Complications of Growing Rods Incidence and Management

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Disclosures

Author	Relationships Disclosed
Behrooz A. Akbarnia	DePuy Spine (a, b),K2M (a, b), Ellipse (a, b), K Spine (a) Nuvasive (a,b,c)

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(b) Consultant
(c) Stock/Shareholder
(d) Speakers' Bureau
(e) Other Financial Support

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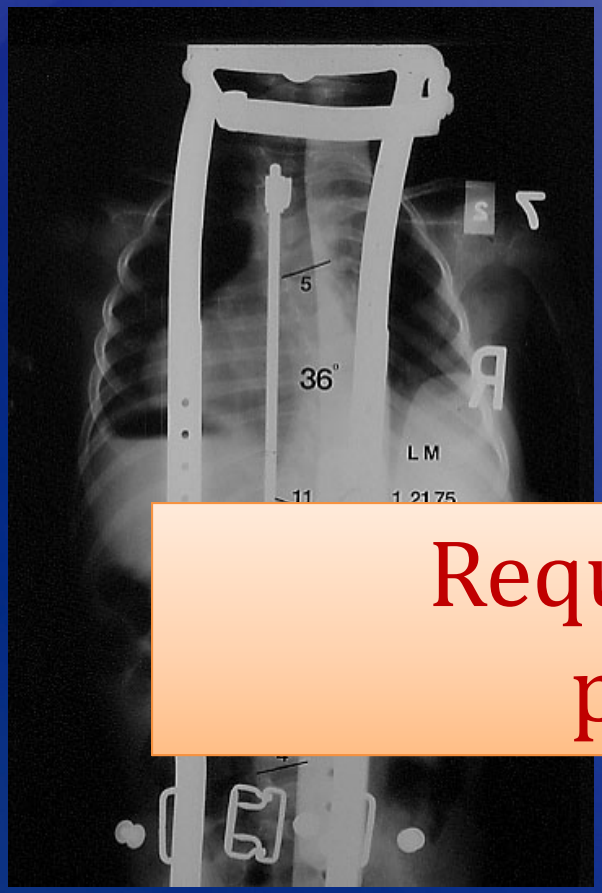
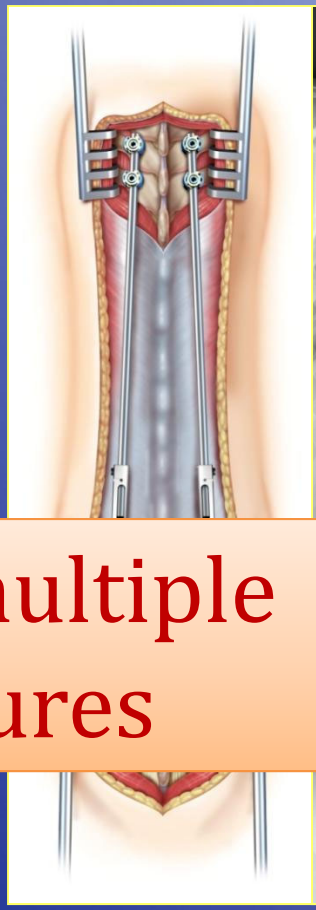
No Evidence Based Medicine in EOS

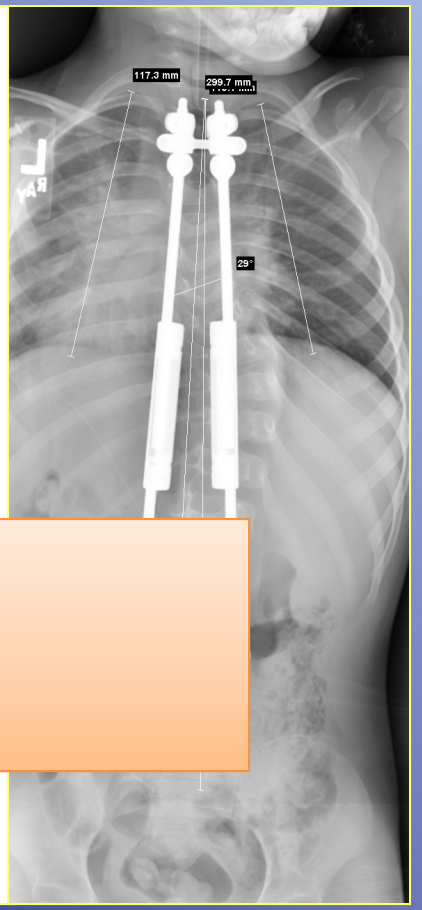
OBM

Growing Rods

- GR is a distraction based technique and has evolved over the past 50 years







Requires multiple procedures

Reasons for Complications

- Indication for treatment
- Choice of treatment method
- Patient's pathology
- Age
- Number of surgeries
- Technical errors in surgery
- Others

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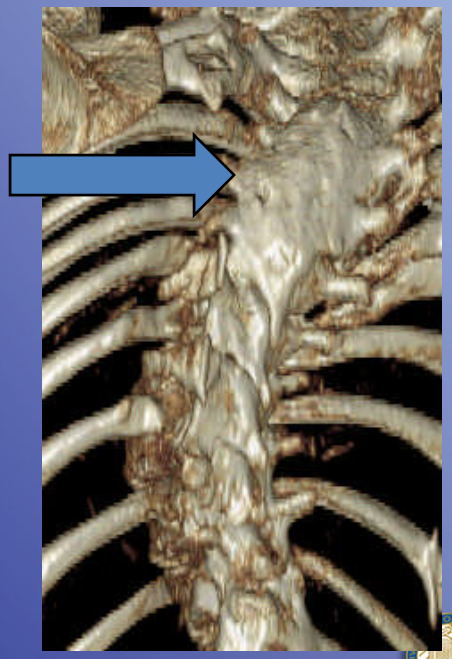
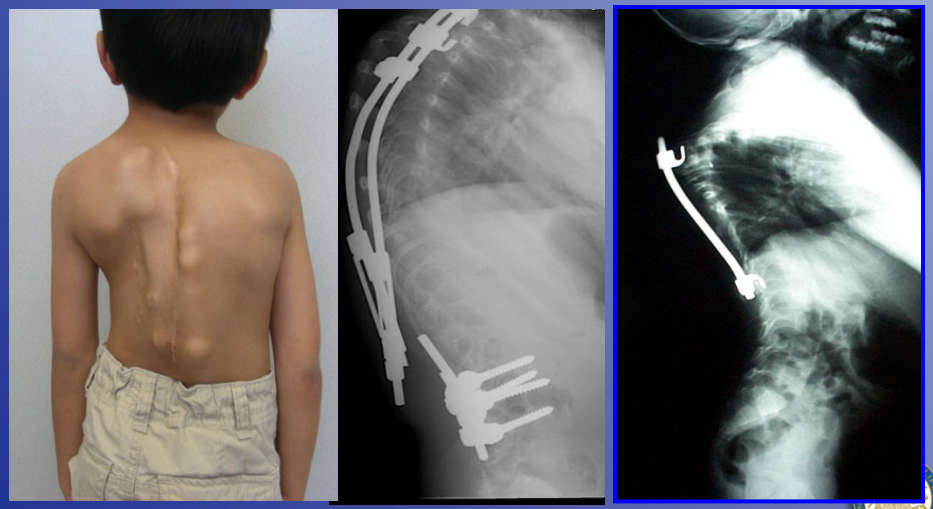
General Complications for Growing Rods

- **Inherent challenges**
  - No bony fusion
  - Construct is weight bearing for the lifetime of its use
  - Susceptible to loosening and failure
- Growing rod constructs require frequent lengthening procedures and patients are susceptible to the risks associated with each procedure:
  - Skin, Anesthesia , Hospitalization, unwanted fusion



Specific Complications for Growing Rods

- **Skin-related complications**:
  - Superficial wound infection
  - Deep wound infection
- **Implant-related complications**:
  - Implant prominence
  - Rod fracture
  - Screw pull out
  - Hook dislodgement



Sankar, Acevedo,Skaggs Spine 2010

Specific Complications for Growing Rods

- **Alignment complications:**
  - Coronal decompensation (C7 to sacrum)
  - Junctional kyphosis
  - Curve decompensation
- **Neurological complications**
  - Neurologic deficit caused during implant insertion or by excessive lengthening

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Infection

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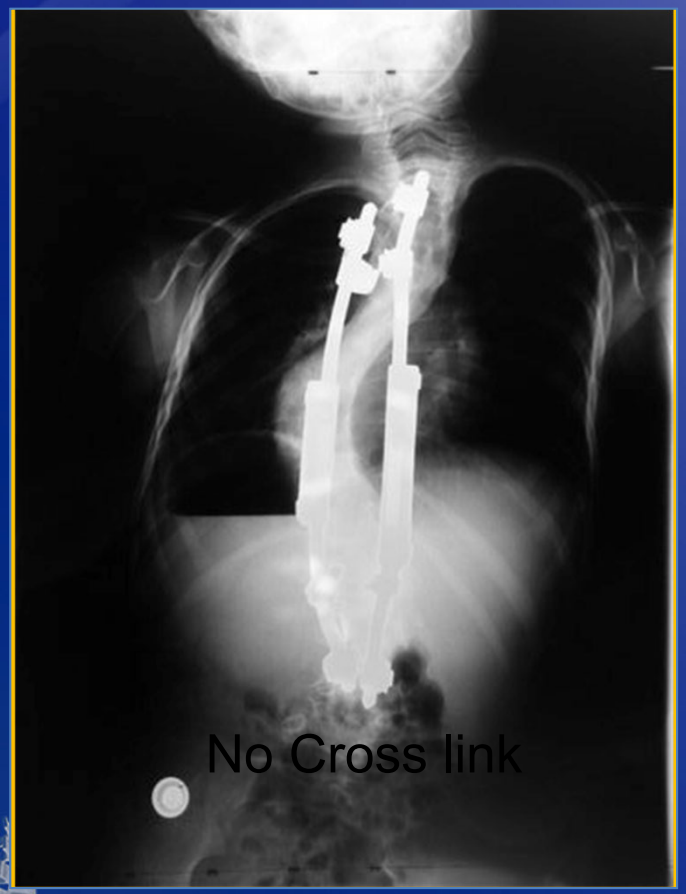
Poor Selection of Instrumentation levels and Rod Contouring

At age 6 y.o and 2 years after growing rod



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Growing Rod Implant Complications

- Anchors
- Rods

- True complication
- Growth related

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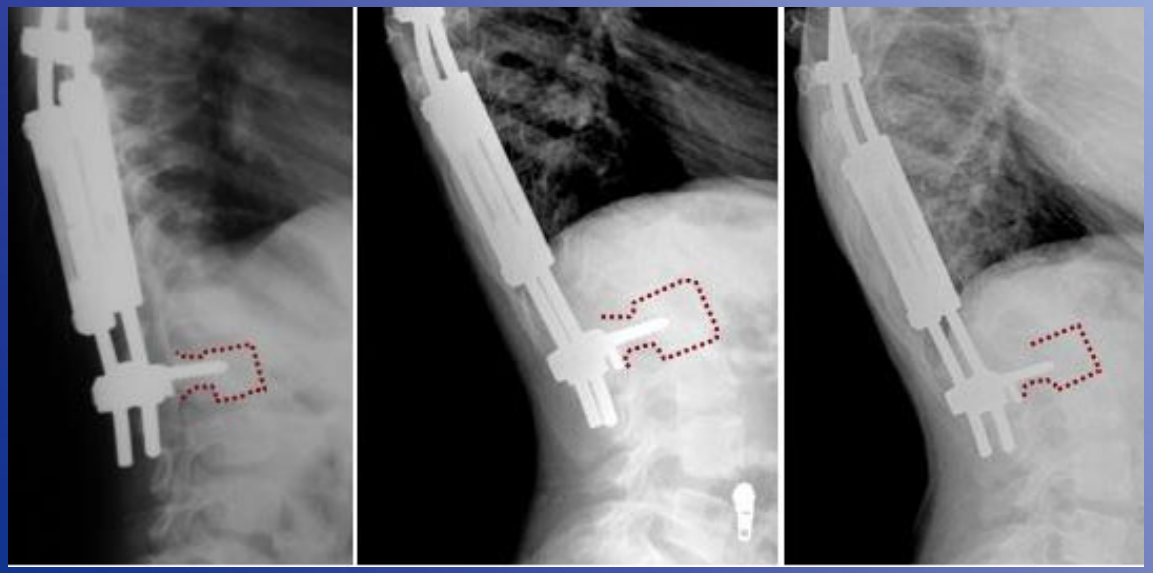
Screws Affected by Growth



1997 → 20001

Dr. El-Sebaie, Cairo

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Implant Prominence

- Exploration of fusion
- Removal Implants
- New Implants
- Revision T3-T5 and L4-5 foundations

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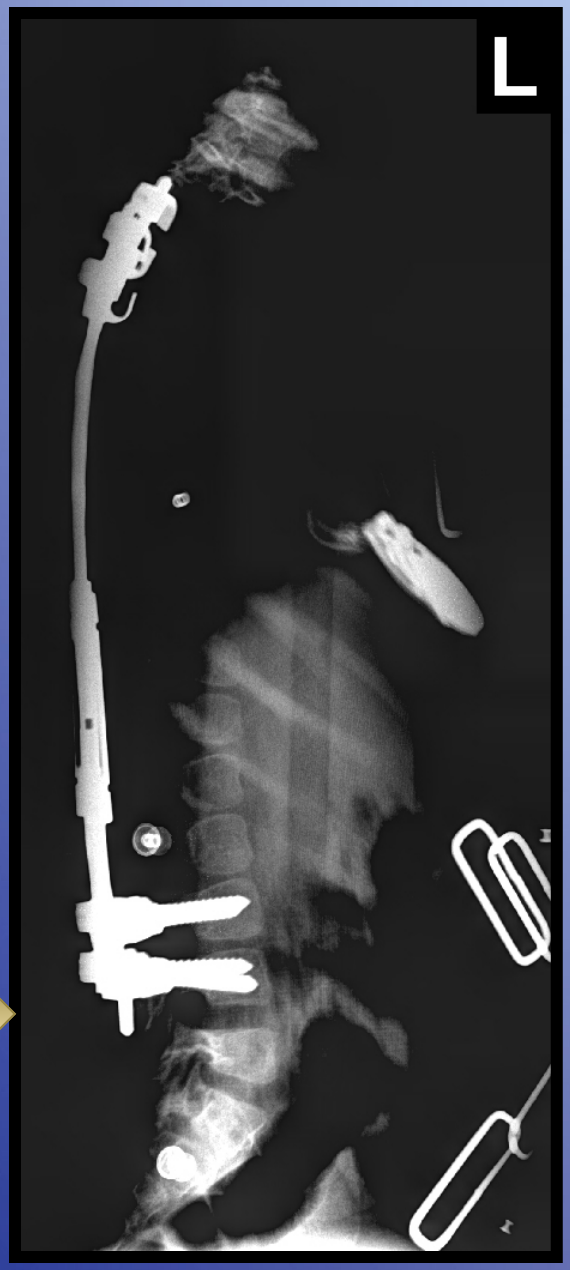

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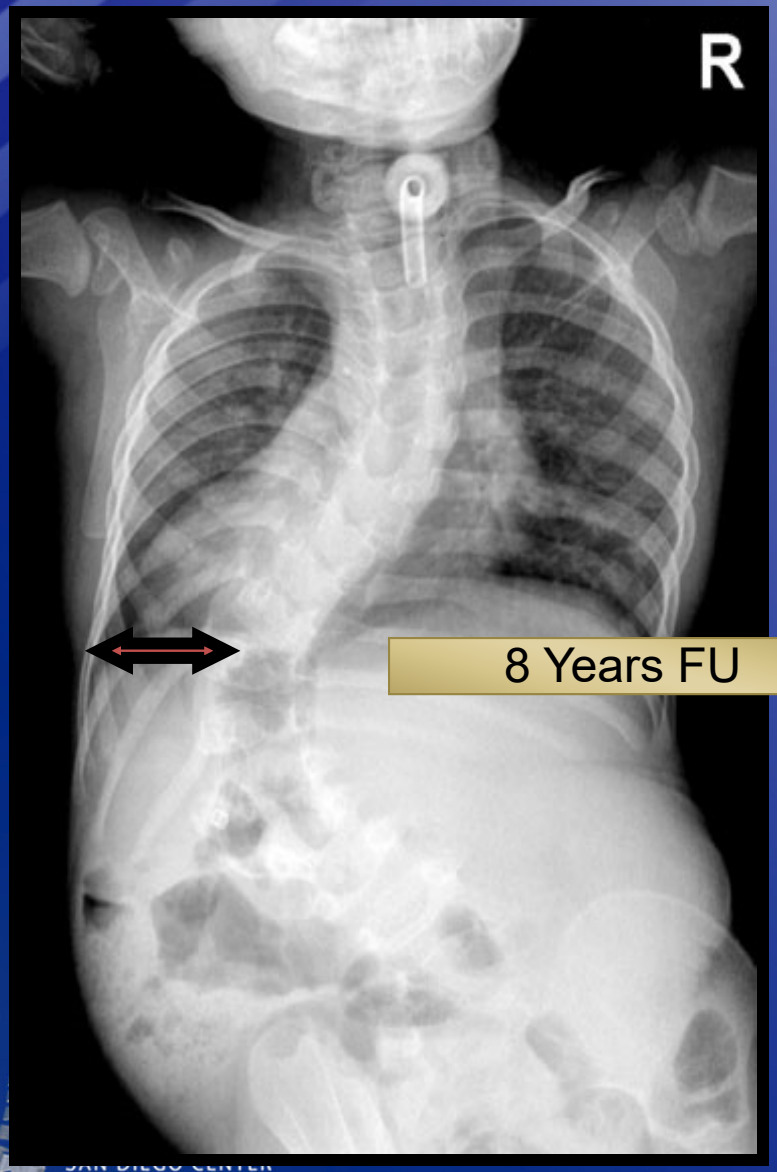
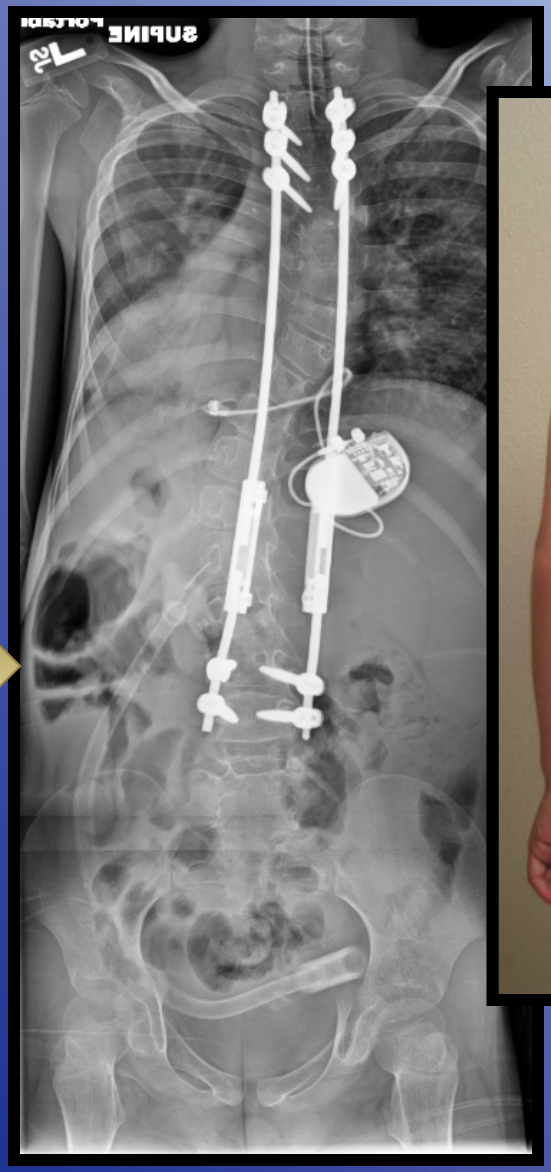


8 Years FU



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Risk Factors for Growing Rod Fractures

Yang, Sponseller, Thompson et al, Spine in press

- Implant risk factors for rod fracture:
  - single rods (77% vs 23%)
  - small rod diameter
  - stainless steel rods
  - proximity to tandem connectors
  - small tandem connectors
- Patient-related: ambulation, prior fx (30%)
  - Repeat fractures remain a challenge

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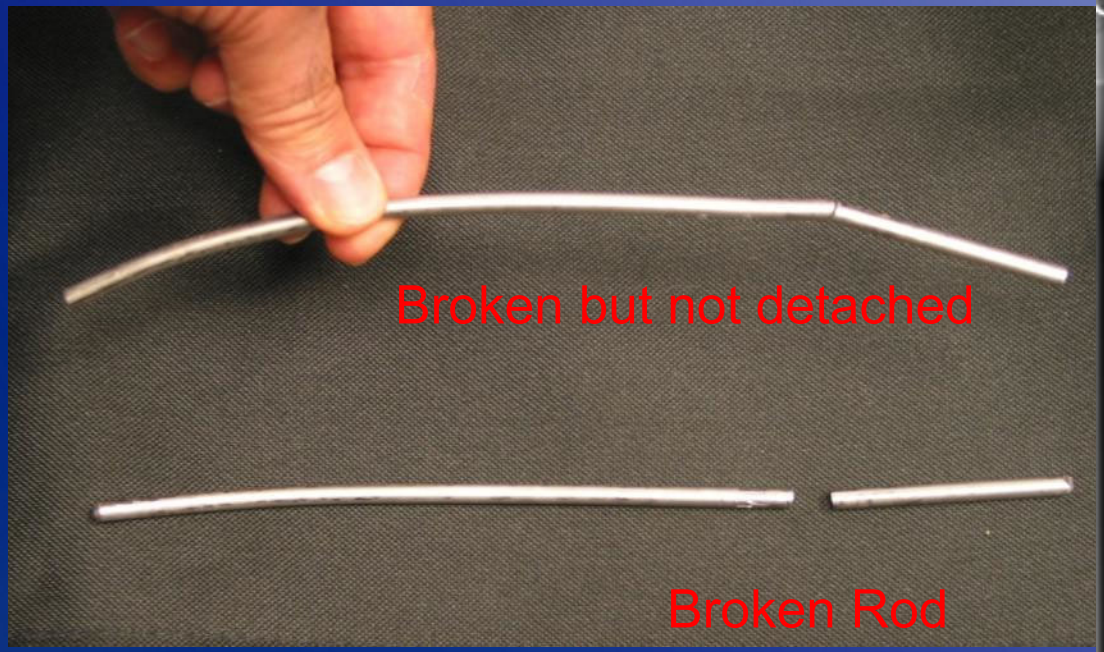
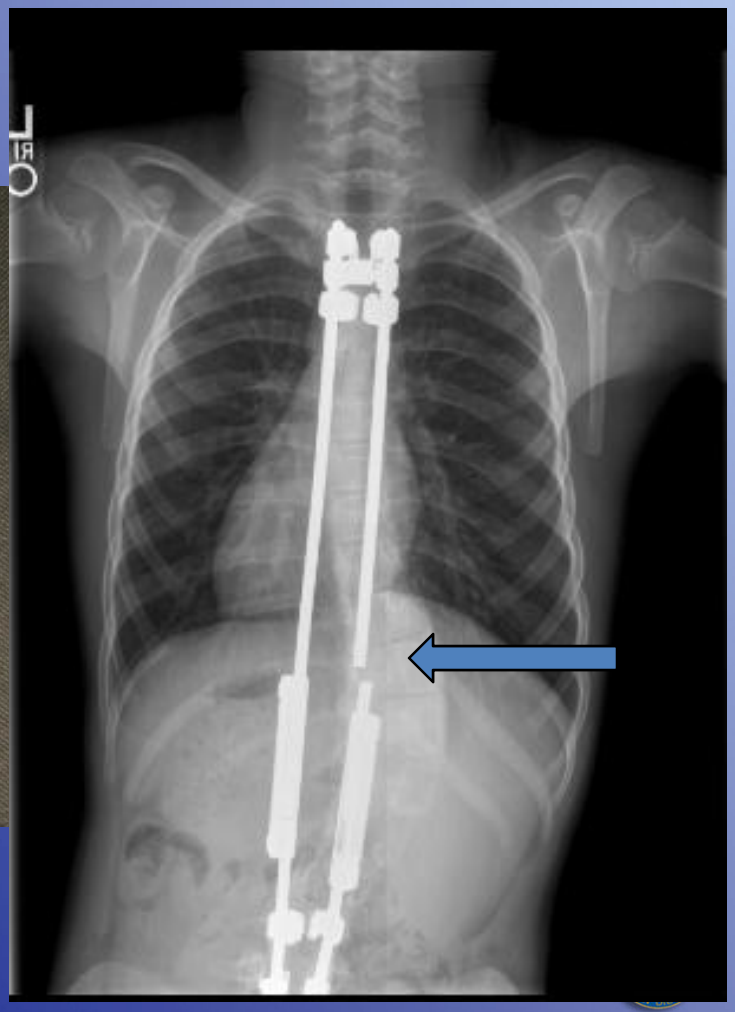
Rod Replacement

- Both rods were weak or broken at same level





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Neurologic Risk in Growing Rod Spine Surgery in Early Onset Scoliosis:

Is Neuromonitoring necessary for all cases?

Wudbhav N. Sankar, MD; David L. Skaggs, MD; John B. Emans, MD; David S. Marks, MD; John P. Dormans, MD; Suken A. Shah, MD; Paul D. Sponseller, MD; George H. Thompson, MD, Behrooz A. Akbarnia, MD
and the Growing Spine Study Group

SPINE Volume 34, Number 18, pp 1952–1955, 2009

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Neurologic risk in Growing Rods

Conclusion

Primary Implants
Implant Exchange } 1% risk Neuromonitor

Lengthening } ? Risk

0/361cases

3 anecdotal cases

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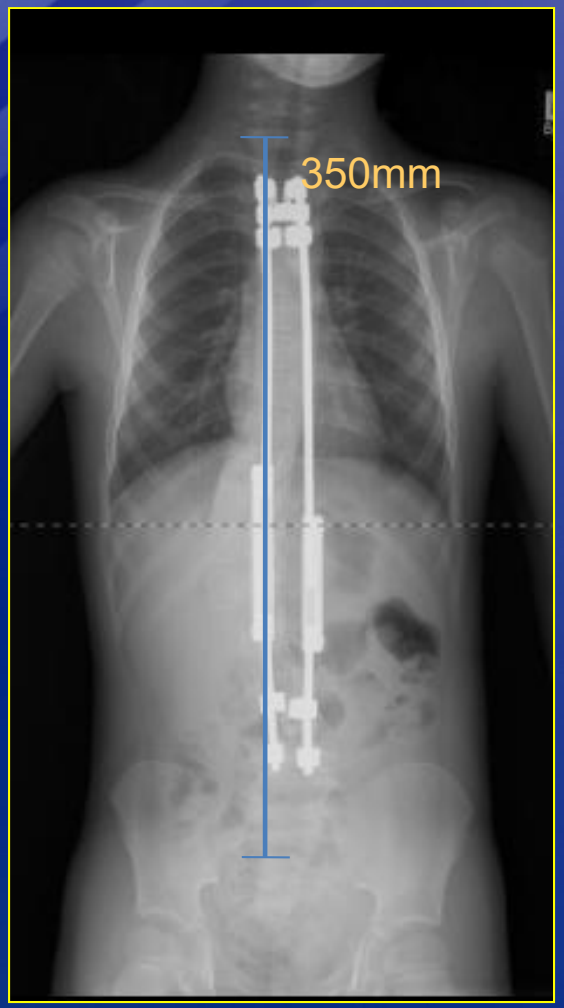
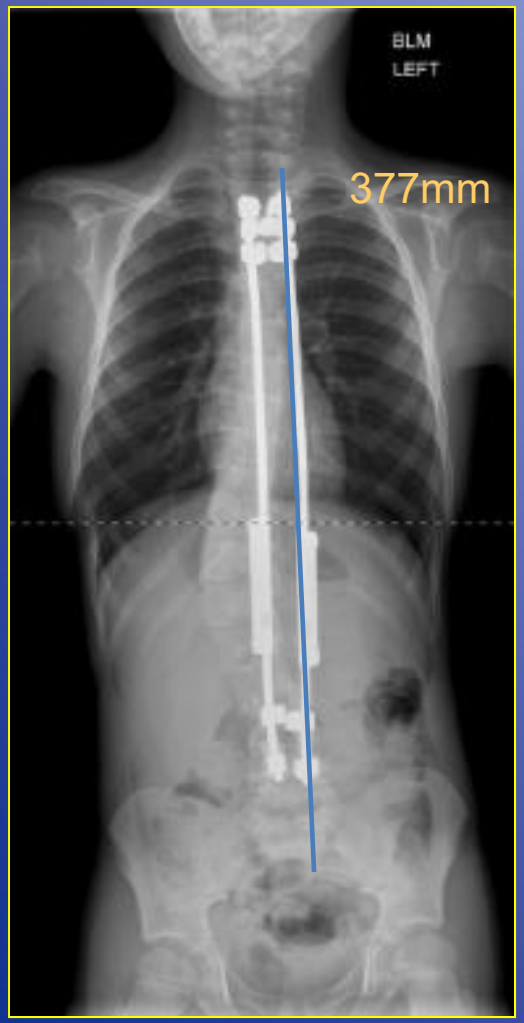
Neuro Deficit after 27 mm of lengthening



Pre-lengthening



Post-lengthening

No monitoring changes

1 week later Gait Abnormal Reported

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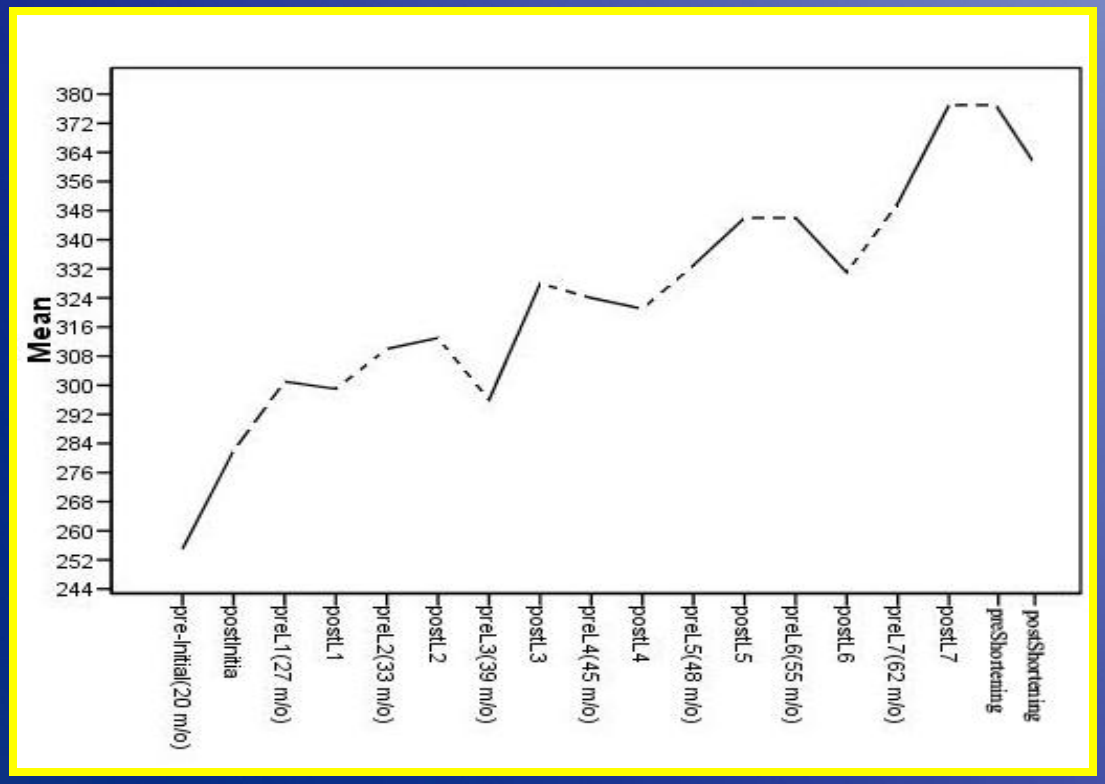
Rods Shortened 16 mm that day

- Gait returned to normal by office visit next week



Would shortening <1cm prevent these problems???

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Complications of Growing-Rod Treatment for Early-Onset Scoliosis

Analysis of One Hundred and Forty Patients

By Shay Bess, MD, Behrooz A. Akbarnia, MD, George H. Thompson, MD, Paul D. Sponseller, MD, Suken A. Shah, MD, Hazem El Sebaie, FRCS, MD, Oheneba Boachie-Adjei, MD, Lawrence I. Karlin, MD, Sarah Canale, BS, Connie Poe-Kochert, RN, CNP, and David L. Skaggs, MD

From the all GSSG patients database, 140 patients met the inclusion criteria and underwent a total of 897 growing-rod procedures.

JBJS November 2010

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Demographics & Treatment Groups

- 140 patients (1987-2005)
- Avg. age =73.2 mo. (19.5-144 mo.)
- 897 GR surgeries
  - 13.3 levels (7-18)
  - 6.4 procedures/ pt (2-15)
  - 4.5 lengthening/ pt (0-13)
  - Final fusion=53 pts (37%)
- Follow up=59.4 mo. (24-166 mo.)

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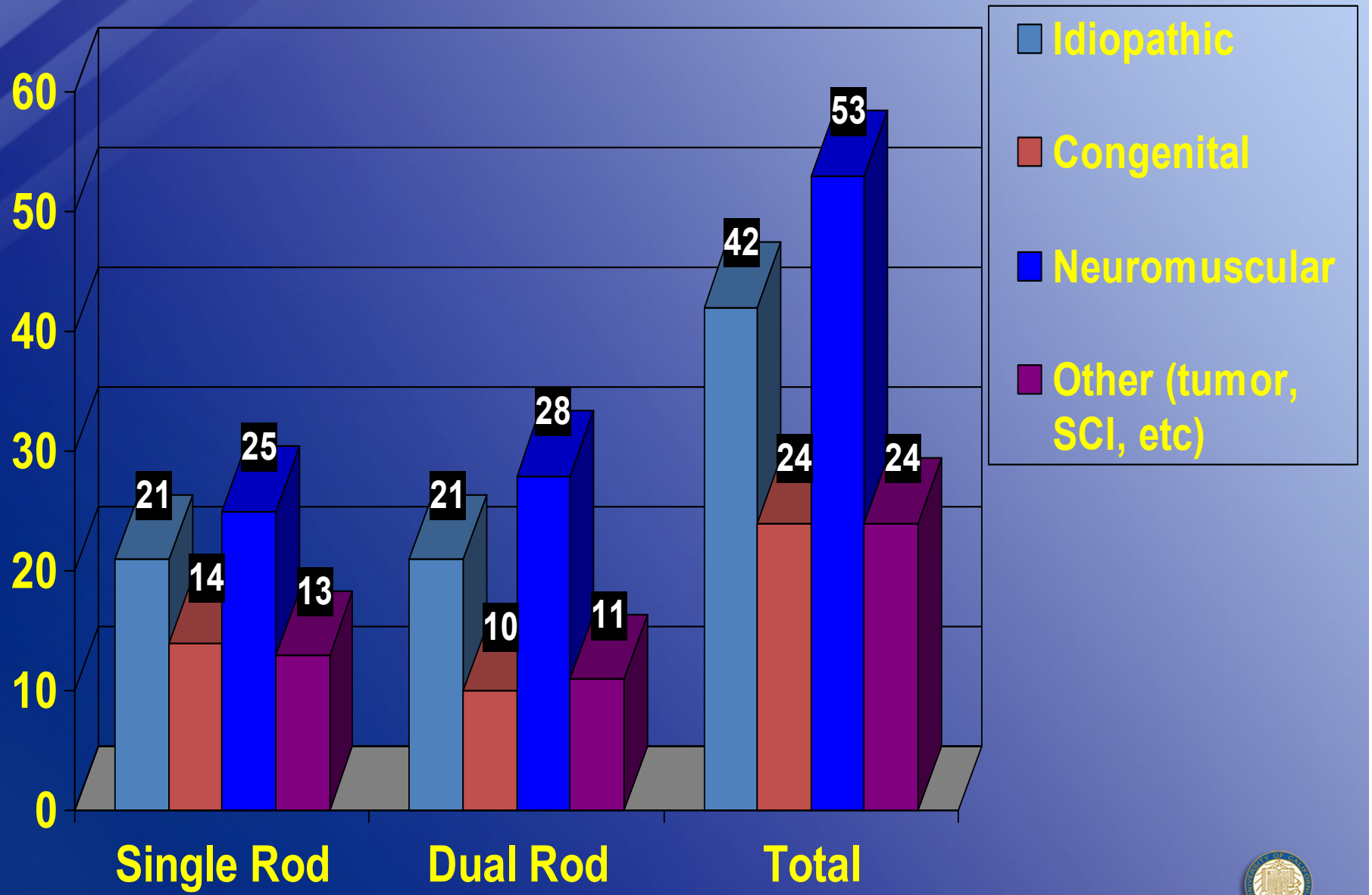
Diagnosis



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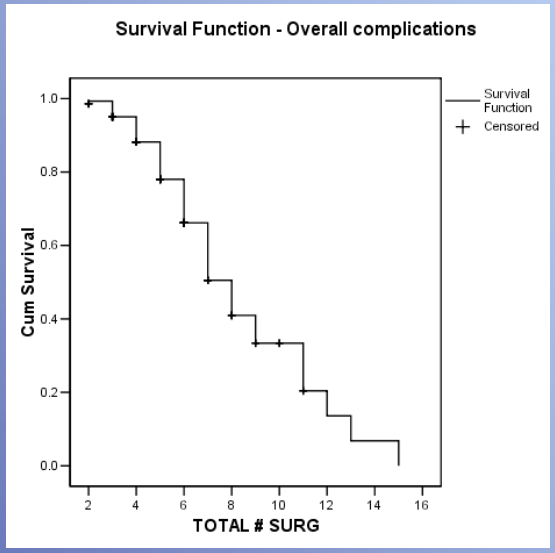
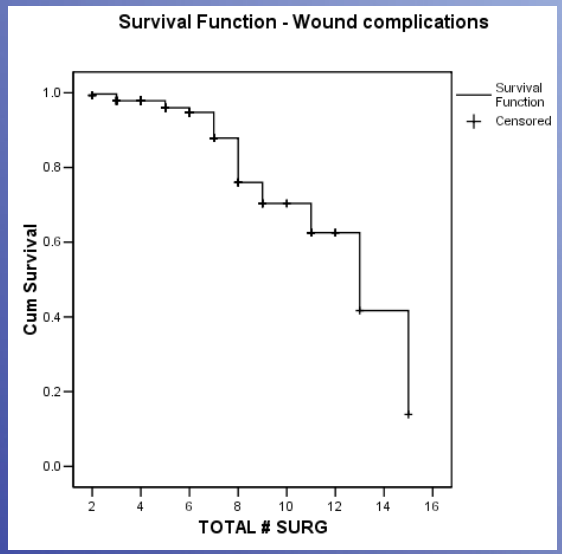
Results

- Kaplan-Meier Survival Analysis
- Total complications vs. Procedures
  - 50% survivorship at 7 surgeries
- Wound Complications vs. Procedures
  - 90% survivorship at 7 surgeries
  - 40% survivorship at 13 surgeries
- Odds Ratio: Complication vs. Procedure
  - 24% increased complication risk each additional procedure
  - (Odds Ratio=1.24, 95% Confidence Interval: 1.07, 1.44, p=0.005)
- Odds Ratio: Complication vs. Age
  - 13% decrease complication risk each year increased age initial surgery
  - (Odds Ratio=0.87, 95% Confidence Interval: 0.75, 1.00, p=0.057).





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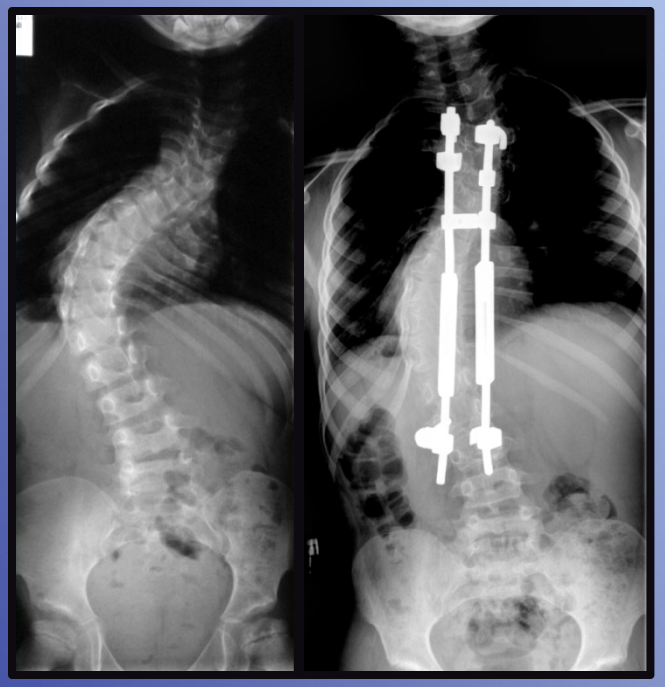
Conclusions

- Complication rates per growing rod procedure are comparable to other surgical treatments for scoliosis.
- Complications are likely due to multiple spine procedures per patient.



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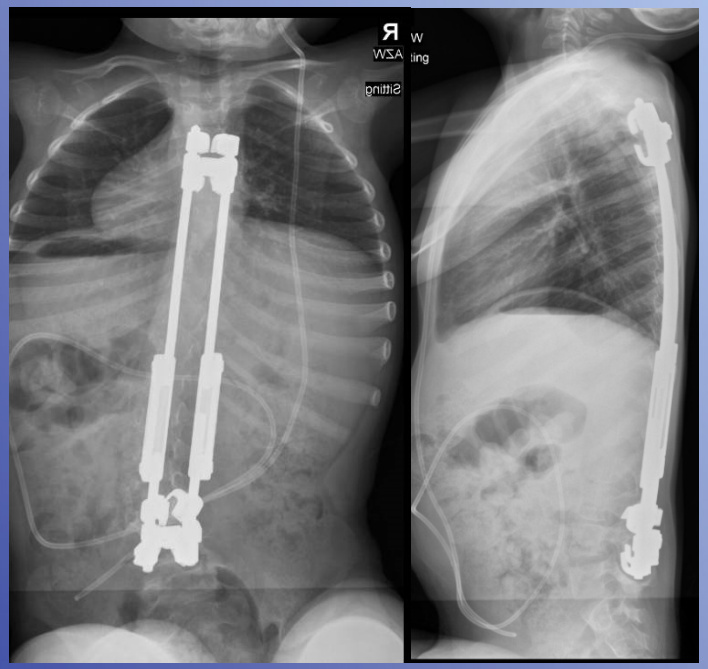
Conclusions

- Dual rod constructs reduce the number unplanned surgeries caused by implant-related complications.
- Sub-M placement decreases complication rates and wound problems, and reduces the number of unplanned surgeries.



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SPINE Volume 35, Number 23, pp 2091–2096

Comparison of Complications Among Growing Spinal Implants

Wudbhav N. Sankar, MD, Daniel C. Acevedo, MD, and David L. Skaggs, MD

- Authors suggested that the previous studies has underestimated the growing implants complications.
- Complications of three major growing spinal implants (GR, Hybrid construct, VEPTR) in 36 EOS patients treated by one surgeon, at one center were retrospectively reviewed with a mean F/U of 51 m.
- The effect of Cobb angle, kyphosis, age and BMI was evaluated on the complication rate.

Results

- There were 74 major complications, 72 unplanned surgeries & 2 neurologic injuries
- The mean number of complications per patient increased over the first 3 yrs of treatment

Table 2. Complications in Growing Spine Surgery

Major Complications	Ccx Rate	Ccxs/cm Growth	Ccxs/yr Treatment	Ccxs/Planned Surgeries
Dual growing rods	2.30/patient	0.20/cm	0.52/yr	0.47/surgery
Hybrid	0.86/patient	0.19/cm	0.36/yr	0.29/surgery
VEPTR	2.37/patient	0.97/cm	0.52/yr	0.44/surgery

CCx indicates complication; cmvisu, centimeter; yr, year.

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Conclusion

- The overall complication rate in this study is much higher than previous studies
- Complication rate seemed to be lower in hybrid construct
- Cobb angle, kyphosis, age and BMI were not found to have an effect on complication rate

Conclusion

- Comparison of predictable complications of VEPTR (or any expandable device)

Growing Rod	VEPTR
Multiple surgeries, infection	Multiple surgeries, infection
Rod breakage	Drift of device attachments
Premature spine fusion beneath rod	Chest wall stiffness? Rib fusion

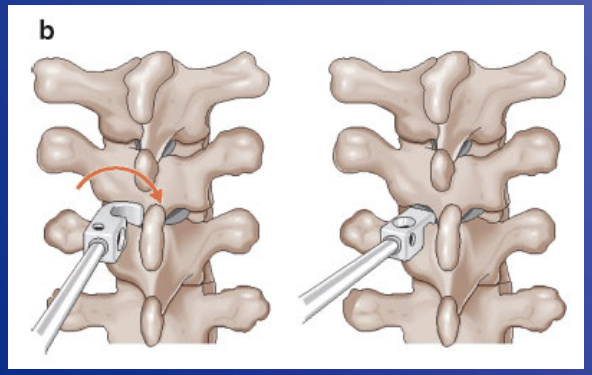
How to Avoid and how to Treat Complications

- Patient selection
- Correct surgical procedure (levels, sagittal alignment, techniques of exposure and instrumentation
- Early detection of potential complications
- Treatment of complication (long term goal)

Technical Consideration

- Implant:

1. Careful radiographic examination for accurate placement of implants
2. Treat the rigid curves with cast, traction or release before surgery
3. Proper rod contouring to correct both coronal and sagittal deformity



• Reduce Frequency of Surgeries

Courtesy of Ken Cheung, M.D.

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Thank you

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