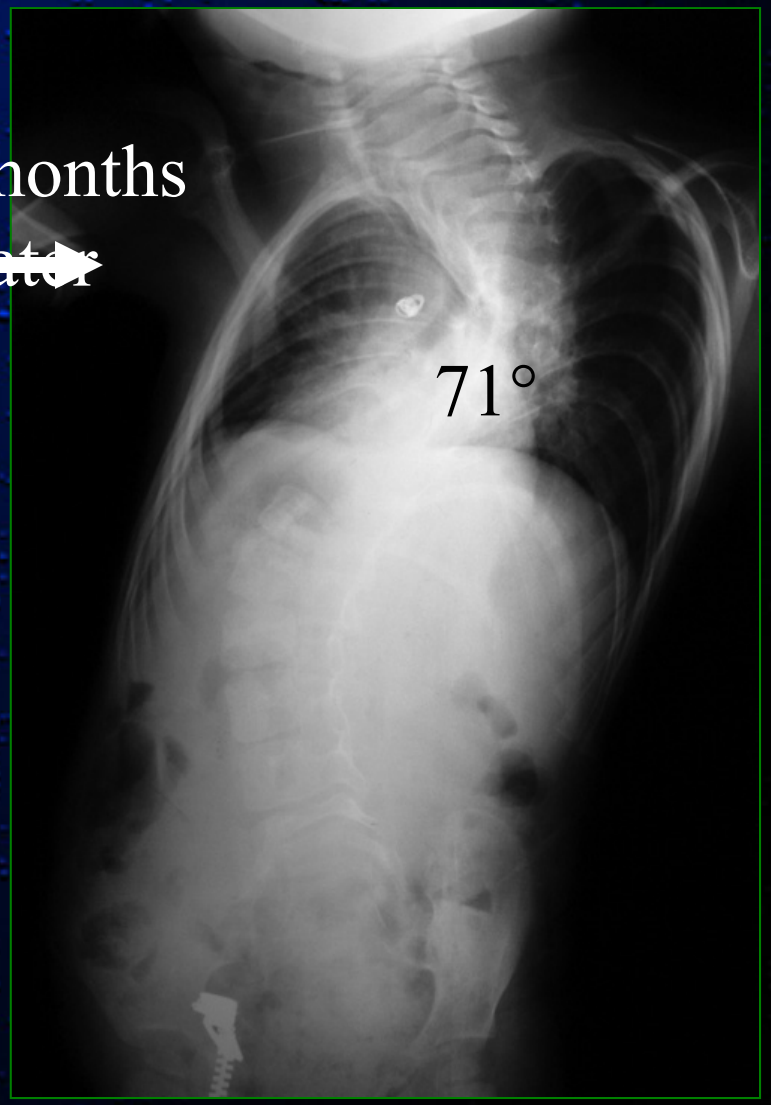


Post op Jan 2003

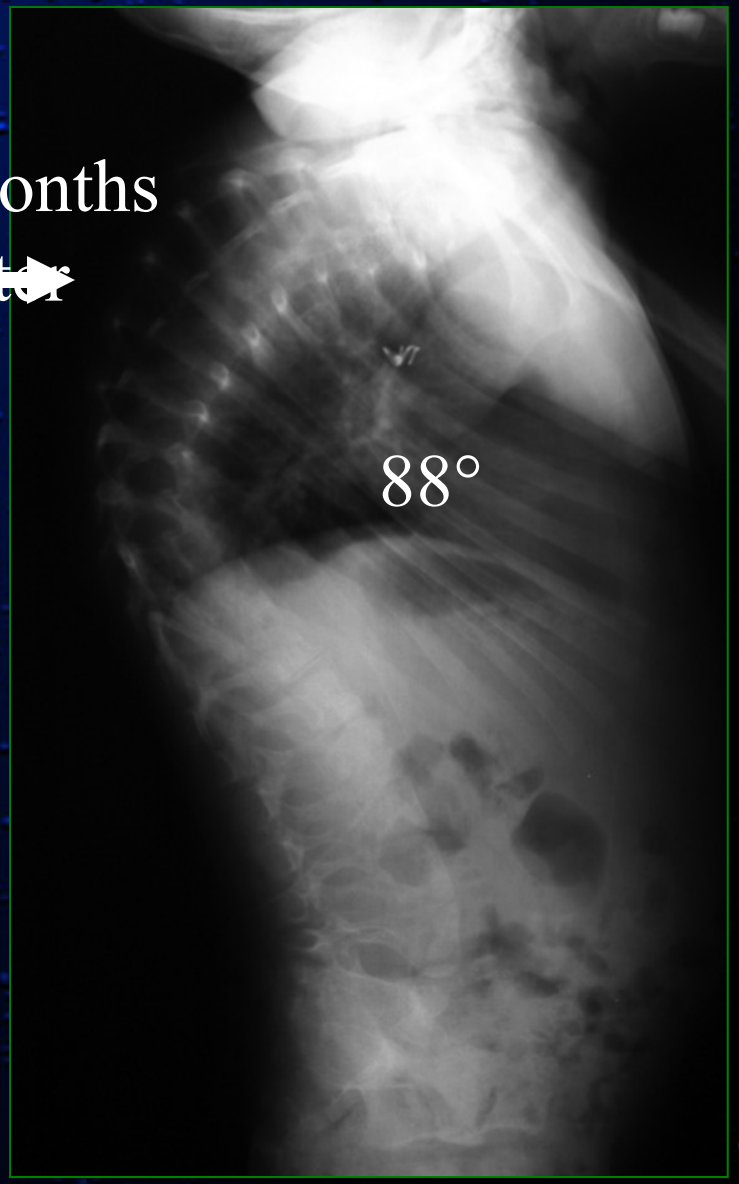
W.C.

- 3 + 6 yr old male
- Lateral meningocele syndrome
- Progressive kyphoscoliosis
- PMH significant for:
  - ASD & VSD repair at 1 yr
  - Repair of cleft palate
  - Bilateral hernia repair
  - Mental delay
  - Bilateral ptosis

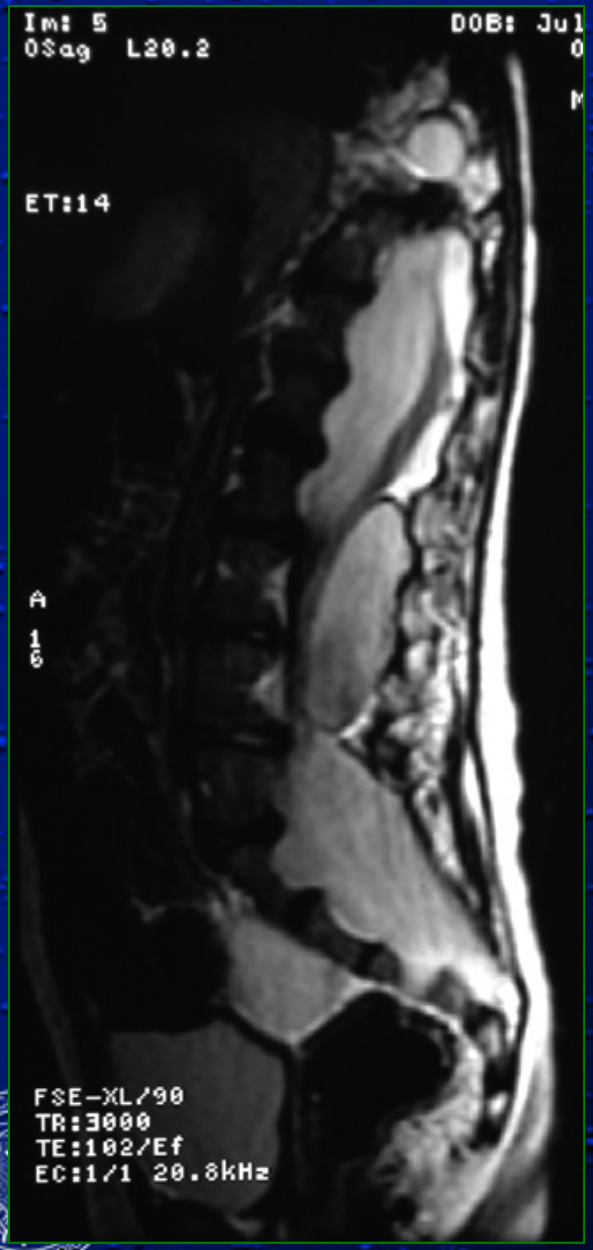
20 months later



20 months later

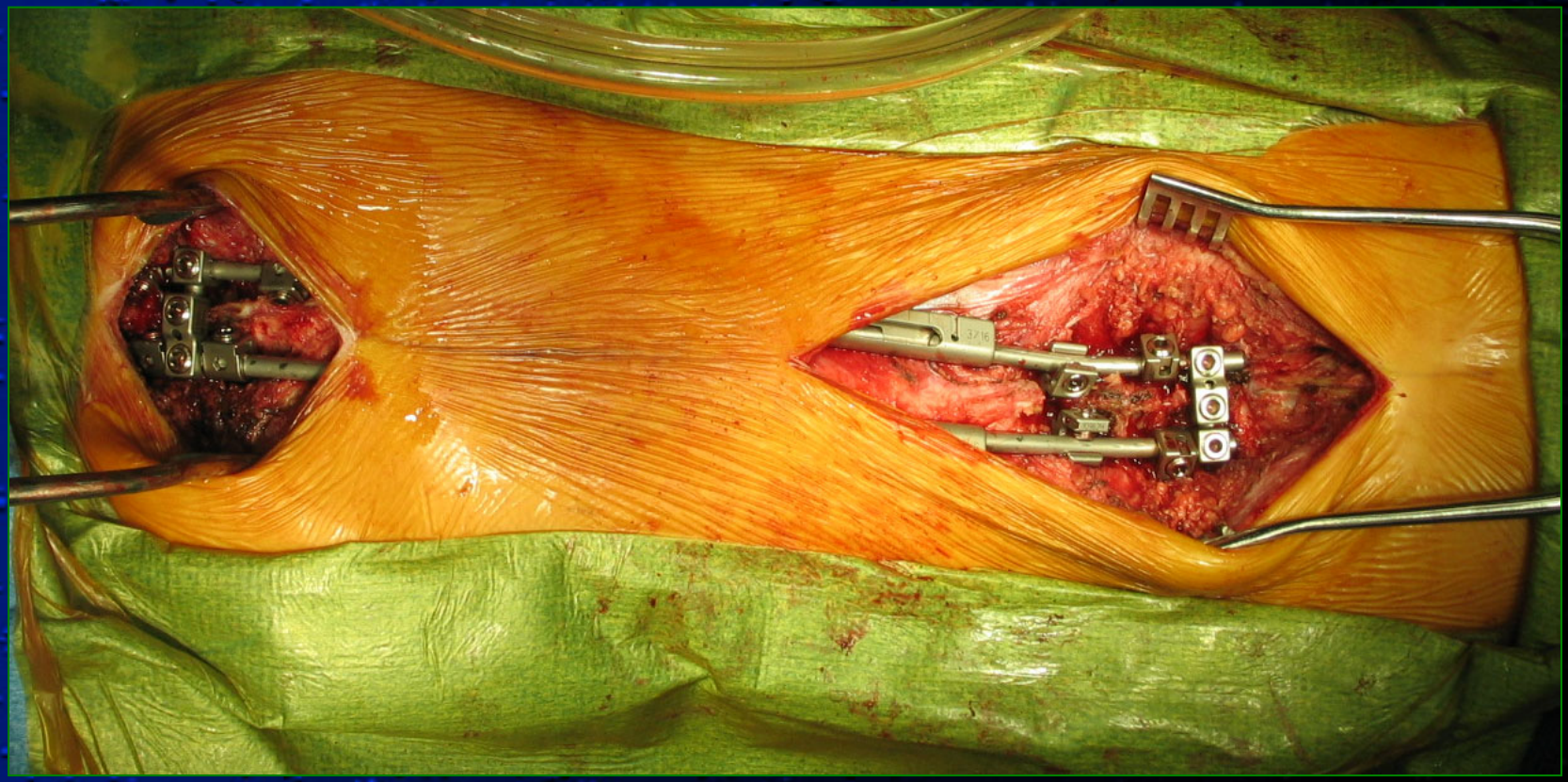


Pre-op MRI

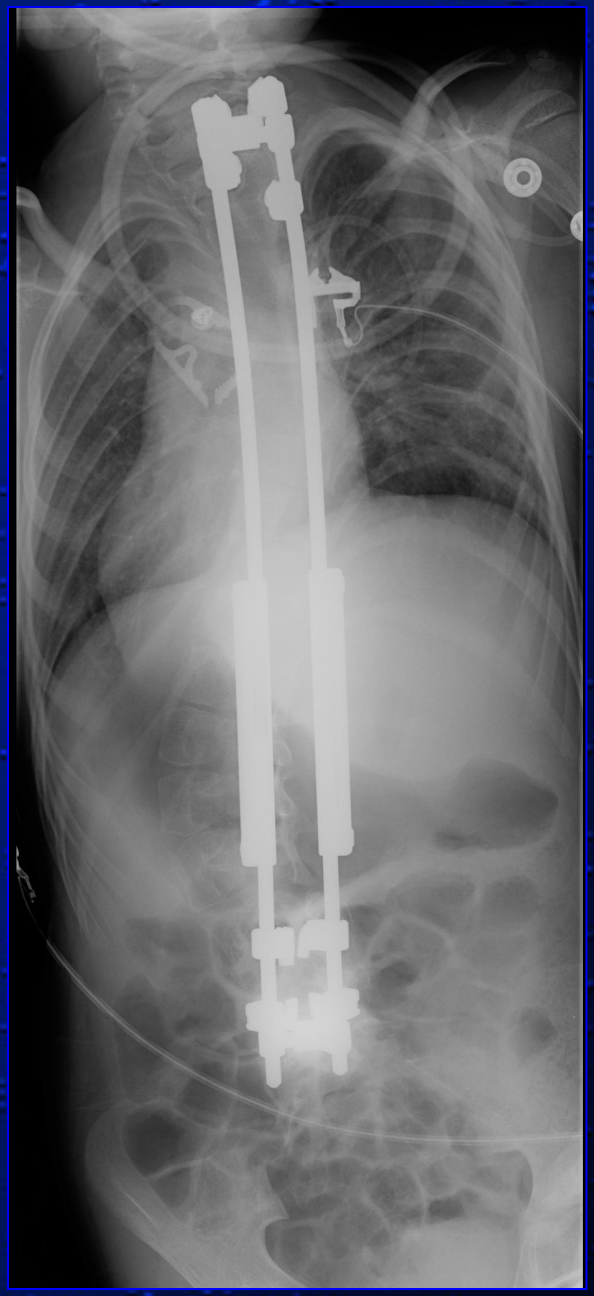

Im: 5
0Sag L20.2
DOB: Jul
0
M
ET:14
A
1
6
FSE-XL/90
TR:3000
TE:102/Ef
EC:1/1 20.8kHz


0Ax I50.8
Oct 25 04
Mag = 1.5
FL:
ROT:
ET:14
R
I
L
S
FSE
TR:5200
TE:91/Ef
EC:1/1 20.8kHz
4.0thk/4.0sp
PSRW = 978 L = 547

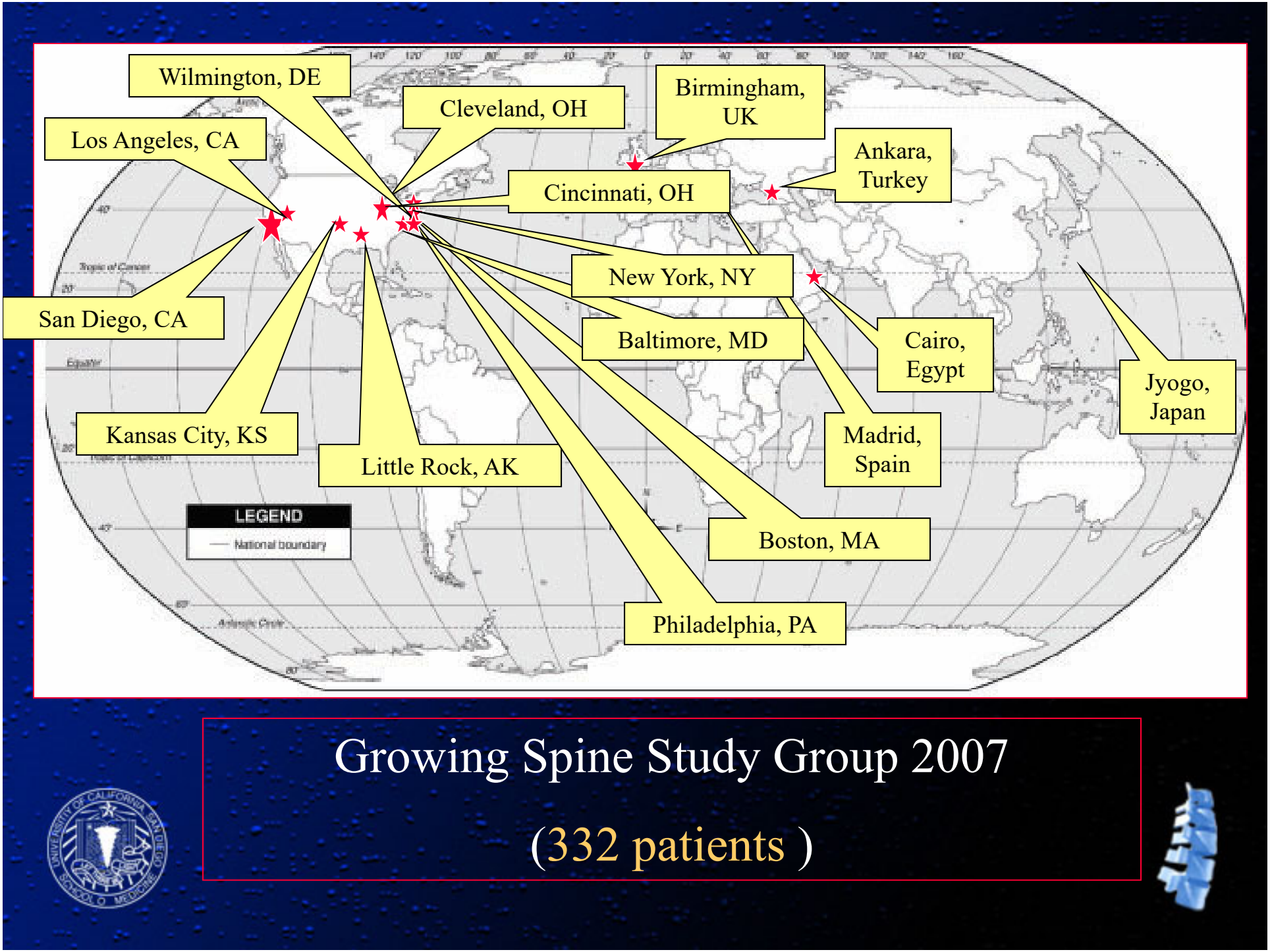
71°



W.C. Post-op



3
years
FU



Growing Spine Study Group 2007

(332 patients)

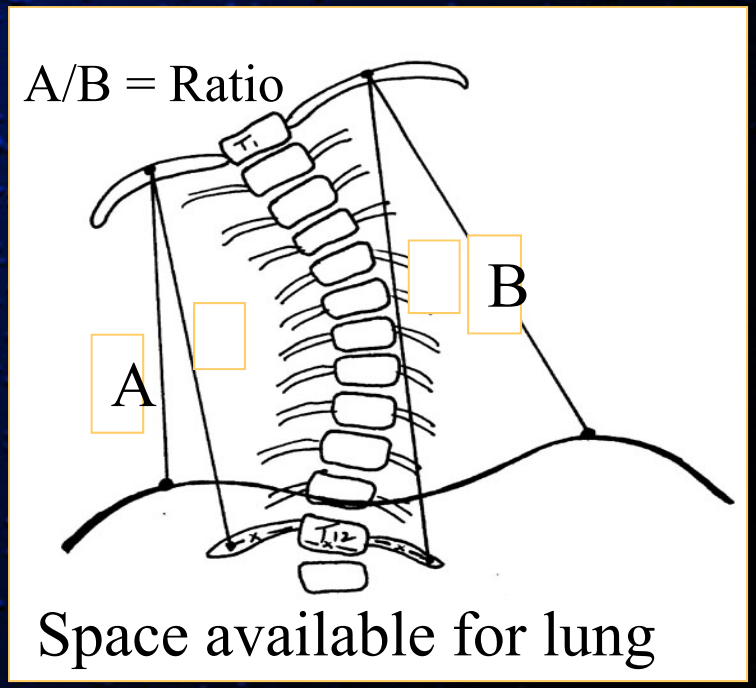
Growth per Year (cm)

- Total Group 1.21
- Under 5 years 1.19
- 5-10 year 1.13
- Under treatment 1.01
- Post final fusion group 1.66

Results – Campbell (SAL) Ratio

Thoracic curves N=14

Pre-op	**0.87**
Post-op	**0.96**
F/U	**1.0**



Mean change

Pre-post	*Pre-F/U*	*Post-F/U*
13%	15%*	5%

P= 0.0031

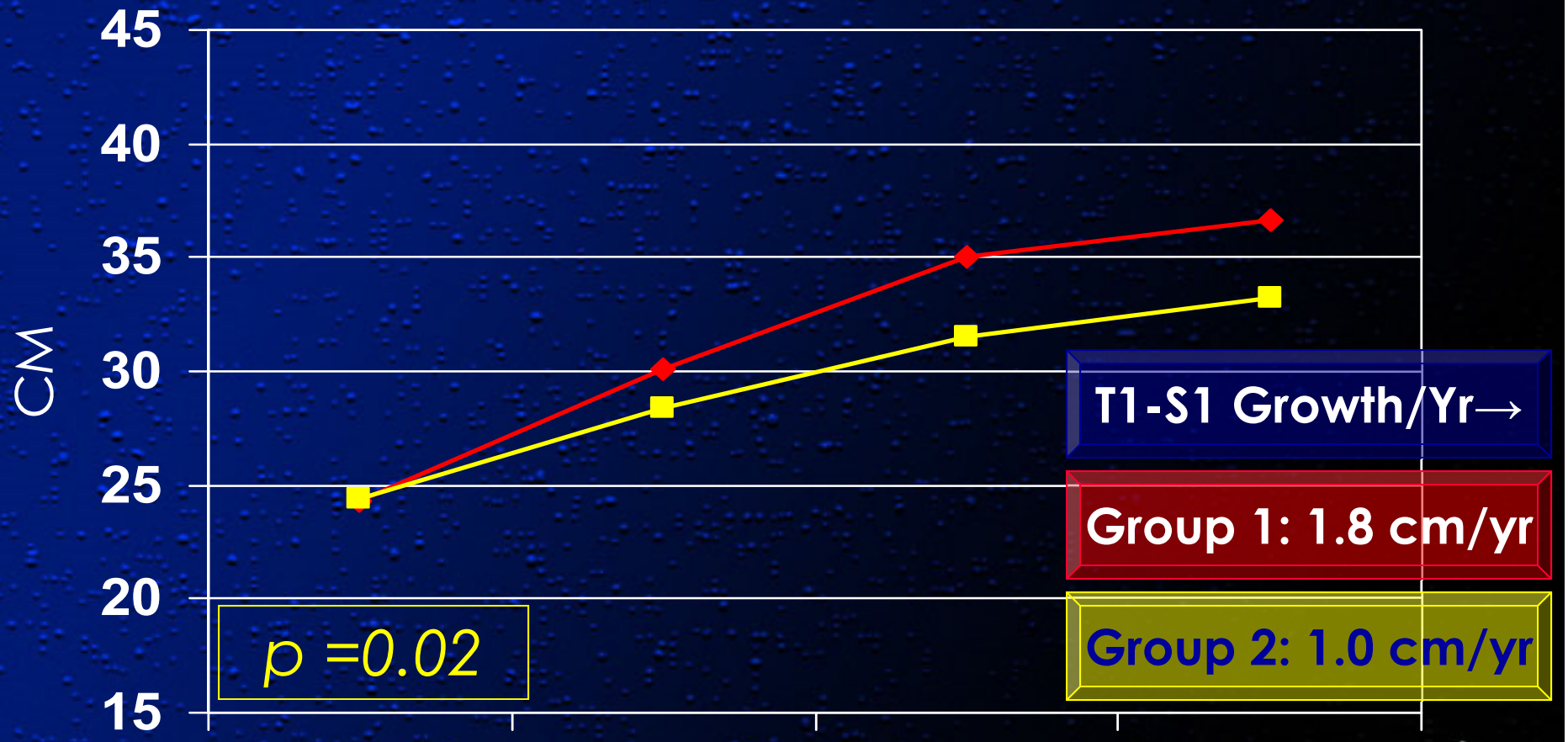
RESULTS (cont'd)

*excluding congenital patients

	Pre-Initial	Post-Initial	Post-Final
GROUP 1*			
Primary Cobb (°)	**89.6** (58-130)	**35.1** (15-62)	**20** (4-43)
T1-S1 Length (cm)	**24.3** (20.6-31.2)	**30.1** (26.0-35.5)	**36.6** (34 → 1.8 cm/yr
GROUP 2*			
Primary Cobb (°)	**71** (50-105)	**36.7** (17-55)	**36.7** (17-65)
T1-S1 Length (cm)	**24.4** (18.5-28.3)	**28.4** (21.3-32.6)	**33.2** (26 → 1.0 cm/yr

Group 1 vs. Group 2: % correction & growth rate $p<0.05$

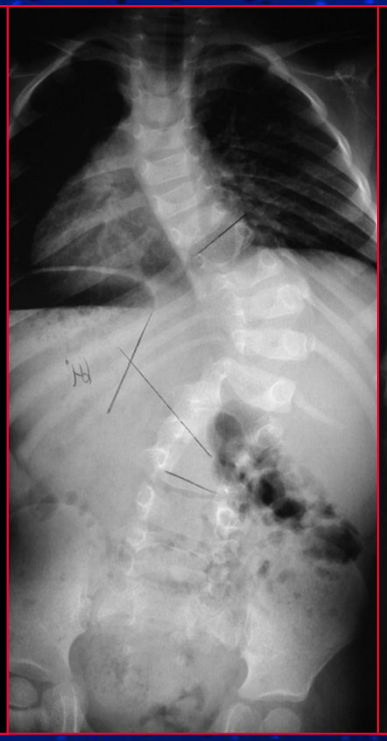
Δ T1-S1 LENGTH
GROUP 1 vs GROUP 2

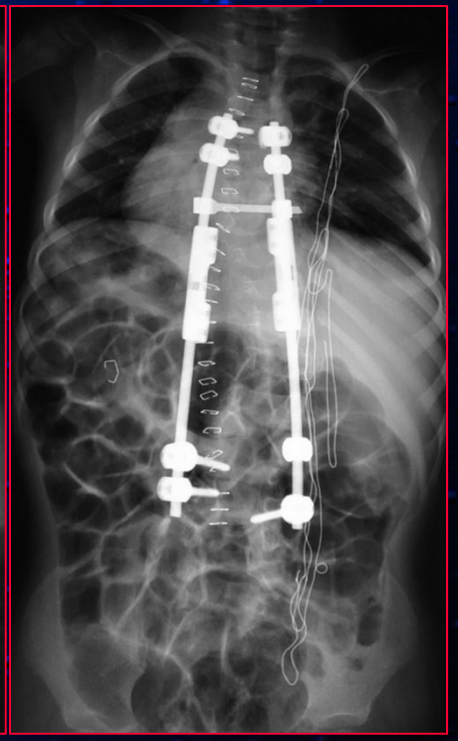
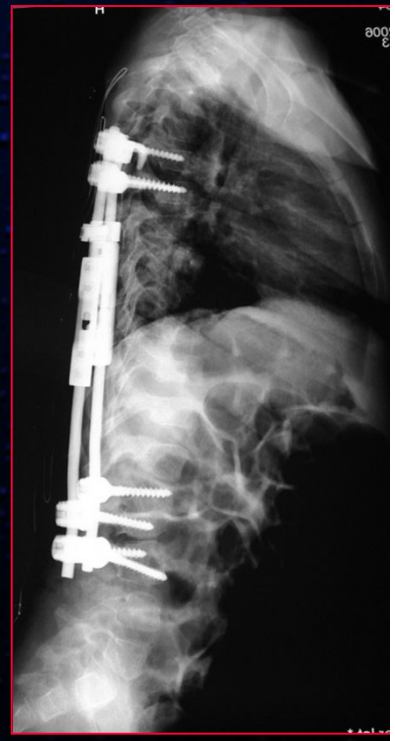


Safety and Efficacy of Growing Rod Techniques for Pediatric Congenital Spinal Deformities

Hazem B. Elsebaie, FRCS, Muharrem Yazici, MD, George H. Thompson, MD, John B. Emans, MD, David S. Marks, FRCS, David L. Skaggs, MD, Alvin H. Crawford, MD, Lawrence I. Karlin, MD, Richard E. McCarthy, MD, Connie Poe-Kochert, NP, Patricia Kostial, RN, BSN, Tina Chen, BS and Behrooz A. Akbarnia, MD.

GSSG 2007 IMAST

Dr M. Yazici



METHODS:

19 patients

age: 6 ys 10 ms (3±2 to 10±7)

Segmentation 5 formation 4, mixed 5 and unclassified or not recorded 5.

Affected vertebrae per patient 5.2 (2-9).

Follow up period 3 years 9 months (2±6 to 6±0).

Number of lengthenings 4.3 (1-10) per patient.

RESULTS:

Scoliosis: 65.3º (40º-90º) pre-initial
to 44.9º (13º-79º) post initial (31.2% correction)
and 47.2º (18º-78º) at the last follow-up.

T1-S1 from 263.8mm after initial surgery
to 310.5mm at last follow-up
Average T1-S1 length increase 12mm per year.

The space available for lungs (SAL) ratio from
0.81 preoperatively to 0.94 post latest follow up.

Complications in 8 of 19 patients (42%), total of 15 complications out of 100 procedures (15%): 2 pulmonary, 2 infections and 11 implant-related.

There were NO Neurological complications in any of the patients during the treatment period.

CONCLUSION:

The growing rod technique is a safe and effective treatment for congenital spinal deformities.

There is less correction at initial surgery than with other etiologies. There was minimal loss of correction over the treatment period.

The spinal growth and the SAL improved.

The rate of complication is acceptable.

Growing rod technique can be used in selected patients with congenital spinal deformities.

Complications of the Dual Growing Rod Technique: Can We Identify Risk Factors ?

Behrooz Akbarnia MD*, Marc Asher MD**, Ramin Bagheri, MD*,
Oheneba Boachie-Adjei, MD§, Sarah Canale BS*,
Patricia Kostial RN, BSN*, David Marks FRCS#, Richard McCarthy MD¥,
Michael Mendelow, MD†, Connie Poe-Kochert, CNP‡,
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From The Growing Spine Study Group

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SRS Annual Meeting September 2006

Conclusion

- Risk factors include younger age and longer treatment periods
- Lengthening interval of ~6 mos seems to strike a balance between the risks of implant and wound complications

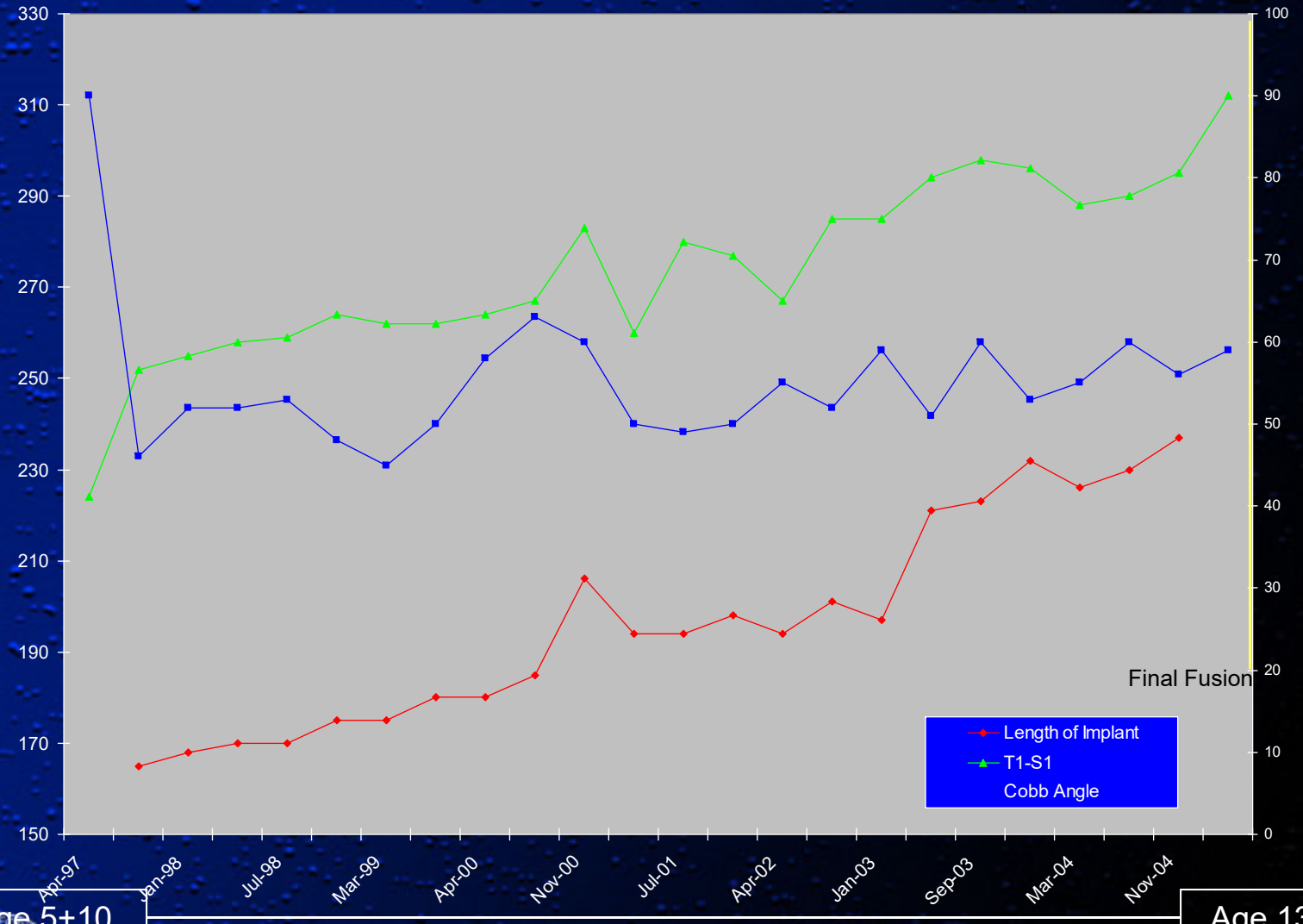
Conclusion

- Higher risk of implant complications in IIS may be due to normal neurologic status and increased activity
- Aggressive treatment of superficial wounds needed to prevent deep infections

Indications

- Progressive deformity
- Non responsive to cast, brace or traction
- Growth remaining
- Over the age 12-18 months
- Cooperative family
- Diagnosis?

5 + 10 Year Old Girl with Progressive IIS until Final Fusion



Age 5+10

Age 13 +6

N.O. 5+11 Girl (IIS)

Scoliosis:

Pre-op 90°

Post-op 55°

T1- S1(mm):

Pre-op 224

Post-op 273

FU 331

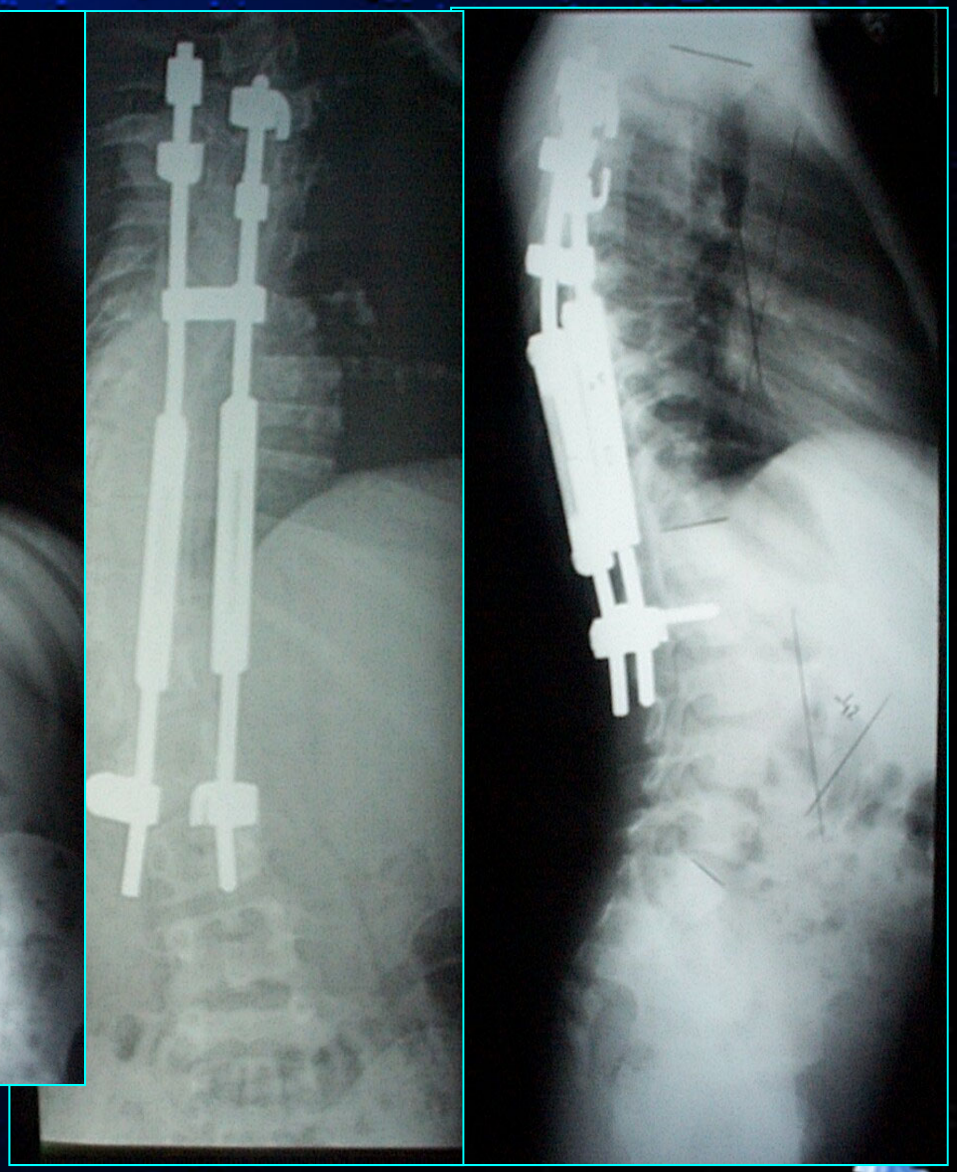
Elongation 4.9

Growth 5.8

Total 10.7 cm

1.2 cm per year

Preop



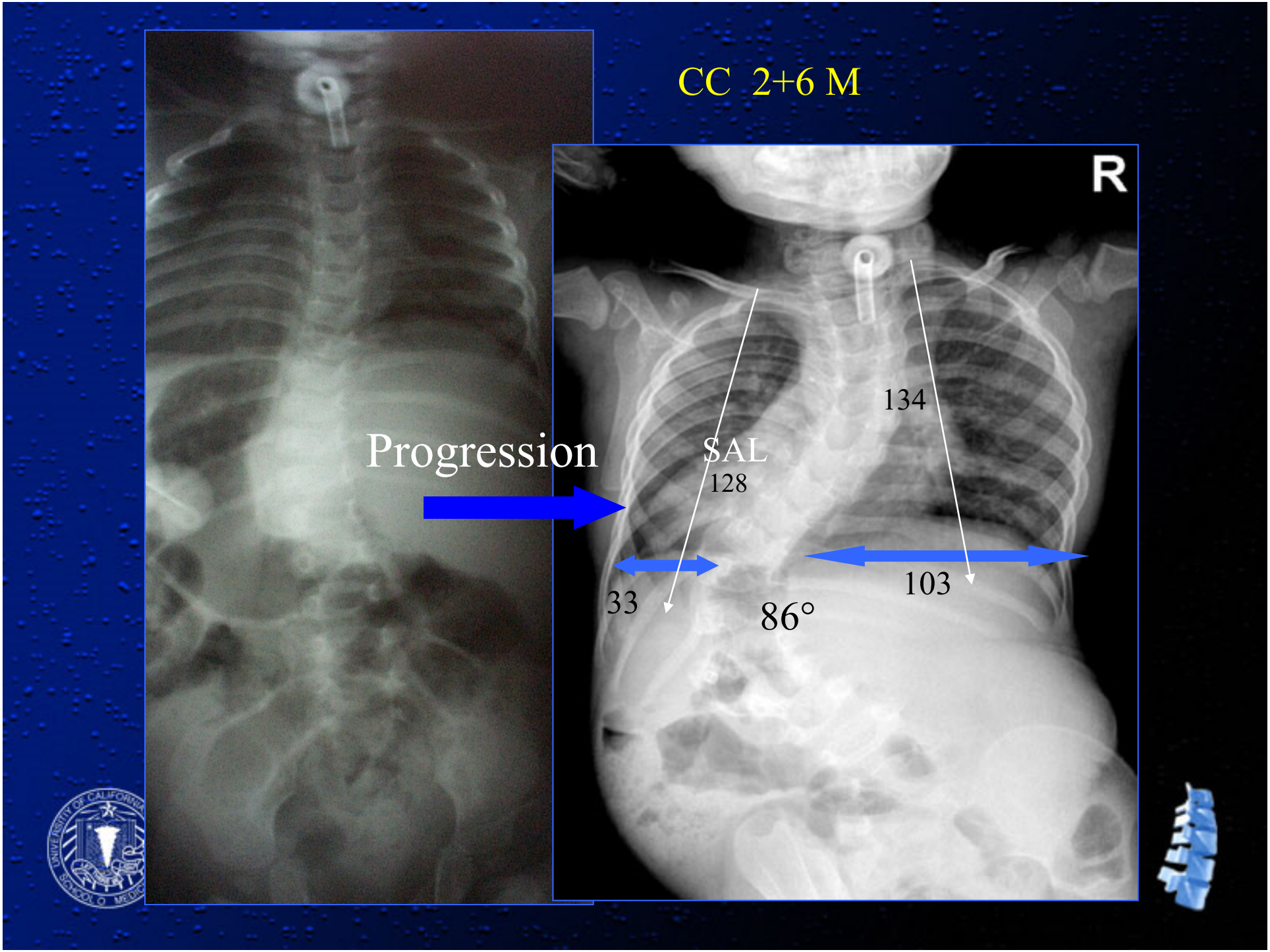
6 years FU

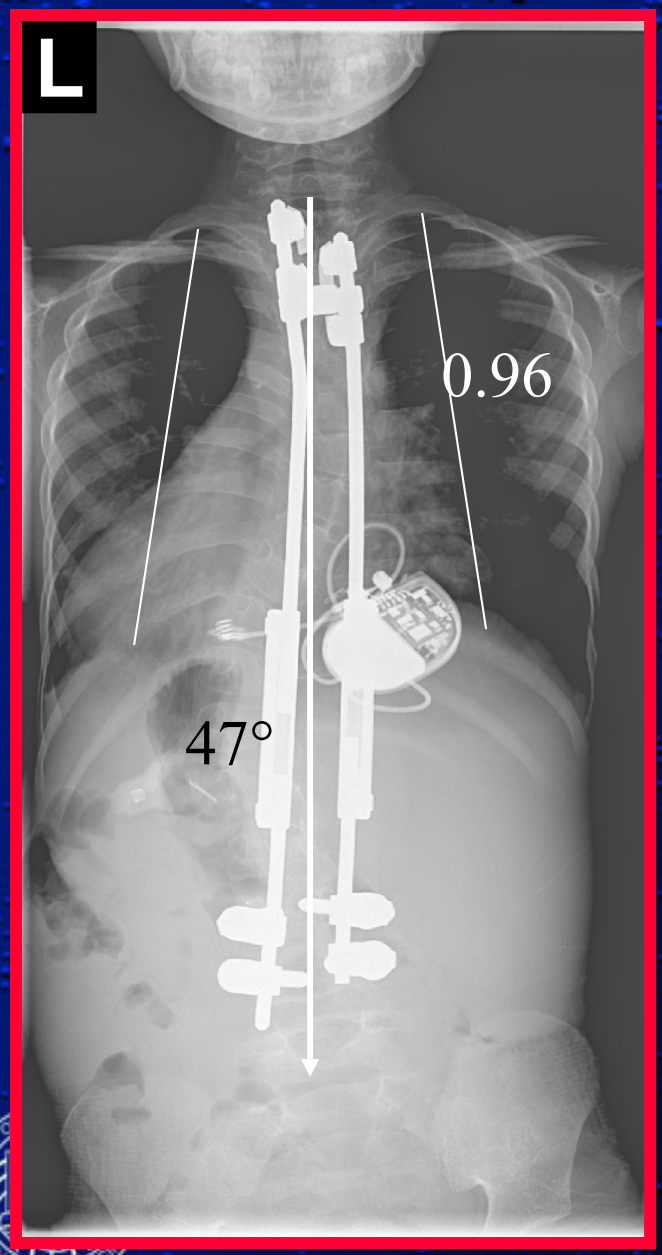
6 year Follow-up

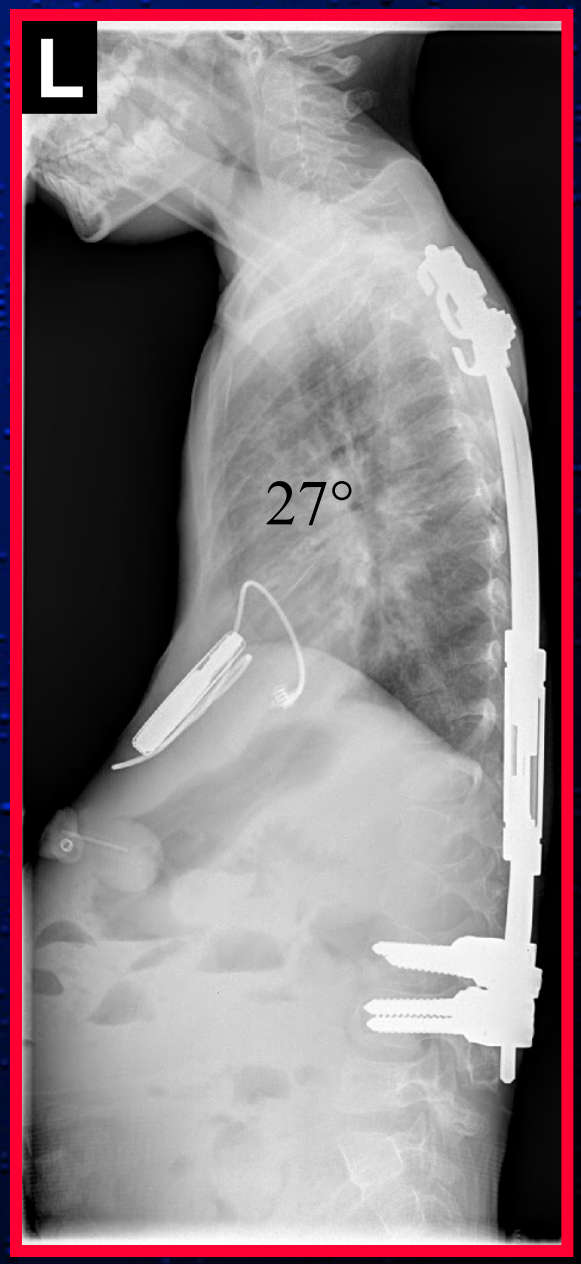
Clinical History (CC)

- Two and half year-old male with progressive scoliosis not responding to one year of brace treatment.
- Several episodes of pneumonia.
- Had a trach. for congenital airway anomaly.

CC 2+6 M.


CC 2+6 M
R
Progression
SAL
128
134
33
86°
103





5 year
after initial
surgery

CC Age 7+3

Cobb:

Pre 86°

FU 47°

T1-S1:

Pre 211mm

Post 247mm

FU 302 mm

Total 9.1 cm

Length. # 9

Word of Caution?

- Stiff curves require initial traction or release
- Kyphosis that is not flexible
- If surgeon is not fully experienced in technique
- If surgeon can't manage the expected complications
- If the family is not understand the complexity of the problem and treatment or not cooperative
- If no benefit is expected from this technique

Last Take Home Message

- This technique has a high but manageable complication rate
- With careful patient selection, the benefits of the dual growing rod technique outweigh the complications
- The family should fully understand the long-term commitment and risks before treatment is initiated

What option to choose?

Future Direction

- Natural history
- Better outcome tools
- Developing new techniques for less invasive approach
- Potentially preserving spinal and chest wall motion
- Multi-center research needed to answer complex questions
- Long term observation needed to know the effect of the treatment on the quality of life.


Thank you