Scoliosis treatment

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SRU 2019

Management of Adolescent Idiopathic Scoliosis (AIS)

First Presentation – Is this scoliosis?

Yes (Cobb angle ≥ 10°)

Non-structural
- Postural scoliosis
- Hysterical scoliosis
- Sciatic scoliosis
- Inflammatory
- Limb length discrepancy
- Hip contractures

Structural
- Birth history
- Developmental history
- Syndromic i.e. limb defect or organ involvement
- Neurological signs and symptoms
- Neurocutaneous stigmata
- Curve pattern
- Marfanoid habitus or features of hyperlaxity

Non-idiopathic

Investigation to identify cause
E.g. MRI/CT scans
Echocardiography
Ultrasound kidney
Genetic study

AIS
(diagnosis of exclusion)

No (Cobb angle < 10°)
*Need to exclude kyphosis

I	Observe yearly
II	Observe 6 monthly
III	Observe yearly
IV	Discharge

Four Different Growth Periods[α]

	Category	Outcome
I	Pre-menarche **before Growth Spurt**	Progression is dependent on the age and the growth velocity.
II	Pre-menarche **during Growth Spurt**	Curve will progress very aggressively as the increment of height velocity is greatest at this point.
III	Post-menarche	Progression is approximately 5 – 10 degrees over a year
IV	After attaining Risser 4 or skeletal maturity (determined radiographically)	Progression is approximately 1 degree a year for skeletal matured group* (for thoracic curve more than 50 degrees and lumbar curve more than 30 degrees)

Cobb angle	I	II	III	IV
≥10°	Observe 6 monthly	Observe 4 monthly	Observe 6 monthly	Observe yearly (Risser 4) Discharge (Risser 5)
≥20°	Brace	Brace	Brace	Observe yearly (Risser 4) Observe 2 yearly (Risser 5)
≥45°	Brace	Open triradiate: Brace Closed triradiate: PSF	PSF	PSF (Risser 4) Observe 2 yearly or PSF if curve progression (Risser 5)
≥60°	Growing rod	Open triradiate: Growing rod Closed triradiate: PSF	PSF	PSF

Weinstein S, ... IV. Curve progression in idiopathic scoliosis. J Bone Joint Surg Am. 1983 Apr;65(4):447-55.

Idiopathic scoliosis

- **Infantile idiopathic scoliosis- 0-3 yrs**
- Juvenile idiopathic scoliosis- 4-9 yrs
- Adolescent idiopathic scoliosis - 10-20 yrs

AIS – most common type

Early degeneration

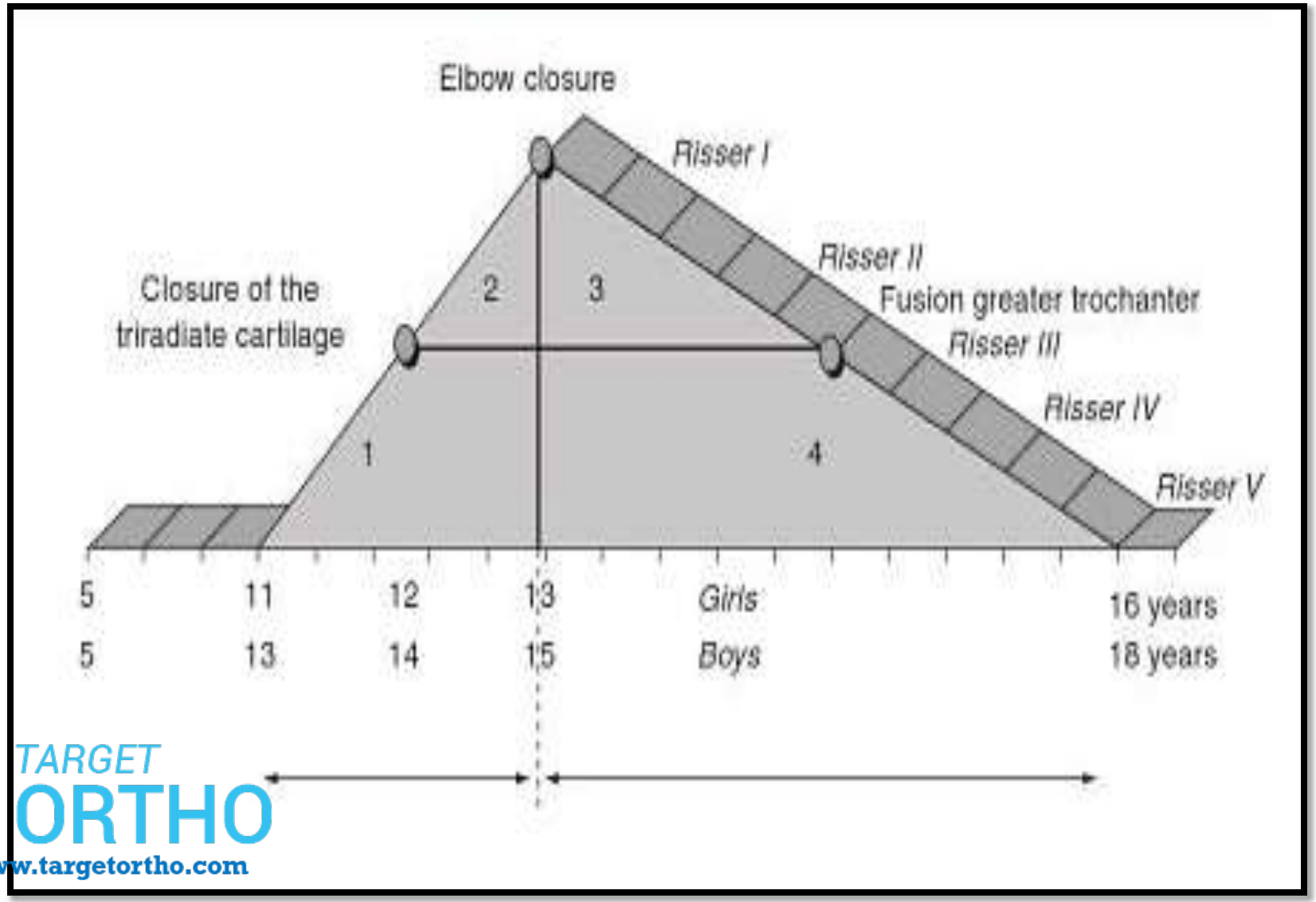
– Low back pain

curves > 90- cardiopulmonary dysfunction

Curve progression

- **Curve magnitude**
  - *before skeletal maturity*
    - » > 25° before skeletal maturity will continue to progress
  - *after skeletal maturity*
    - » > 50° thoracic curve will progress 1-2° / year
    - » > 40° lumbar curve will progress 1-2° / year

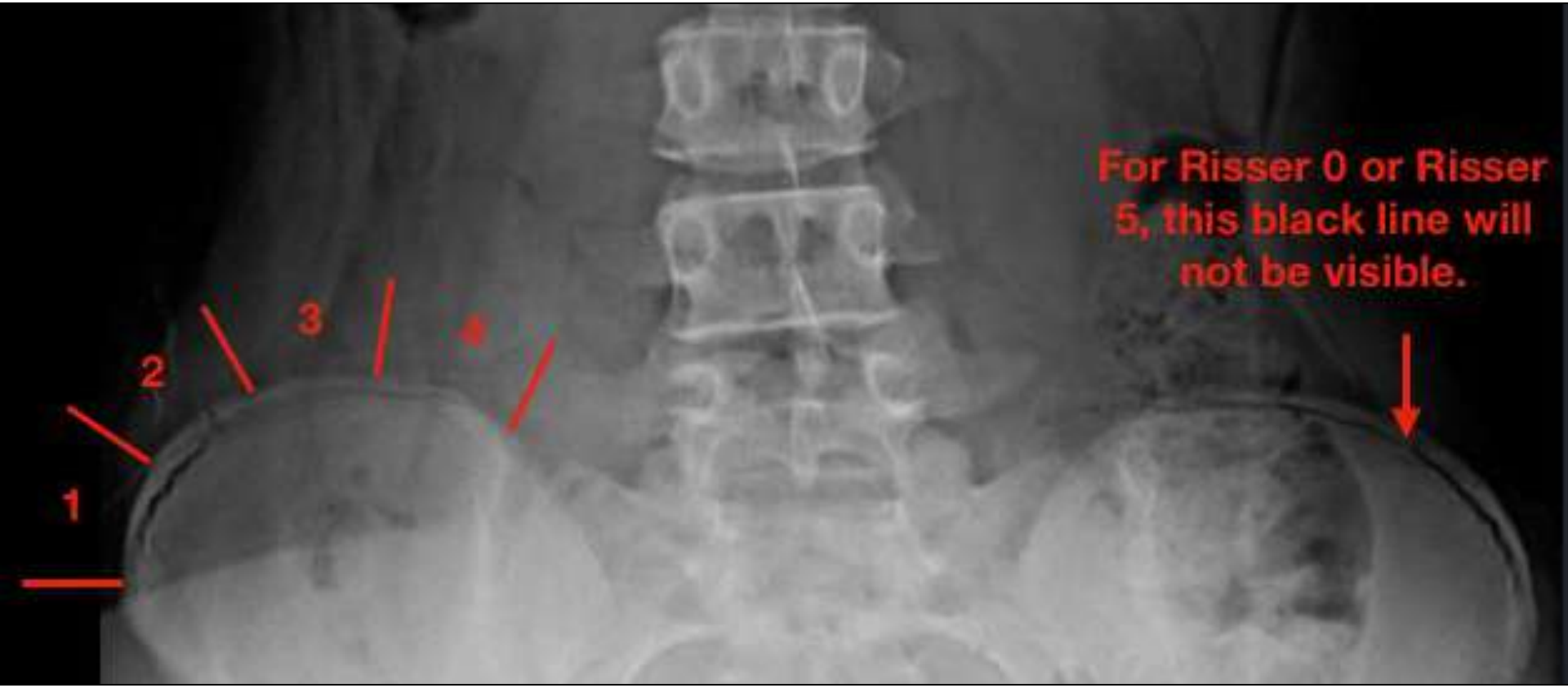
Assessment of progression

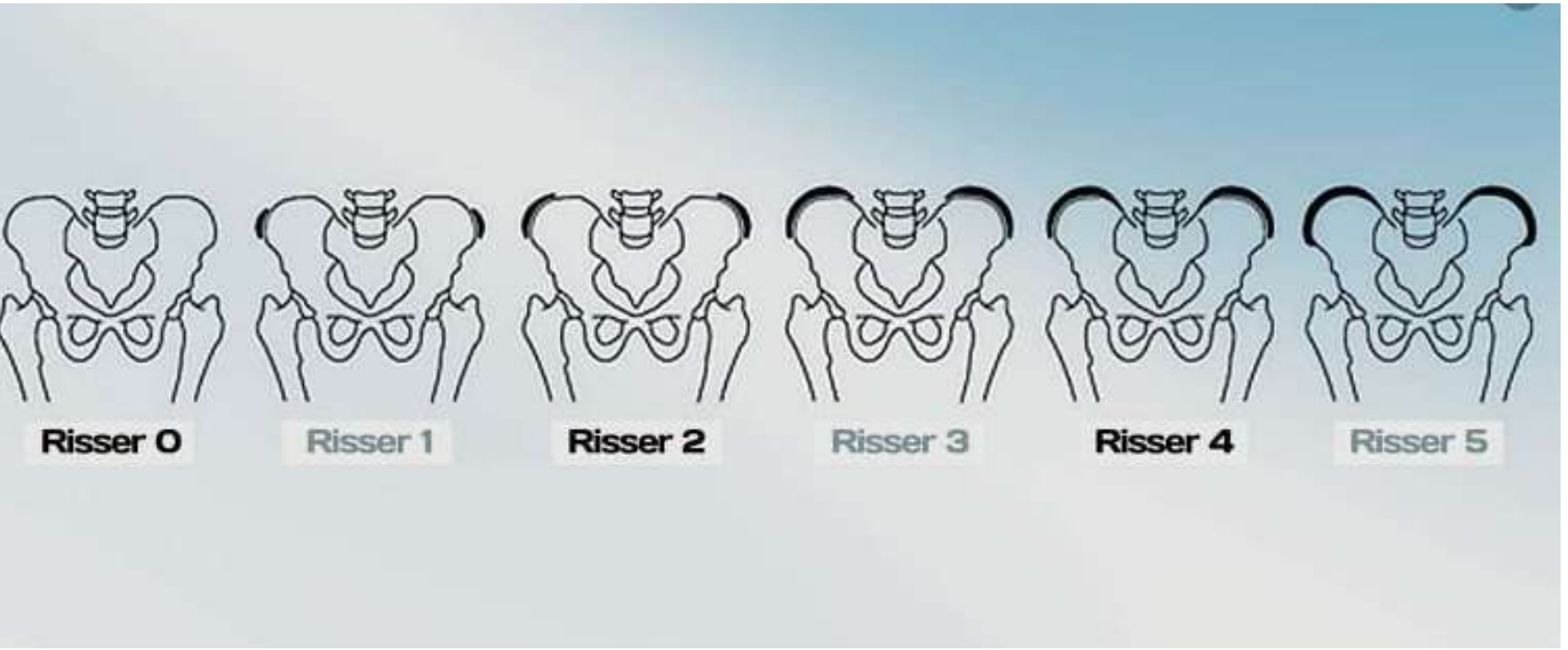


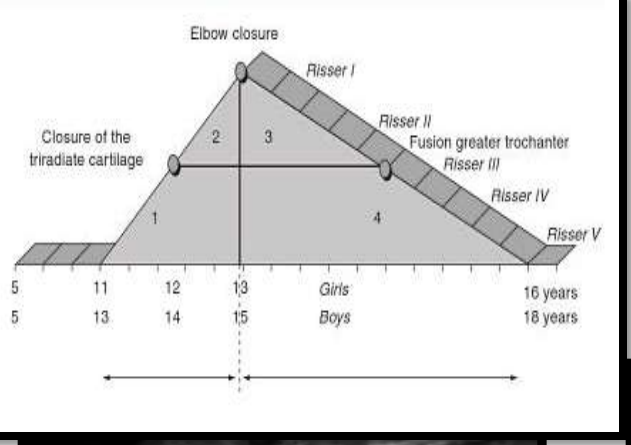
Assessment of progression

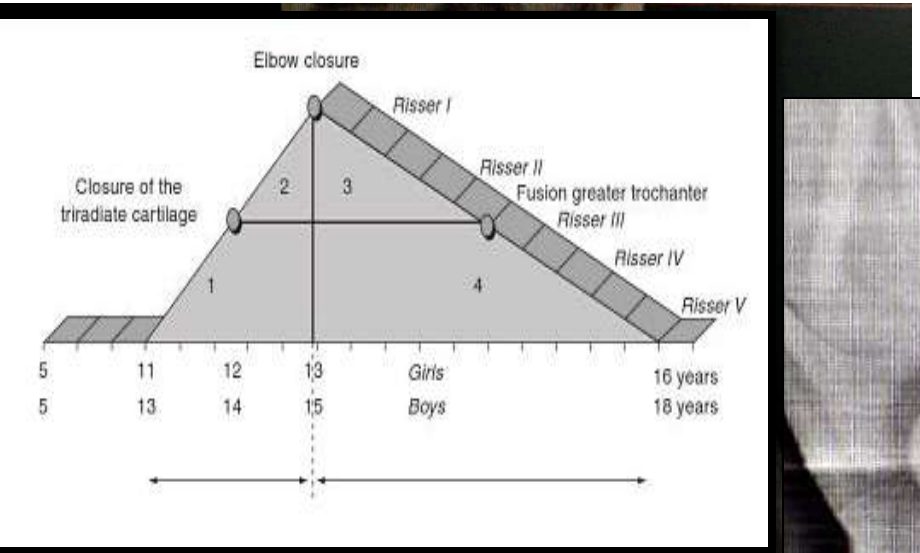
1. Rissers grading

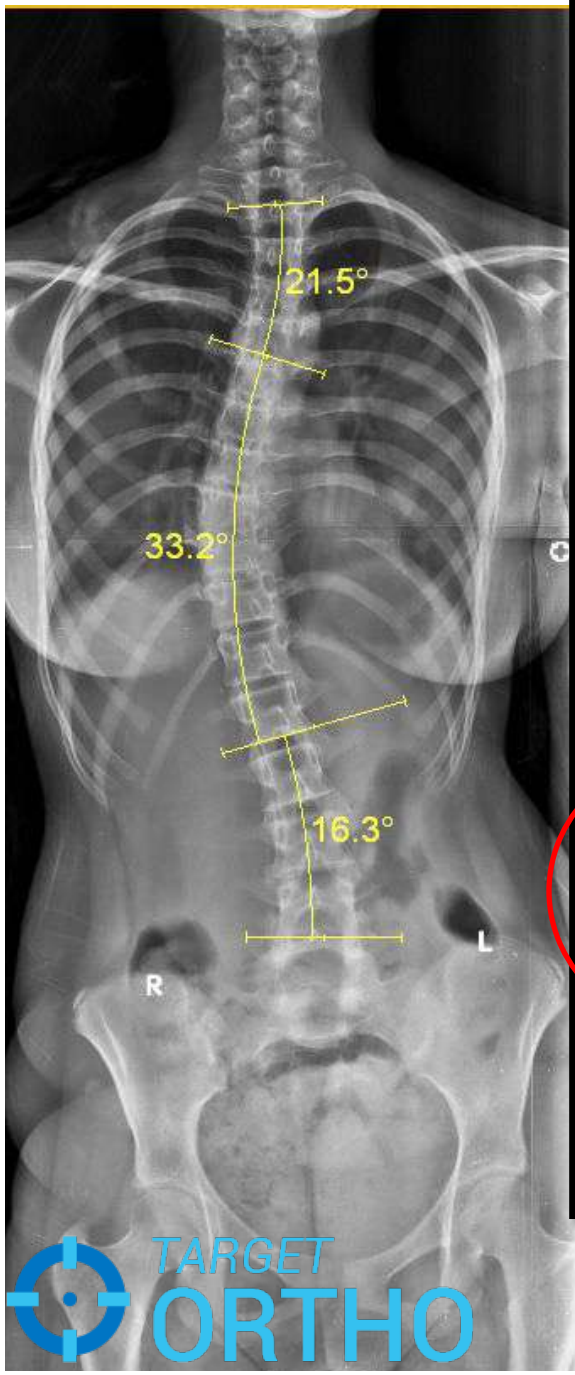
2. Fusion of triradiate cartilage & greater trochanter

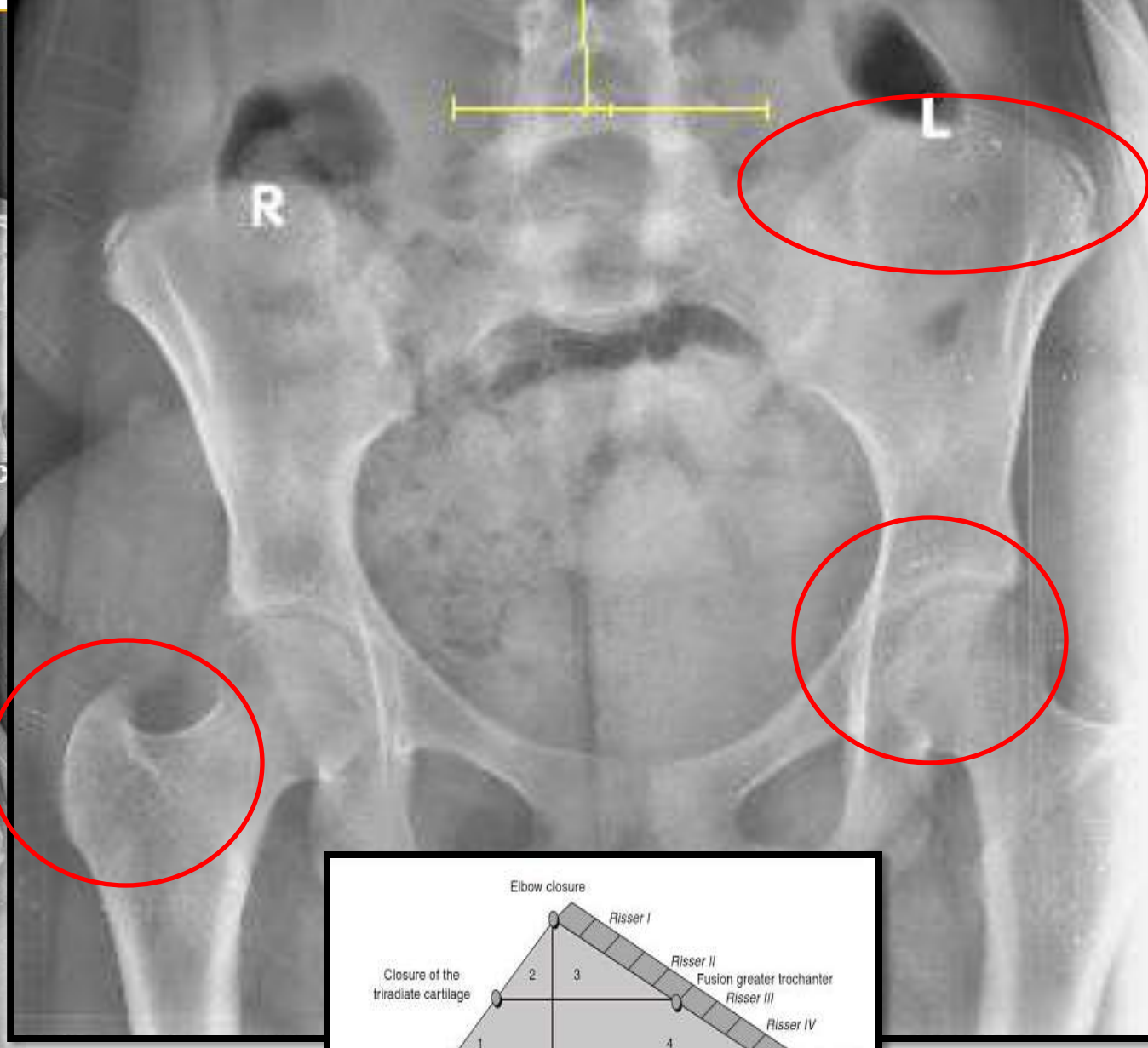


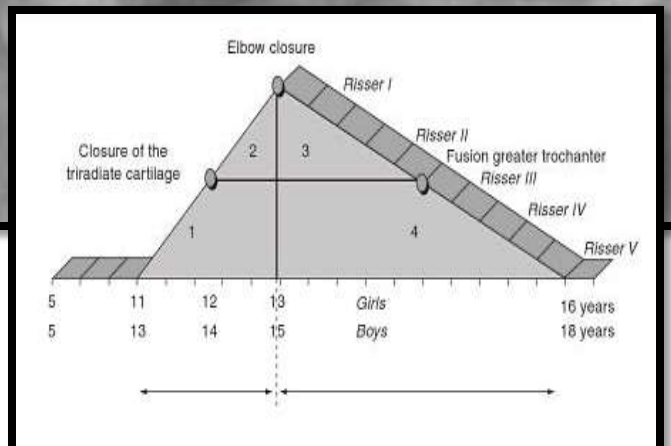


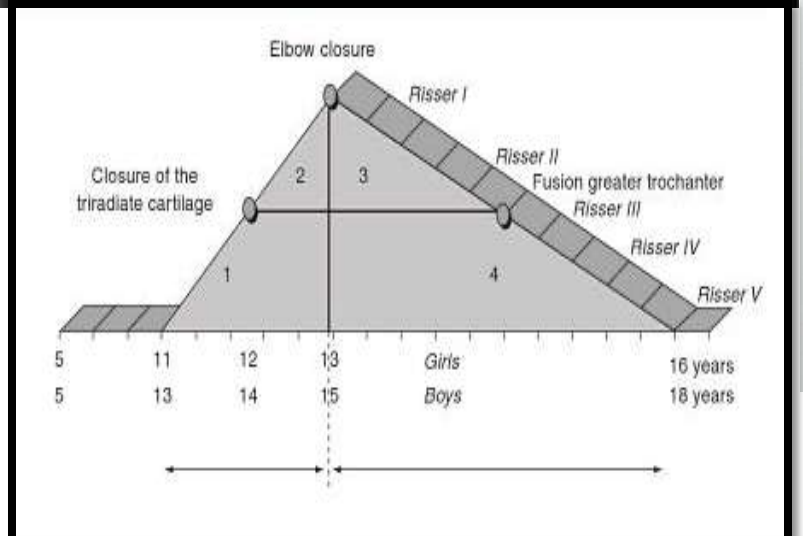












Curve progression

- **Curve type**
  - **thoracic more likely to progress than lumbar**
  - **double curves more likely to progress than single curves**

Adolescent Idiopathic Scoliosis

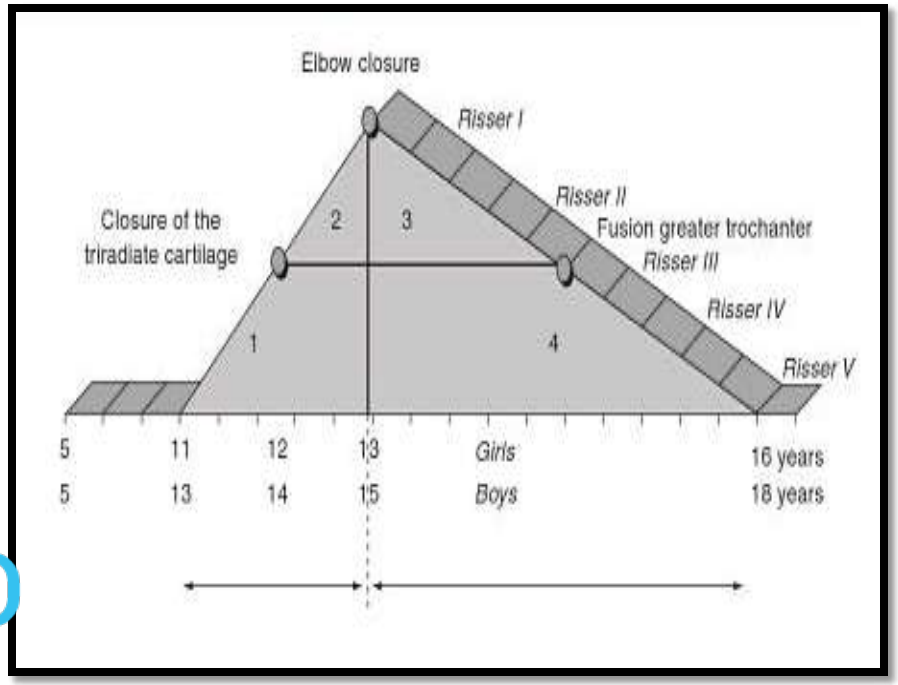
- Based on skeletal maturity of patient, magnitude of deformity, and curve progression
- **Nonoperative**
  - **observation alone**
  - **bracing**
- **Operative treatment**
  - **posterior spinal fusion**
  - **anterior spinal fusion**
  - **anterior / posterior spinal fusion**

Observation

Indications

Cobb angle < 25°

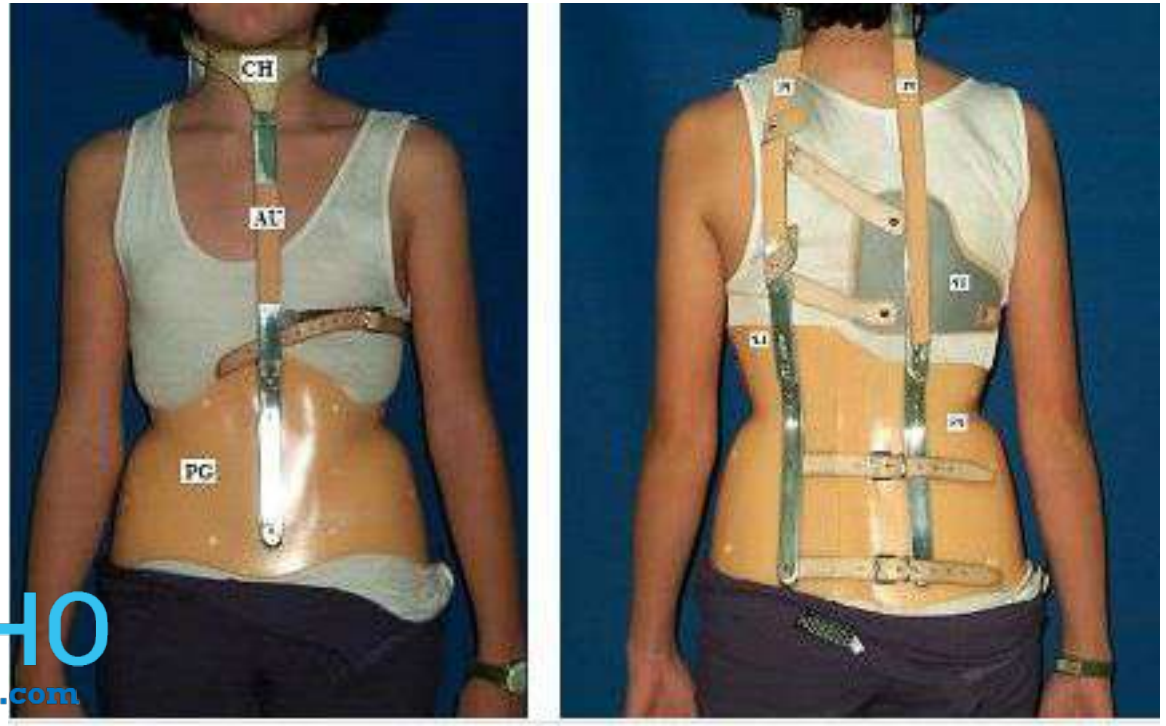
Serial radiographs to monitor for progression



Bracing

- cobb angle- 25° to 45°
- Flexible curve in skeletally immature patient (Risser 0, 1, 2)
- Goal is to stop progression, not to correct deformity
- Recommended for 16-23 hours/day until skeletal maturity or surgical intervention deemed necessary (actual wear minimum 12 hours required to slow progression

- Curves with apex above T7
  - Milwaukee brace (cervicothoracolumbosacral orthosis)
    - extends to neck for apex above T7



- **Apex at T7 or below**
  - » TLSO
  - » Boston-style brace (under arm)
  - » Charleston Bending brace is a curved night brace

Bracing

Bracing – continued till skeletal maturity *(rissers grade 4/5, 2 yrs post menarchal)*

Gradually weaned off over next 6 months.

Bracing success

- Not much curve progression
- Avoidence of surgery
- Cosmetic satisfaction

Bracing not indicated :

- Skeletal maturity
- Curve >45deg
- Curve <25deg – no evidence of progression
- Obese pt
- Thoracic lordosis

Surgery for AIS

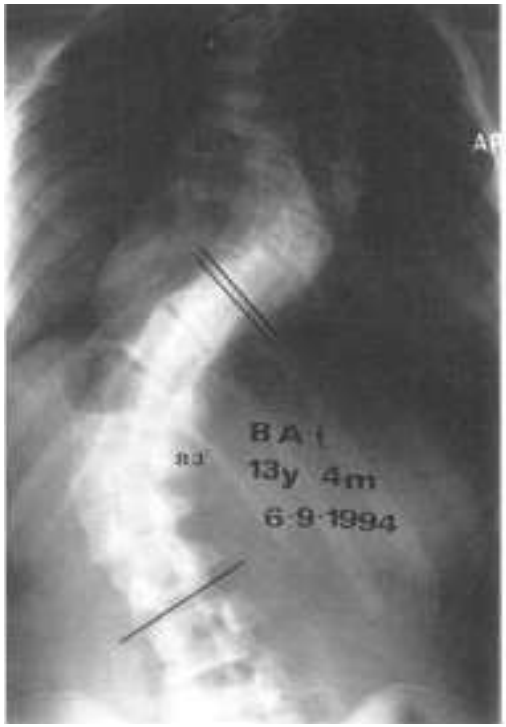
1. Curve magnitude > 45deg / 50deg – risk of curve progression even in adulthood
2. Pain – curve related
3. Cosmetic deformity
4. Failure of brace

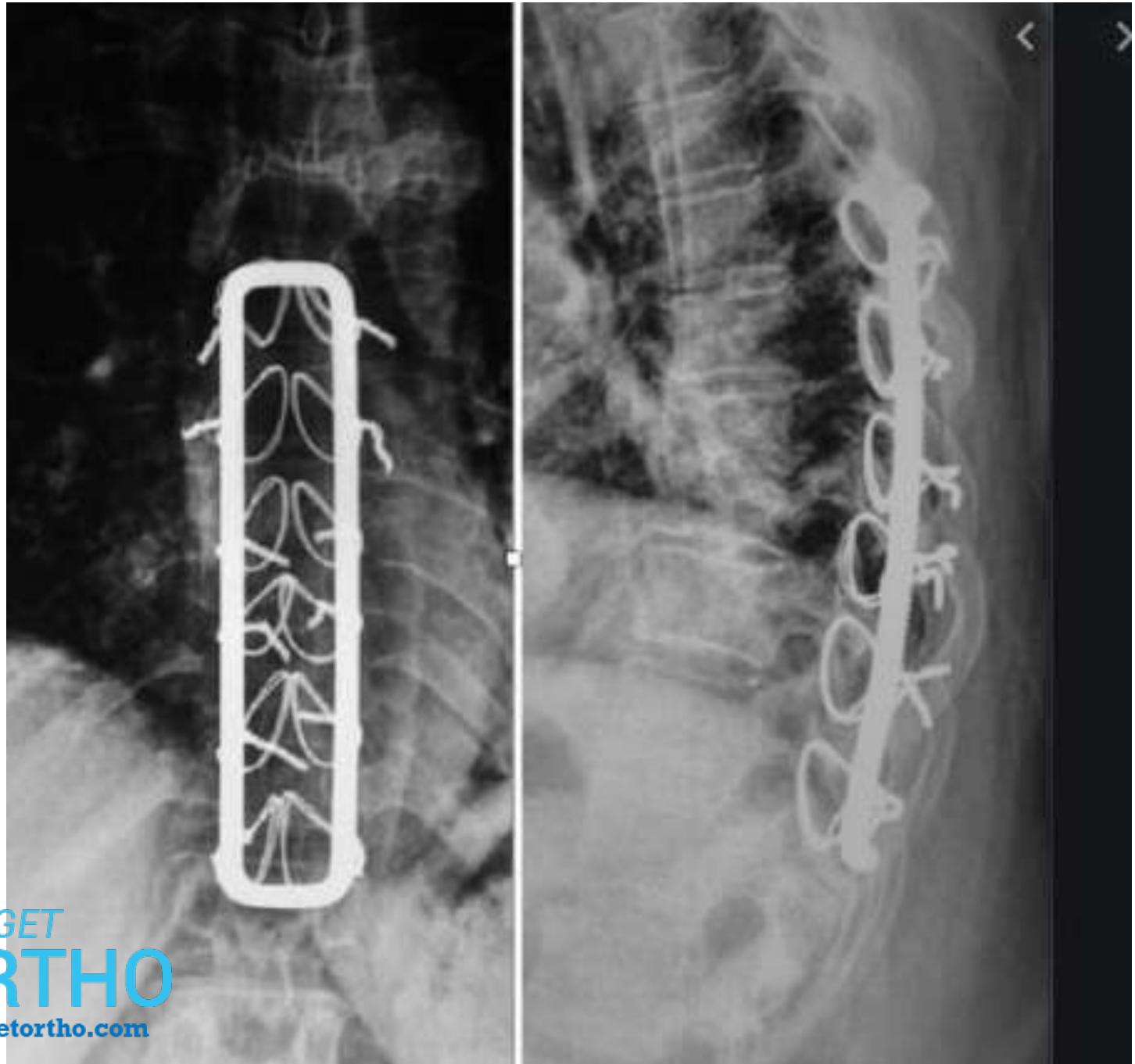
Posterior correction and fusion- most common

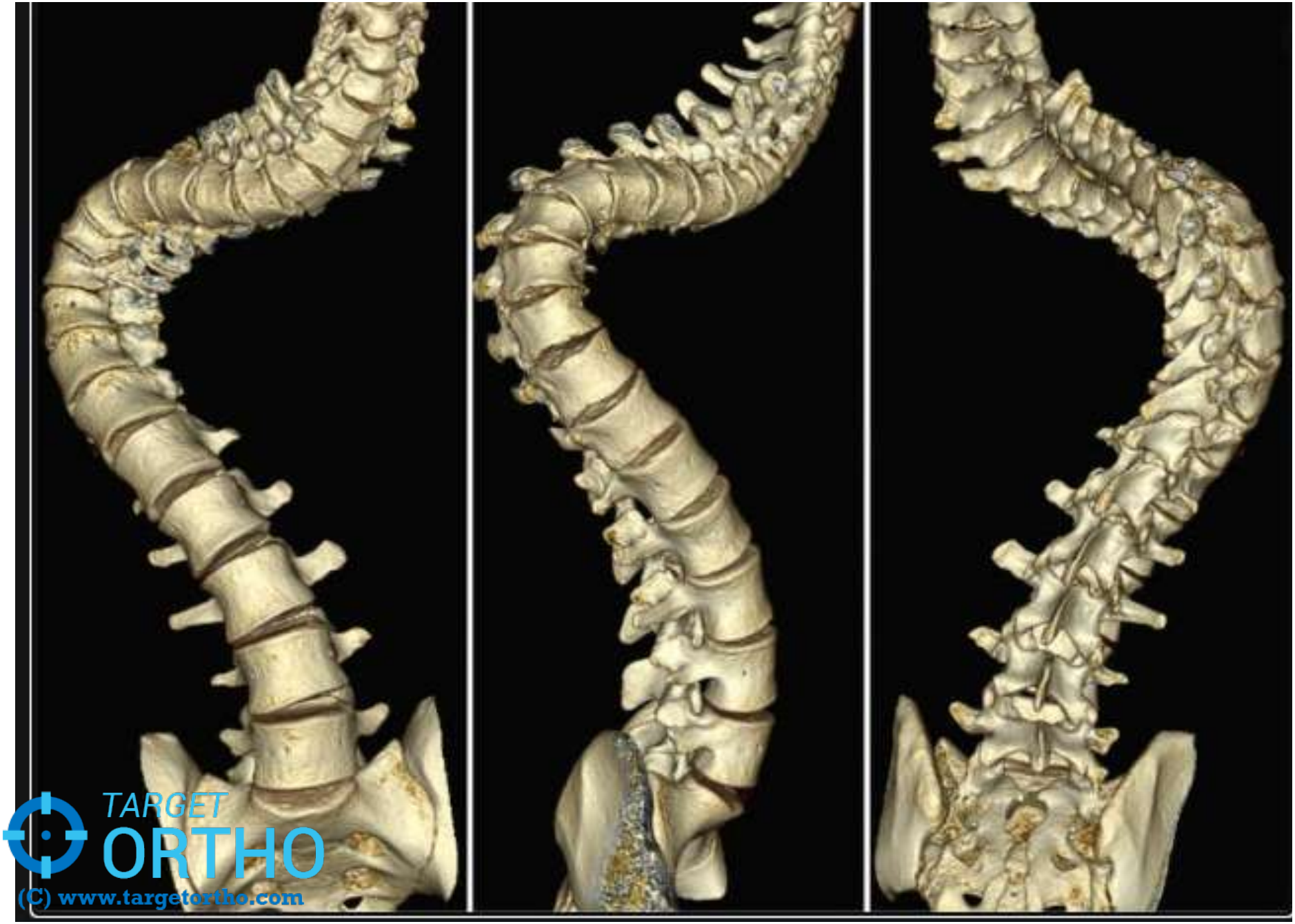
Anterior surgery – Rarely indicated

Harrington rods

Hartshell rectangle



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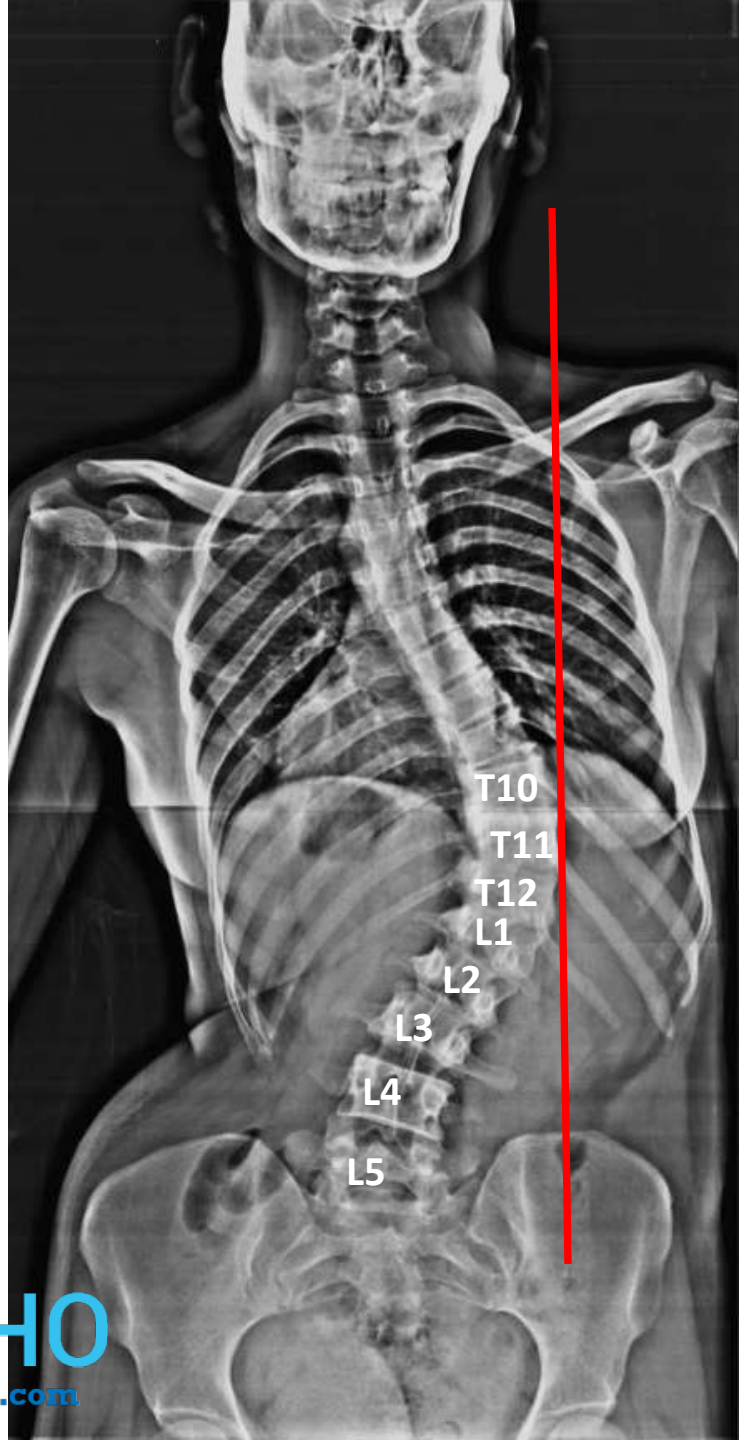
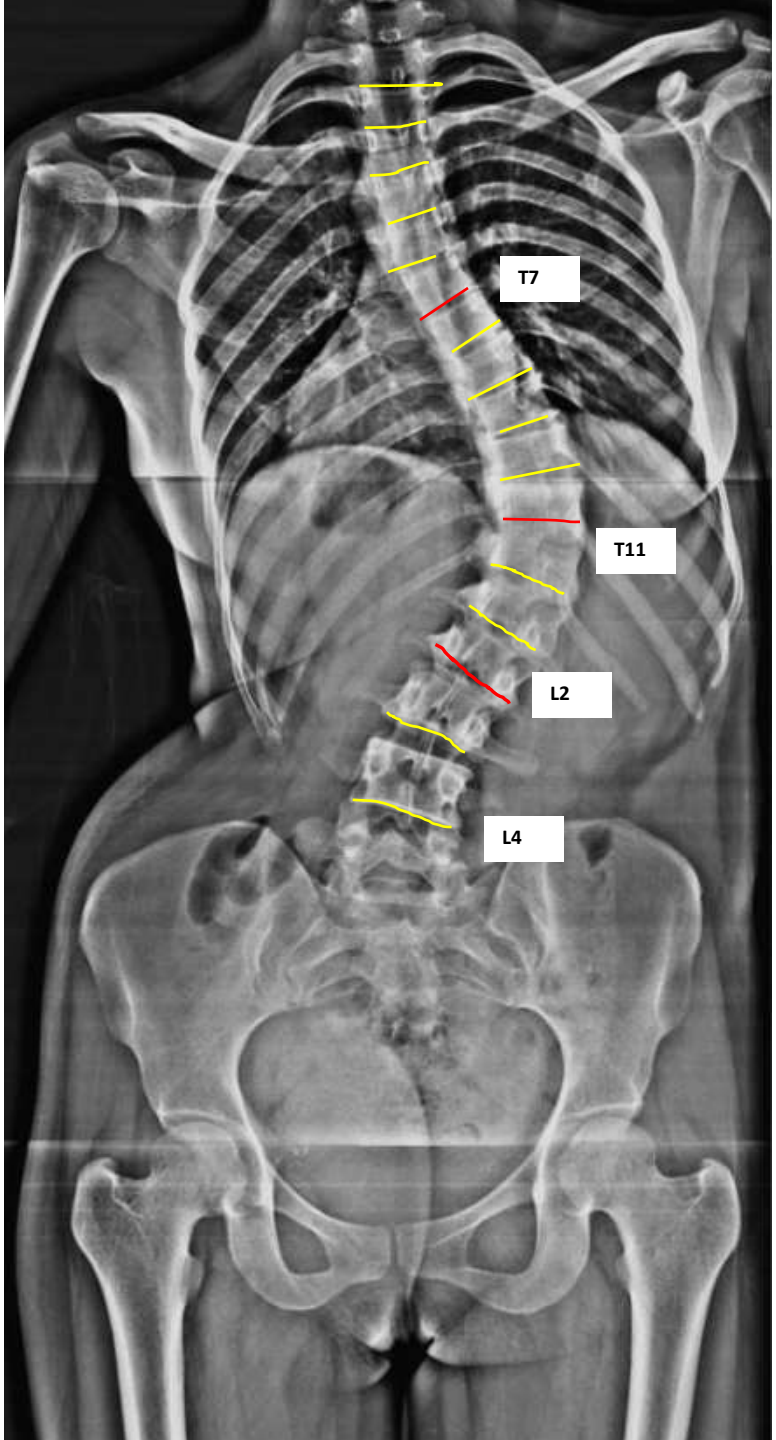
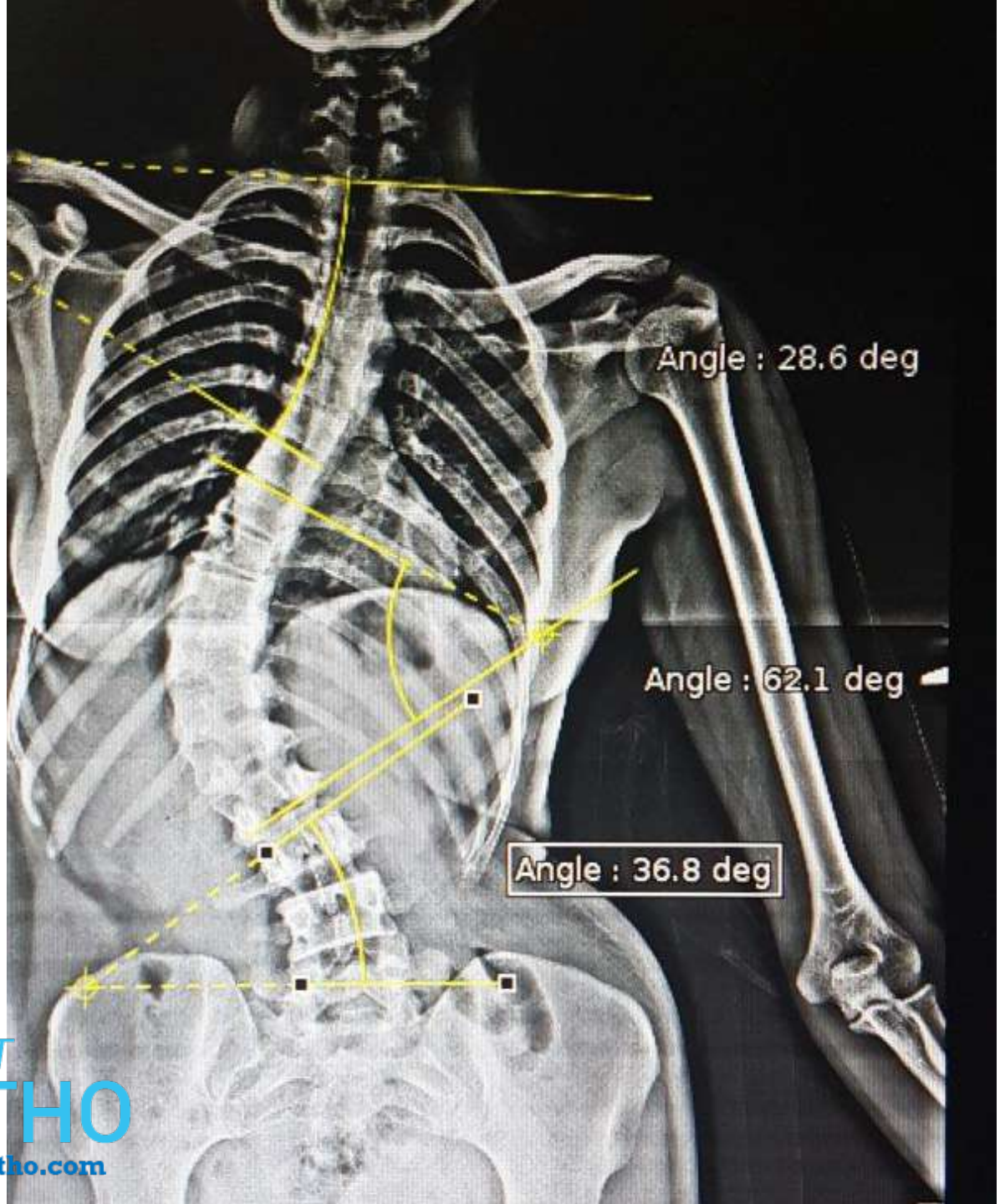
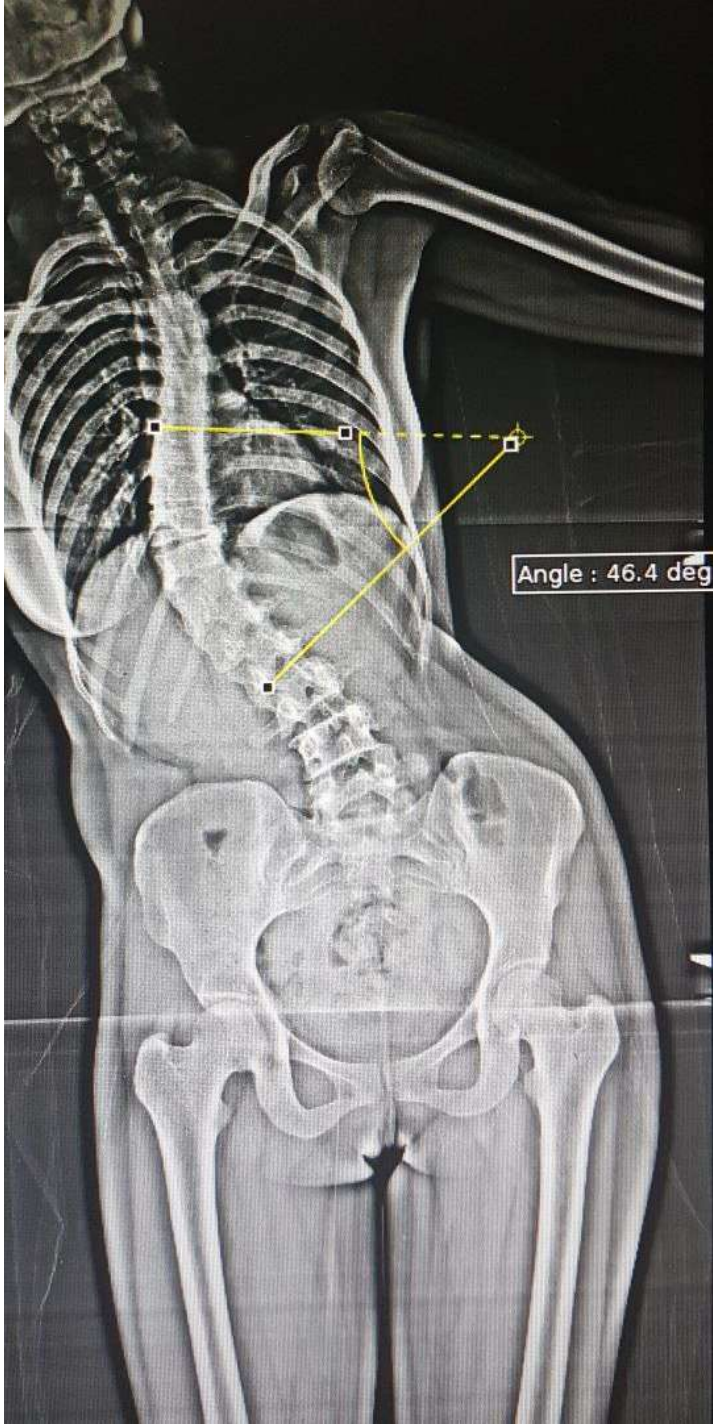
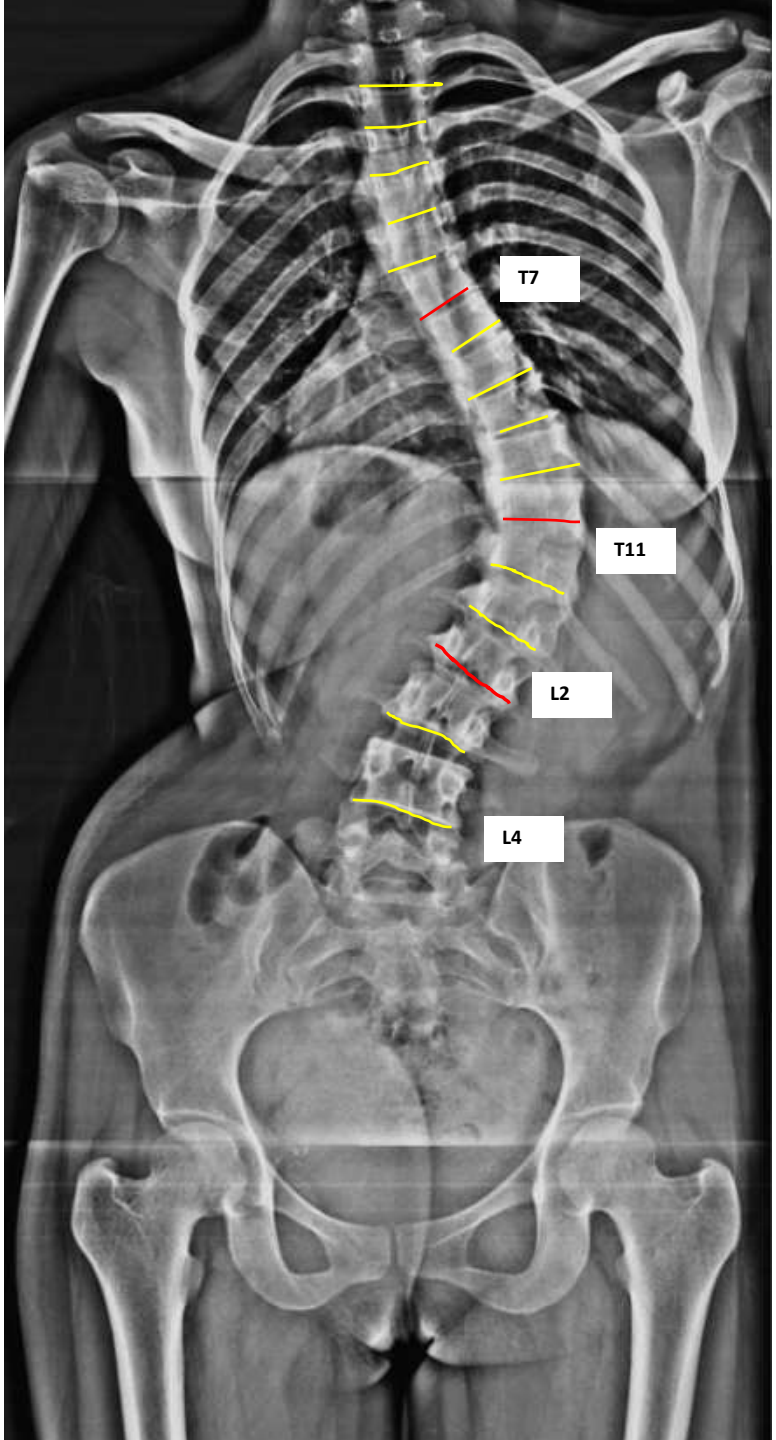
Identifying the levels in AIS











Upper end vertebra- T7

Lower end vertebra – L2

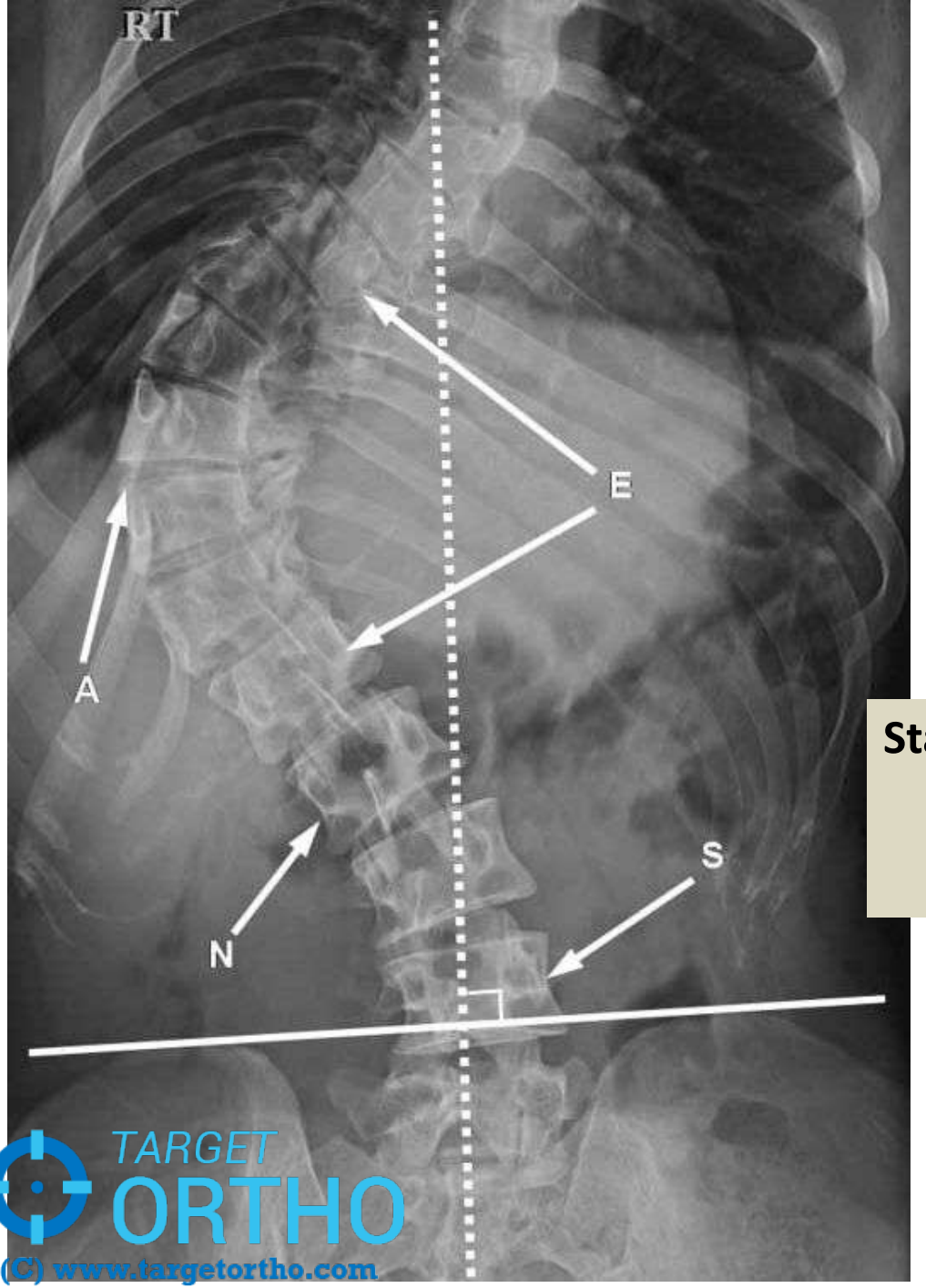
Upper instrumented vertebra= Upper end vertebra +1

Rt thoracic curve

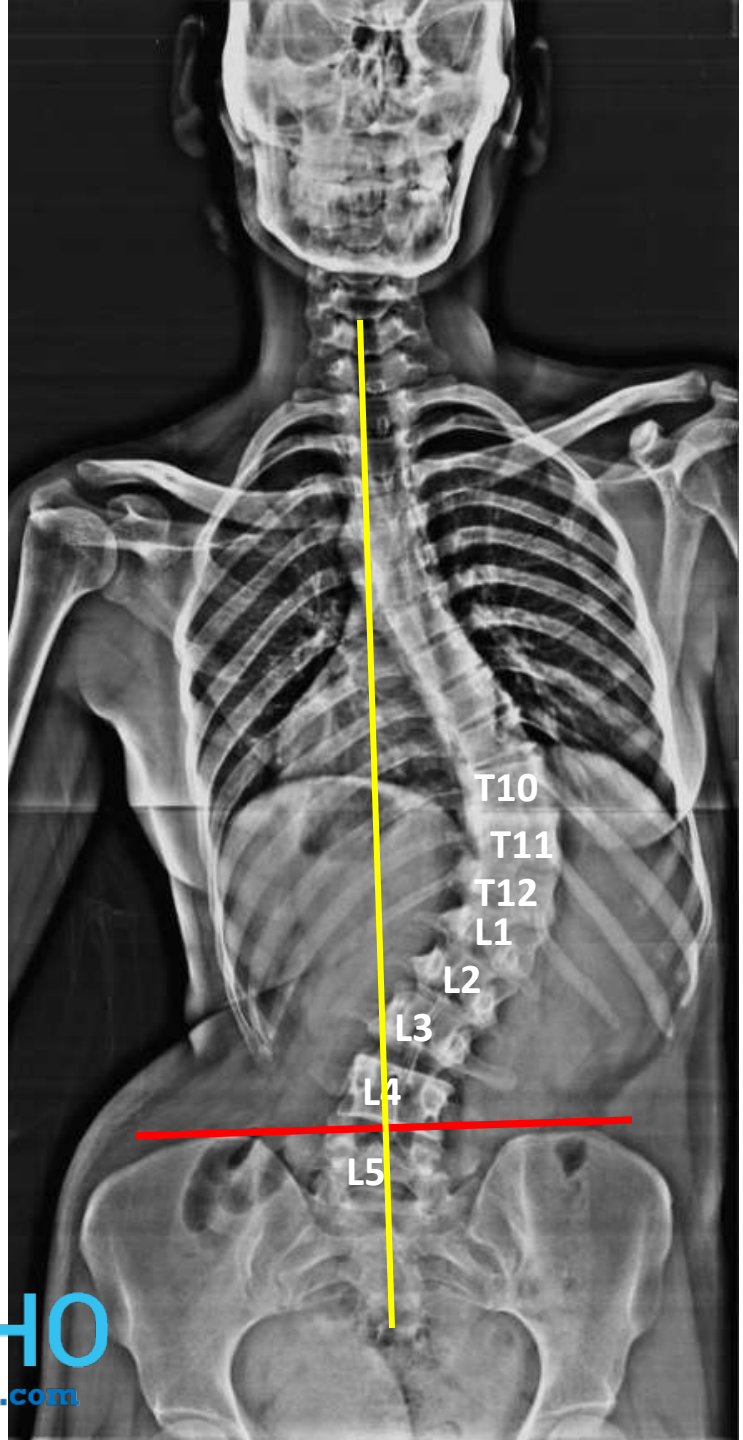
Rt shoulder is high- **T4**

Shoulder levels are same- **T3**

Left shoulder is high- **T2**



Stable vertebra (S) - is one that is bisected or nearly bisected by the CSVL (dotted line).



L4- stable vertebra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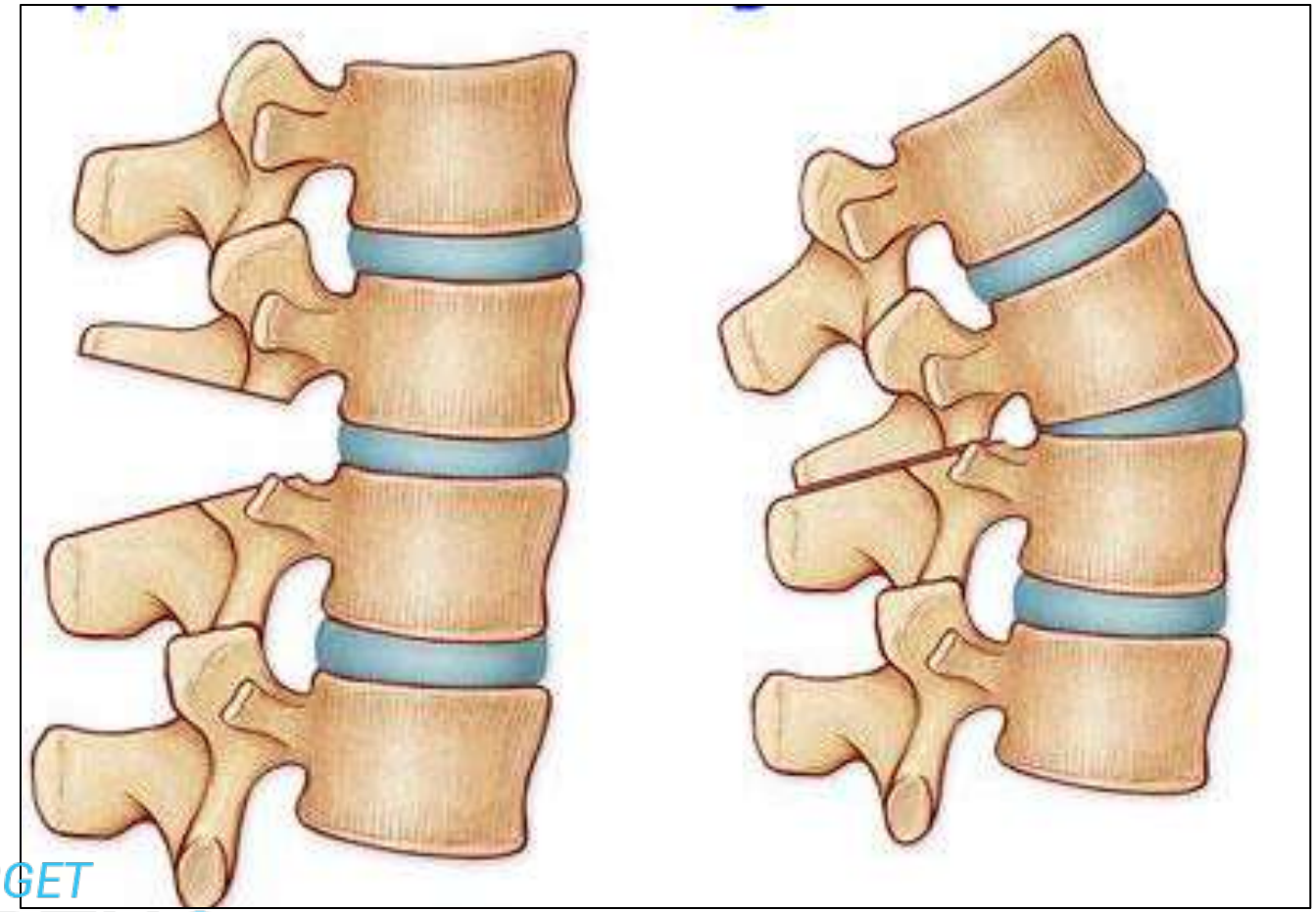
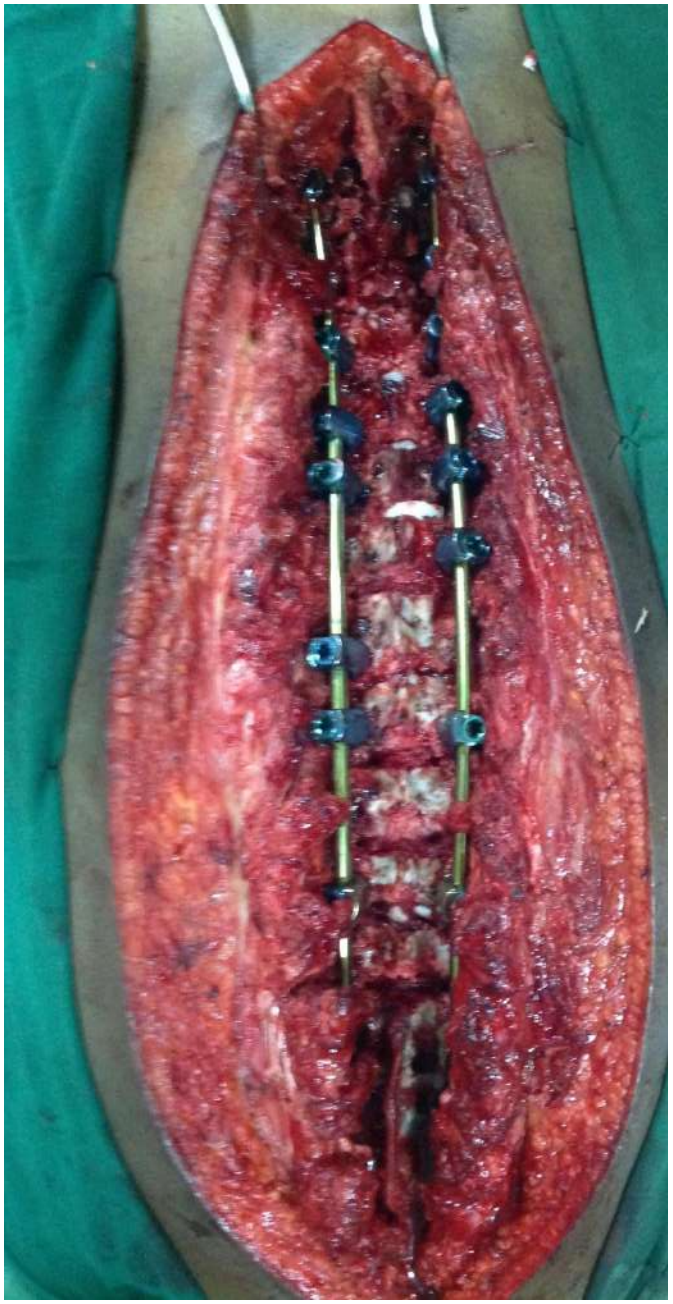
Modes of correction

- Posterior release – facetectomy / pontes osteotomy
- Cantelever technique
- Rod rotation method

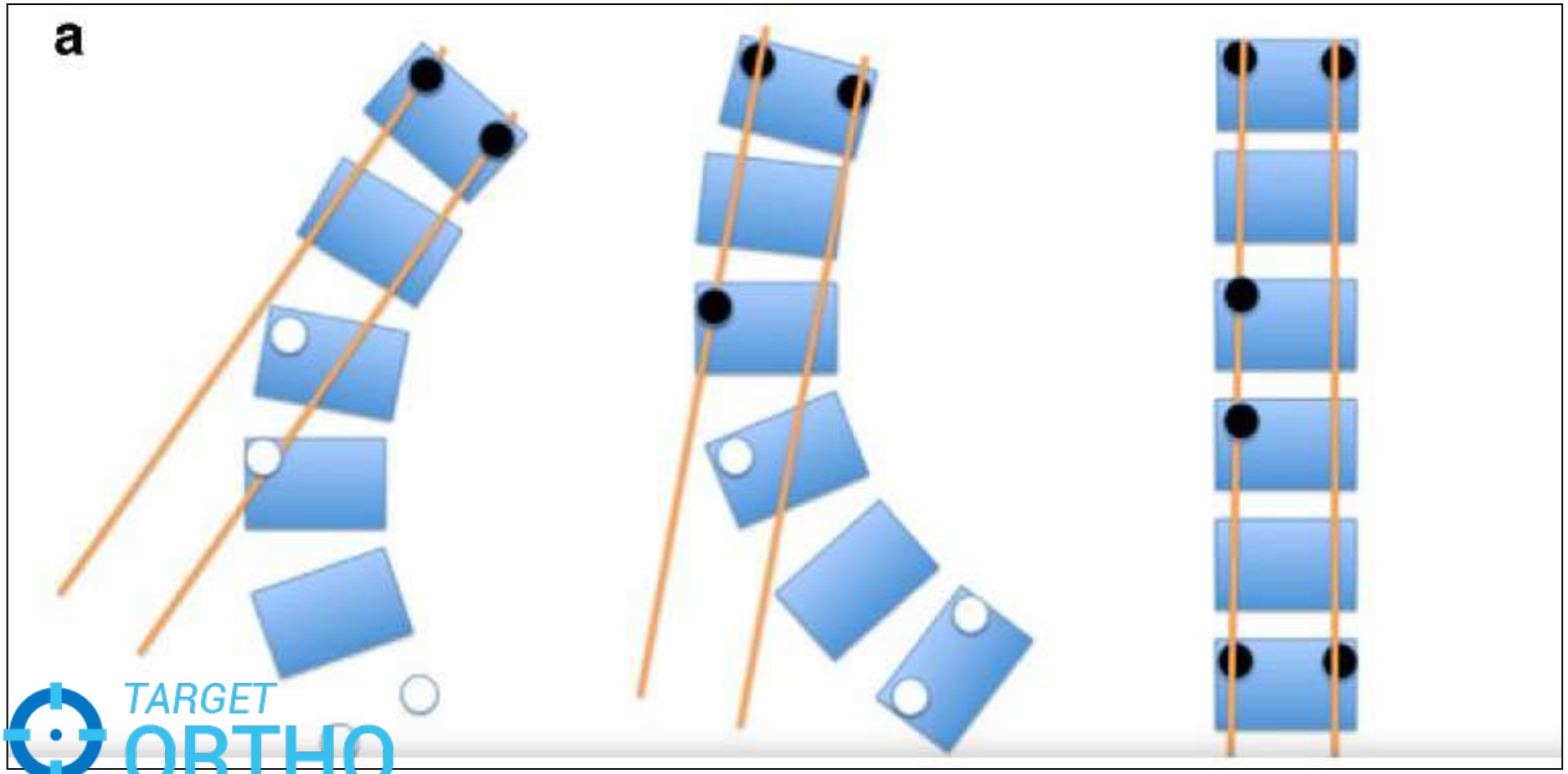
surgical treatment



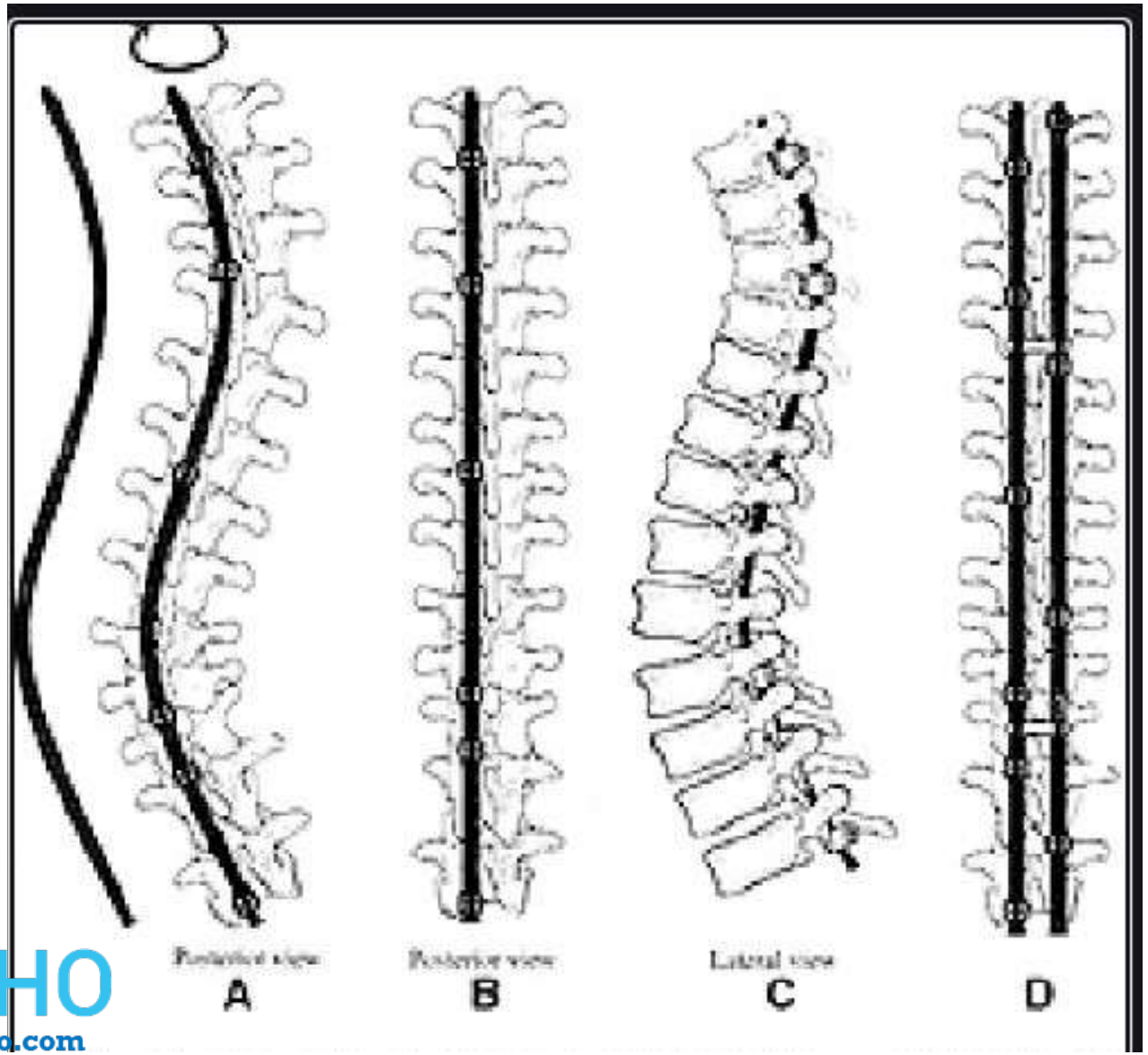
Pontes osteotomy



Cantelever technique



Rod rotation technique



Anterior spinal fusion

Indications

Best for thoracolumbar and lumbar

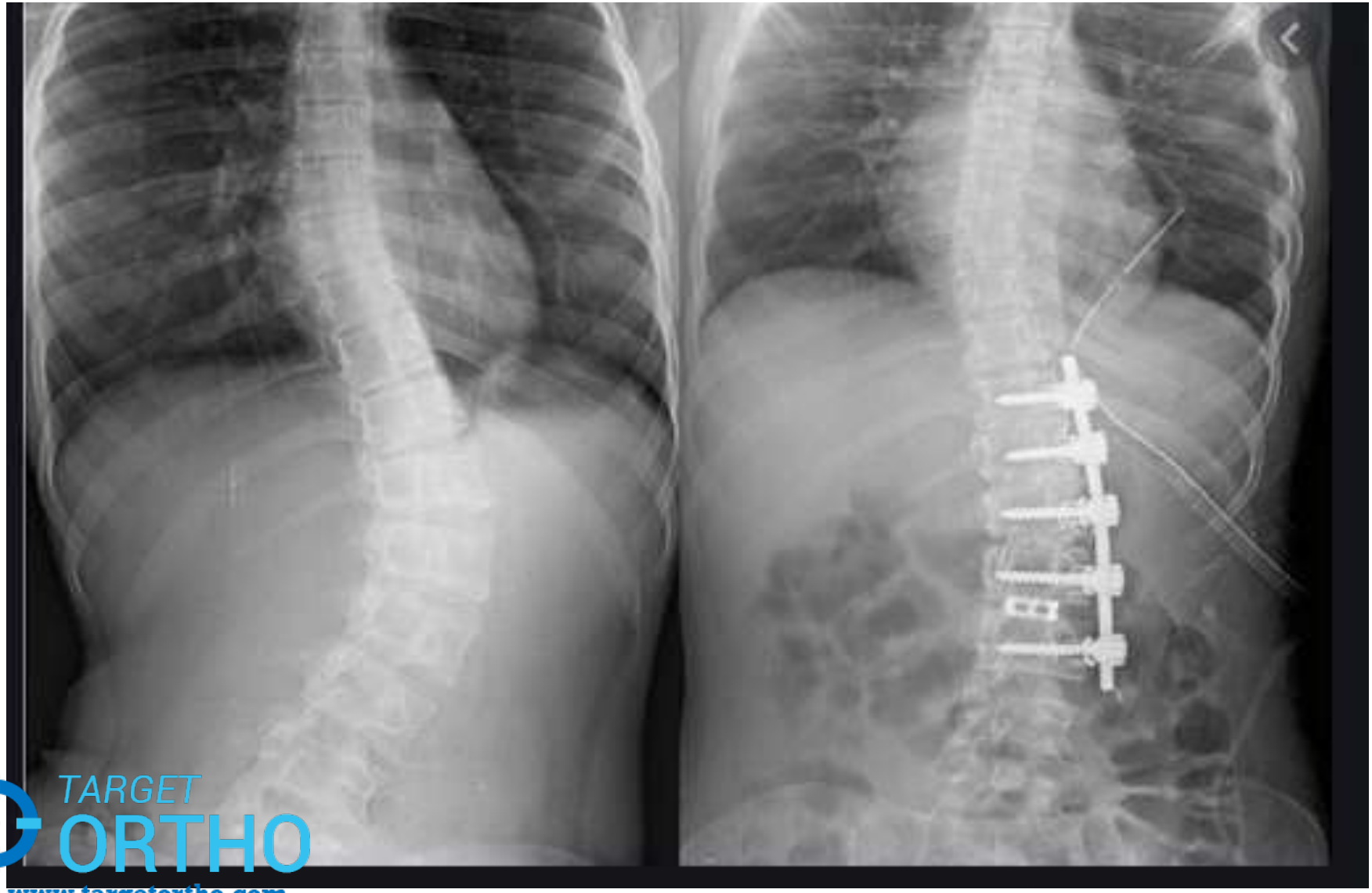
Better correction while saving lumbar fusion levels

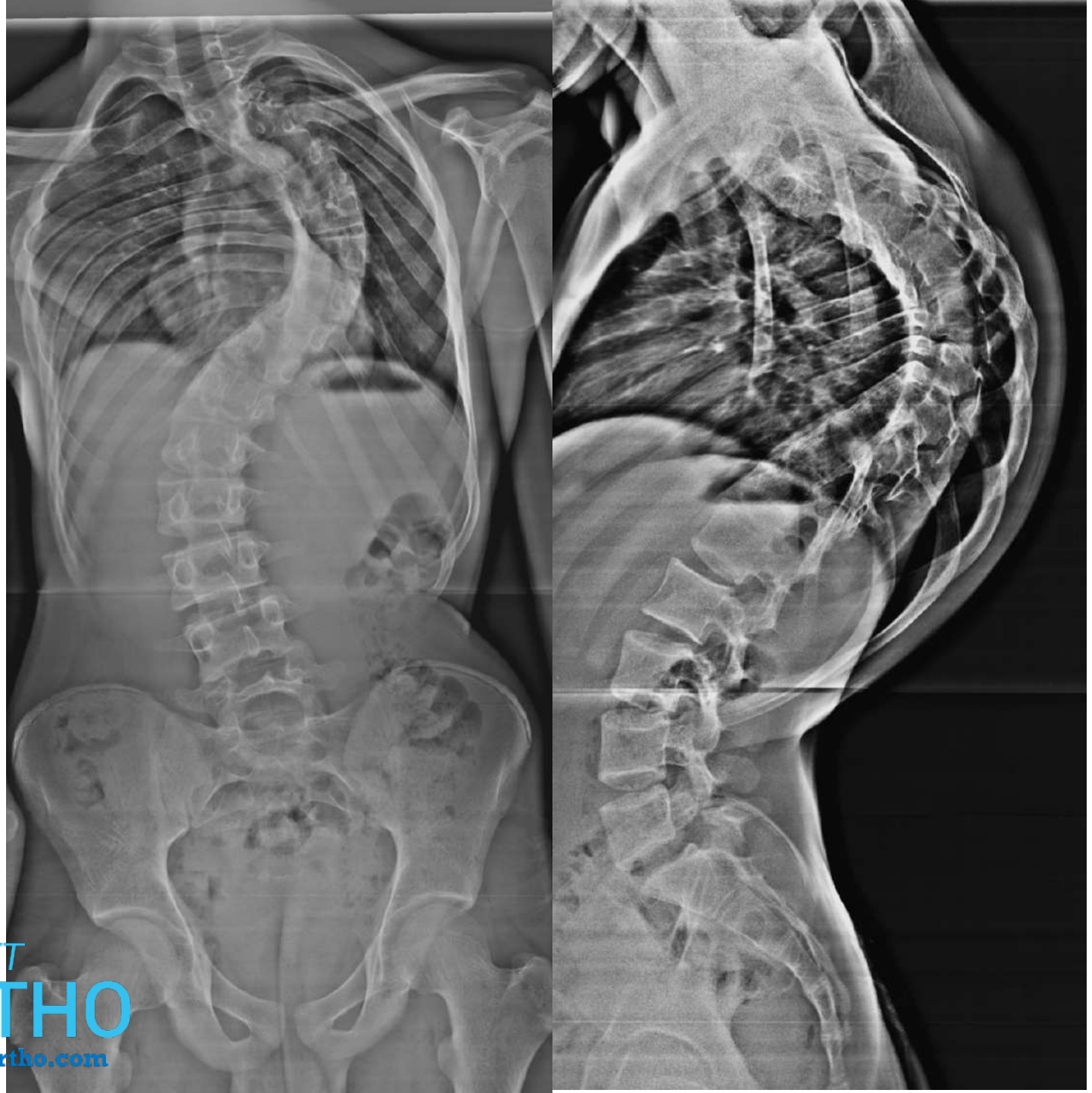
Disadvantage

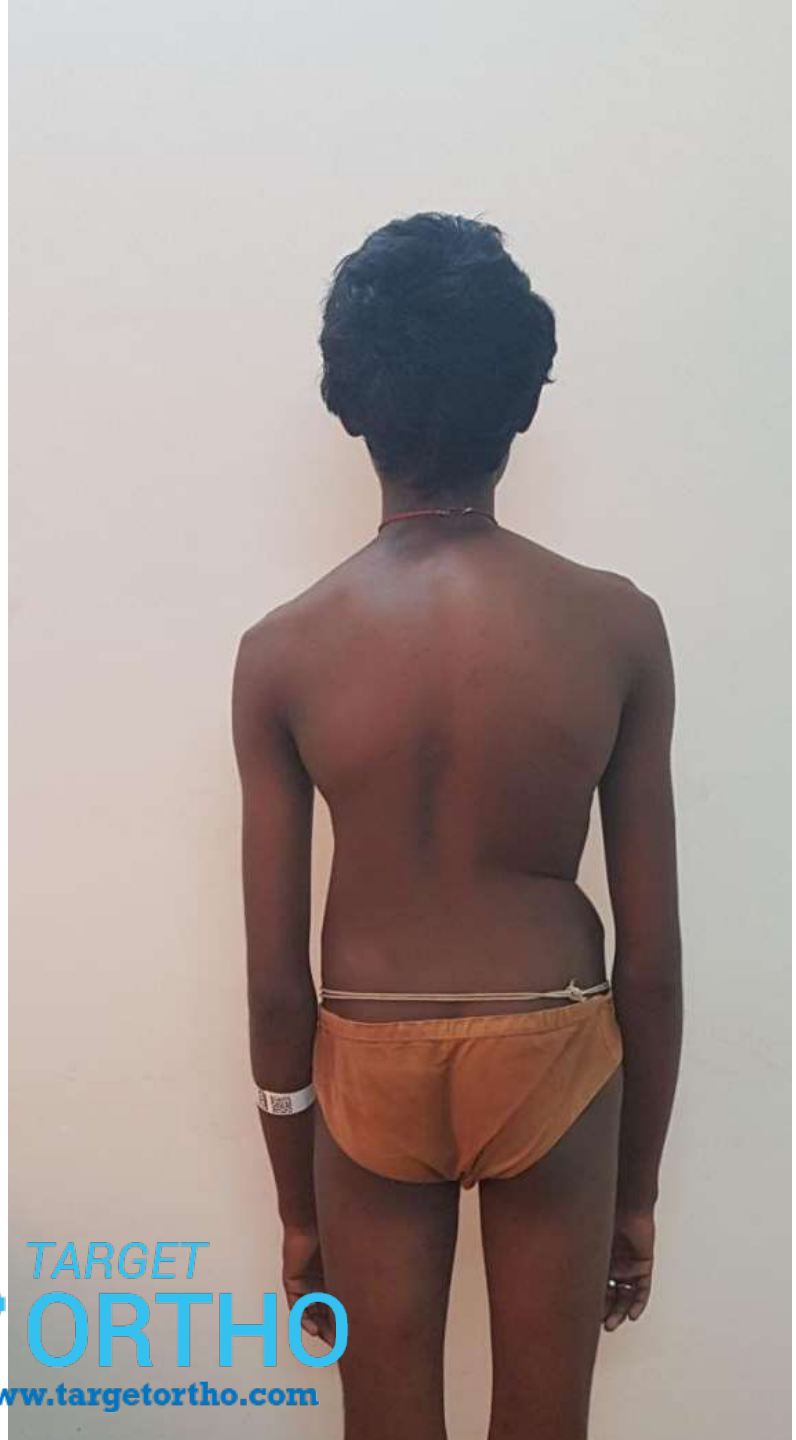
Exposure related morbidity

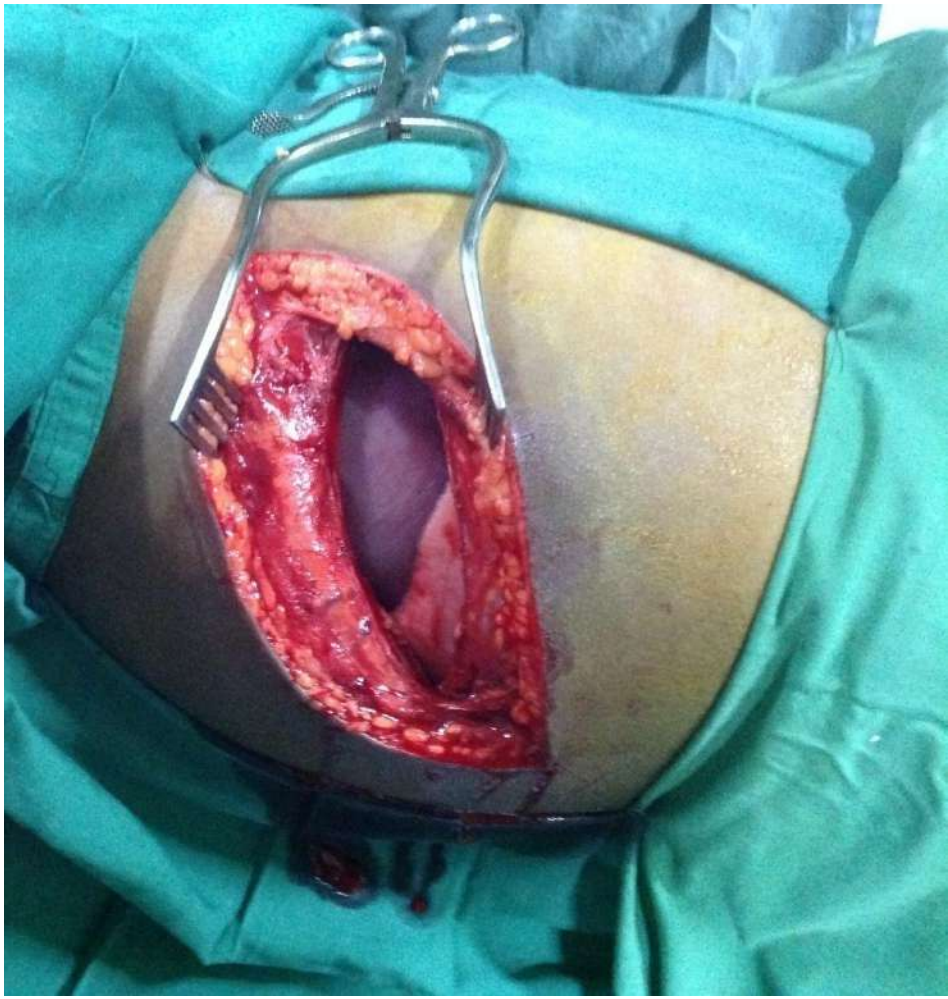
fusion levels

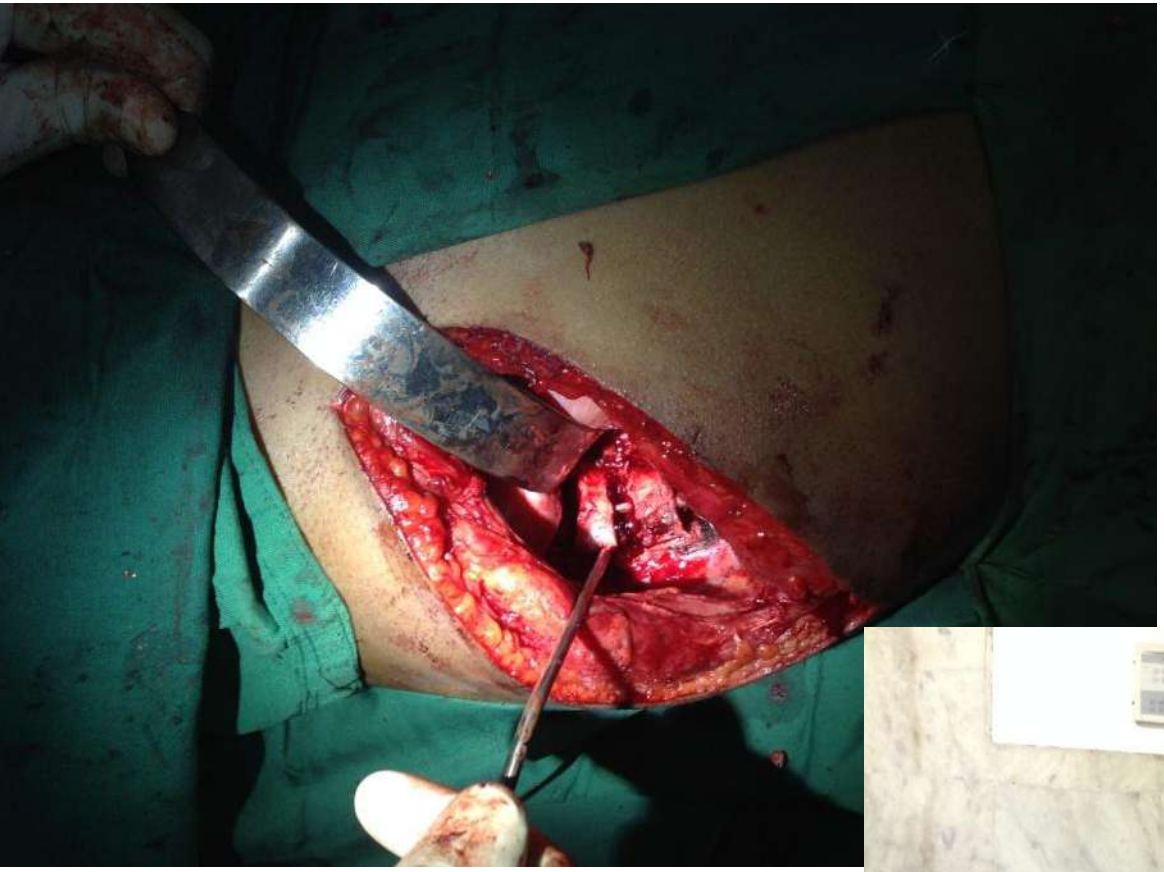
typically fuse from end vertebra to end vertebra

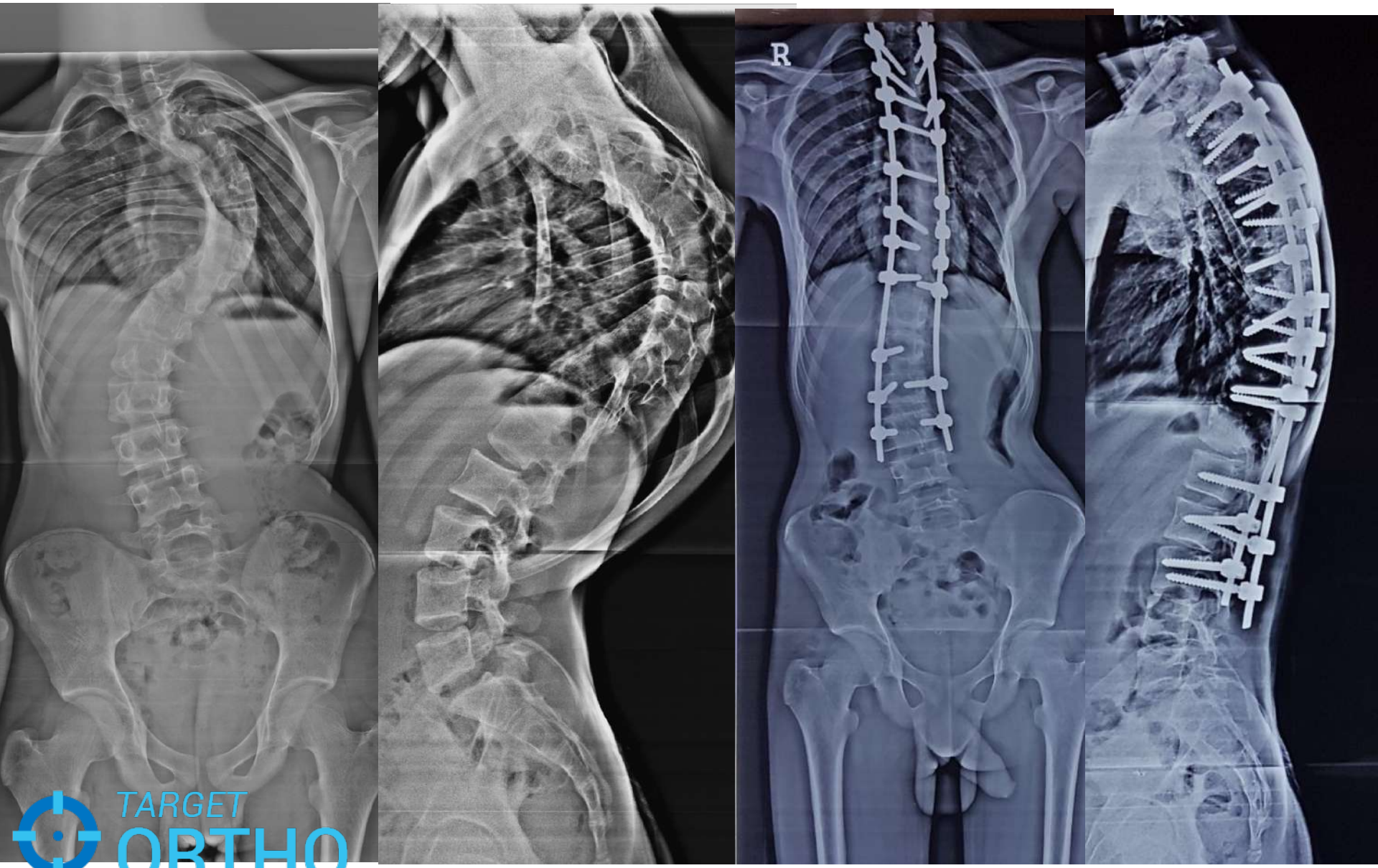




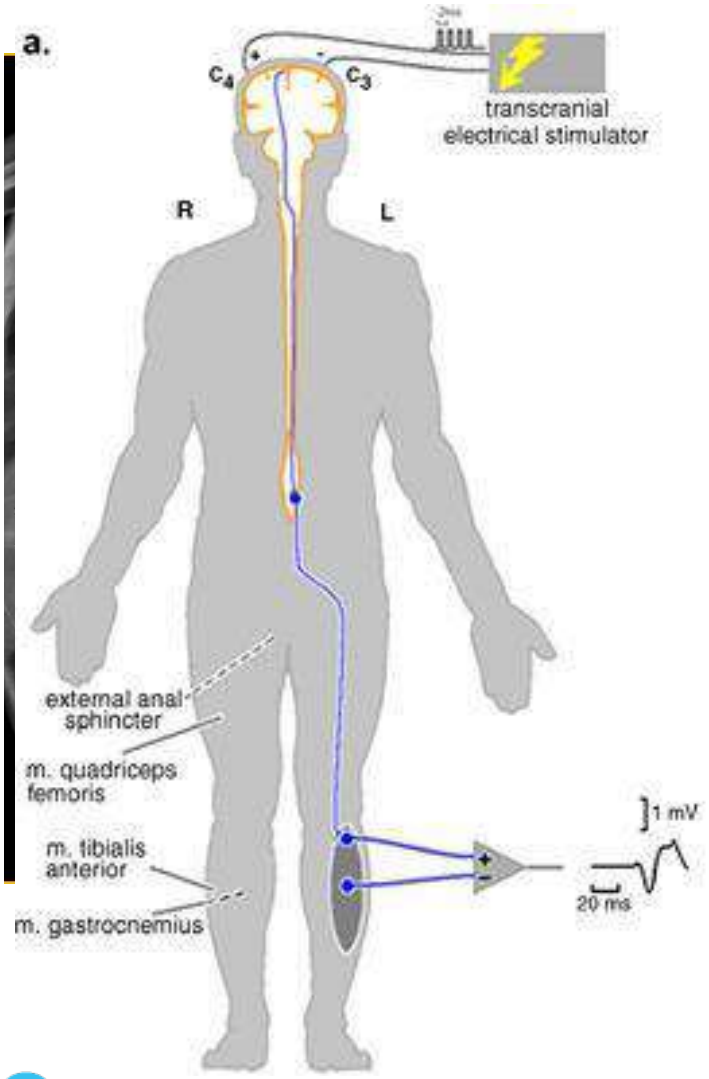


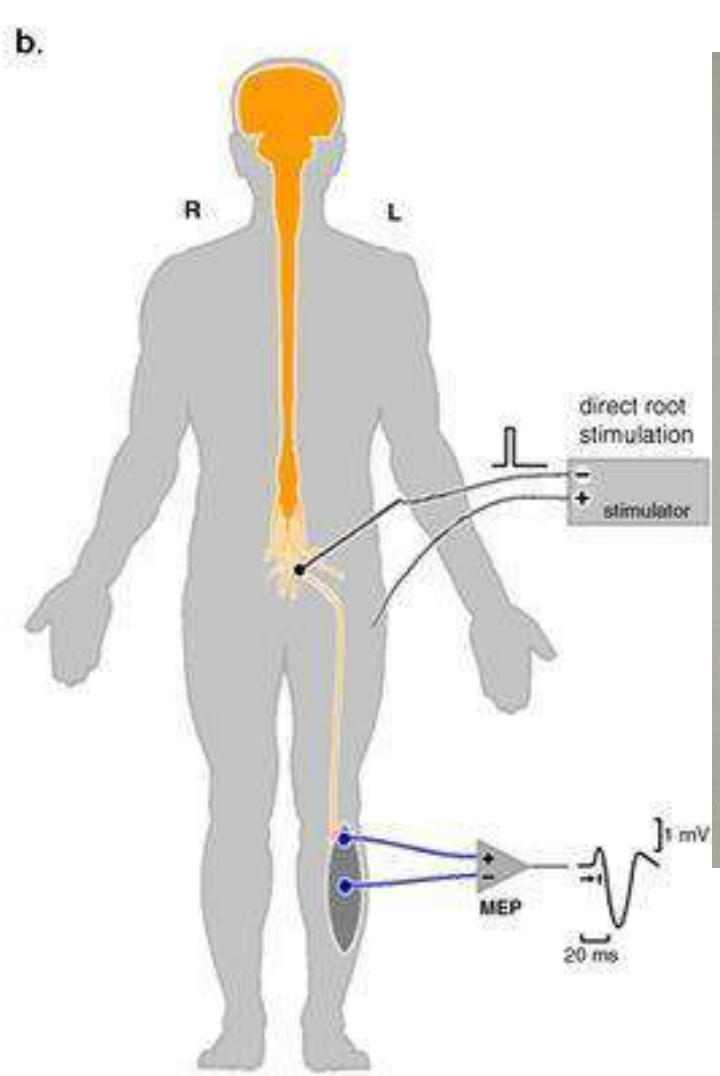






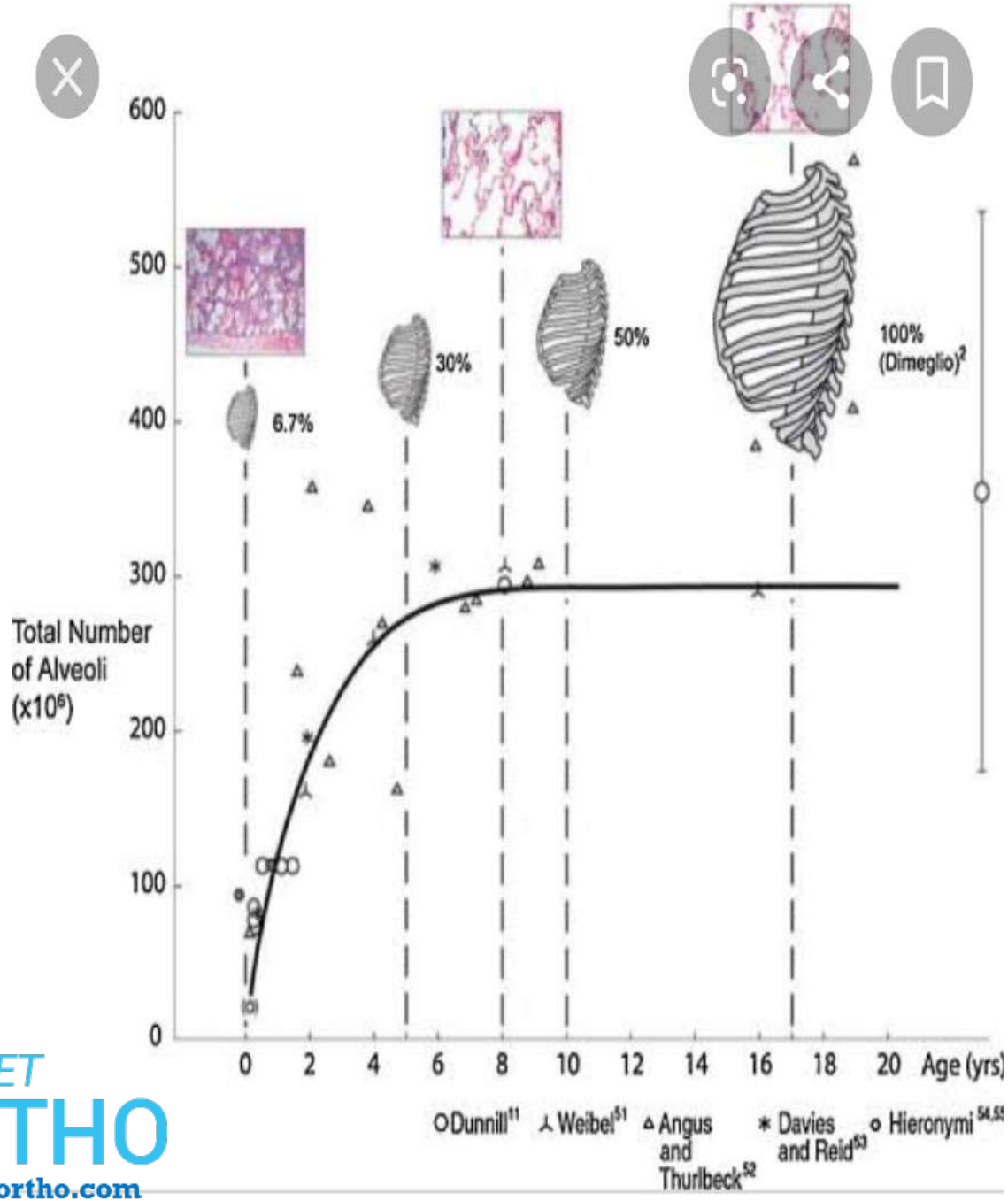
- **Neurologic Monitoring**
  - Somatosensory-evoked potentials (SSEPs)
  - Motor-evoked potentials (MEP)
    - motor-evoked potentials can provide an intraoperative warning of impending spinal cord dysfunction
  - neurologic event defined as drop in amplitude of > 50%
  - if neurologic injury occurs intraoperatively consider
    - check for technical problems
    - check blood pressure and elevate if low
    - check hemoglobin and transfuse as necessary
    - lessen/reverse correction
    - administer Stagnaras wake up test
    - remove instrumentation if the spine is stable



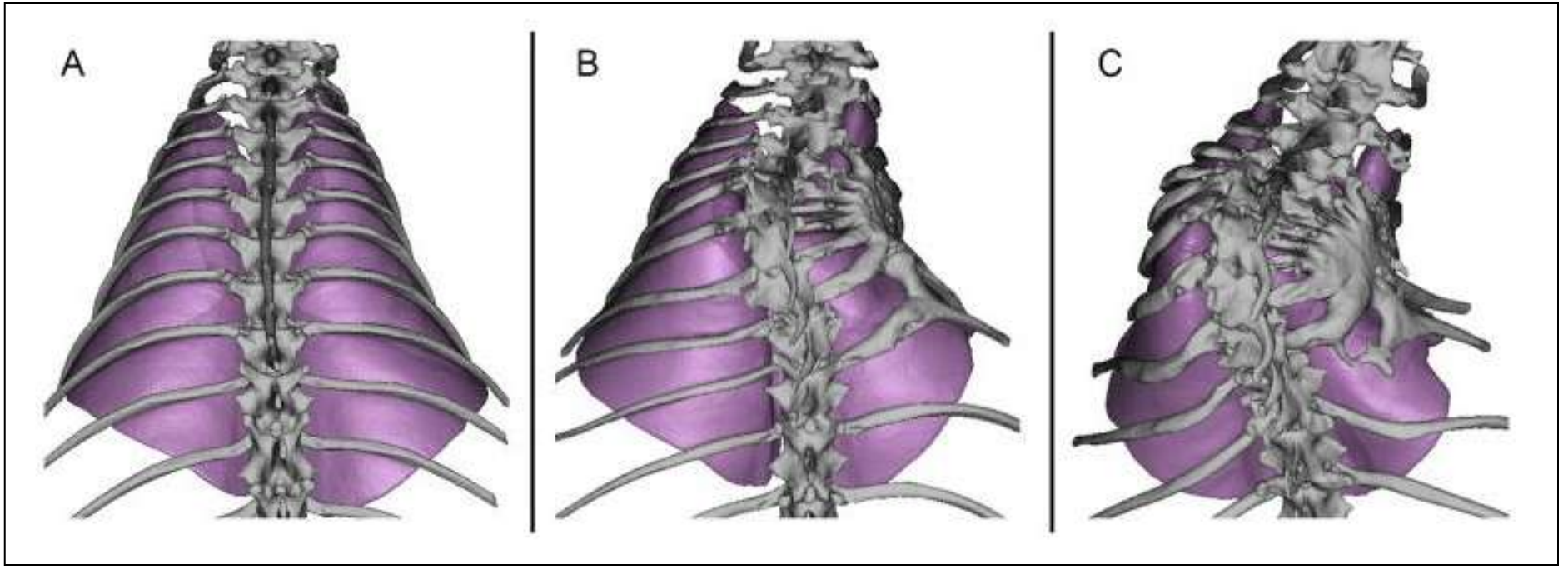


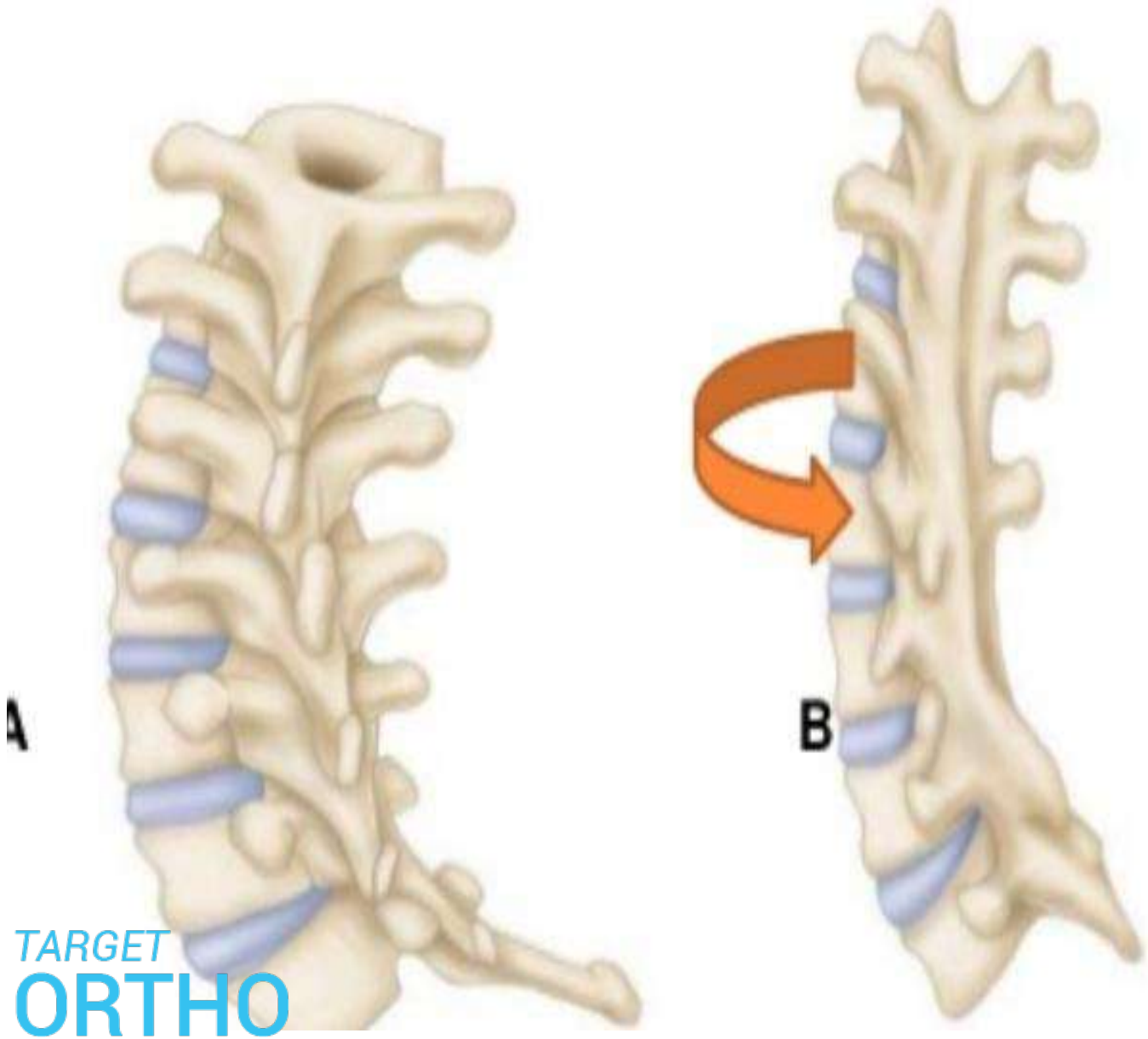
Complication

- Neurologic injury
- Pseudoarthrosis (1-2%)
- Infection (1-2%)
- Flat back syndrome
- Crankshaft phenomenon
- SMA syndrome (superior mesenteric artery [SMA] syndrome)
- Hardware failure



What happens in deformed chest?





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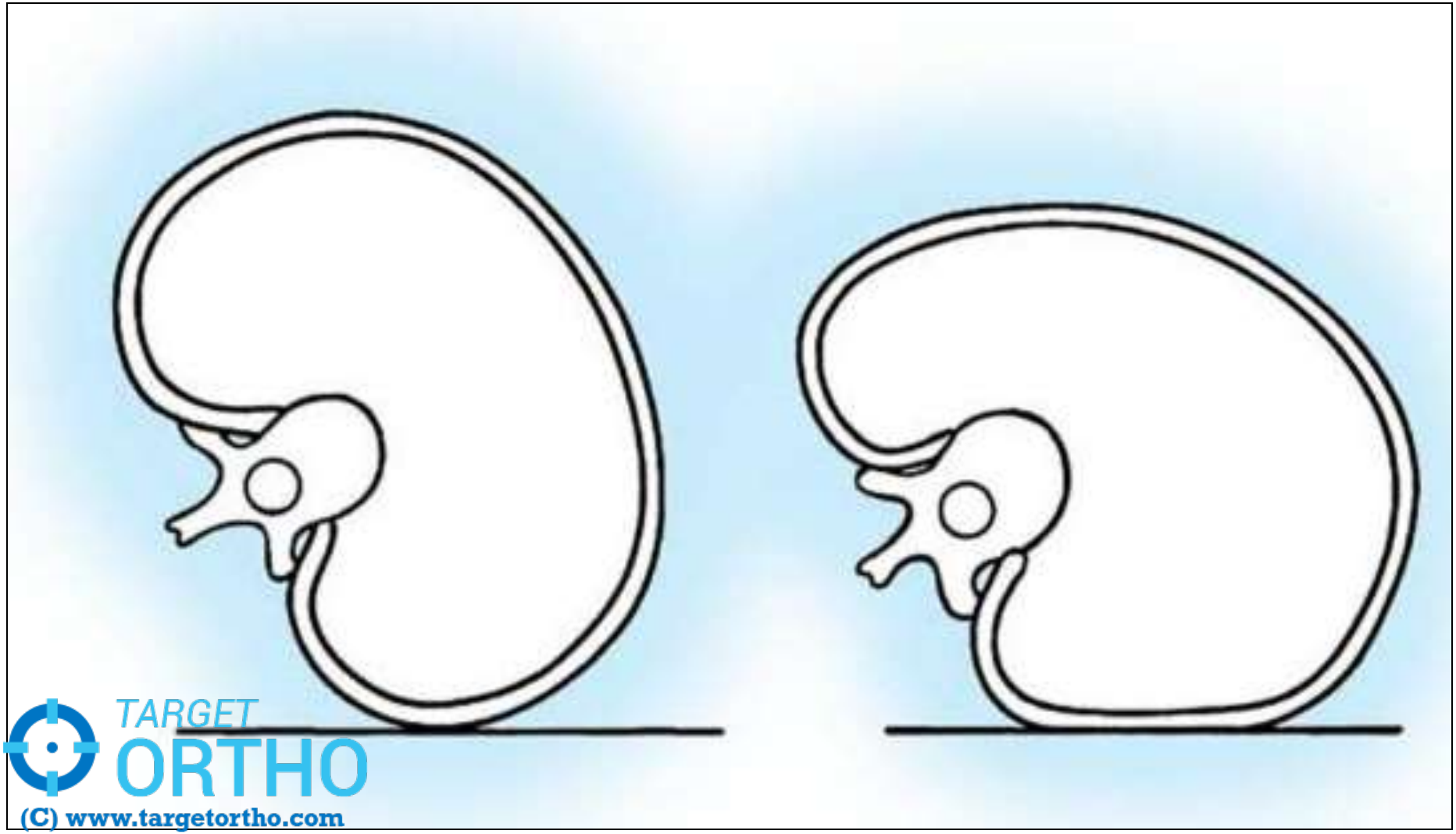
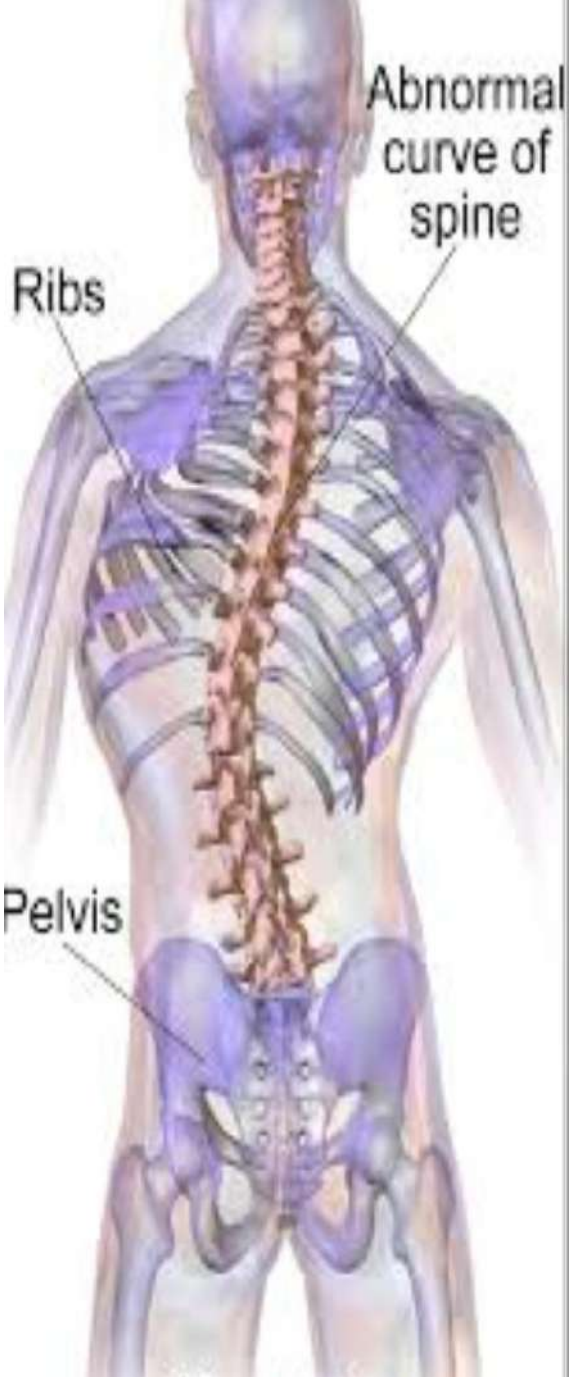
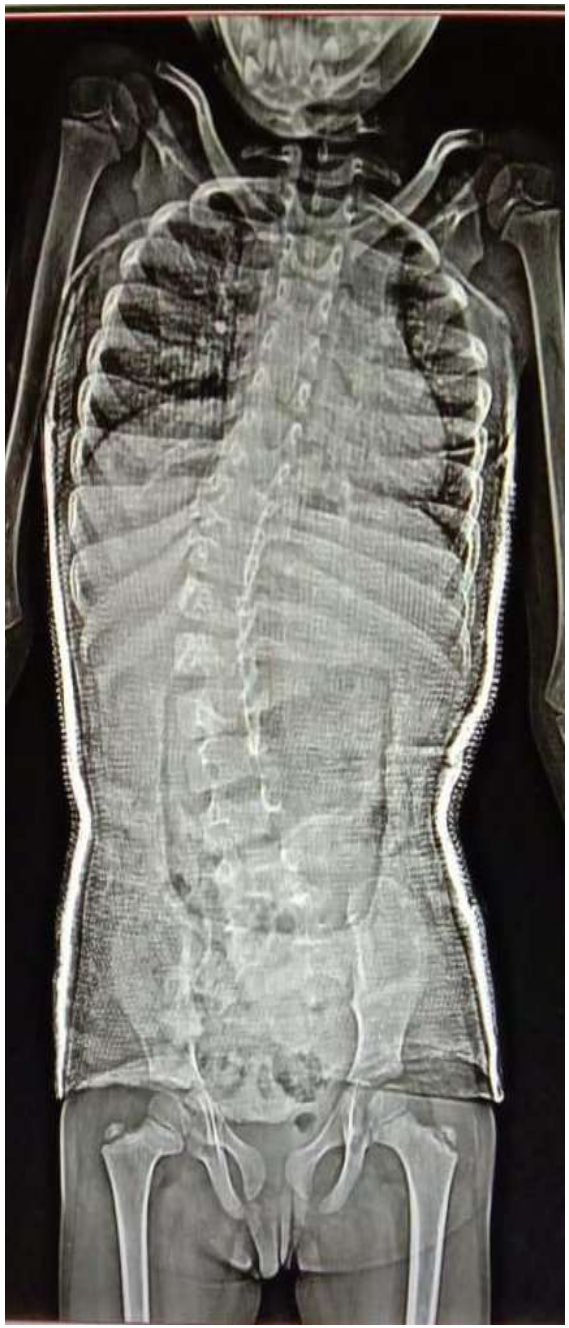
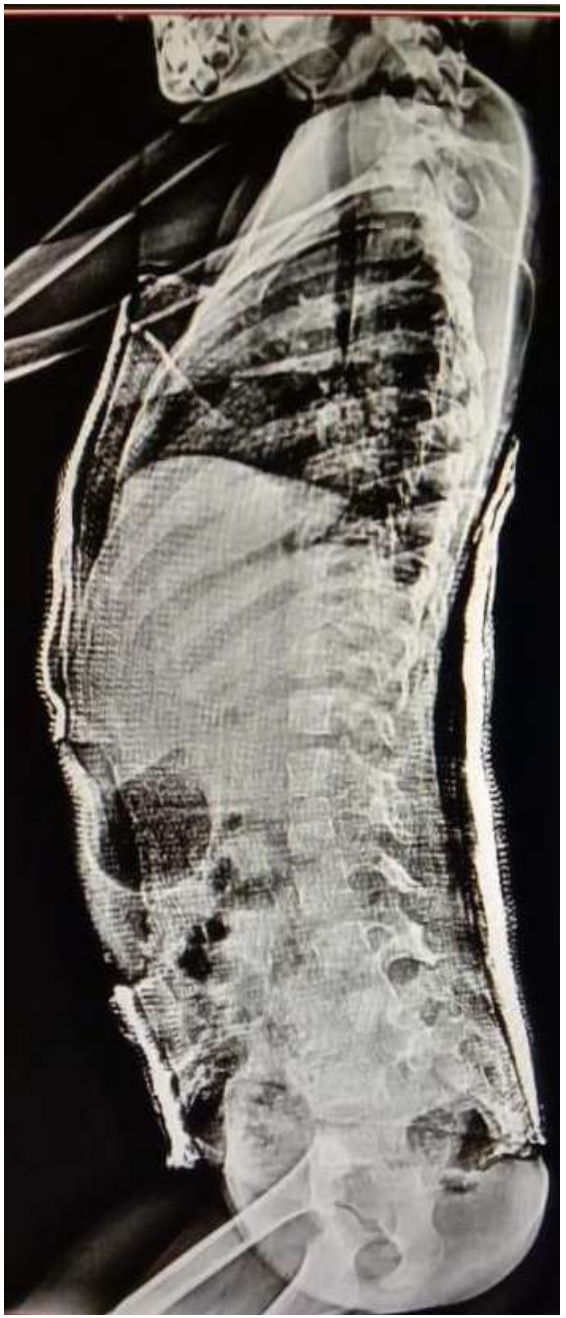
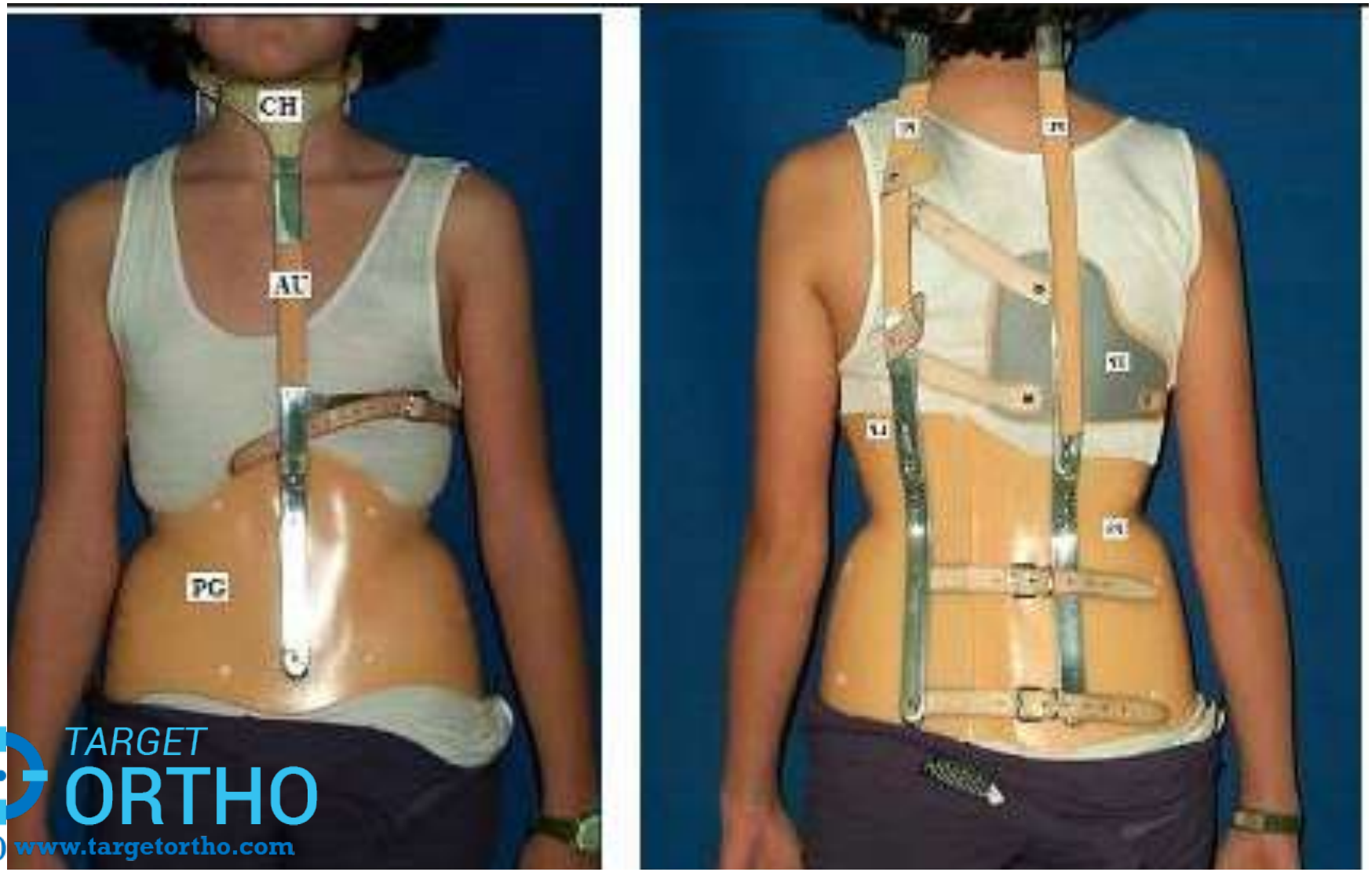




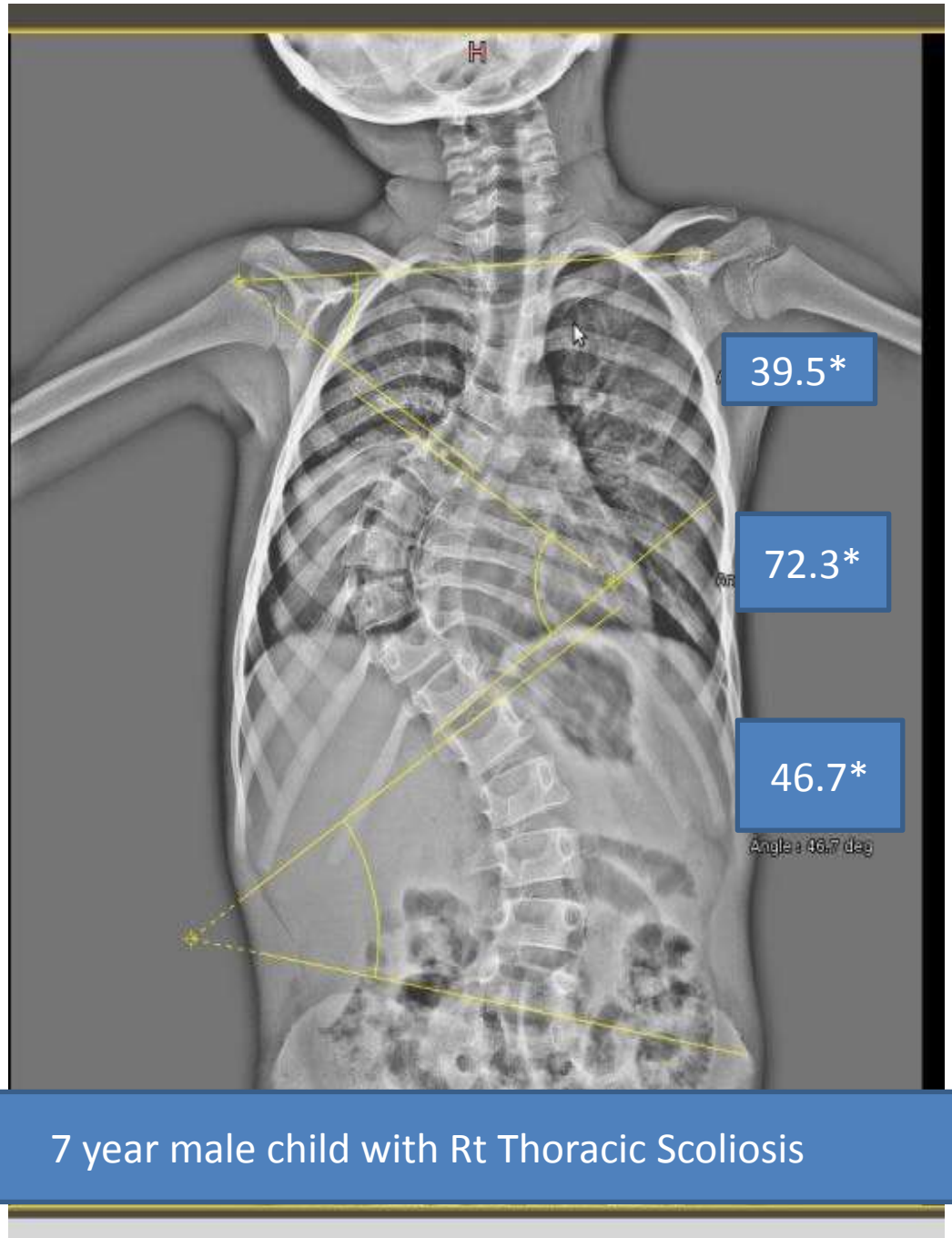




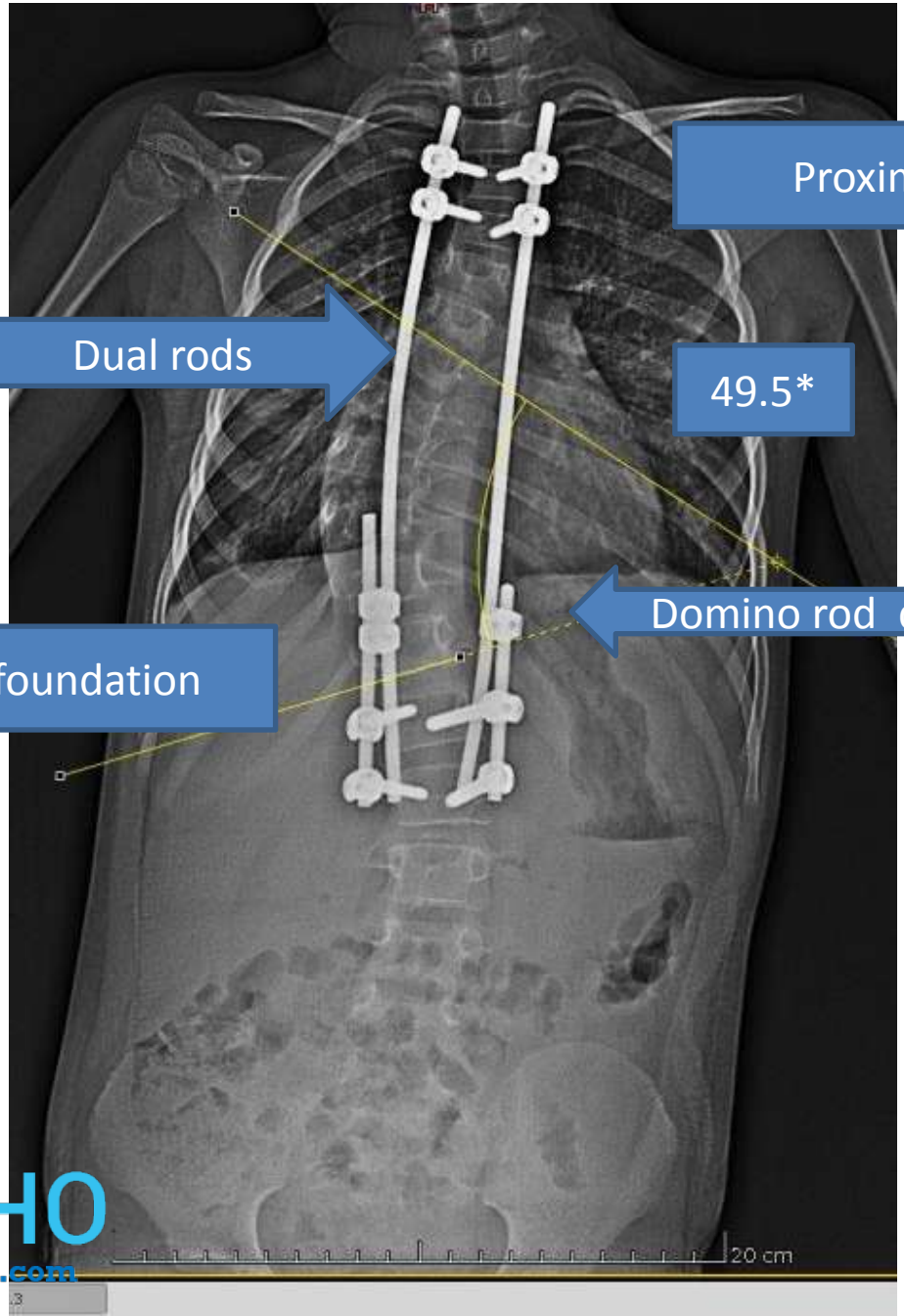
Spinal brace

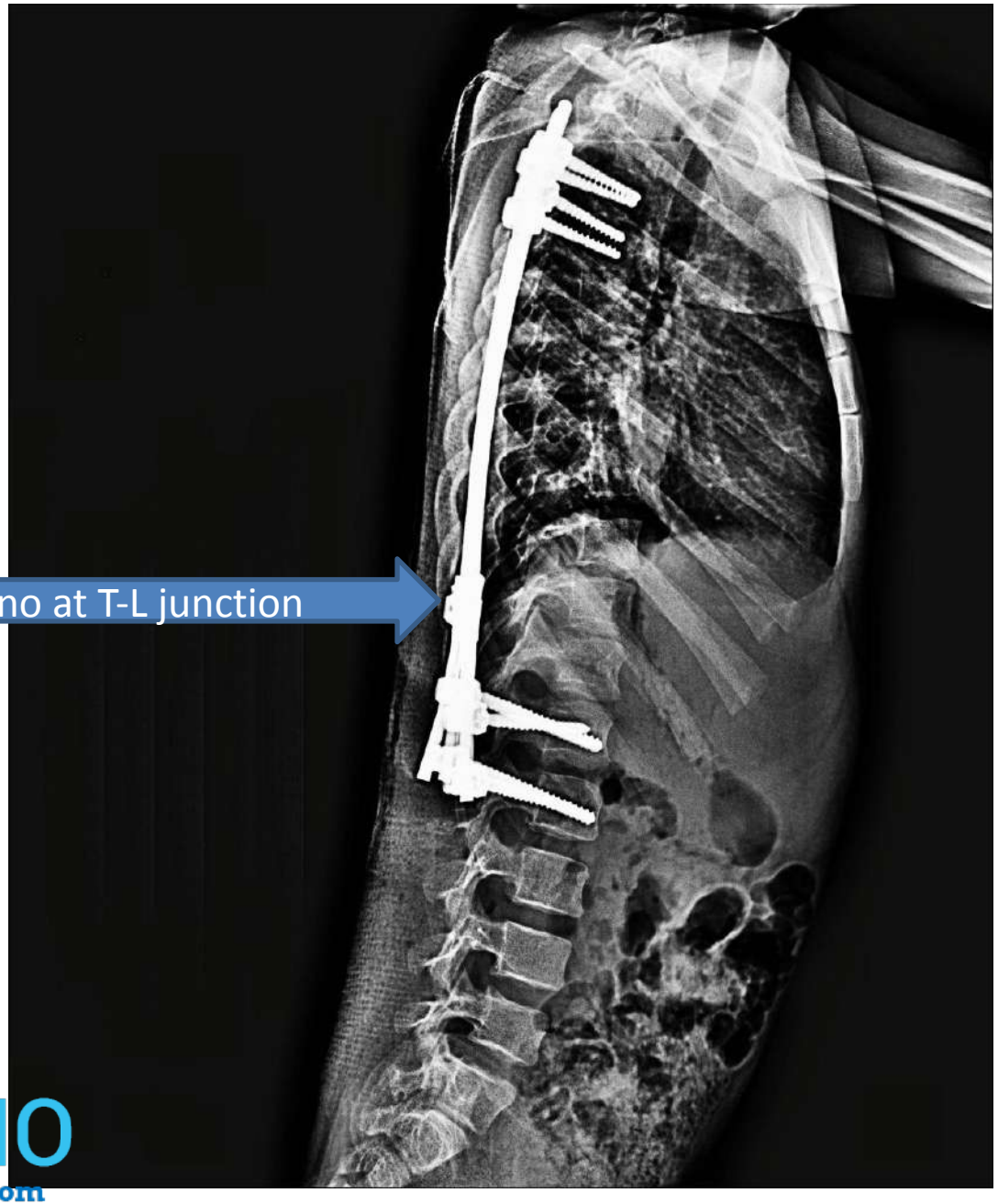


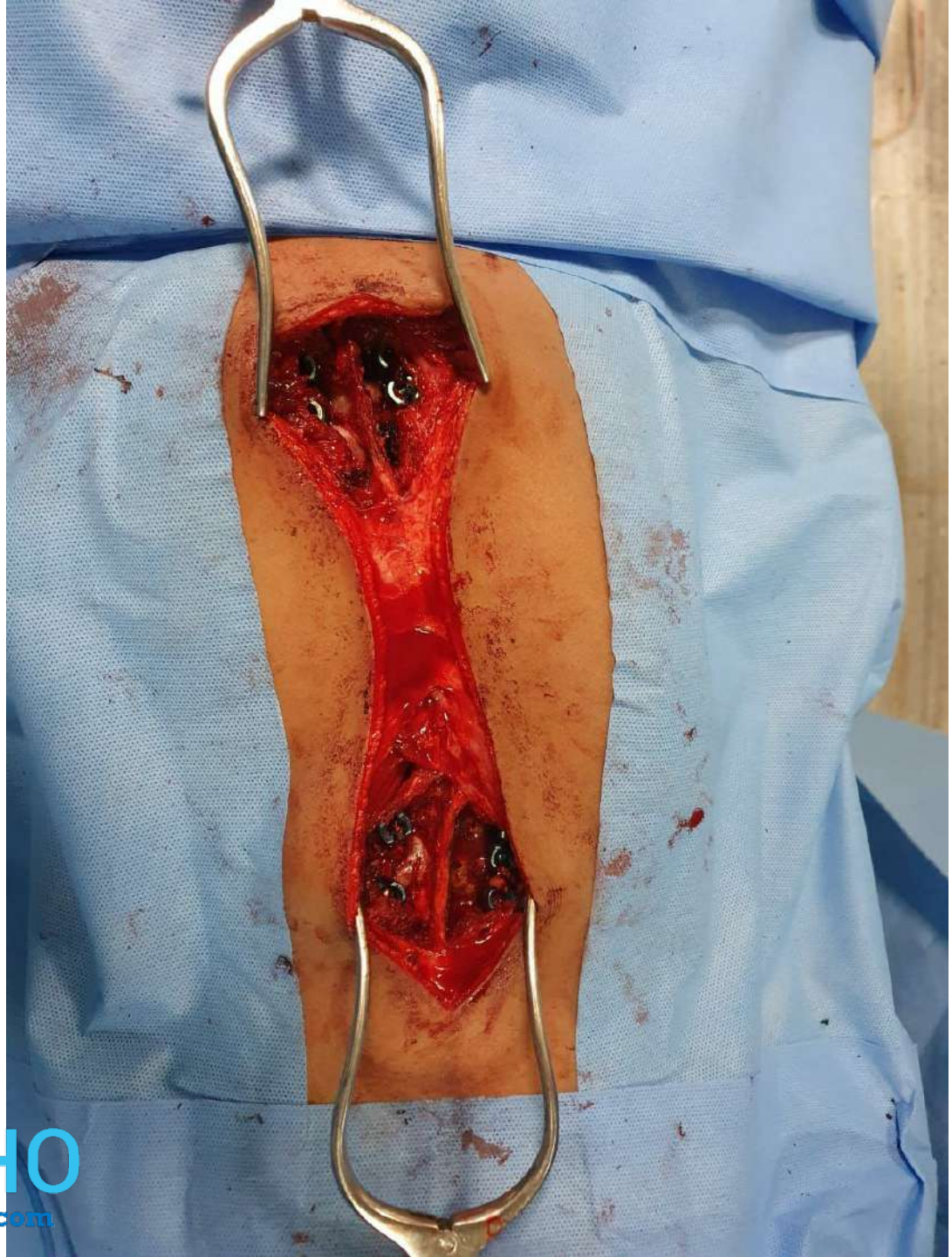
Growth rods



7 year male child with Rt Thoracic Scoliosis







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- Syndromic i.e. limb defect or organ involvement
- Neurological signs and symptoms
- Neurocutaneous stigmata
- Curve pattern
- Marfanoid habitus or features of hyperlaxity

Non-idiopathic

Investigation to identify cause
E.g. MRI/CT scans
Echocardiography
Ultrasound kidney
Genetic study

AIS (diagnosis of exclusion)

No (Cobb angle < 10°) *Need to exclude kyphosis

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I	Pre-menarche **before Growth Spurt**	Progression is dependent on the age and the growth velocity.
II	Pre-menarche **during Growth Spurt**	Curve will progress very aggressively as the increment of height velocity is greatest at this point.
III	Post-menarche	Progression is approximately 5 – 10 degrees over a year
IV	After attaining Risser 4 or skeletal maturity (determined radiographically)	Progression is approximately 1 degree a year for skeletal matured group* (for thoracic curve more than 50 degrees and lumbar curve more than 30 degrees)

Cobb angle	I	II	III	IV
≥10°	Observe 6 monthly	Observe 4 monthly	Observe 6 monthly	Observe yearly (Risser 4) Discharge (Risser 5)
≥20°	Brace	Brace	Brace	Observe yearly (Risser 4) Observe 2 yearly (Risser 5)
≥45°	Brace	Open triradiate: Brace Closed triradiate: PSF	PSF	PSF (Risser 4) Observe 2 yearly or PSF if curve progression (Risser 5)
≥60°	Growing rod	Open triradiate: Growing rod Closed triradiate: PSF	PSF	PSF

Weinstein SL, Ponseti IV. Curve progression in idiopathic scoliosis. J Bone Joint Surg Am. 1983 Apr;65(4):447-55.

Thank you

Congenital Scoliosis

- **Treatment**Nonoperative
  - **observation and bracing**
- Operative
  - **posterior fusion (+/- osteotomies and modest correction)**
  - **anterior/posterior spinal fusion +/- vertebrectomy**
  - **distraction based growing rod construct**
  - **osteotomies between ribs**
  - **Hemi-Vertebrectomy**.

- **observation and bracing**
  - indications for observation
    - absence of documented progression, ie:
      - » incarcerated hemivertebrae
      - » nonsegmental hemivertebrae
      - » some partially segmented hemivertebrae
  - bracing
    - not indicated in primary treatment of congenital scoliosis (no effectiveness shown)
    - may be used to control supple compensatory curves, but effectiveness is unproven

Operative

- 1. **posterior fusion (+/- osteotomies and modest correction)**
  - indications
    - hemi-vertebrae opposite a unlateral bar that does not require a vertebrectomy at any age. this otherwise will relentlessly progress until fused.
    - older patients with significant progression, neurologic deficits, or declining respiratory function
    - having many pedicle screws may decrease crankshaft phenomenon adn obviate the need for an anterior fusion.

- 2. **anterior/posterior spinal fusion +/- vertebrectomy**
  - indications
    - young patients with significant progression, neurologic deficits, or declining respiratory function
      - » girls < 10 yrs
      - » boys < 12 yrs
    - patients with failure of formation with contralateral failure of segmentation at any age that requires hemi-vertebrectomy and/or significant correction. This may be done from a posterior approach
  - technique
    - nutritional status of patient must be optimized prior to surgery

3. **distraction based growing rod construct**

- indications
  - may be used in an attempt to control deformity during spinal growth and delay arthrodesis
- outcomes
  - need to be lengthened approximately every 6 months for best results

4.osteotomies between ribs

- indications
  - mulitple (>4) fused ribs wit potential for thoracic insufficiency syndrome
- outcomes
  - long-term follow up is needed to determine efficacy. the downside is this may make the chest stiff and hurt pulmonary function

5. Hemi-Vertebrectomy - usally done from a posterior approach, particularly with kyphosis.

- indications –

  age 3-8 years (younger is difficult to get good anchor purchase)

- progressive or significant deformity

Complication

- Crankshaft phenomenon
- Short stature
- Neurologic injury
- Soft-tissue compromise