

Fusionless Techniques for Idiopathic Scoliosis

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Scoliosis Deformity Development and Progression

- Idiopathic scoliosis is associated with relative anterior spinal overgrowth and apical lordosis.
- Asymmetric spinal growth and biomechanical imbalance, perpetuated by the **Hueter–Volkman law***, has been considered as an etiology for progression of the deformity.

* Growth is stimulated by tensile forces and inhibited by compression forces.





Spine Fusion and instrumentation remains the definitive treatment for children with severe spinal deformities.

- However spinal fusion sacrifices spinal flexibility, alters stresses on adjacent unfused segments, and may lead to spinal imbalance in the long term.



Fusionless Techniques would maximize spinal growth and allow spinal motion, and maintain intervertebral disc integrity, while correcting scoliosis.

- The goal would be to provide a means for children to “*grow out of*” their deformity and end with a more normal spinal contour.



Fusionless Techniques

- **Nonsurgical methods**
 - Cast
 - Brace
- **Surgical methods**
 - **Distraction-Based Techniques**
 - Growing rods
 - VEPTR
 - Hybrid growing rods
 - MAGEC rods
 - **Growth Guidance (Shilla) Technique**
 - **Compression-Based Techniques (Growth Modulation)**
 - Stapling
 - Tethering



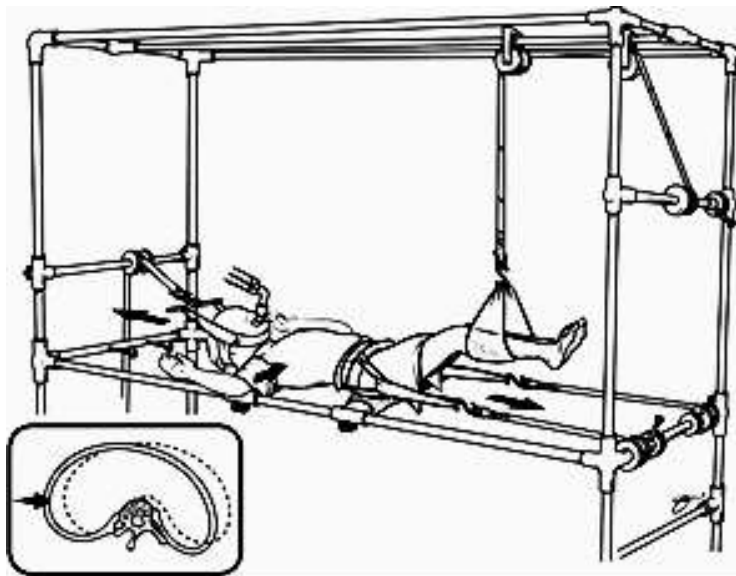
Cast

- **Indications**

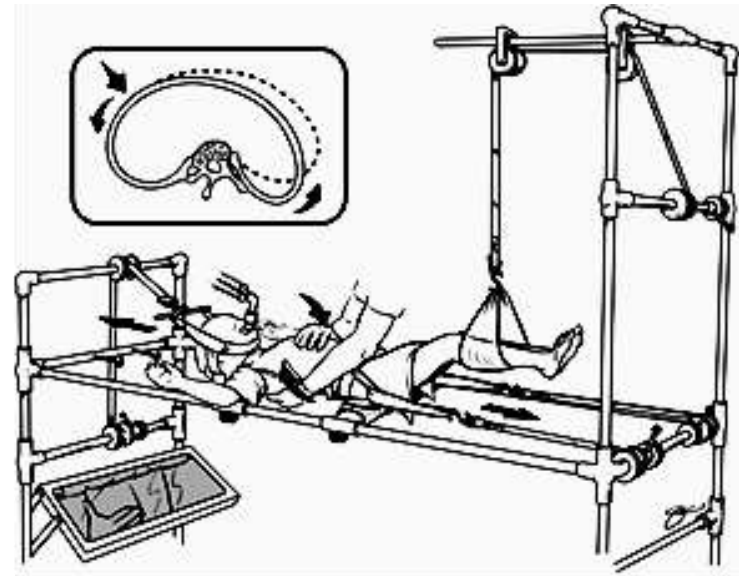
- A child < 5 years
- Curve < 60° with documented progression (10 - 20°), or anticipated progression (rib-vertebral angle difference > 20° and/or rib phase II)

- **Types**

- A. Translational (Risser) cast
- B. Derotational (Mehta/Cotrel) cast



(A) Translational (Risser) cast
(correction through lateral translation).



(B) Derotational (Mehta/Cotrel) cast
(Correction through derotation).



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Brace

- **Indications**

- Skeletally immature patient (Risser ≤ 2 & postmenarchal ≤ 6 m).
- Curve $< 40^\circ$ with flexibility $\geq 50\%$.

- **Protocol**

- Brace wear is 23 h/day.
- Weaning at skeletal maturity (Risser 4 or postmenarchal > 12 m).

- **Types**

- Milwaukee
- Boston
- Cheneau
- Wilmington,



Fusionless Techniques

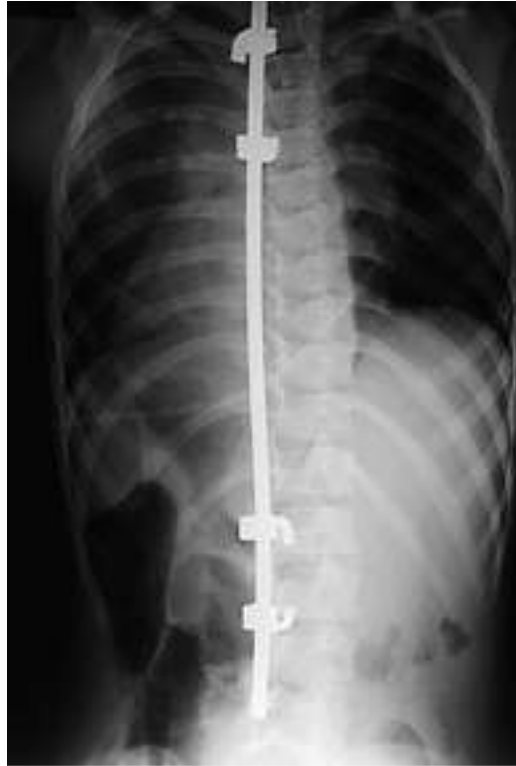
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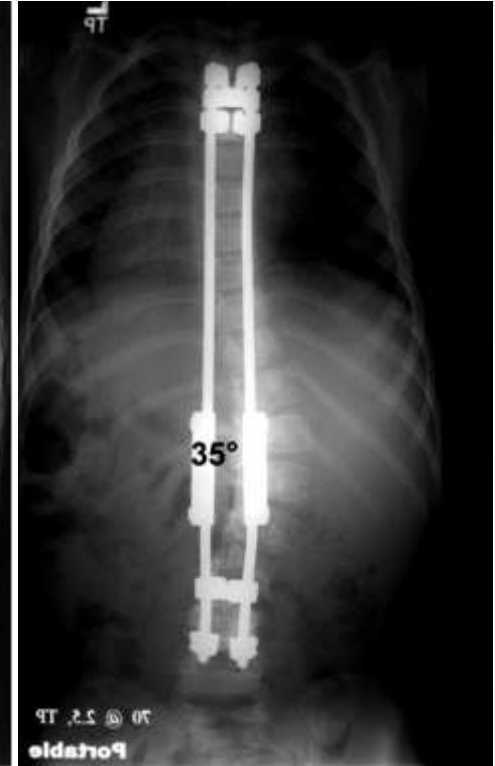
Growing Rods

- Indications

- Progressive deformity when cast or brace treatment has failed.
- The rods are lengthened every 6 m.



A: Single growing rod



B: Dual growing rods



Fusionless Techniques

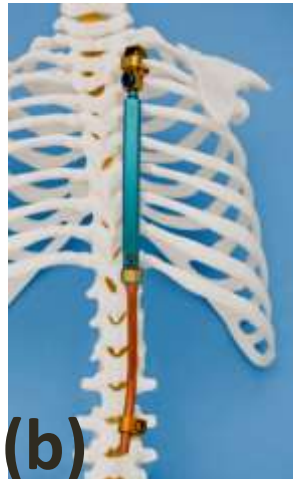
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Vertical Expandable Prosthetic Titanium Rib (VEPTR)

- Concept

- VEPTR is used for patients with chest wall and/or spinal deformities where the thorax is unable to support normal respiration or lung growth (**Thoracic Insufficiency Syndrome**) and progressive thoracic congenital scoliosis with concave fused ribs.
- Attached to the ribs proximally and (a) caudal ribs, (b) a lumbar vertebra or (c) to the ilium distally .
- Lengthened every 6 m.



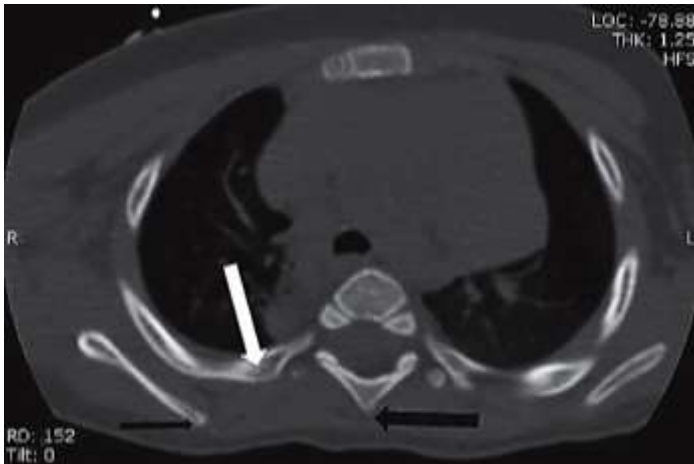
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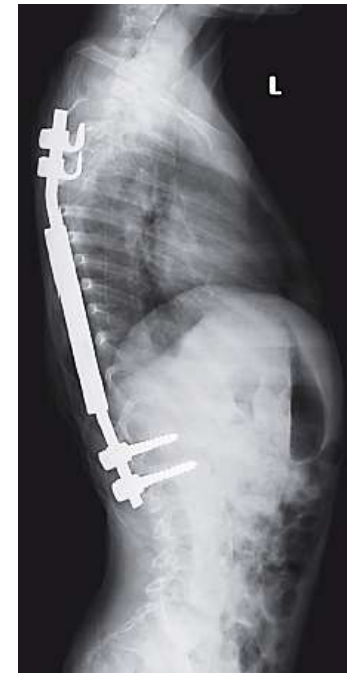
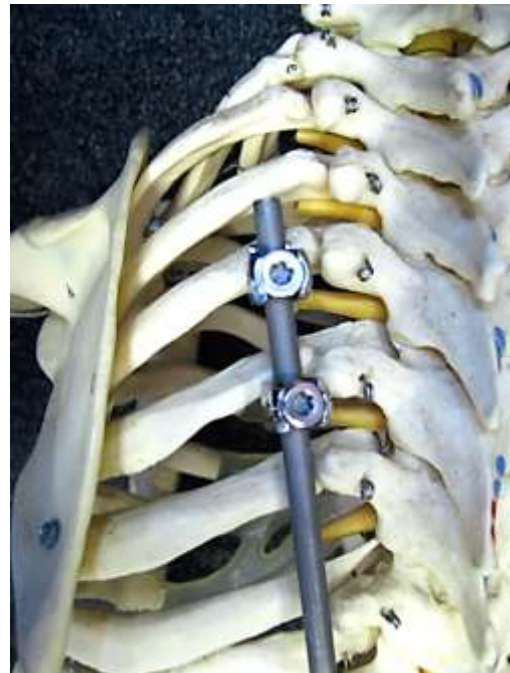


Hybrid Growing Rods

- **Concept** **(HGR= VEPTER (proximal) + GR (distal))**
 - Fusion of the upper thorax for the upper anchors of growing rods adversely affects pulmonary function.
 - Hybrid systems utilizing standard hooks avoid this fusion by using ribs as the upper anchor.
 - In addition, soft-tissue coverage of the hook on the rib position is usually better than when using spinal fixation.



The attachment point of the rib anchor (*white arrow*) is in a trough with good soft tissue coverage between the spinous process (*thick black arrow*) and scapula (*thin black arrow*).



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MAGnetic Expansion Control (MAGEC) Growing Rods

- Concept

- The rod includes an actuator portion with a small internal magnet, which allows the rod to be lengthened by the use of external Remote Control.
- Especially helpful in children with comorbidities making repeated surgeries difficult.



Complications of Distraction-Based Implants

1. **Pullout** from the spine, erosion through the rib and rod breakage.
2. **Kyphosis** leading to sagittal imbalance.
3. **Wound complications** due to the prominence of implants under the skin and poor healing potential in chronically malnourished patients.
4. **law of diminishing returns**: decreased spinal length gained after each lengthening because of increased spinal stiffness and autofusion.
5. **Risk of repeated general anesthesia** and significant psychological effects.



Fusionless Techniques

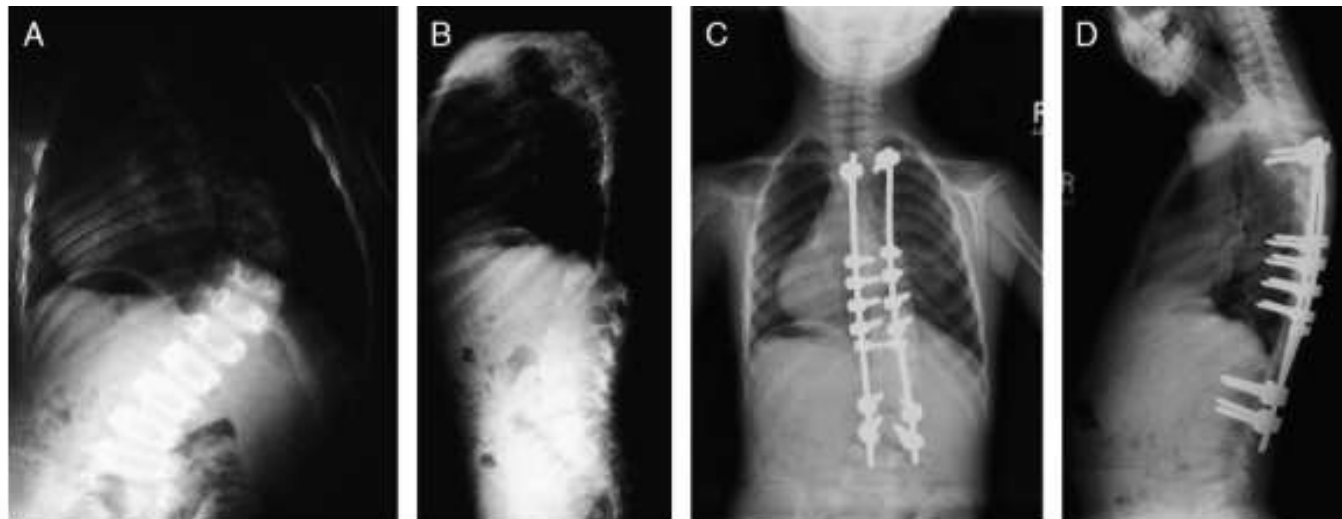
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Growth Guidance (Shilla) Technique

- Concept

- Luque trolley system (grandfather of Shilla).
- 3 - 4 apical segments instrumentation and fusion +
- 4 - 6 gliding pedicle screws (Shilla growing screws) at each end of the construct. These screws are placed without subperiosteal exposure to decrease the risk of autofusion.



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Compression-Based Techniques (Growth Modulation)

- **Concept**

- Based on the Hueter-Volkman Law, growth inhibition by compression of the convexity of the deformity.
- Scoliosis will then correct through growth on the concavity.



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Stapling



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Tethering

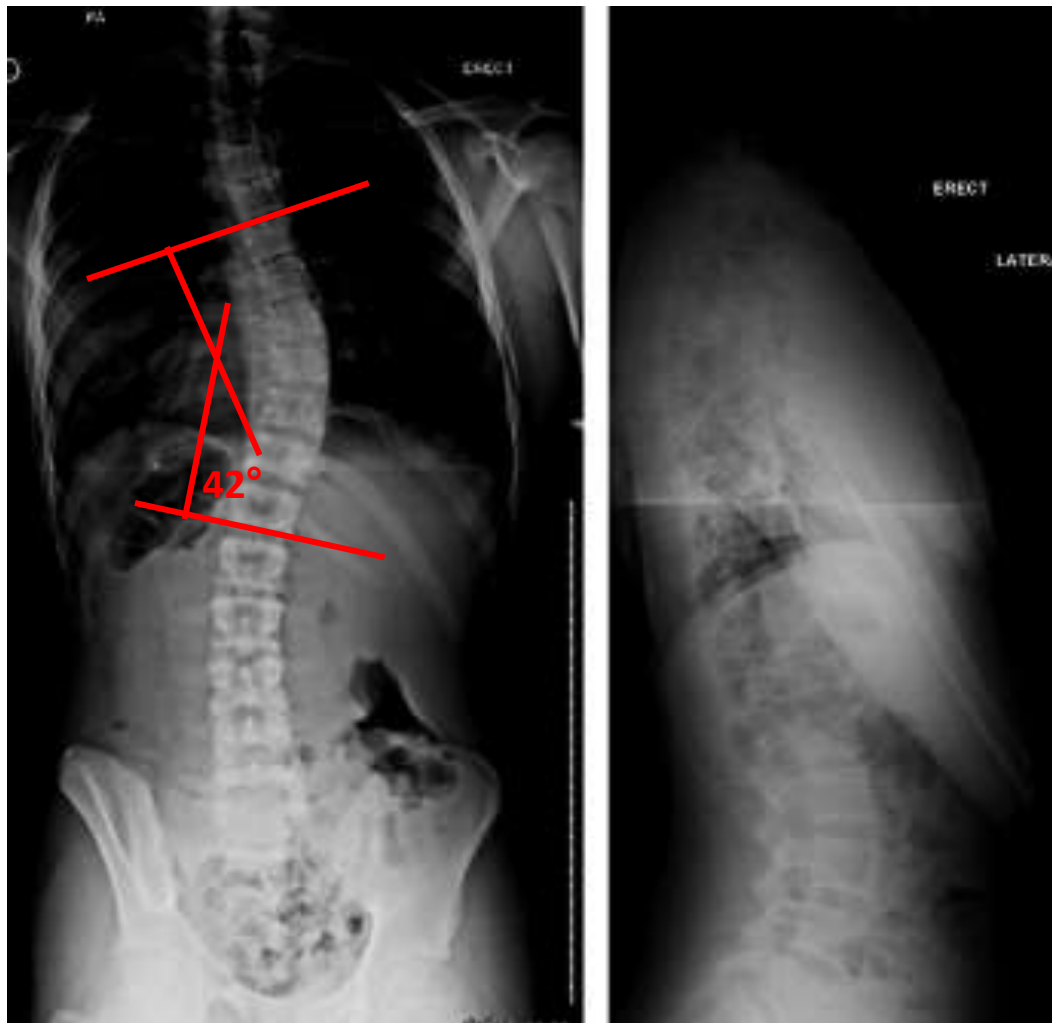
- **Indications**

- skeletally immature patients (premenarchal, Risser \leq 2 and Sanders score \leq 4)
- Thoracic curves ranging from 35° - 60° with flexibility $<$ 30° .

- **Contradictions**

- Thoracic hyperkyphosis $>$ 40°.
- Rotational prominence $>$ 20°.

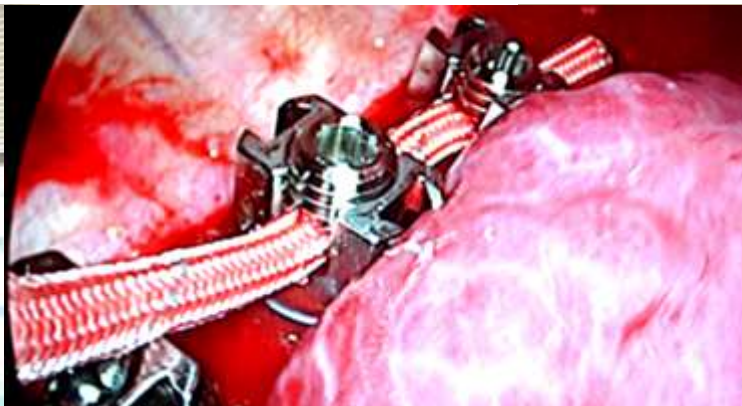
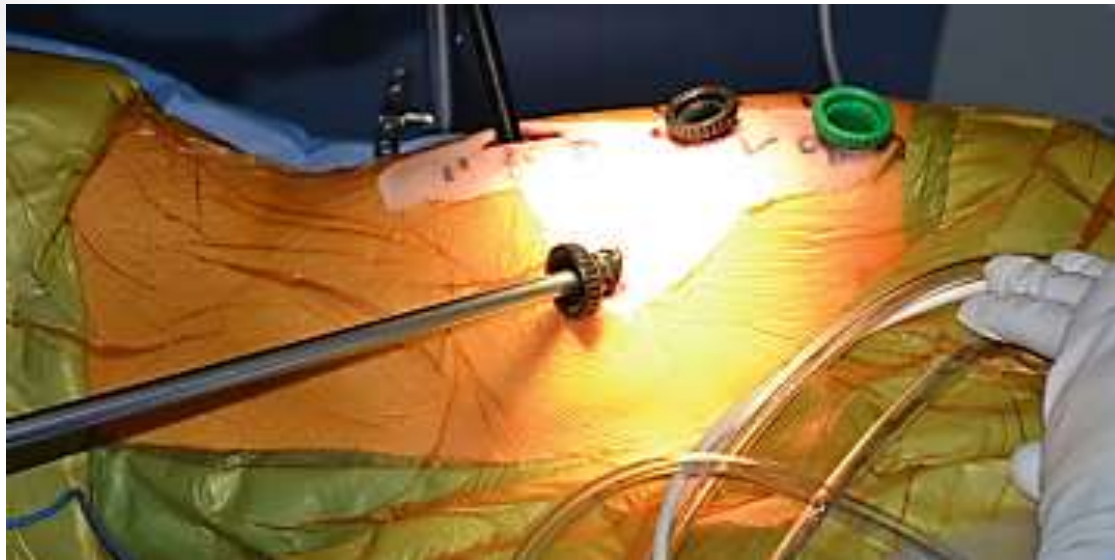




14 years old boy (Risser 3) with a 42° right thoracic curve that had failed bracing.



Surgical Technique



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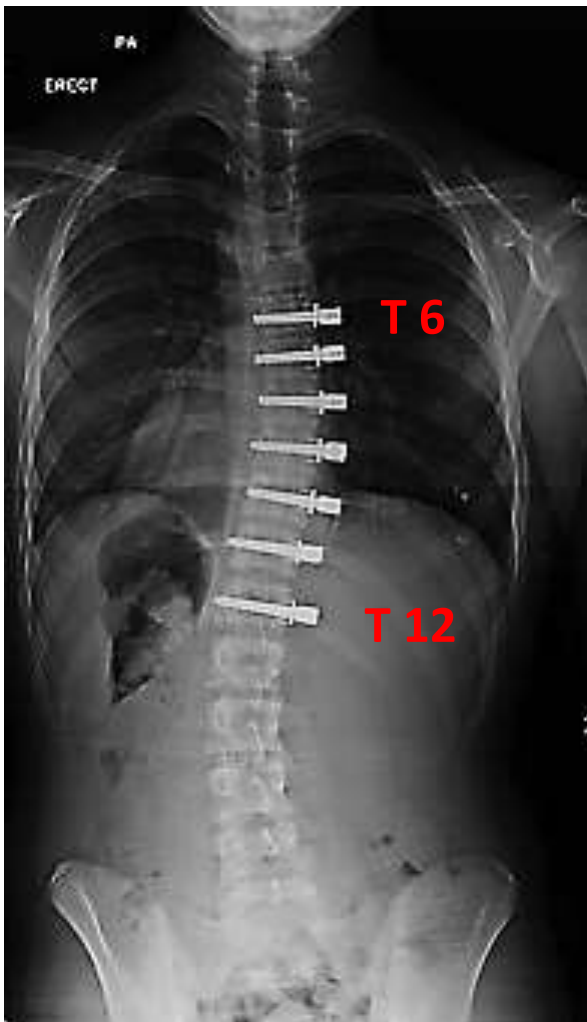


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Right T6-T12 anterior vertebral body tethering with correction to **25°** (postoperative).





2 years postoperative (Risser 5) with a **10°** curve.



Thank you

