

Spinal Deformities: Scoliosis and Kyphosis

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Normal Spinal Curvatures

Lateral View

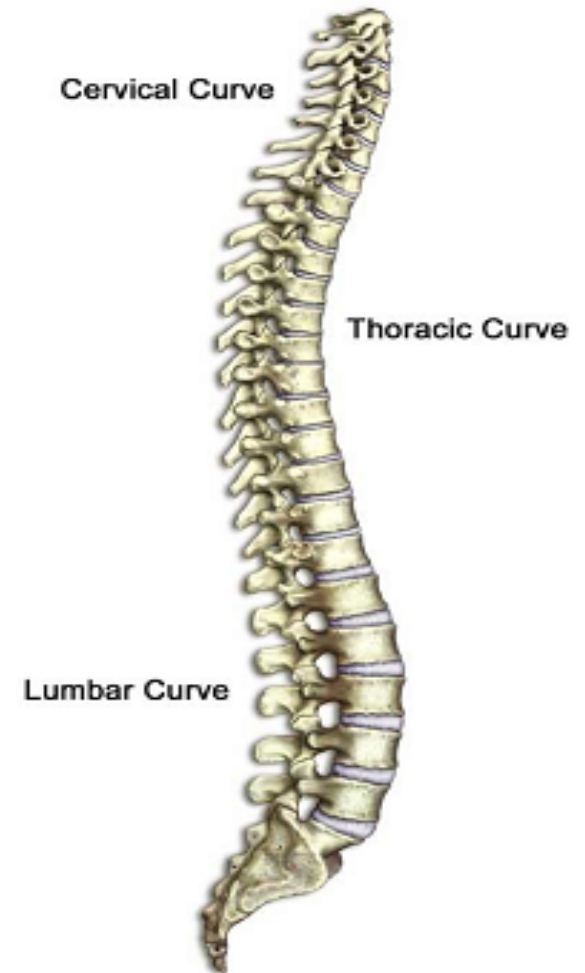
Lordosis

- Cervical
- Lumbar (30 - 60 degrees)

Kyphosis

- Thoracic (20 - 40 degrees)
- Sacrum / coccyx

P-A views should show straight line of spine



What
is
Scoliosis



Scoliosis

Various definitions

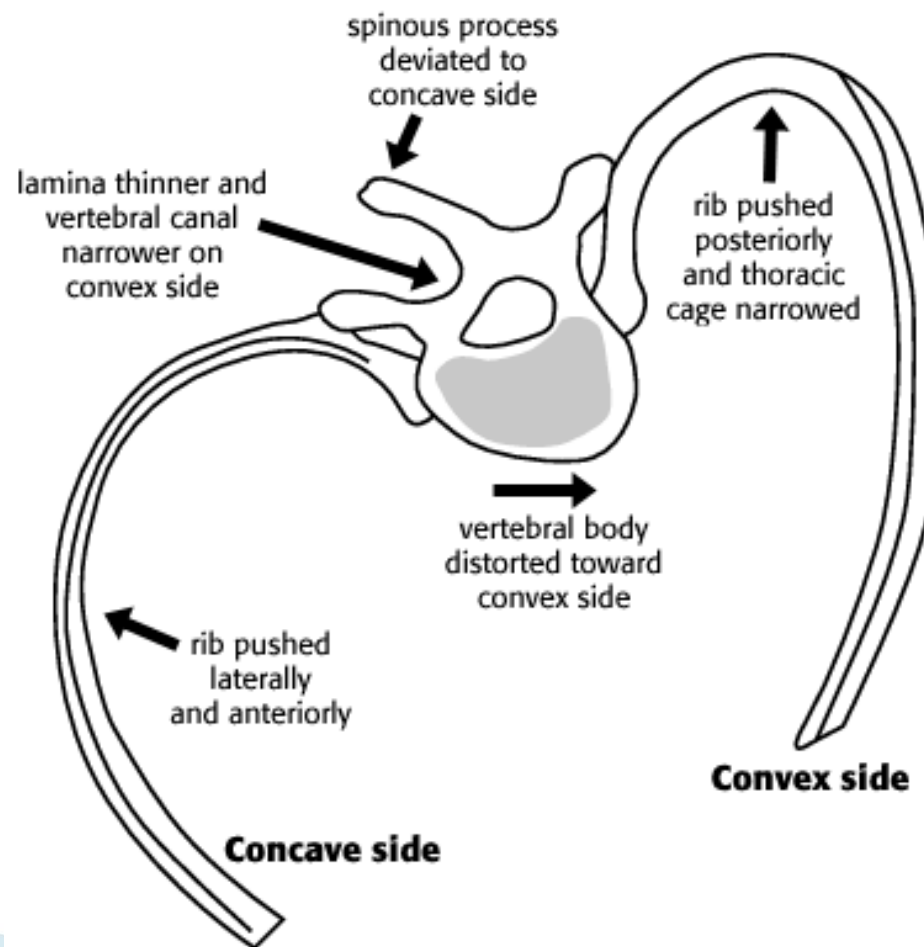
1. Lateral curvature of the spine or
2. Deformity in the frontal Plane

May be associated with deformities in other planes:

1. Saggital
 2. Torsional
- 

Associated deformities


▶ Vertebral rotation




Scoliosis: Classification

- ▶ These are the various methods of classification:
 - Curve location
 - Age at onset
 - Primary or secondary
 - Based on curve rigidity
 - Aetiological

Classification: Curve location

- ▶ Cervical: apex between C2 and C6
 - ▶ Cervicothoracic: apex between C7 and T1
 - ▶ Thoracic: apex between T2 and T11
 - ▶ Thoracolumbar: apex between T12 and L1
 - ▶ Lumbar: apex between L2 and L4
 - ▶ Lumbosacral: apex at L5 or below
- 


Classification: Age of onset

- ▶ **Infantile** (ages 0 to 3 years)
 - ▶ **Juvenile** (age 4 to 10 years)
 - ▶ **Adolescent** (11 to 17 years)
 - ▶ **Adult** (> 18 years)
- 


Classification: Primary or secondary

- ▶ Primary curve is the first to developed
- ▶ Secondary curve develops after primary curve to balance the head over the pelvis

Classification: Curve rigidity

- ▶ **Non-Structural (Postural) rigidity:** It is caused by postural issues, such as leg length discrepancies or anomalies elsewhere in the body. It is flexible and it disappears when leaning forward
 - ▶ **Structural scoliosis:** Relatively rigid. It involves rotation of the vertebral aside the side-to-side curve. Does not disappear with forward bending
- 


Classification: Aetiological

- ▶ **Idiopathic: 80% of scoliosis belong to this group**
 - ▶ **Syndrome-related**
 - ▶ **Neuromuscular**
 - ▶ **Congenital**
- 


Idiopathic scoliosis

- ▶ Infantile
 - Resolving
 - Progressive
 - ▶ Juvenile
 - ▶ Adolescent
- 


Characteristics of idiopathic scoliosis:

- ▶ More common in females
 - ▶ Ratio of girls to boys with *small* curves ($\leq 10^\circ$) is equal, but for curves $>30^\circ$ the ratio is 10:1
 - ▶ Scoliosis tends to progress more often in girls (so girls with scoliosis are more likely to require treatment)
- 

Natural history of scoliosis


- ▶ Of adolescents diagnosed with scoliosis, only 10% have curve progression requiring medical intervention
 - ▶ Three main determinants of curve progression are:
 - (1) Patient gender
 - (2) Future growth potential
 - (3) Curve magnitude at time of diagnosis
- 

Clinical features: History


- ▶ Family history of scoliosis
 - ▶ Recent growth
 - ▶ Physical changes of puberty (onset of menses).
 - ▶ Age at onset,
 - ▶ Rate of curve progression,
 - ▶ Presence of neurologic symptoms
 - ▶ Pain is not a prominent feature of idiopathic scoliosis. If present, think of an underline cause!
- 

Clinical features:

Physical Examination

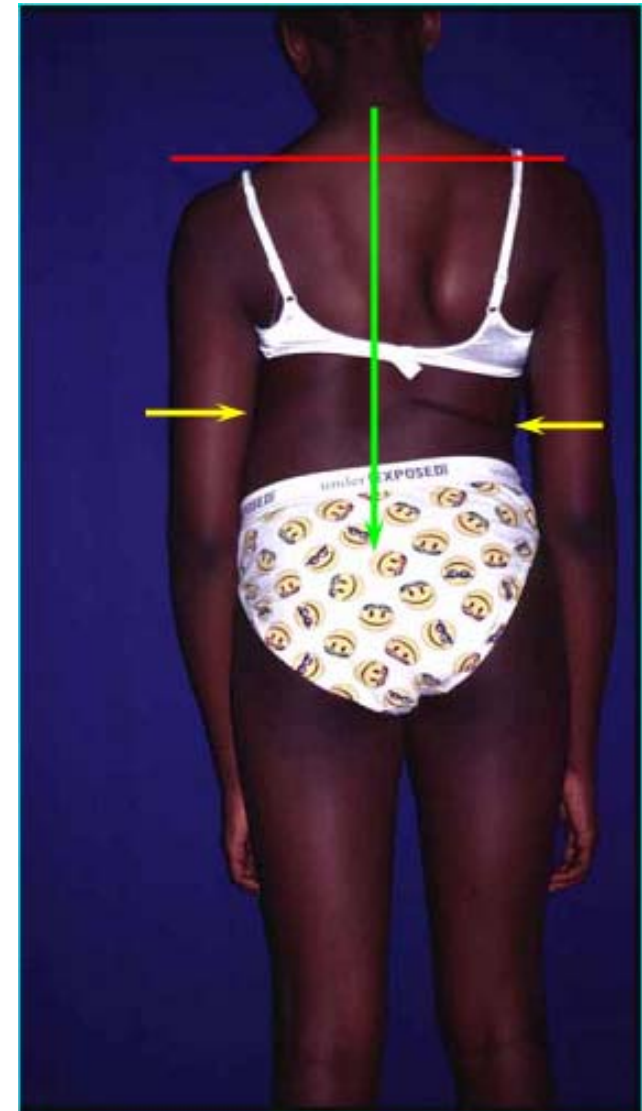
- ▶ Trunk shape
 - ▶ Trunk balance
 - ▶ Neurologic system
 - ▶ Limb length,
 - ▶ Skin markings e.g. café au lait spots
 - ▶ Associated skeletal abnormalities.
 - ▶ Assessment of pubertal development includes assessment of the stages of breast development and the
 - ▶ Presence of axillary/pubertic hair (Tanner stages).
- 

Physical Examination hints

- ▶ Shoulders are at different heights
 - ▶ One shoulder blade is more prominent than the other
 - ▶ Head is not centered directly above the pelvis
 - ▶ Pelvis is oblique
 - ▶ Rib cages are at different heights
 - ▶ Asymmetry of the waist
 - ▶ Changes in look or texture of skin overlying the spine (dimples, hairy patches, color changes)
 - ▶ Leaning of entire body to one side
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Trunk shape and balance

- ▶ Shoulder Balance
- ▶ Coronal Balance
- ▶ Waistline Asymmetry

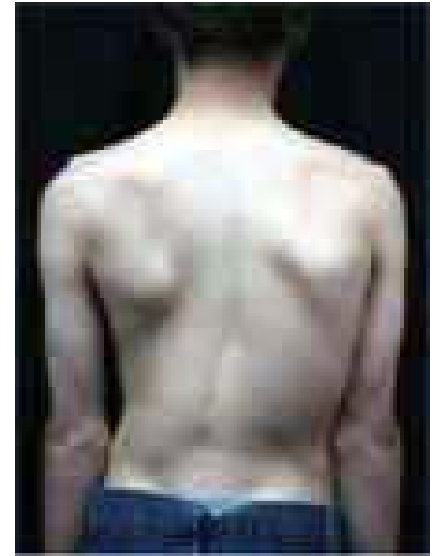


Trunk shape and balance



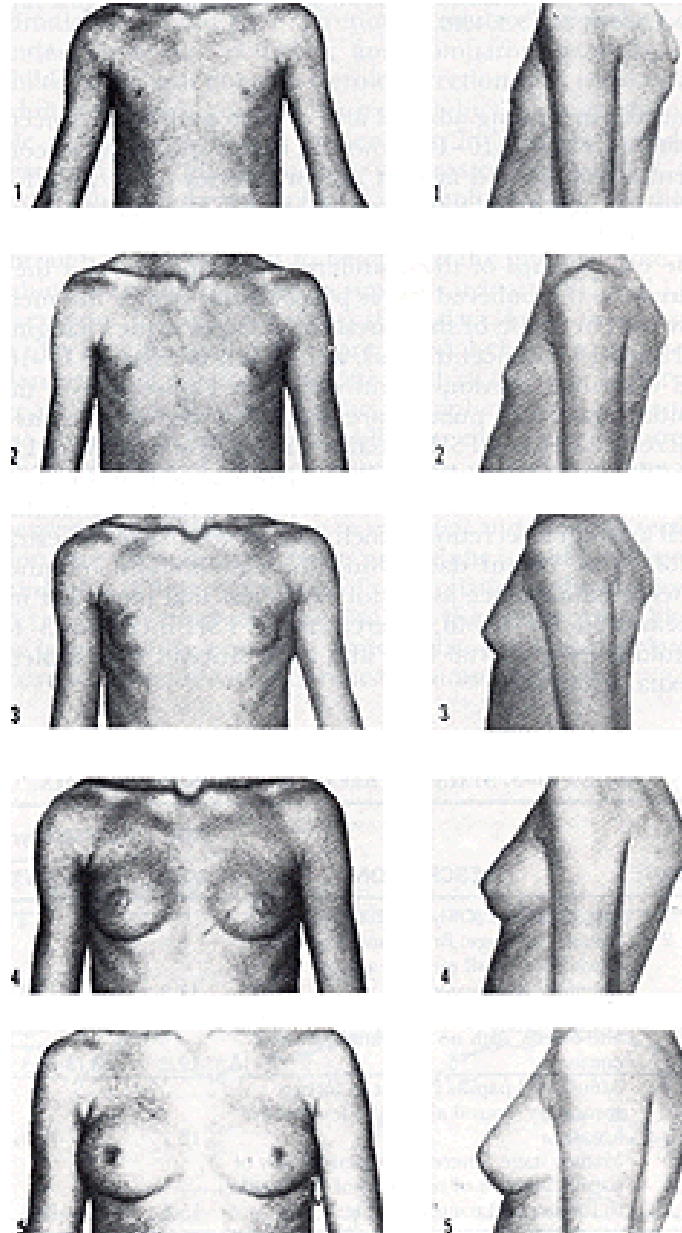
Trunk shape and balance: Adam's forward bend test

- ▶ Patient is asked to lean forward with feet together and bend 90 degrees at the waist.
- ▶ The examiner can then easily view from this angle any asymmetry of the trunk or any abnormal spinal curvatures.



Tanner staging

- ▶ Used for assessing future growth potential:
- ▶ Tanner stages 2-3 (just after onset of pubertal growth) are the stages of maximal scoliosis progression

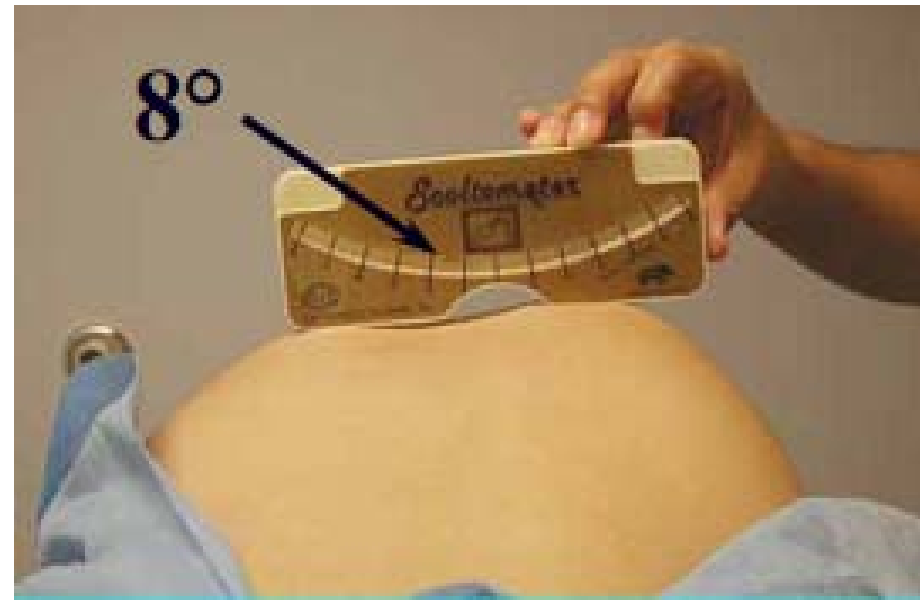


Tanner staging of breast development in girls

Stage 1: Prepubertal; Stage 2: Breast bud stage with elevation of breast and papilla; enlargement of areola; Stage 3: Further enlargement of breast and areola; no separation of their contour; Stage 4: Areola and papilla form a secondary mound above level of breast; Stage 5: Mature stage with projection of papilla only, related to recession of areola. (Reprinted by permission from Marshall, WA, Tanner, JM, Arch Dis Child 1970; 45:13. Copyright Br Med J Publishing Group.)

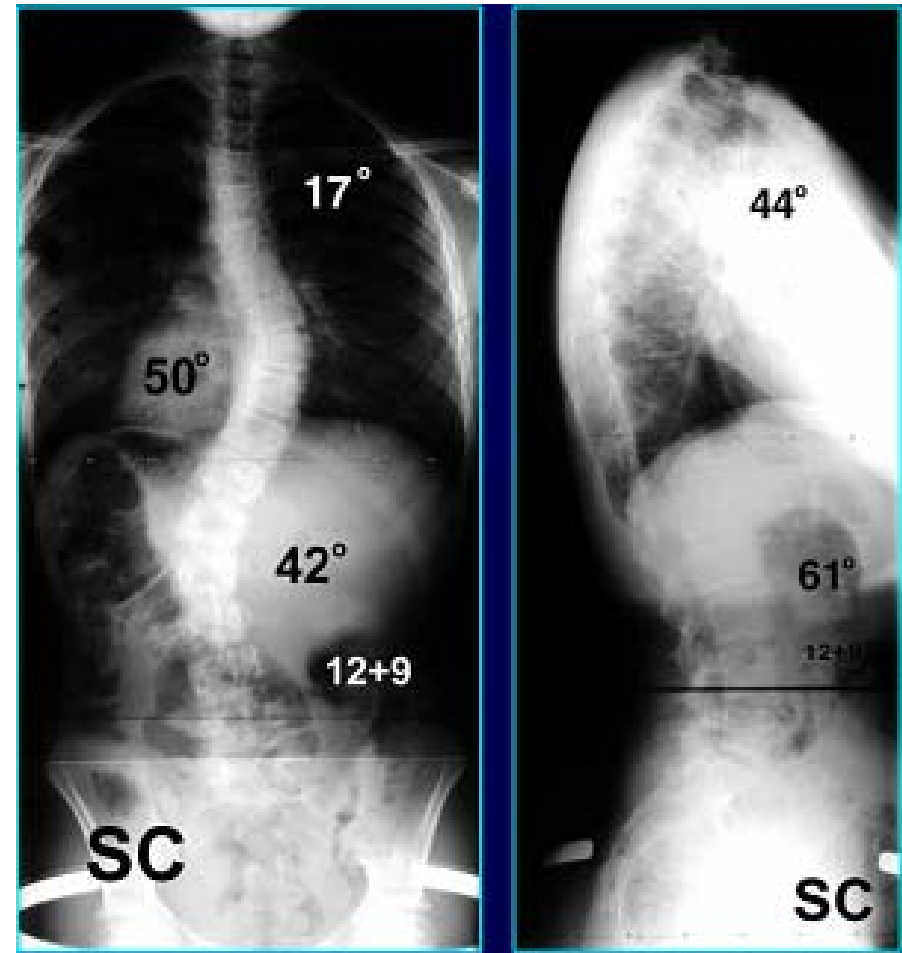
Scoliometer

- ▶ Measures the angle of trunk rotation
- ▶ Useful for screening purposes



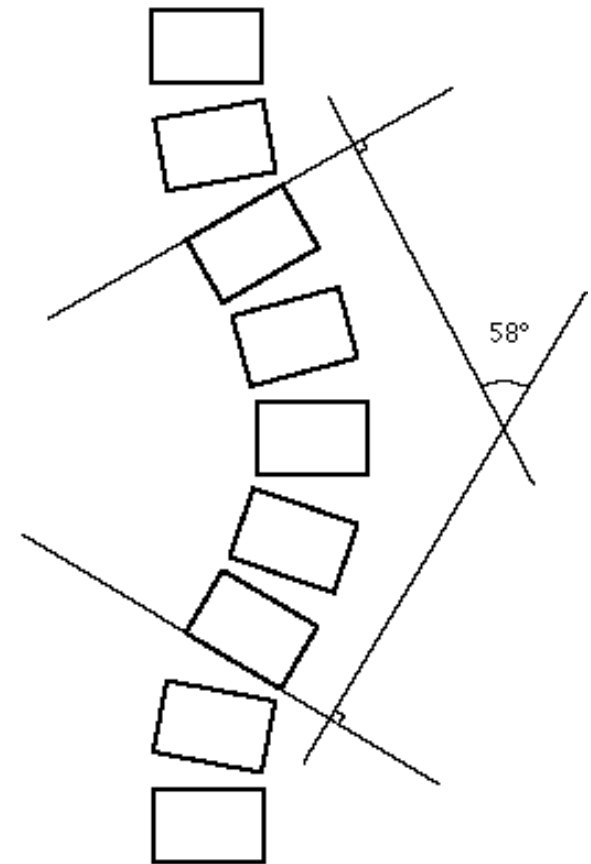
Radiological examinations

- ▶ AP and Lateral - Standing
- ▶ Full length spine
- ▶ Look for:
 - Cobb angles
 - Risser's Sign
 - Curve type
 - Sagittal & Coronal Balance



Measure spinal curvature using *Cobb method*:

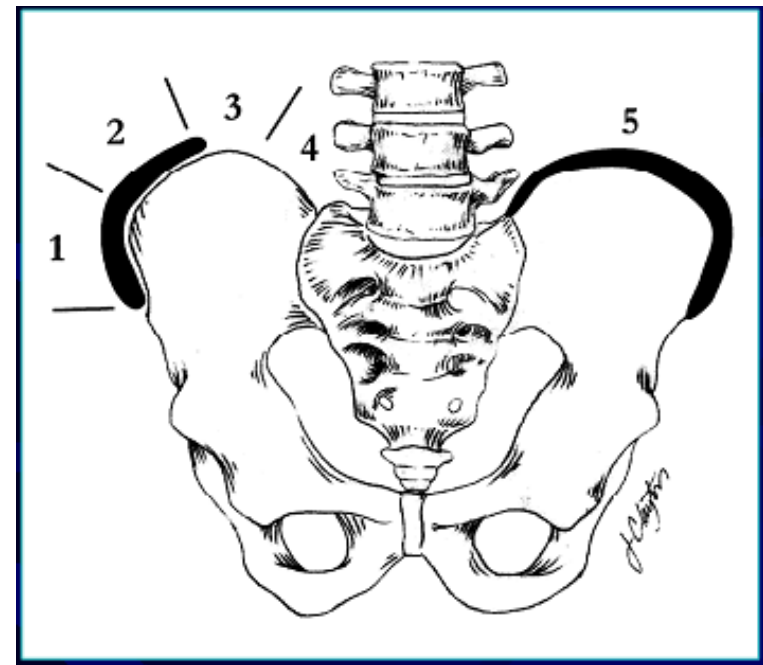
- Choose the most tilted vertebra above & below apex of the curve.
- Angle between intersecting lines drawn perpendicular to the top of the superior vertebrae and bottom of the inferior vertebrae is the Cobb angle.




Risser's sign

▶ Method of assessing spinal maturity and potentials for growth


- **Stage 0.** No bone growth on the iliac crest.
- **Stage 1.** Bone growth covers less than 25% of the iliac crest.
- **Stage 2.** Bone growth covers 25%-50% of the iliac crest.
- **Stage 3.** Bone growth covers 50-75% of the iliac crest.
- **Stage 4.** Bone growth covers 75-100% of the iliac crest.
- **Stage 5.** Bone growth completely covers and is fused to the iliac crest



Scoliosis: Treatment

- ▶ The three O's
 - ▶ **O**bservation
 - ▶ **O**rthosis (Braces)
 - ▶ **O**peration (Surgery)
- 

Scoliosis Rx: Observation

- ▶ Small degree curve <25 in adolescent (still growing)
 - ▶ For moderate curves <45 in skeletally matured patients
 - ▶ Watch and see if curve progresses
- 

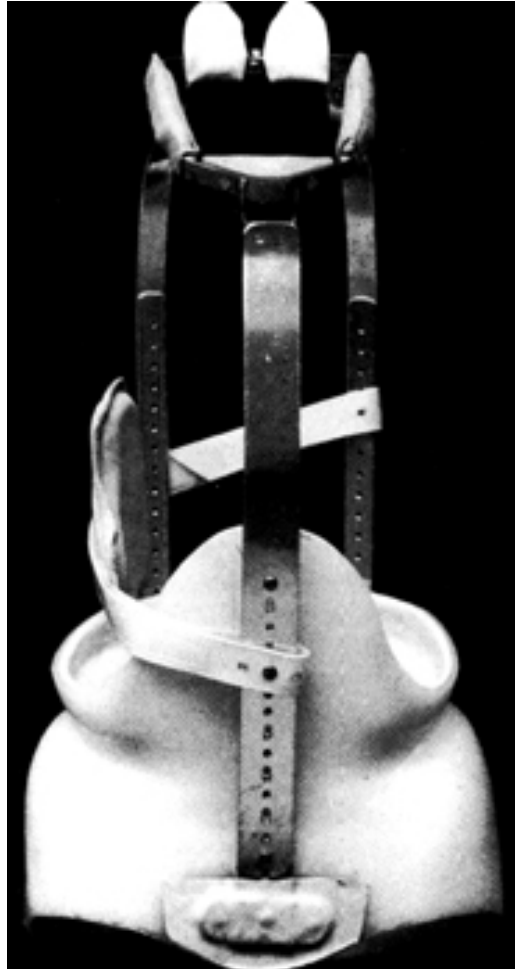
Scoliosis Rx: Orthosis

- ▶ Indicated when curves are 25 -45 degrees
- ▶ Most common is Boston brace (Thoraco-lumbar-sacral orthosis)
- ▶ Bracing does not *correct* scoliosis, but may prevent serious progression
- ▶ Usually worn until patient reaches Risser grade 4 or 5



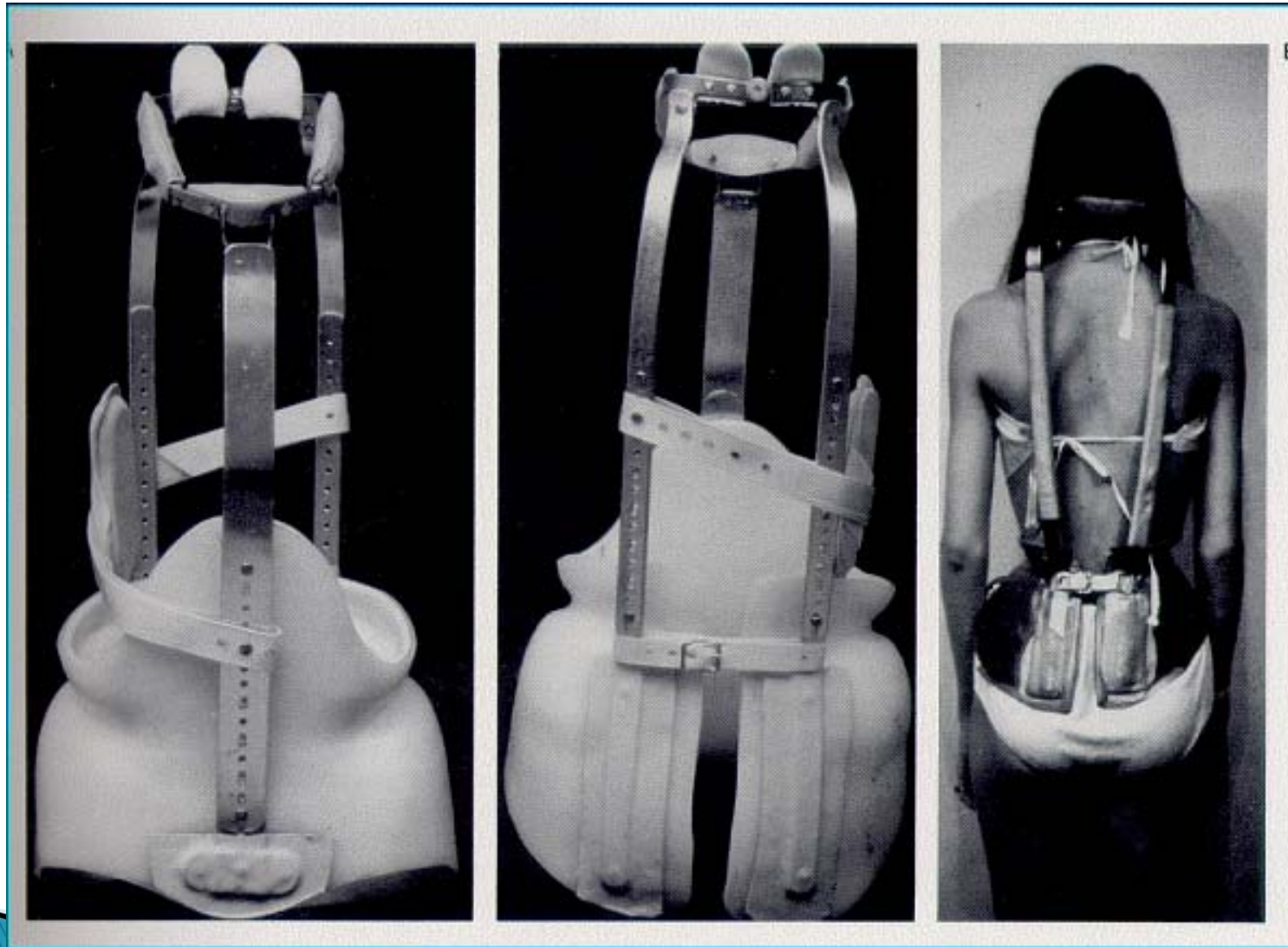
Orthosis for Scoliosis

Milwaukee




Boston Brace

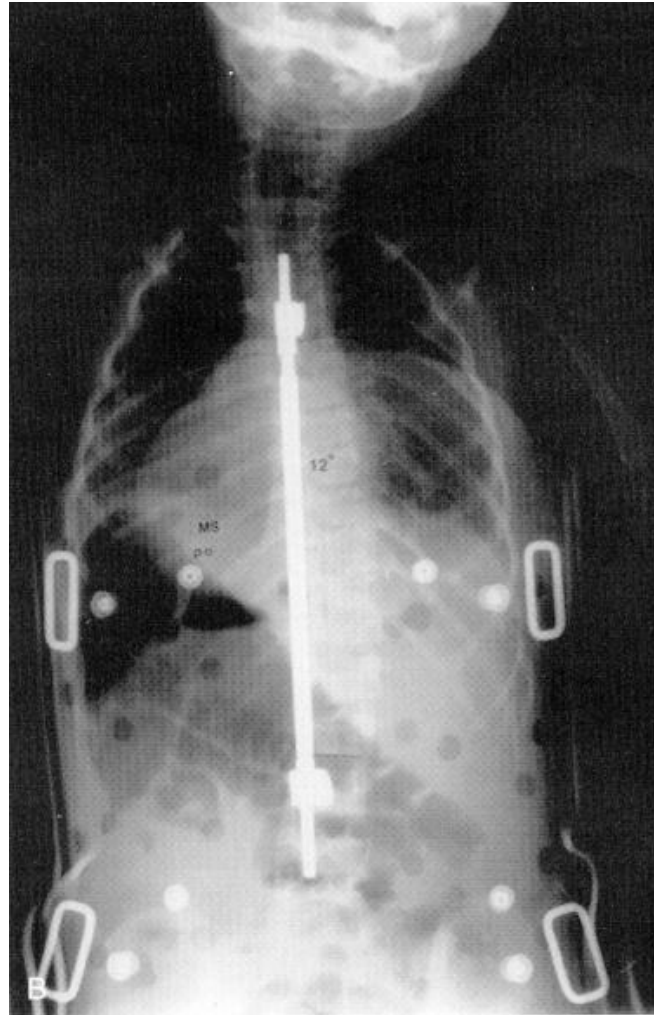
Milwaukee brace



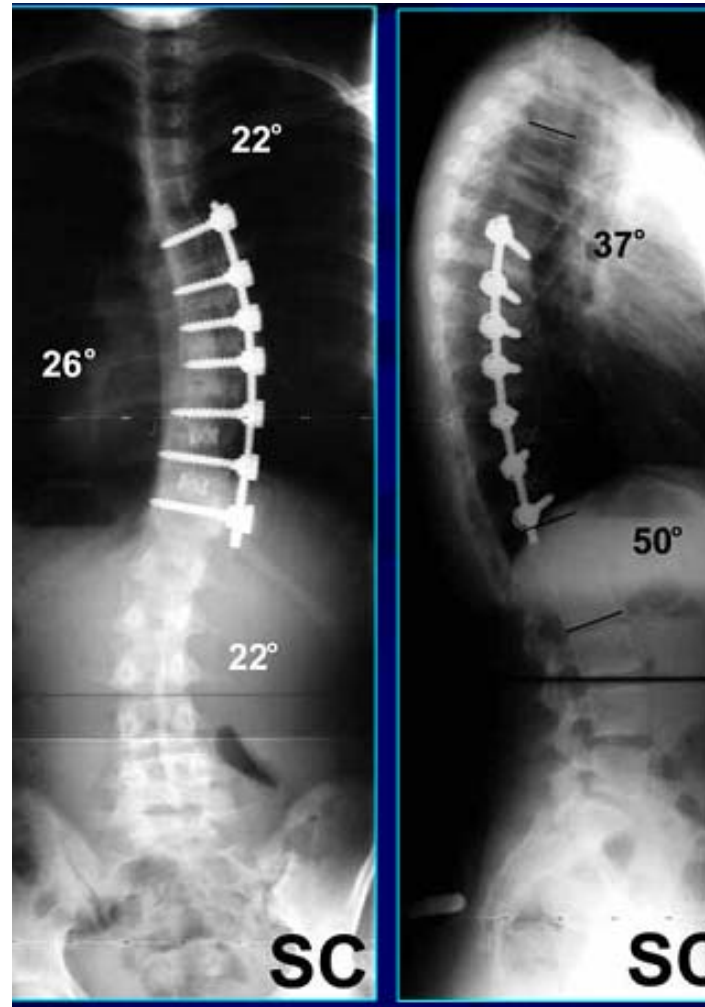
Scoliosis Rx: Surgery

- ▶ For curves >50 degrees
 - ▶ For smaller curves that are bothersome
 - ▶ Correction of curve and prevention of further progression
 - ▶ Employs Implants, rods and spinal fusion
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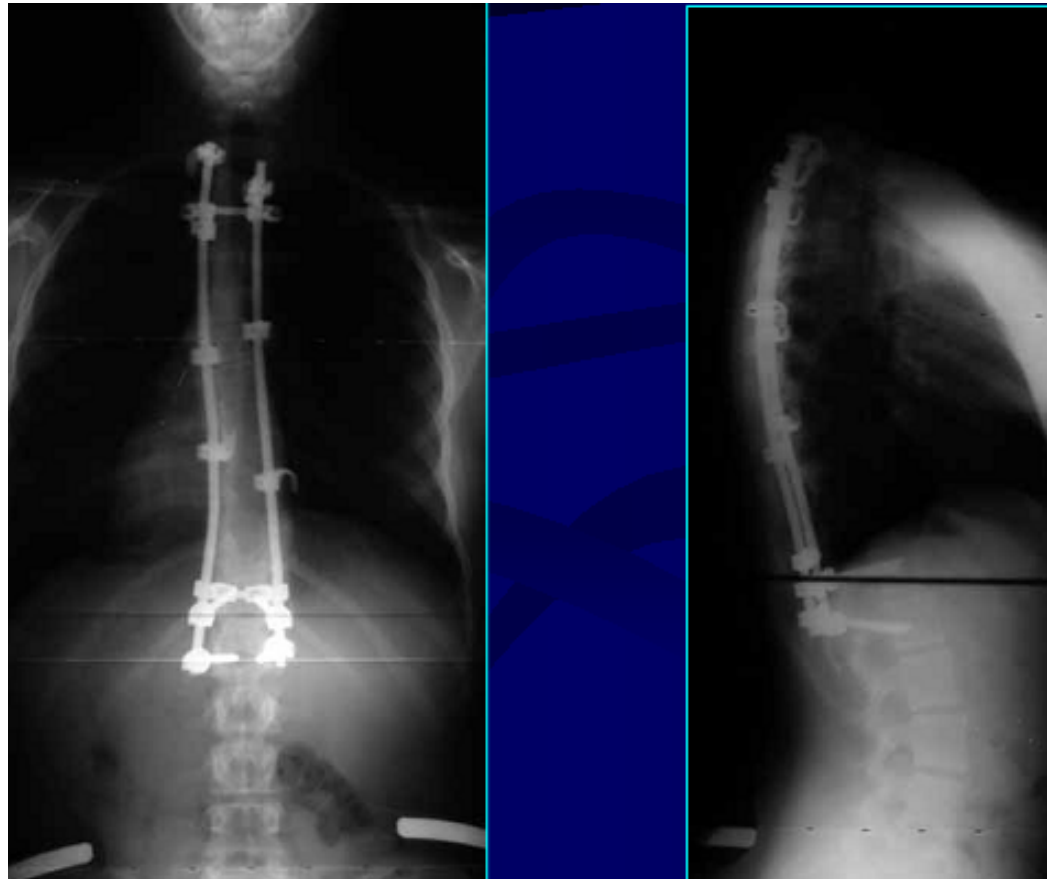
Surgery for scoliosis




Rods



Posterior hooks and rods



Conclusions

- ▶ 90% of kids with scoliosis will not require medical intervention
 - ▶ Girls are much more likely than boys to need intervention for scoliosis
 - ▶ Bracing can slow progression of many curves and significantly decrease need for surgery
 - ▶ Spinal fusion surgery is recommended for curves greater than 45 – 50 degrees
- 

Other causes: Neuropathic


▶ Upper motor neuron

- Cerebral palsy
- Spinocerebellar degeneration
- Friedreich disease
- Charcot–Marie–Tooth disease
- Syringomyelia
- Spinal cord tumor
- Spinal cord trauma


▶ Lower motor neuron

- Poliomyelitis
- Traumatic
- Spinal muscular atrophy
- Myelomeningocele (paralytic)
- Dysautonomia (Riley–Day syndrome)

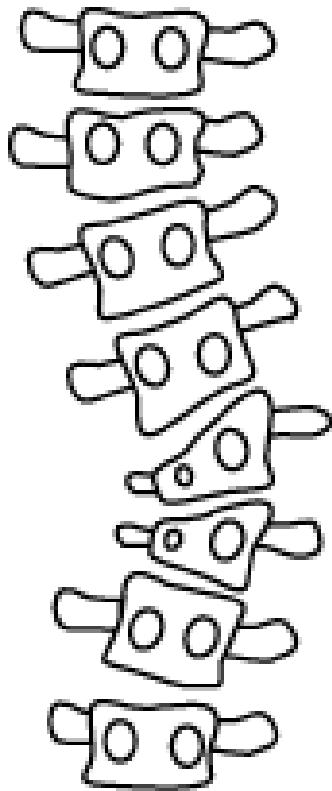
Other Causes: Myopathic

- ▶ Arthrogryposis
 - ▶ Muscular dystrophy
 - Duchenne (pseudohypertrophic)
 - Limb-girdle
 - Fascioscapulohumeral
 - Fiber-type disproportion
 - ▶ Congenital hypotonia
 - ▶ Myotonia dystrophica
- 

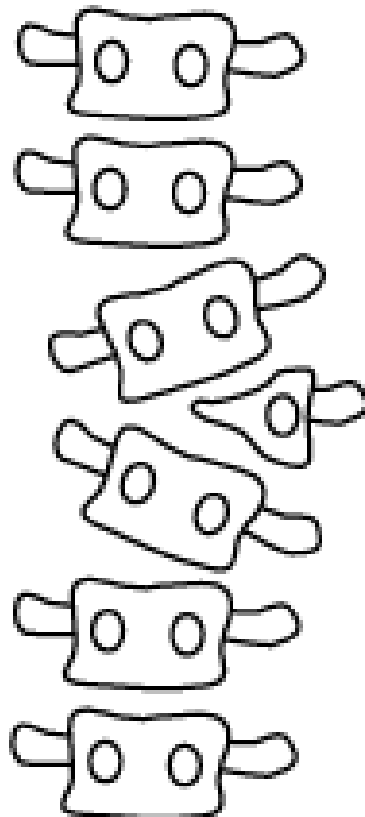
Causes: Congenital

- ▶ Failure of formation
 - Wedge vertebra
 - Hemivertebra
 - ▶ Failure of segmentation
 - Unilateral bar
 - Bilateral (fusion)
 - ▶ Mixed
- 

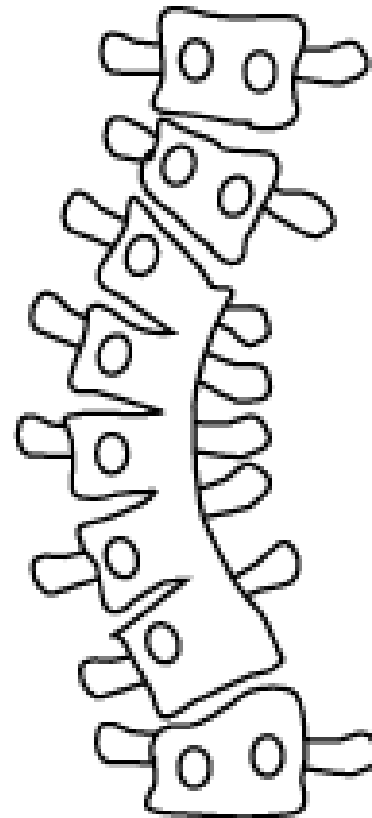
Congenital scoliosis



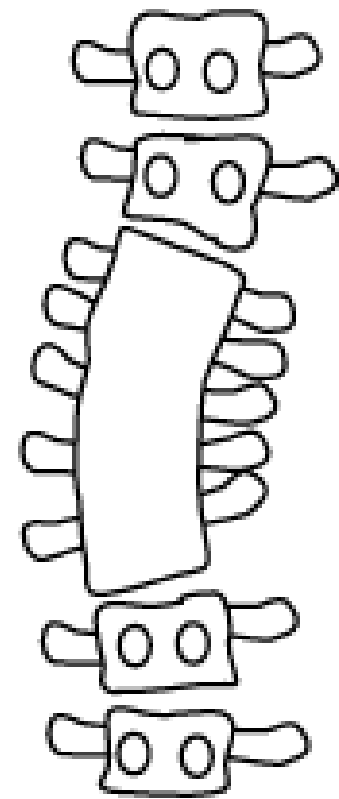
partial
unilateral
failure of
formation
(wedge vertebrae)



complete
unilateral
failure of
formation
(hemivertebra)




unilateral
failure of
segmentation
(congenital bar)



bilateral
failure of
segmentation
(block vertebra)

Neural tube defects

- ▶ Myelomeningocele
 - ▶ Meningocele
 - ▶ Spinal dysraphism
 - ▶ Diastematomyelia
- 


Soft tissue contractures

- ▶ Post burns
- ▶ Post empyema
- ▶ Post irradiation


Functional

- ▶ Postural
- ▶ Secondary to short leg
- ▶ Due to muscle spasm


KYPHOSIS

- ▶ Kyphosis is a curvature of the spine in the sagittal plane, in which the convexity of the curve is directed posteriorly
 - ▶ Normal thoracic kyphosis: 20–40 degrees
 - ▶ Lordosis is a curvature of the spine in the sagittal plane, in which the convexity of the curve is directed anteriorly
 - ▶ Normal lumbar lordosis: 30–60 degrees
- 

Causes of Kyphosis

- ▶ Postural
 - ▶ Congenital
 1. Failure of formation
 2. Failure of segmentation
 - ▶ Scheuermann's
 - ▶ Trauma
 - ▶ Post Laminectomy
 - ▶ Infection e.g., TB
 - ▶ Metabolic e.g., Rickets, osteoporosis
 - ▶ Developmental e.g., Achondroplasia
 - ▶ Neuromuscular e.g., Poliomyelitis
 - ▶ Myelomeningocele
 - ▶ Post irradiation
 - ▶ Neurofibromatosis
 - ▶ Spinal tumours
- 

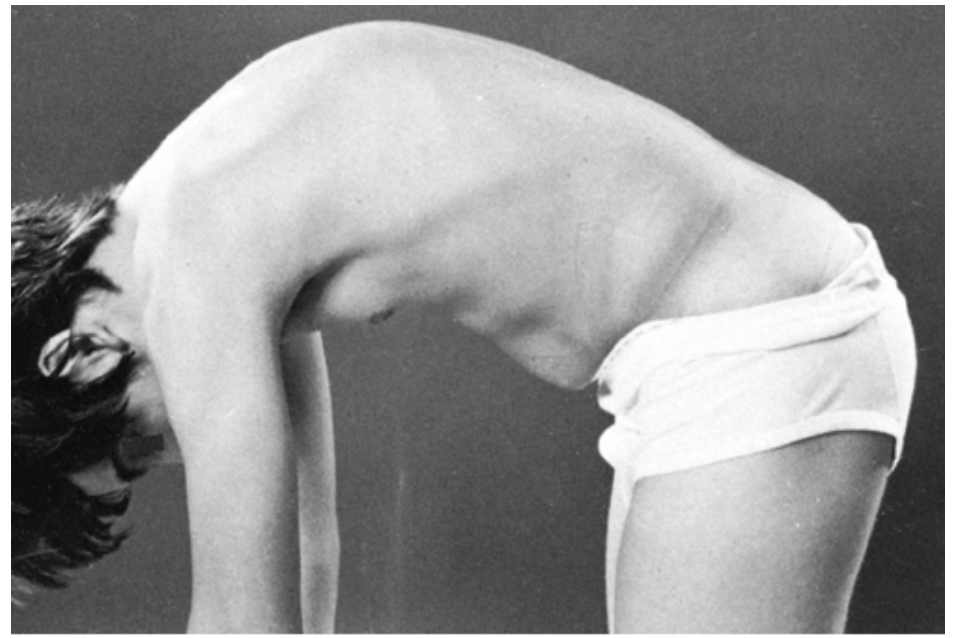
Postural Kyphosis

- ▶ Female > Male
 - ▶ Adolescent growth spurt
 - ▶ Poor posture
 - ▶ Remains flexible
 - ▶ Treatment not usually necessary
 - ▶ Important to rule out more serious causes
- 

Excluding more serious causes

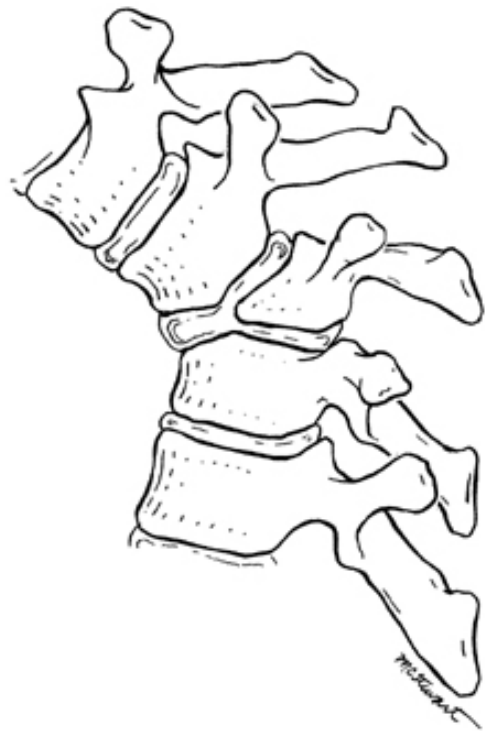


Postural

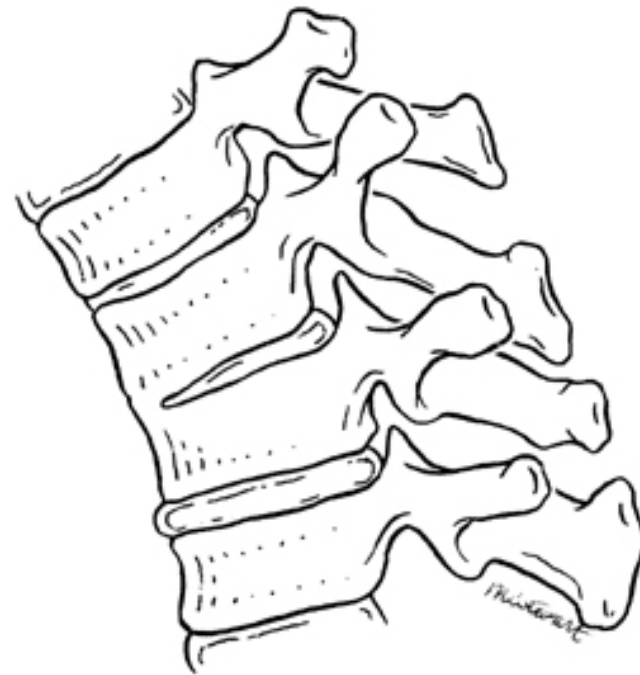


Schuermann's

Congenital kyphosis



Type I: Failure of formation



Type II: Failure of segmentation

Congenital kyphosis


- ▶ Progression varies: worse with type I
- ▶ Associated Intraspinal abnormalities in 19–29%
- ▶ Neurologic involvement
 - Usually in acute, angular short segment types
 - Usually due to tethering

Congenital Kyphosis: Treatment

- ▶ Non operative
- ▶ Operative

Congenital Kyphosis

Non operative Tx


- ▶ For non–progressive deformities with no neurological complication
 - ▶ Observation
 - 4–6monthly
 - Full length Standing AP/Lateral X–rays
 - ▶ Thorough neurological exam at each visit
 - ▶ ±Bracing but not usually helpful
- 

Congenital Kyphosis

Operative Tx

- ▶ Progressive deformity
- ▶ Any neurological complication
- ▶ Various approaches can be used

Scheuermann's Kyphosis

- ▶ Starts in adolescence
 - ▶ More common in males
 - ▶ Wedging of 3 or more consecutive vertebrae ≥ 5 deg
 - ▶ Most usually thoracic
 - ▶ May progress rapidly during the adolescent growth spurt
 - ▶ Atypical forms may occur
- 

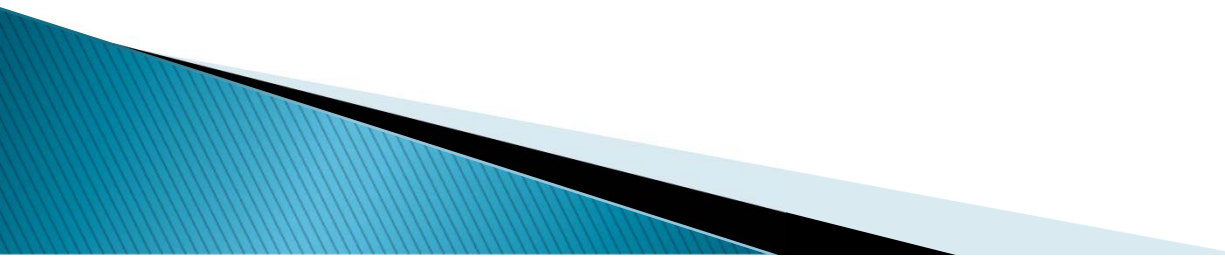
Schuermann's Kyphosis: Clinical features

History

- ▶ Starts at puberty
- ▶ Progressive
- ▶ Postural abnormality: round-shouldered
- ▶ Backache

Schuermann's Kyphosis: Clinical features


Examination

- ▶ Adam's forward bending test
 - ▶ Thoracic kyphosis:angular
 - ▶ Compensatory lumbar hyperlordosis
 - ▶ Mild scoliosis commonly present
 - ▶ Neurological examination usually normal
- 

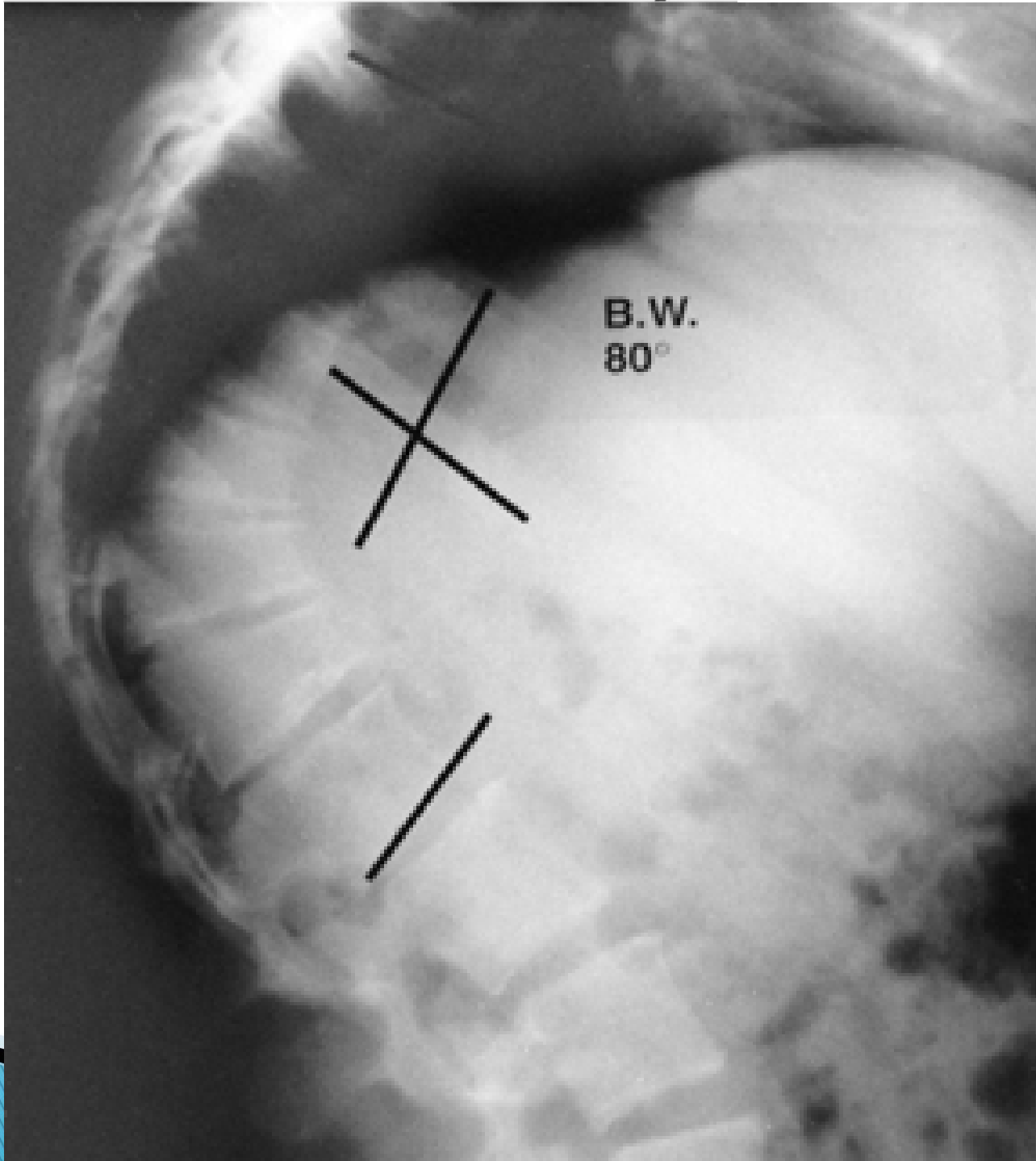
Schuermann's Kyphosis: X-rays

- ▶ Criterion for diagnosis of Scheuermann disease on a lateral radiograph is more than 5 degrees of wedging of at least three adjacent vertebrae
- ▶ The wedging is anterior

Schuermann's: X-rays


- ▶ Schmorl nodes (*small translucent defects in the subchondral bone*) often are seen in the vertebrae
 - ▶ Cobb's angle on lateral film is >40 degrees
 - ▶ Vertebral end plates appears irregular and fragmented
 - ▶ \pm mild scoliosis
- 

Schuermann's: X-rays



Schuermann's: Treatment

Indications for treatment

- ▶ Pain
 - ▶ Progression of deformity
 - ▶ Neurologic compromise
 - ▶ Cardiopulmonary compromise
 - ▶ Cosmesis
- 

Schuermann's: Treatment

- ▶ Observation,
- ▶ Nonoperative methods
- ▶ Surgery


Schuermann's: Treatment

Observation

- ▶ Deformity is mild
- ▶ Non-progressive
- ▶ Observe every 6 months with lateral radiographs

Schuermann's: Treatment

Non-operative methods

- ▶ Exercise
 - ▶ Physical therapy,
 - ▶ Bracing (Milwaukee)
 - ▶ Casting
 - ▶ Electrical stimulation (Efficacy doubted)
- 

Schuermann's: Treatment

Surgery

Indicated in rigid curves >60 degrees

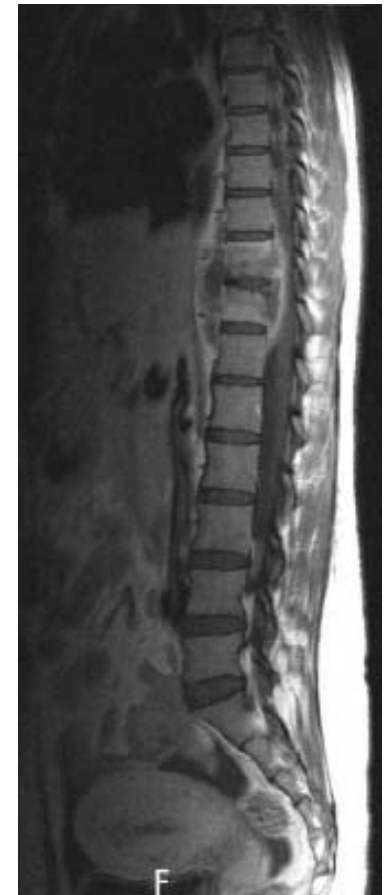
- ▶ posterior approach
- ▶ anterior approach
- ▶ combined anterior and posterior approach

SPINAL TB


- ▶ Spine is the most common site of skeletal tuberculosis
- ▶ Most dangerous site too

SPINAL TB: Pathology


- ▶ Haematogenous
- ▶ Starts in vertebral body adjacent to disc
- ▶ Bone destruction and caseation follows
- ▶ Spreads to adjacent disc space and then to adjacent vertebra
- ▶ May also spread to paravertebral tissues (Cold abscess)
- ▶ Collapse of vertebra on each other leads to Kyphosis and instability



Spinal TB: Causes of cord damage

- :
 - ▶ Pressure from abscess
 - ▶ Pressure from displaced bones
 - ▶ Ischaemia from spinal artery thrombosis
- 

Spinal TB: Clinical features

- ▶ Back pain
 - ▶ Back deformity
 - Kyphosis
 - Swelling
 - ▶ Neurological
 - Paraparesis
 - Paraplegia
 - Paraesthesia
 - ▶ Groin swelling (Psoas abscess)
 - ▶ ± Long history of ill health (weight loss, cough, anorexia etc)
- 

Spinal TB: X-Ray

Early X-ray features

- ▶ Osteoporosis of two adjacent vertebrae
- ▶ Narrowing of disc space


Late X-ray features

- ▶ Wedge collapse of adjacent vertebrae
- ▶ Kyphosis
- ▶ Paravertebral shadows: Paravertebral abscess


Healing

- ▶ Bone density increases

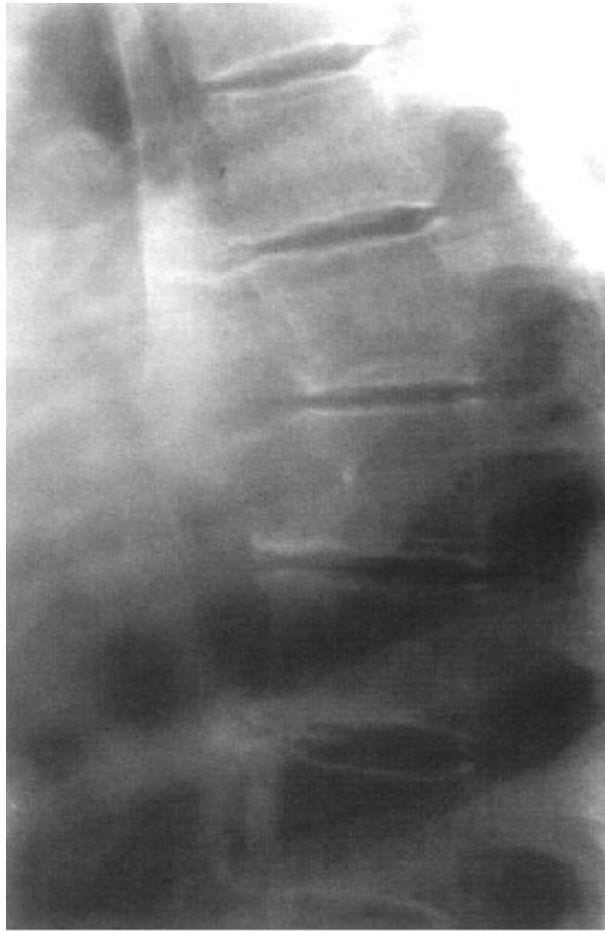
Other Investigations

- ▶ Chest X-ray
 - ▶ ± Sputum examination
 - ▶ FBC
 - ▶ ESR: Increased
 - ▶ Mantoux test
 - ▶ CT-Scan
 - ▶ MRI
 - ▶ Needle biopsy for histology and bacteriological examination
- 


SPINAL TB: Objectives of treatment

- ▶ Confirm the diagnosis,
 - ▶ Achieve bacteriological cure
 - ▶ Treat compression of the spinal cord and its sequelae
 - ▶ Treat spinal deformity and its sequelae such as late onset paraplegia.
- 

TB Spine: X-ray features



SPINAL TB: Chemotherapy


- ▶ Sufficient for most cases of spinal TB
 - ▶ Combination chemotherapy which must contain Rifampicin and INH
 - ▶ Duration for 6–9 months
 - ▶ **Initial Phase**
 1. Isoniazid
 2. Rifampicin
 3. Ethambutol
 4. Pirazinamide
 - ▶ **Continuation phase**
 1. Isoniazid
 2. Rifampicin
- 

Chemotherapy

Chemotherapy is supplemented with spinal support in the form of:

- ▶ Braces
- ▶ Casts
 - Lumbar jacket for lumbar TB
 - Thoracolumbar jacket for Thoracic Koch
 - Minerva jacket for cervical Koch
- Duration is usually for about 3 months

SPINAL TB: Surgery

- ▶ Failure of response to chemotherapy
 - ▶ Relief of cord compression in patients with persistent or recurrent neurological deficit
 - ▶ Spinal Instability
- 

Aim of Surgery

- ▶ Debridement
- ▶ Fixation

