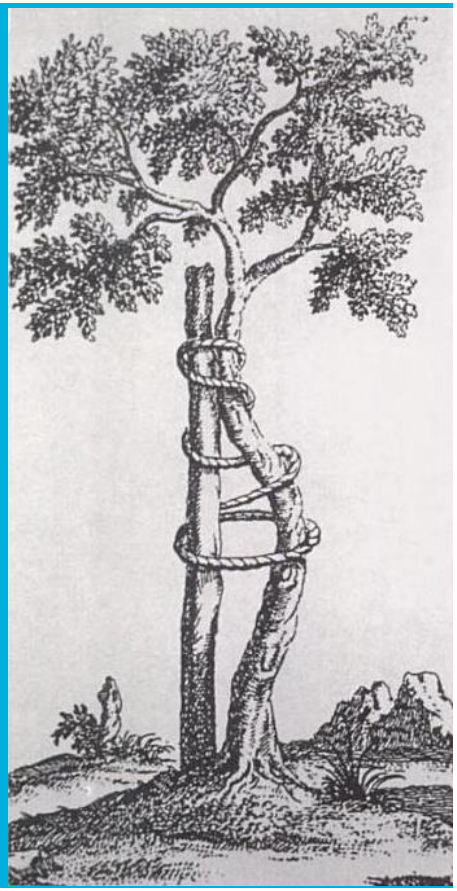
Anaesthesia for paediatric orthopaedic procedures



BAPA-SKA Refresher Course 2019 Tilburg

Mark Hendriks
Nijmegen

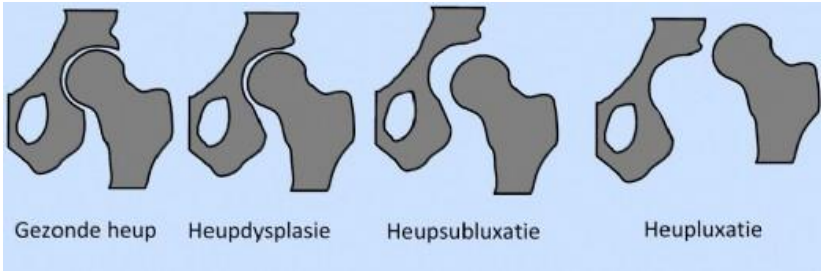
Radboudumc

Topics

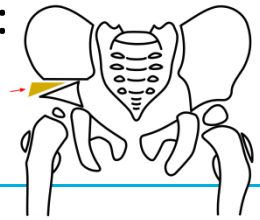
- Hip surgery
- Scoliosis surgery

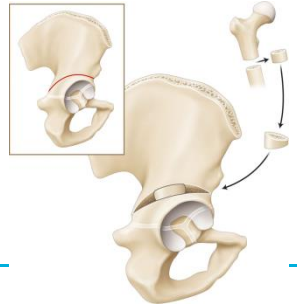
- Bone tumor surgery
- Patellar surgery
- Musculoskeletal infection
- Fractures

Developmental dysplasia hip



- Incidence 1-7% of newborns
- Spectrum:
- Conservative treatment:
  - Flexion-abduction
  - Pavlik Harness-> Camp spreading orthosis
- Luxation of hip:
  - Closed reduction and spica cast in anesthesia
  - Failure/late presentation:
    - From 6 month: surgical reduction and cast
    - ~ 18 month: Surgical reduction and pelvic (+/-femoral) osteotomy and cast
- Osteotomy: Salter: Dega:

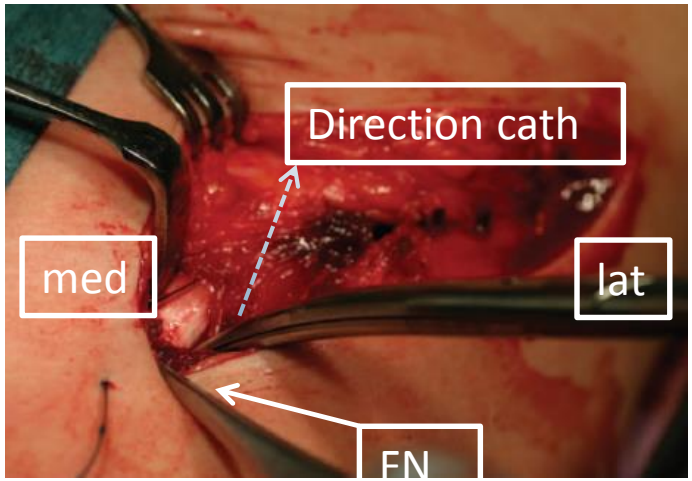




CO pediatrics 2018; 30:1. J Am Acad Orthop Surg 2016;24: 615-624.
Orthopaedics & Traumatology: Surgery & Research 104 (2018) S147–S157

analgesia for unilateral pelvic and femoral osteotomy

- Incisional continuous fascia iliaca block v.s. continuous iv morphine
- 28 children aged 3 yr for Salter pelvic osteotomy
- Catheter threaded cranially along femoral nerve by orthopedic surgeon
- Randomisation and blinding
  - Ropivacaine 2 mg/ml 0.1 ml/kg/hr
  - Morphine 20 mcg/kg/hr iv
- Outcomes:
  - Group R:
    - no morphine necessary, less sedated
    - Earlier solid food (5 vs 15 hr postop)
  - Urinary retention R: 5% M: 40%
- standard approach for salter osteotomy+/-femoral osteotomy
  - 5%: femoral nerve not successfully approached (revision cases)
  - Dega osteotomy: probably no acces to femoral nerve.



Anesth Analg 2009;109:1799 –803

analgesia for unilateral pelvic and femoral osteotomy

- Continuous epidural or psoas compartment block in children[1]
  - 40 children 1-12 yrs , neurostimulator for PCB
  - Randomised and blinded
  - Comparable groups
  - Less failure in PCB group:
    - Early stop in 5/20 epidural pts
    - Catheter occlusion: 2
    - Urinary retention: 3

- PCB is an advanced block with possibly higher rate of complications

	Groupe APD	Groupe BCCP
Données démographiques		
Âge (années)	6 (1–11)	6 (1–12)
Sexe (M/F)	6/13	9/11
Poids (kg)	21,5 (9–59)	21 (10–49)
Score ASA (I/II)	17/2	16/4
Type de chirurgie		
Ostéotomies de bassin	16	14
Ostéotomies du fémur	2	2
Ostéotomies de bassin+fémur	1	4
Durée de la chirurgie (min)	135 (80–215)	150 (50–224)

Les données sont exprimées en médiane (extrêmes) ou en nombre pour le sexe ratio, les scores ASA et le type de chirurgie.

Effets indésirables notés lors des 48 premières heures postopératoires pour les deux techniques d'ALR.

	APD *n* (%)	BCCP *n* (%)	*p*
Patient présentant au moins un effet adverse	17 (89,4)	11 (55)	0,03
Nausées/vomissements	14 (73,6)	11 (55)	NS
Rétention urinaire	10 (52,6)	5 (25)	NS
Prurit	0	2 (10)	NS
Arrêt prématuré	5 (26,3)	0	0,02
Cathéter occlus	2	0	
Rétention urinaire répétée	3	0	

[1]C. Dadure et al. / AFAR 29 (2010) 610–615.

Single shot PCB vs caudal

- Ropivacaine 2,5 mg/ml epi 5 mcg/ml
  - 1 ml/kg
  - PCB: neurstimulator as Dadure
- First morphine dose
  - C/PCB: 6.7vs 14.5 hr
- Total morphine 24 hr:
  - C/PCB: 0.4 vs 0.2 mg/kg
- Urinary retention:
  - C/PCB: 30% vs 5 %

- Of note: PCB is an advanced technique Experience!

	Group C (n = 20)	Group P (n = 20)
Age, mean (SD), y	3 (1.3)	2.7 (1.4)
Sex, n (male/female)	7/13	8/12
Body mass index, mean (SD), kg/m^2	24.9 (3.2)	24.6 (3)
ASA, n (I/II)	9/11	8/12
Duration of surgery, mean (SD), min	114 (15.4)	112.3 (16.7)
Type of osteotomy, n		
Periacetabular	11	10
Proximal femur	5	4
Combined	4	6
Duration of anesthesia, mean (SD), min	144 (18.1)	139 (17.6)
Duration of block performance, mean (SD), min	6.6 (1.2)	7.4 (1.6)

	Group C (n = 20)	Group P (n = 20)
Intraoperative fentanyl, median (range), µg/kg	2 (2–3)	2 (2–3)
Patients needed supplemental fentanyl, n (%)	4 (20)	6 (30)
Time to first morphine dose, median (range), hrs	6.7 (4.9–9.3)	14.5 (11.8–19)*
Total morphine dose in first postoperative 24 hrs, mean (SD), mg/kg	0.41 (0.07)	0.19 (0.05)†

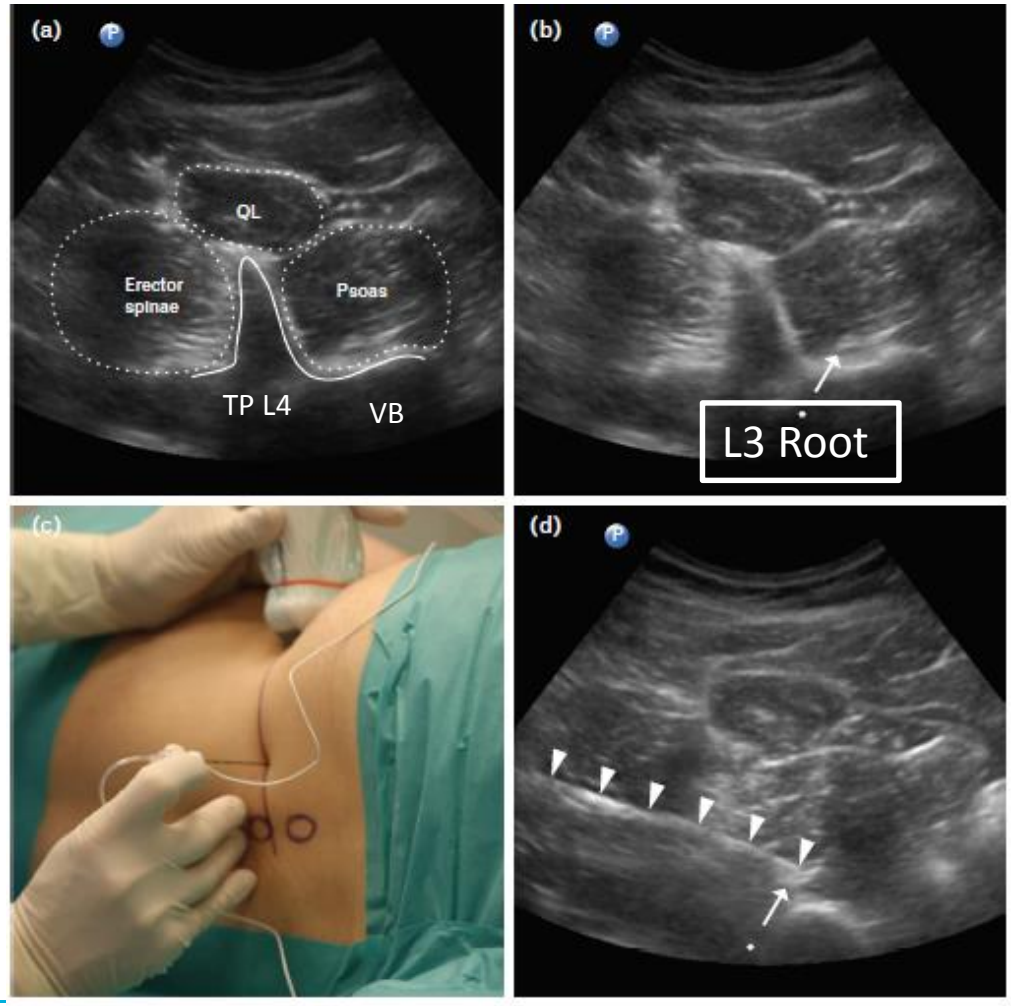
Omar et al. RAPM Volume 36, Number 2, March-April 2011

Radboudumc

The shamrock lumbar plexus block

- Adults

- Passing caudal to the L4 Transverse Process
- Neurostimulator to reduce possibility of intraneural injection
- High plasma levels
- Intravascular injection still possible!

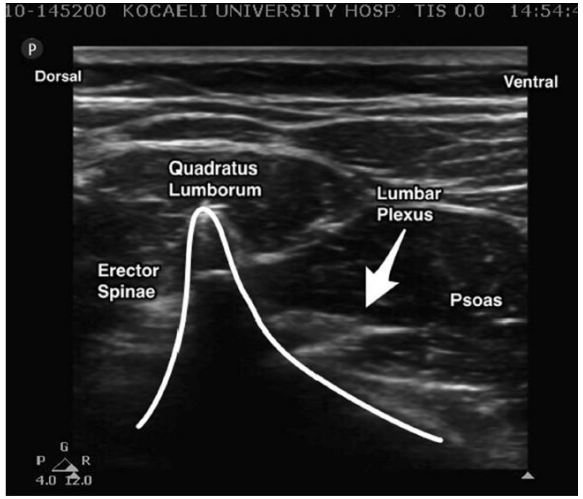


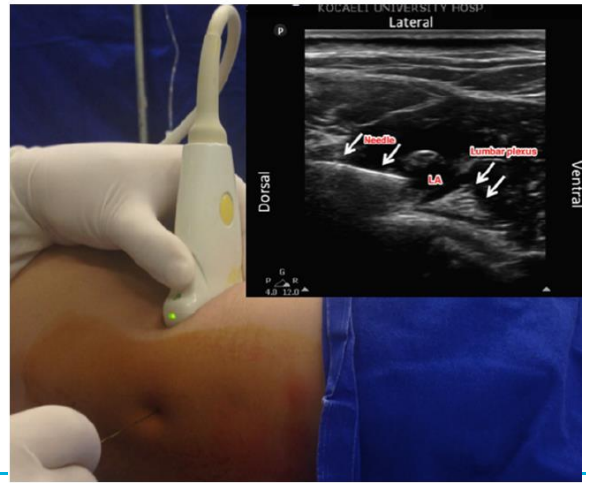
Eur J Anaesthesiol 2015; 32:764–770

Radboudumc

USG lumbar plexus block in children

- 75 children 1-6 yr for hip surgery
- Shamrock orientation
- neurostimulator
- Single shot bupivacaine 2,5 mg/ml 1 ml/kg
- Max 20 ml
- Cheops> 3: Paracetamol IV after 10 hr (mean)
- Only 1 needed morphine immediately in PACU





Gürkan et al. J Clin Monit Comput (2017) 31:331–336

Radboudumc

USG lumbar plexus block in children

- Major hip surgery
- Sauter/Shamrock approach
- 21 Children 6-18 yr
- Neurostimulator
- 0.5 ml/kg ropivacaine 2 mg/ml
- Max 40 ml
- Catheter with ropivacaine
- 20/21 block of FN and LFCN
- No sciatic block
- Morphine equiv. mg/kg intraop/pacu/0-12 hr/12-14 hr:
  0.17/0.08/ 0.06 /0.06
- Good pain relief immediately postoperatively exept for 1 without block

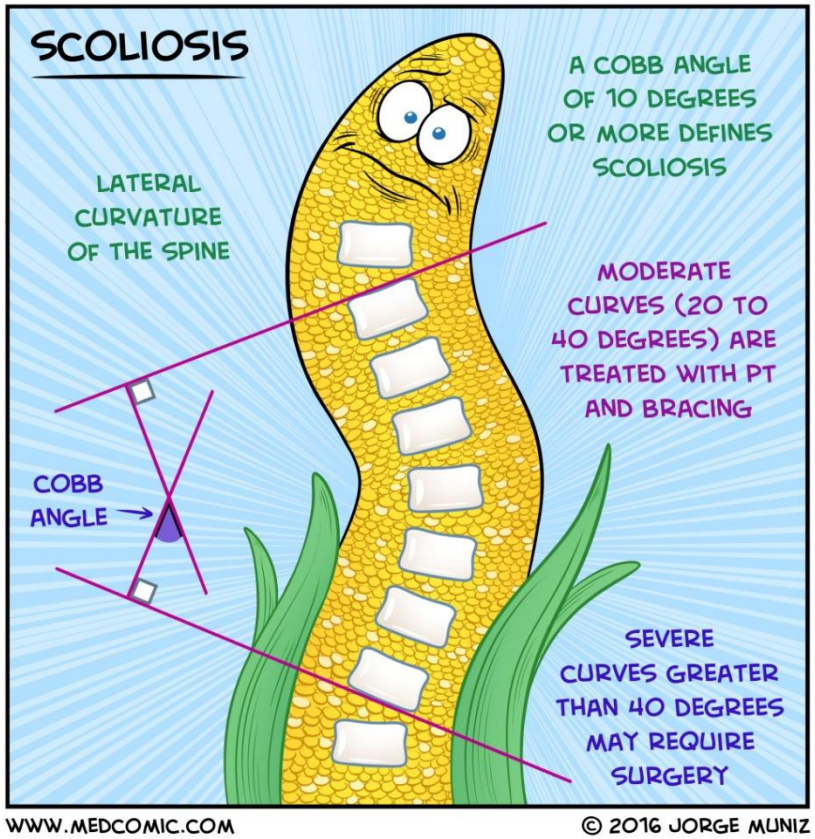
Boretsky et Al. Pediatric Anesthesia. 2018;1–5.

Radboudumc

If your institution does DDH repair

- Salter osteotomy for unilateral DDH repair: what is your postoperative pain strategy?
  - Epidural catheter
  - Single shot caudal with local anesthetic and clonidine
  - Lumbar Plexus block USG
  - Morphine

Scoliosis


SCOLIOSIS
A COBB ANGLE OF 10 DEGREES OR MORE DEFINES SCOLIOSIS
LATERAL CURVATURE OF THE SPINE
MODERATE CURVES (20 TO 40 DEGREES) ARE TREATED WITH PT AND BRACING
COBB ANGLE
SEVERE CURVES GREATER THAN 40 DEGREES MAY REQUIRE SURGERY
WWW.MEDCOMIC.COM
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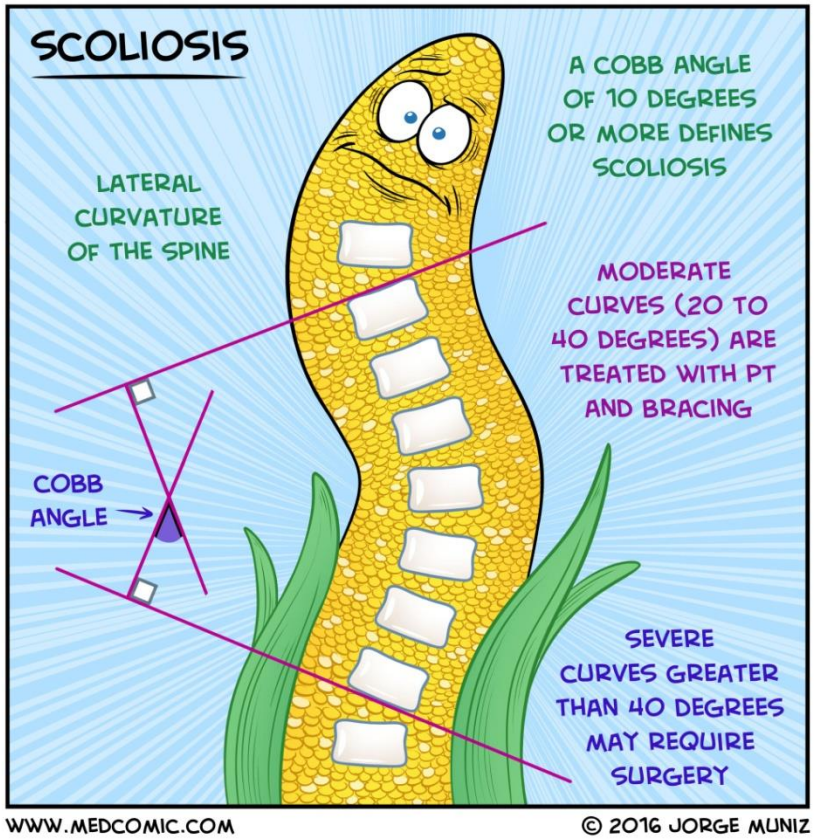
Scoliosis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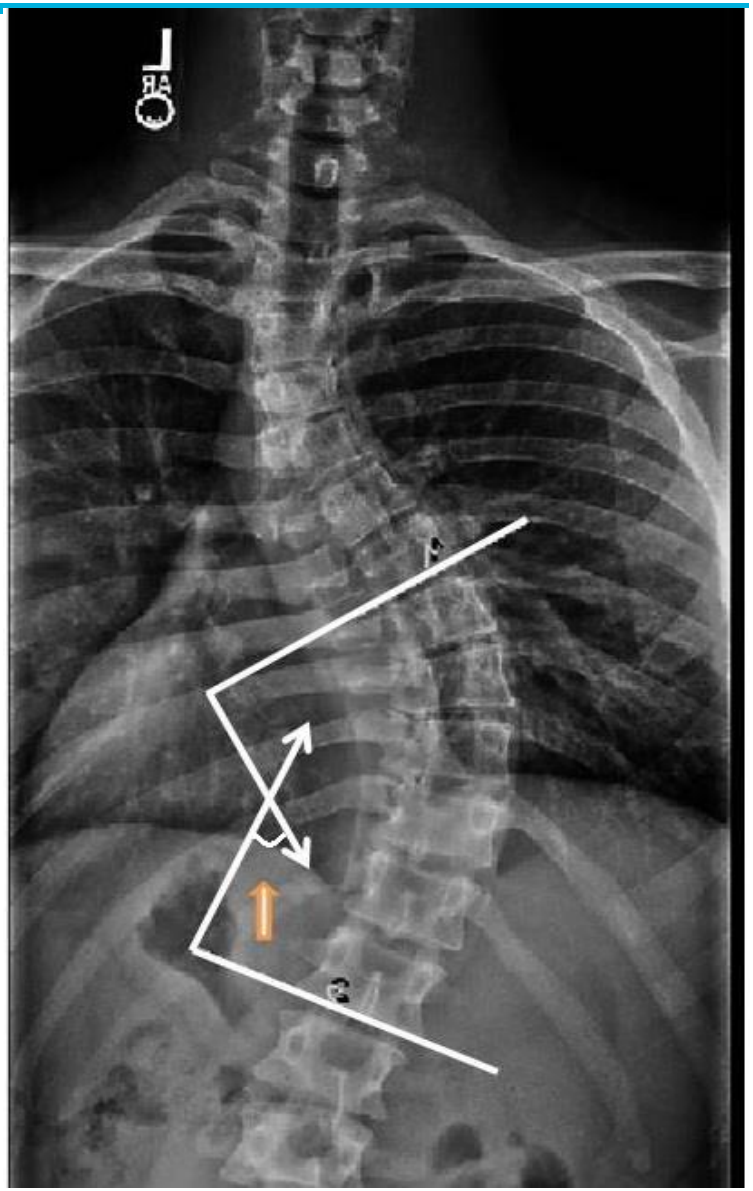
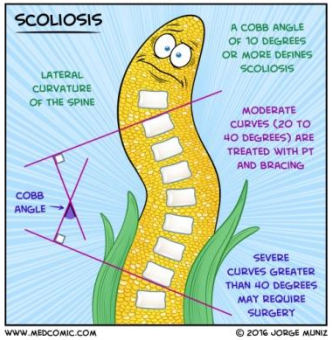


Scoliosis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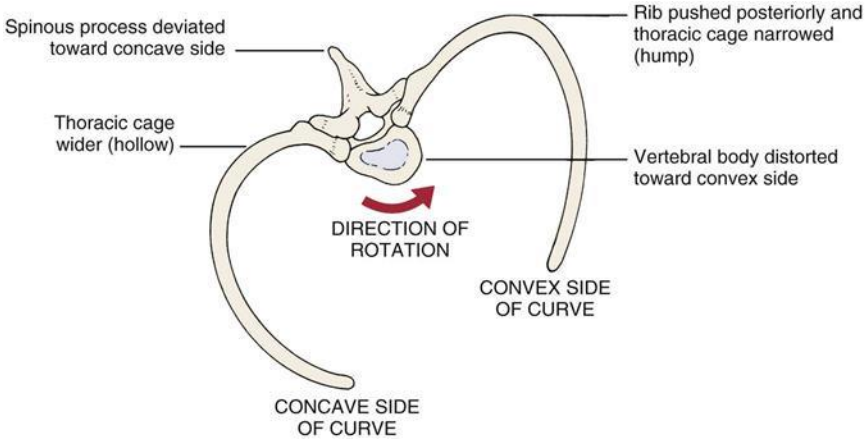
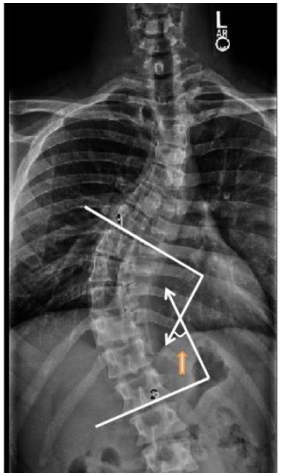

Spinous process deviated toward concave side
Rib pushed posteriorly and thoracic cage narrowed (hump)
Thoracic cage wider (hollow)
Vertebral body distorted toward convex side
DIRECTION OF ROTATION
CONVEX SIDE OF CURVE
CONCAVE SIDE OF CURVE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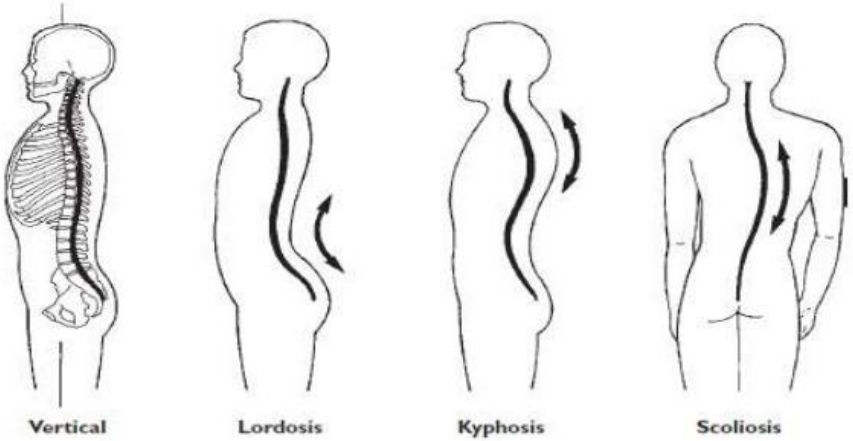
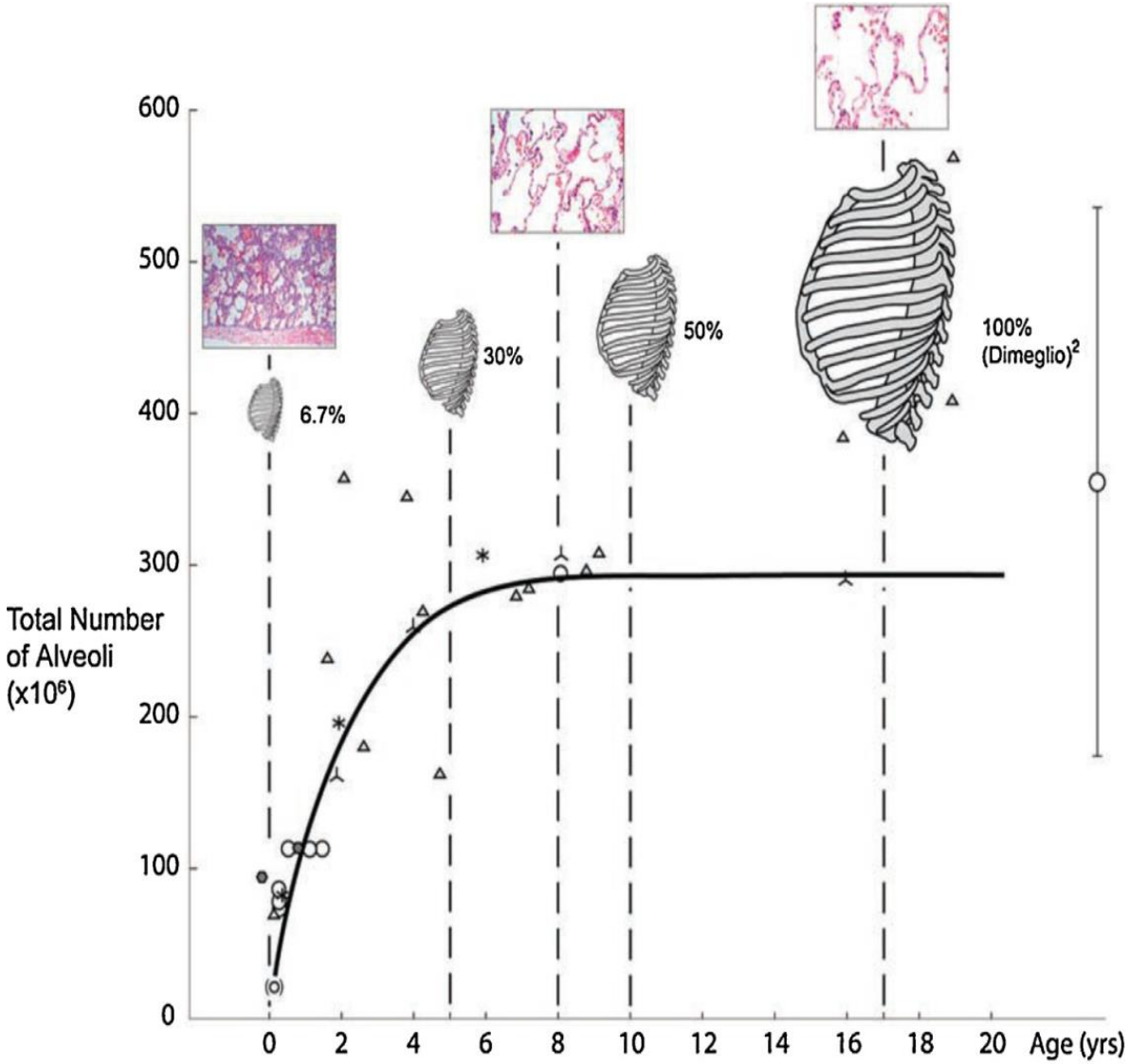

Vertical
Lordosis
Kyphosis
Scoliosis

Spinal developement

- T1-S1 length:
  - 0-5 yrs: 2 cm/yr
  - 5-10 yrs: 1 cm/yr
  - >10 yrs: 2 cm/yr

- Alveolar number
  - Max at 8 yr
- Thoracic cage volume
  - Age 10: 50%
  - Age 17: 100%
- df



J Bone Joint Surg Am 2007;89(Suppl 1):108–22.

Radboudumc

Scoliosis classification to etiology

- Idiopathic
  - Infantile <4 yr: 1%
  - Juvenile 4-9: 12 %
  - Adolescent >10: 87%
- Congenital
  - Bony abnormalities: limited to very severe
  - Neural tube defects
- Neuromuscular
  - Motor neuron: *upper: Cerebral Palsy
    *lower: Spinal Muscle Atrophy
  - Muscular: e.g Duchenne,
- Neurofibromatosis
- Mesenchymal: Marfan, MPS, OI,
- Trauma/acquired/tumor

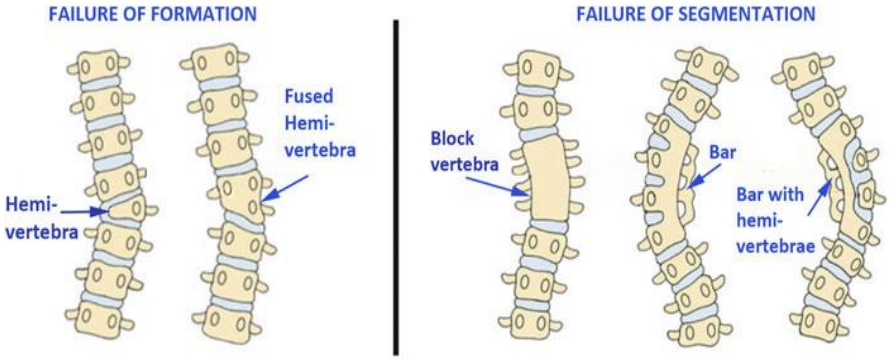
Scoliosis classification: to Age

- **< 10 yr**: Early Onset Scoliosis
  - Congenital
  - Idiopathic
    - Infant 0-3 yr
    - Juvenile 4-10 yr
  - Neuromuscular
  - Syndromal
- **> 10 yr**: Adolescent scoliosis
  - Congenital
  - Idiopathic (AIS) 85%
  - Neuromuscular (M. Duchenne)
  - Syndromal
  - Trauma
- **Adult** (degenerative)

-very rare
-management and timing depends of many factors
-surgery "experimental"
-high complication rate or failure

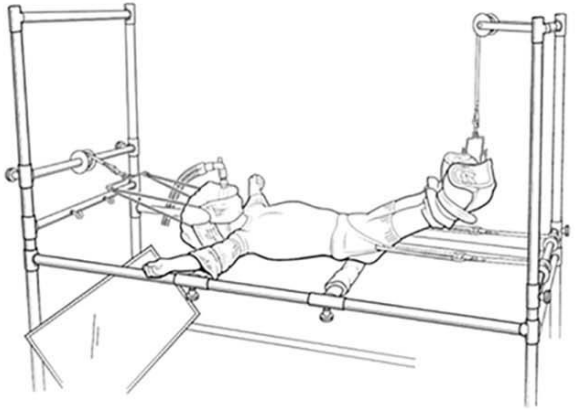
-less rare
-management more established
-surgery: Posterior Spinal Fusion

Early Onset Scoliosis



- Congenital
  - failure of formation/segmentation
    - Cardiac (10%) and urologic (25%) comorbidity (VACTRL)
    - Rib and chest wall malformations:
      - respiratory insuff and casting not usefull
  - Neural Tube Defects: Meningomyelocele etc
- Idiopathic
  - Infantile and juvenile
    - If>20° Check for underlying spinal condition
    - Eg Syrinx, Chiari
    - Spontaneous resolution possible (to 80 %)
    - Casting to avoid or delay surgery
- Neuromuscular
- Syndromal

Elongation-Derotation-Flexion treatment

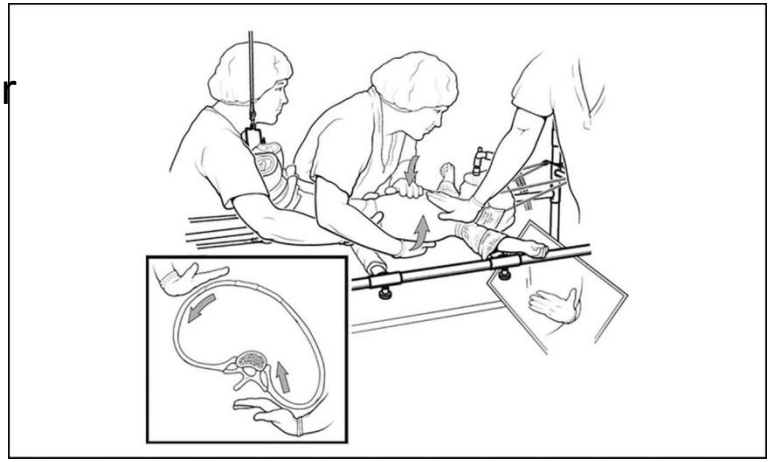


A

B

- Mainly abandoned after introduction Harrington rod

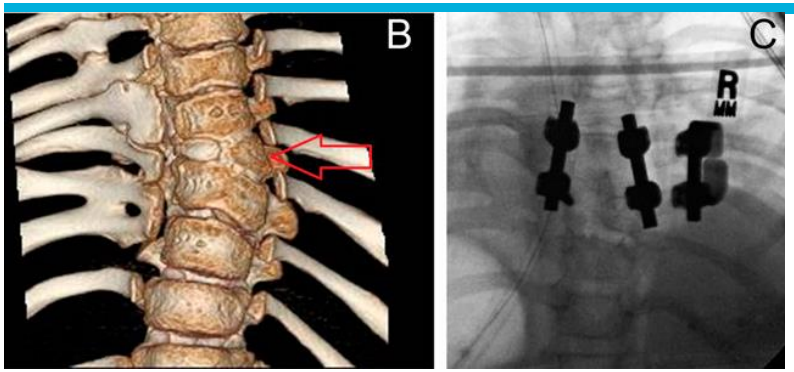
- Re-introduced for delaying surgery in EOS after disappointing long term results with early fusion
- Repeat every 2 months
- Usually with general anesthesia
- Guedel next to tube
- Cut out for abdominal distention/breathing



EOS

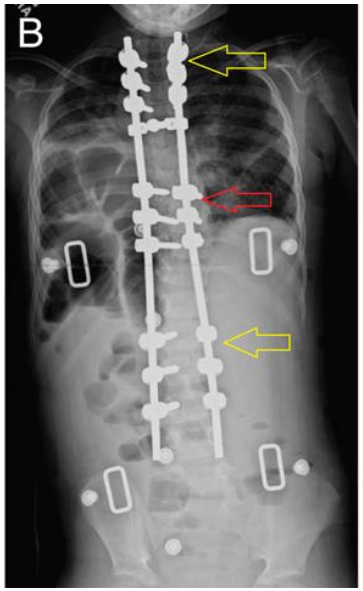
- If progression: Thoracic Insufficiency Syndrome
  - Double mortality rate at age 40
- BUT: avoid spinal fusion before 8 or 10 yr
  - if more than 60% of thoracic spine fused before 8 yr, the VC at skeletal mature age is only 40 % predicted
- Casting and bracing to delay surgical intervention
- Hemivertebrae: short segment resection and fixation
- Growth allowing surgery:
  - Growing Rods
    - Traditional: surgical opening for distraction every 4-6 months
    - Growth guiding: Shilla construction
    - Magnetically Controlled Growing Rod: distraction
  - VEPTR: extensive bony abnormalities and progression at young age
  - High incidence of device/technical complications (25-50%)

I.Helenius EFORT Open Rev 2018;3

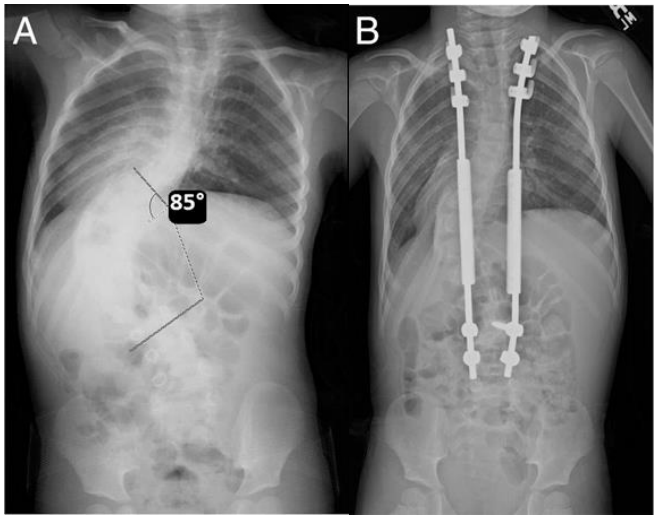


Hemivertebrae resection

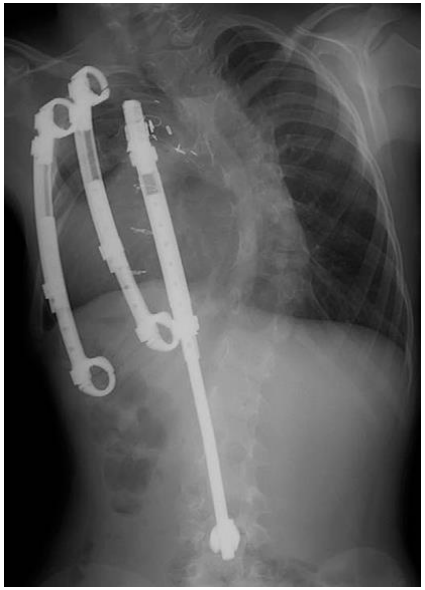
Surgery for EOS



Growth guiding



Magnetic Controlled Growing Rod



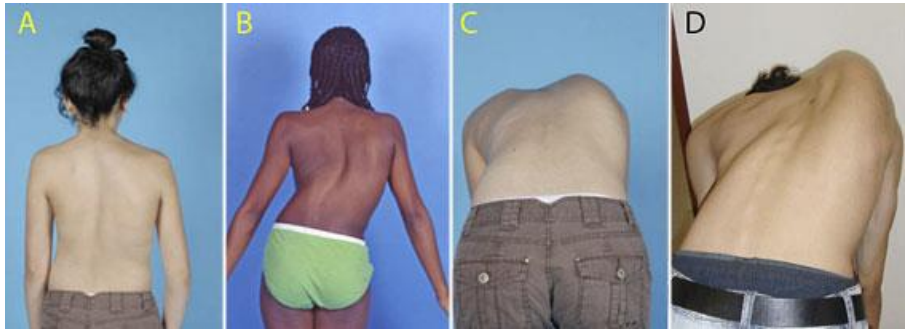
VEPTR

Pediatrics. 2016;137(1):e20150709

Radboudumc

Adolescent idiopathic scoliosis AIS

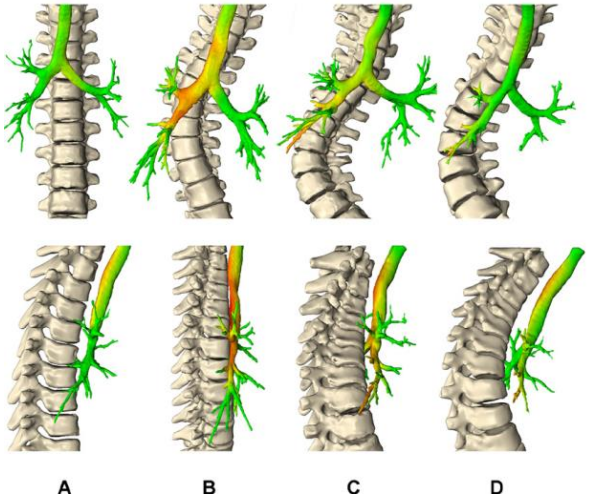
- 85% of all scoliosis cases
- 4/100 adolescents
- Bracing works!
- Surgery indicated if Cobb > 45 ° and still growing.
- USA NIS administrative database 75.000 cases 2001-2014
- complications:
  - Mortality: 0.1%
  - Neurologic: 0.9%
  - Respiratory: 3%
  - Cardiac: 0.8%
  - VTE: 0.1%
  - GIT: 3%
- Median stay: 5 days

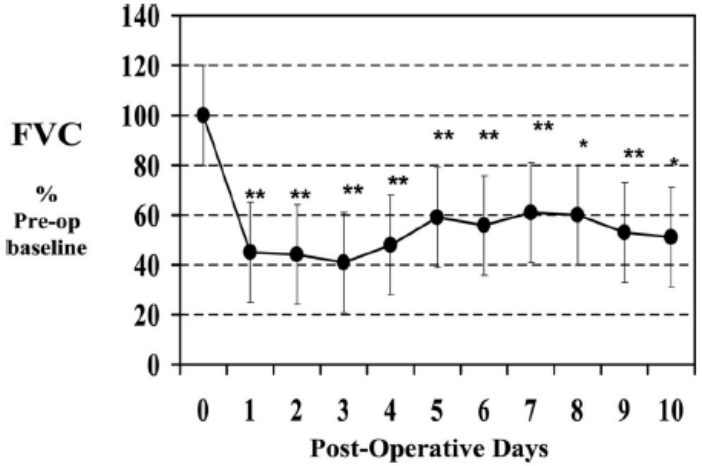


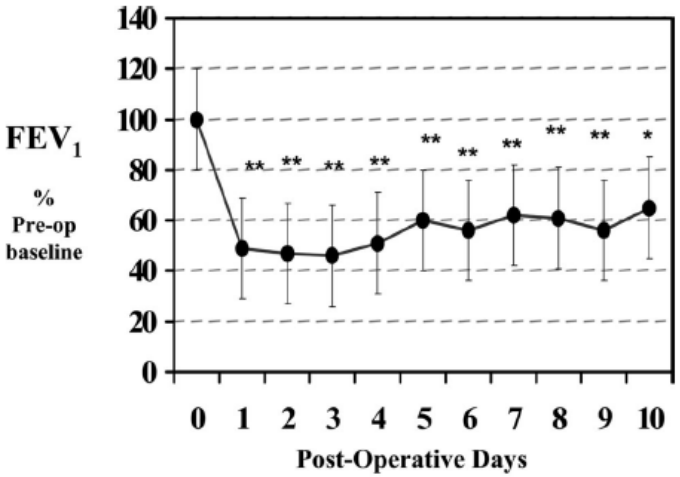
Neurosurg Focus 43 (4):E3, 2017. BRAIST N Engl J Med. 2013; 369:1512-1521

Pulmonary Risk factors

- Cobb angle (75-100°)
- Thoracic curve:
  - => 8 vertebra
  - Hypokyphosis
  - Cephalad curve
- Postoperative PFT







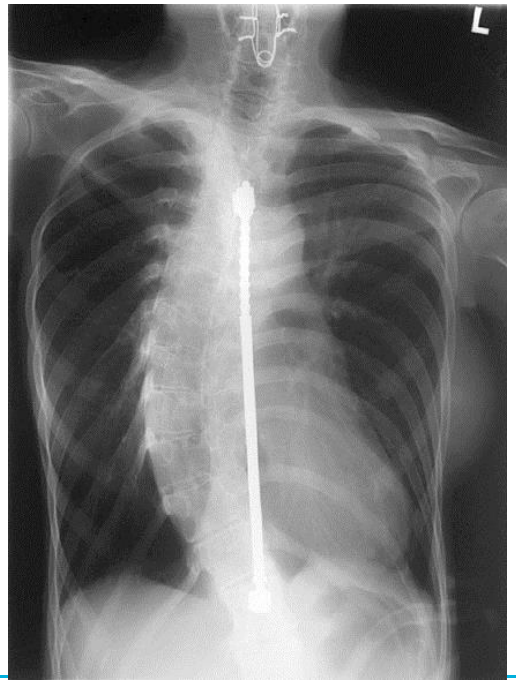
Spine 2005;30:2182-2185. J Bone Surg Am 2005;87:1937-1946. *BMJ Open Resp Res* 2018;**5**:e000264

Radboudumc

Scoliosis surgery

Scoliosis surgery

- 1911: spinal fusion (spondylodesis): with autologous bone graft
- 1920: metal implants (instrumentation)
- 1962: **Harrington rod** and bilateral modifications

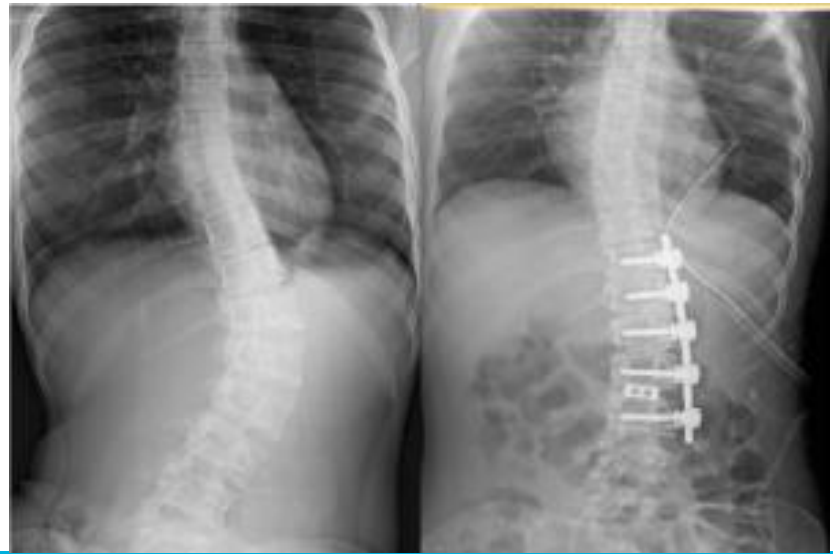


Scoliosis surgery

- 1911: spinal fusion (spondylodesis): with autologous bone graft
- 1920: metal implants (instrumentation)
- 1962: Harrington Rod and bilateral modifications
- 1975: **Luque: sublaminar wiring**
  - Immediate stability
  - Higher risk for neurologic structures

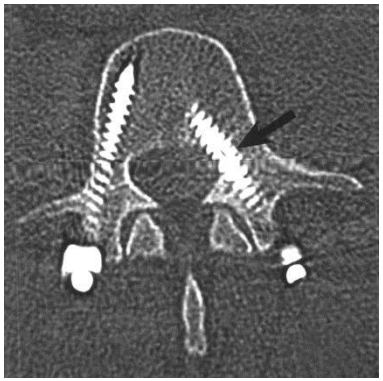
Scoliosis surgery

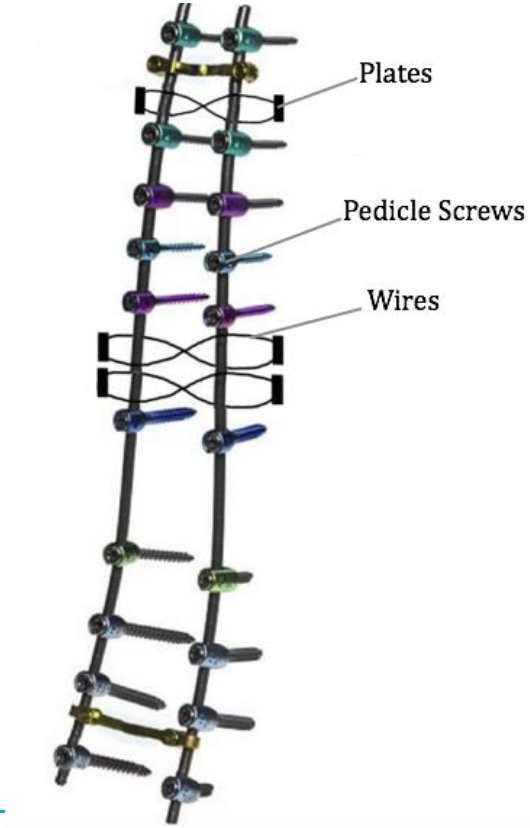
- 1911: spondylodesis: fusing the spine with autologous bone graft
- 1920: metal implants (instrumentation)
- 1962: Harrington Rod and bilateral modifications
- 1975: Luque: sublaminar wiring
- 1973: **anterior/ventral procedures:**
  - shorter distance necessary.
  - anterior release additional to posterior correction
  - thoracic level: thoracotomy complications



Scoliosis surgery

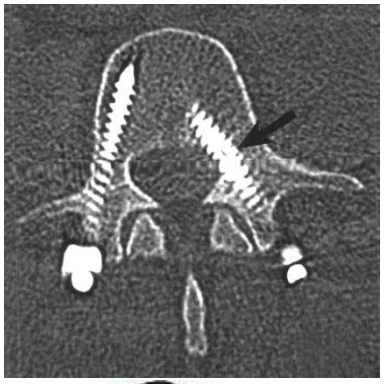
- 1911: spondylodesis: fusing the spine with autologous bone graft
- 1920: metal implants (instrumentation)
- 1962: Harrington Rod and bilateral modifications
- 1975: Luque: sublaminar wiring
- 1973: anterior/ventral procedures
- 1984: **Cotrel and Dubousset**:
  - pedicle screws, hooks and rods.
  - segmental distraction and rotation
  - spinal fusion with autologous bone
  - immediate stability
  - diminished need for pelvic fixation or anterior procedures

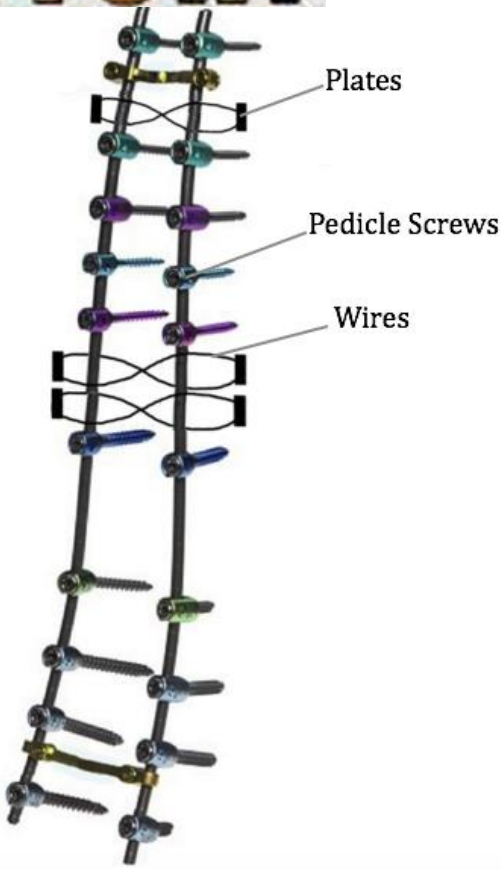




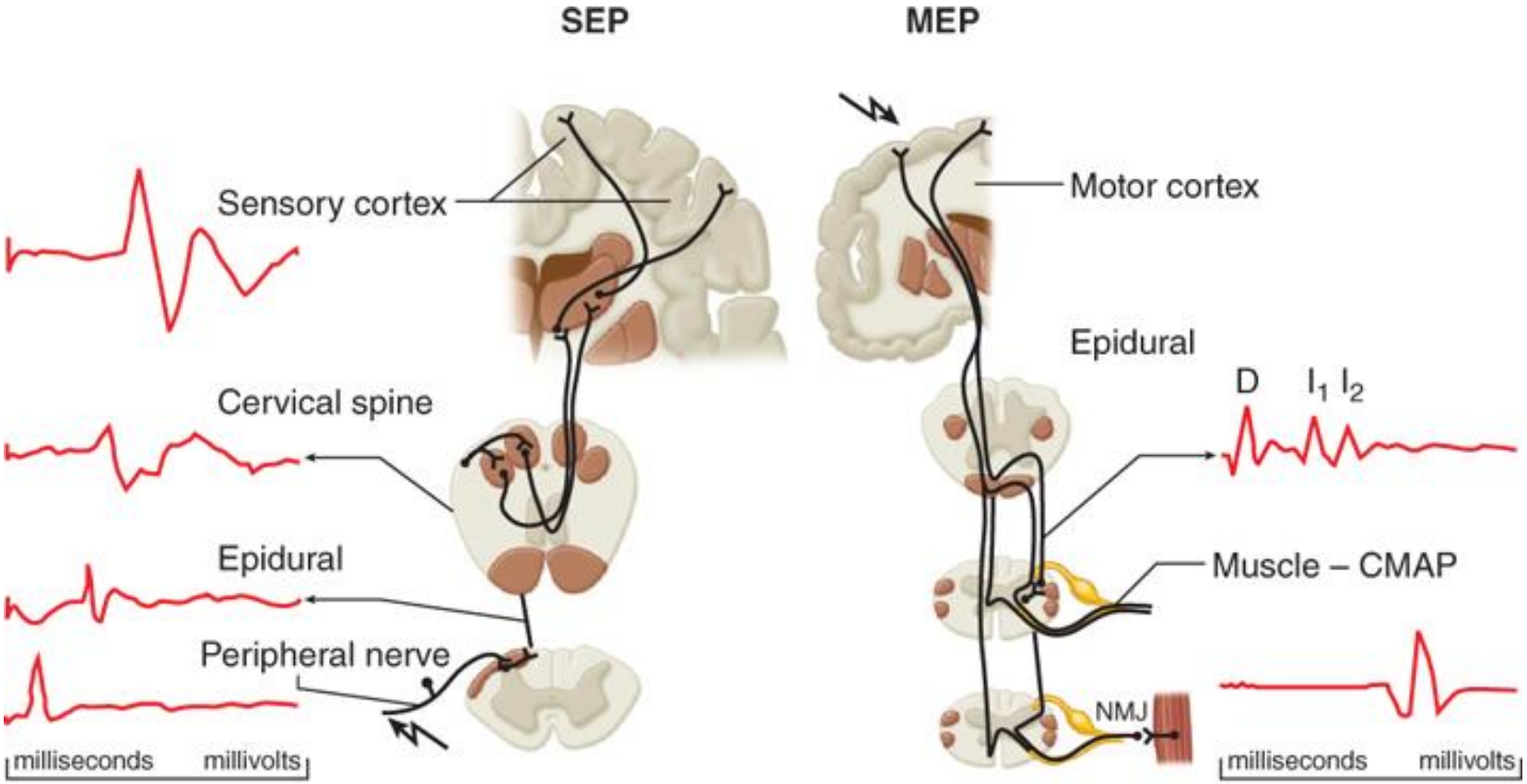
Scoliosis surgery

- 1911: spondylodesis: fusing the spine with autologous bone graft
- 1920: metal implants (instrumentation)
- 1962: Harrington Rod and bilateral modifications
- 1975: Luque: sublaminar wiring
- 1973: anterior/ventral procedures
- 1984: Cotrel and Dubousset:
  - pedicle screws, hooks and rod
  - distraction and rotation
- **Posterior Spinal Fusion**
- Osteotomy/vertebrectomy..
- Iliac wing fixation or not
- Intraoperative external traction..





Neurophysiological monitoring



Standard IONM

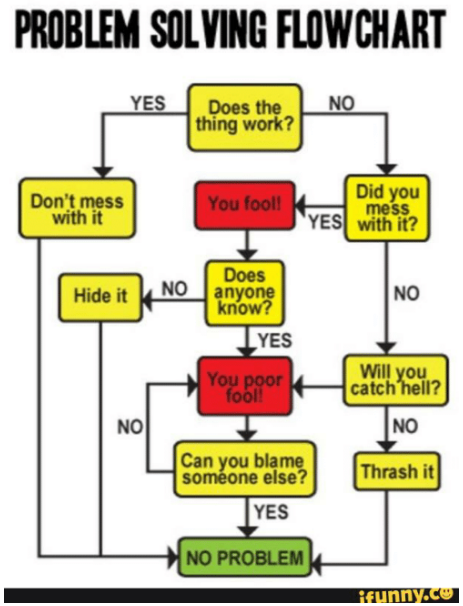
- SSEP
  - Dorsal tract monitoring: vibration and proprioception sense
  - No information on integrity of motor tract/anterior myelum
  - Maximum 0.5 MAC of halogenated agents and 50 % NO
  - Avoid bolus of propofol
  - Sensitive to change in temperature and circulation

- TcMEP
  - Short acting NM blocking agent
  - Preferably propofol-opioid based anaesthesia
  - Maximum halogenated agents: 0.3 MAC.
  - Bite block to protect tongue from masseter contractions
  - Not measurable in 10 % of neuromuscular patients

It can be done with vapour as well

Clin Spine Surg Volume 30, Number 9, November 2017.
SPINE 2014 Volume 39 , Number 22 , pp E1318 - E1324

Approach to signal change



- protocol with surgeon and neurophysiology
- Standardized check list and flow chart
- Consensus on “relevant signal change”
  - 80 % decrease in TcMEP
  - 50 % decrease in SSEP
  - Any significant change immediately following surgical action
- Communicate clearly and document time
- Who should take part in discussion?

Team approach to signal change

- Check the wires, patient position and events
  - Anaesthesia drug bolus?
  - Surgery: Traction, pedicle screw, curve correction, accident?
- Optimise spinal cord circulation:
  - Increase MAP[1] up to…… 85 mmHg?
  - Fluid bolus?
- Check and correct:
  - Blood gas, electrolytes, hemoglobin, temperature
- Re-assess and consider:
    - Undo surgical action
    - Prednisolone high dose?
    - Wake up test
    - Removal of all material or limited stabilisation
- Local protocol for spinal cord injury if neurologic symptoms

Radboudumc

[1]SPINE 2018 Volume 43, Number 13, pp 890–894

Blood loss estimation pediatric

	Idiopathic PSF	Idiopathic anterior	NeuMu CP PSF	NeuMu CP anterior	NeuMu DMD
BL range (mL)	750-1500	350-650	1300-2200	900-1800	1500-4000
Per level (mL)	65-150	60-135	100-190	100-190	
Transfusion	18%				

- 86 consecutive AIS with TXA, Cell Saver, MAP 50-65, Transfusion trigger 7 g/dL (4,3 mmol/L)
- Lowest hemoglobine at day 2
- 1 pt received Tx at day 1 and 3 at day 2 postop: 5 %.

Eur Spine J (2004) 13 (Suppl. 1) : S6–S17. The Spine Journal 14 (2014) 2938–2945

Prevention of bleeding and transfusion

- Risk factors:
  - Osteotomies (e.g. Ponte), vertebrectomy, iliac crest bone grafts
  - Neuromuscular origine
  - Low hemoglobine…
  - Low body weight
  - Duration of surgery (or levels fused> 8?)
  - Valproic acid
- Pre-operative optimisation
  - Bleeding disorder?
  - Nutritional status: iron, vitamin B12/Folic acid
  - Osteoporosis?
  - Erythropoietine: Hgb<8 mmol/L (12.9 g/dL)
  - Autologous donation?
  - Objections to bloodtransfusion?

Review: J Am Acad Orthop Surg 2017;25: 480-488

Prevention of bleeding and transfusion

- Positioning abdomen free Anesth Analg 2000;91:552–7
- Normothermia (?) J Pediatr Orthop Volume 38, Number 9, October 2018
- Cloth stability
  - Antifibrinolytics reduce BL 25 % and BTx Cochrane Reviews 2016, Issue 9. Art.: CD006883.
    - Tranexamic acid: But what dose?bolus 20 mg/kg infusion 5 mg/kg/hr. Max 50 mg/kg/24 hr.
    - Aminocaproic acid also works
- Control MAP< 65 mm Hg at incision Spine Deformity 1 (2013) 115e122
  - Anesthetics, Beta-B, vasodilators, CCB, spinal morphine
- Cell saver: reduction of 6-55% of allogenic transfusion depending on pre-donation/hemodilution. Small bowl
- Surgical hemostatic materials
- Transfusion trigger: Comorbidity, bleeding and circulation status.
- Mass transfusion protocol
- Orthopedics Consensus based guideline Spine Deformity 6 (2018) 424e429
- Focus in perioperative care pathway to reduce bleeding and transfusions

J Am Acad Orthop Surg 2017;25: 480-488

Anesthesia technique desires

- Reliable neuromonitoring possible
- Allows fast awakening if necessary
- Early extubation if planned
- Smooth and reliable transition to postoperative analgesia

Practice overseas

	NZ AUS (2007)[1]	UK (2007)[1]	UK (later)[2]
Centers (number)	10	17	21
Halogen/propofol (%)	82/18	81/19	43/57
Remifentanil (%)	80	88	90
Morphine spinal (%)	40	0	14
Ketamine infusion intraop (%)	80	12	
Epidural catheter(s) (%)	50	65	38
NSAID (%)	50	82	86
SSEP/TcMEP or mMEP	78/	100/82	90/-
Tranexamic Acid/aprotinin	20/40	59/71	81/0
Pre-donation	33	24	0
Cell saver Routine/indication	80	76	81/14

Radboudumc

[1]Anaesth Intensive Care 2010; **38: 1077-1084.** [2]Pediatric Anesthesia 21 (2011) 50–53

Remifentanil

- 30 % higher use of PCA morphine 24 hr after PSF with remifentanil infusion compared to morphine intraoperative technique[1]
- **Opioid Tolerance**: decreased pharmacologic effect of dose of opioid.
  - After several hours of remifentanil infusion
  - Can be overcome by administering more opioid
- **Hyperalgesia**: nociceptive sensitisation: increased pain from a stimulus that normaly provokes pain
  - Cannot be overcome by administering more opioid
- Dose dependent phenomena
- Can also develop with other potent opioids
- May occur after several hours of remifentanil 0.2-0.25 mcg/kg/min

[1]Development of Acute Opioid Tolerance During Infusion of Remifentanil for Pediatric Scoliosis Surgery. Anesth Analg 2006;102:1662–7.
Remifentanil tolerance and hyperalgesia: short-term gain, long-term pain? Anaesthesia 2016, 71, 1347–1362

Postoperative analgesia

- Opioids
  - Morphine
  - Intrathecal morphine many
  - Methadone Pediatric Anesthesia 23 (2013) 51–57
  - Extended release epidural morphine? Anesth analg June 2017 Volume 124 • Number 6
- Benzodiazepines (muscle spasm?)
- Epidural catheter: One? Two?

Postoperative epidural analgesia versus systemic analgesia for thoraco-lumbar spine surgery in children (Review)

Guay J, Suresh S, Kopp S, Johnson RL

Version published: 16 January 2019

Epidural analgesia

- Cochrane 2019:
- There is moderate- and low-quality evidence

- There may be a *small additional reduction* in pain up to 72 hours after surgery with epidural analgesia compared with systemic analgesia.
- Two very small studies showed epidural analgesia with local anaesthetic alone may accelerate the return of gastrointestinal function.
- The *safety* of this technique in children undergoing thoraco-lumbar surgery is uncertain due to the very low-quality of the evidence.
- The study in *'Studies awaiting classification'* may alter the conclusions of the review once assessed.

Postoperative analgesia

- Adjuvants:
  - Dexamethason Wang et al. Medicine (2018) 97:20. positive meta analysis
  - Gabapentin Anesth Analg May 2010; 110: 5. positive if 5 days use. Not single dos
  - Ketamine: isolated use: many negative trials
  - Magnesiumsulphate and Ketamine *Acta Anaesthesiol Scand* 2014; ***58:*** *572–579*
  - NSAID: normal dose postoperative is reasonable Eur Spine J (2017) 26:2719–2728
- So many roads…….

Duchenne Muscular Dystrophy

- 1/5000 newborn males
- Supportive treatment:
  - survival up to 30-40 years with Non-invasive Ventilation
- Corticosteroid therapy:
  - Loss of ambulation 9,5-> 11-12 years: after pubertal growth spurt
  - Delaying decline of respiratory and cardiac dysfunction
  - Decreasing need for scoliosis correction
  - Osteoporosis
- Severe increased respiratory risk from FVC <35%
- Dilating cardiomyopathy develops from adolescence (ACE blocker)
- Goal of scoliosis surgery:
  - Optimizing patient for wheelchair bound life style:
    - QoL, sitting balance
  - Possibly slowing respiratory decline

Duchenne muscular dystrophy: the management of scoliosis. *J Spine Surg* 2016;2(3):185-194

Multidisciplinary preparation and optimisation

Rehabilitation specialist

Neurologist

Orthopedic surgeon

Physical Therapist

Center for Ventilatory support at home

Occupational Therapist

cardiologist

pediatrician

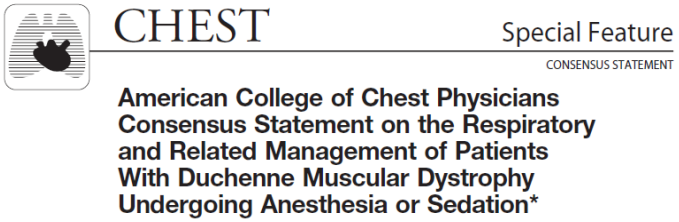
Pediatric intensivist

pulmologist

anesthesiologist

Duchenne Parent Project

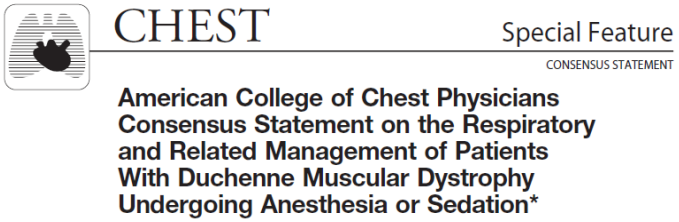
Preparation



- Indication:
  - consider at cobb angle 20 °
  - Currently 1/3 of all DMD patients
- Timely
  - Assess nutritional status
  - Air stacking (LVR)
  - Manual or mechanical Cough Assist if CPF< 270 L/min
  - Start up Non-Invasive Ventilation
    - If nocturnal hypoventilation
    - Perioperative or permanent from FVC 35-40%
  - Discuss attitude towards tracheostomy
  - Schedule before important decrease in cardiac function
- PFT < 6 months old
- Cardiac US < 1 yr old. If decreased function: < 6 months old

Duchenne muscular dystrophy: the management of scoliosis. *J Spine Surg* 2016;2(3):185-194

Preparation

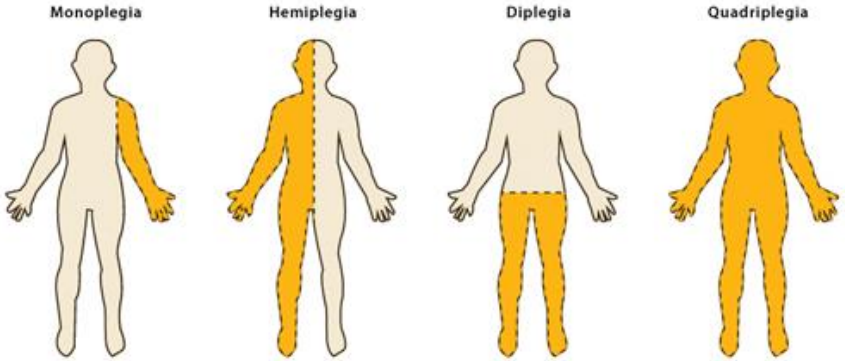


- Blood loss 2-4 liter
  - Poorly contracting vascular smooth muscle
- Anaesthesia technique adapted to DMD
  - Arterial and central venous access
  - Cardiac cripple: cardiac output measurement
- If NIV: extubate to NIV
- Postoperative analgesia: may benefit more of epidural?

Duchenne muscular dystrophy: the management of scoliosis. *J Spine Surg* 2016;2(3):185-194

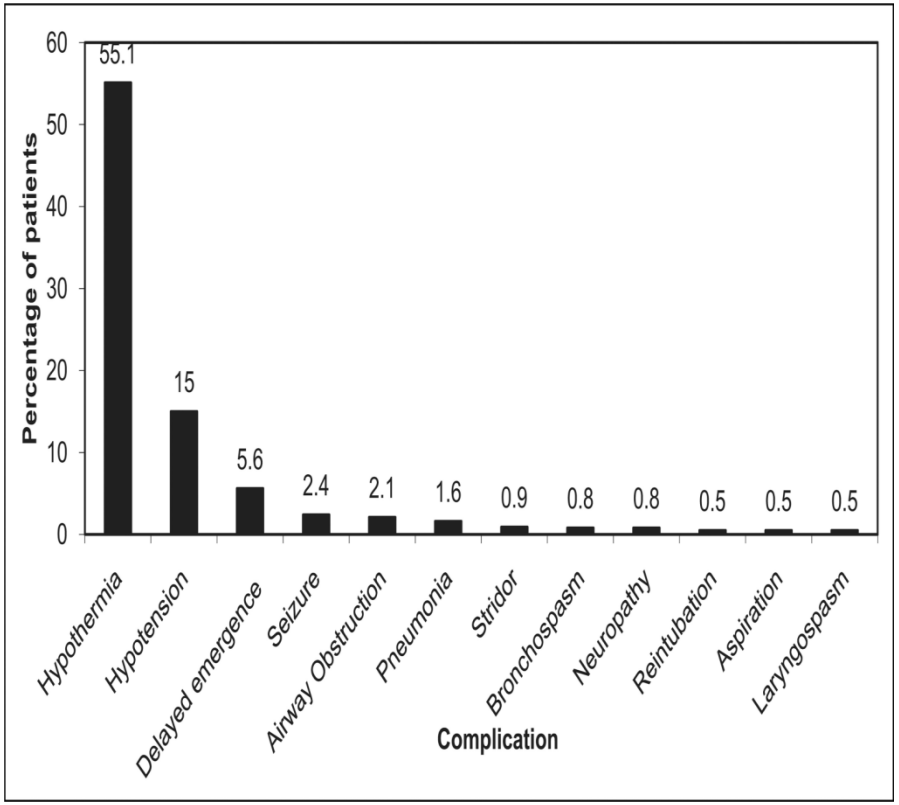
Neuromuscular scoliosis: Cerebral Palsy

- Motor dysfunction due to abnormal development or injuy to immature brain
- 2/1000 live birth
- Cause:
  - 80% no obvious
  - 10% birth complications
  - 10% post-natal
- Classification: motor deficit: Gross Motor Function Classification System I-V
  - I: walks without limitation. V: self-mobility severely limited
  - Distribution:
  - Nature:
    - Spastic (70%)
    - Dyskinetic (10%)
    - Ataxic (10%)



CP

- Multisystem comorbidity
  - Oromotor dysfunction
  - 30 % have epilepsy
- Altered mental developement
- GMFCS IV-V: 50 % severe scoliosis
- Perioperative care:
  - Multidisciplinary!
  - Rehabilitation
- Complications perioperatively:



J Child Neurol. 2012 July ; 27(7): 859–866.

CP, scoliosis and complications

- Prospective multicenter evaluation of 127 CP patients
  - Approach: posterior 122, A/P: 12, Anterior: 1
- Major perioperative complications
  - Pulmonary: 30%
  - GI: 20%
  - Wound infection with repeat surgery: 5%

- Risk factors
  - Major kyfosis
  - Increasing Estimated blood loss
  - No tranexamic acid use
  - Staged procedures
- Major complication doubled ICU and hospital stay

Eur Spine J (2016) 25:795–800

Syndromic scoliosis

- Taking in to account the specific comorbidity and status:
  - Neurofibromatosis
  - Ehlers-Danloss
  - Marfan
  - Osteogenesis imperfecta
  - Mucopolisaccharidosis
  - Arthrogryposis

Complications pediatric scoliosis

(%)	Total 19,360	Idiopathic 11,226	Congenital 2012	Neuromusc 4657	Other 1464
Death	0.1	0.02	0.3	0.3	0.1
New deficit	1	0.8	2	1.1	1.6
Supp infection	1	0.5	1.3	1.7	1.2
Deep infection	1.7	0.8	0.9	3.8	2.1
Pulmonary	1	0.6	1.1	1.9	1.8
Vision deficit	< 0.01				

SPINE 2011 Volume 36, Number 18, pp 1484–1491

Setting up a Multidisciplinary clinical pathway for pediatric scoliosis surgery

- May reduce SSI Spine Deformity 7 (2019) 33e39
- May reduce postoperative pain and length of stay Spine Deformity 4 (2016) 288e295
- May decrease length of stay Anesth Analg 2017;125:812–9

- May be fun with the most coffee purchasing specialist in hospital BMJ 2015

- Just propose….