

# Non-Fusion Distraction Procedures: Spine-Based



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# Outline

- Rationale for spine-based distraction
  - Mechanical
  - Biological
- Indications
- Techniques
- Complications

# “Spine-Based”

- Anchored in the spine
- Directed at spinal balance
  - Rather than thorax itself

# Importance of Early Spinal deformity correction

- Pulmonary
  - PFTs and QOL suffer with early TSF (Vitale)
- Abdominal
- Comfort?
- Energy costs
- Self-Image
- Late degenerative effects
- Many remain to be proven
  - Clinical research

# Four Decades of History

- Harrington 1962
- Moe 1984
- Marchetti (end fusions, 1975)
- Apical fusions- did not help control spine
- Dual rods (Akbarnia, McCarthy)
- Regular lengthening (Akbarnia, Thompson)
  - “drive the spine”

# Spine-Based distraction -mechanical advantages

- “Foundation” stability
  - Different anchor types and numbers
- Continuum of anchor points
  - T1-pelvis
  - Not limited by rib shape

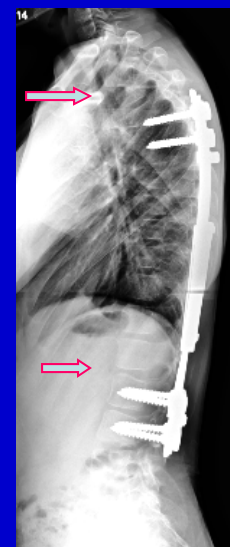
# Mechanical advantages

- Some control of kyphosis
  - Posterior cantilever from rigid foundations
  - More with pedicle screws?
- Adjustable
  - Change balance
  - To a limited degree

# Spine-based Distraction

## -mechanical disadvantages

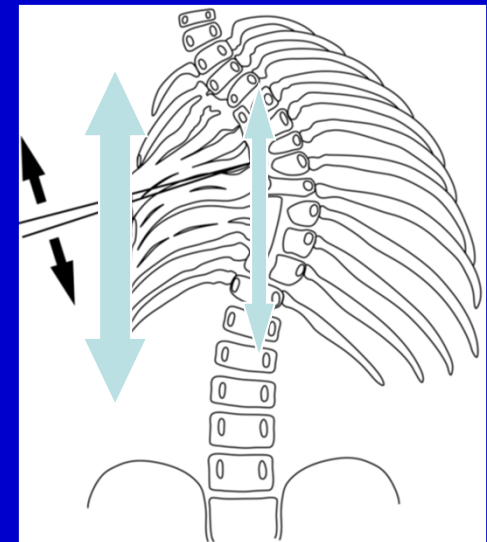
- Relatively kyphogenic
  - Distracting from back
  - muscle can't help
  - Cantilever if anchors OK
- Junctional stresses
  - Cause PJK, DJK, DJD?
  - Are these less with rib procedures?





# Mechanical Disadvantages

- Unprotected Implant stresses
  - Relatively high fracture rate
    - 10+%
- Less leverage than rib cage



# Spine-based Distraction -biological advantages

- Rib movements unimpaired
- Intercostals not scarred
- Implant prominence minimal

# Biological advantages

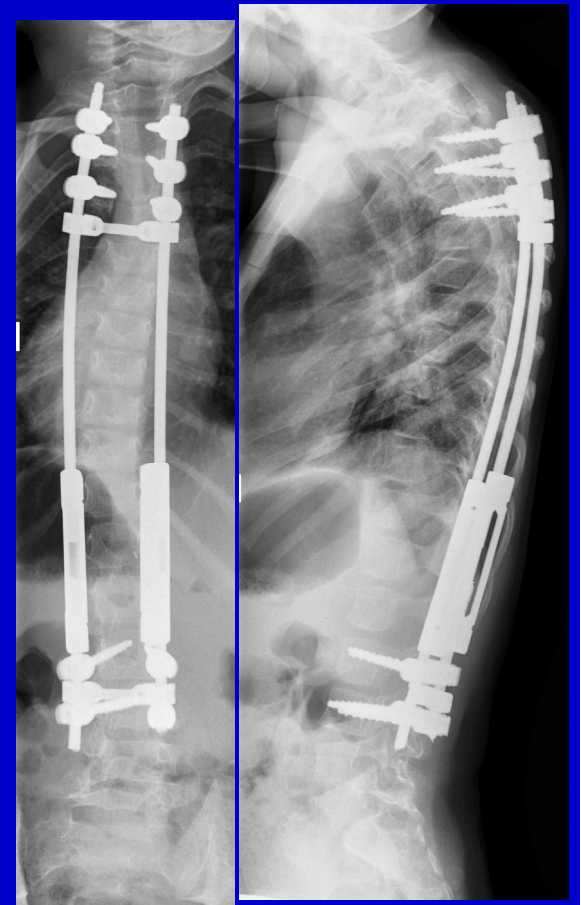
- May maximize length
  - What is optimal distraction frequency?
- Prevents “heroic” procedures
  - Anterior / posterior
  - VCR



# •Spine-based Distraction

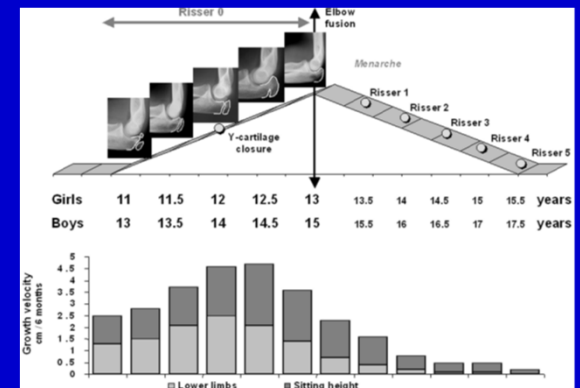
## -biological disadvantages

- Spine stiffens
  - May auto-fuse
- Paraspinous muscle atrophies
- “Buys” a future fusion
  - Or effective fusion
- Young bone can “drift”
  - Rigid implant pushes through



# Indications

- Curve > ~60°
- Progressive rotation
- Poor brace experience
- >~4 yrs spinal growth remaining
  - Harrington: age <10
- Etiologies – any?
  - Idiopathic
  - Neuromuscular
  - Genetic/syndromic



# Indications

- “Cost”-benefit remains to be analyzed
  - Different for each diagnosis
- Exciting opportunity for research

# Contra-indications

- Stiff curves
  - Role of traction / casting?
- Osteoporosis
- Dysplastic bone
- Rib fusions
- Poor soft tissues coverage

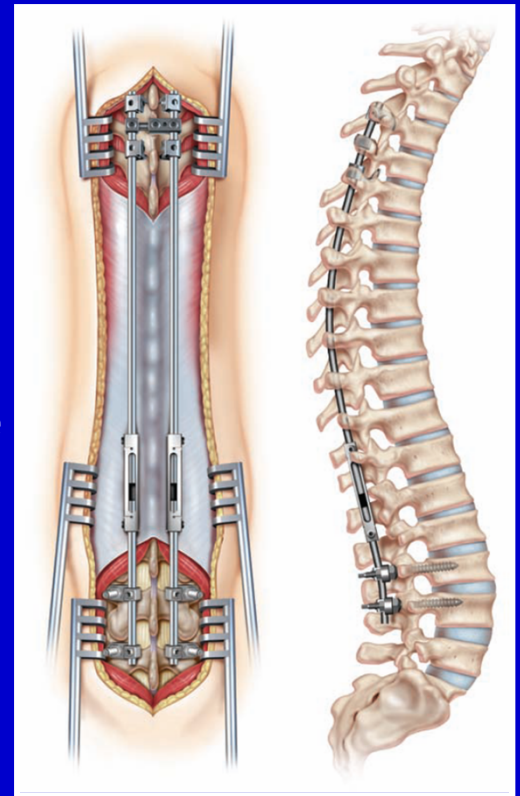
# Technique: Foundations

- Marchetti, Faldini 1975: “end-fusions”
- Mahar, Akbarnia
  - Porcine pull-out test
  - 4 screws is strongest foundation
  - Hooks better in lumbar spine than thoracic
    - Birmingham construct
  - Cross-links did not prevent pull-out
  - Does not address young pedicles, drift



# Technique

- Proximal foundation
  - $\geq 2$  levels
    - Consider 3 if osteopenic
  - Address coronal & sagittal plane
  - Allograft or autograft fusion
  - Anchor types
    - Some cautions with young screws
  - Preserve supraspinous ligament



# Technique

- Distal foundation
  - $\geq 2$  levels
  - Pelvis an option
  - Hooks a disadvantage?
- Pelvic fixation
  - Ilium preferred
  - Bury screws if used; add second anchor
  - Rods: less modular but better tolerated



# Technique

- Neuromonitoring for initial procedure
- May eliminate for subsequent procedures if quick, no prior events?
  - Surgeon's discretion
  - Same time as a wake-up test
    - Sankar, Skaggs

# Construct

- Dual Rods: McCarthy, Akbarnia, Marks
- Rod diameter
  - 3.5-5 mm
- Metal
  - Ti vs SS vs others
  - Ti has better fatigue properties
- Cross-links
  - May decrease implant cut-out
  - May concentrate stress

# Distractors

- Colinear (tandem)
- Side-to-side (wedding band)
- Distraction mechanism
- Automated (Phenix)
- Vs Self-distracting (Luque trolley, Shilla)
  - Guided growth

# Spine-based Distraction: Results

- 12 cm total spinal growth
  - Approximates expected growth
- Complications 0.5-1+ per patient
- Dual rods superior
- Apical fusion not beneficial

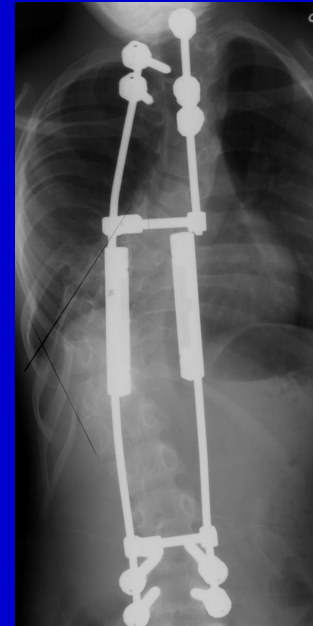
# Complications

Bess et al 2008

- 143 patients with 910 procedures
  - Mean 6 yrs at 1<sup>st</sup> with 5 yrs f/u
  - 4.5 per patient
- > 2 complications per patient
- >1 unplanned procedure per patient
  - Fewer with dual rods
- Wound complications ~25% of patients

# Rod fracture

- Long unprotected segment





# Summary:

## Spine-based distractive procedures

- Versatile
- Low prominence
- Preserve rib motion
- Continued technical improvements