7TH INTERNATIONAL CONGRESS ON EARLY ONSET SCOLIOSIS AND GROWING SPINE

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GSF

Vertebral column lengthening with open wedge osteotomy in congenital bars

Practical tip/trick/pitfall

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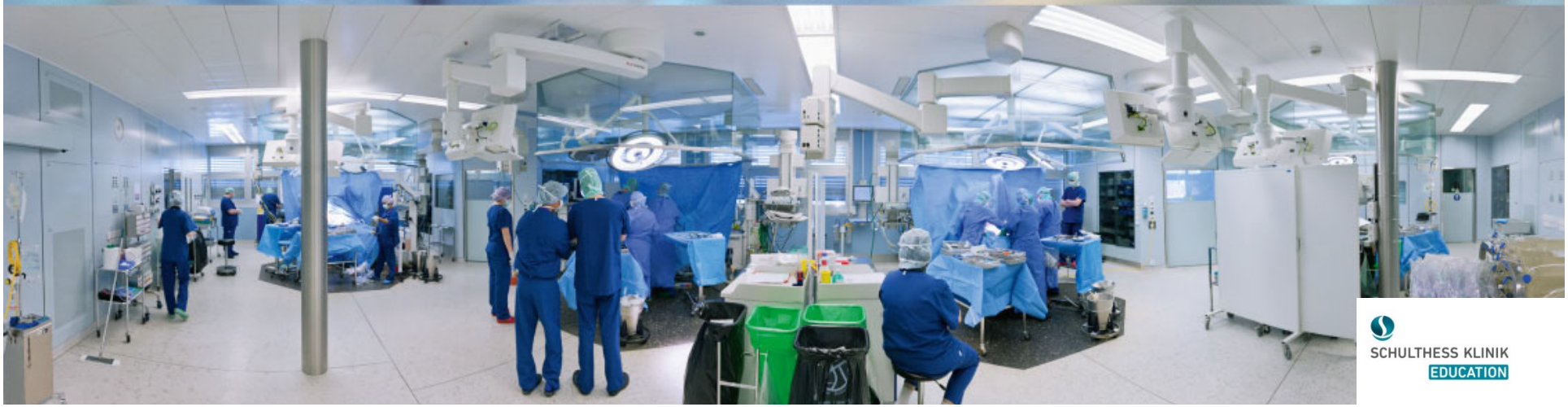

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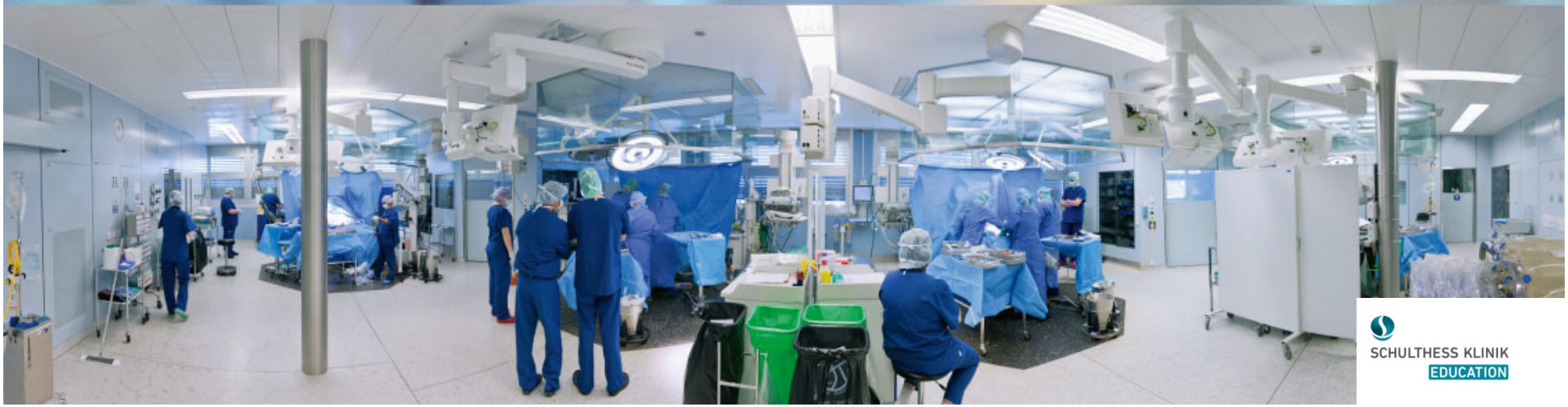
Disclosure

- **Consulting Fees: DePuy Synthes**
- **Royalty: DePuy Synthes, Medacta**



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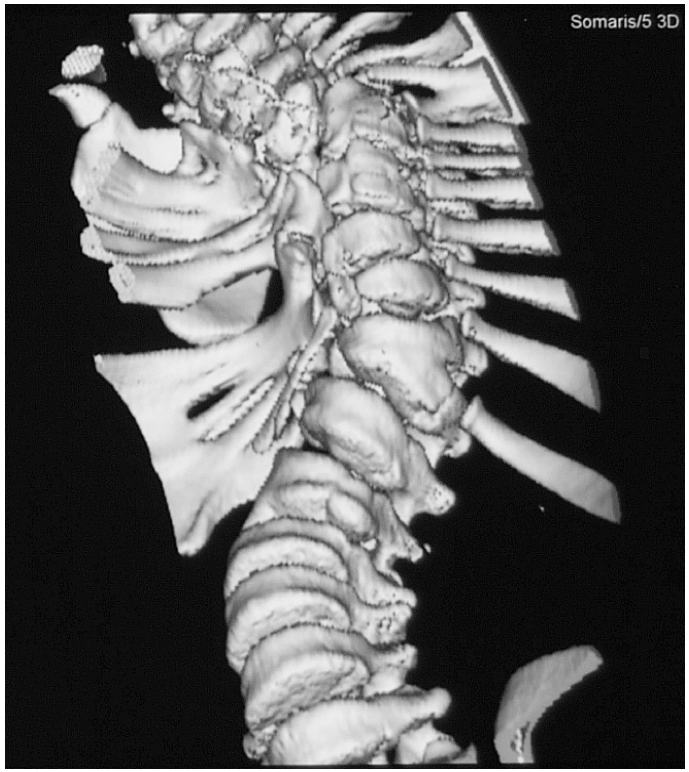
Introduction

- Surgical treatment of early onset scoliosis (EOS) is one of the most difficult challanges in modern pediatric spine surgery
- Young children with progressive spine deformity can have life-threating cardiopulmonary complications
- Ideal timing and type of intervention remains debatable
- The development of deformity at an early age will have a more significant impact on spinal growth, thoracic volume, and cardiopulmonary development
- Appropriate treatment of the spinal deformity in these children in a timely manner is necessary to avoid these consequences

Introduction

- Distraction of the spine may cause neurological damage
- Deformity correction with distraction is common practice:
  - avoided or
  - performed slowly through growing rods or an indirect distraction method (e.g. VEPTR)
- A surgical method to correct spinal deformity by osteotomy of the congenital bar and straight distraction in congenital scoliosis has not been reported to my knowledge



Vertebral column lengthening with open wedge osteotomy in congenital bars

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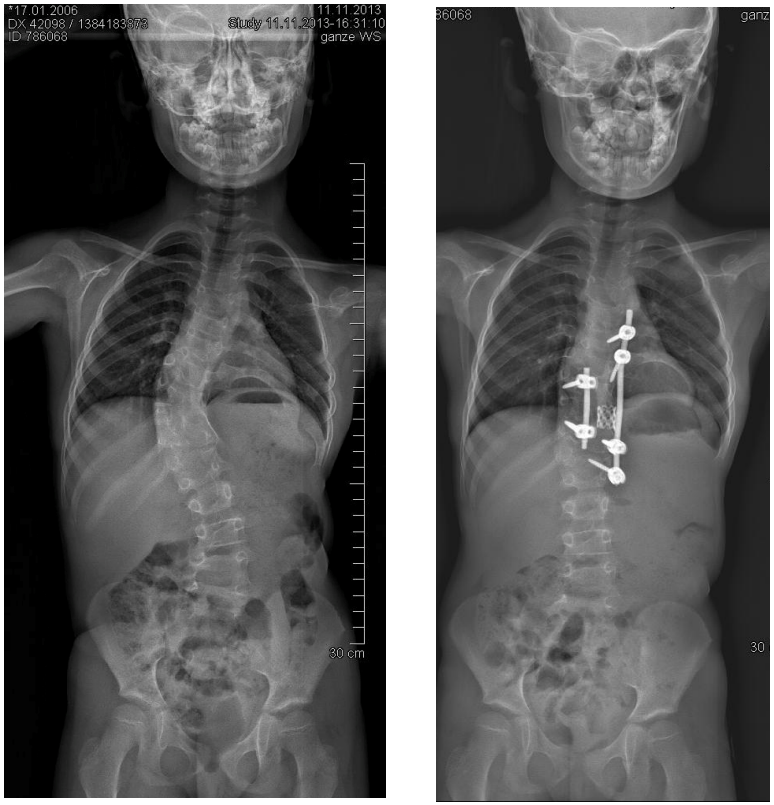
Up to date treatment in growing spine

- Nonoperative EOS
  - Casting
  - Bracing
  - Observation



Vertebral column lengthening with open wedge osteotomy in congenital bars

- Operative EOS
  - **Distraction based**
    - Growing rod (internal or external)
    - VEPTR
    - Magec & Phenix
  - **Guided Growth**
    - Luque trolley
    - Shilla
  - **Compression Based**
    - Staples
    - Tether /Screws/bands/

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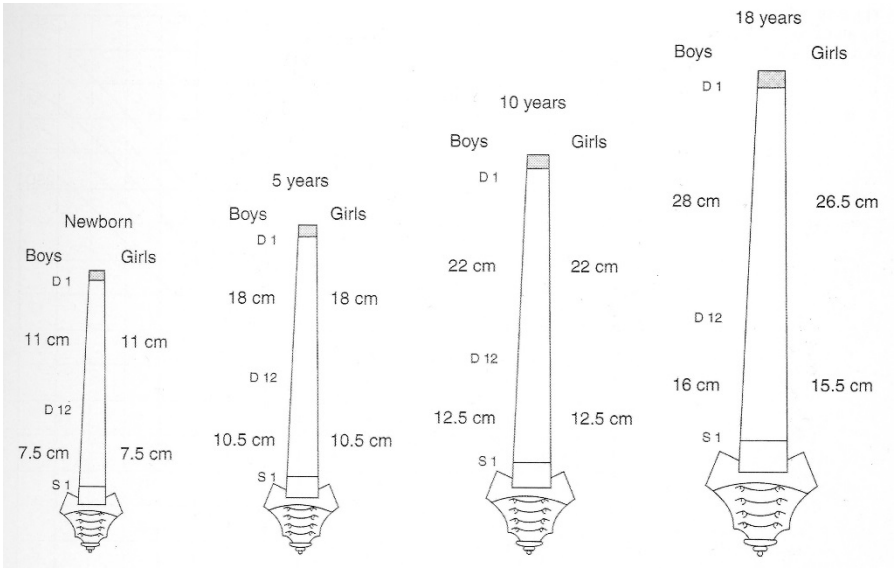
Indications for surgery

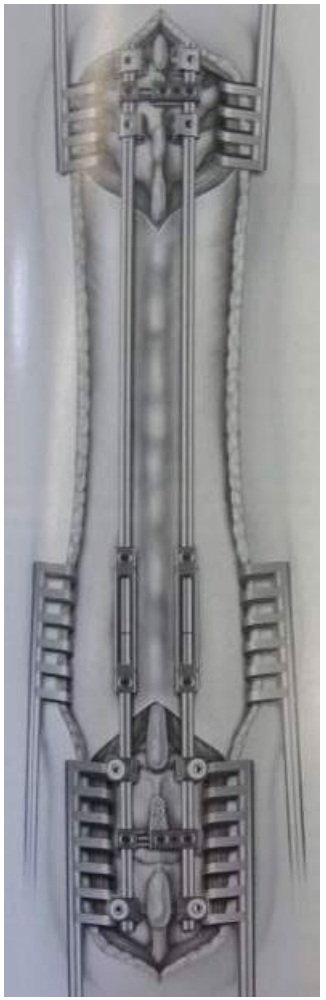
- EOS
  - Cobb angle > 25°
  - RVAD < 20° (only for IIS !)
  - Failure of brace/casting treatment
  - Documented progression
  - Prediction of further curve progression?
  - Classification?

  - INDIVIDUAL
  - Depends from a lot of criteria



Surgical techniques

- In situ fusion
  - Anterior
  - Posterior
  - Combined
- Early correction with fusion
- Distraction based
- Compression based
- Guided Growth
- Osteotomies
- Vertebral column resection (VCR)

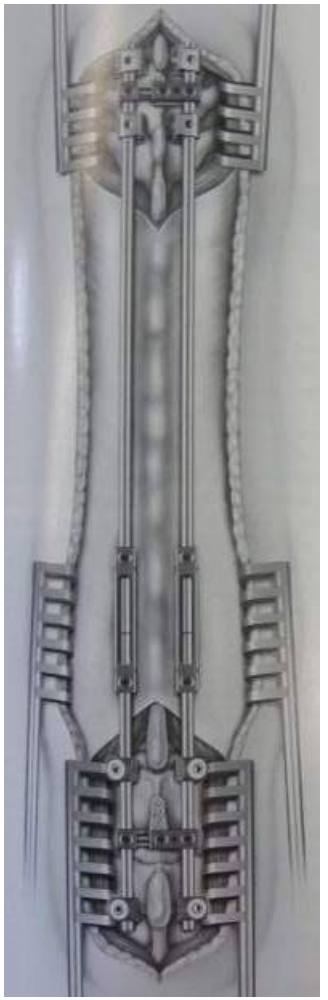


Surgical techniques

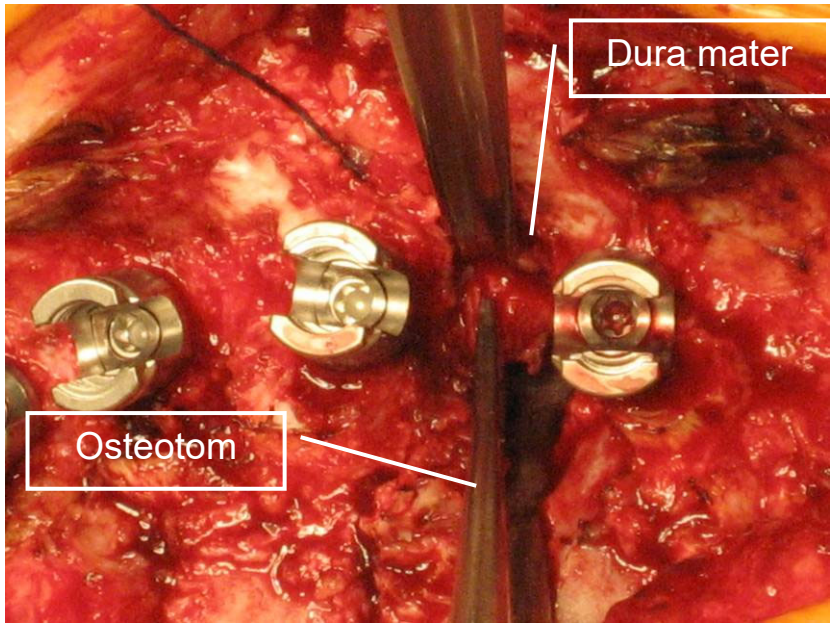
- In situ fusion
  - Anterior
  - Posterior
  - Combined
- Early correction with fusion

= not Growth Friendly!

- Distraction based
- Compression based ??
- Guided Growth ?
- Osteotomies ?
  - With compression ?
  - With distraction
- Vertebral column resection (VCR) ??



Osteotomy

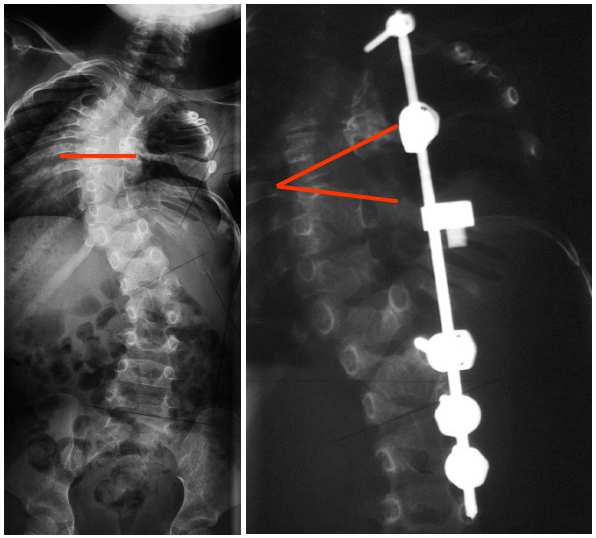


- With compression ?
  - Secure
  - Shortening
- With distraction
  - How long of construct do we need?
  - How big a distraction?
  - Short as possible?
  - One side or both side?
  - How can we do a safe surgery?
  - Can we later shortened the implants construct?
  - Can we managed with less distraction?
  - How can I expand the thorax with less instrumentation?

Why do an opening wedge?
Rational and **consequences** :

Normal

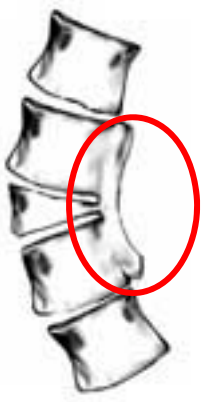
Short



- If failure of segmentation / formation occurs, the growth of the unsegmented side is inhibited – BAR FORMATION
- The spine & chest wall is SHORTER on the side of the bar
  - You need lengthening: as early as possible, so that all the intact spinal regions can grow normally
  - You need expansion: plasticity of chest wall of the younger children is high
- The contralateral side is near normal regarding length
  - We can use it as an indicator how much to open the wedge and distract: simply follow the „normal“ side – also if a growing construct is used

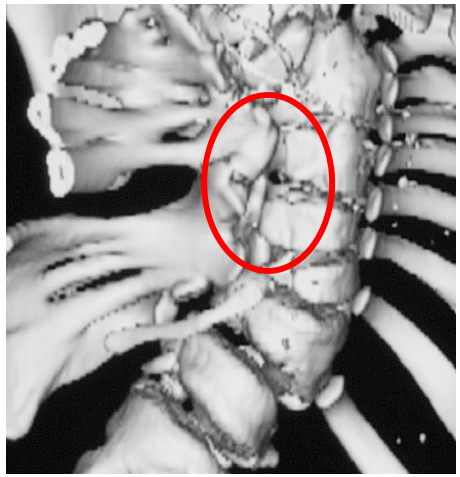
Why do an opening wedge?
Rational and **consequences** :

N o r m a l



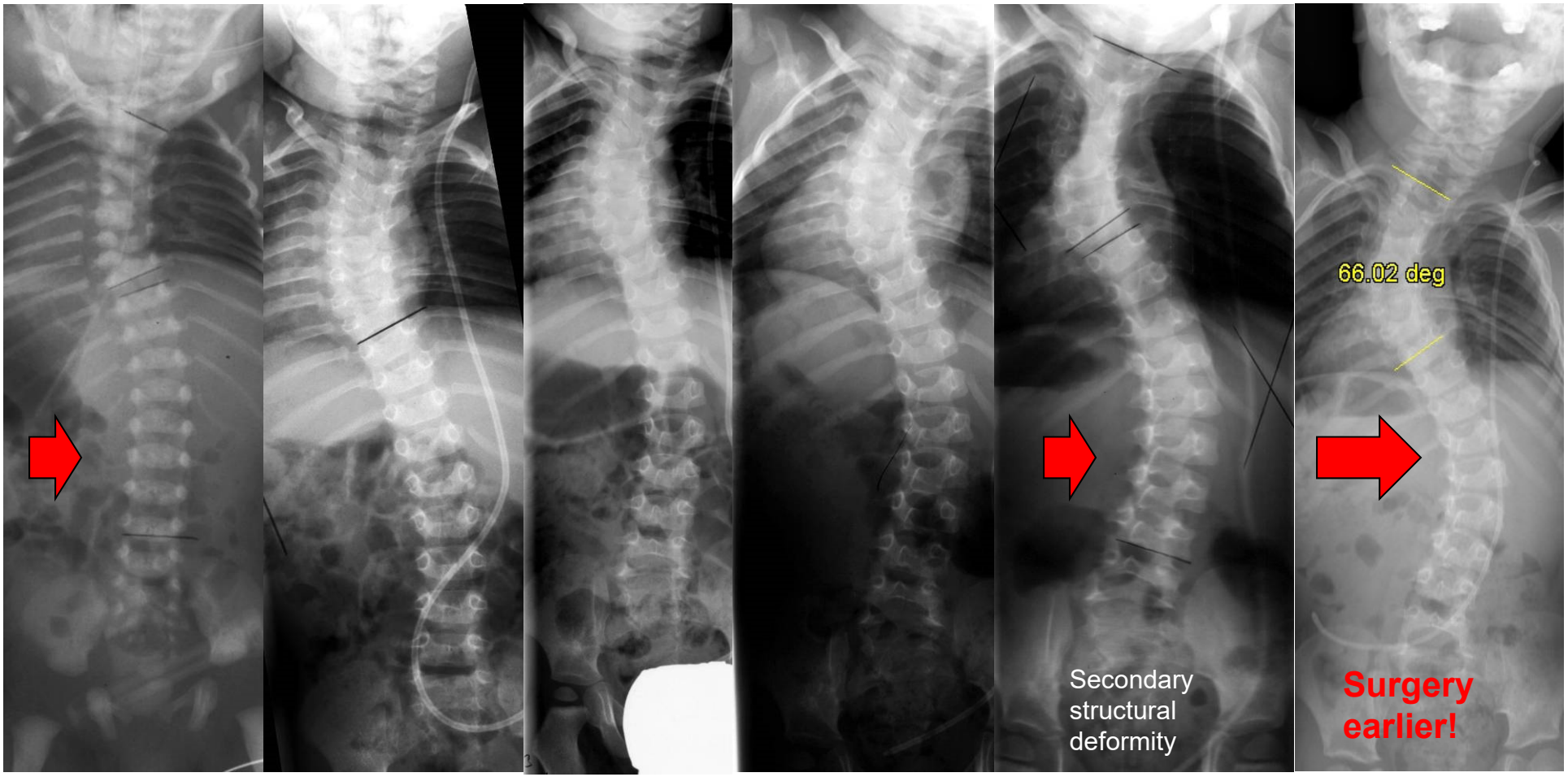
S h o r t

safe zone

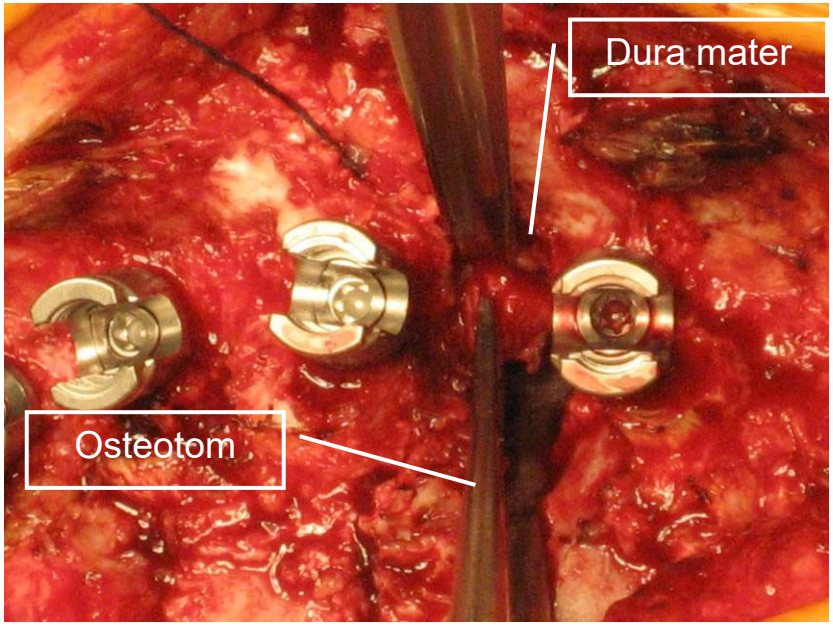


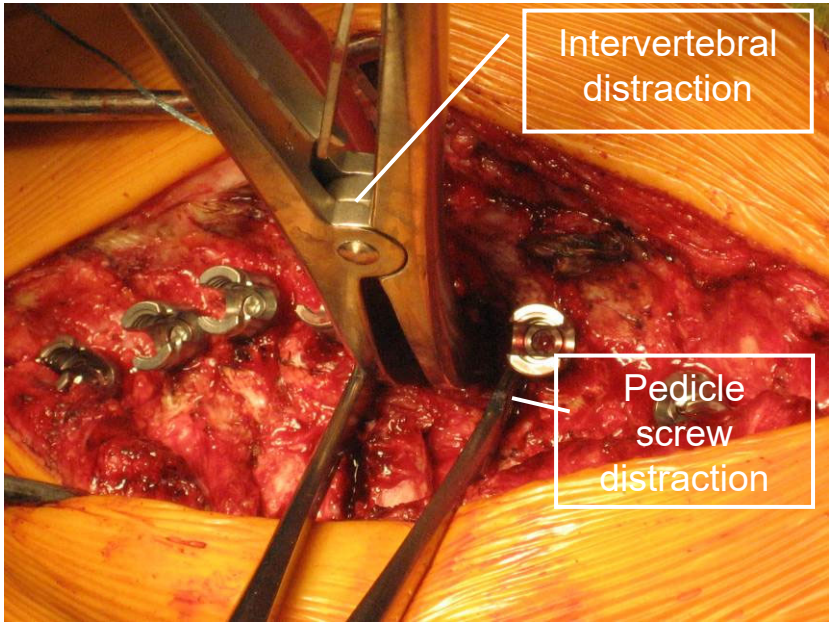
- No anatomical structures (like nerves or vessels) at risk in the bar region
  - This allows the surgeon to perform an osteotomy in a safe zone
- The bar shifts from anterior to posterior during development “moves backward” or “migrates”: (the anterior column is transferred posteriorly or hypo plastic!)
  - The surgeon can easily perform the osteotomy from a posterior approach to an anterior approach
  - and safely open the wedge between the stable bony structures
  - It is possible to keep the growing instrument shorter (we can save the developed spine areas from surgery!)

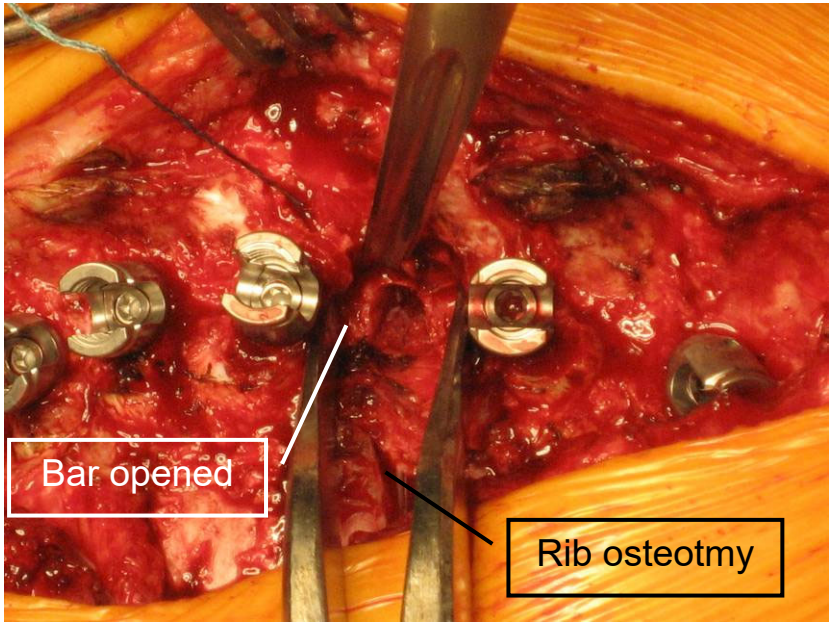
Case 1

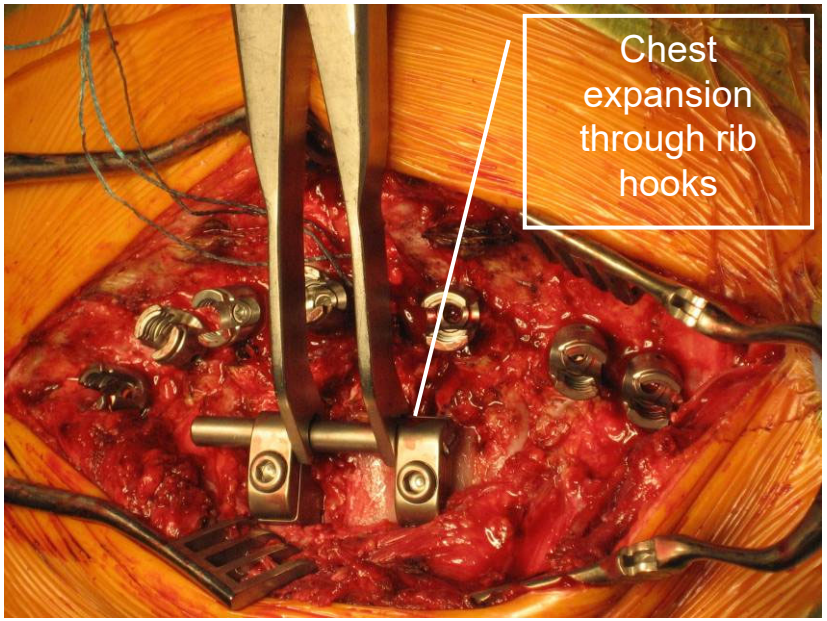


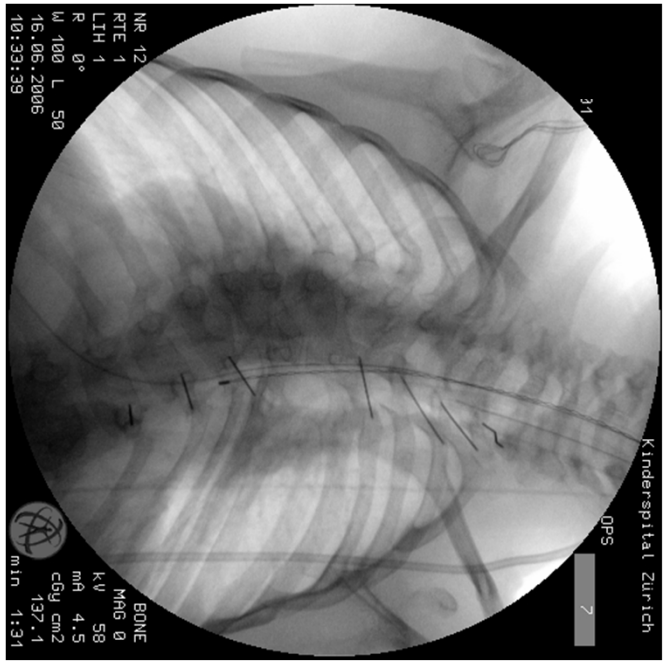
1 day | 1 year | 2 years | 3 years | 4 years | 5 years

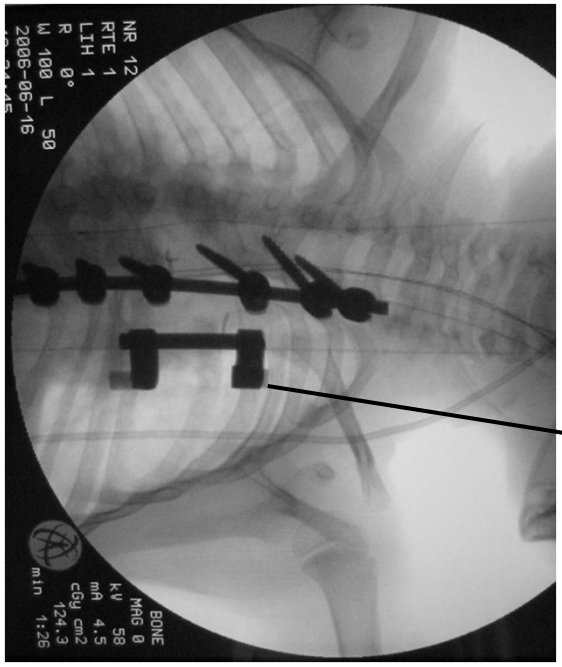

Dura mater
Osteotom


Intervertebral distraction
Pedicle screw distraction

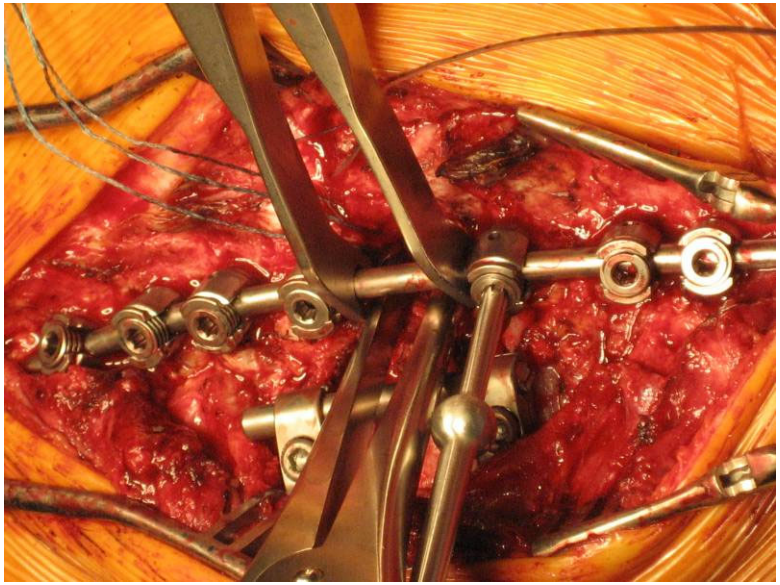

Bar opened
Rib osteotmy


Chest expansion through rib hooks

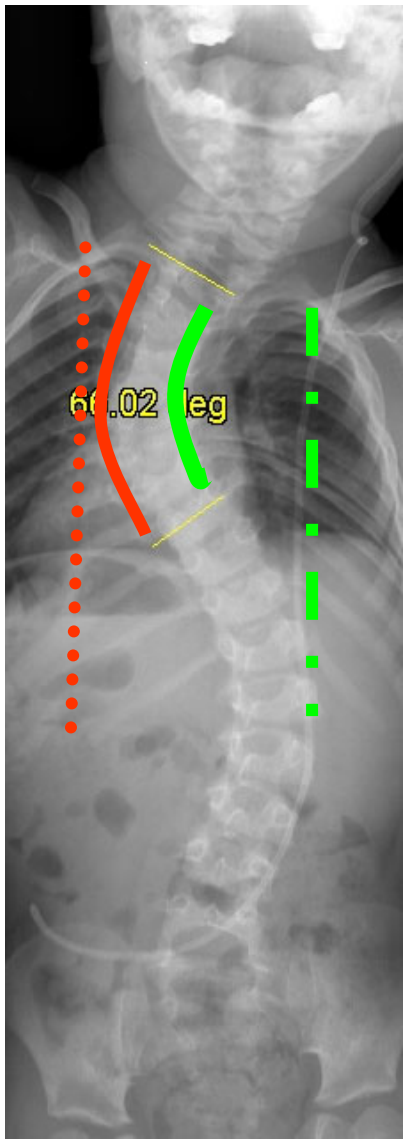




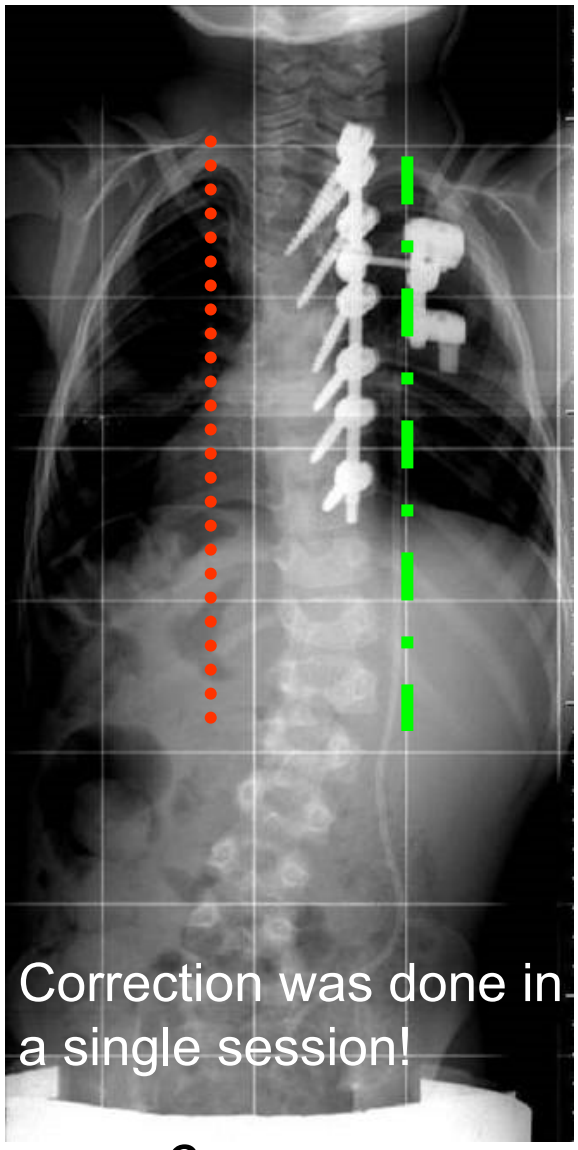
Chest expansion through rib hooks



Reversal of progression

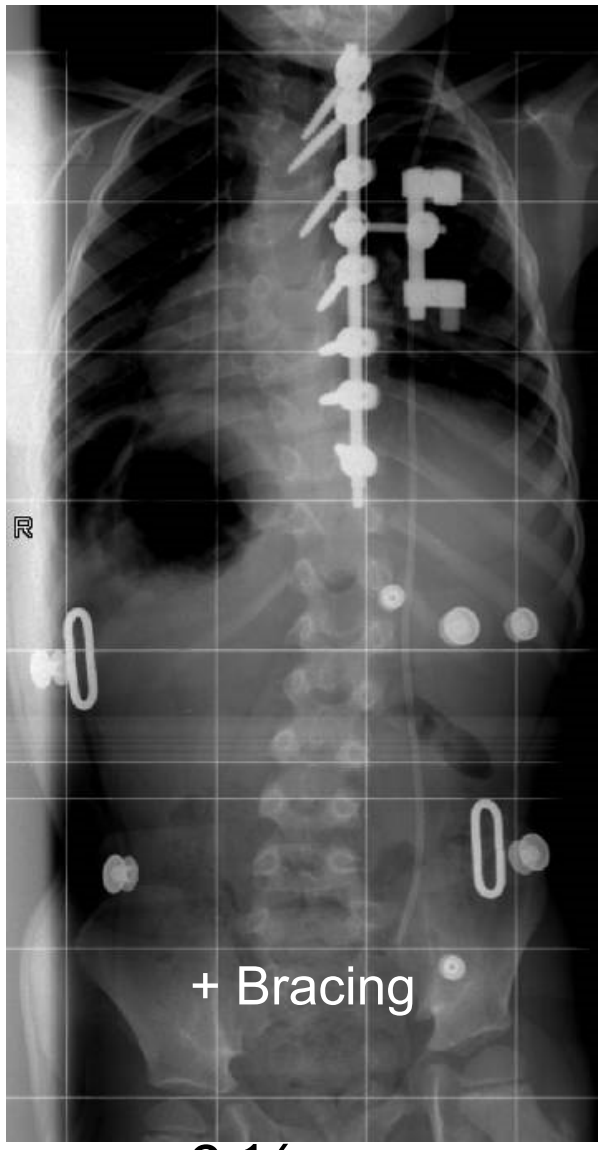


5 yrs



6 yrs

Thoracic high



6 ½ yrs

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Methods

Surgical technique:

- posterior approach
- Careful periosteal preparation of surgical site to avoid unwanted fusion (scalpel and bipolar forceps!)
- concave side exposure of the bar to the anterior aspect
- near circumferential osteotomy around the dural sac
- opening up of the osteotomized segment to correct the curve by distraction under continuous intraoperative spinal cord monitoring
- stabilization without fusion on one side only using pedicle screws, rods and special (low profile) rib hooks

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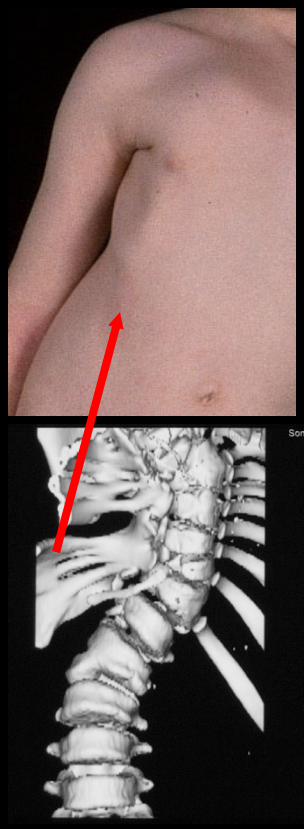
Case 2



Immediate postoperative images:

note the improved spinal balance and the improved chest configuration

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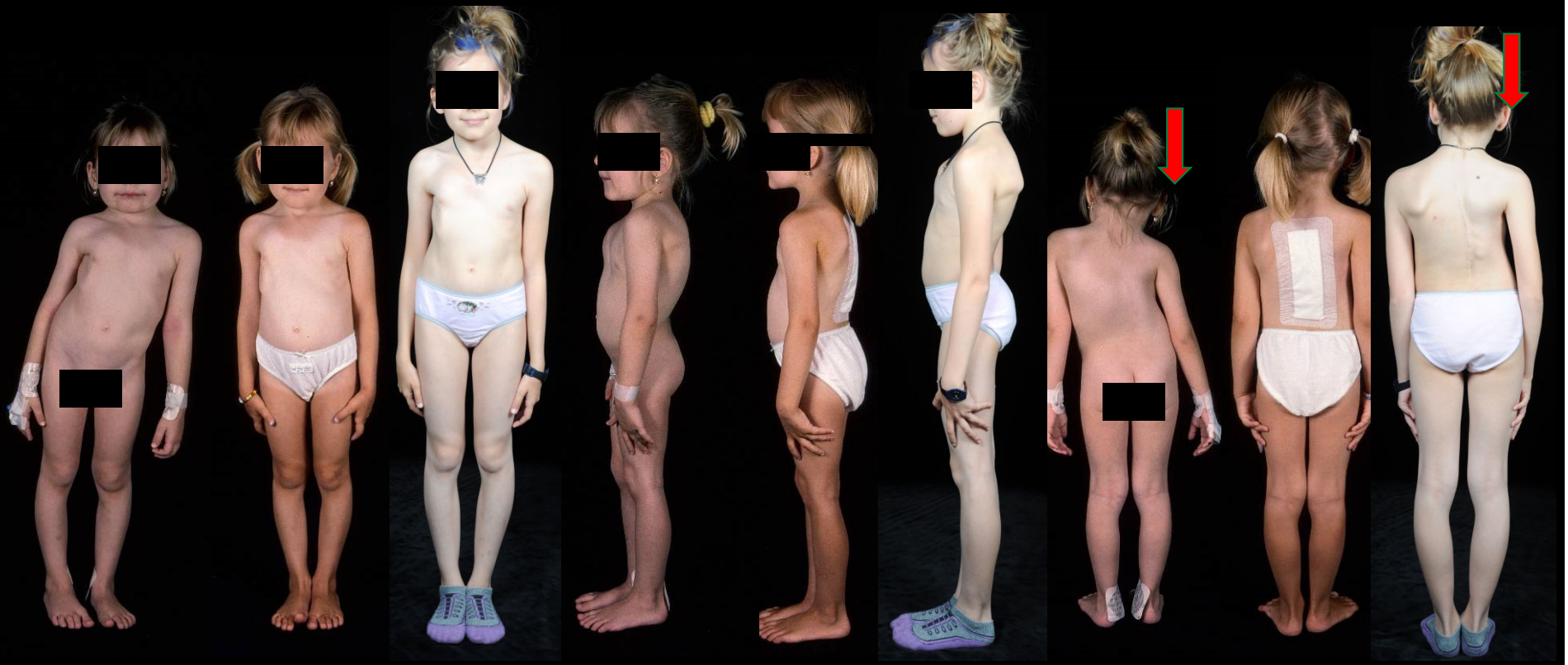
Case 2



The improved spinal balance and chest configuration remained stable. Clinical pictures of the **7 years follow up**

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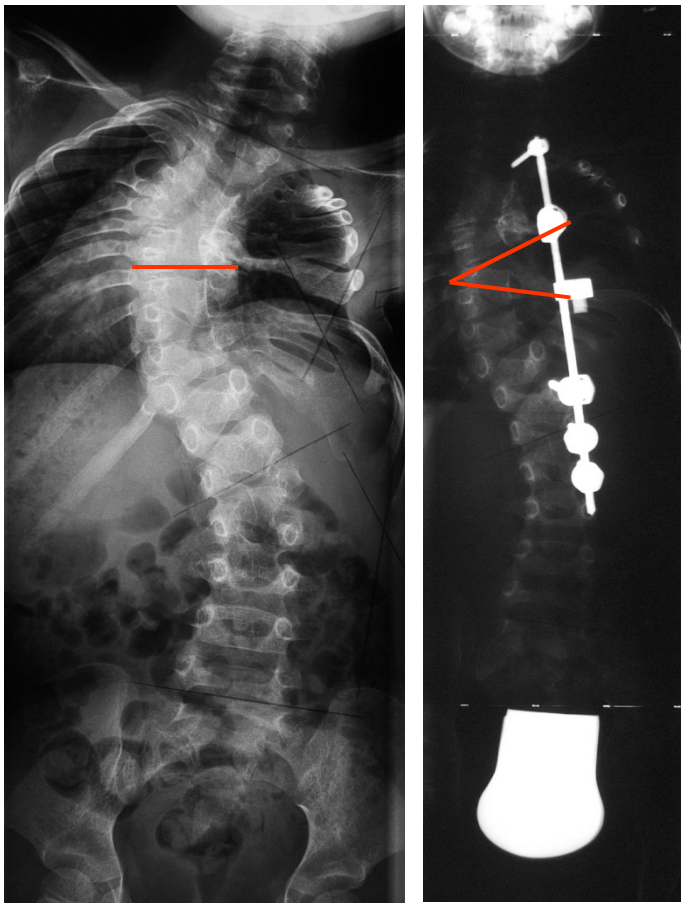
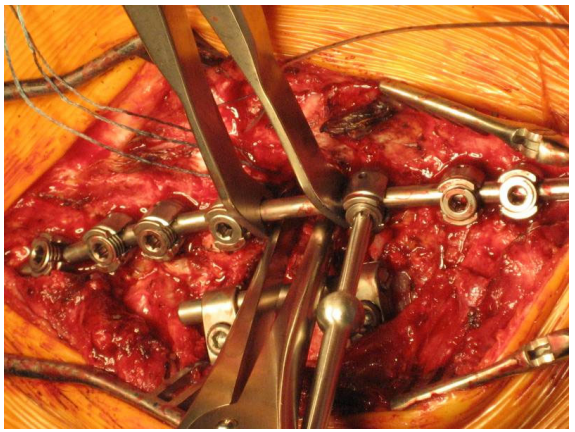
Results

- Correction measured in degrees is not relevant!
- Multimodal monitoring of the spinal cord during surgery revealed in two cases potential damage of the spinal cord immediately after the correction; the final correction was delayed in both cases for one week
- Ultimately, no postoperative neurological complications were detected
- Screw breakage and loosening in 3 patients



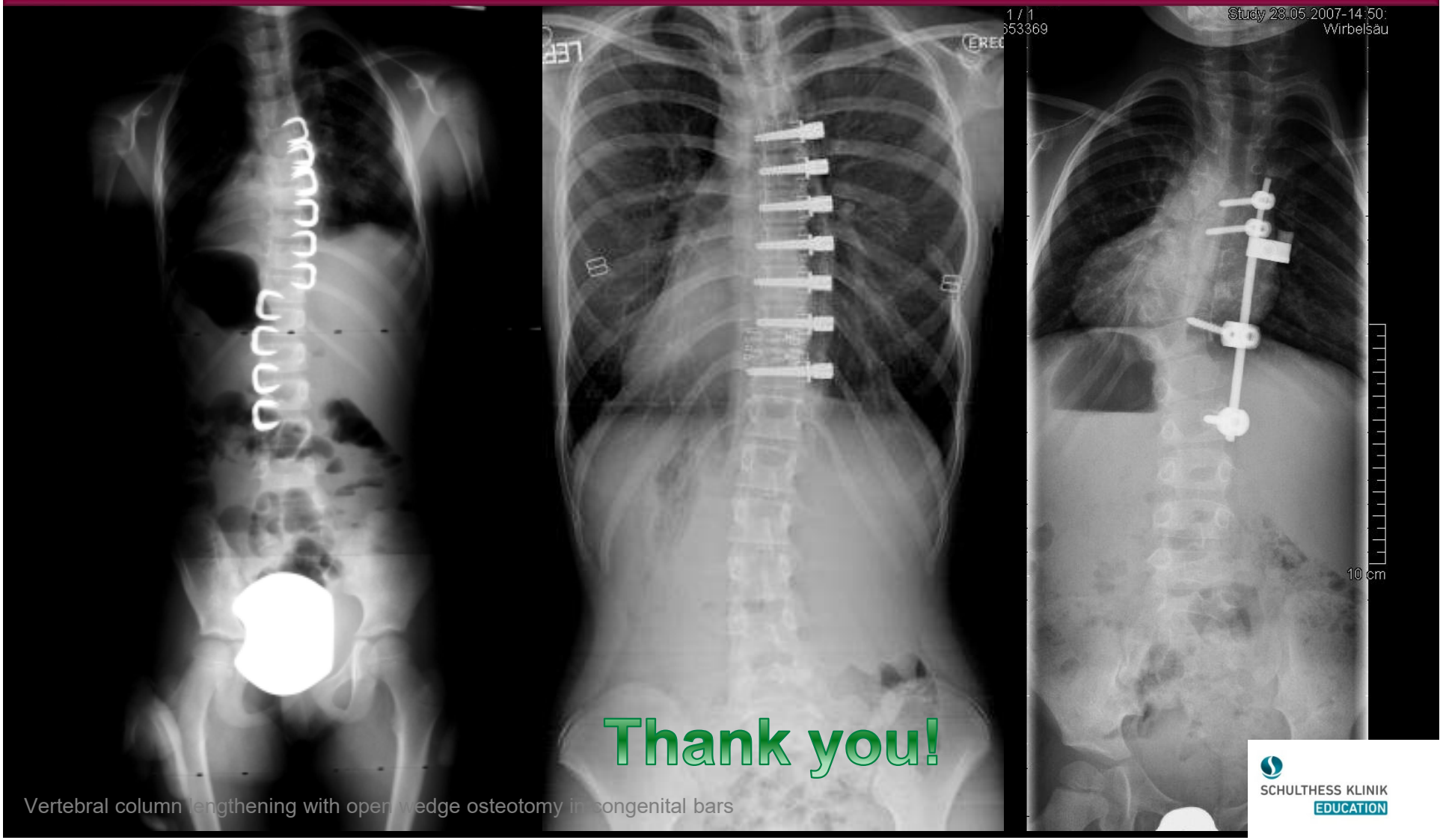
Name	Age yrs	sex	N° of instr levels	N° of distract	Halo-traction	Complications	F-up yrs
ML	4.5	F	T2 – L3	8	no	no	16
PE	3.5	F	T1 – L2	8	no	Screw loosening	10
ZsM	2.5	M	T5 – L1	3	no	Intaop neurol – postponed surg Screw loosening	8
KN	5	M	T2 – T11	5	no	Intaop neurol – postponed surg	7
PM	3.5	M	T1 – L1	4	yes	Screw breakage – no consequences	5.5
SJ	3.5	F	T1 – T9	2	no	no	3.5
DG	5.5	M	T1 – T5	1	no	Postop dysbalance, hence 2nd suregery	2.5
MT	5	F	T7 – L1	0	no	no	1 mths

Conclusions



- Spinal opening-wedge osteotomy is an effective surgical technique for the correction of congenital scoliosis
- Surgery is performed only at the most affected region of the spine. All other regions (secondary curves, convex side) of the spine are left intact if possible
- Careful periosteal preparation of surgical site to avoid unwanted fusion (Fusionless surgery!)
- The goal of surgery is to achieve the greatest correction possible at this site
- Try to do your correction in the fused spine section!
- The surgery should be performed as early as possible, so that all the intact spinal regions can grow normally. Timing! Prevention!
- The use of intraoperative spinal cord monitoring is essential

Less fusion & fusionless surgery is now & in the future!



Vertebral column lengthening with open wedge osteotomy in congenital bars

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