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.

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Idiopathic scoliosis

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

AIS – most common type

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Early degeneration

– Low back pain

curves > 90- cardiopulmonary dysfunction

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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

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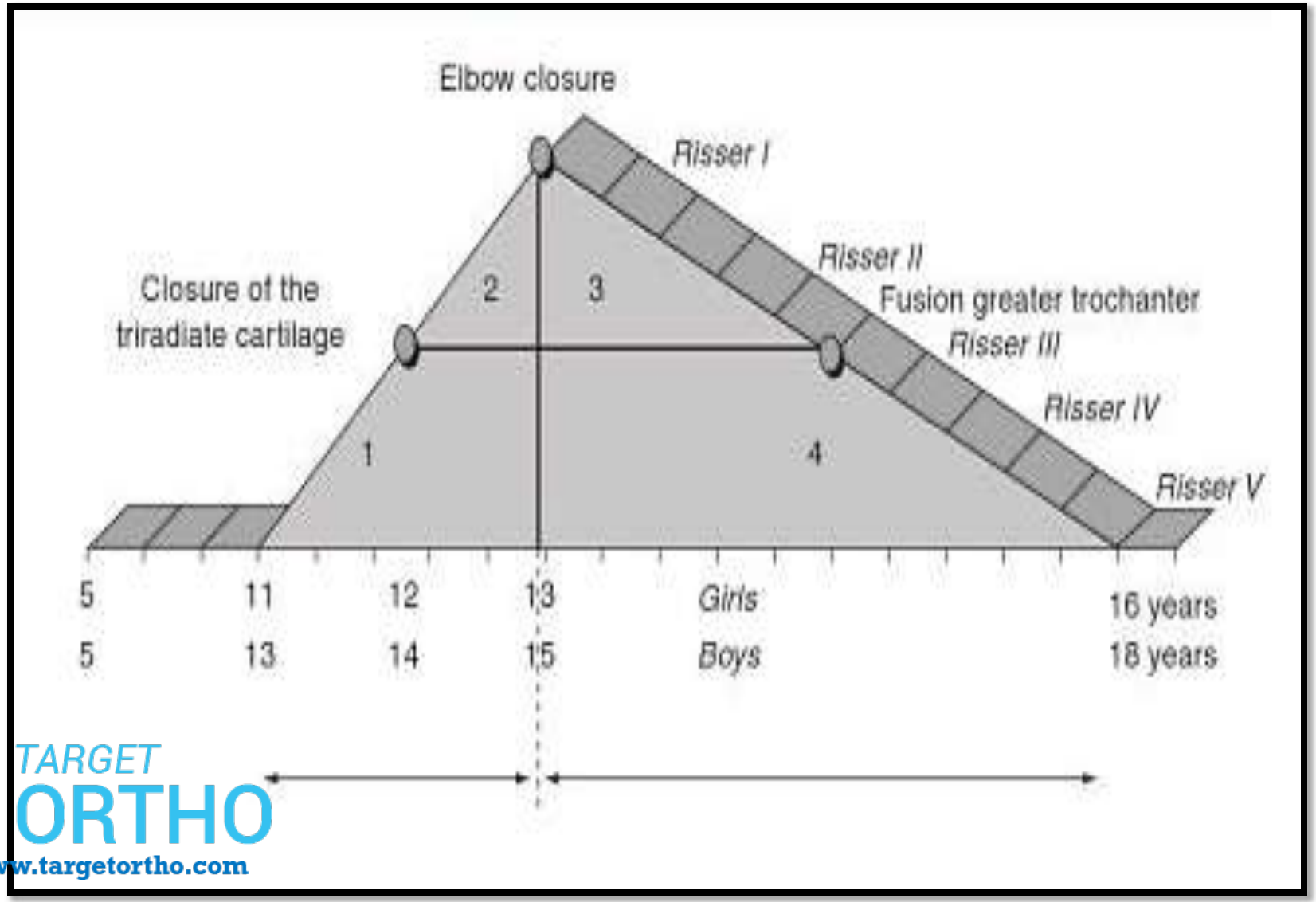
Assessment of progression



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Assessment of progression

1. Rissers grading

2. Fusion of triradiate cartilage & greater trochanter

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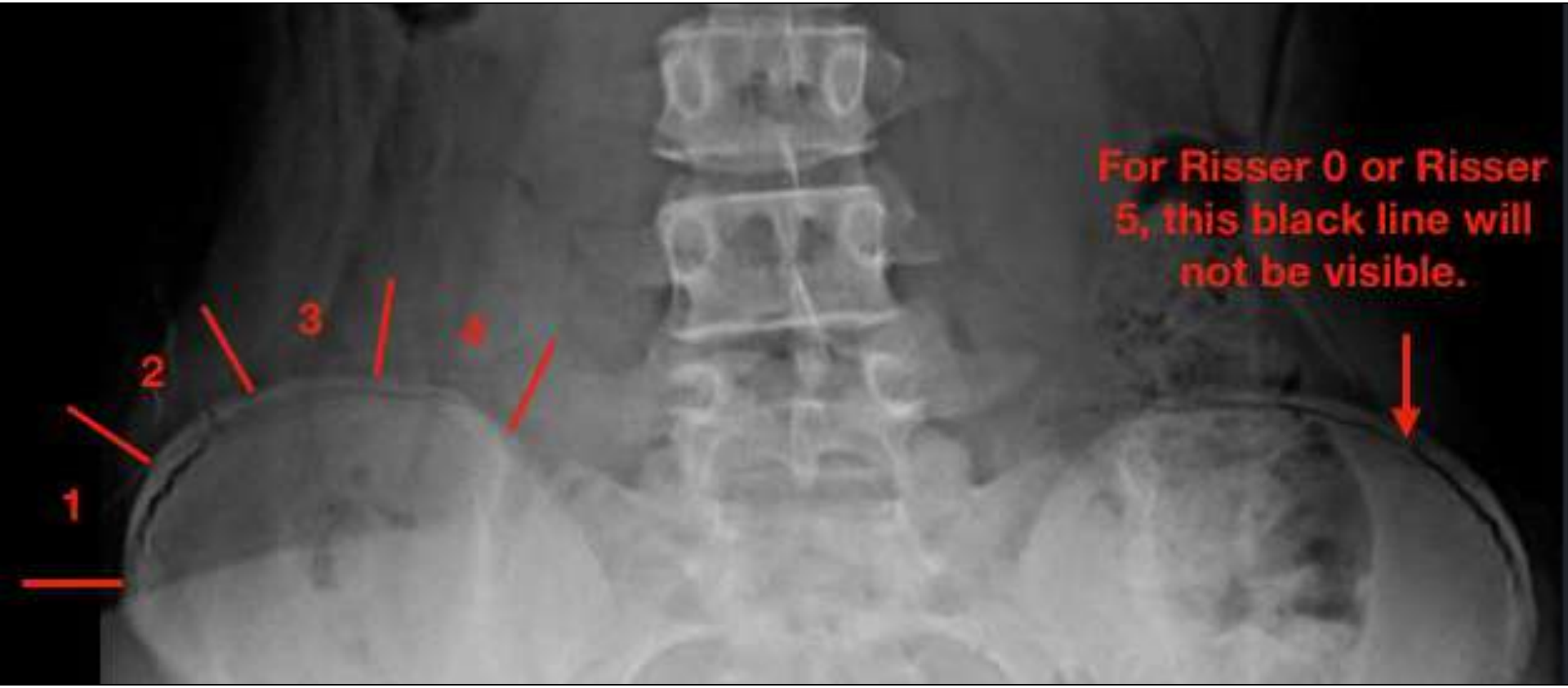

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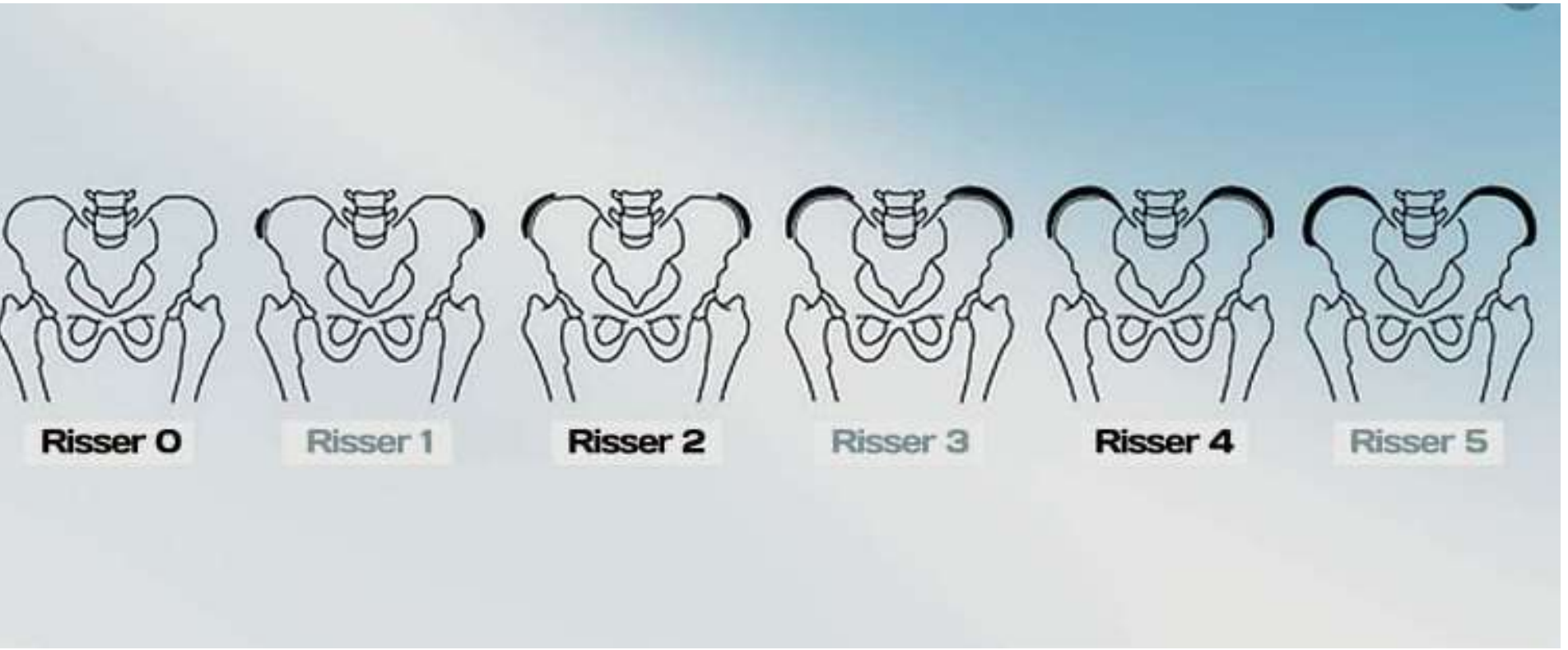

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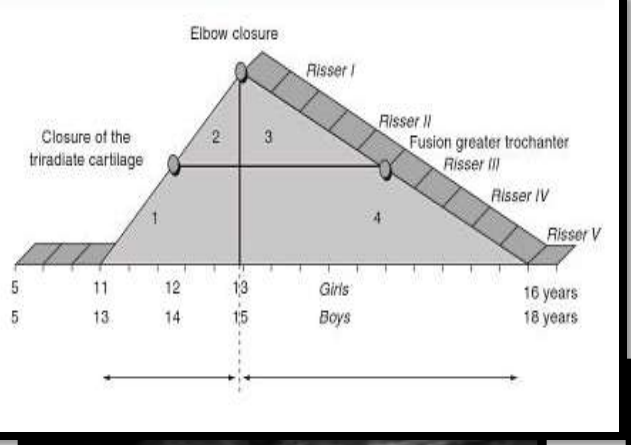

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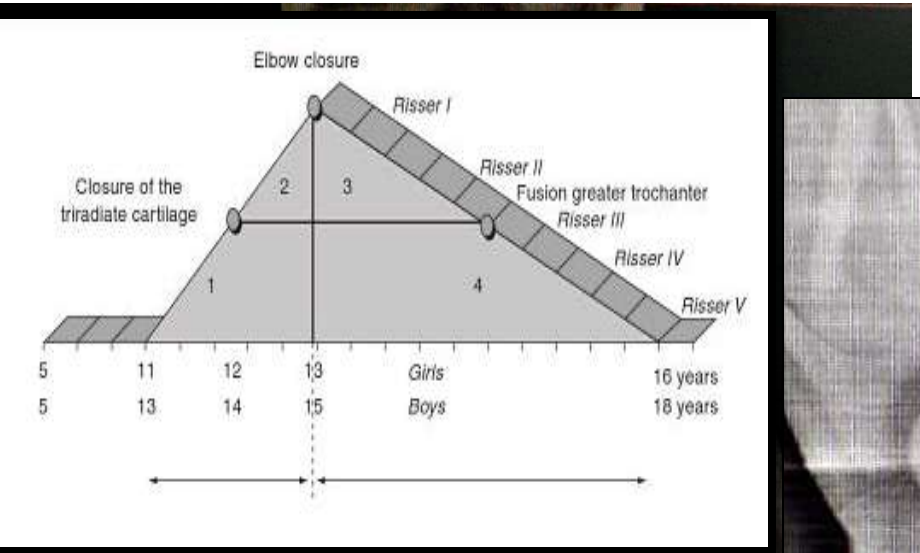

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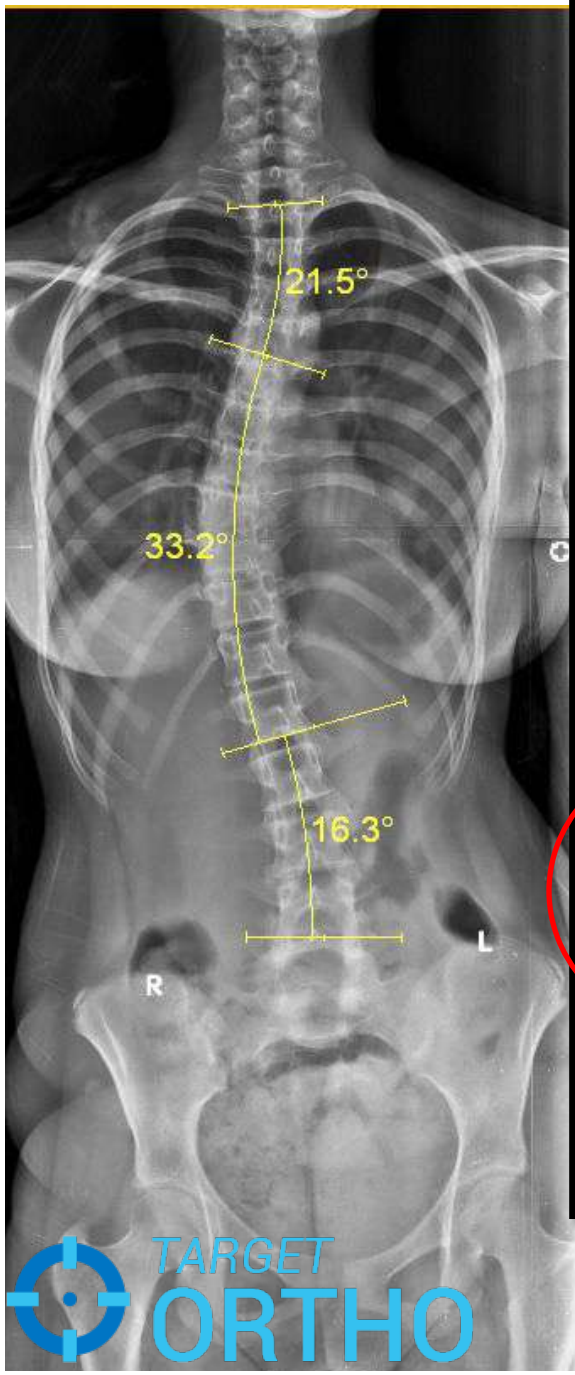

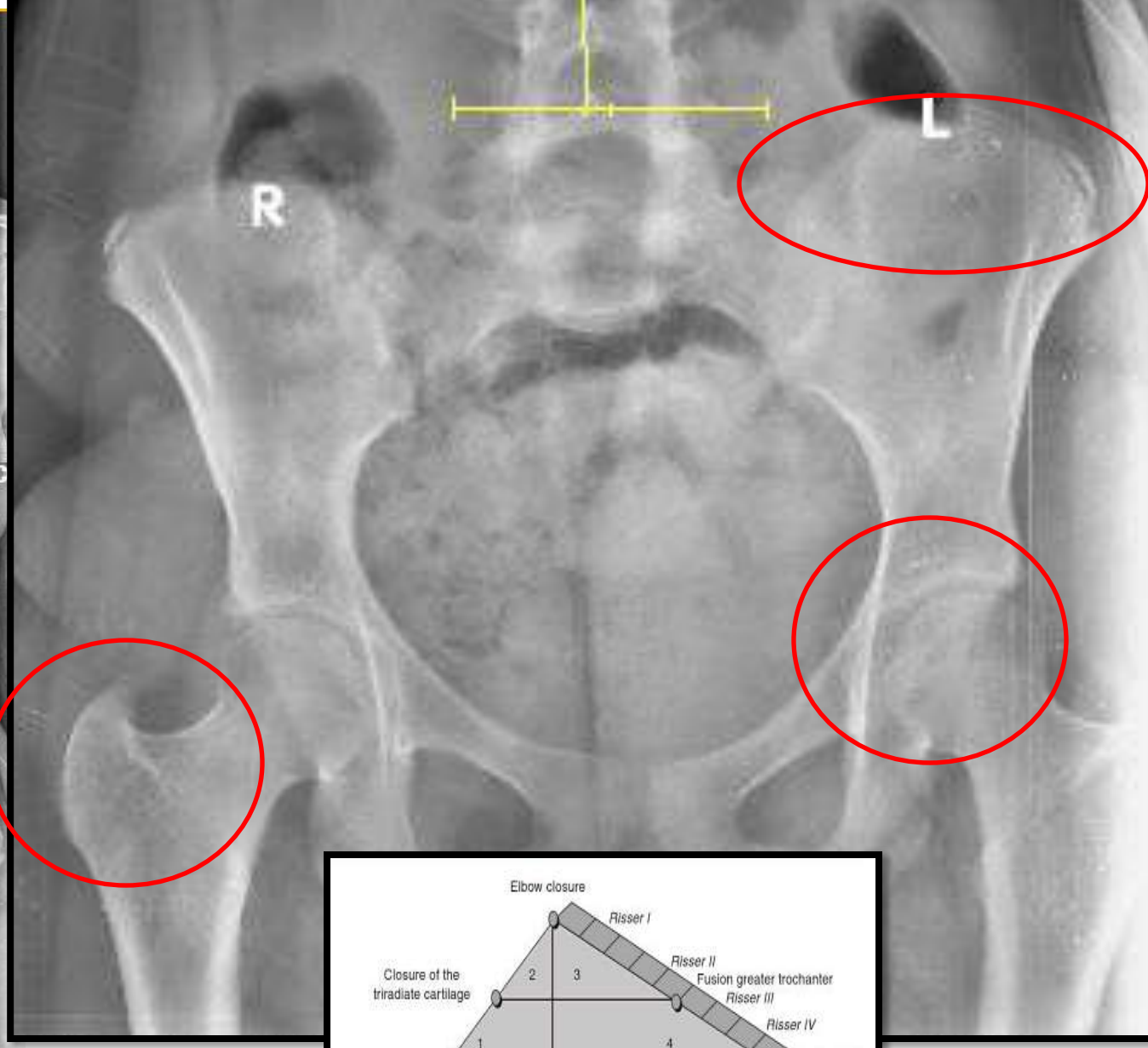

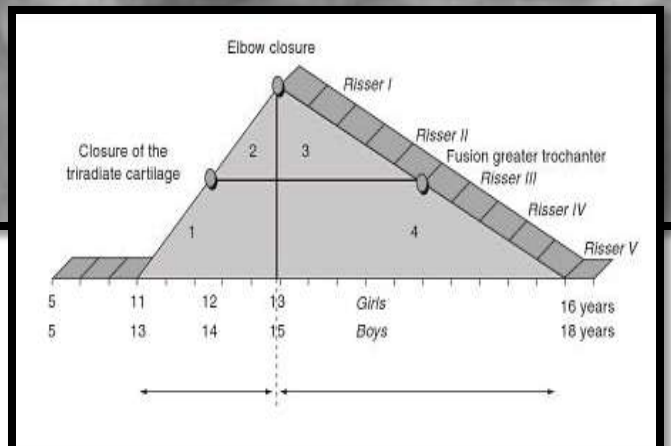

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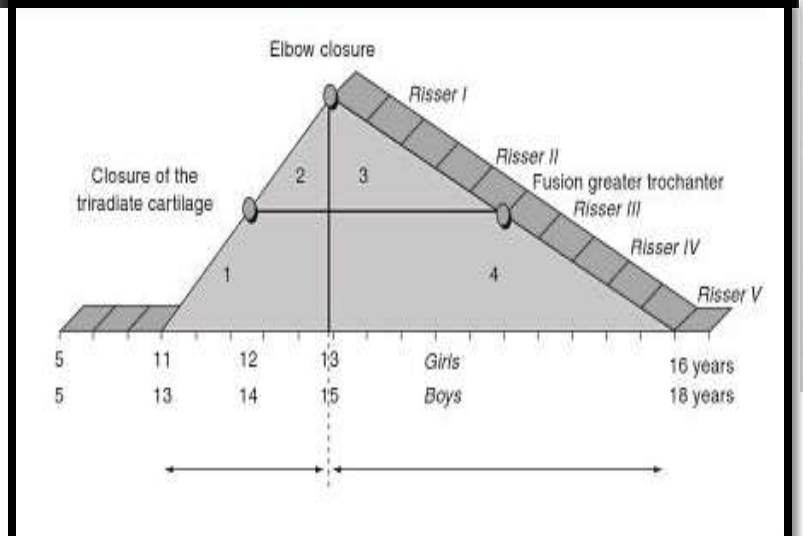

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Curve progression

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

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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**

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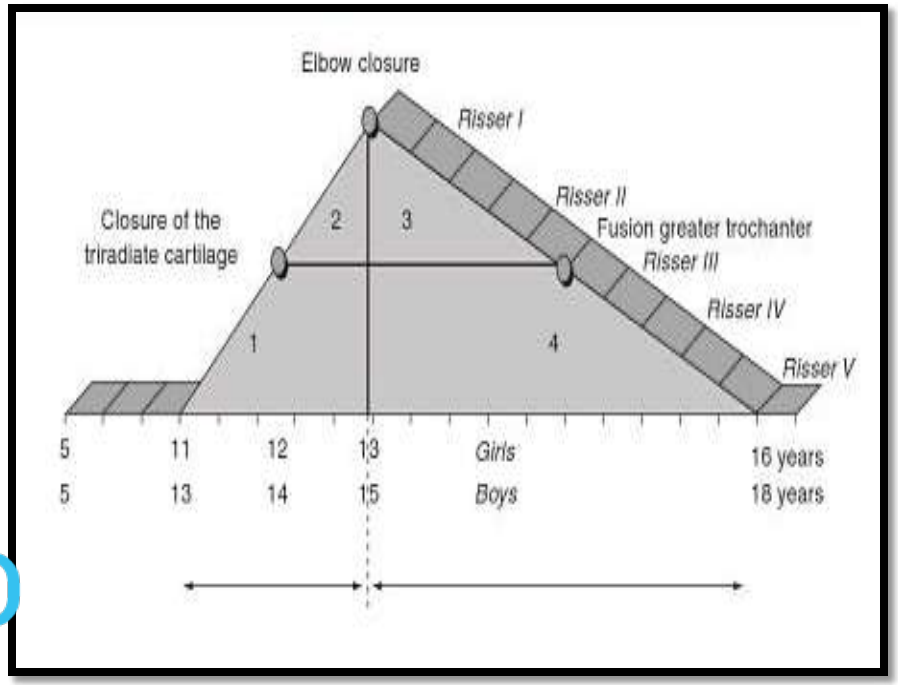
Observation

Indications

Cobb angle < 25°

Serial radiographs to monitor for progression



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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

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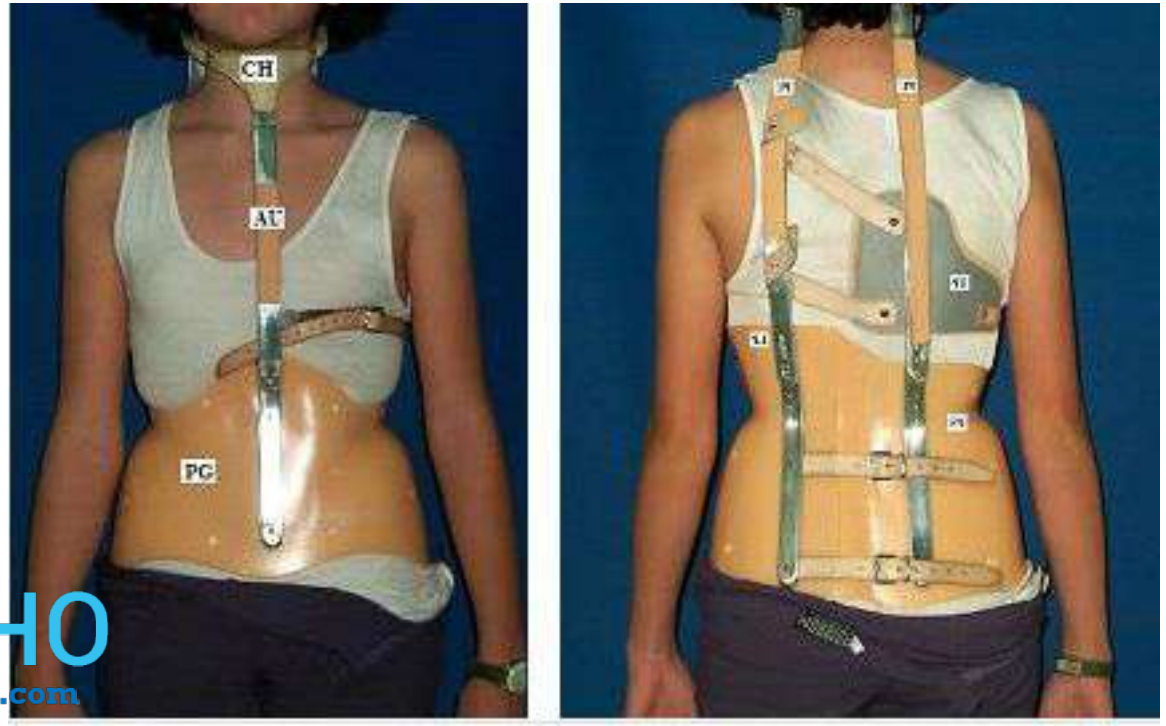
- Curves with apex above T7
  - Milwaukee brace (cervicothoracolumbosacral orthosis)
    - extends to neck for apex above T7



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

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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

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Bracing not indicated :

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

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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

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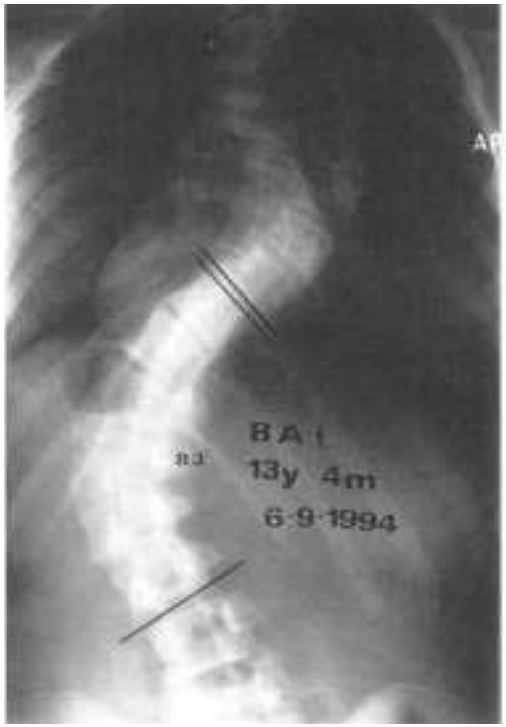
Harrington rods

Hartshell rectangle



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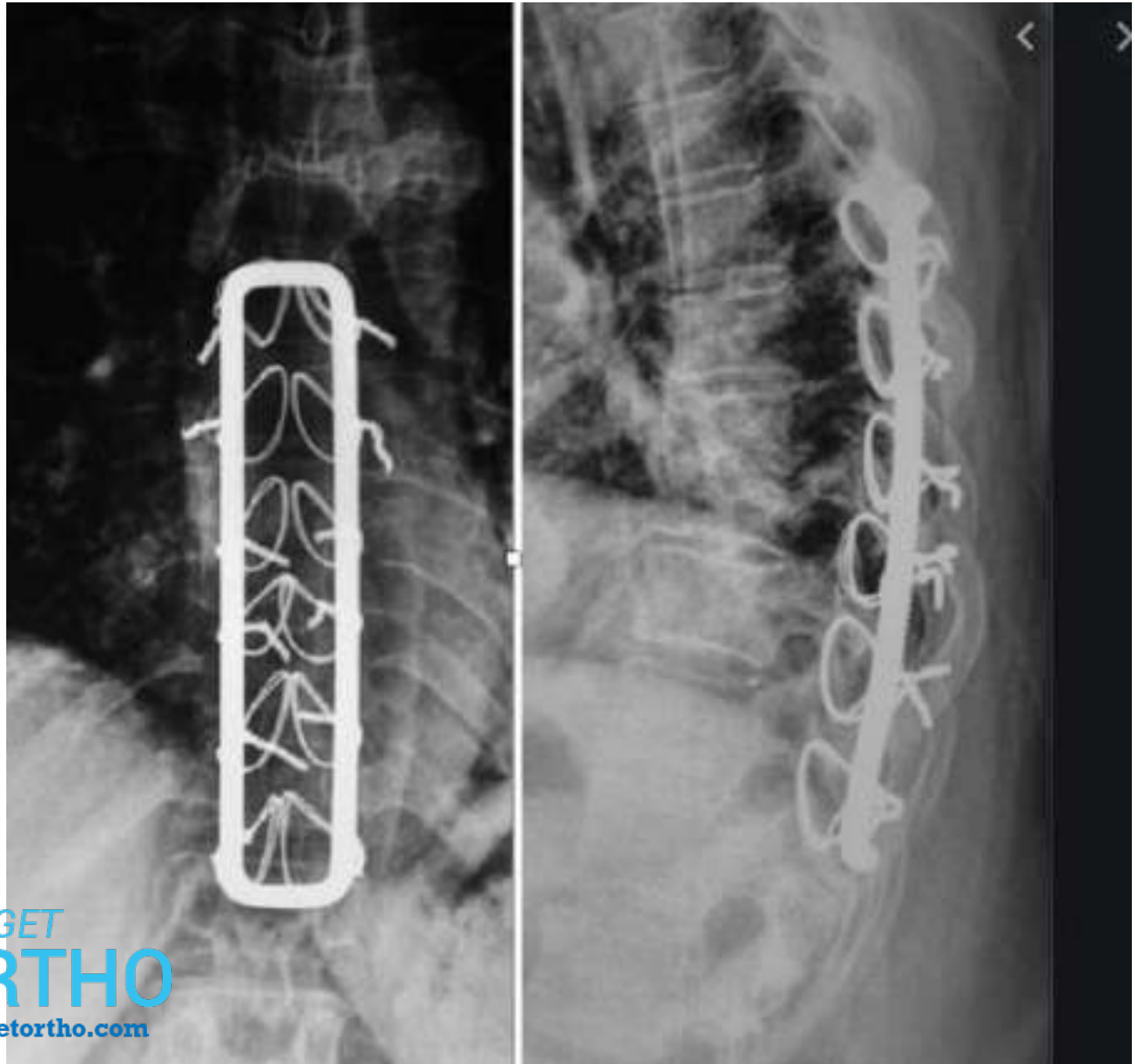

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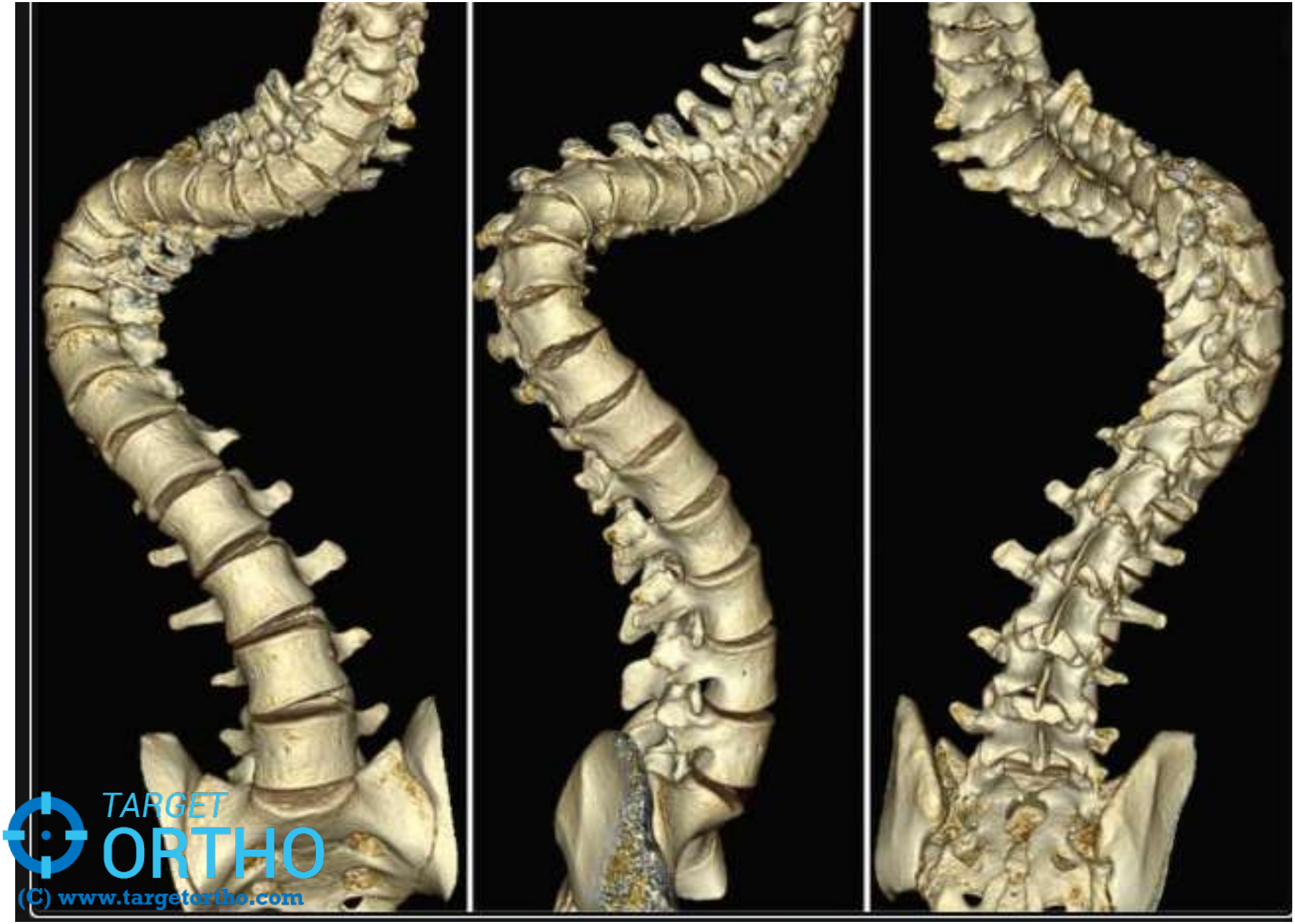
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Identifying the levels in AIS

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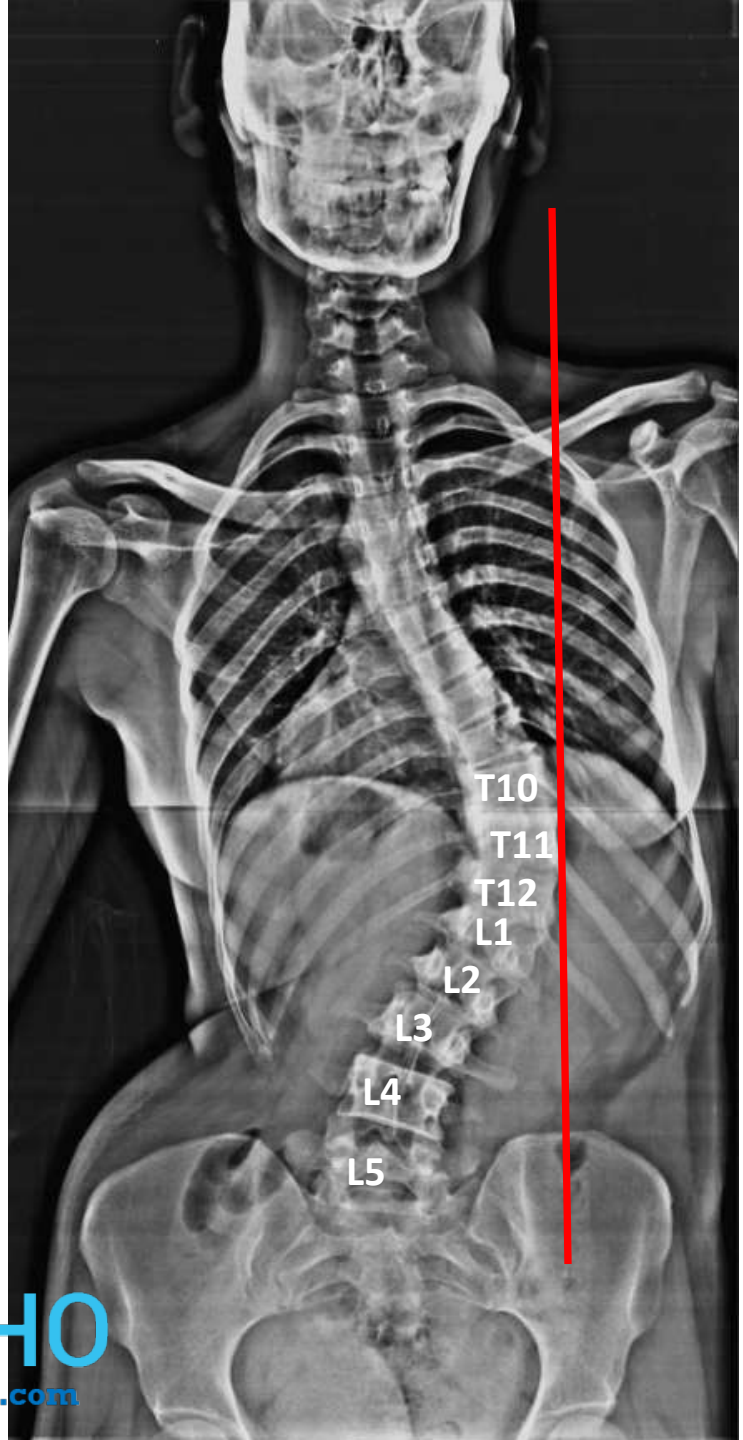

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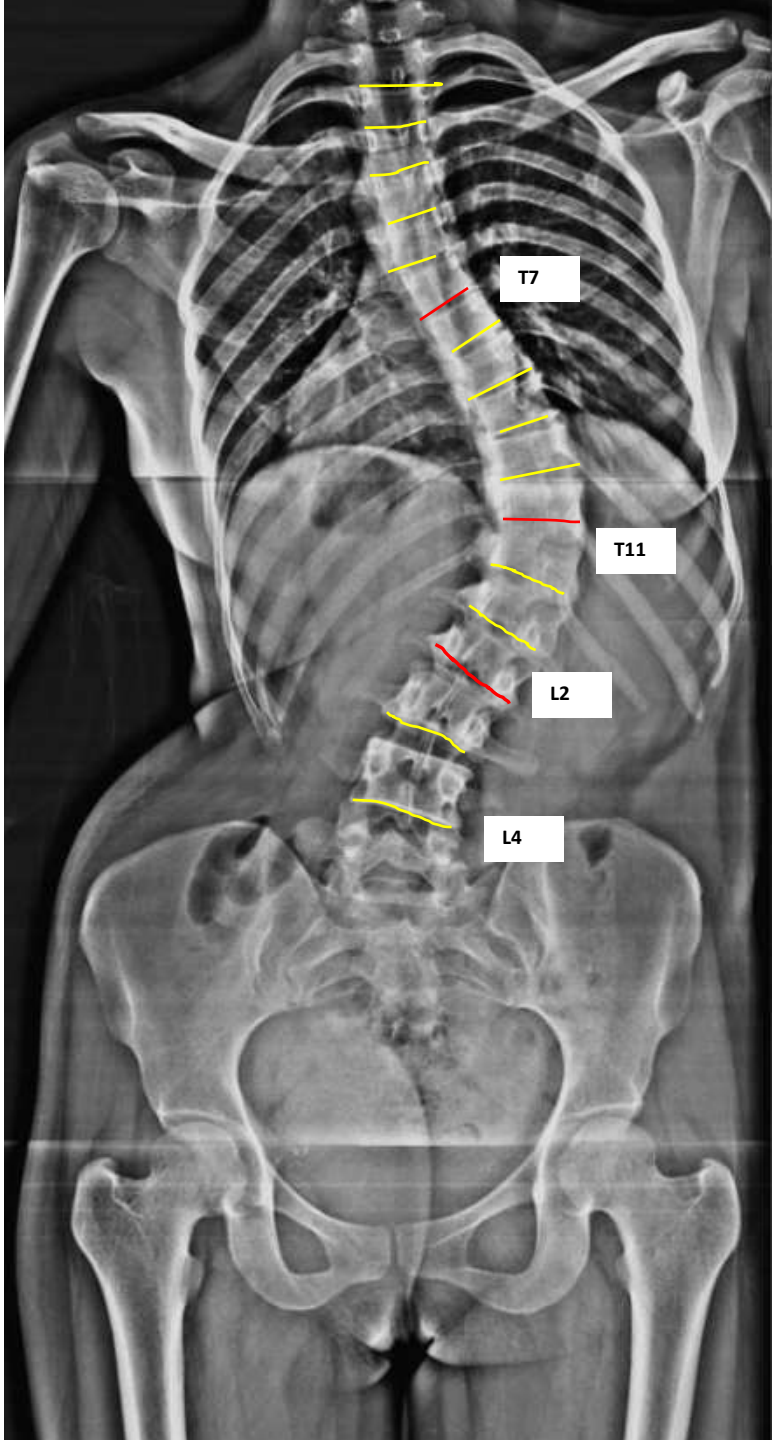

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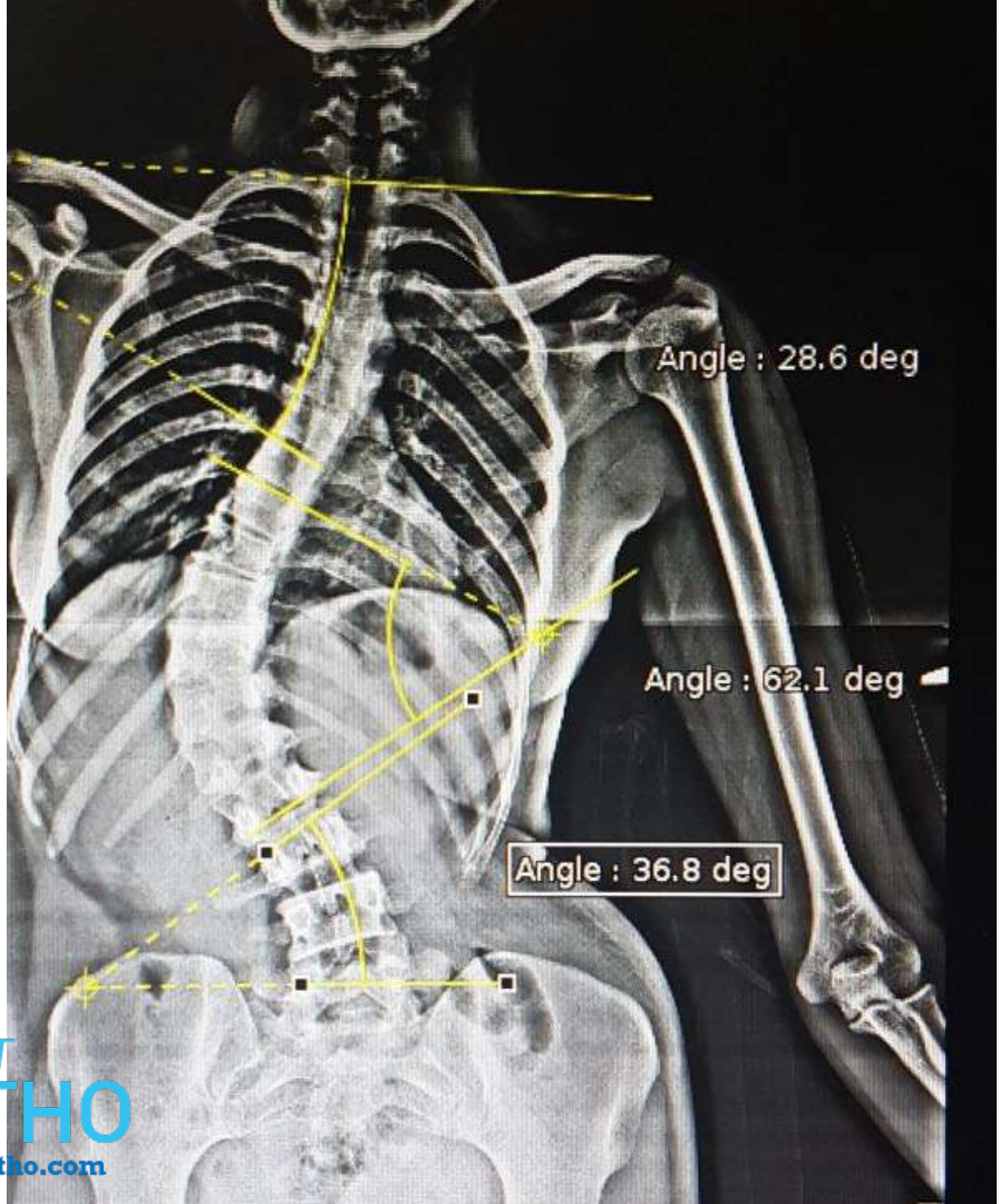

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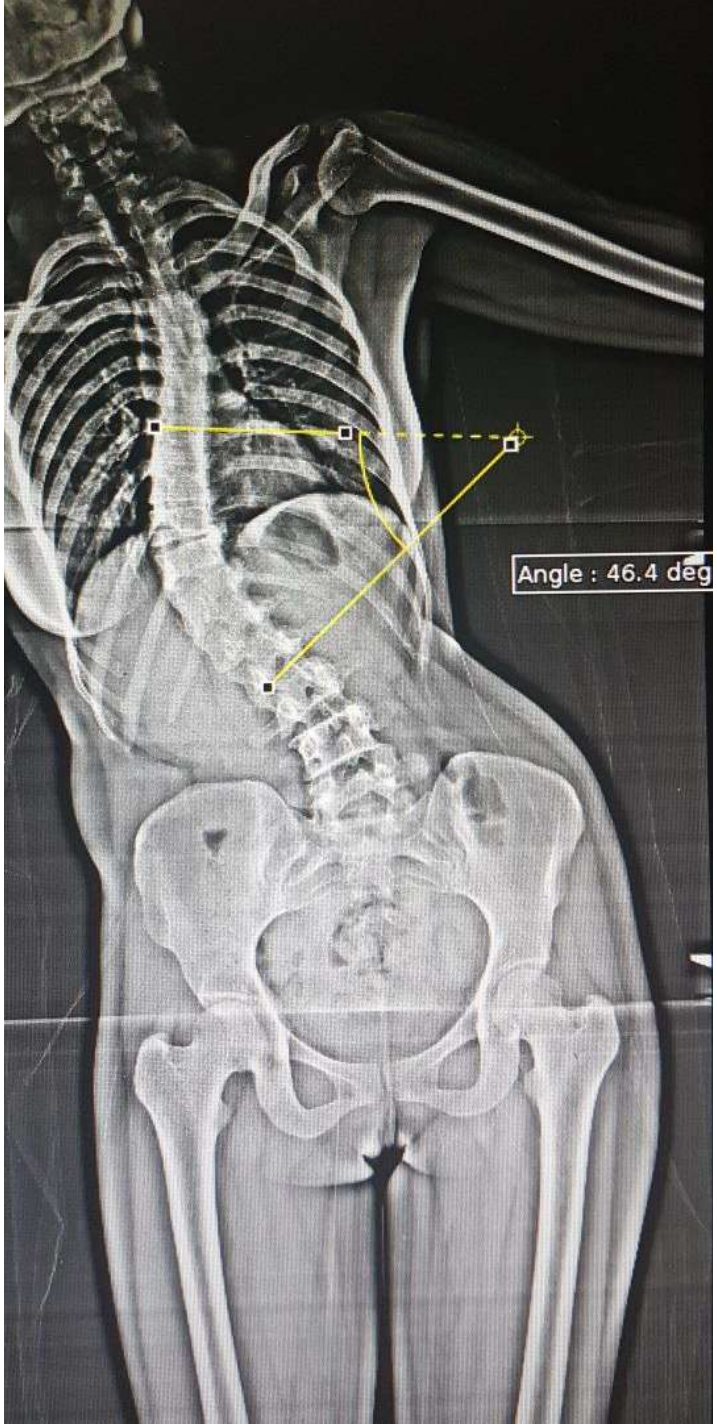

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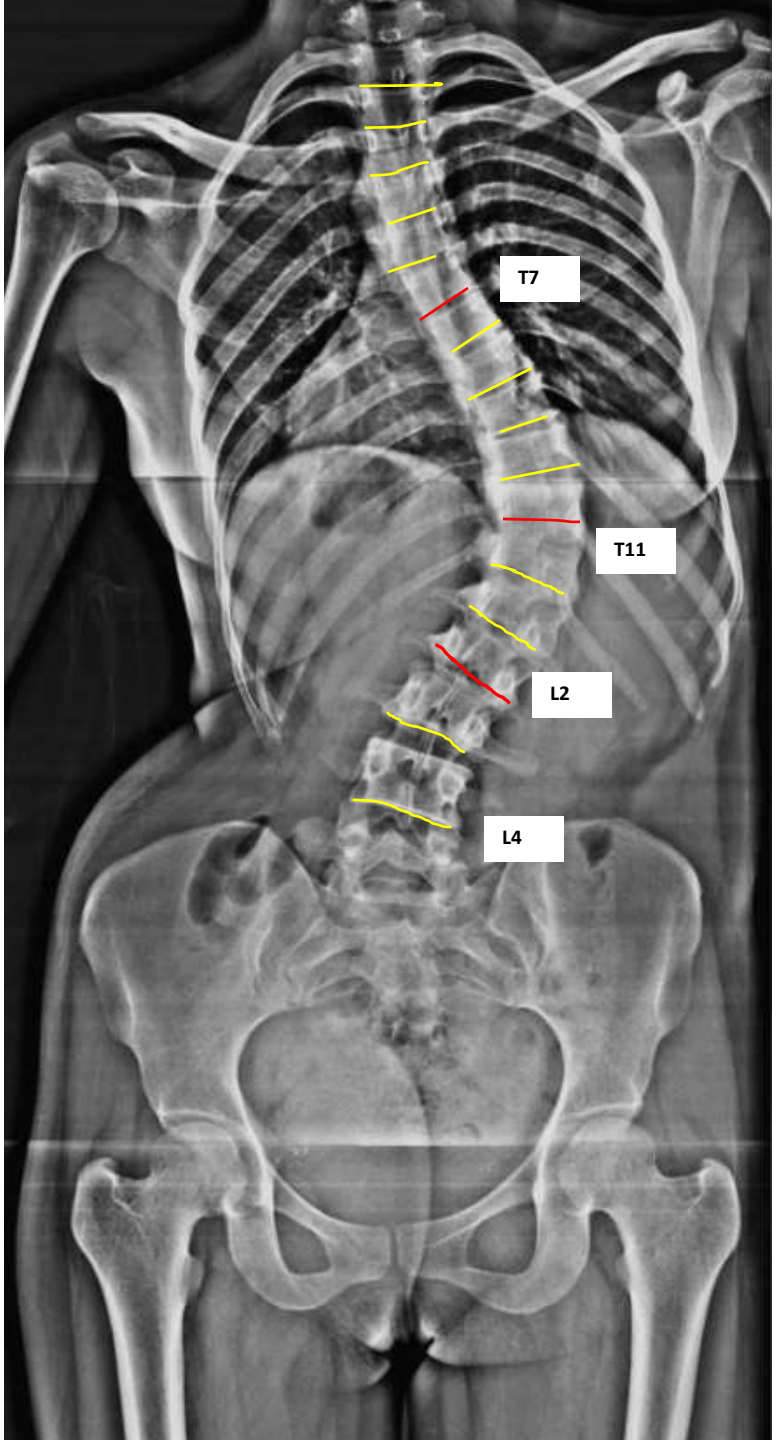

Upper end vertebra- T7

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**

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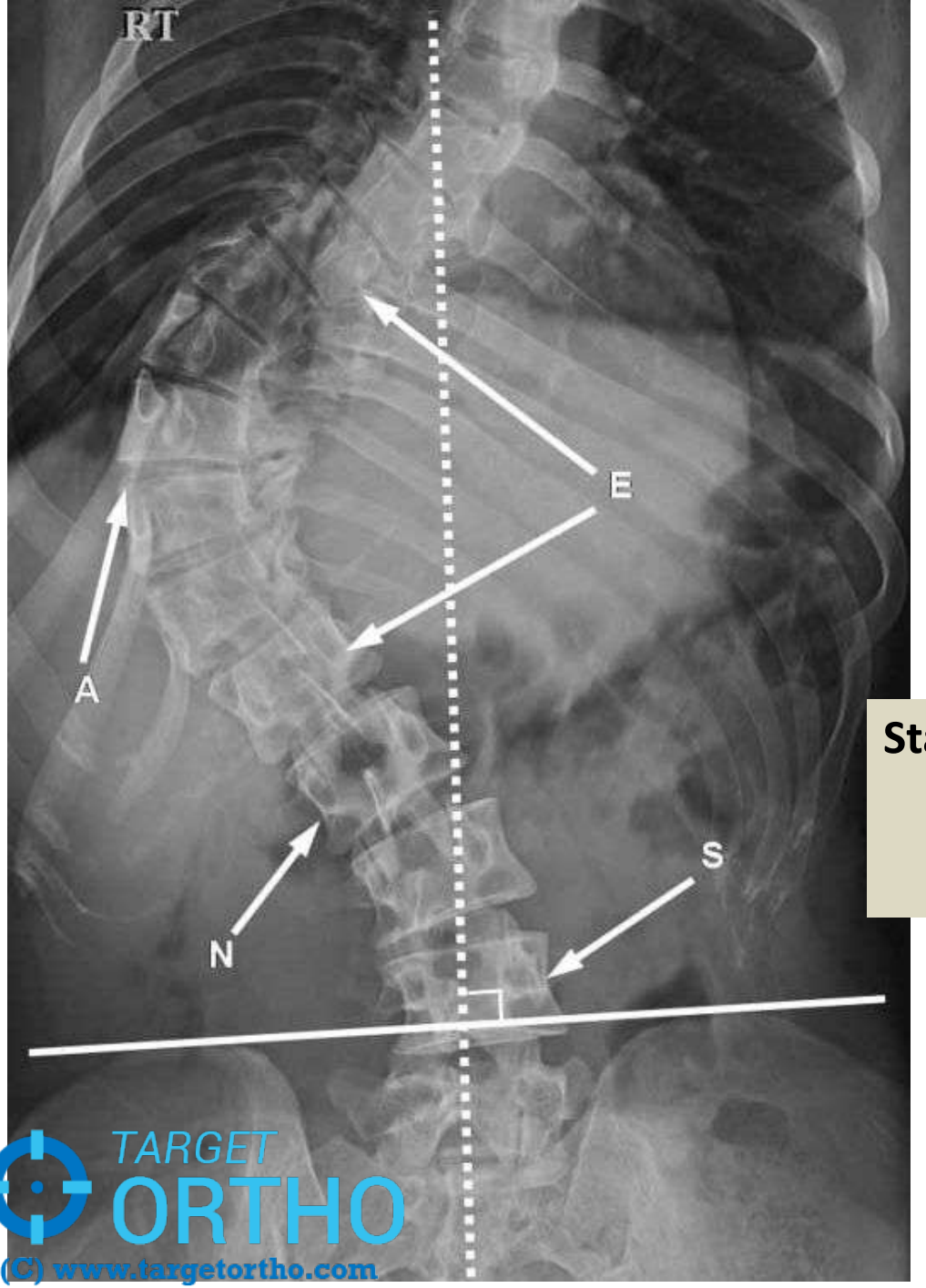

Stable vertebra (S) - is one that is bisected or nearly bisected by the CSVL (dotted line).

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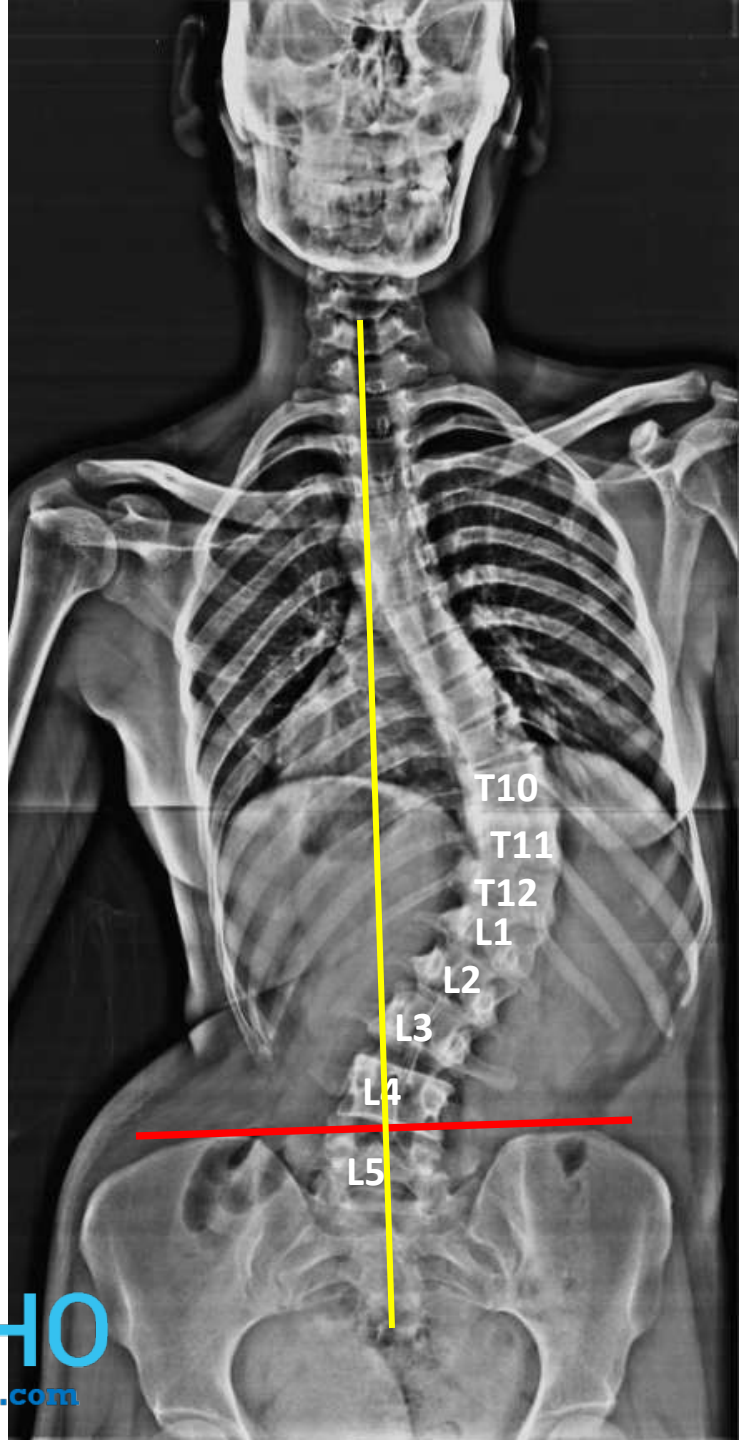

L4- stable vertebra

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Modes of correction

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

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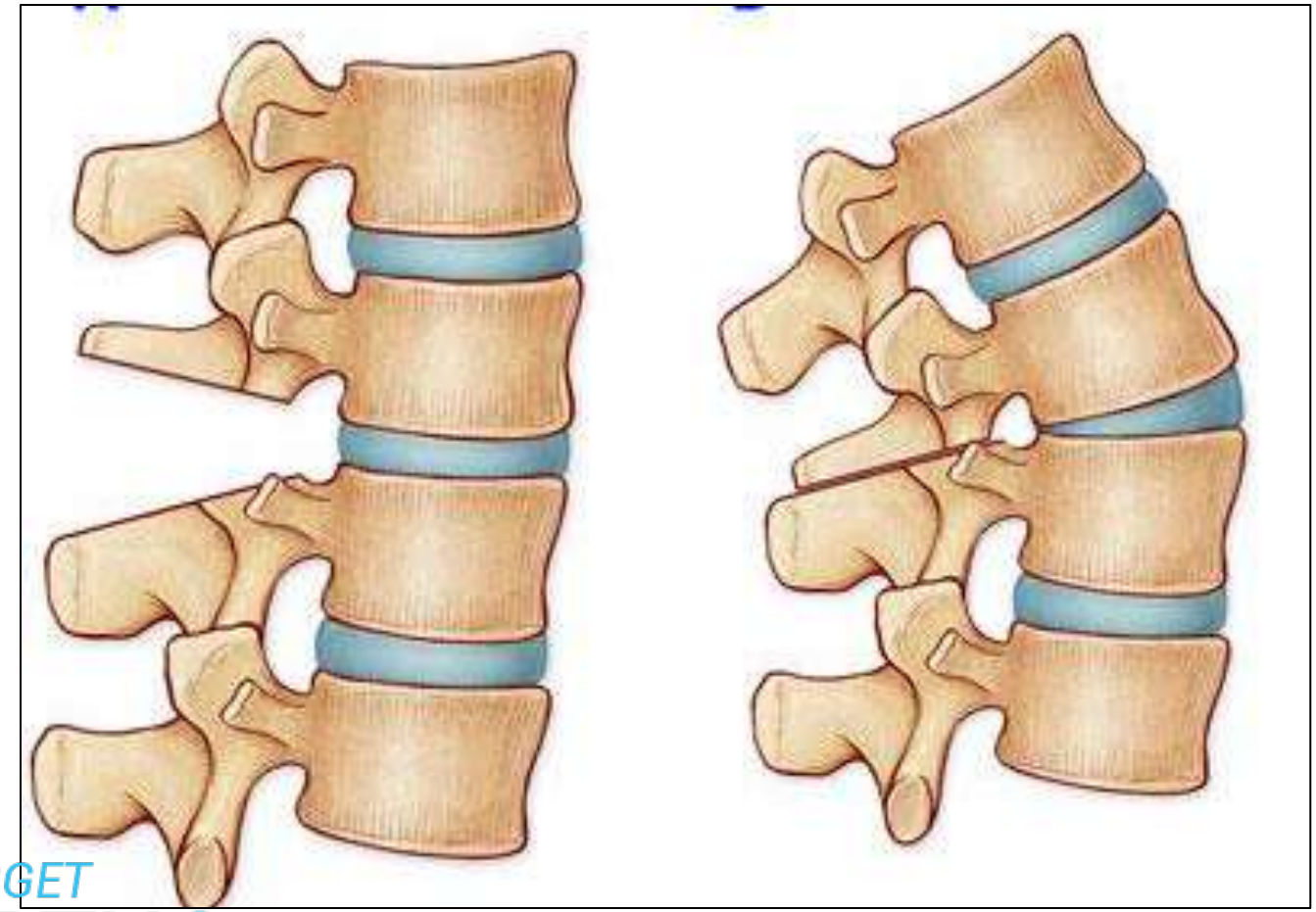
surgical treatment



Pontes osteotomy

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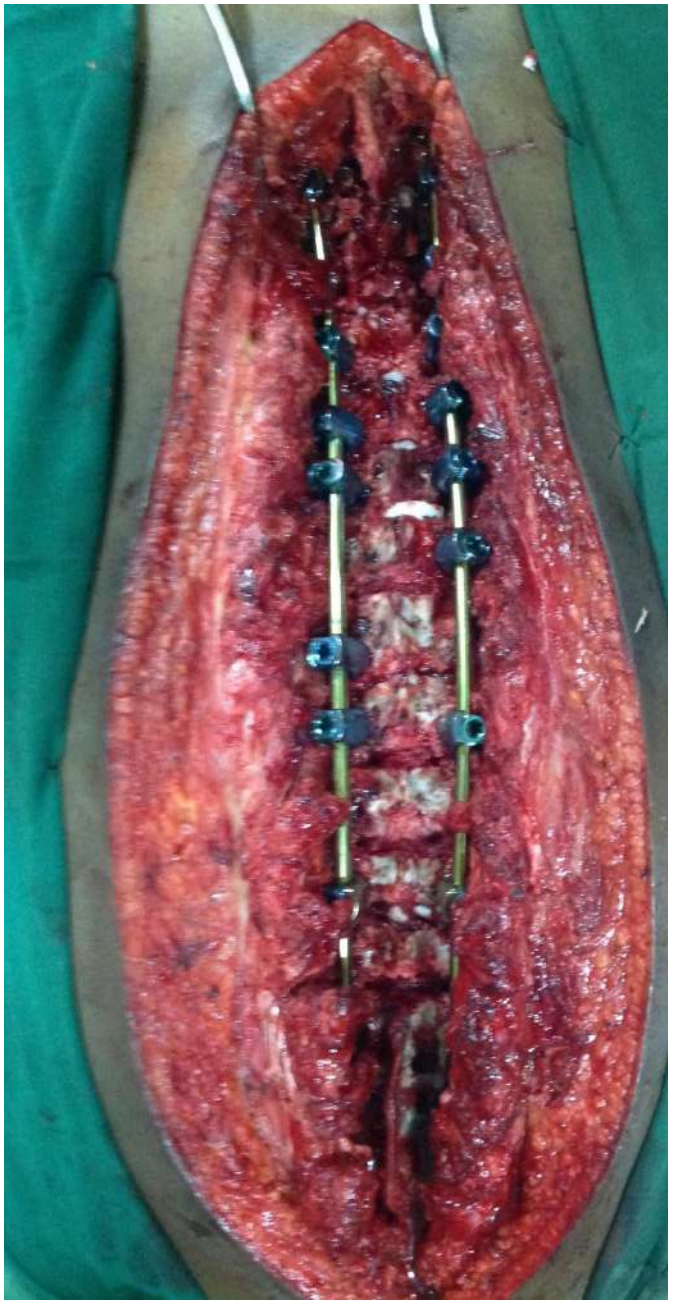

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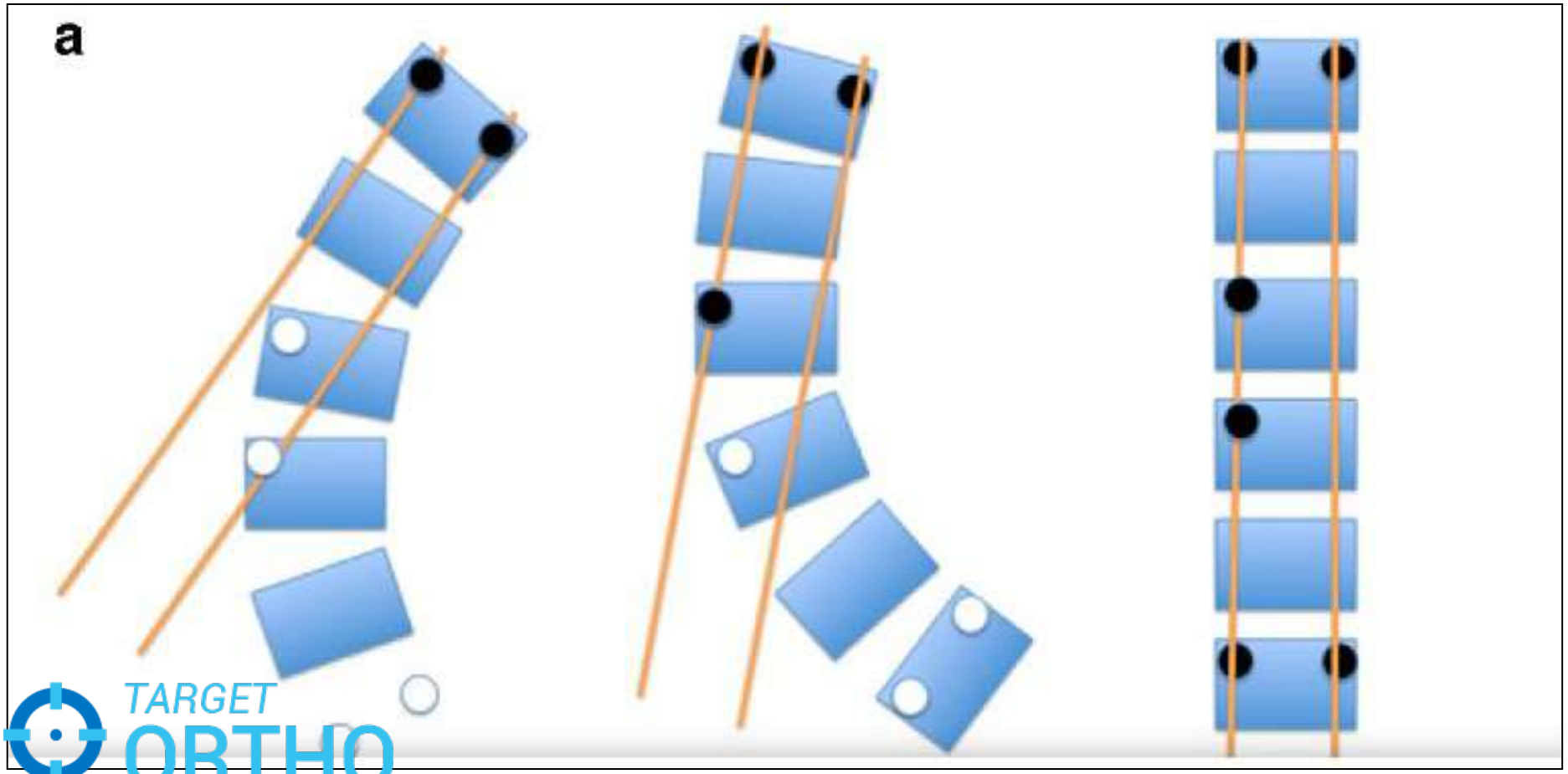
Cantelever technique



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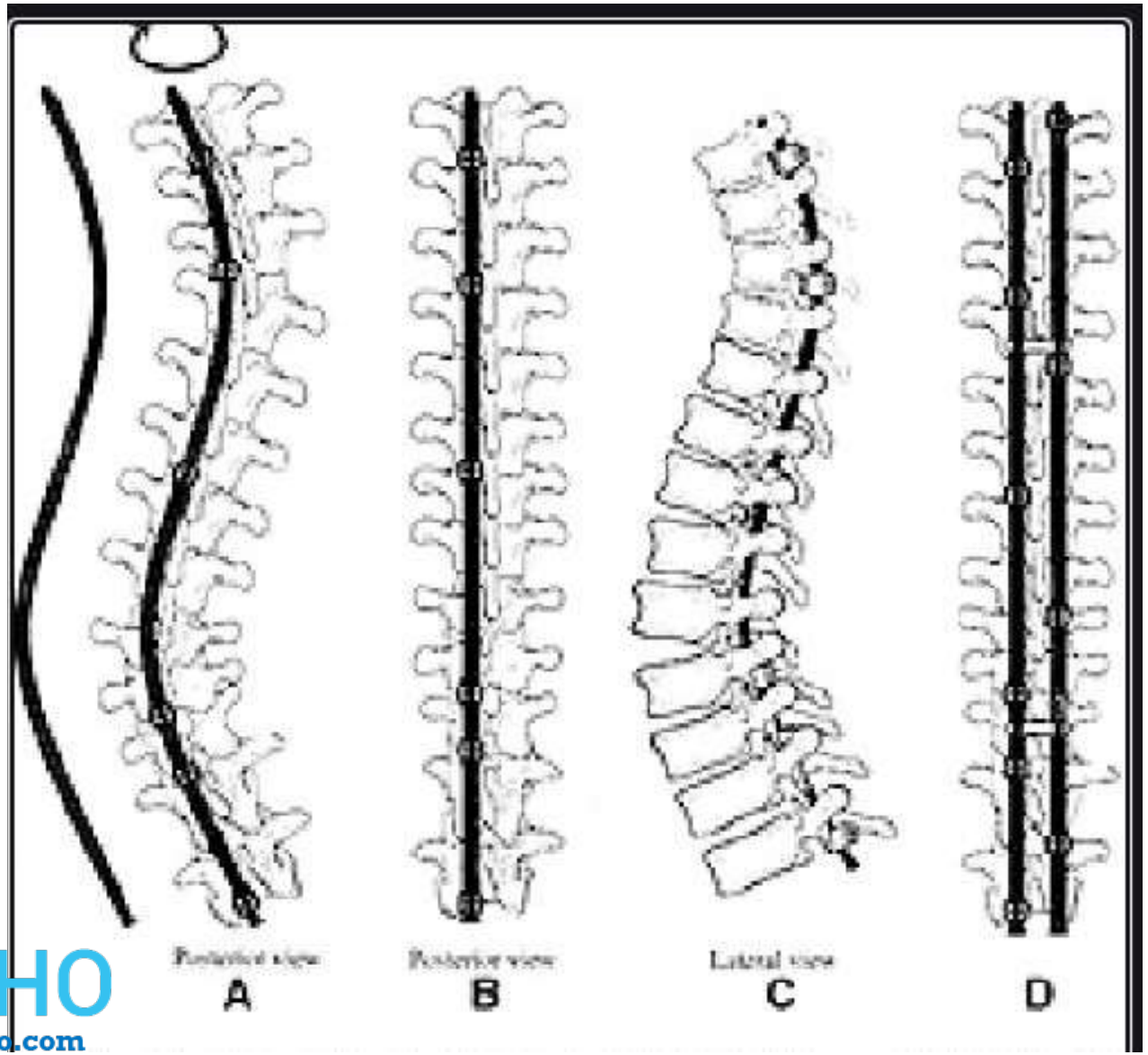
Rod rotation technique



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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

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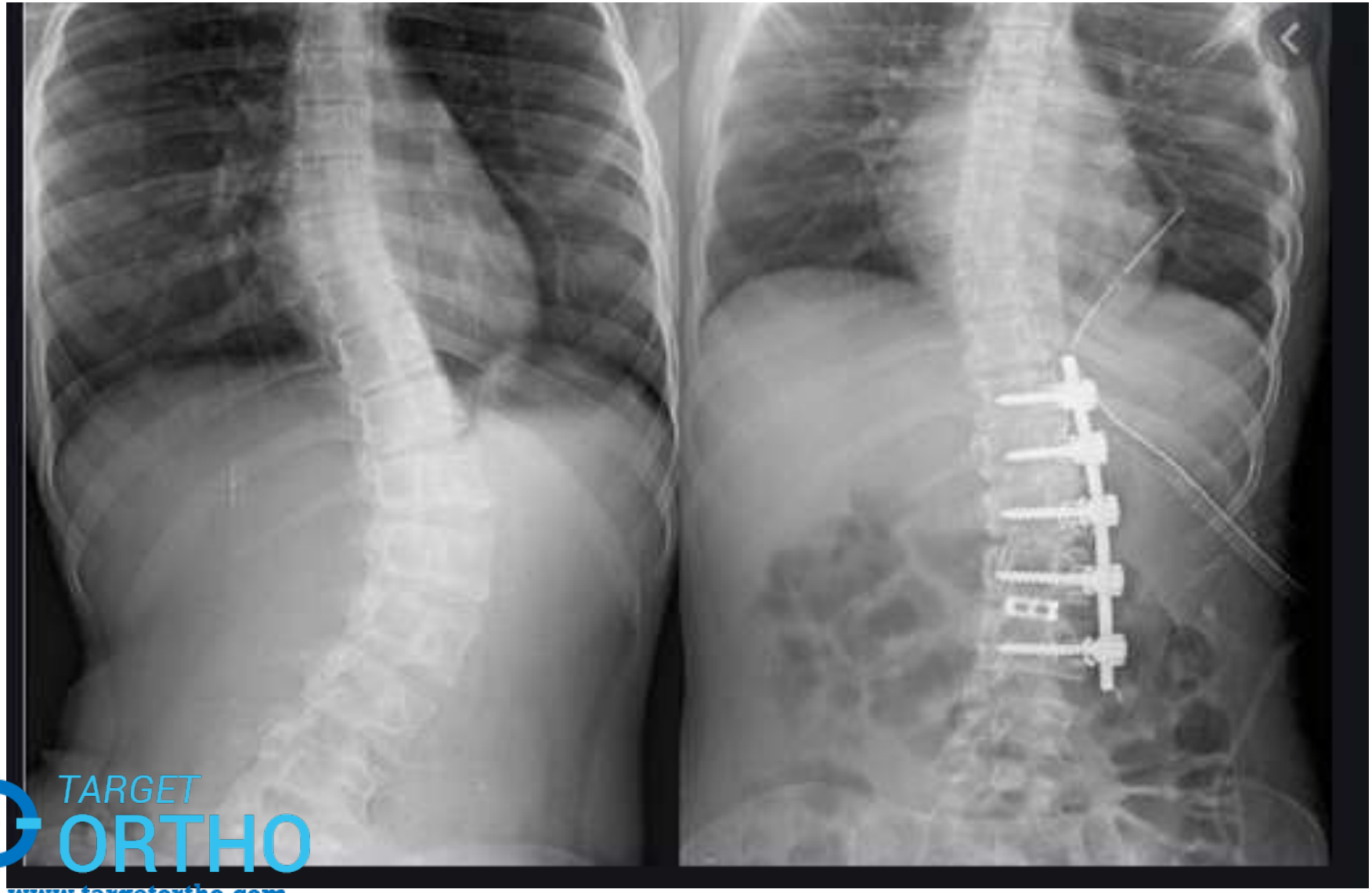

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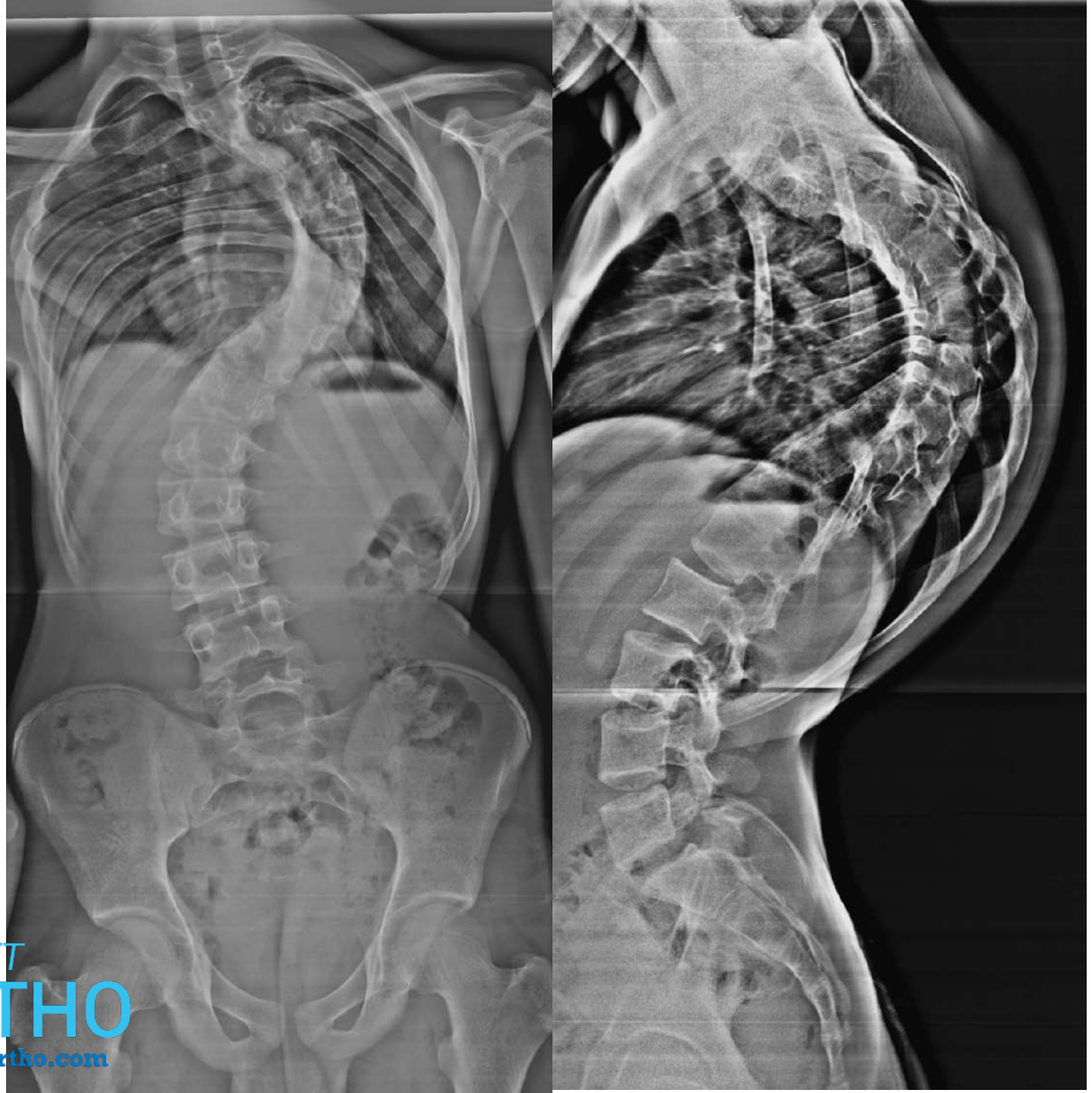

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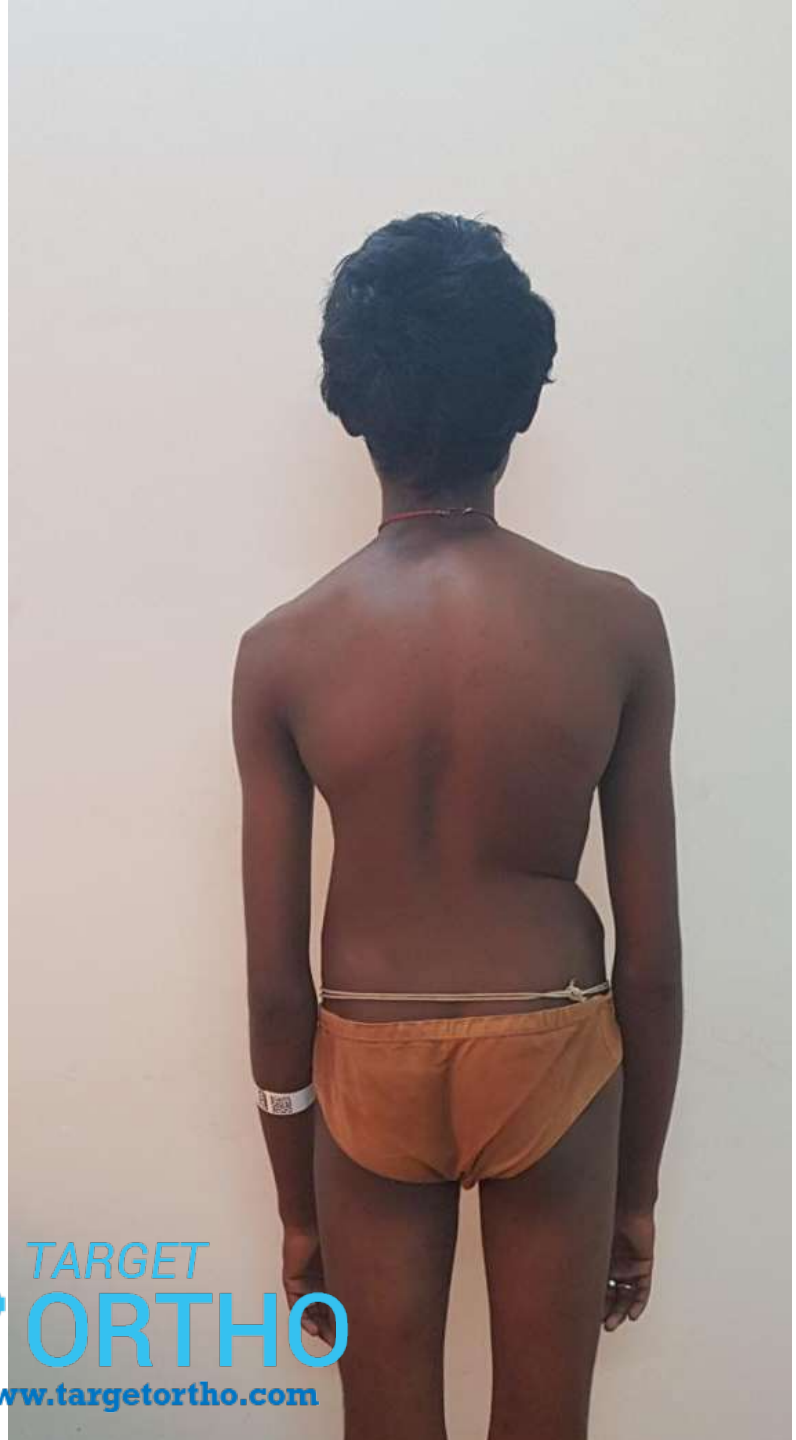

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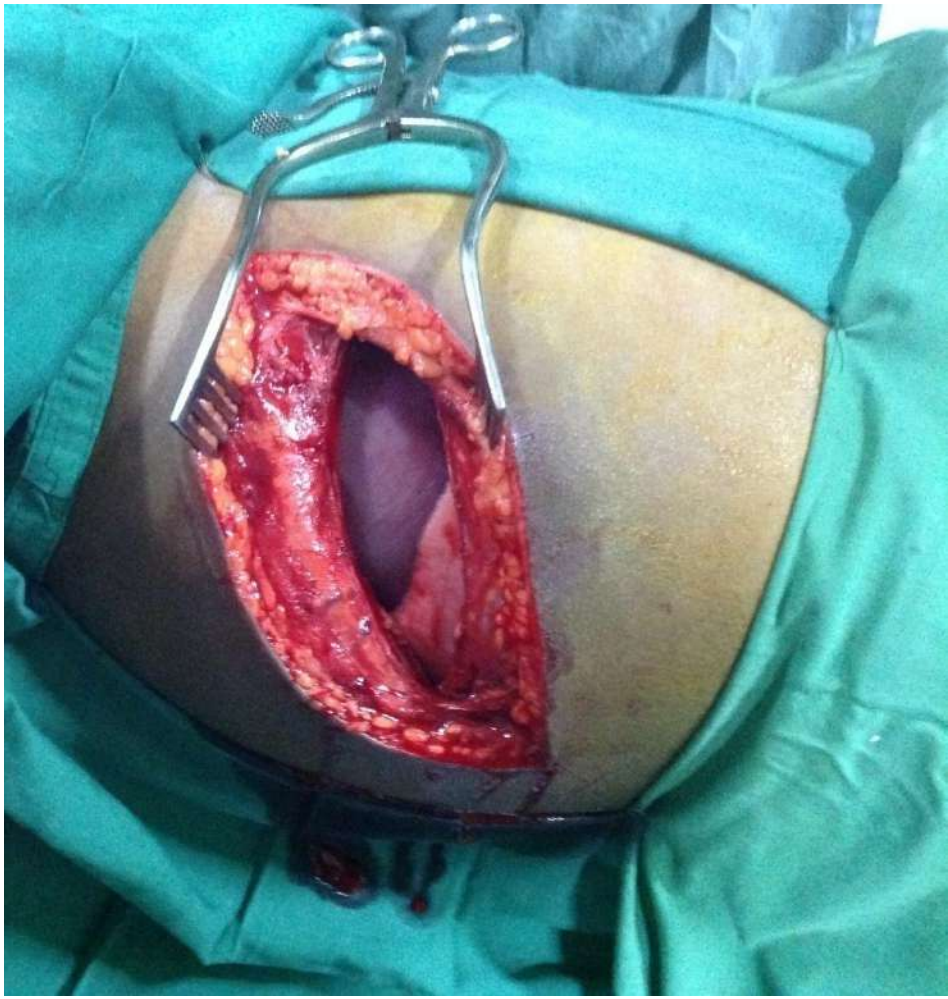

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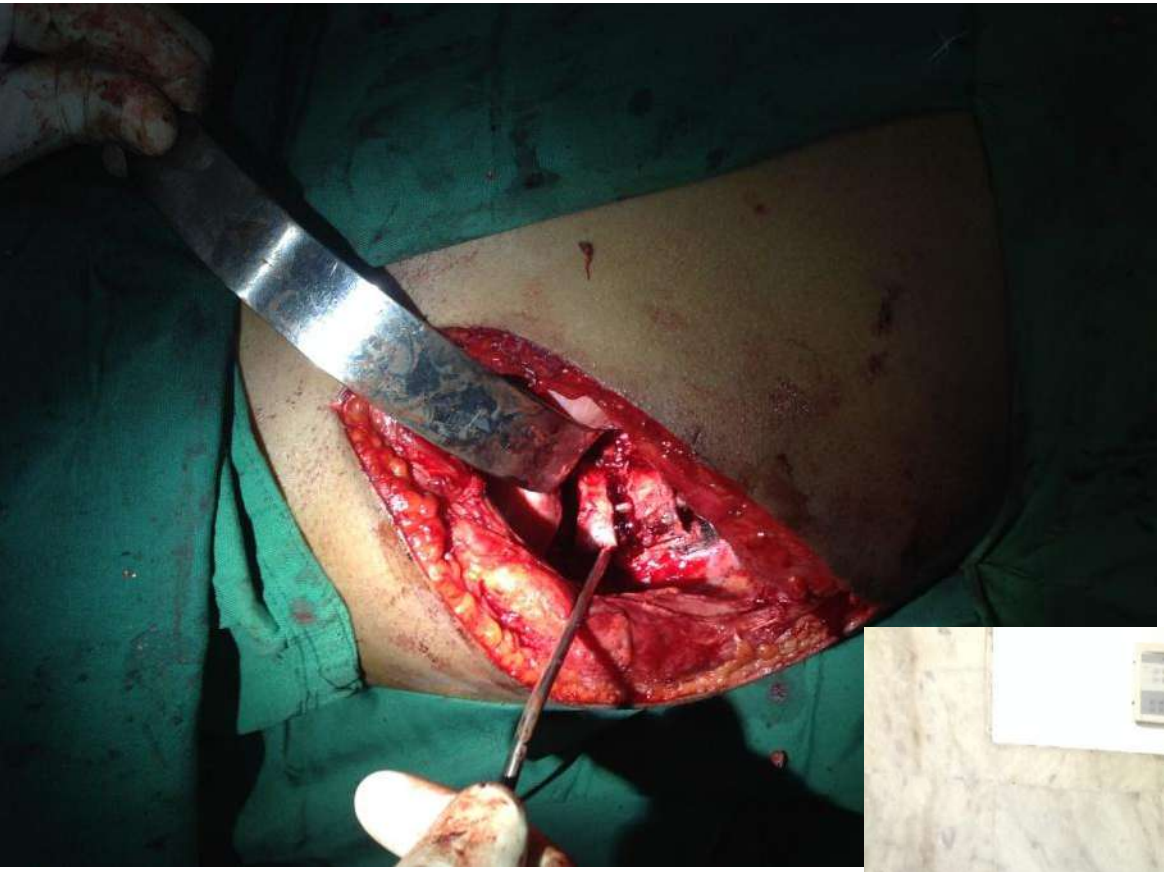

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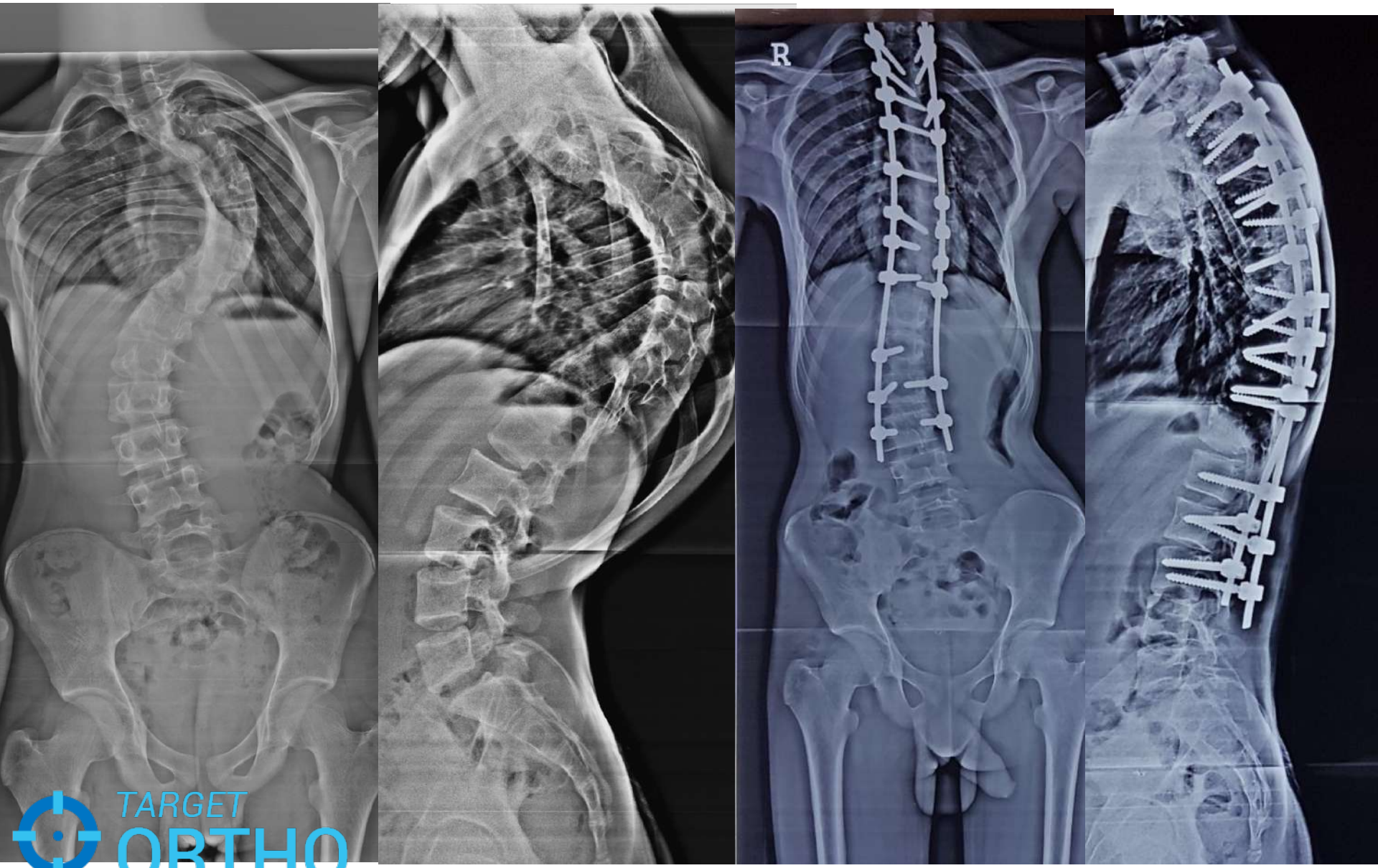

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- **Neurologic Monitoring**
  - Somatosensory-evoked potentials (SSEPs)
  - Motor-evoked potentials (MEP)
    - motor-evoked potentials can provide an intraoperative warning of impending spinal cord dysfunction
  - neurologic event defined as drop 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

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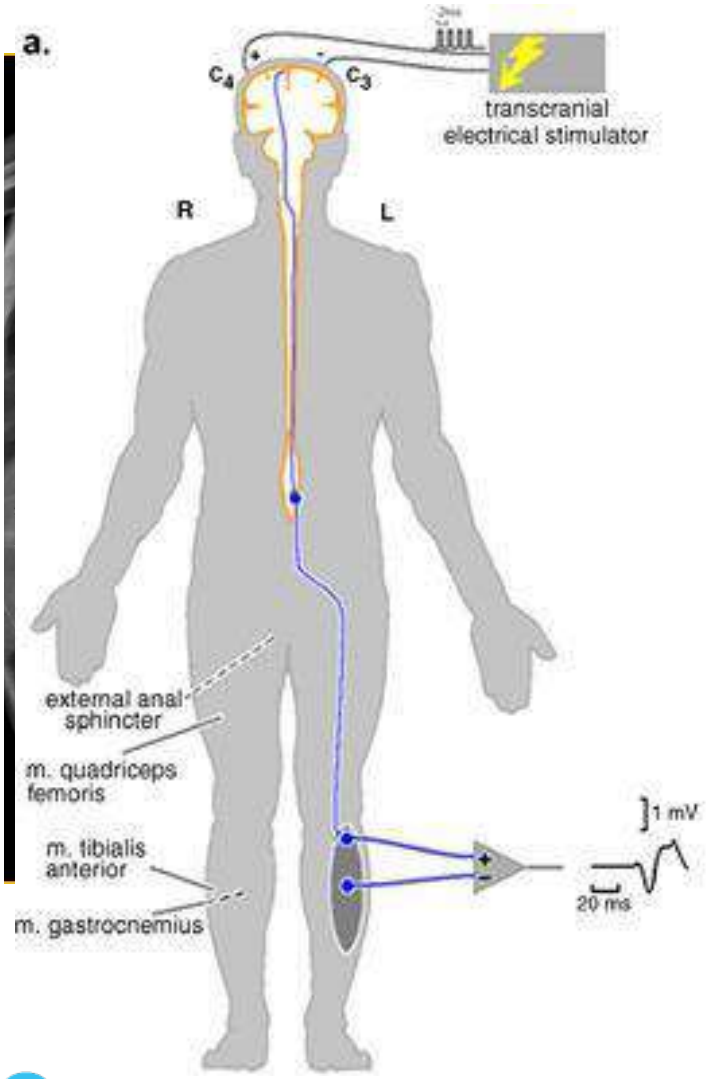

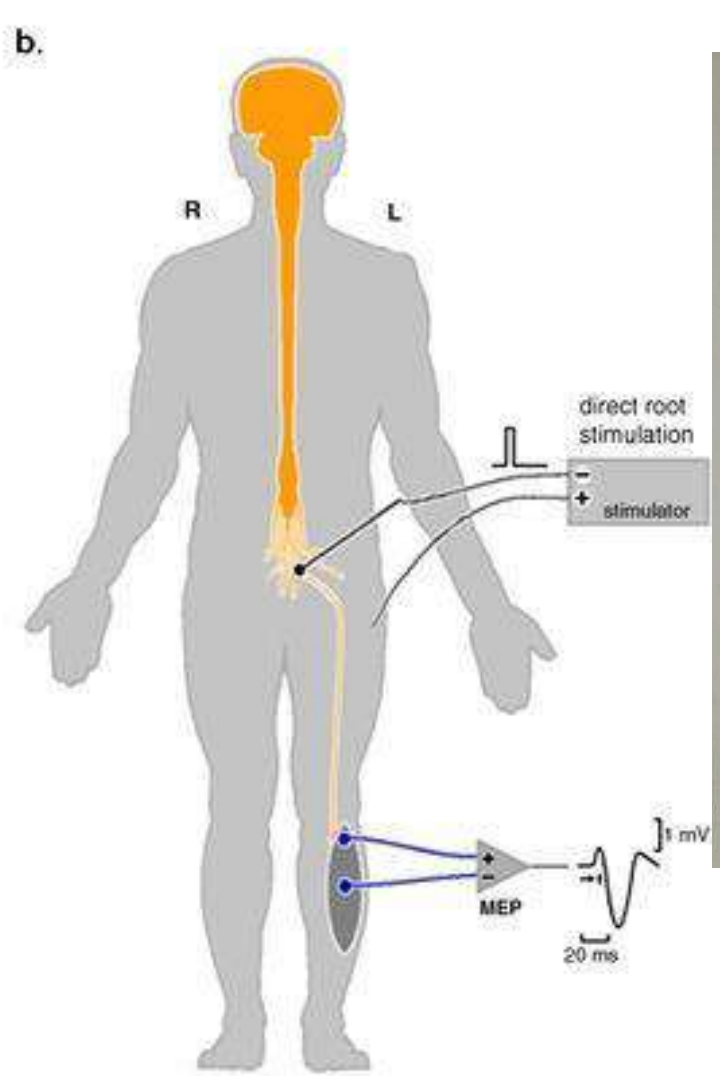

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Complication

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

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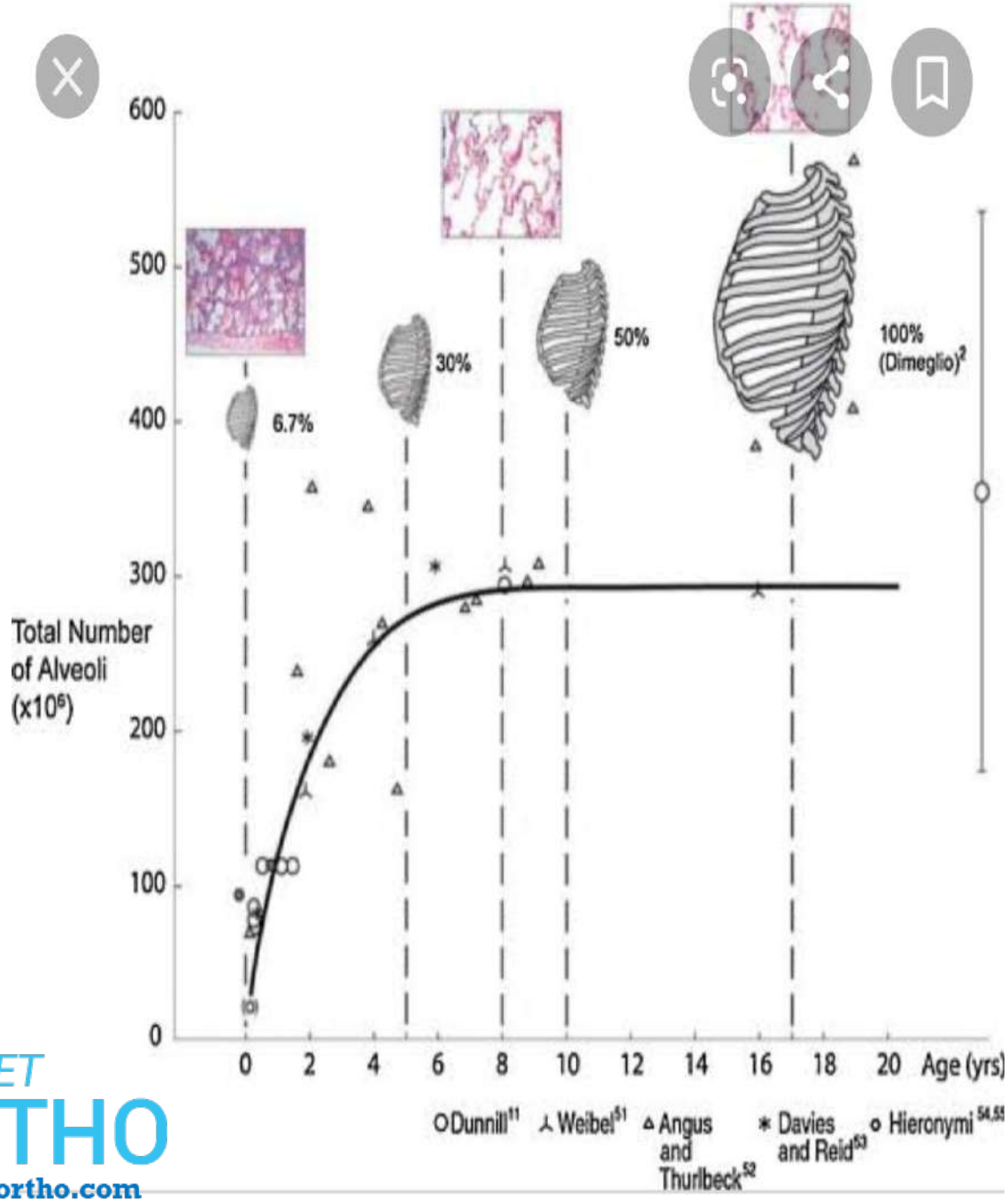

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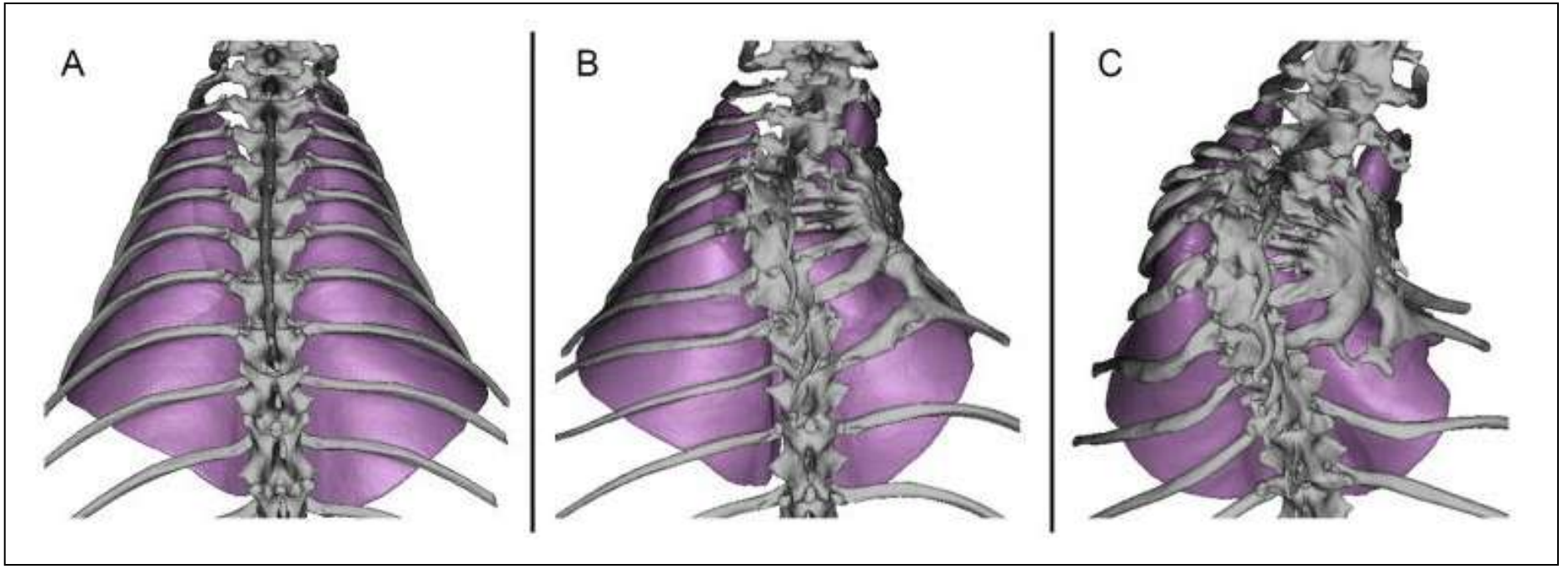
What happens in deformed chest?



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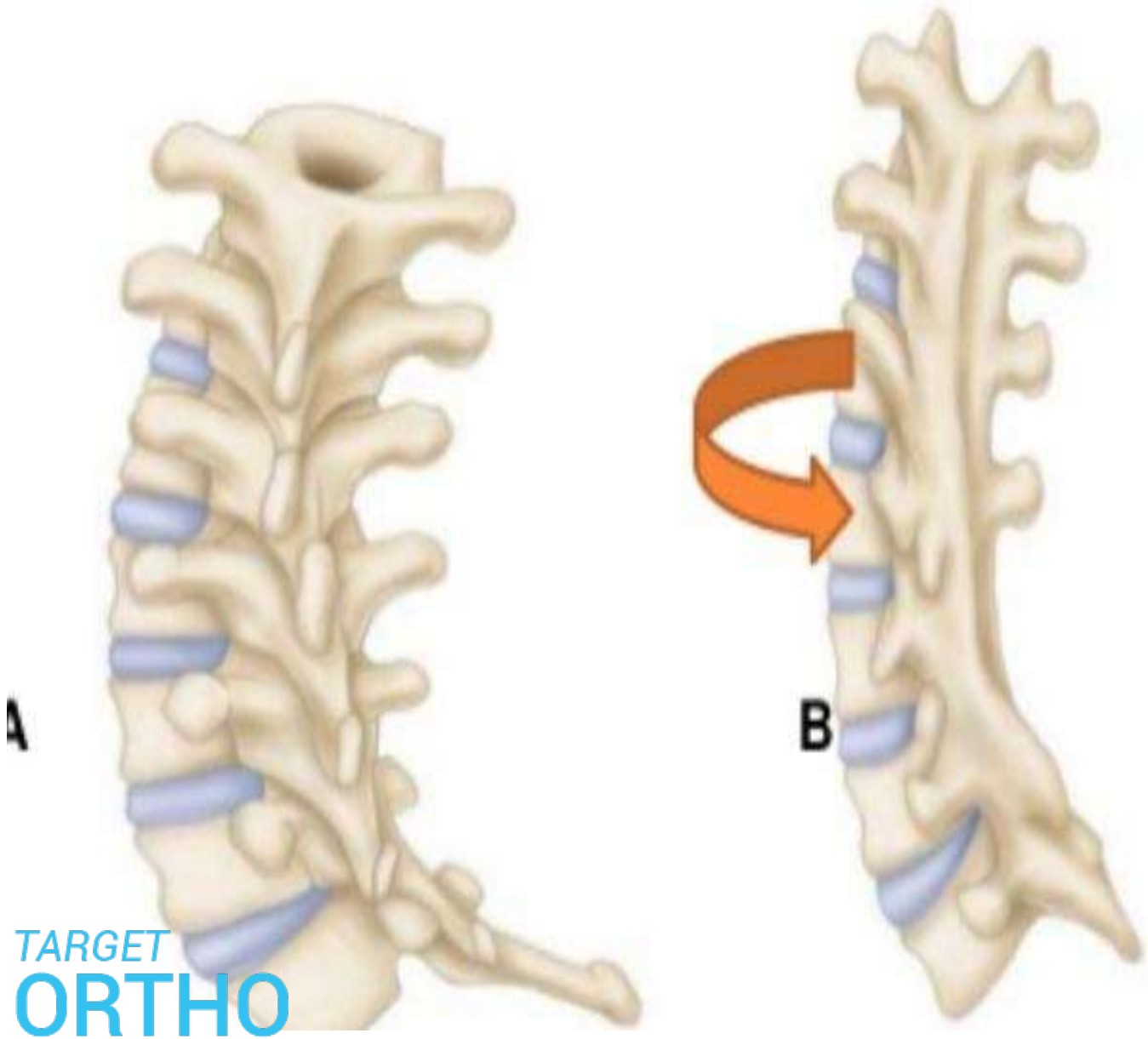

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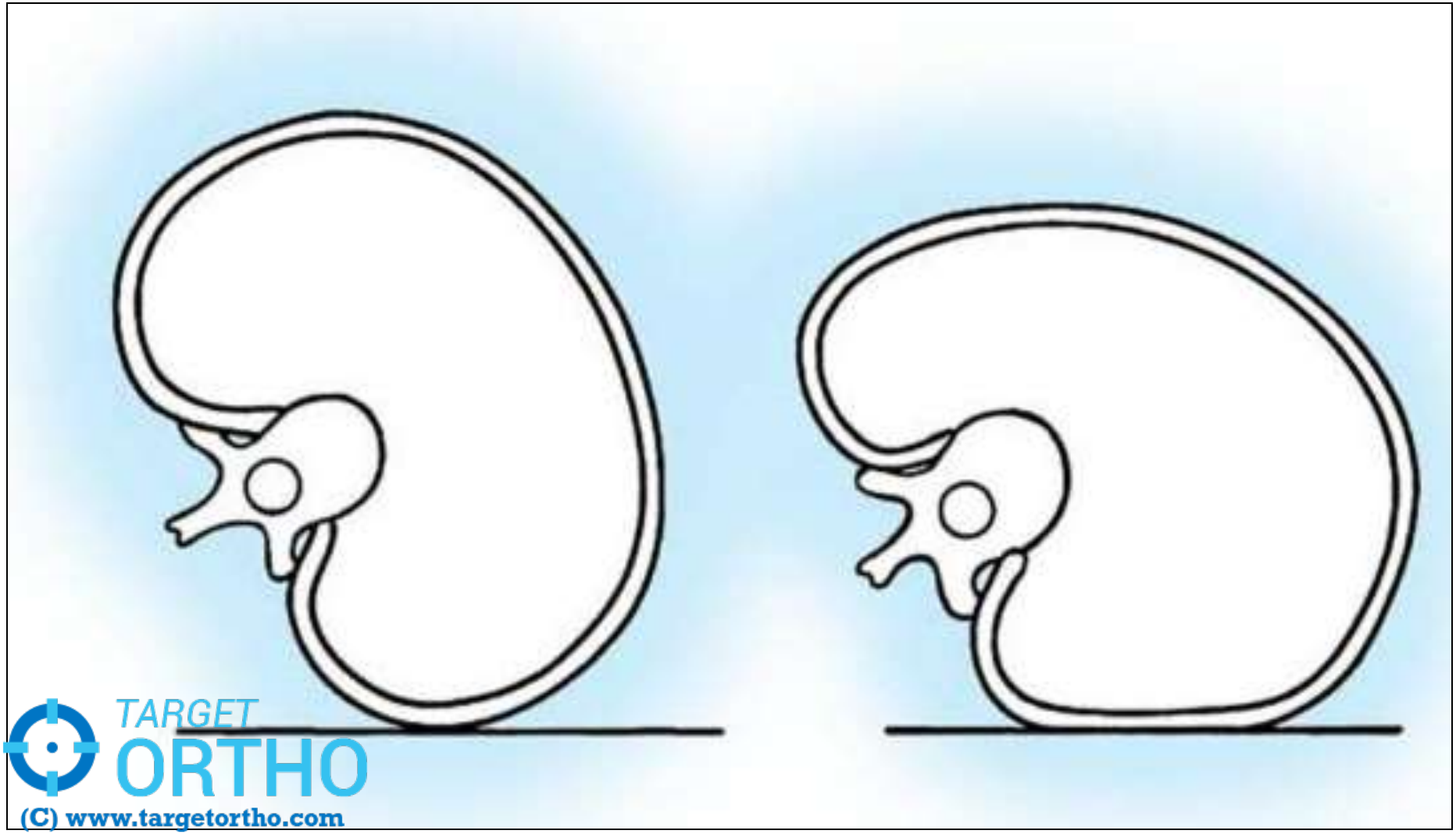
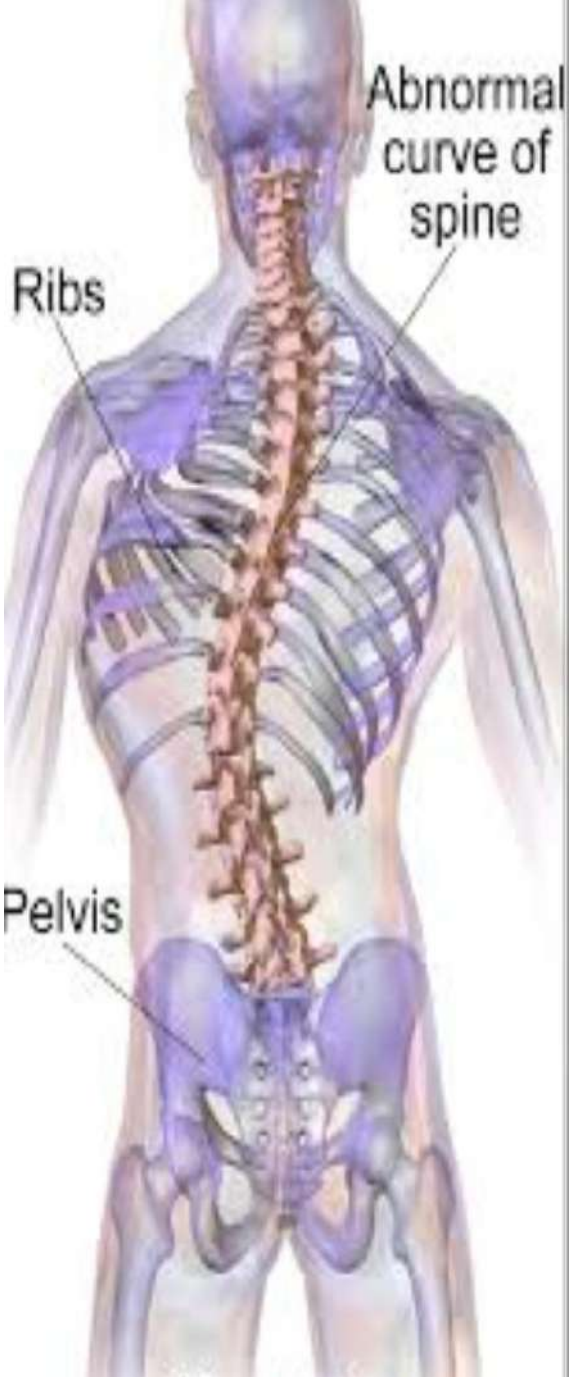
What happens in deformed chest?





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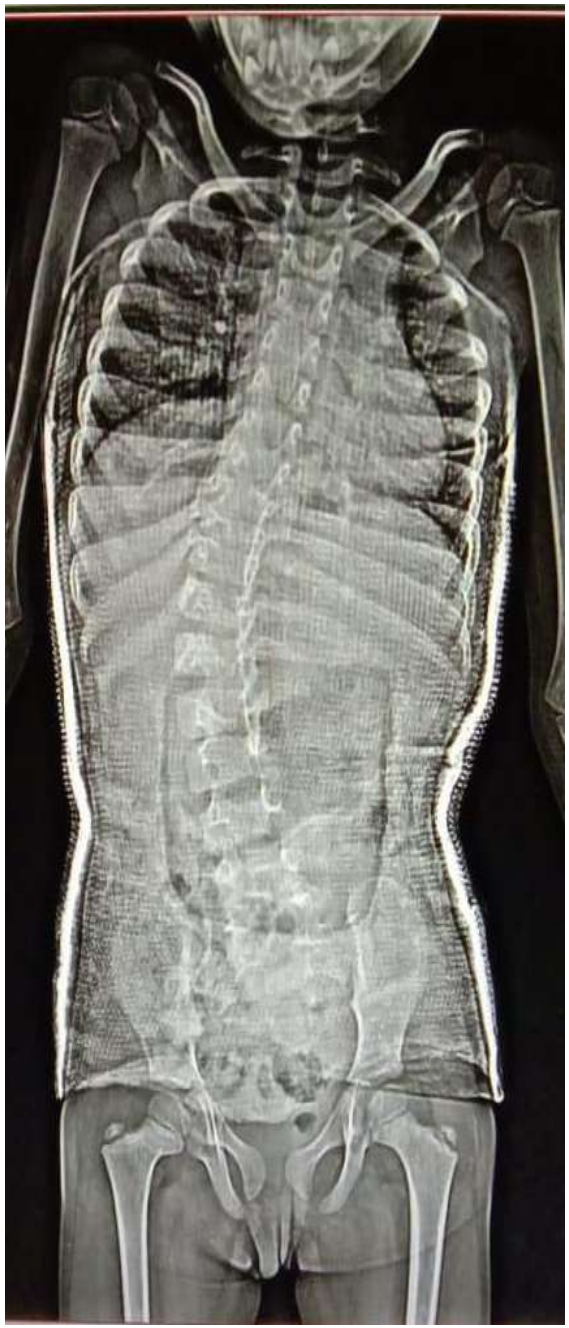

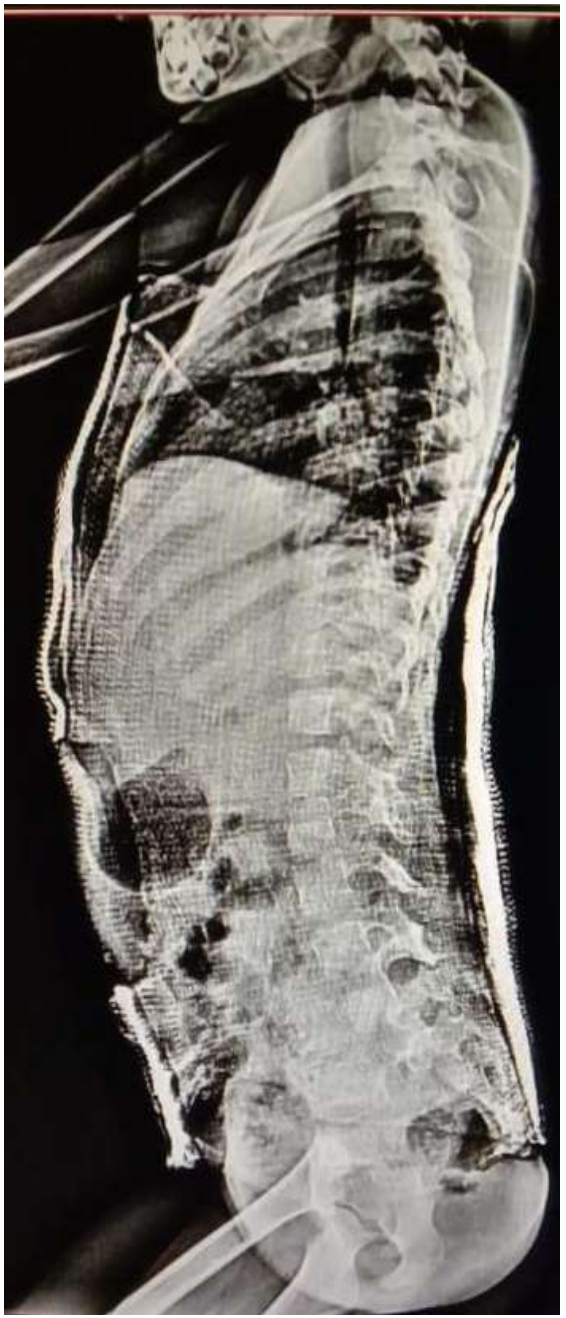

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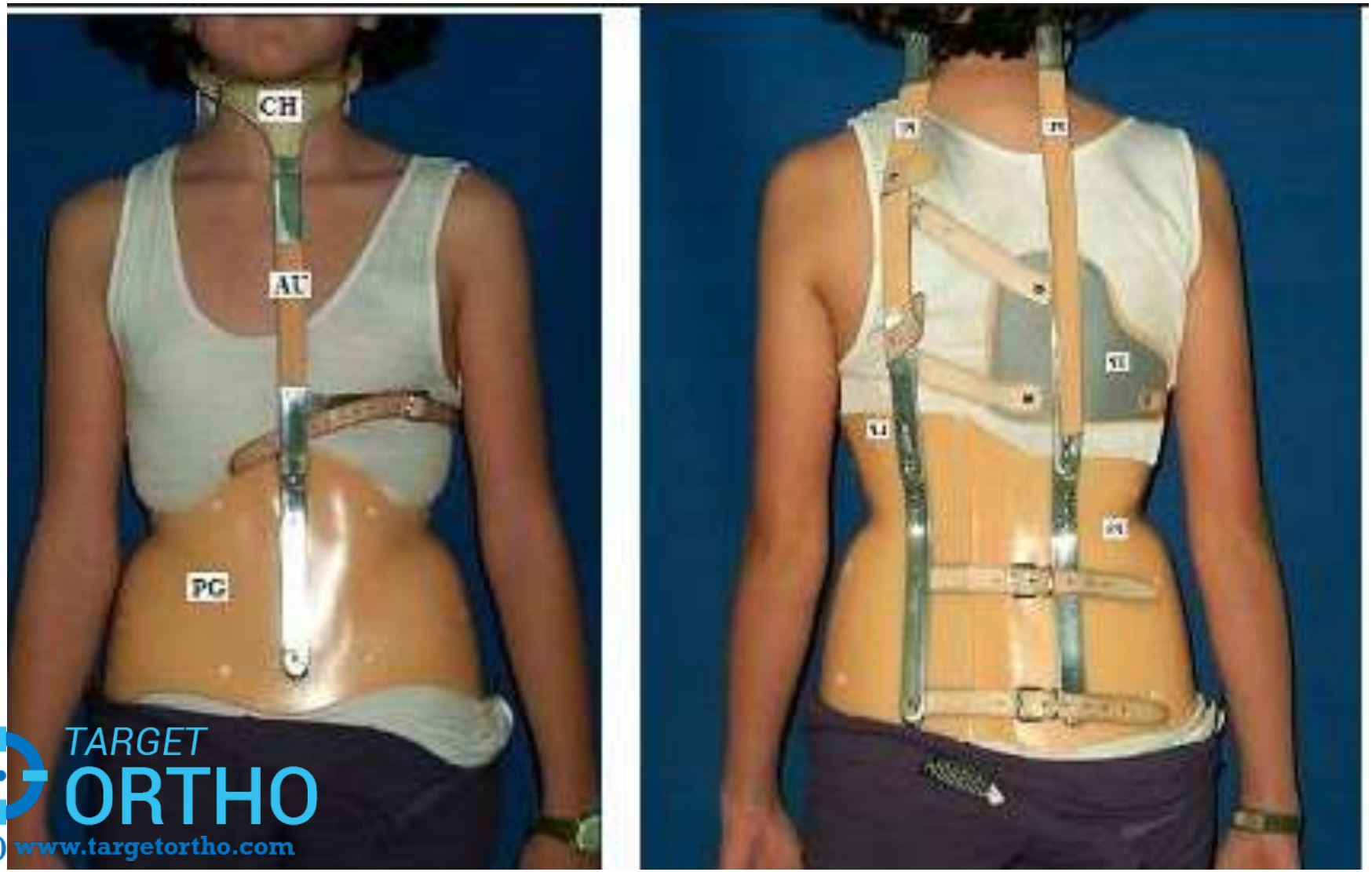
Spinal brace



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Growth rods

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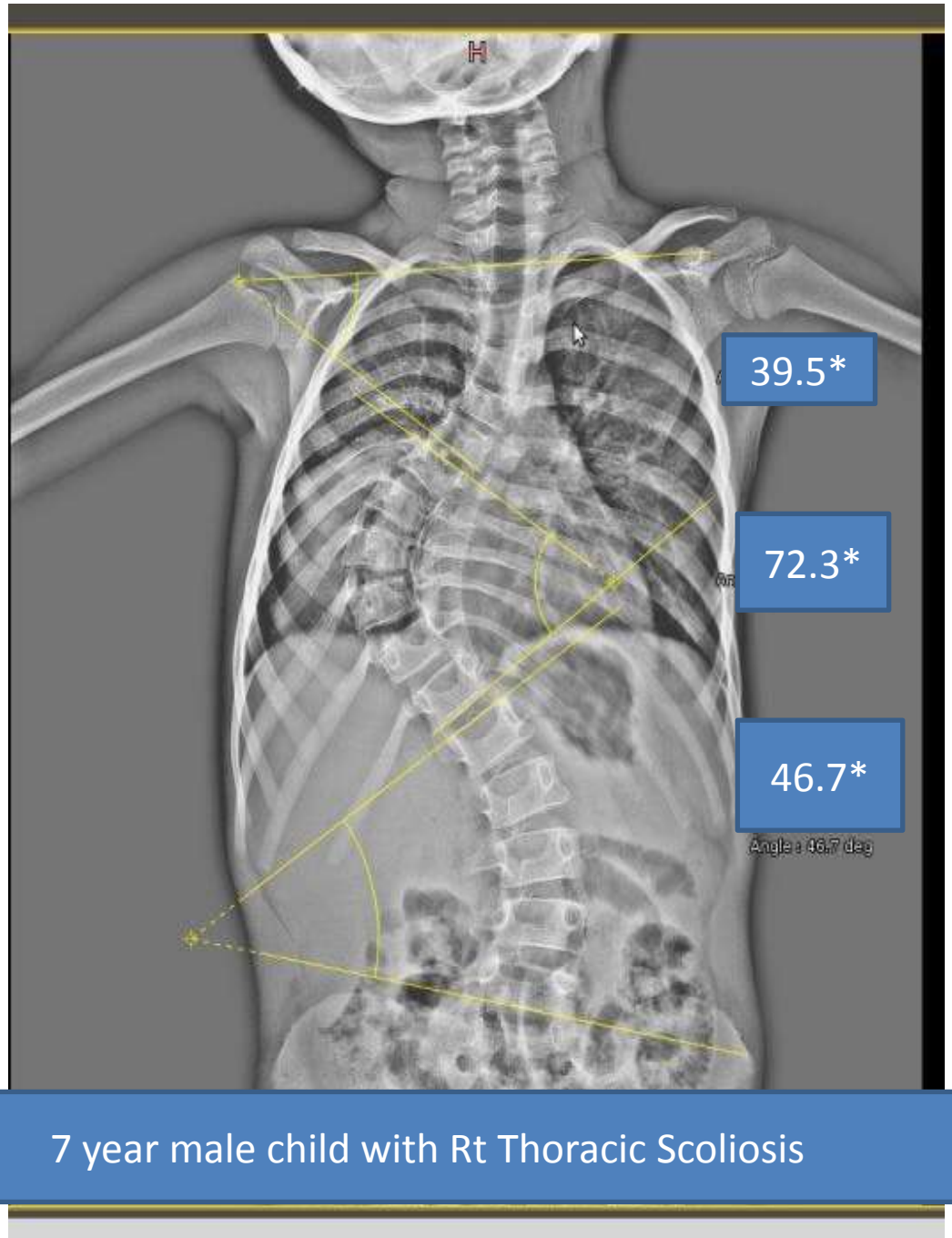

7 year male child with Rt Thoracic Scoliosis

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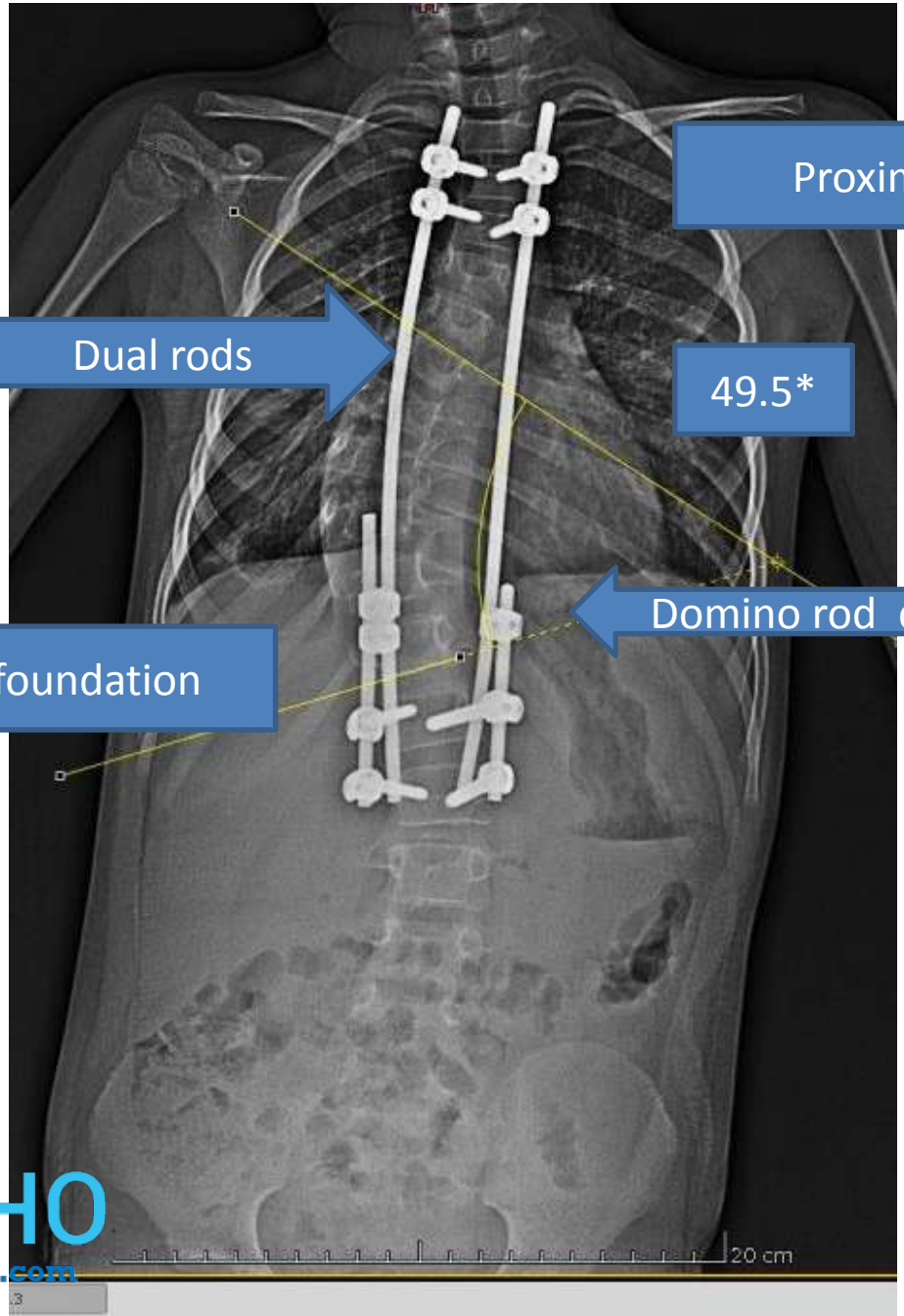

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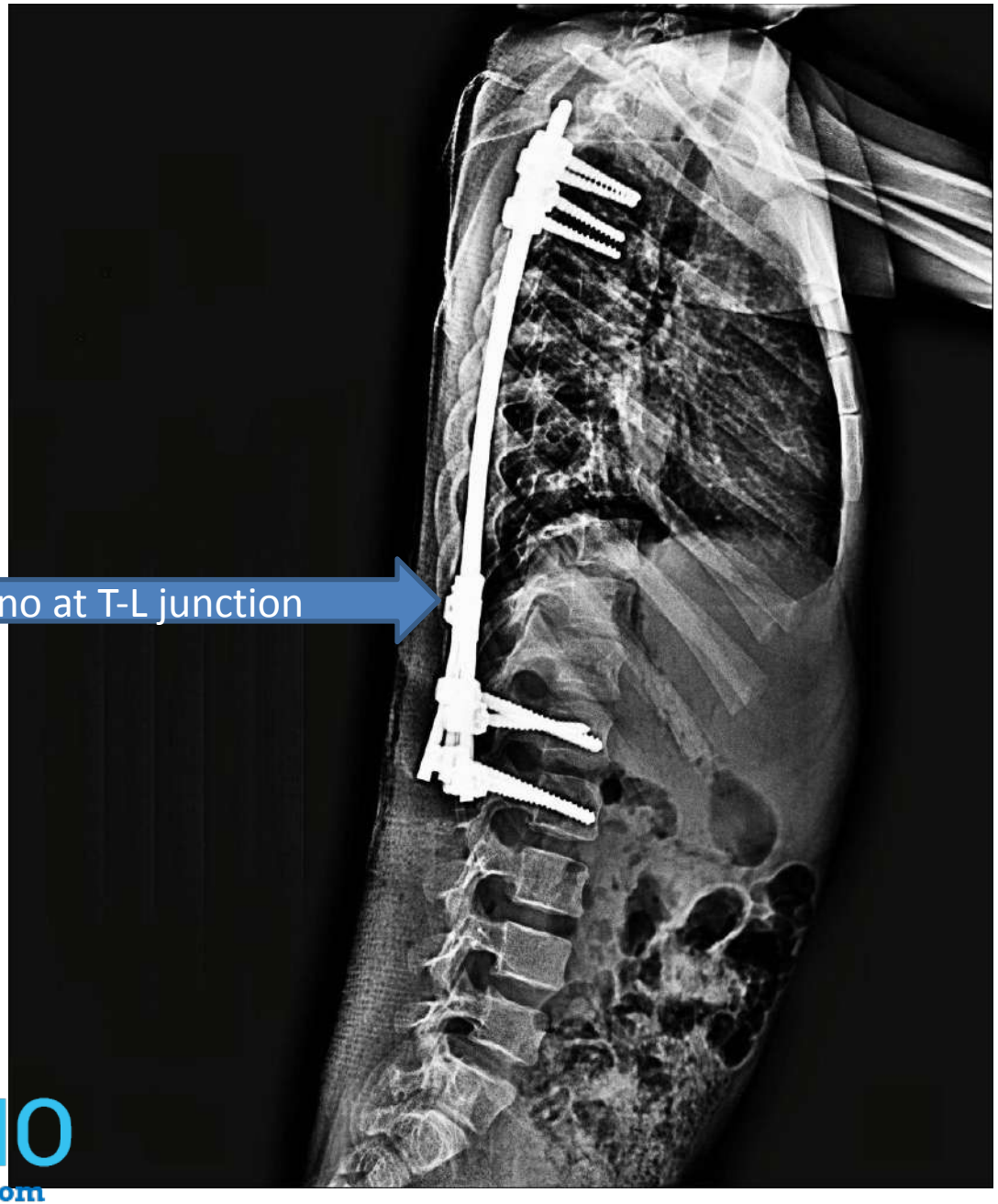

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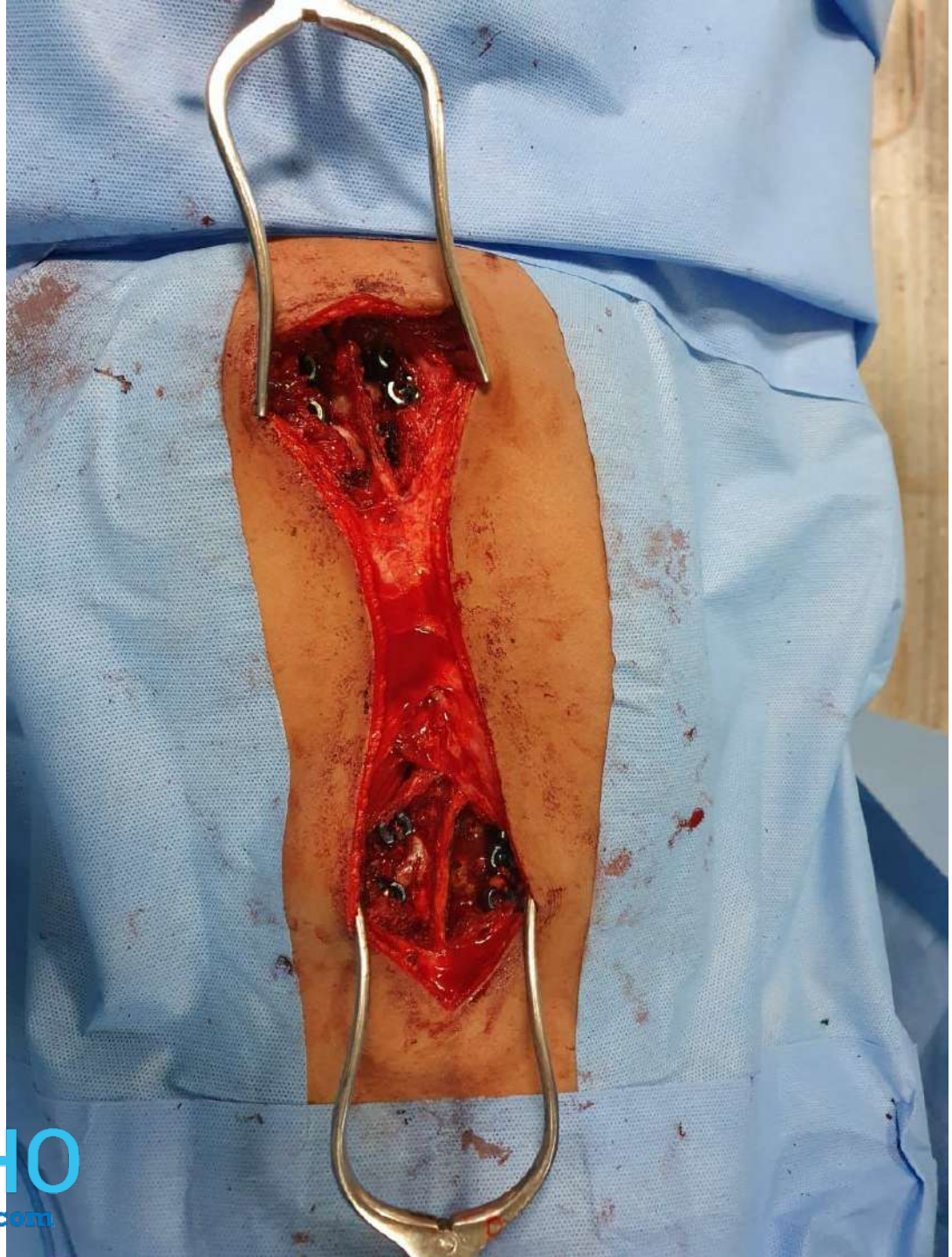

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SRU 2019

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

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Thank you

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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**.

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- **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

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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.

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- 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

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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

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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

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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

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Complication

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

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