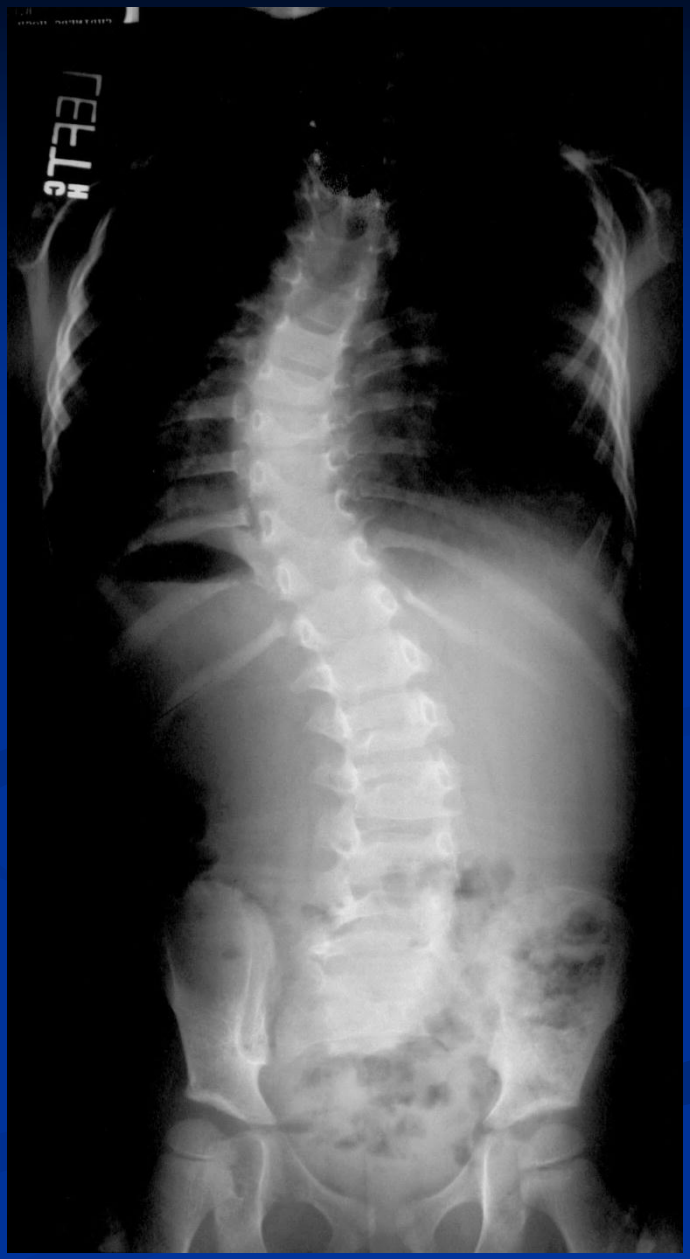
New and Forgotten Growth Modulation Strategies for the Growing Child with Spine Deformity

Randal R. Betz, MD



Disclosures

- Royalties: Medtronic, DePuy Synthes Spine
- Consultant: DePuy Synthes Spine
- Research Grants: DePuy Synthes Spine (to Chest Wall & Spine Deformity Study Group and Harms Study Group)

Objectives

- To present growth modulation options for growing children with spine deformity
  - Congenital scoliosis
    - Bracing
    - Hemiepiphysiodesis
    - Patience and fusion
  - Idiopathic / syndromic scoliosis
    - Aggressive bracing
    - VBS: vertebral body stapling
    - VBT: vertebral body tethering

Objectives

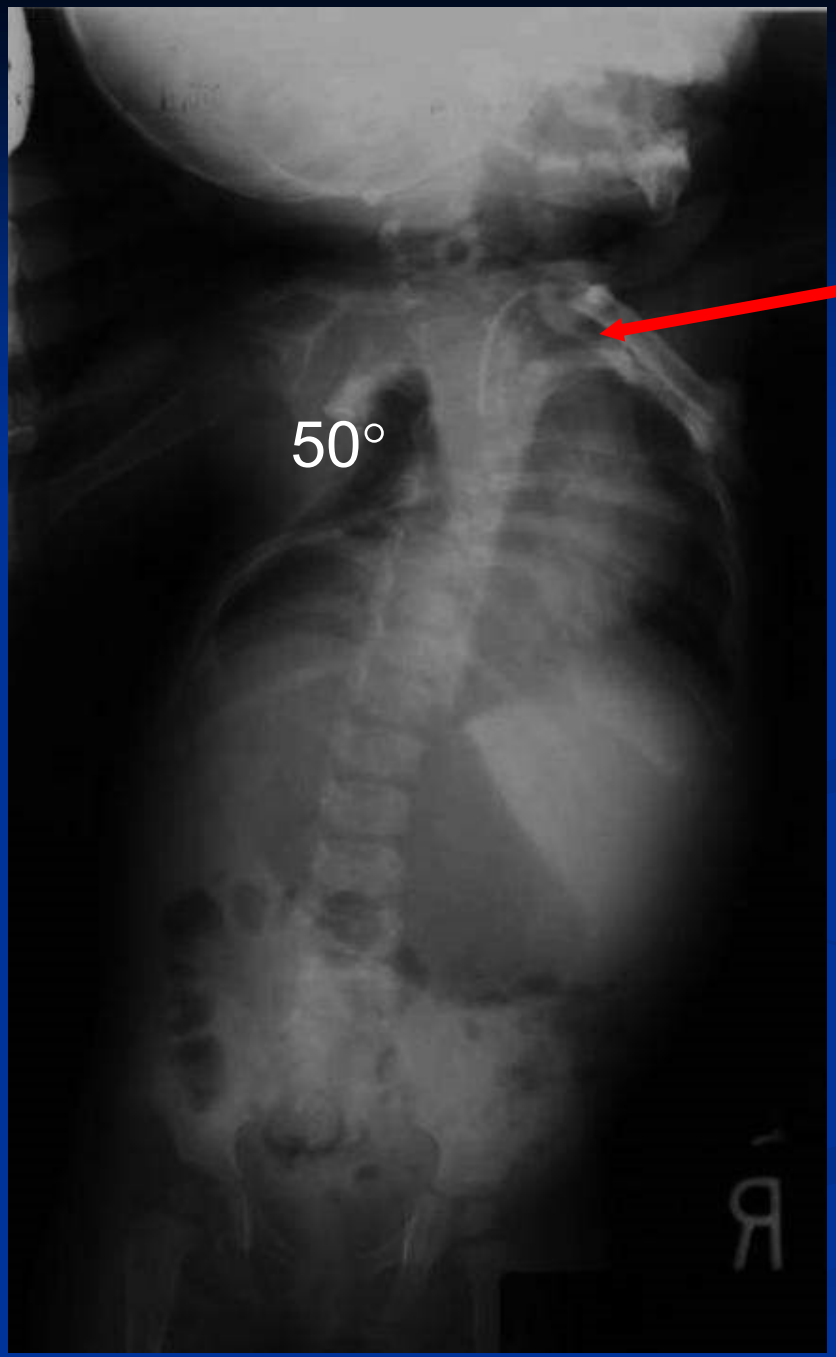
- Not covering:
  - Growing rods
  - Titanium rib
  - Shilla
  - Phenix noninvasive lengthening growing system

  - The above are or will be discussed thoroughly during the rest of the meeting

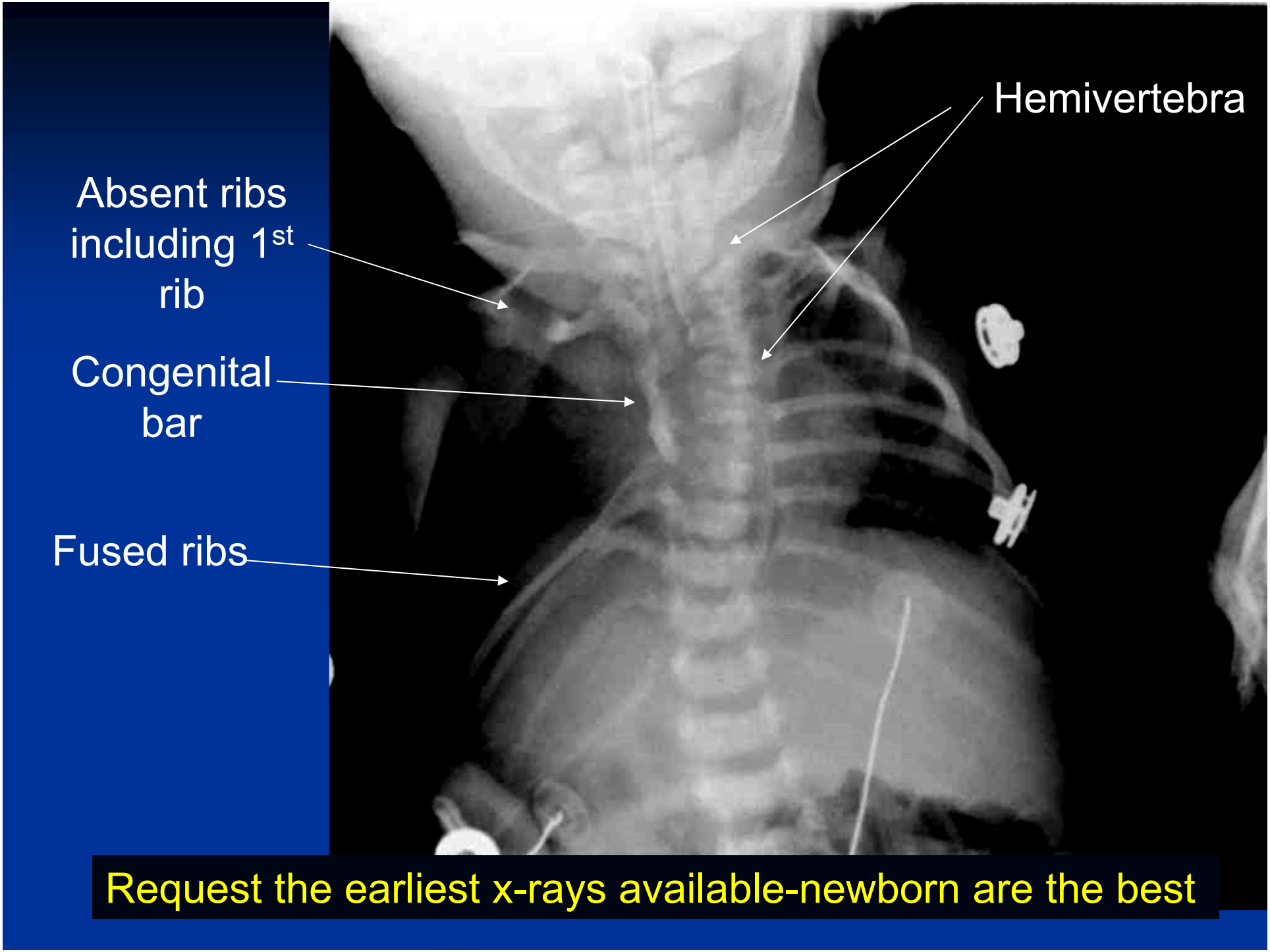
Congenital Scoliosis

- What's the deformity
  - Easy?
- What's the natural history

14 mo old

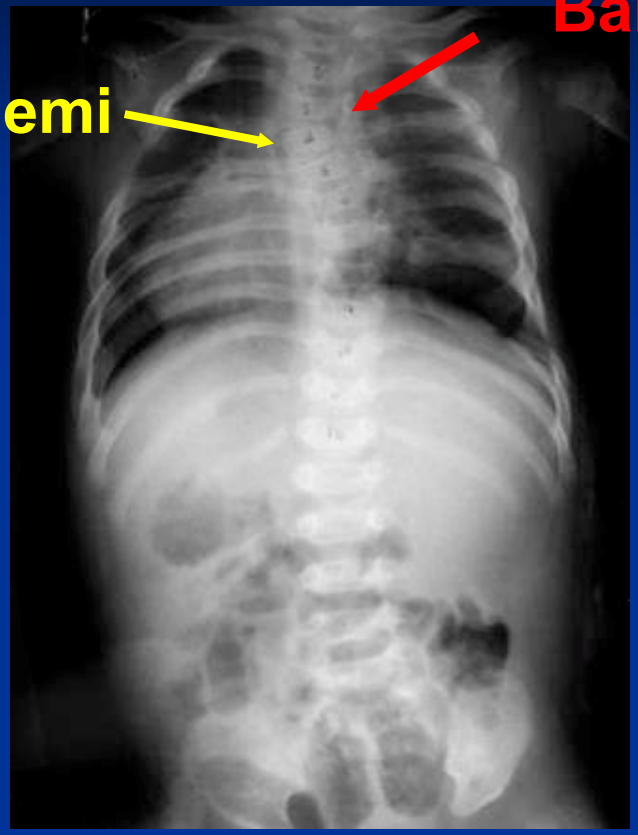


What is the deformity?

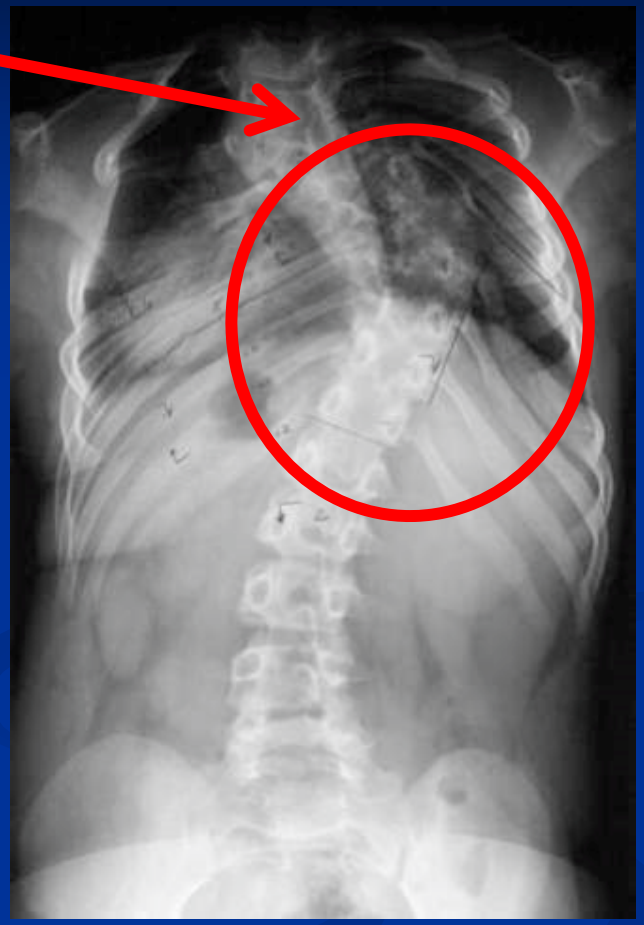


Request the earliest x-rays available-newborn are the best

Watch out for the development of a structural compensatory curve



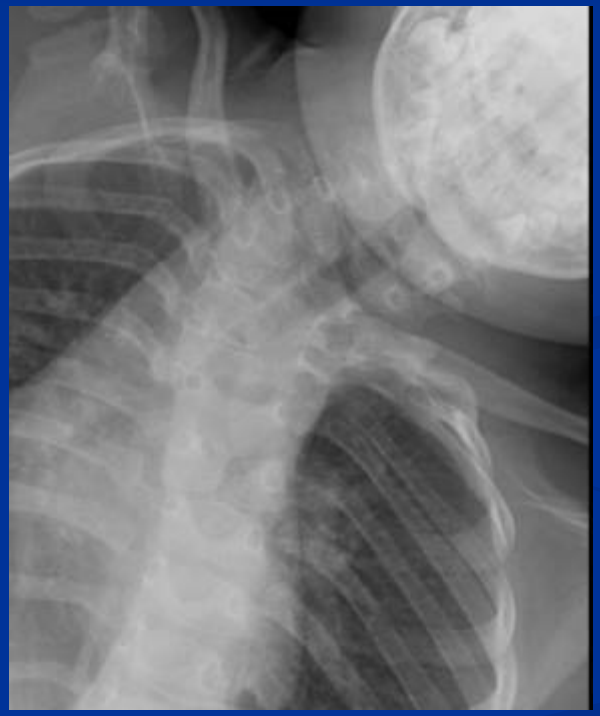
Age 1



Age 8

E.G.

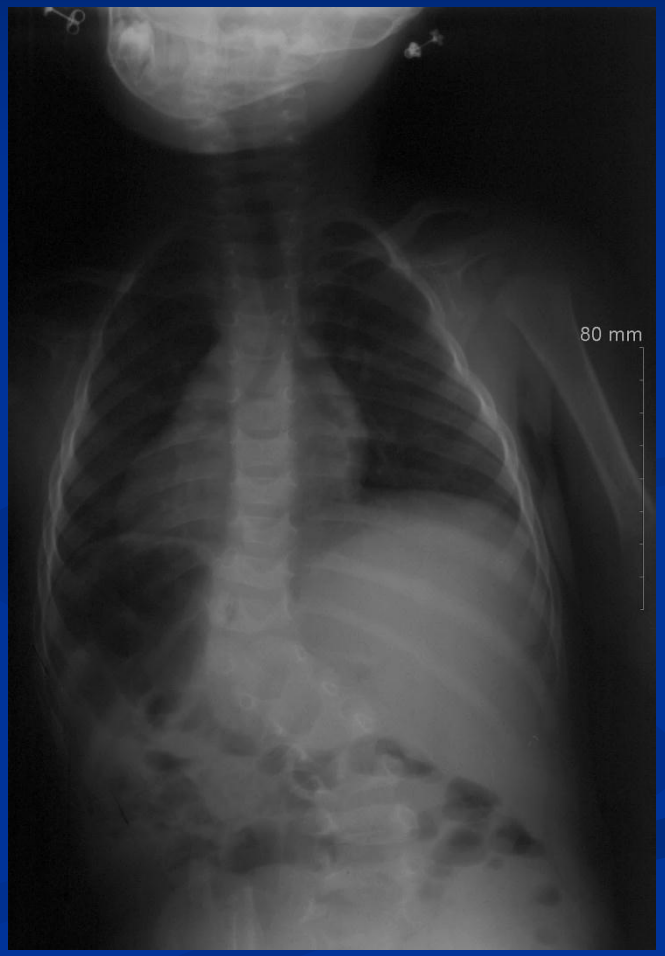
Similar case from John Emans – required treatment of both the congenital and the now structural compensatory curve



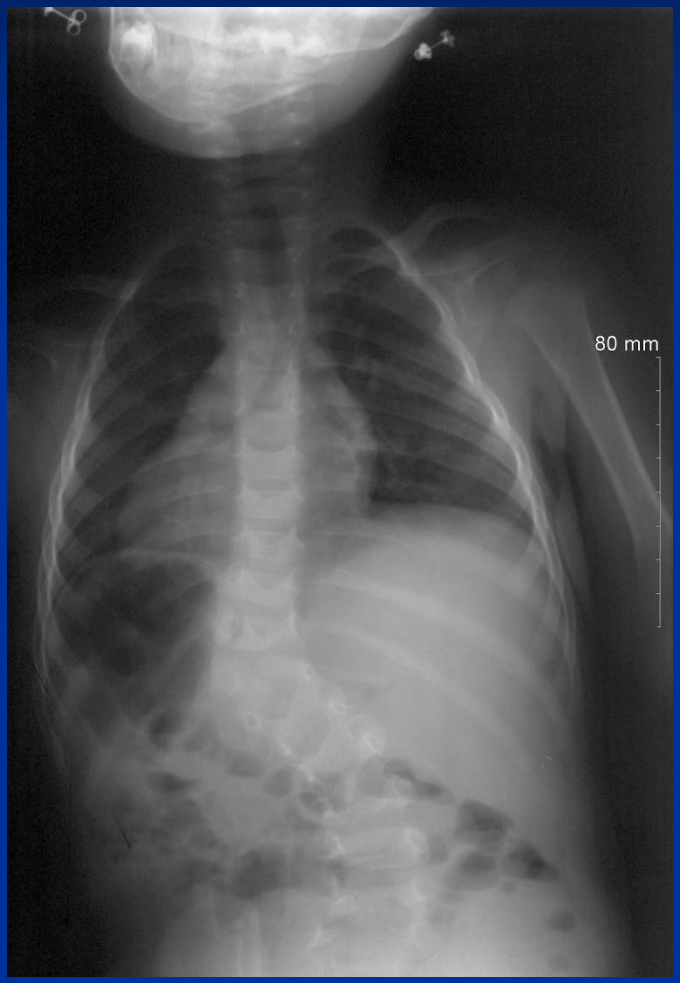
Case courtesy of John Emans

Forgotten Growth Modulation Technique: Bracing the Compensatory Curve

- T12 congenital hemivertebra initially diagnosed at < 1 year of age
- Approximately 50° curve
- 40° compensatory lumbar curve
- Brace recommended for compensatory curve



Age 18 mo



Age 18 mo

8 years old now

Convex Hemiepiphysiodesis for Congenital Scoliosis

- Thompson *et al*,1995
  - 50% of patients no change or deteriorated
- Winter *et al*, 1988
  - 13 patients
    - 7 stabilized
    - 5 ≥ 5° of correction

It works but read the technique carefully

Thompson AG *et al*. Long-term results of combined anterior and posterior convex hemiepiphysiodesis for congenital scoliosis due to hemivertebrae. *Spine*. 1995;20:1380-5

Winter RB *et al*. Convex growth arrest for progressive congenital scoliosis due to hemivertebrae. *JPO* 1988;8:633-8

Convex Hemiepiphysiodesis for Congenital Scoliosis

- The ideal patient
  - has a pure scoliosis (no major element of kyphosis or lordosis)
  - has a progressive curve < 70°
  - has a curve of five segments or less
  - is aged ≤ 5 years, and
  - does not have a curve involving the cervical spine
- At operation,
  - the concavity should never be exposed either anteriorly or posteriorly
  - exactly how much of the growth plate should be excised is difficult to determine. If too much is excised, a complete bilateral fusion will result, and no epiphysiodesis effect will occur. If too little is excised, a pseudarthrosis may occur or too much convex growth will remain.

Winter et al. *JPO* 1988;8(6):633-8.

Patience and Time Can be Growth Modulation: Watching and then Fusion In Situ

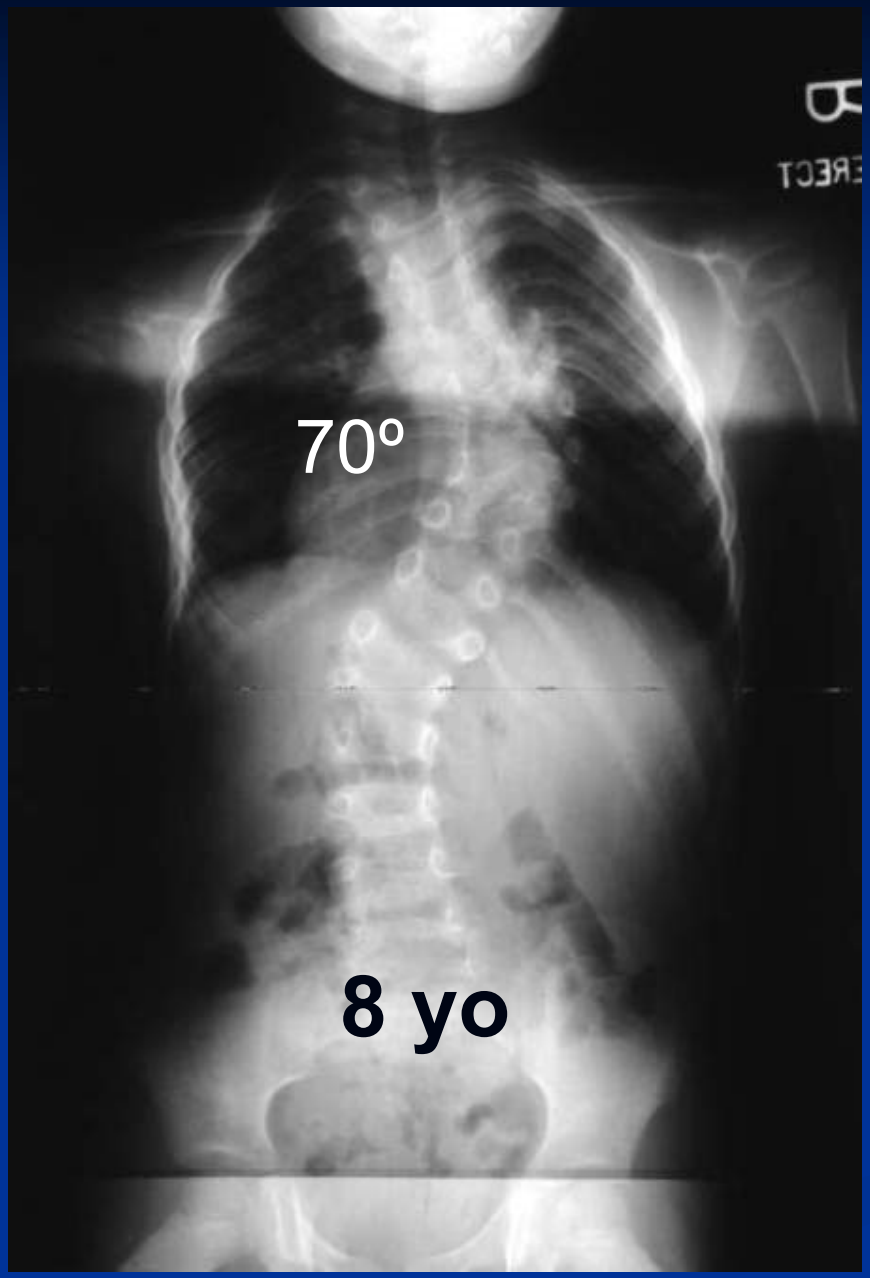
- Winter *et al,* 1984
  - PSF with instrumentation 36% correction
- Works but MUST fuse long first vertebrae that reverses direction above and below to prevent adding on and crankshaft

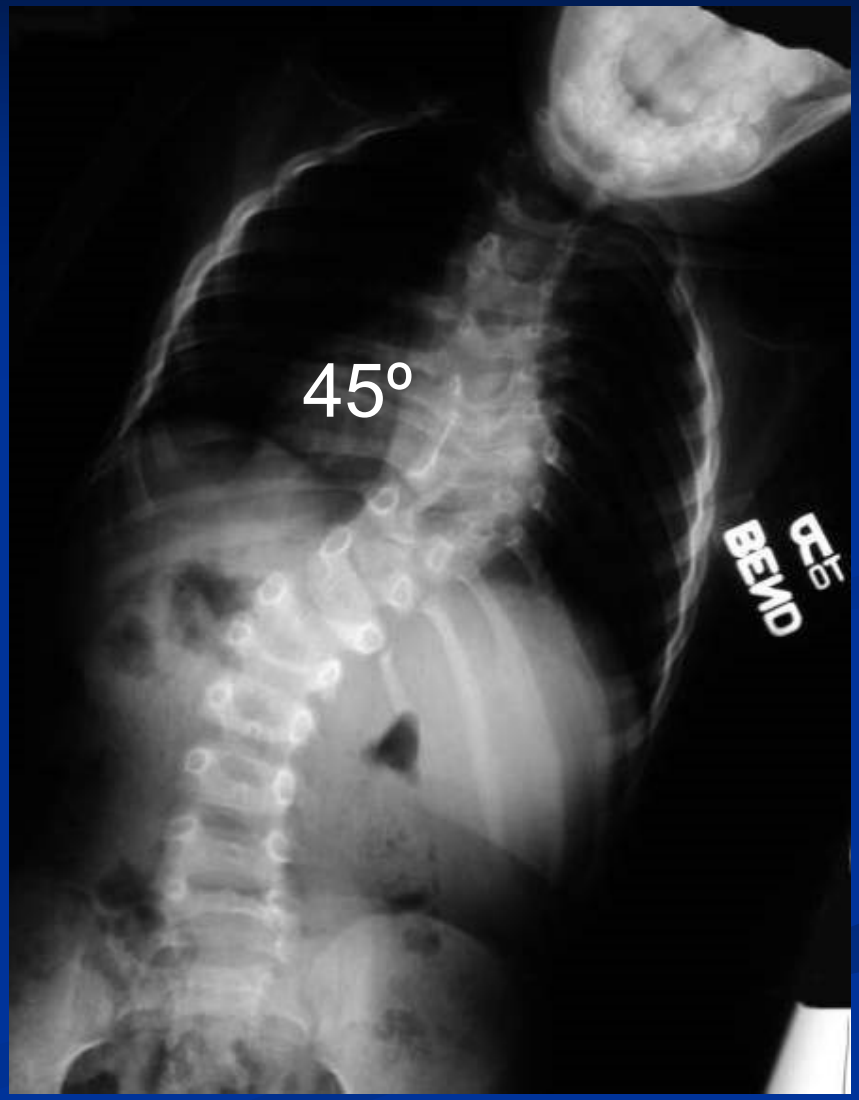
Winter et al. Posterior spinal arthrodesis for congenital scoliosis. An analysis of the cases of 290 patients, 5 to 19 years old. JBJS 1984;66-A:1188-97

Case Example

Age 2

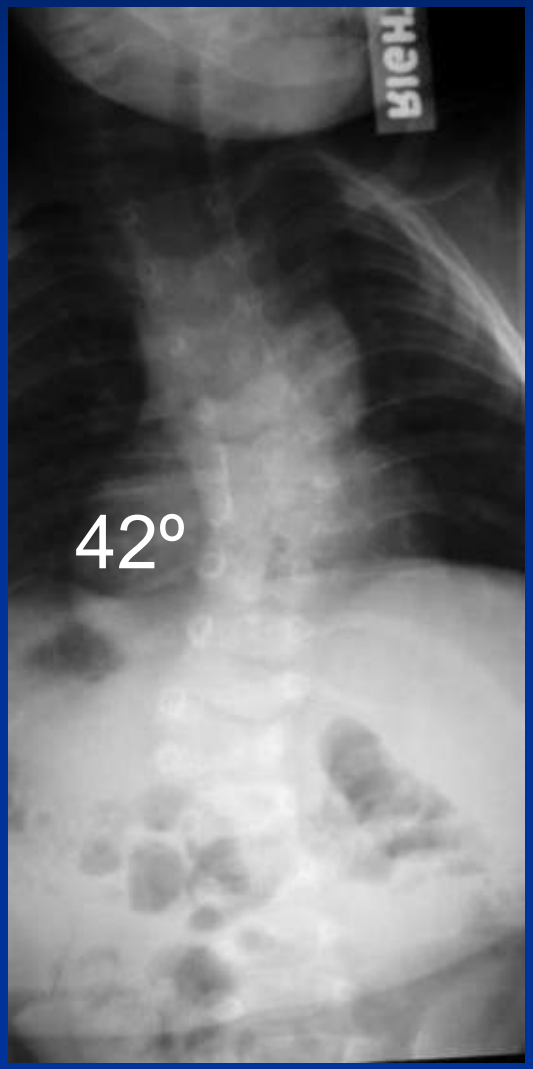
Age 4

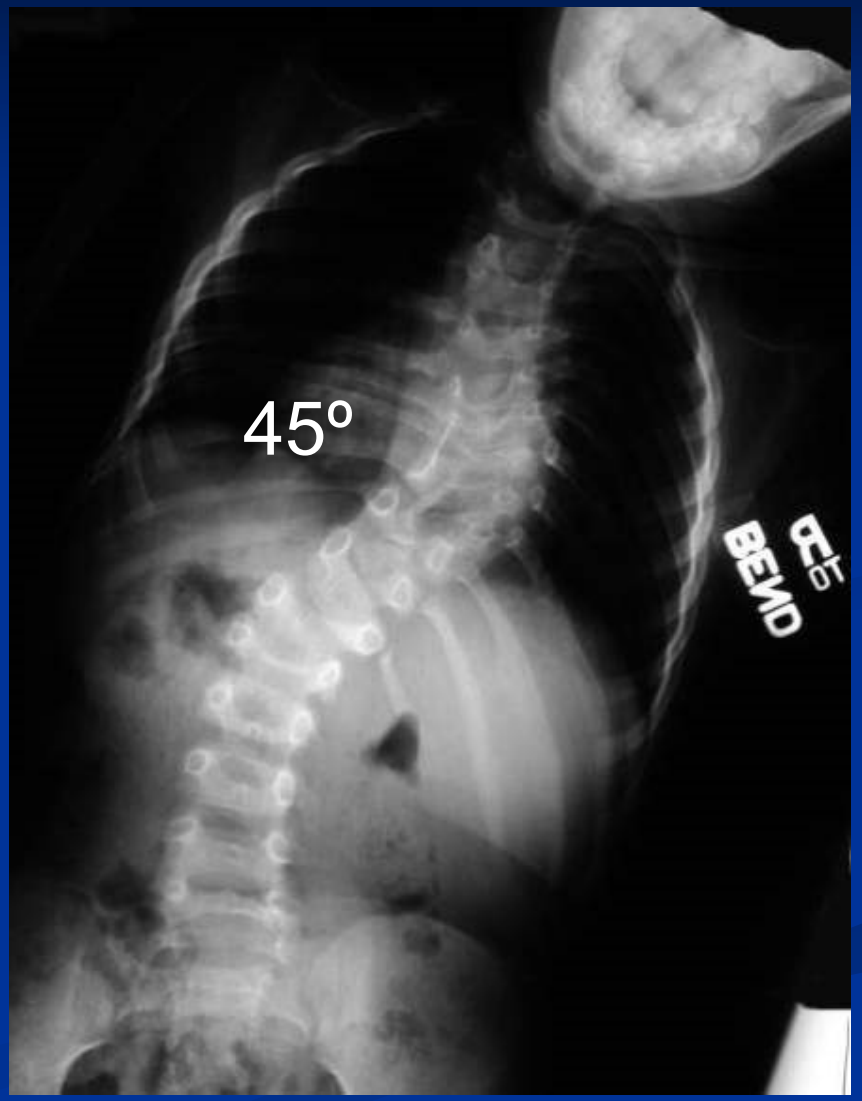

70º
8 yo


45º

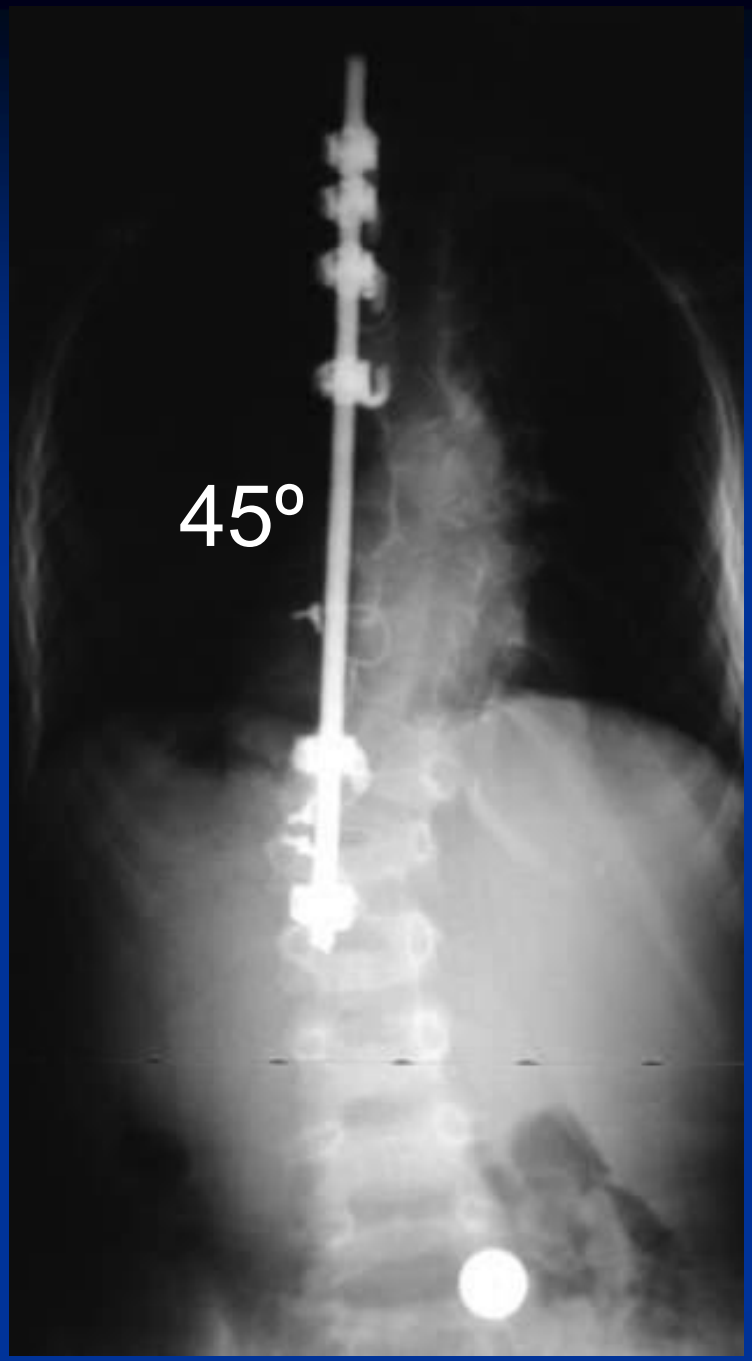
Rigid portion still measures same as it did at age 2

Age 2





Fusion was done at age 8



Age 14

FVC: 51%, FEV_1: 53%

Is early fusion beneficial from a pulmonary viewpoint?

Goldberg *et al* Spine, 2003

- Casted/braced, with surgery after age 10 years, N=6
  - FVC 68.33% nl
- Surgery before age 10 years, N=11
  - FVC 41% nl (14 -72%)

Goldberg CJ *et al*: Respiratory function and cosmesis at maturity in infantile-onset scoliosis. Spine 2003:28;2397-406

VEPTR Pulmonary Outcomes
From Gadepalli et al, J Ped Surg 46:2001

		Preoperative	Postoperative	P
PFT	FEV_1	54.6 ± 22	51.8 ± 20	.63
	FVC	58.1 ± 24	55.9 ± 20	.62
	RV	145.3 ± 112	105.6 ± 31	.34
3DCTR	Total volume	944.2 ± 450	1042.1 ± 311	.19

FEV_1 indicates forced expiratory volume in 1 second; FVC, forced vital capacity

Gadepalli SK *et al*: Vertical expandable prosthetic titanium rib device insertion: does it improve pulmonary function? J Ped Surg 46:77-80, 2011

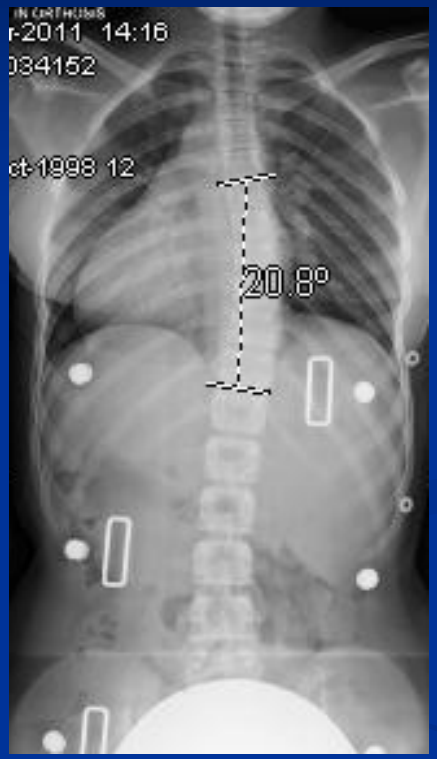
Moving on to Idiopathic

- Aggressive bracing
- Vertebral body stapling
- Vertebral body tethering

Aggressive bracing: Boston during the day and Providence at night

Algorithm for how I decide if needs Providence or not

Erect Boston



Supine Boston

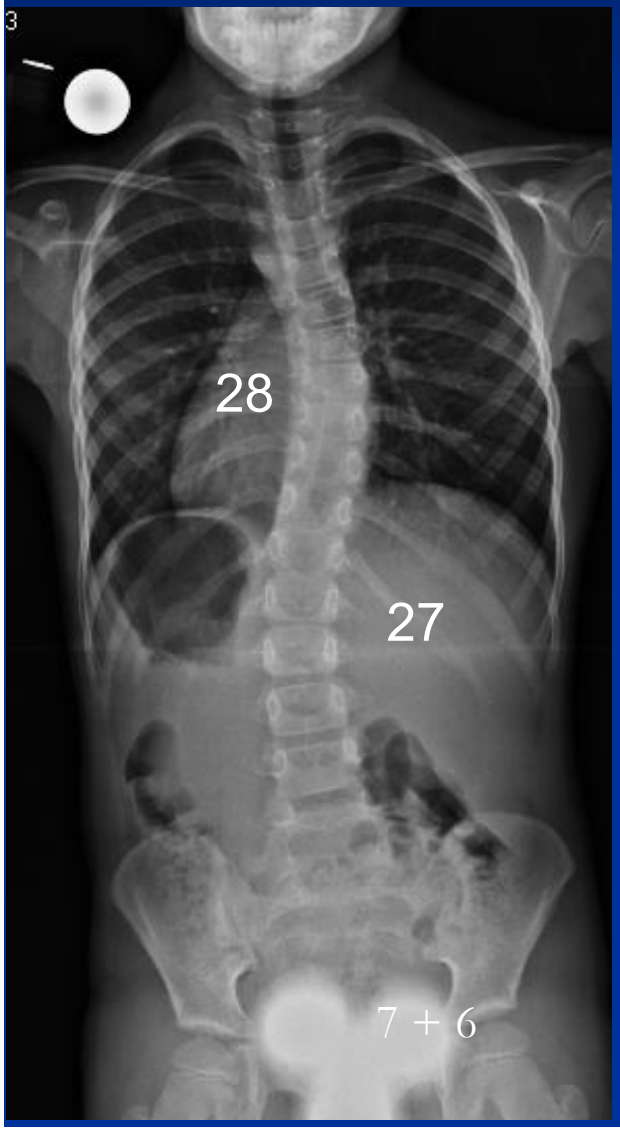
Providence

J.H.

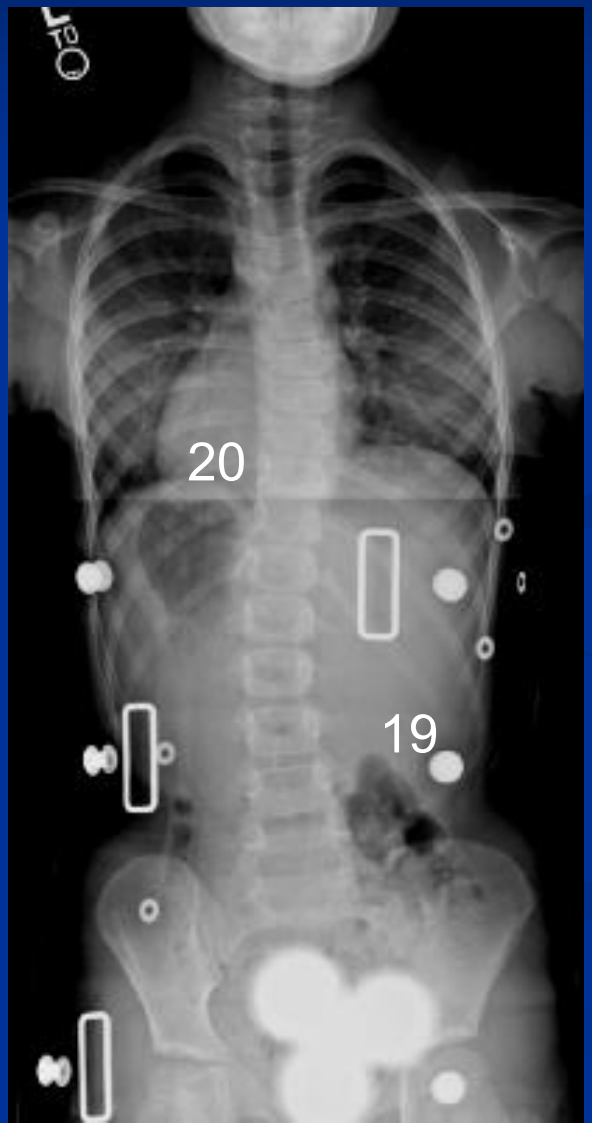
M.S.

Aggressive Bracing
Case #1 7 yo, JIS, nl MRI

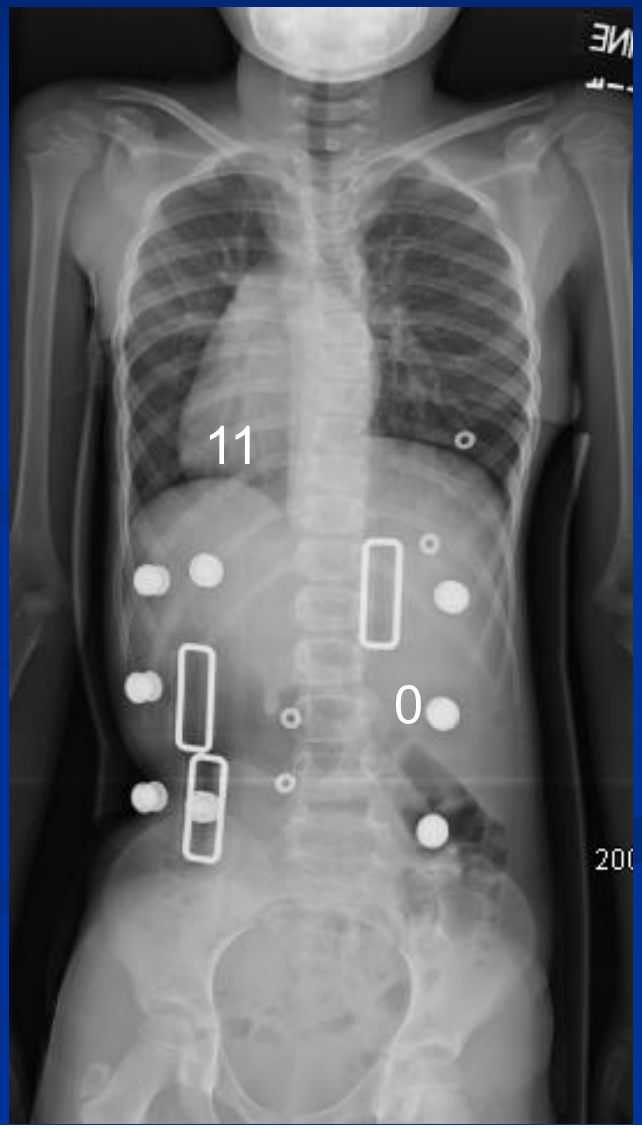
Pre bracing



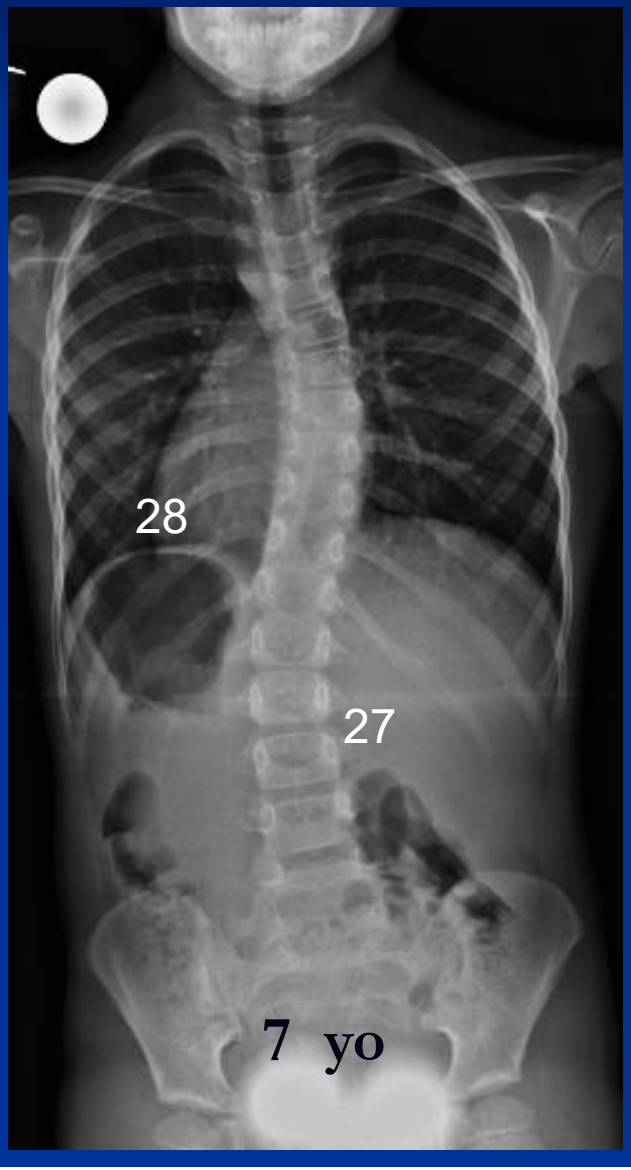
Boston

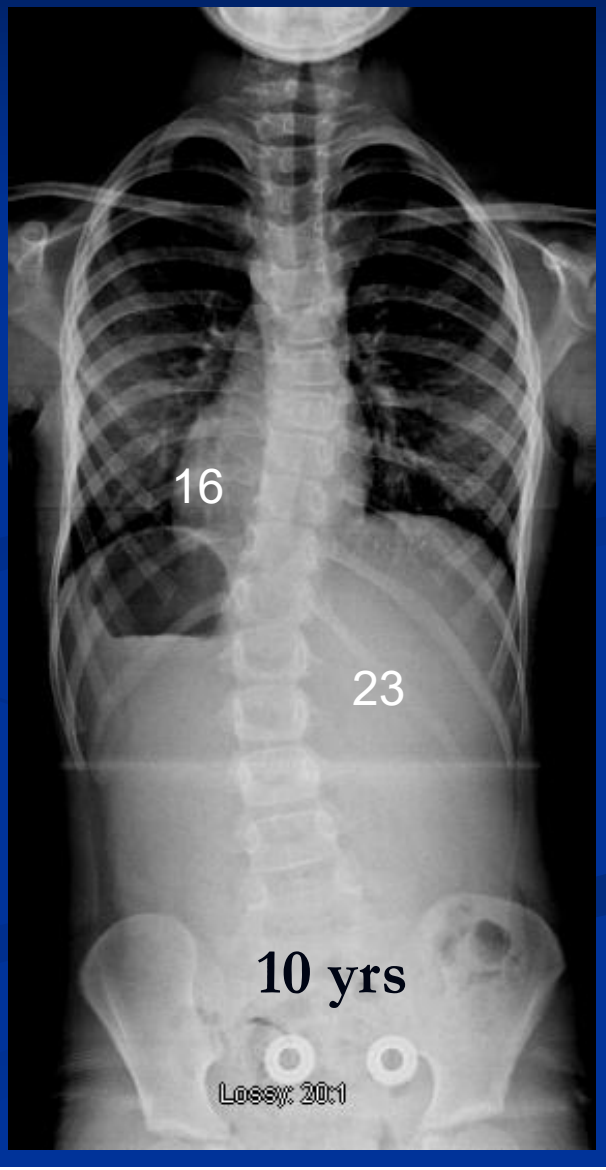


Providence



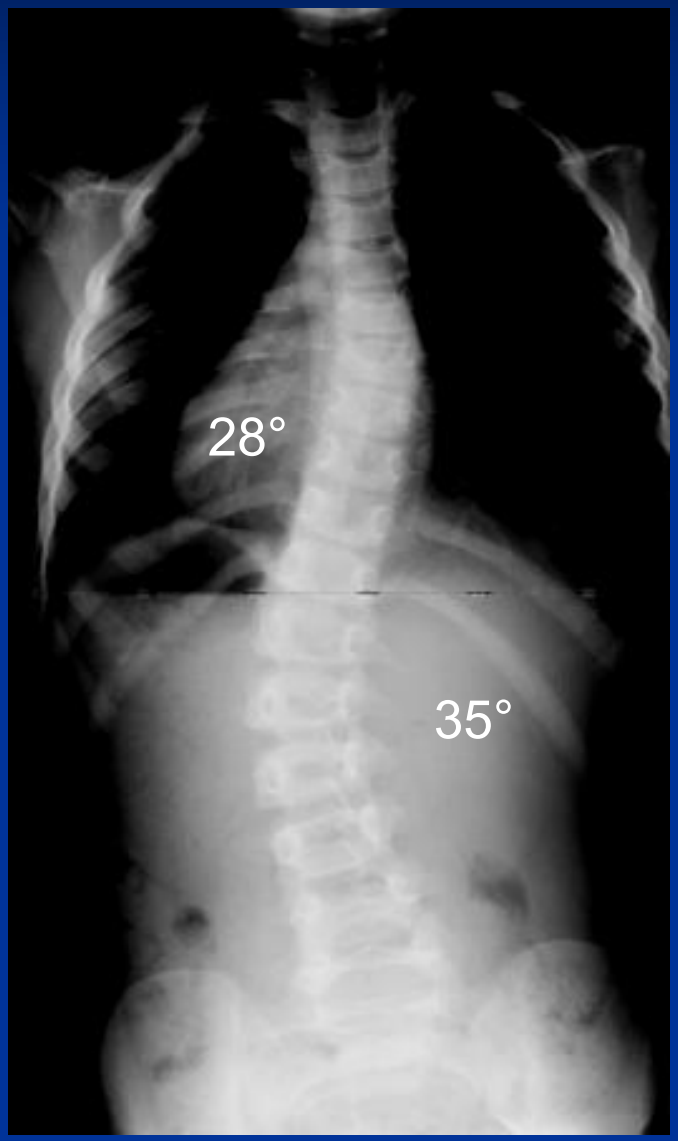
Now only 10 years: continued bracing ? Or still candidate for fusionless option—use original curve magnitude



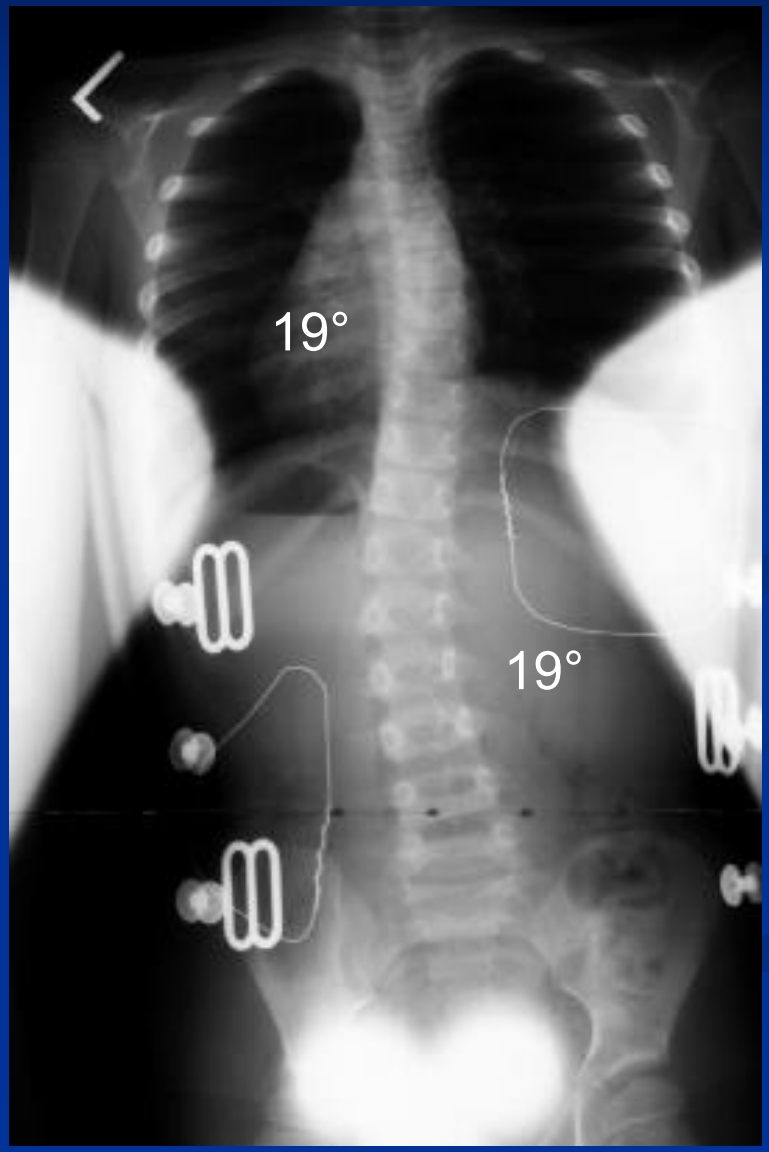


August 2007 at 5 + 3, 46.5”

Pre brace

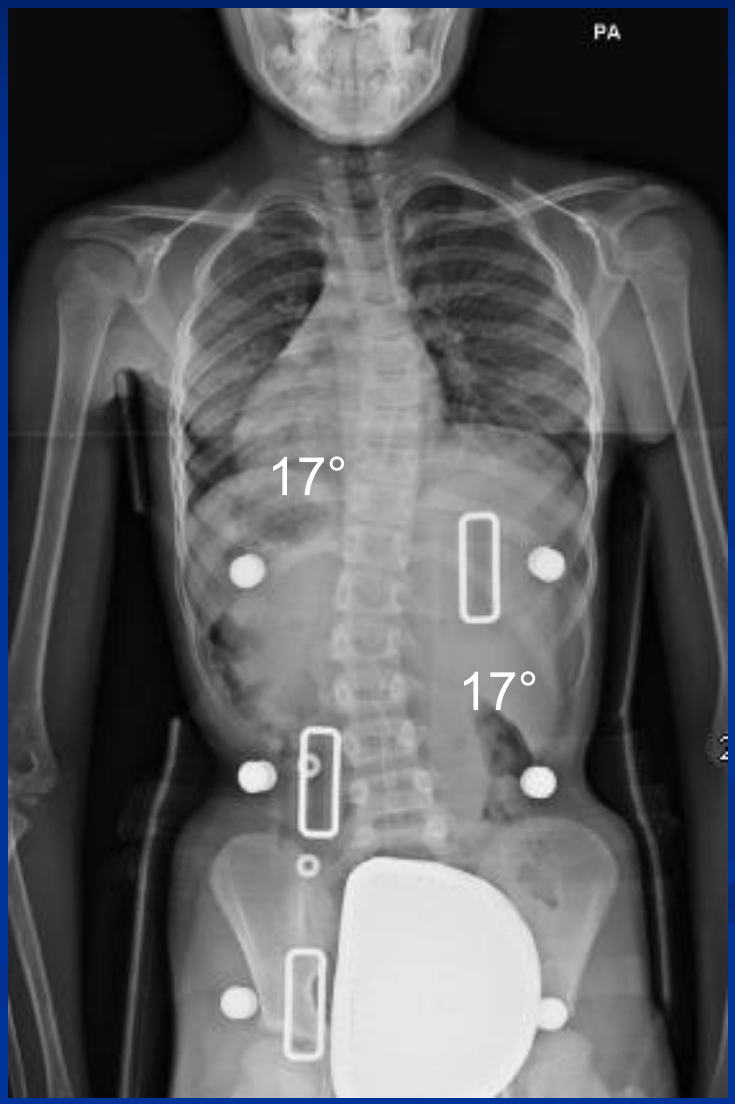


First TLSO



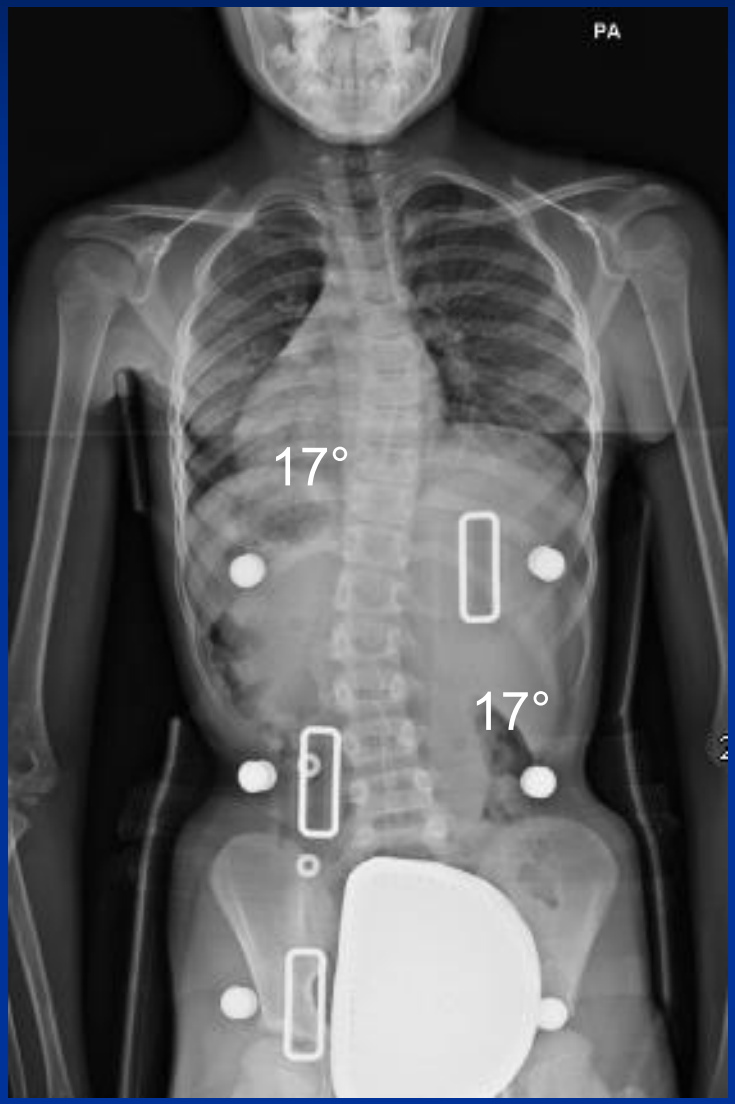
4 yrs later, continues to be a great (Boston) brace wearer. Can we do even better?

At 9 yo



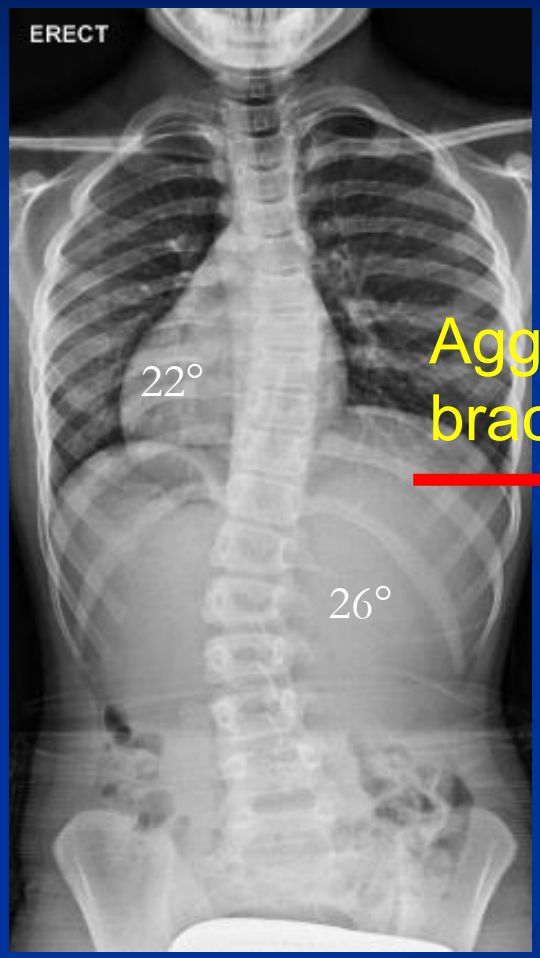
At 9 yo, 47.5” tall

Continue Boston (daytime) TLSO and add Providence (nighttime) TLSO



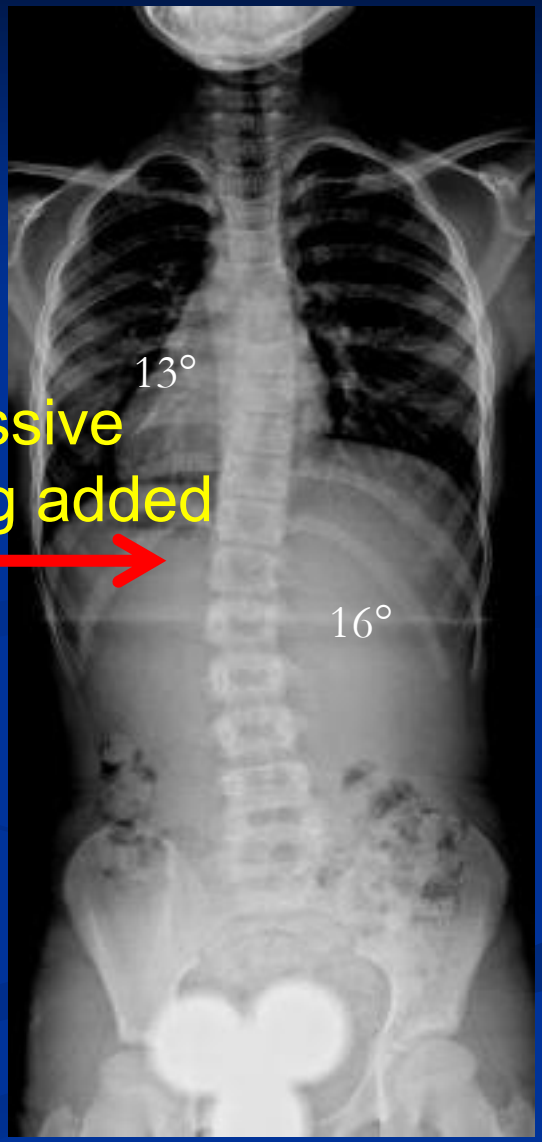
August 2007 at 5 + 3, 46.5”

Age 9



Aggressive bracing added

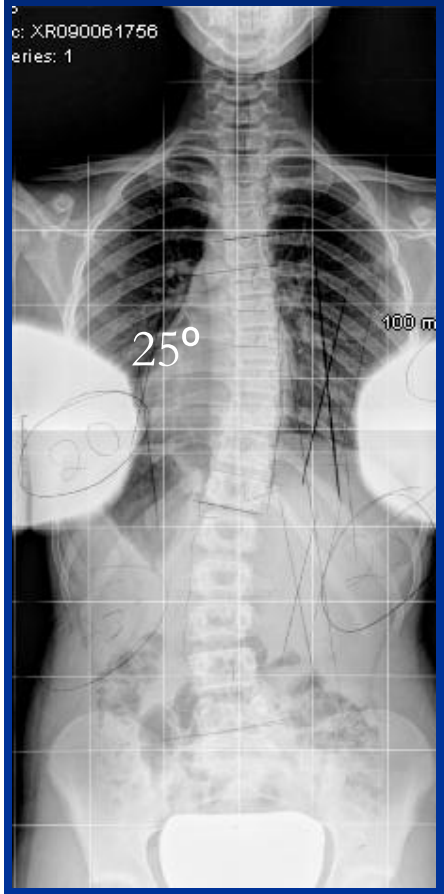
July 2012 at 10 + 2, 50” tall

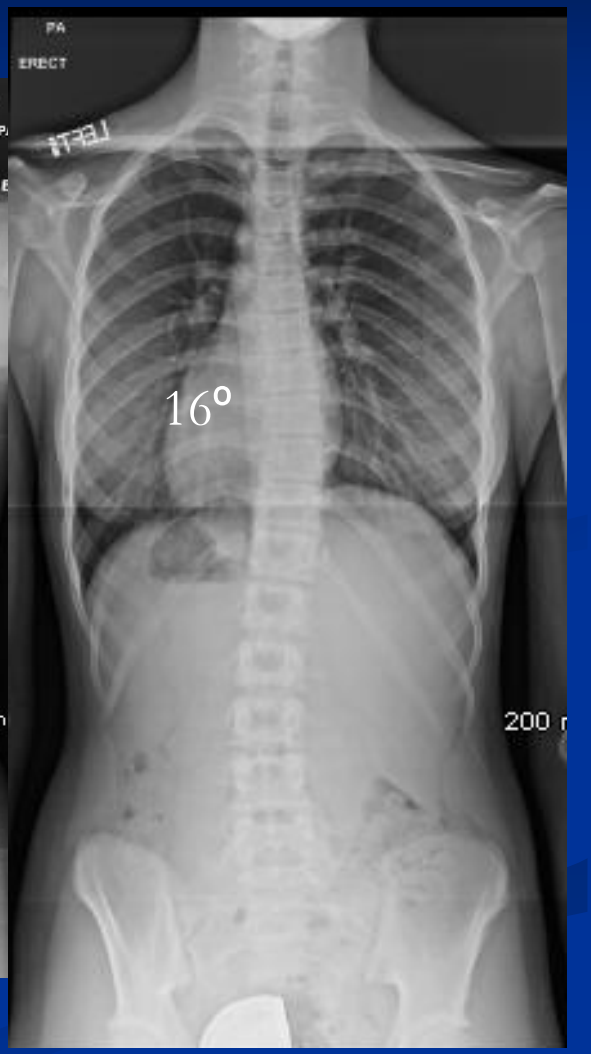


All x-rays out of brace for 24 hrs

Growth Modulation via Bracing thru Maturity

DK: 11 yo premenarche





11yo, R=0, S=3

15yo, R=4, S=7

Aggressive Bracing: What Have We Learned

- We try to get almost all patients desiring stapling to try a brace
  - Many find out brace is not so bad and continue on without stapling
- In many cases of moderate scoliosis (< 35°) with significant growth remaining we can get curve correction
  - Need flexible curve on bend film and excellent in brace correction
  - Need patient /parent compliance
- Need formal review with a good cohort thru skeletal maturity to know if correction holds up

Cost of Treatment

- Bracing $1000
  - New brace every 12-18 months
  - Total cost if seven braces = $7K
- Growing rods initial $20K
  - Lengthening every 6 months @ $5K
- Spinal fusion $100K
  - If complication such as infection: $250K (higher risk after growing systems)

History of Vertebral Body Stapling

- Nachlas & Borden, 1951
- Smith, 1954

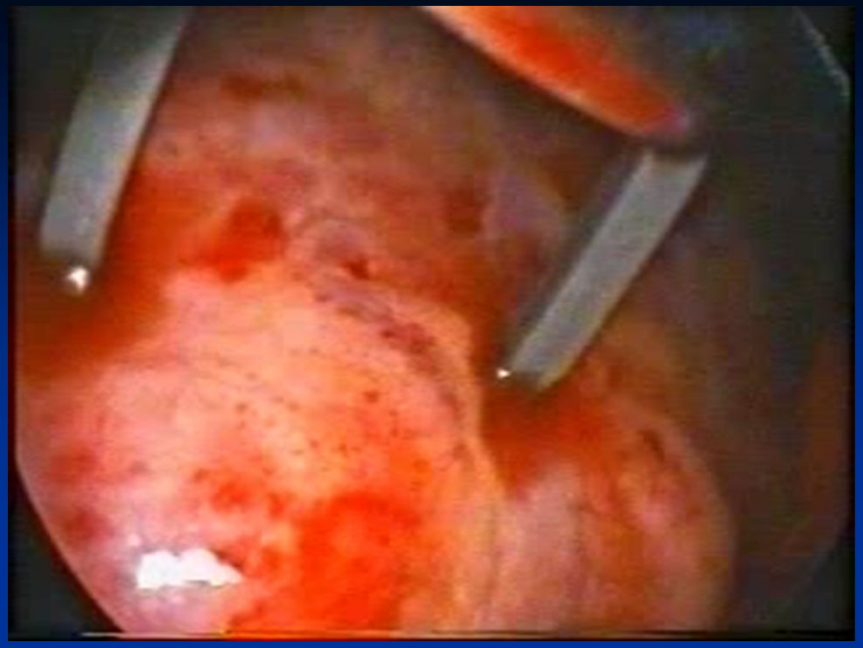
Dr Crawford's Adult Patient

Shape Memory Alloy Staple

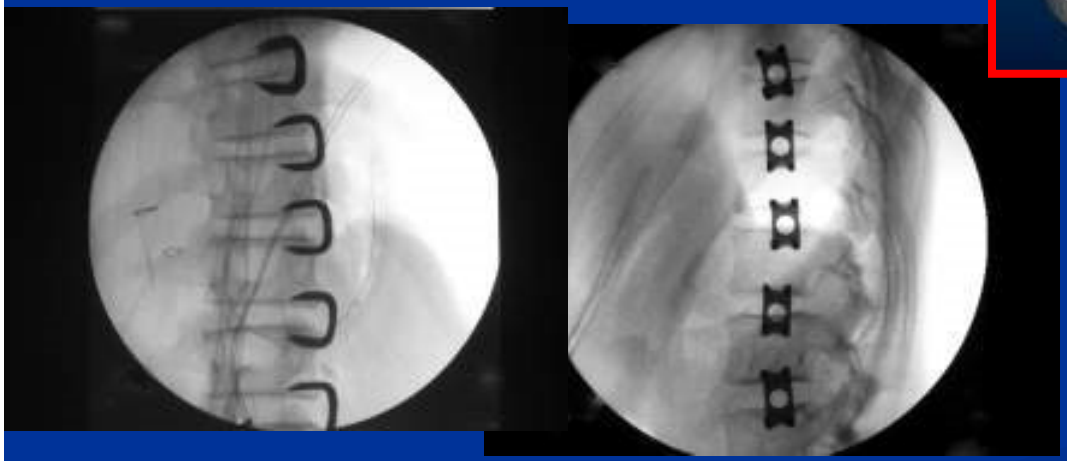
NITINOL

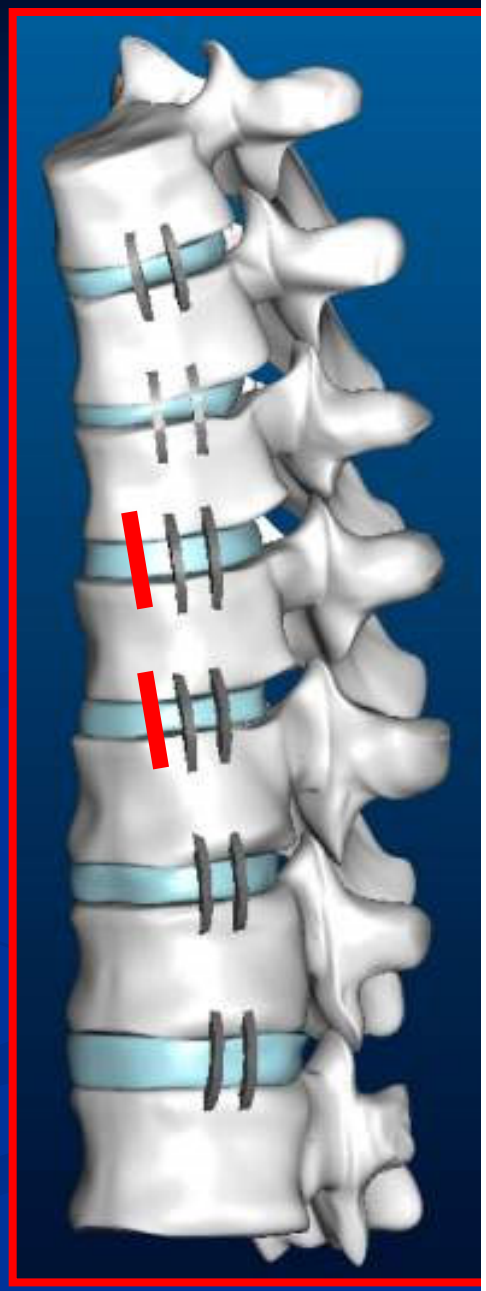
NIckel-**TI**tanium-**N**aval-**O**rdnance-**L**aboratory

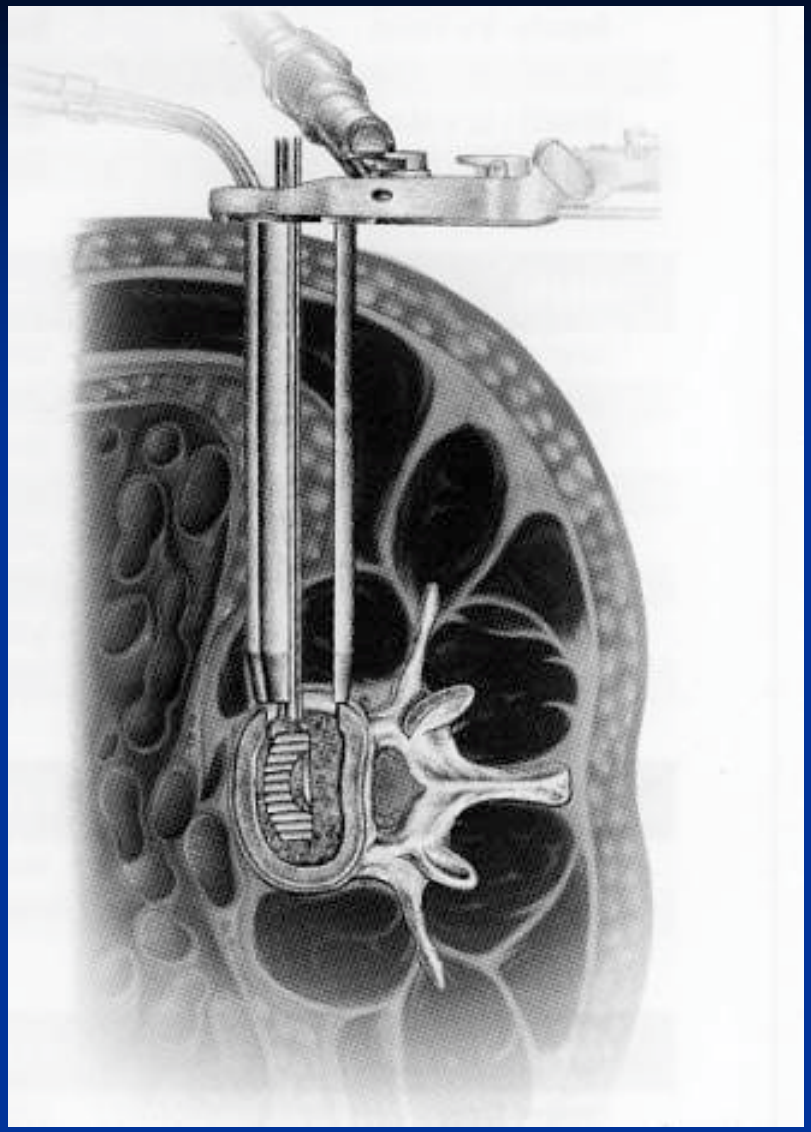
- 50% Nickel
  50% Titanium
- Improved pullout
- Constant force after implantation

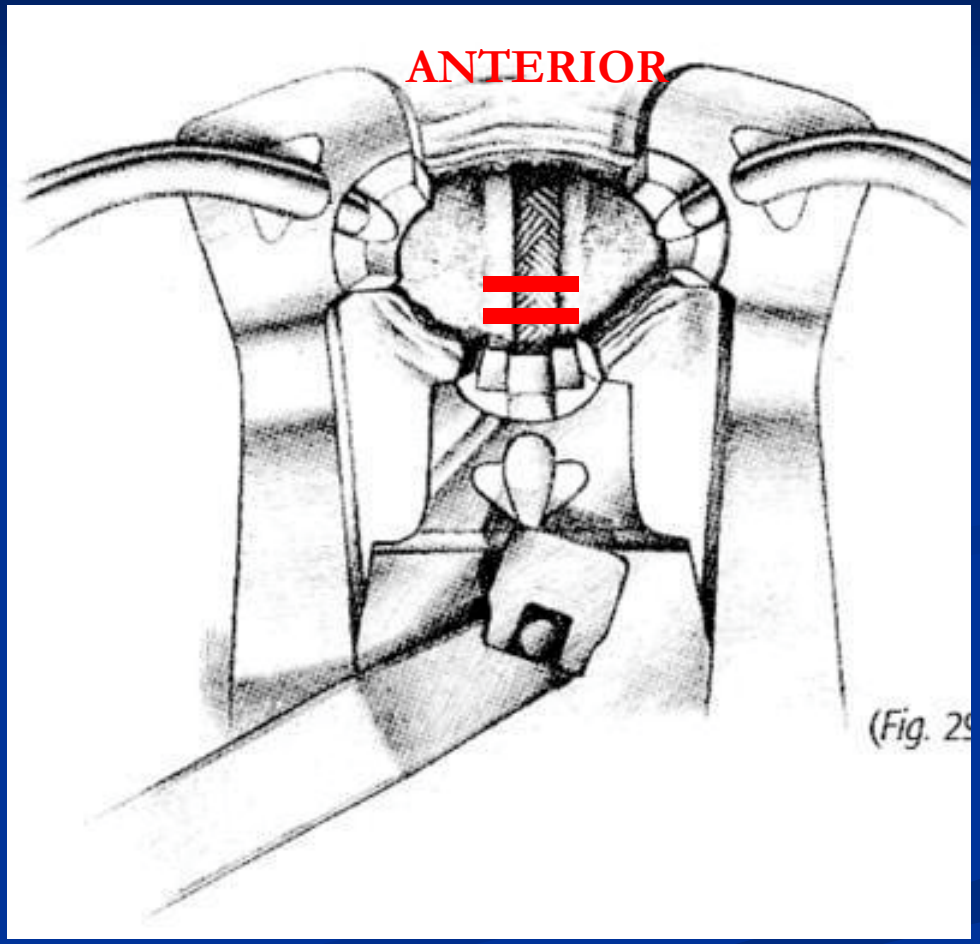


Video

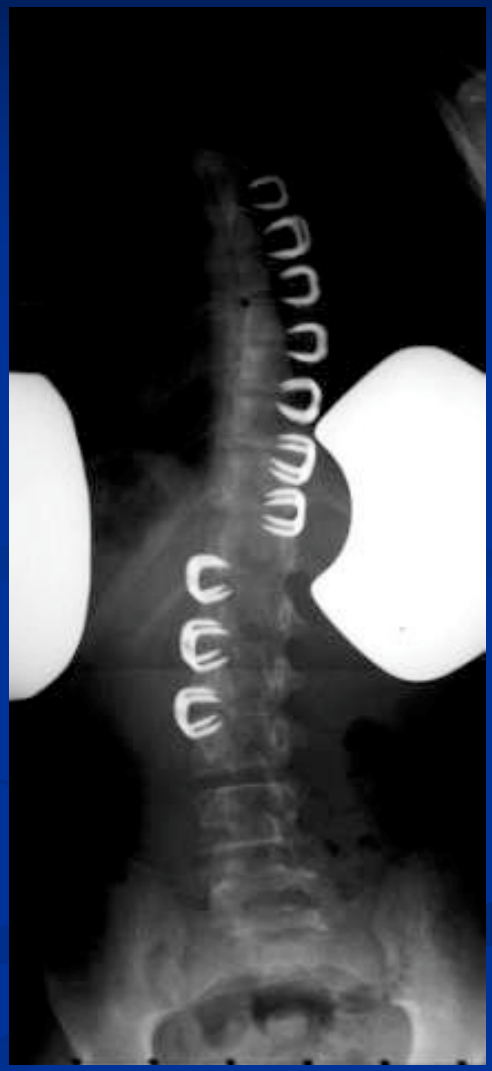







ANTERIOR

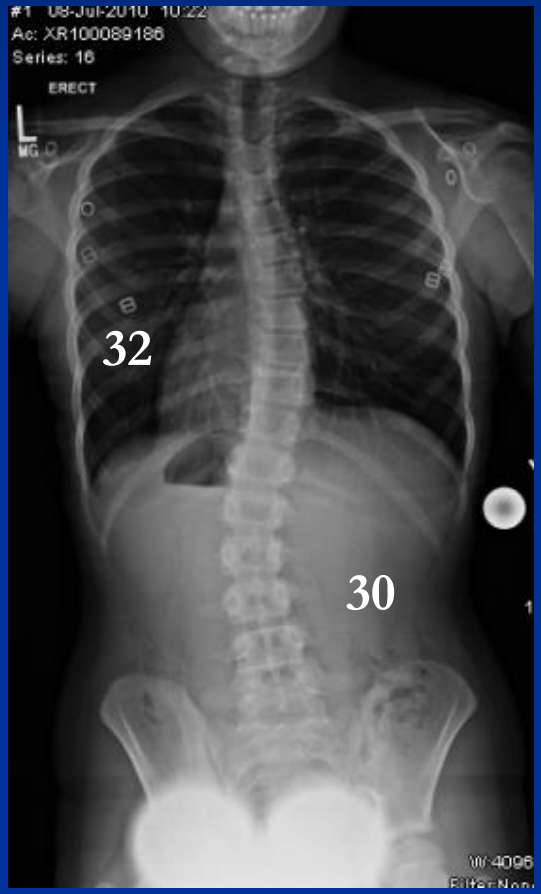




VBS vs. Bracing for Idiopathic Scoliosis

- Inclusion criteria
  - Idiopathic scoliosis
  - Coronal curve magnitude of 25 to 44°
  - Risser 0 or 1
  - Minimum two-year follow up
  - Matched for age at initiation of treatment
- VBS database (2002-2007)
  - 43 patients, 55 curves
- Bracing: Göteborg scoliosis database (1968-1994)
  - 53 patients, 70 curves

Case Example: 10 yo female, R=0,S=3



Subanalysis of Groups When Matched for Age av 10.5yrs
VBS: 55 curves, Bracing: 70 curves

	No change/ improvement (%)	Progression (%)	P value (Fisher's exact test)
Thoracic curves 25-34°			
VBS (N=25)	80	20	0.09
Bracing (N=36)	58	42	
Thoracic curves 35-44°			
VBS (N=11)	18	82	0.21
Bracing (N=13)	46	54	
Lumbar curves 25-34°			
VBS (N=13)	77	23	0.27
Bracing (N=18)	56	44	
Lumbar curves 35-44°			
VBS (N=6)	67	33	0.16
Bracing (N=3)	0	100	

Our most current VBS Cohort Reviewed Retrospectively

- 63 patients who met our inclusion criteria
  - Diagnosis of idiopathic scoliosis
  - Age 7-15 years old at time of surgery
  - Preoperative coronal curve magnitude of
    - 20-35° for thoracic curves
    - 20-45° for lumbar curves
  - Preoperative Risser sign of 0 or 1
  - Minimum of 2-year follow-up

Auriemma, Cahill, Samdani et al 2012

Demographics

- The mean age at time of stapling was 10.78 years old overall
  - 11.16 years old for boys (range 7-14)
  - 10.7 years old for girls (range 7-14)
- Curve Types
  - 25 (40%) with thoracic curves
  - 20 (32%) with lumbar curves
  - 18 (28%) with double curves.
  - Total of 81 stapled curves (43 thoracic, 38 lumbar)
- Mean preoperative Cobb angle
  - Thoracic curves: 29.1° (range 20-35)
  - Lumbar curves: 30.5° (range 20-45)
- Mean length of follow-up was 3.43 years

Results

- *Thoracic curves*
  - 43 thoracic curves at most recent follow-up, success rate of 32/43 (74%)
    - 11 failures: 6 had undergone fusion and 5 had progressed to a magnitude of > 10° than their pre-treatment measurement but had not undergone fusion
- *Lumbar Curves*
  - 38 lumbar curves at most recent follow-up, success rate of 31/43 (82%)
    - 7 failures: 3 had undergone fusion and 4 had progressed to a magnitude of > 10° than their pre-treatment measurement but had not undergone fusion

Follow-up to Skeletal Maturity
Defined by Having a Risser Score ≥ 4

- The success rate for mature thoracic curves was 71% (12/17)
- The success rate for mature TL/ Lumbar curves at most recent follow-up was 89% (17/19)

Sanders, JPO 2011

TABLE III Logistic Projection of the Probability of Lenke Type-1 and Type-3 Curves Progressing to Surgery Assuming a >50° Threshold*†

Curve	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	Stage 7, 8
10°	2% (0% to 40%)	0% (0% to 15%)	0% (0% to 0%)	0% (0% to 0%)	0% (0% to 0%)	0% (0% to 0%)	0% (0% to 1%)
15°	23% (4% to 69%)	11% (1% to 58%)	0% (0% to 2%)	0% (0% to 0%)	0% (0% to 0%)	0% (0% to 0%)	0% (0% to 7%)
20°	84% (40% to 98%)	92% (56% to 99%)	0% (0% to 14%)	0% (0% to 1%)	0% (0% to 1%)	0% (0% to 1%)	0% (0% to 26%)
25°	99% (68% to 100%)	100% (92% to 100%)	29% (3% to 84%)	0% (0% to 5%)	0% (0% to 5%)	0% (0% to 2%)	0% (0% to 64%)
30°	100% (83% to 100%)	100% (98% to 100%)	100% (47% to 100%)	0% (0% to 27%)	0% (0% to 22%)	0% (0% to 11%)	0% (0% to 91%)
35°	100% (91% to 100%)	100% (100% to 100%)	100% (89% to 100%)	0% (0% to 79%)	0% (0% to 65%)	0% (0% to 41%)	0% (0% to 98%)
40°	100% (95% to 100%)	100% (100% to 100%)	100% (98% to 100%)	15% (0% to 99%)	0% (0% to 94%)	0% (0% to 83%)	0% (0% to 100%)
45°	100% (98% to 100%)	100% (100% to 100%)	100% (100% to 100%)	88% (2% to 100%)	1% (0% to 99%)	0% (0% to 98%)	0% (0% to 100%)

Risk of progression to ≥ 50° (to fusion!!!)

Progression Risk of Idiopathic Juvenile Scoliosis During Pubertal Growth

YP Charles, Alain Dimeglio *et al*

- Patients with JIS and curves > 30° treated with bracing
  - 100% risk for curve progression needing fusion
- Curves ranging from 21° to 30°
  - 75% risk

Spine 31:1933–42, 2006

Other Current Literature on VBS

- O'Leary *et al*, Spine 36:1579–83, 2011
  - Their 11 patients included myelodysplasia, congenital scoliosis, juvenile scoliosis, infantile scoliosis, Marfan's, paralytic scoliosis, and neuromuscular scoliosis showing >50% failure. Average pre-op curves were 68°.
    - This is a patient population with extreme curves different from our cohort.
- Ohlin *et al, SRS* 2012
  - 9 immature patients with moderate thoracic AIS with mean pre-op Cobb 38º (2 pts <35, 7 pts ≥ 35) underwent endoscopic vertebral stapling. 7/9 pts with curves ≥ 35 progressed to fusion.
    - The 1st erect curve averaged 34° in this cohort of patients

Stapling "VBS" is for the flexible moderate scoliosis
-Not for the severe or failing braced large curves

Initial Correction is Important in Predicting Outcome

Thoracic curves were subanalyzed based on magnitude of Cobb angle on 1st erect x-ray

Thoracic curves with 1st erect x-ray measuring:	Success Rate
≥ 25°	67% (10/15)
< 25°	81% (22/27)
< 20°	100% (17/17)

Initial Correction is Important in Predicting Outcome

Lumbar curves were subanalyzed based on magnitude of Cobb angle on 1st erect x-ray

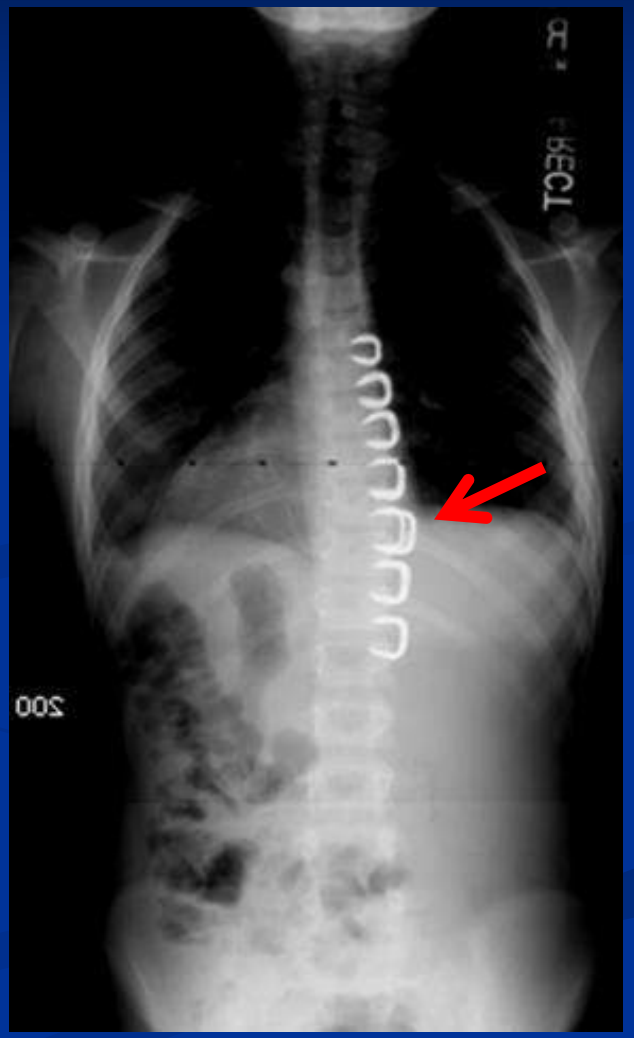
Lumbar curves with 1st erect x-ray measuring:	Success Rate
≥ 25°	67% (2/3)
< 25°	82% (28/34)
< 20°	85% (22/26)
< 15°	91% (21/23)

Complications: 63 Patients, 390 Staples

- Medical
  - 2 patients: superior mesenteric artery (SMA) syndrome
  - 1 patient: superficial infection
  - 2 patients: atelectasis requiring bronchoscopy
- Neurologic deficits
  - No documented neuromonitoring changes
  - 1 patient: temporary foot dystonia, MRI negative and resolved within 3 months after surgery

Complications: 63 Patients, 390 Staples

- 5/390 (1.2%) staples moved / backed out
- 4/390 (1%) staples broke
- 4/63 (6%) patients: overcorrection of the stapled curve
  - 3 had removal, and curve did not change
  - 1 observed



Indications: Based on Current Clinical Reviews

- Age
  - < 13 yrs girls, < 15 yrs boys
- Growth remaining
  - Risser 0 or 1
  - 1 year of growth by wrist x-ray
  - Sanders digital hand stage ≤ 4
- Coronal curve
  - Thoracic curves 25 to ≤ 35
  - TL/Lumbar curves 25 to ≤ 45°
  - flexible to < 20°
- Sagittal thoracic curve < 40°

Discussion: Current Practice

- If thoracic curve measures > 35° or thoracic curve ≤ 35º does not bend below 20°, then will consider
  - tethering -or-
  - adding a posterior rib to spine hybrid construct at same time (do posterior first)

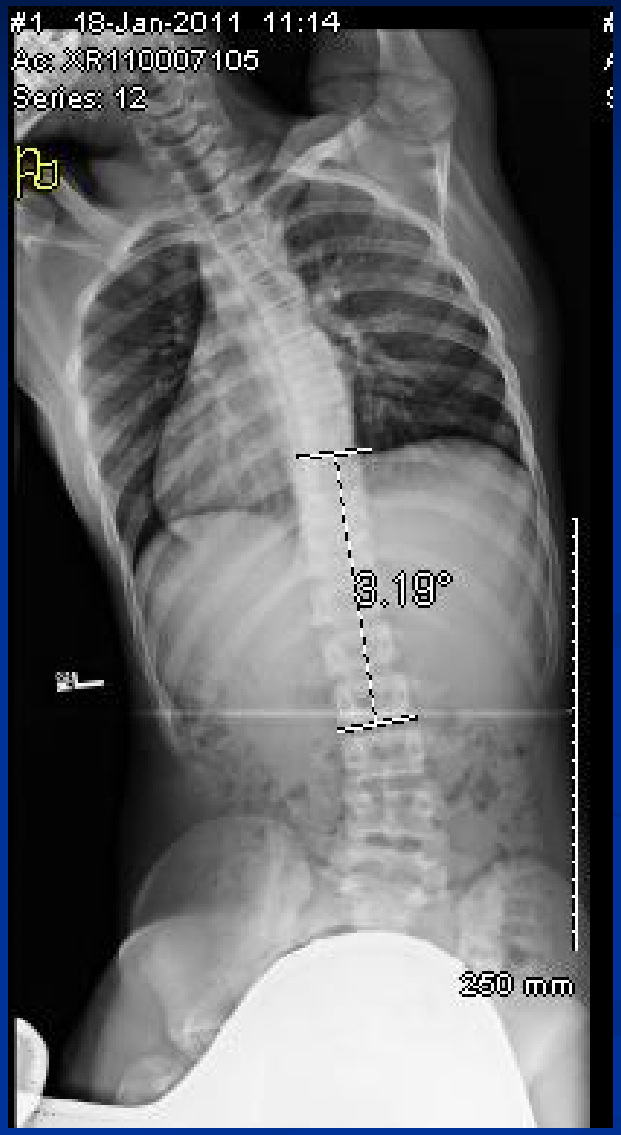
Current Practice

- Intra-op correction to straight as possible is critical
  - Use translation for correction
  - Push on adjacent levels (usually using staple inserter in existing implanted staple) while stapling next proximal level

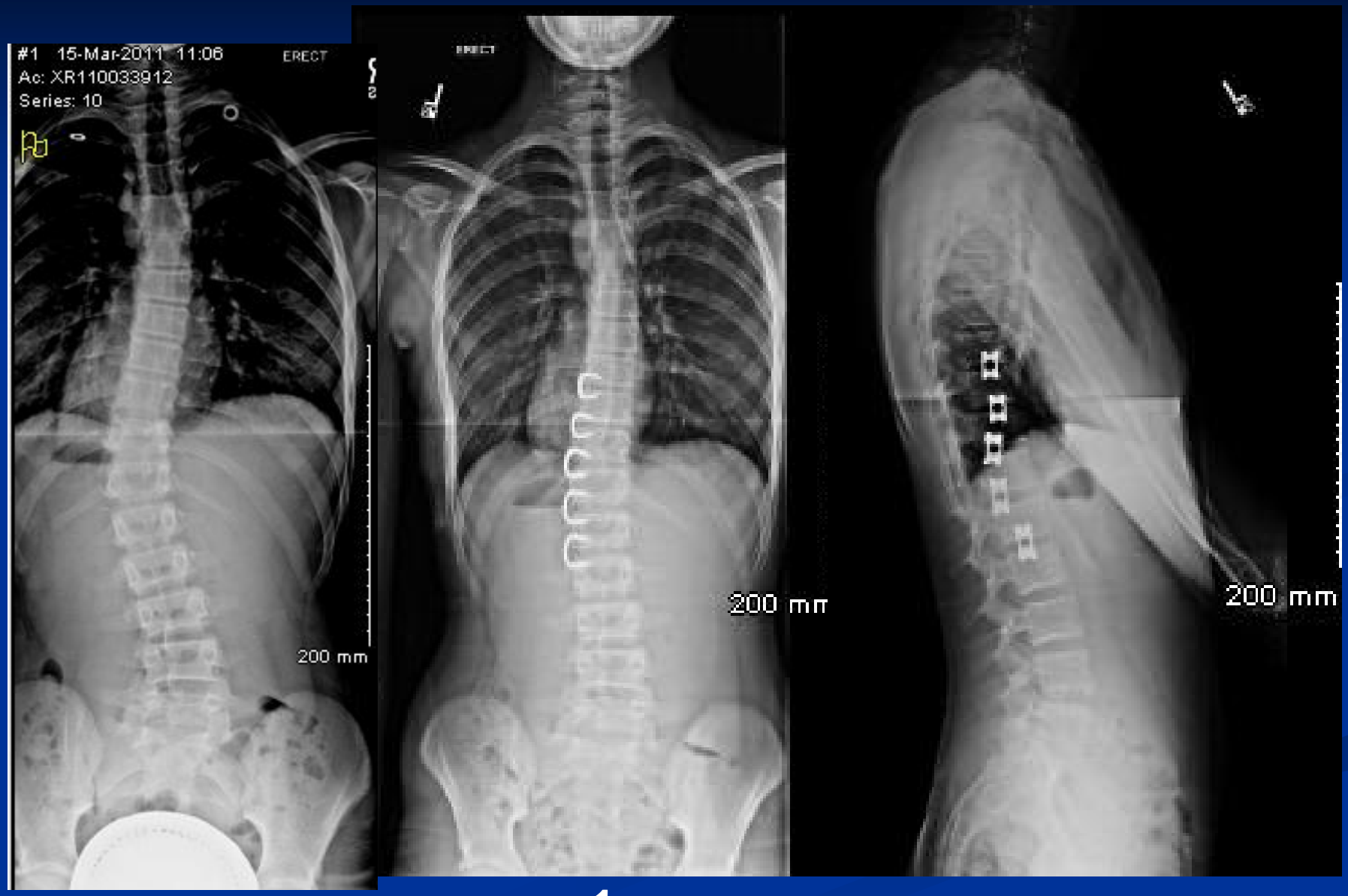
Discussion: Current Practice

If curves are not < 20° on first erect film, or progresses past 20° then put the child in corrective brace until curve measures < 20°

Aggressive Correction Strategy for TL/L curves



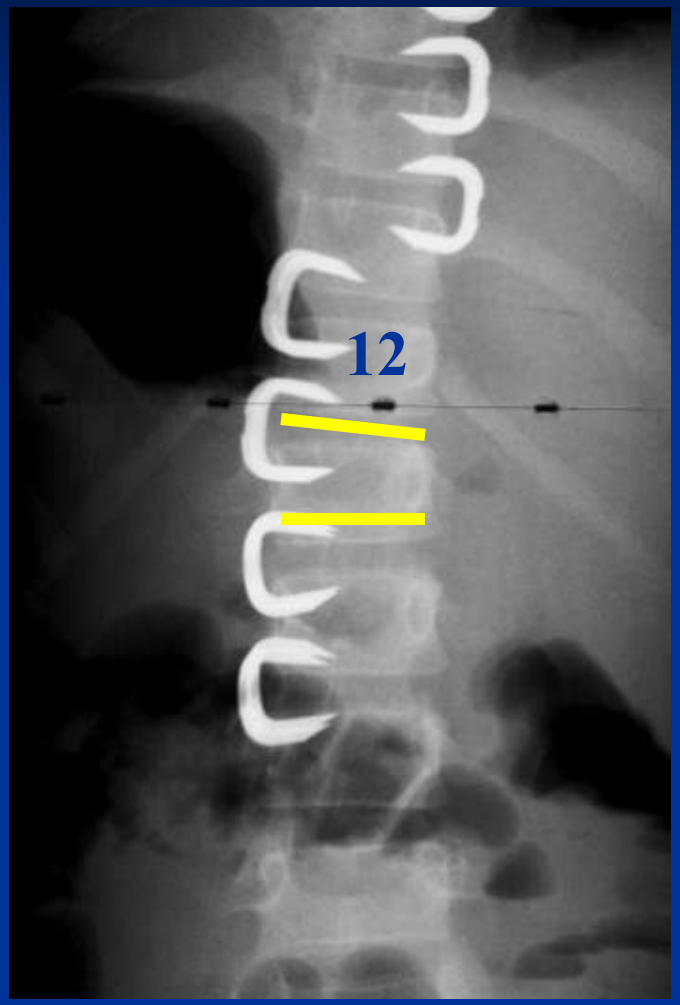
12 yo, risser 0, sanders 3


#1 15-Mar-2011 11:06
Ac: XR110033912
Series: 10
ERECT
200 mm
200 mm
200 mm

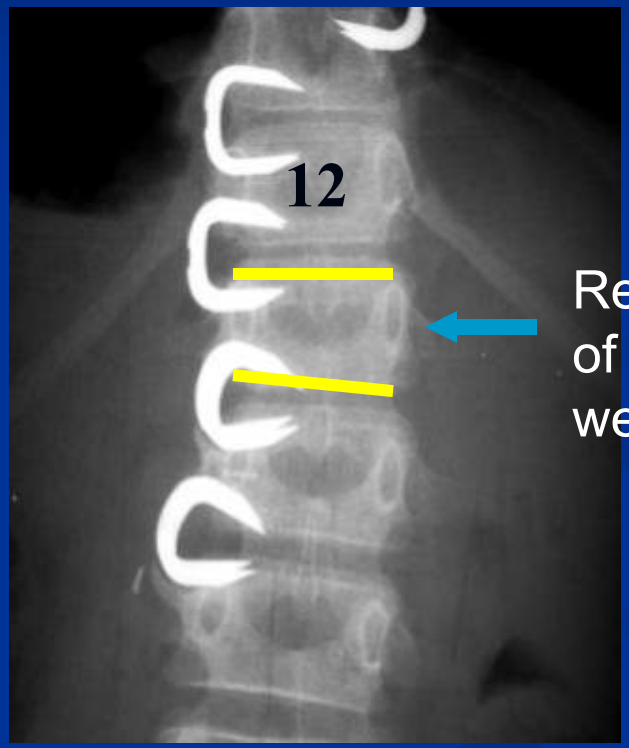
1 st erect

14 yo, risser 3-4, sanders 7

Growth Modulation

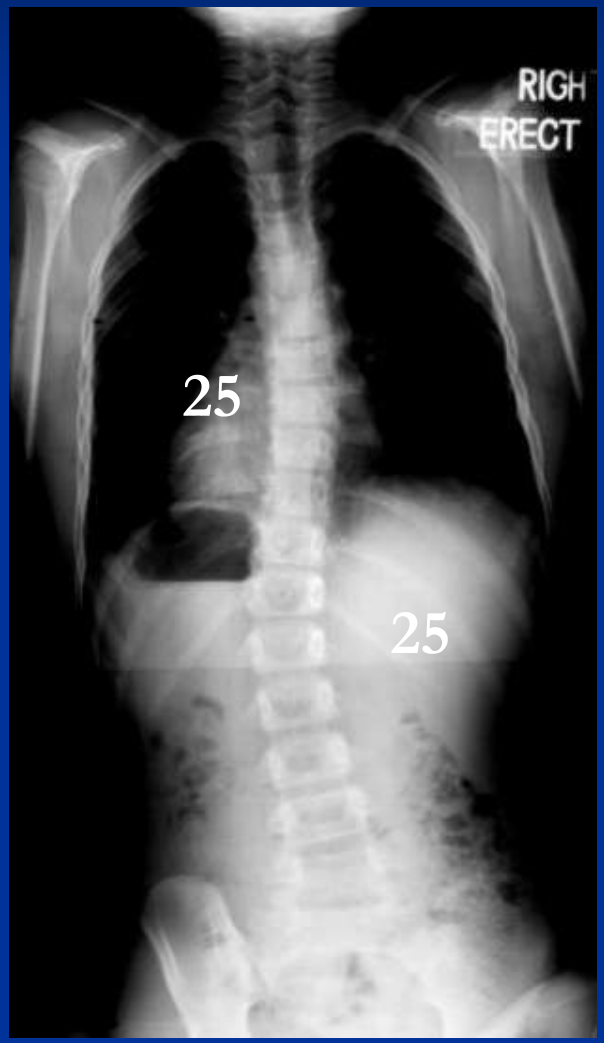


2002



2005

12 yo female Premenarchal



axial BIOTECH™

ScoliScore™ AIS Prognostic Test

2749 East Parleys Way, Suite 200, Salt Lake City, UT 84109-9921
Toll Free: (877) 294-2598 Tel: (801) 984-9098 Fax: (801) 984-9099
www.axialbiotech.com

For Sample Use Only

AIS Prognostic Assay Test Result Form

PATIENT INFORMATION

Patient Name:	Jane Sample	Specimen Barcode	SCO-5001-01829A
Medical Record # or Patient #:	MED-123	Gender	female
Physician Name:	Dr Clinical Trial	Cobb Angle:	14
Physician's	2749 E. Parleys Way Suite 200	Date of Birth	05 - Mar - 1997
		Collection Date	09 - Dec - 2008
	Salt Lake City UT 84109	Receive Date	12 - Dec - 2008
		Report Date:	05 - Jan - 2009 10:03 AM

ASSAY DESCRIPTION

ScoliScore AIS Prognostic Assay is preformed on DNA extracted saliva. A multiplex PCR reaction and Taqman detection are used to determine the genotype for a panel of 53 single nucleotide polymorphisms (SNP's). The ScoliScore AIS Progression Score ranges from 1 - 200, is calculated using marker weighting factors and a simple accumulation algorithm.

ASSAY RESULTS

SNP ID #	GENOTYPE	SNP ID #	GENOTYPE	SNP ID #	GENOTYPE	SNP ID #	GENOTYPE	SNP ID #	GENOTYPE
RS10000472	TT	RS10004901	TT	RS10168146	AA	RS10493083	TT	RS10787096	CG
RS10794280	CC	RS10798036	GG	RS11083276	AT	RS11747787	AC	RS12474952	TT
RS12618119	GA	RS1265566	TT	RS132898	AG	RS1349887	GC	RS136187	AC
RS1437480	GG	RS1558729	CC	RS16865244	TT	RS16902899	GT	RS16909285	GG
RS16945692	AA	RS16968878	CC	RS17021437	GG	RS17044552	GG	RS17165447	CC
RS17635546	AC	RS17719756	CC	RS1991127	CC	RS2045904	CC	RS2209158	CC
RS239794	TC	RS2449539	TT	RS2700910	AA	RS2976514	AG	RS448013	GG
RS4661748	GG	RS4724981	GG	RS4765072	CC	RS4782809	GC	RS500243	GC
RS6414345	TT	RS6420139	TT	RS6528028	GG	RS6691909	AG	RS6693477	CC
RS6798946	CC	RS6952104	CC	RS7613792	GG	RS7840870	CA	RS8093693	CC
RS831653	AA	RS9945359	GG						

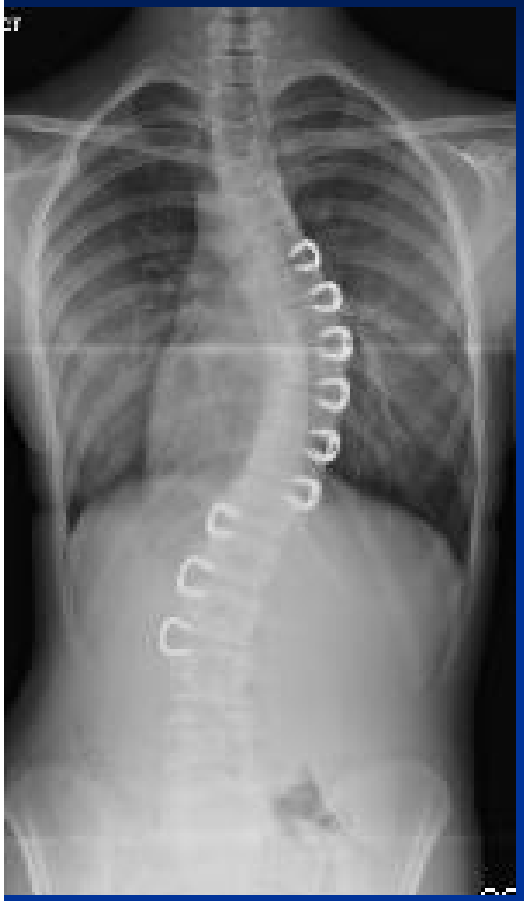
SCOLISCORE AIS PROGRESSION SCORE = **197**

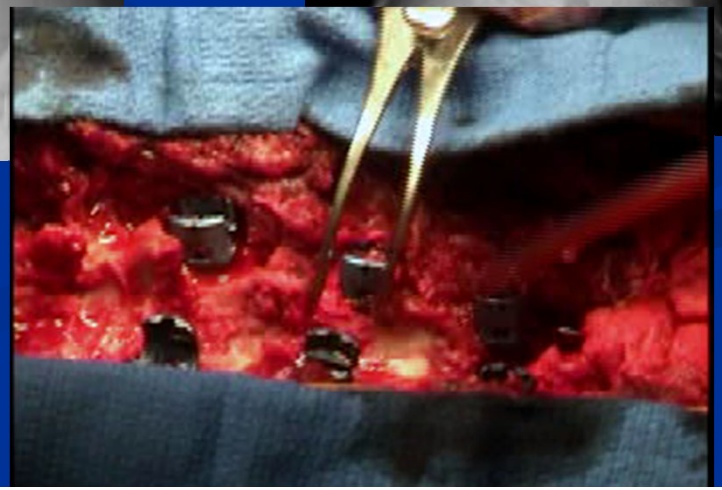
ASSAY INTERPRETATION

This score indicates this patient is at intermediate risk for progression to a severe curve by or before skeletal maturity. ScoliScore results should be interpreted with all other diagnostic information for the AIS patient. Interpretation of ScoliScore results for patients outside the intended use population may not be applicable.

Unfortunately, the positive predictive value of ScoliScore has yet to be proven statistically

Fusion After Failed Stapling

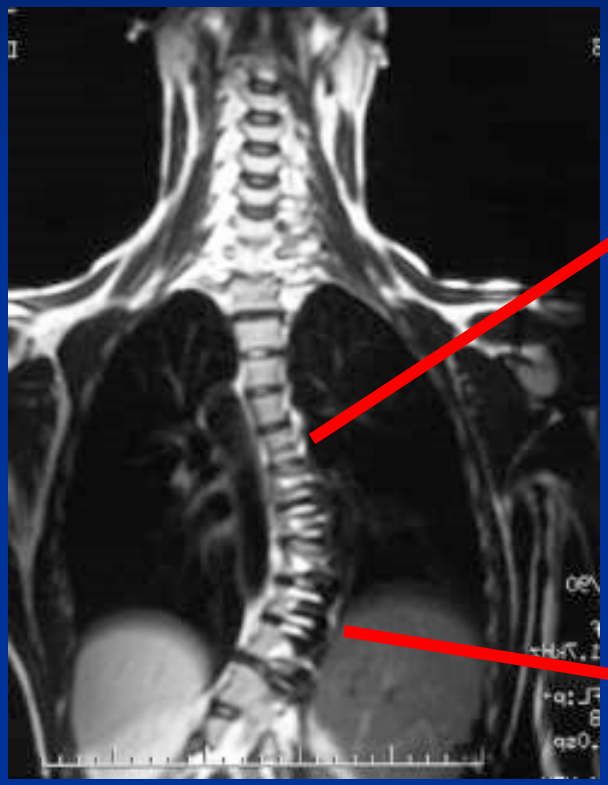


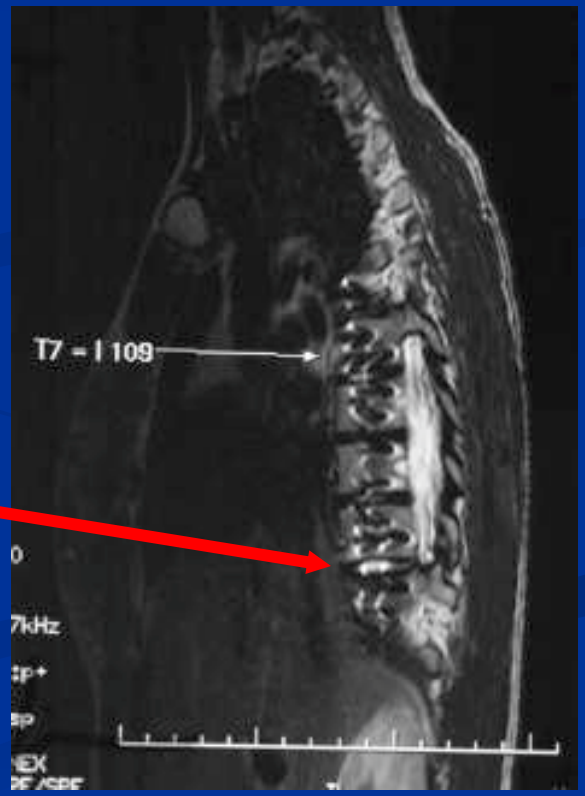


No spontaneous fusion

Video

MRIs: NS

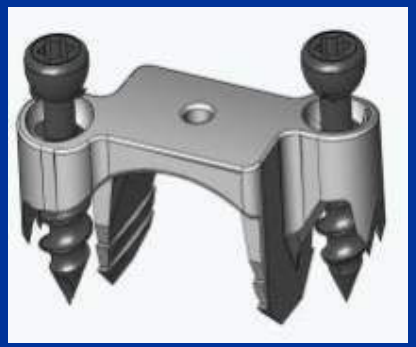




No evidence of degenerative discs

Endoscopic Mechanical Spinal Hemiepiphysiodesis Modifies Spine Growth

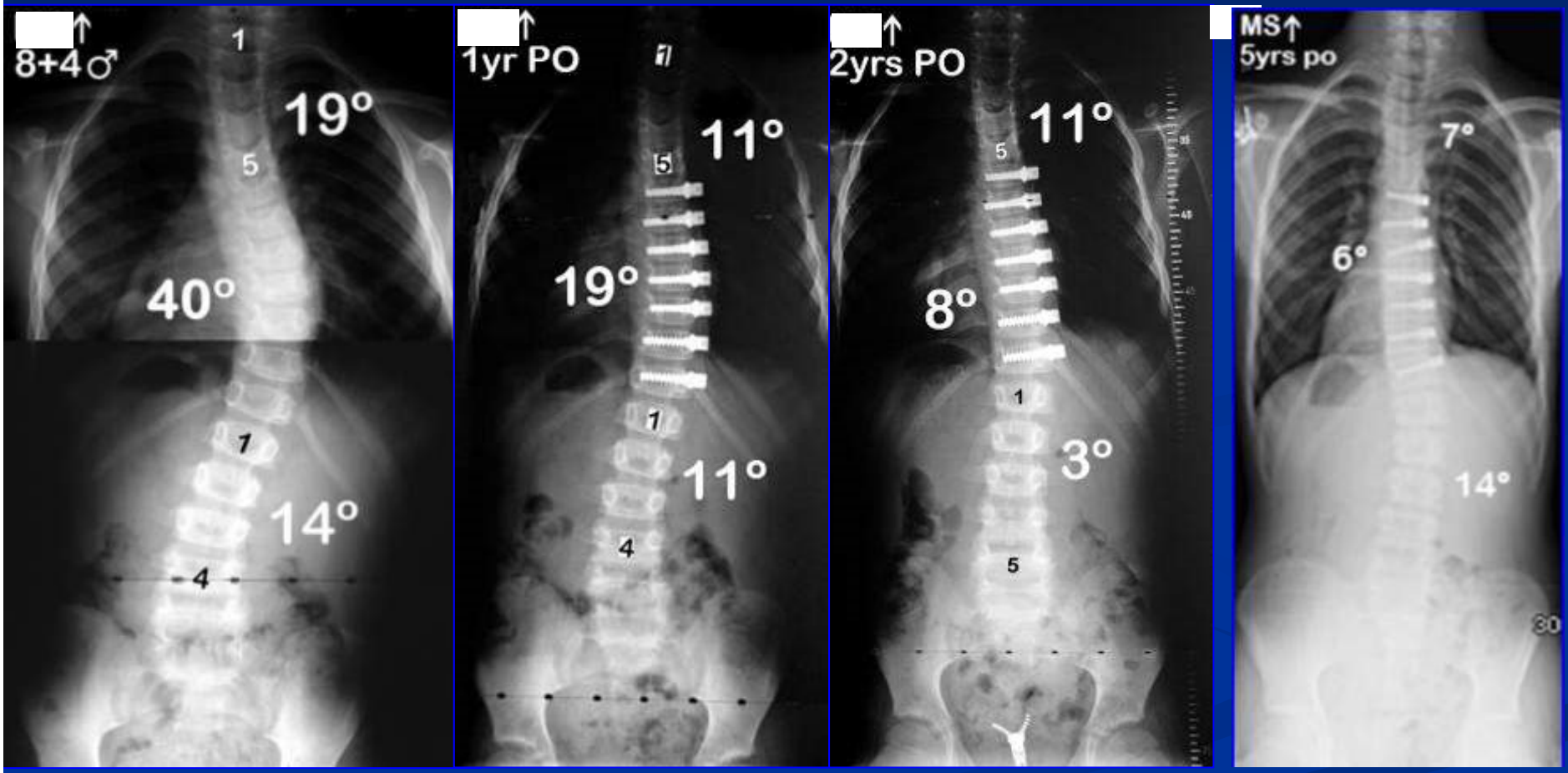
Wall *et al*, Spine 30:1148-53, 2005



Vertebral Body Tethering

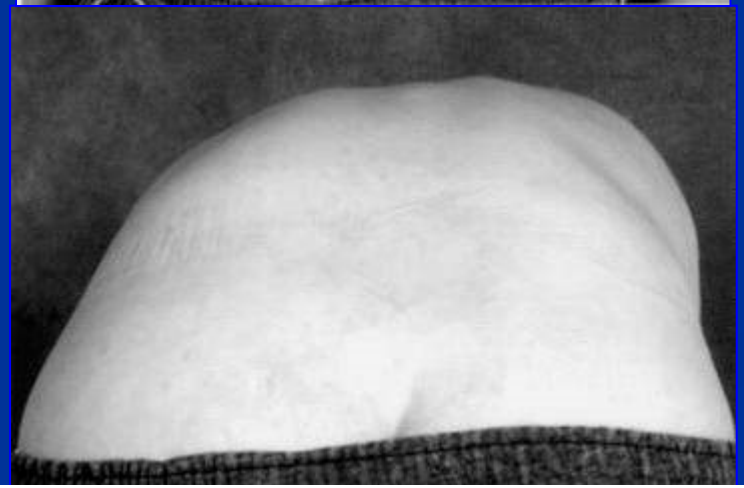
This is a different operation, as it requires segmental vessel ligation as compared to stapling

Lenke's Clinical Tethering Case

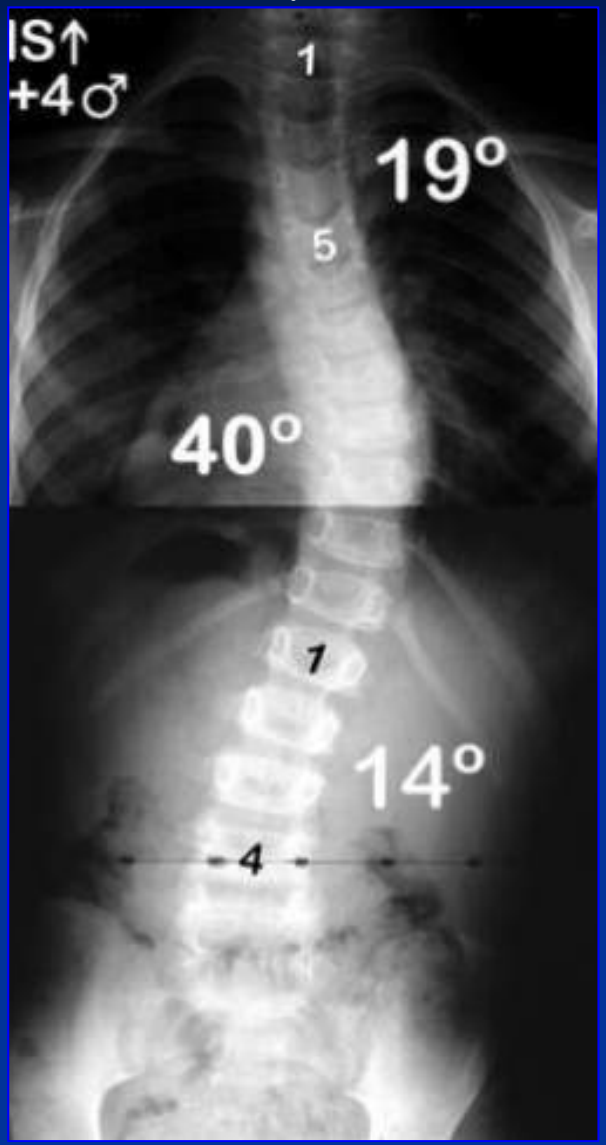


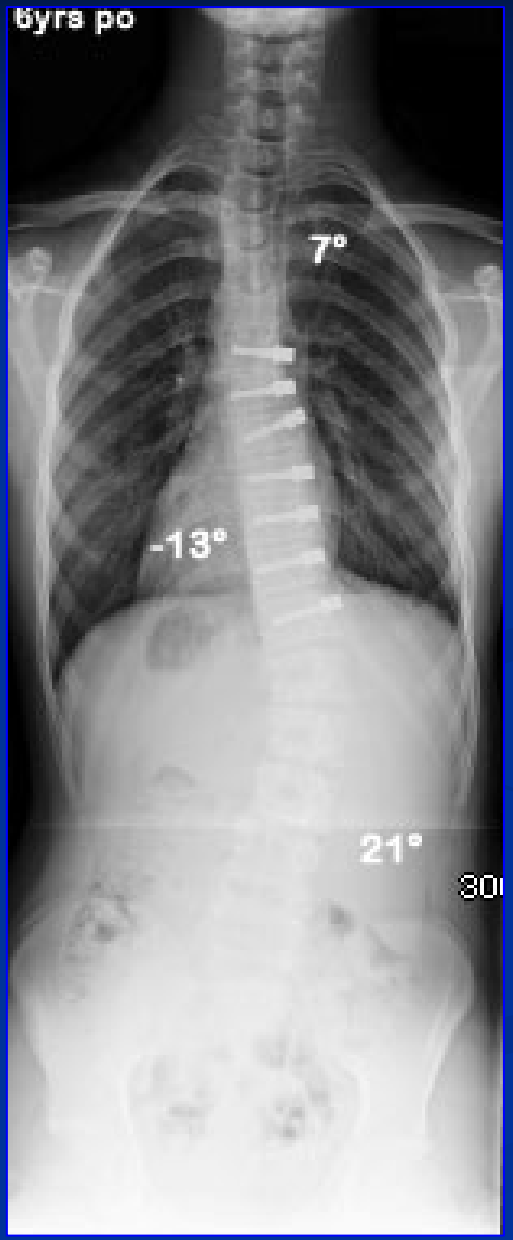
Crawford & Lenke, JBJS-A 2010;92(1):202-9



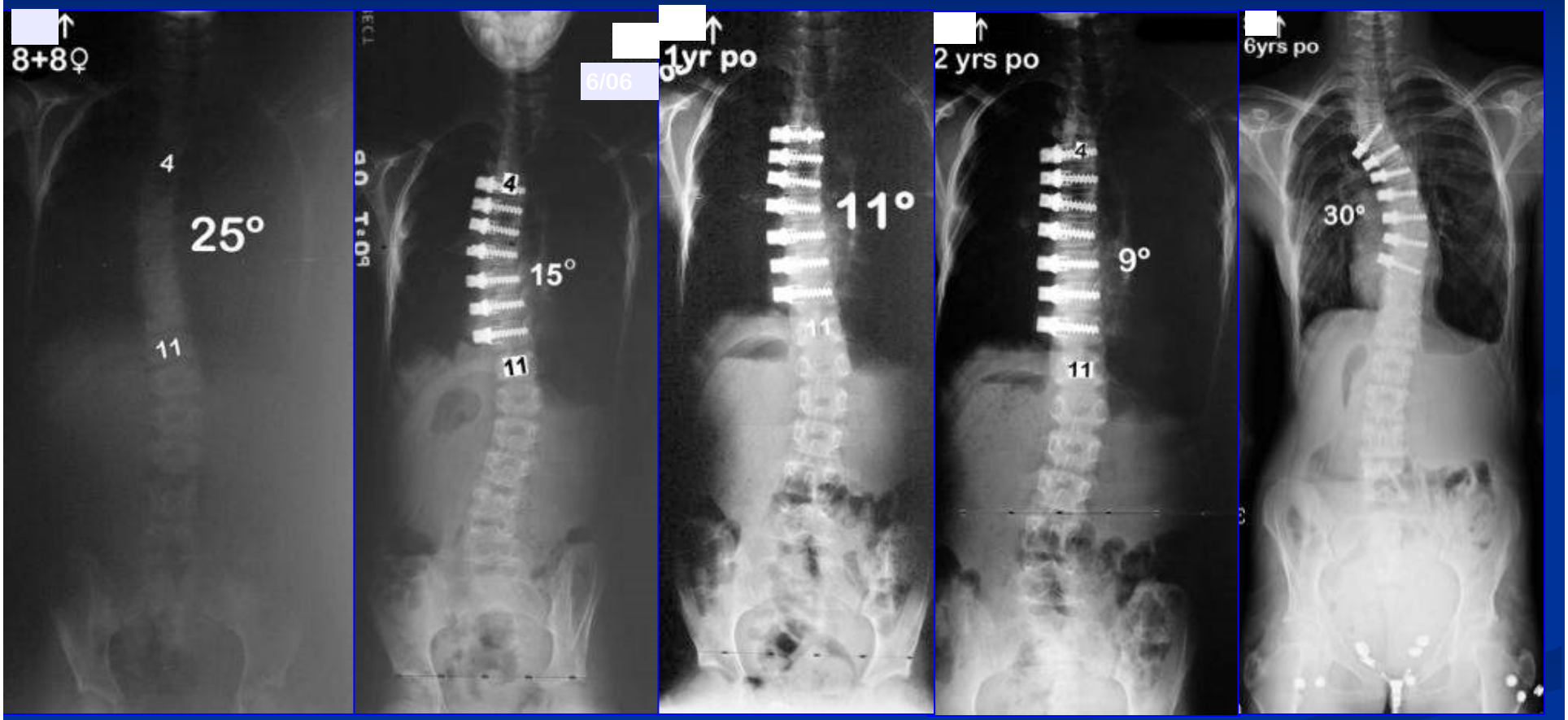



Update Case 1 from Larry





Case 2



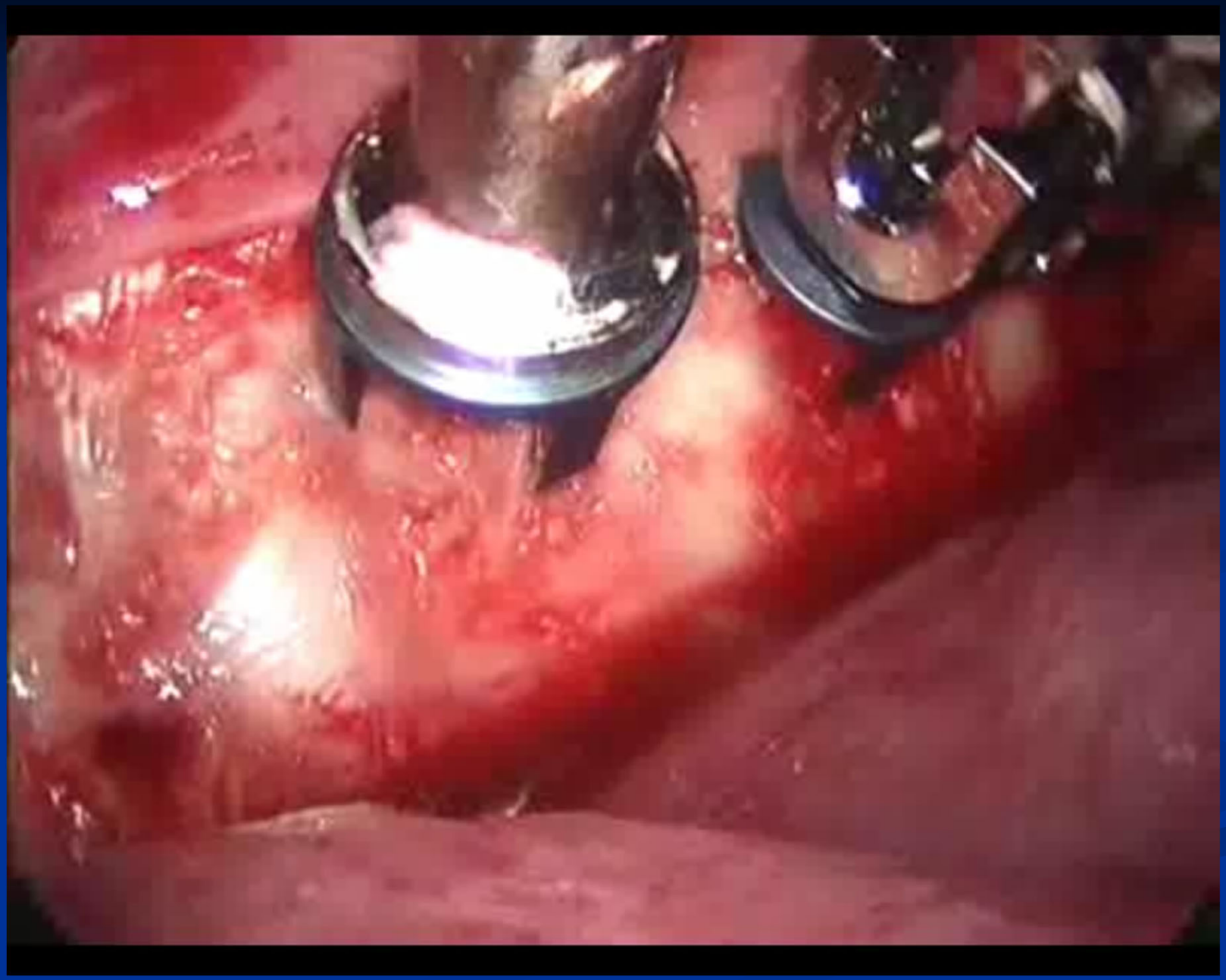
Newton's Clinical Case

Case done outside US

Philadelphia Shriners Hospitals Cases with Dynesys

- Titanium pedicle screws
- Polyethylene-terephthalate (PET)* flexible cable safety extensively studied
- Animal models show vertebral growth modulation

* Dynesys System by Zimmer Spine: an off label (physician directed) procedure…not supported by the company



Current Indications

- Idiopathic scoliosis (adolescent or juvenile) or “idiopathic-like” (i.e. post syrinx decompression)
- > 8 years old with remaining spine growth
- Risser 0-2 , Sanders stage ≤ 4
- Thoracic curve 35° to 60°
- Flexible below 30º

Experience to Date

- Number of patients: 28
- Mean age at surgery (yrs) 12.3
- Range 10-15
- Skeletal maturity
  - Avg. Sanders 3.3 $\pm$ 0.8
  - Avg. Risser 0.64
    - Risser Range 0-2

Experience to Date

- 5/28 patients had stapling of their lumbar curves when the lumbar curve was > 25° and a Lenke type C modifier
- The average number of levels tethered T5–L2 was 6.59 (range 5-8)
- Median blood loss was 150 cc. Only two patients required blood transfusions.

Main Thoracic Cobb

- The average preoperative Cobb for the main thoracic curve was 43.5 (range 31-66°)
- Average flexibility of the main thoracic curve preoperatively was 57.1%
- Mean Cobb at first erect was 21.6 (range 8-47°)
- Average percent correction was 53.1%
- Most recent Cobb was 21.0° (range 0.6-53°)

Lumbar Compensatory Cobb

	Not Stapled (N=18)	Stapled (N=5)
Pre-op lumbar Cobb	24.1 ± 7.8°	35.7 ± 1.2°
1st erect	15.9 ± 6.9°	18.5 ± 5.5°
Most recent	15.4 ± 10.4°	16.8 ± 7.6°

5 patients underwent lumbar bracing postoperatively

Sagittal Measurements

	Pre-Op	1st Erect	Most Recent
Thoracic kyphosis	19.0 ± 10.54°	18.3 ± 12.2°	20.1 ± 10.1°
Lumbar lordosis	48.1 ± 8.85°	41.6 ± 11.2°	46.1 ± 8.7°

Inclinometer Readings

- The mean preoperative inclinometer reading was 13°
- Mean at most recent was 8°

Complications: 2 Patients

- One patient with a 60° pre-op curve had large blood loss
  - She poorly tolerated single lung ventilation intraoperatively
  - CO_2 was continually driven up and her lung persistently obstructed the operative field
  - The surgeon converted the procedure from a thoracoscopic approach to a “mini-open” thoracotomy, after which the procedure was uneventful.
- One patient experienced persistent left lower lobe collapse (down lung) requiring post-op bronchoscopy

Case #1 Feb 2011 12 yo female (NL)

Case #1

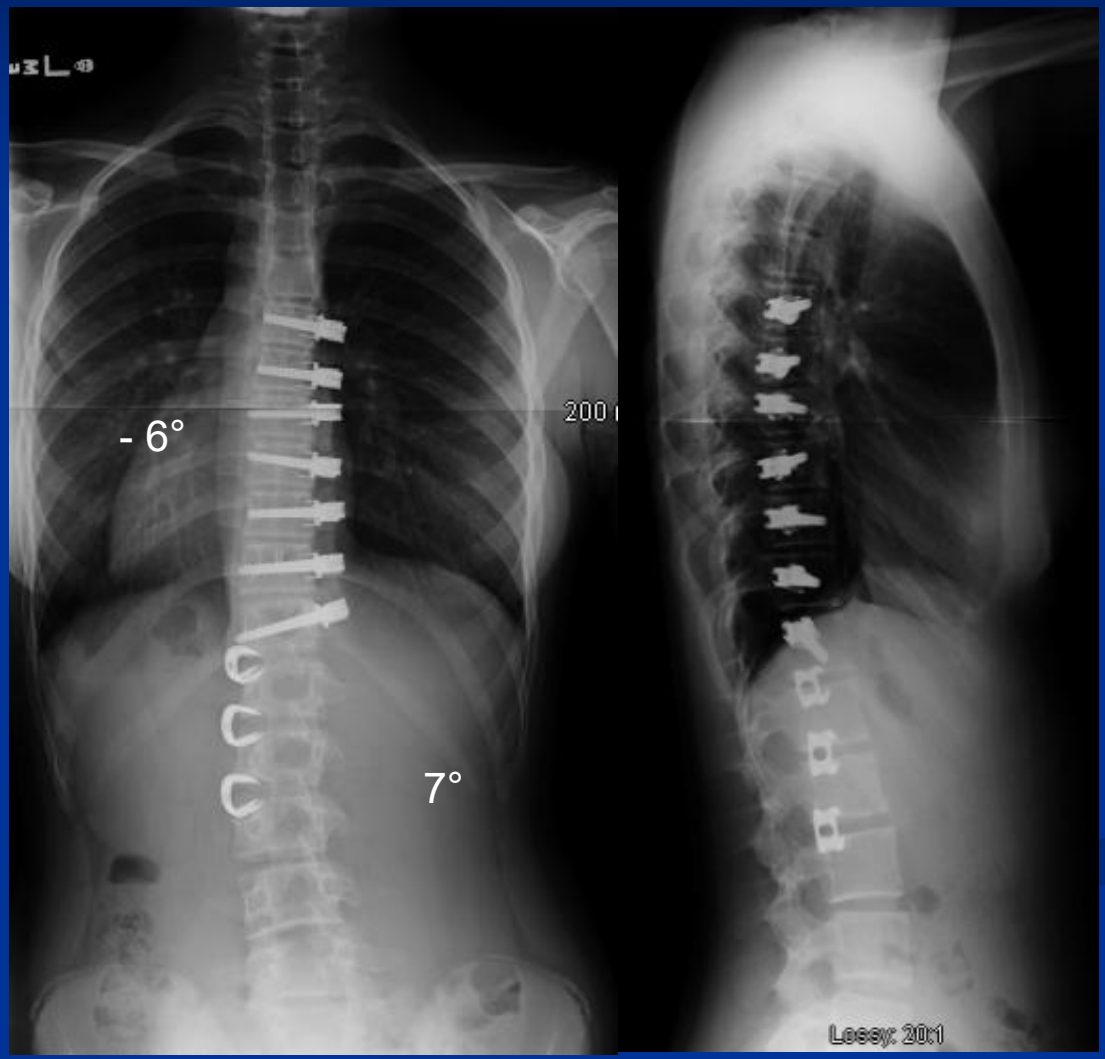
Pre op

1 year post op

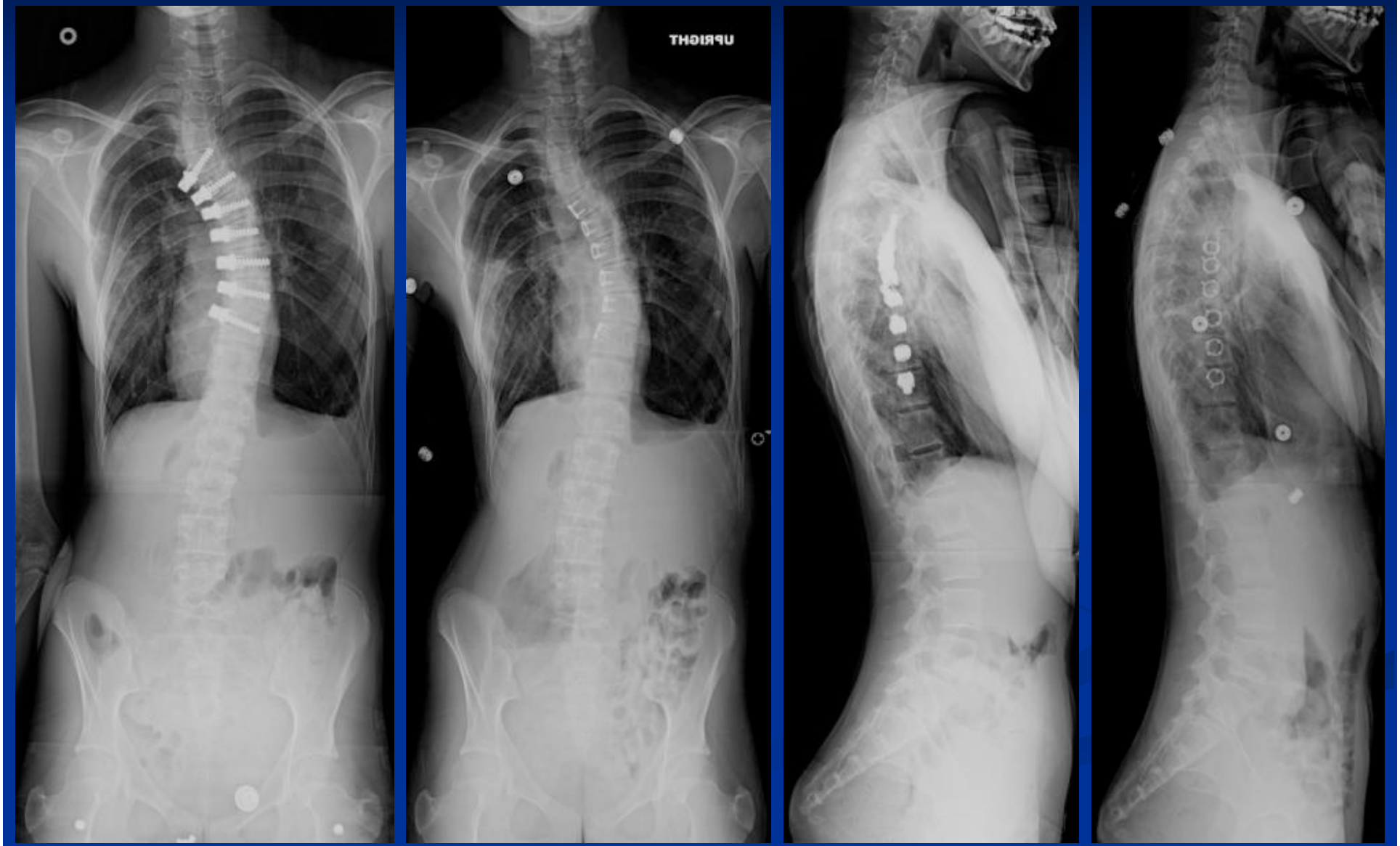
Case #1 Feb 2011 now 14 yo

Pre op

1.5 years post op



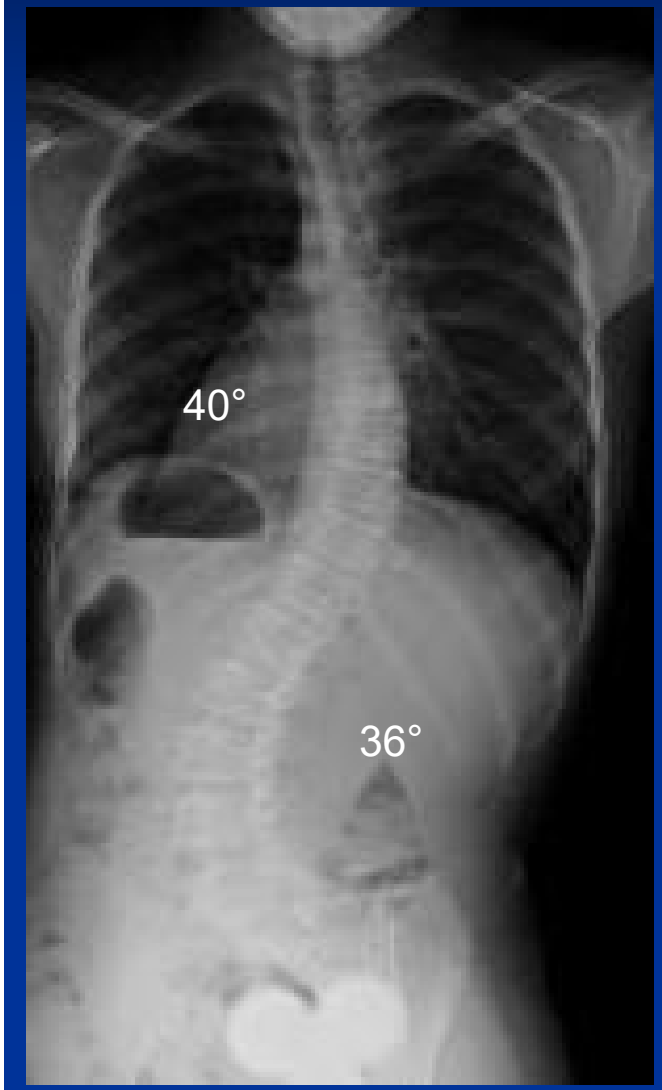
Update of Case 2 from Larry



Case #2 Feb 2011 10 yo female (OQ)

Case #2 Feb 2011 now 11.5 yo

Pre-op



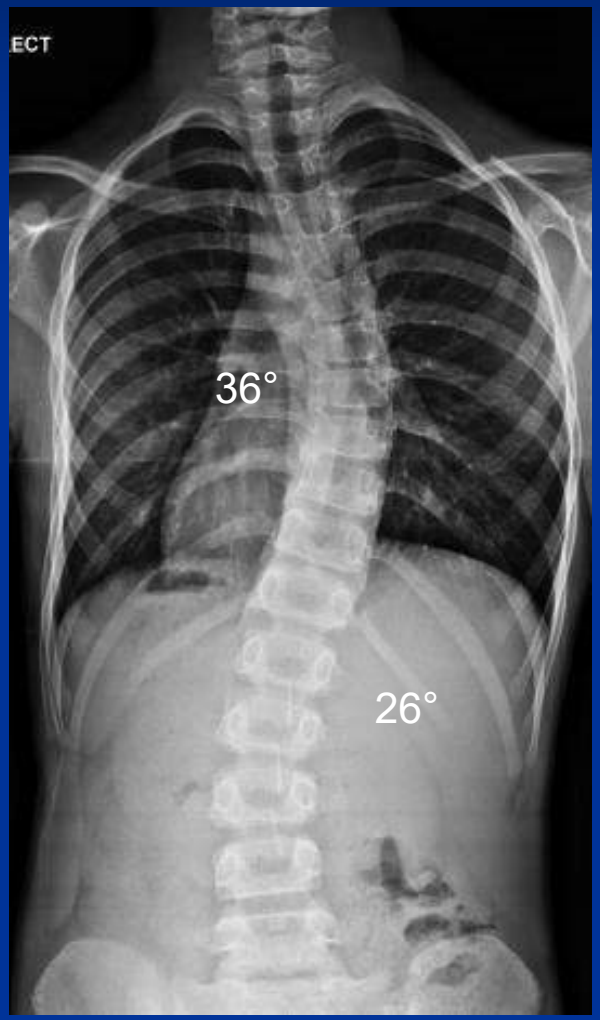
1st erect

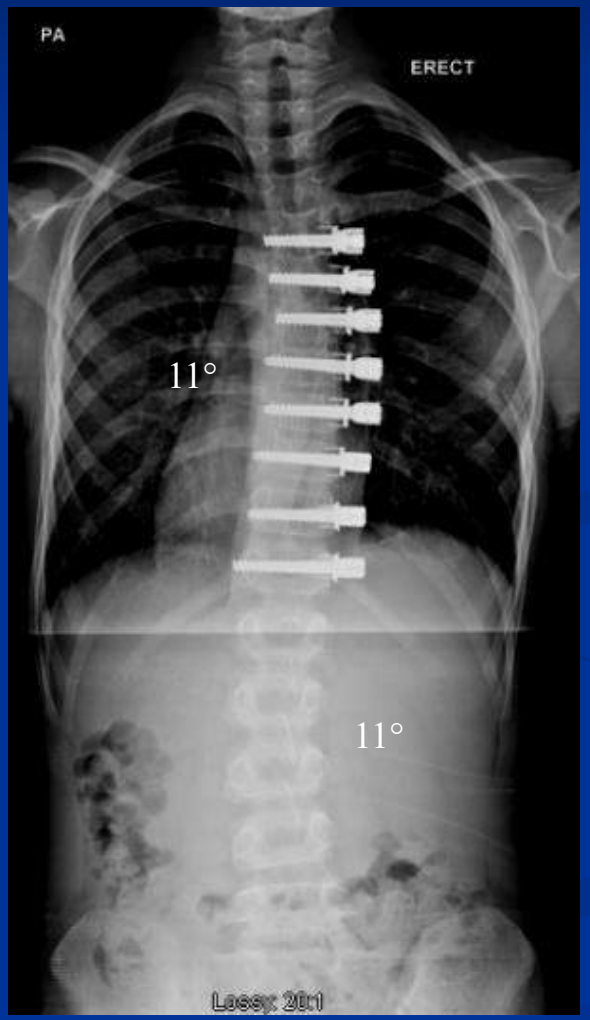
1.5 years post-op

Case # 7 Oct 2011 10 yo male (GL)

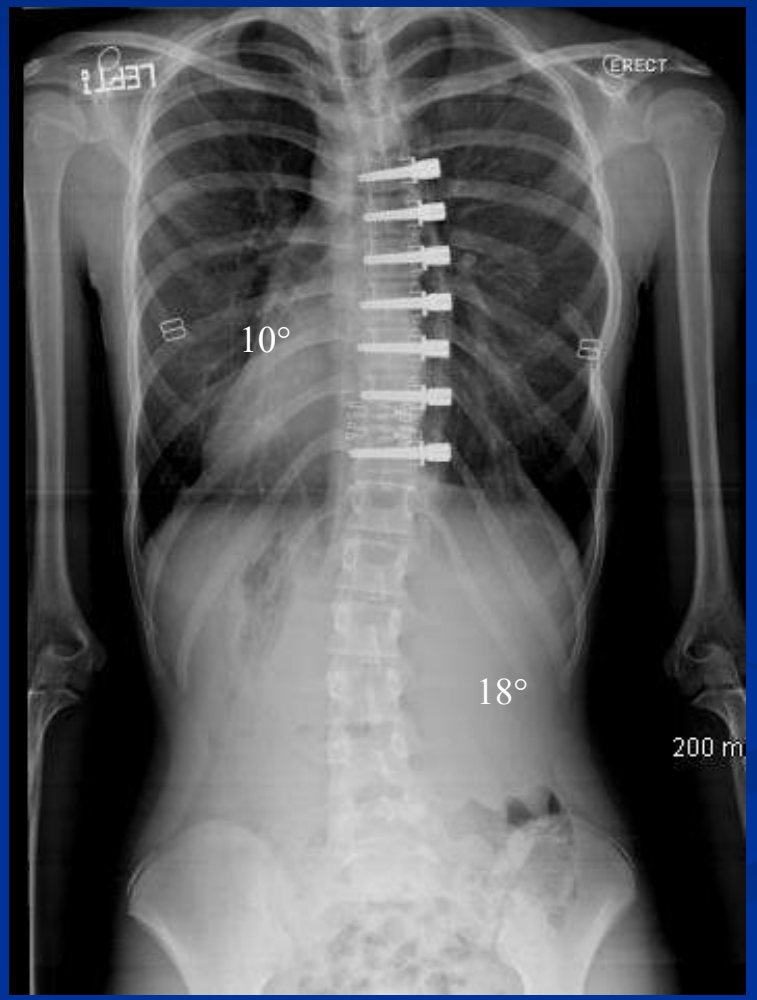
3 months post-op

1 yr post op





Case #8 Nov 2011 13 yo female (BC)



Providence TLSO at night for lumbar

Lateral profiles so far no issues

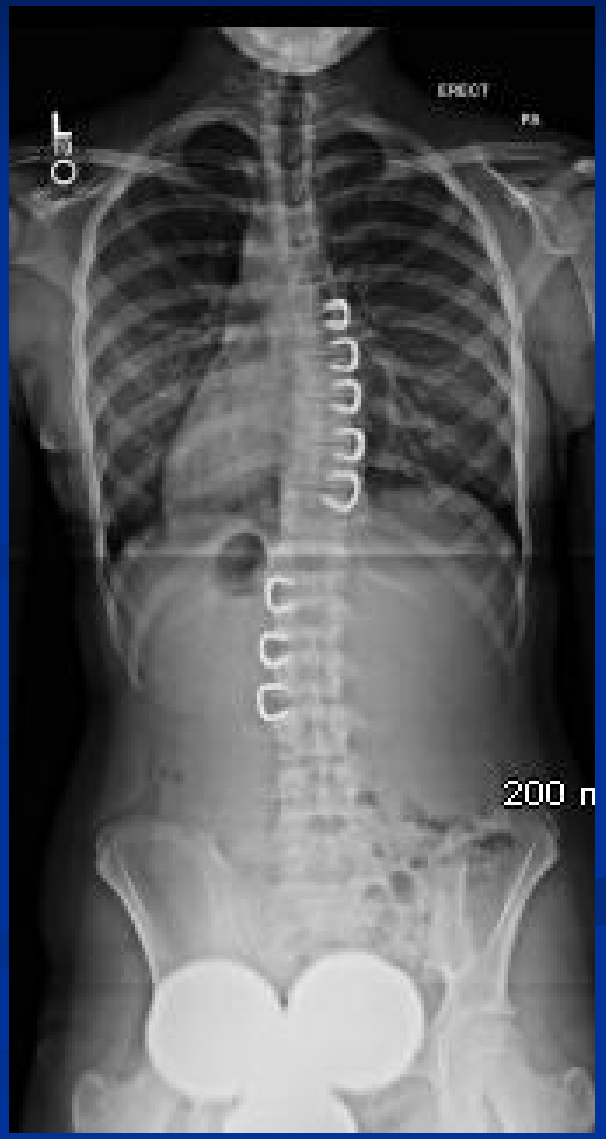
1 year F/U

Summary

- Bracing of compensatory curves, hemiepiphysiodesis, and “patience and fusion” are growth modulation options for children with congenital scoliosis
  - Remember to look at the recommendations of the experienced surgeons if doing hemiepiphysiodesis
  - or instrumented fusion in situ

Summary

- Aggressive bracing for idiopathic scoliosis should be thought of as a growth modulating treatment, especially in JIS and early AIS
- Vertebral body stapling has shown good results for thoracic curves ≤ 35° (74-80 %) and for lumbar curves 25-45° (67-82%) in our reviews. The results hold up at skeletal maturity.
  - In others series with braces (Dimeglio), patients in this age group with 30° curves have 100% failure despite bracing



Summary

- For JIS and early moderate AIS for growth modulation with Stapling to be sucessful
  - Smaller curves , thoracic ≤ 35 degrees and TL / lumbar ≤ 45 degrees
  - Must be flexible to <20 degrees
  - Intraop corrections need to be almost straight
  - For curves with stapling not less than 20 degrees on 1st erect -add supplemental bracing

Summary

- Vertebral body tethering appears promising
  - Appears indicated for the flexible thoracic curves > 35º or the stiff (25 to 35º) curves
    - Requires segmental vessel ligation as compared to stapling

This kind of growth modulation may be more than "maybe promising"