

Inappropriate Use of Growth Sparing Techniques

Time for some
"guidelines" ??

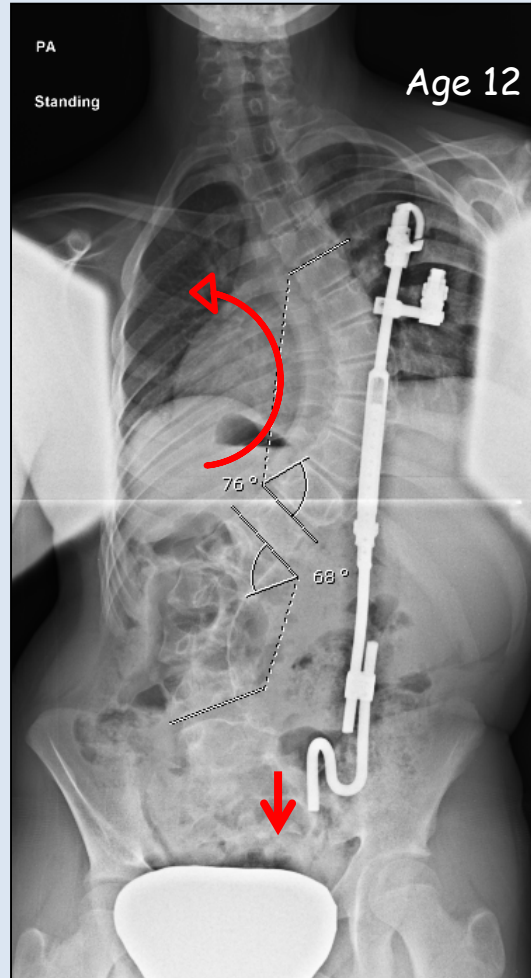
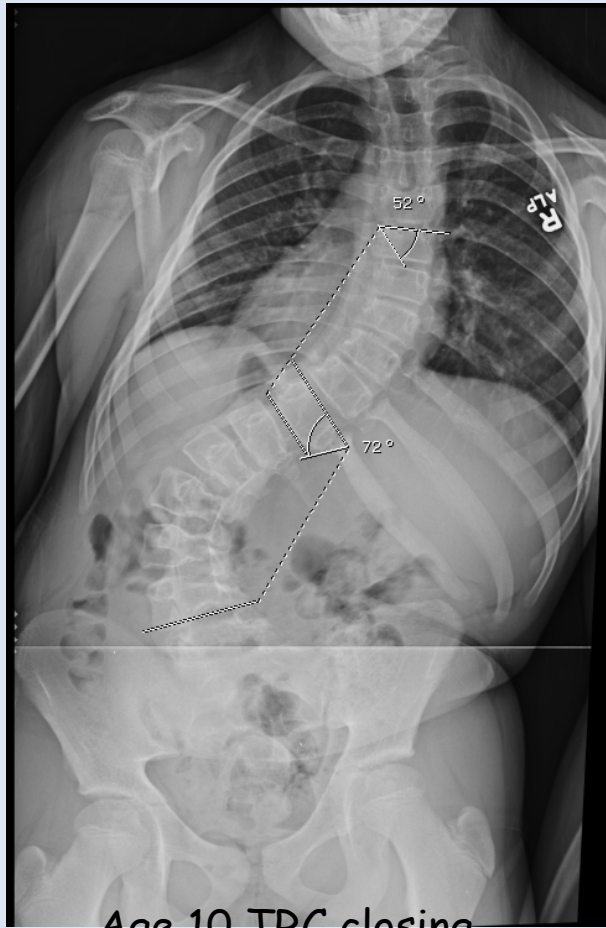
Charles E Johnston MD
Disclosure: Medtronic



EOS - OUTCOMES

- Veptr (1987), current device and technique fairly standardized after 2000
- Growing rods (1978); current dual rod method (late 90's)
- Outcomes starting to emerge
- What should we NOT be doing.....

10 yo F s/p resection R post flank rhabdomyosarc
Rib-pelvis inserted age 10, lengthened x1
No 1° chest wall deformity



Age 10 -> indication for 1 stage definitive fusion; not candidate for repeat surgeries (skin)

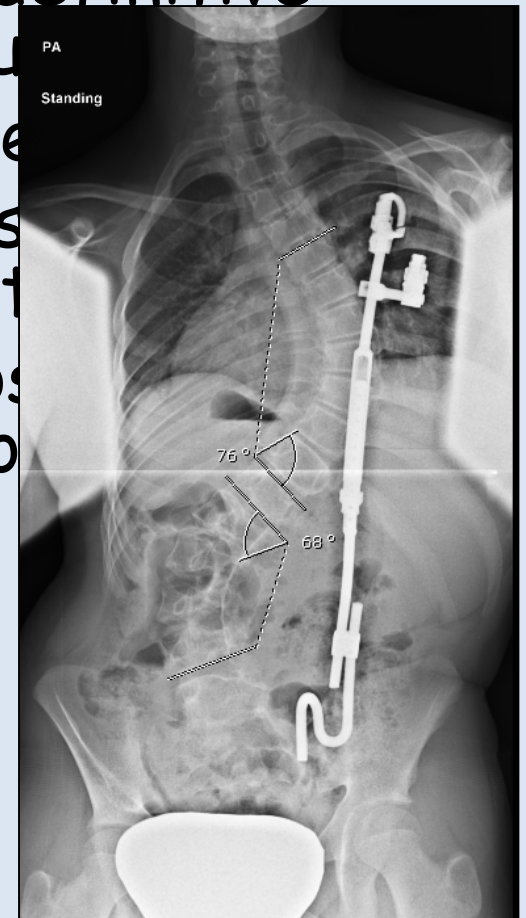
Result of Veptr construct -> no correction L curve; worse Th curve; subsidence of S hook

Clinical - age 12



Radiotherapy
Limited flexion 2° iliac wing
fixation
Pain R lumbar area/crease
Side-bend - none

- 10 yoF -> indication for one stage definitive fusion; not candidate for repeat surgery
- Not appropriate for pelvic anchor
- Device inserted through radiated soft tissue envelope (cancer resection)
- Must be removed to correct scoliosis; tissue risk enormous due to fixation (subsidence) in ilium
- Th curve uncontrolled/worsened
- L curve uncorrected
- Mis-application of a rib-based device for a spine deformity problem + totally ineffective



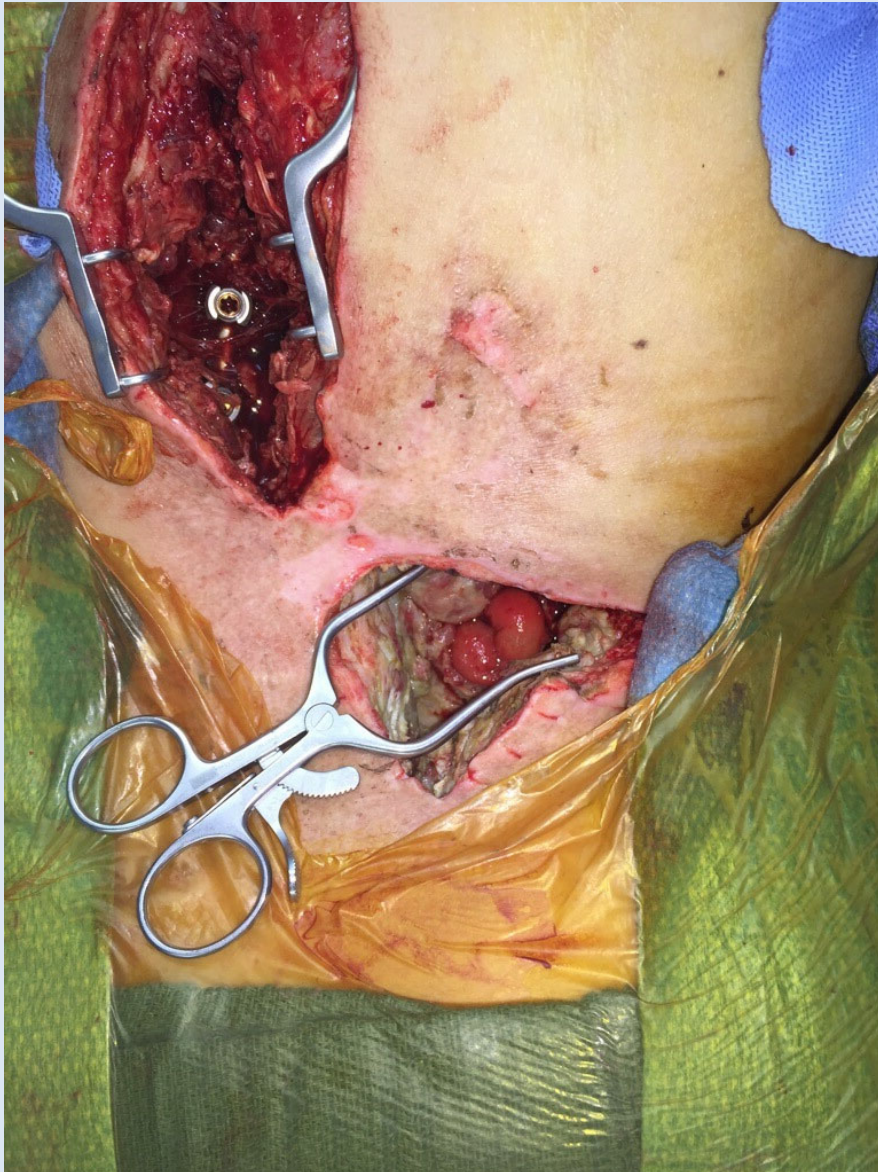
Postop wound necrosis

Wound complication
(transverse +
vertical extension)



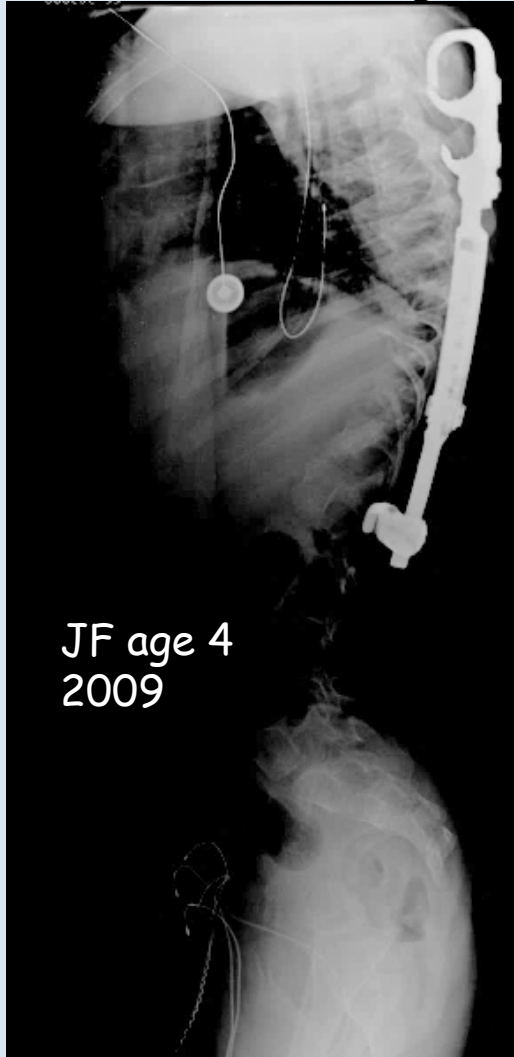
-compromises
eventual
definitive rx
- caused
entirely by
inappropriate
procedure

Cleanup & closure (ileostomy, hyperal) Still haven't treated L curve

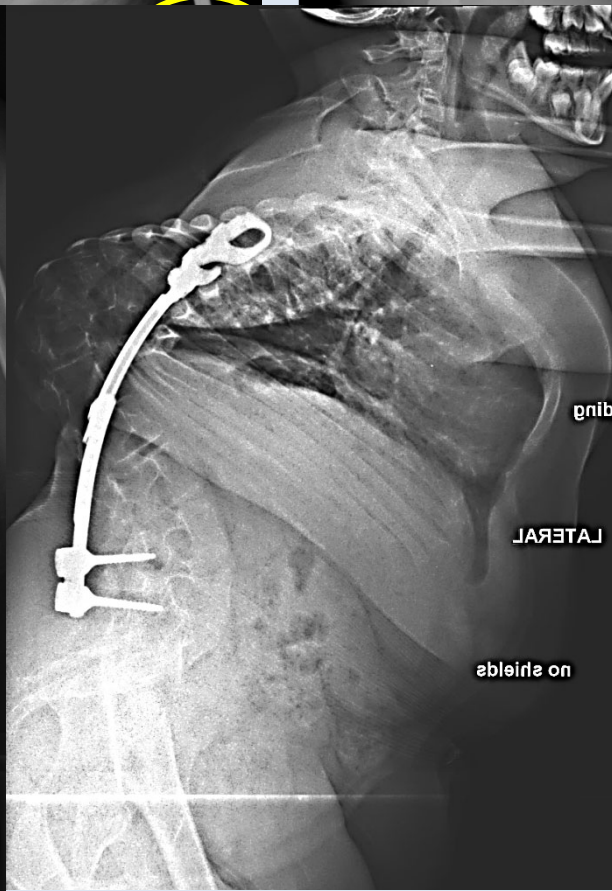
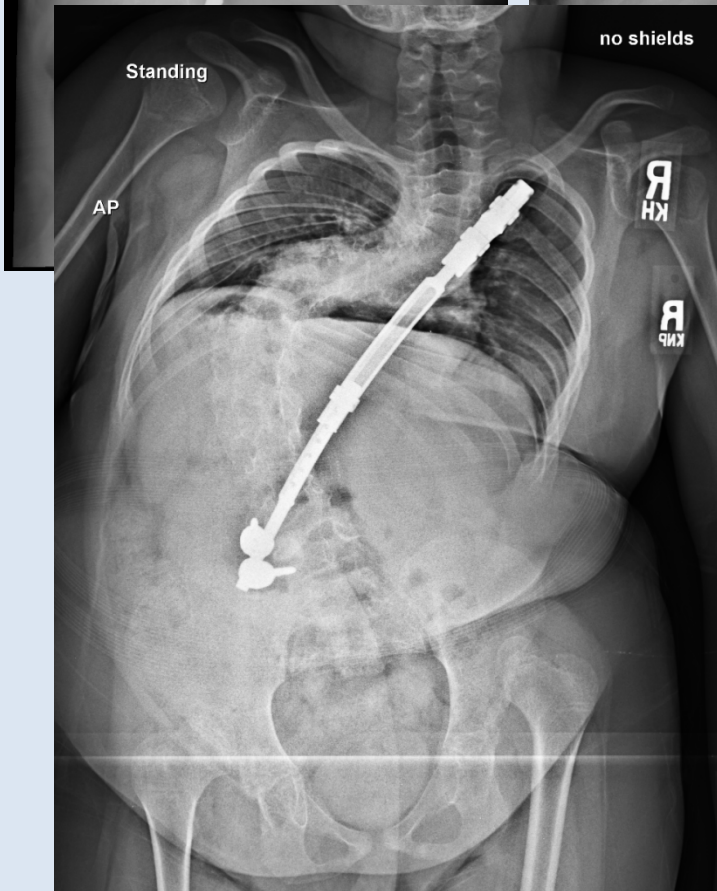
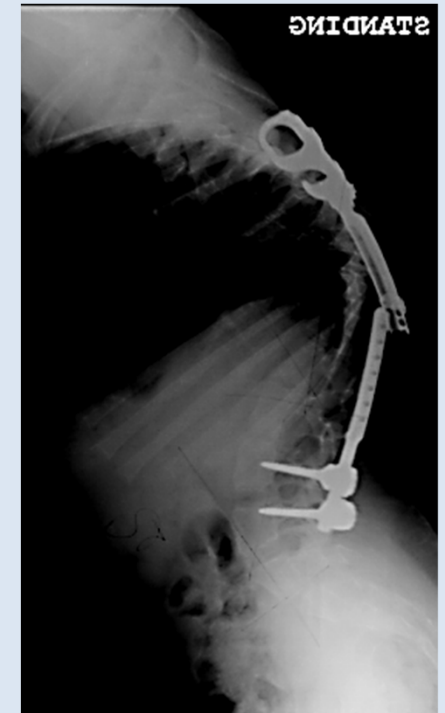
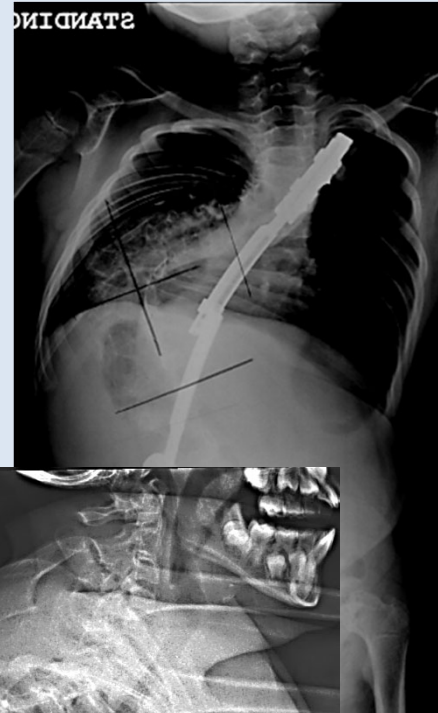
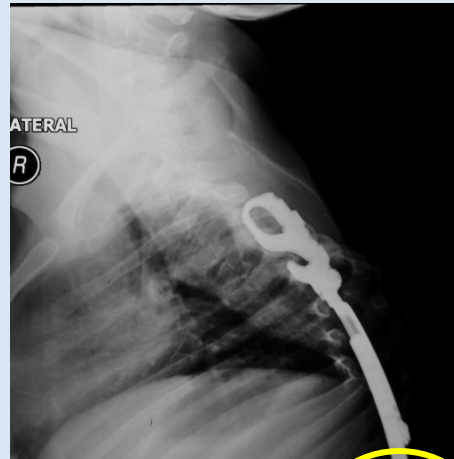


What's Wrong with this Picture?

Not congenital, IIS, CDH



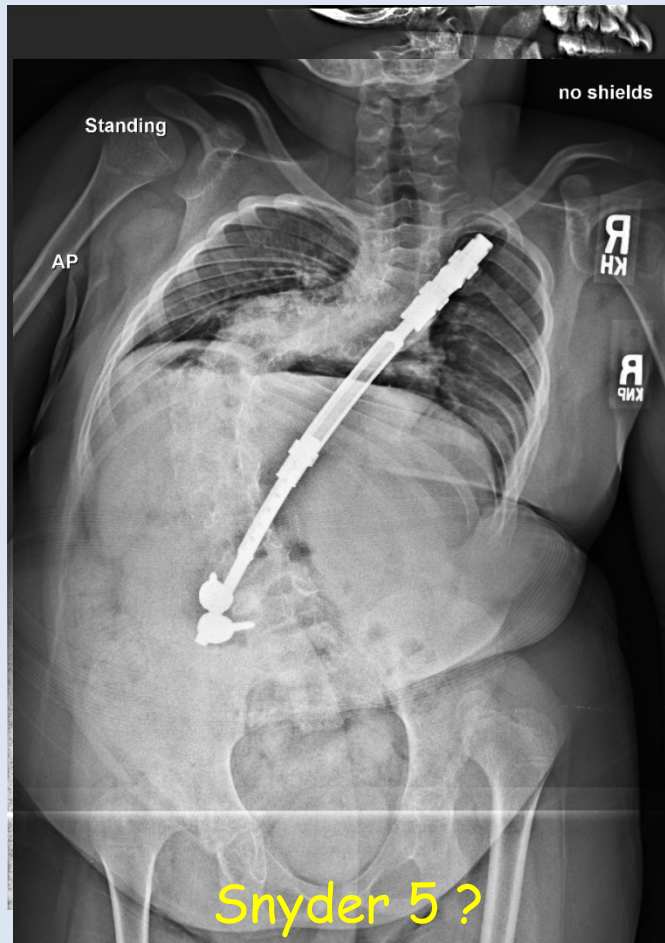
1. Coronal plane correction insufficient /decomp
2. Too short - no control rotational kyphosis or coronal imbalance
3. Single distal anchor not stable for rotation control
4. Why weren't hips treated?



g side screws

3 more
years.....
Sept 2014

PFT 43% pred, impaired ambulation,
deep costo-pelvic fold / permanent flora



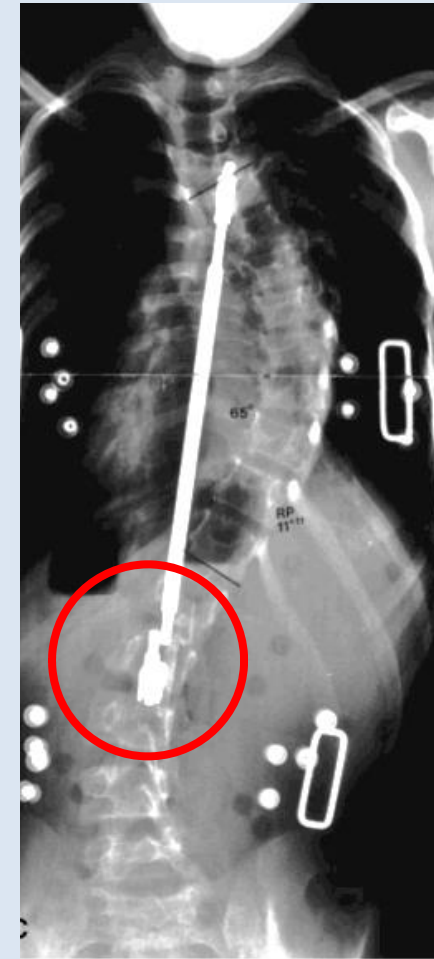
+ve sag balance w/ CDH

Not Just Veptr.....

Not stable



HWR s/p anchor dislodge



Original Harrington
GR (SRS 1978)

Three-Dimensional Evolution of Scoliotic Curve During Instrumentation Without Fusion in Young Children

JPO 2002

Emre Acaroglu, M.D., Muharrem Yazici, M.D., Ahmet Alanay, M.D., and Adil Surat, M.D.

Study conducted at the Hacettepe University, Ankara, Turkey

- 12 patients single GRI, pre-rx → definitive fusion, 4.6 lengthen (2-7)

	Pre-rx	Pre-fusion
• Coronal	58° (40-90)	59° (45-75)
• AVR pedriolle	20 (10-35)	34 (27-40)
• Sagittal	33° (10-48)	43° (20-62)
• Age	6+1	11+7

Single concave distraction rod

	<u>length(cm)</u>	<u>#proc</u>	<u>complic</u>
Moe '84	3.8	5.4	50%
Klemme '97	3.1	6	37%
Mineiro/Weinstein '02	2.0	4.7	32%
Acaroglu '02	4.0	4.6	28%
Thompson '05 _{GSSG}	7.0	3.2	33%

Coronal plane correction - 30% + *BUT.....* small amount of length gained/procedure

Comparison of Single and Dual Growing Rod Techniques Followed Through Definitive Surgery: A Preliminary Study

Thompson, George H. MD*; Akbarnia, Behrooz A. MD†; Kostial, Patricia RN, BSNT; Poe-Kochert, Connie CNP*; Armstrong, Douglas G. MD*; Roh, Jeffrey MD‡; Lowe, Robert MD‡; Asher, Marc A. FRCSS; Marks, David S. MD[//]

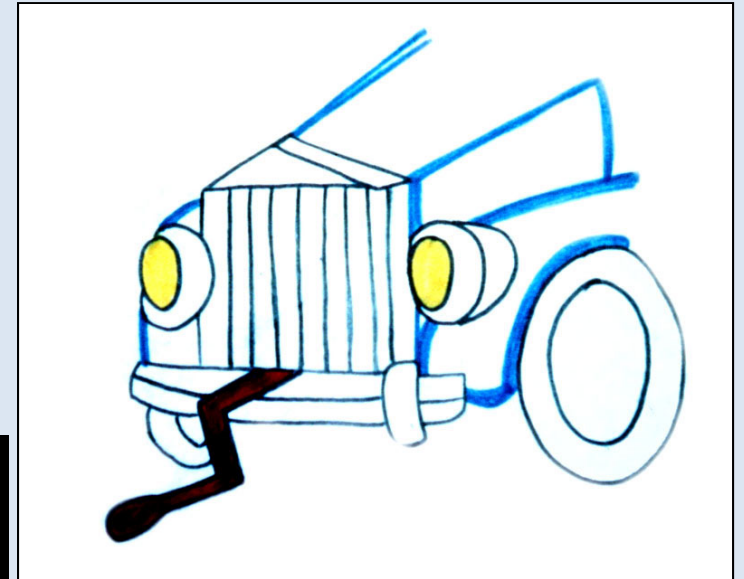
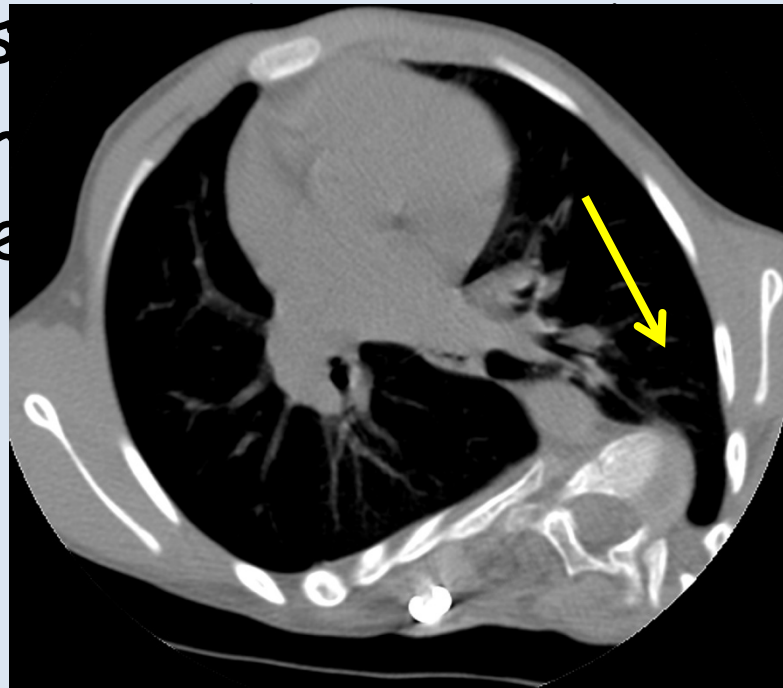
Spine 2005

	SRI/ap	SRIonly	DRI
No. patients	5	16	7
Scoliosis preop (°)	85	61	92
" final (°)	65	39	26
% correction	23	36	71
% correct during lengthen	-47	-8	33
T1-S1 length, preop->final (cm)	6.4	7.6	12.1
Est. length gain (%)	25	80	130
Length/ yr. rx (cm)	0.3	1.0	1.7
Kyphosis preop (°)	42	33	49
" final (°)	55	33	42

Single rod = Crankshaft Machine

(Mineiro, Acaroglu)

- Distraction alone unable to control axial plane (1 anchor)
- Single rod = posterior tether (facet fibrosis + ankylosis within s)
- Rib hum
narrowe



Single GRI - Outcomes

- Inferior coronal plane correction:
 - posterior ankylosis (Law DR)
 - unstable anchors
 - kyphogenic
- Transverse plane worsened by:
 - crankshaft *
 - inefficient distraction *

***Indication for Dual Rod Construct**

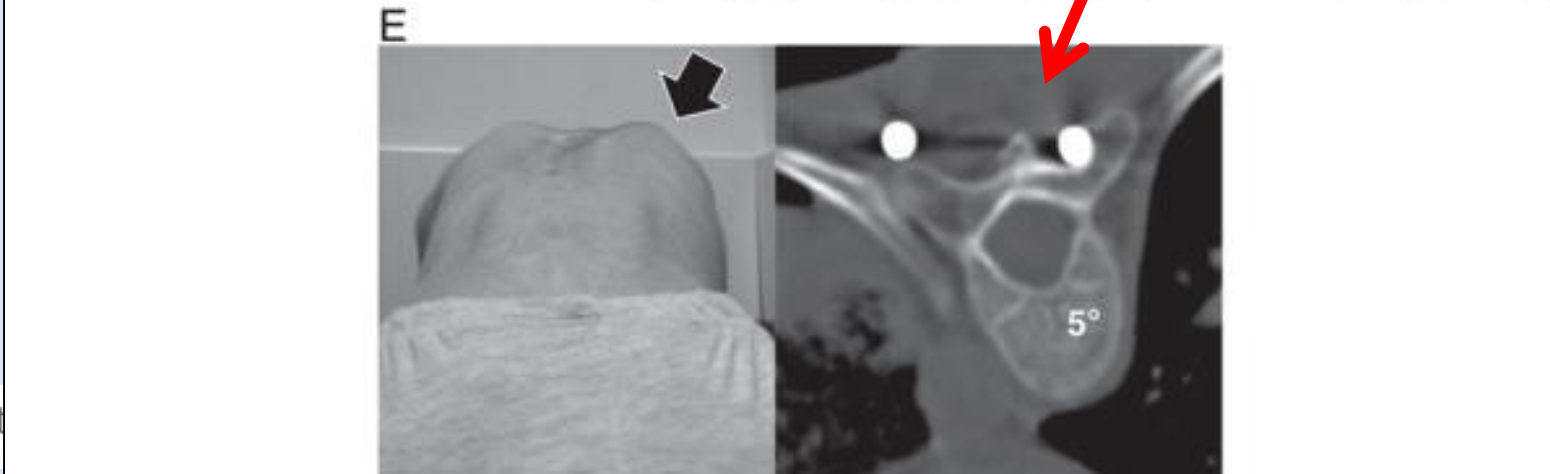
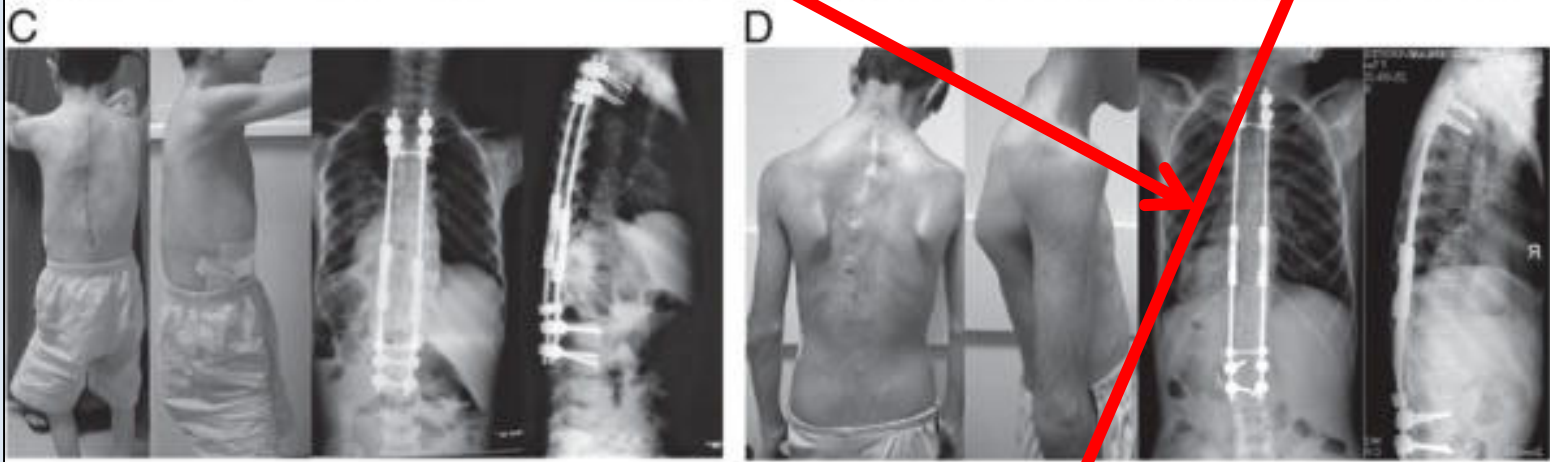
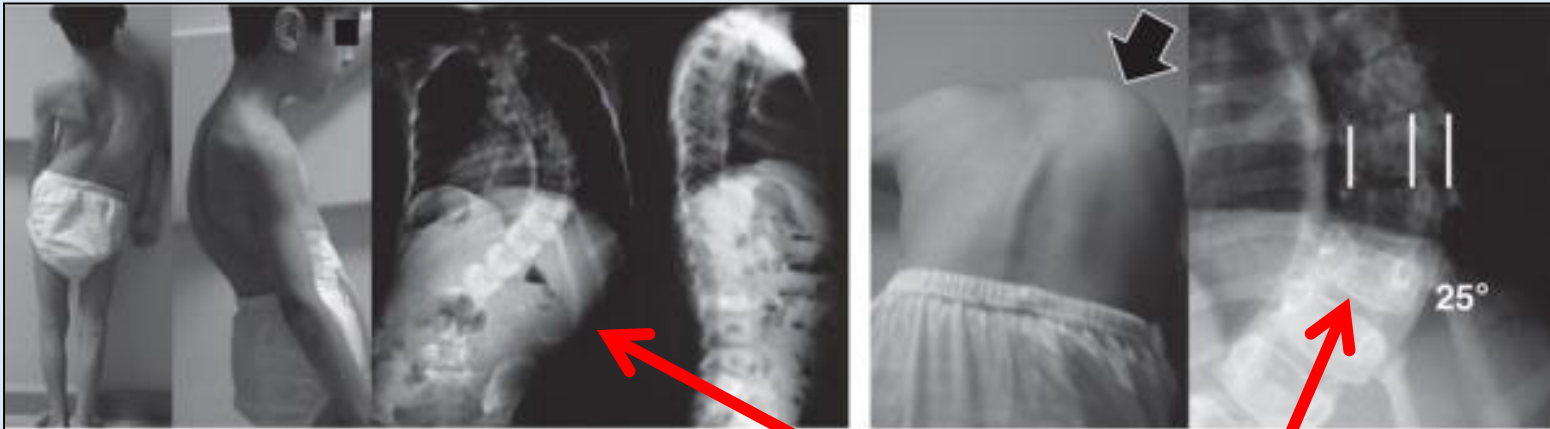
JPO 2014; 34:607

The Effect of Dual Growing Rod Instrumentation on the Apical Vertebral Rotation in Early-onset Idiopathic Scoliosis

Saygin Kamaci, MD, Gokhan Demirkiran, MD, Vusal Ismayilov, MD,
Z. D. Olgun, MD, and Muharrem Yazici, MD

12 patients, f/u 77 mo (57-91)
All idiopathic or idiopathic-like
Pedriolle & CT measures

	Age(mo)	Coronal	Sagittal	AVR	T1-12 _{cm}
Preop	69(36-108)	64(40-98)	46(20-90)	27(18-38)	
IPO		25(10-46)	25(12-50)		16.4(12-18)
f/u	146	20(7-42) <i>p<.001</i>	38(16-83)	18(4-35) <i>p=.003</i>	22.3(19-25.4) <i>p<.001</i>

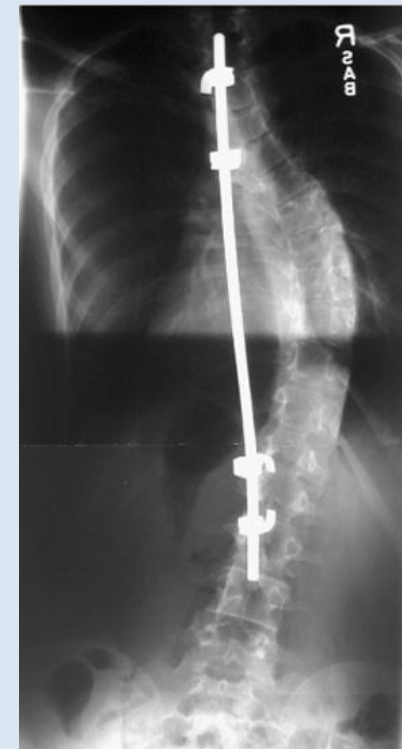


Single rod vs. Dual rod

- Coronal & AVR best corrected by DRI - well established >10 years (GSSG, Hacettepe)
- Why is/was single rod/device still in existence ??

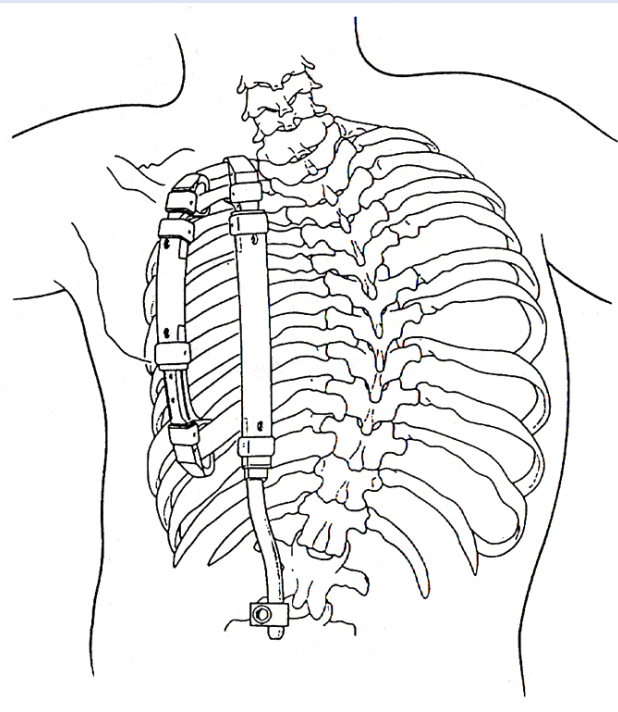
Historical ?

↓ convex hardware prominence?
Minor modifications believed to improve outcomes?



Unilateral VEPTRs

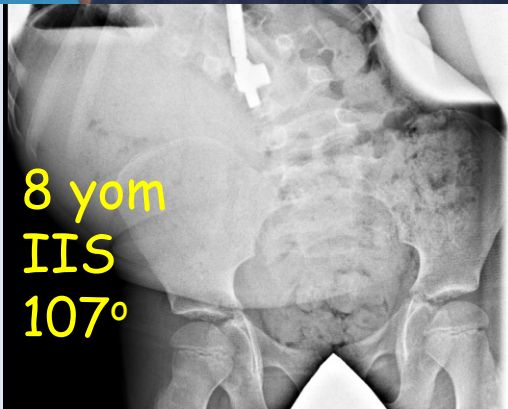
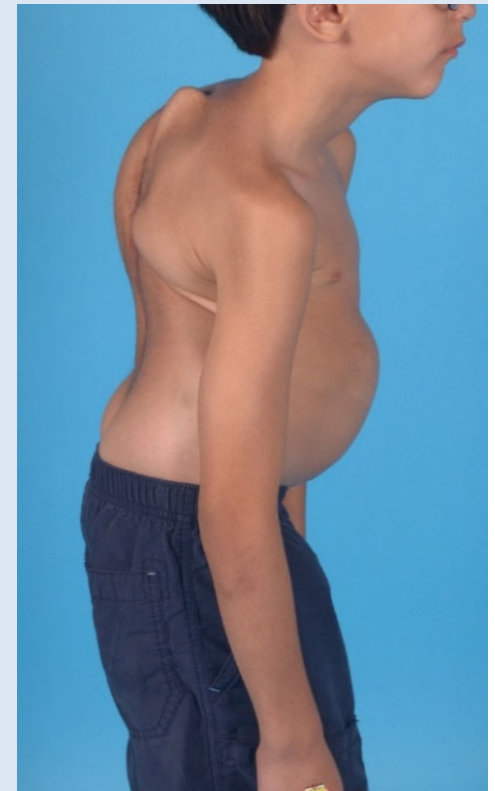
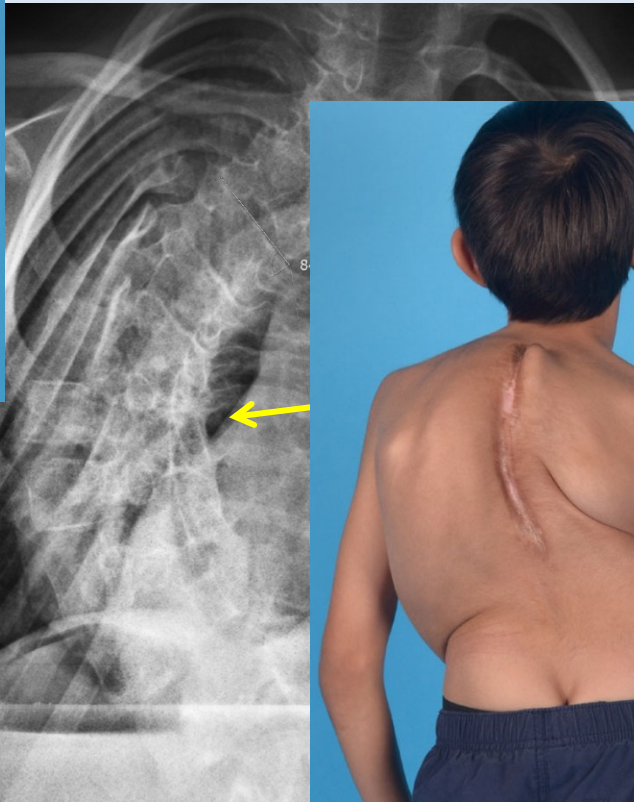
- VEPTR revolutionized treatment of congenital scoliosis w/ fused ribs
- Unfortunately....application to other deformities unsuccessful
(Eiffel tower: only n-m, non-ambulatory)



Theoretical advantage ->
spine contact of anchors and
devices ↓'d
.....fails due to chest wall
immobilization + spontaneous
costo-vertebral fusion

VEPTR for IIS

axial plane, +ve sag balance /pjk
t.p.'s (4 yr Veptr insertion)



HGT -> barely moves

Growing Rod and Vertical Expandable Prosthetic Titanium Rib perform differently for Idiopathic Early Onset Scoliosis at 5-year follow-up ICEOS #38

Paul D. Sponseller MD, Anna McClung BSN, RN, Jeff Pawelek BS, Ron El Hawary MD, George H. Thompson MD, John T. Smith MD, Michael G. Vitale MD, Behrooz A. Akbarnia MD, *Children's Spine Study Group, Growing Spine Study Group*

50 GR, 22 Veptr, min 5 yr f/u

Unilat construct 15/50 GR, 11/22 Veptr
(can't separate out SRI vs DRI)

procedures: Veptr 15, GR 10

Infections: Veptr 22.7%, GR 8%

50%



Results ?

Time Point	Radiographic Parameter	GR	VEPTR	p-Value
PRE-OP	Major curve size (°)	78	74	.388
	Thoracic kyphosis (°)	36	31	.319
	Spinal height (mm)	255	237	.062
	Thoracic height (mm)	153	145	.397
POST-OP	Major curve correction (%)	50.0	27.3	<.001
	Thoracic kyphosis (°)	19	22	.549
	Spinal height (% gain)	17.2	11.6	.737
	Thoracic height (% gain)	18.0	18.3	.651
LENGTHENING PERIOD (POST-OP TO MOST RECENT)	Loss of index curve correction (%)	14.2	20.2	.629
	Spinal height (% gain)	18.5	15.5	.281
	Thoracic height (% gain)	24.2	11.6	.024
MOST RECENT (PRE-INDEX TO PRE-FINAL)	Major curve correction (%)	43.4	16.7	<.001
	Thoracic kyphosis (°)	35	49	.018
	Spinal height (% gain)	34.8	34.2	.885
	Thoracic height (% gain)	45.0	30.4	.199



ng rod

equivalent

(\leftarrow)

tion

sed chest
normality

- CRANKSHAFT - makes a manageable "idiopathic" curve into a monster

Inappropriate Use of Growth-Sparing Constructs

1. When definitive fusion appropriate
 - ~ age 10 F, 12 M
 - T1-12 length (~18-22cm)
2. Rib/chest wall constructs applied to spine based deformity
3. Extension to pelvis/ilic wing in ambulatory patients (per Smith, Ramirez)
4. Patients for whom repeat surgeries contraindicated (cardiac, skin coverage, etc)
5. Hyperkyphosis ? (relative)

A New Classification System to Report Complications in Growing Spine Surgery: A Multicenter Consensus Study

*John T. Smith MD, Charles Johnston MD, David Skaggs MD,
John Flynn MD, and Michael Vitale MD CSSG + GSSG
JPO 2015*

TABLE 1. Complications Classification System

Grading	Device Related	Disease Related
I	Does not require unplanned surgery	Outpatient medical management only
II		Inpatient medical management
IIA	Requires 1 unplanned surgery	
IIB	Requires multiple unplanned surgeries	
III	Requires abandoning growth-friendly strategy	Requires abandoning growth-friendly strategy
IV	Death	Death

III MD

Inappropriate device/procedure used



- Common sense
- Understand / recognize what doesn't help or makes it worse

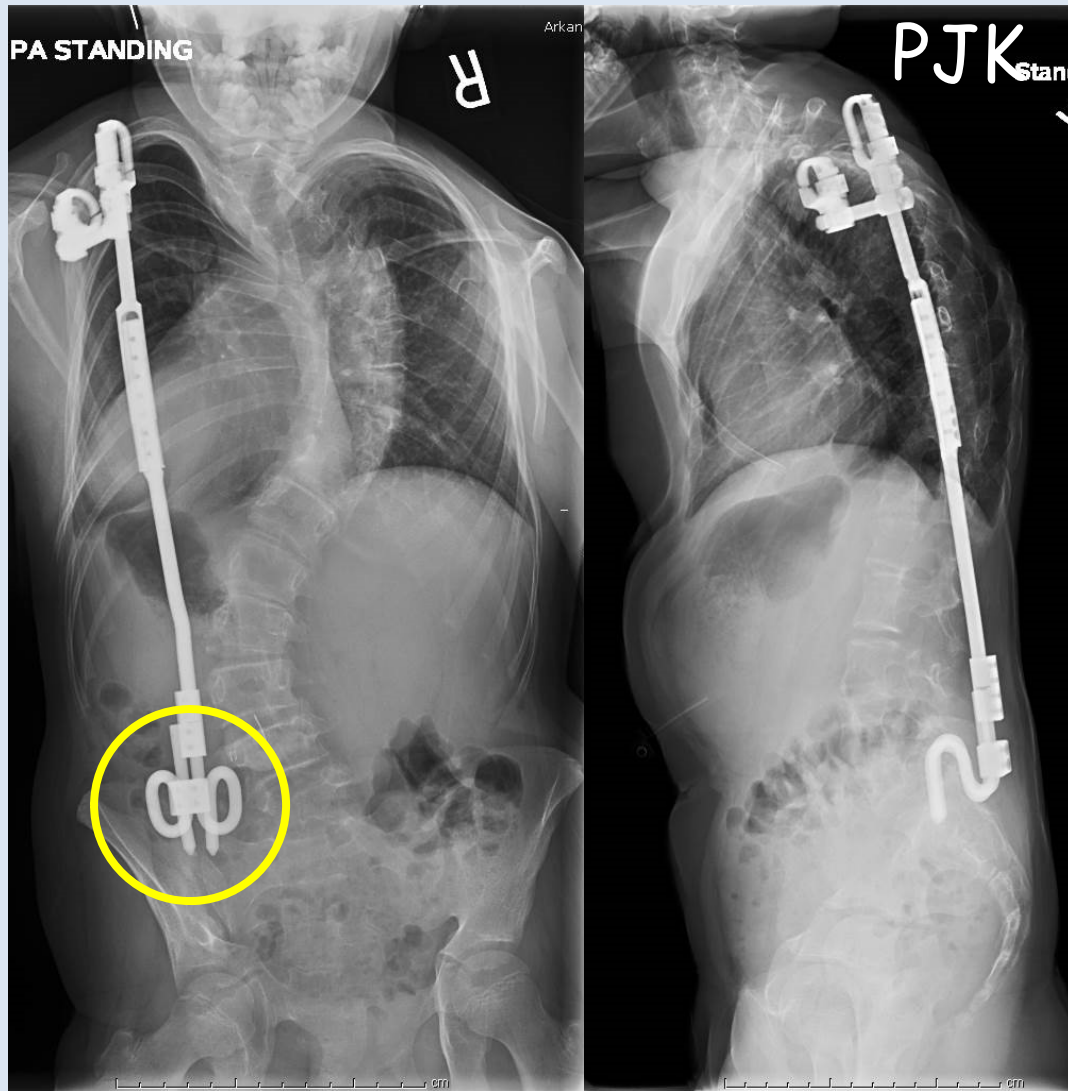
9 yo w/ Marfan - previous growth friendly technique,
failed 2/2 progression, infection -> HWR



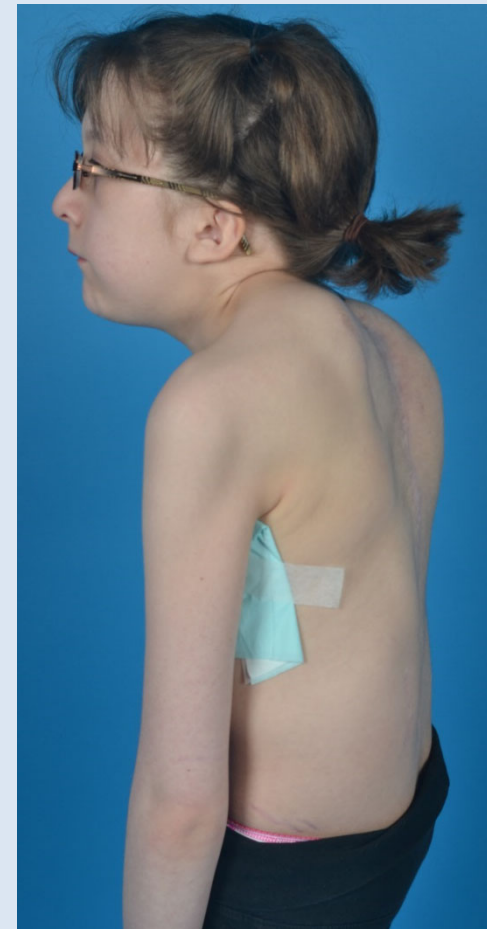
PJK

When this
happens.....

.....Don't repeat with same technique



not stable



Prox cradle drift
+ve sagittal balance
Pain L iliac S hooks