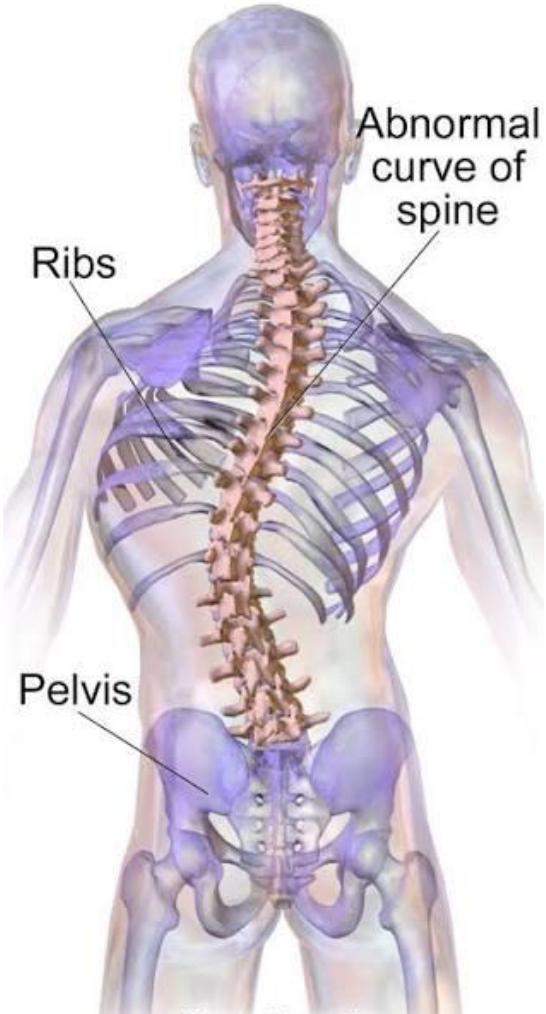
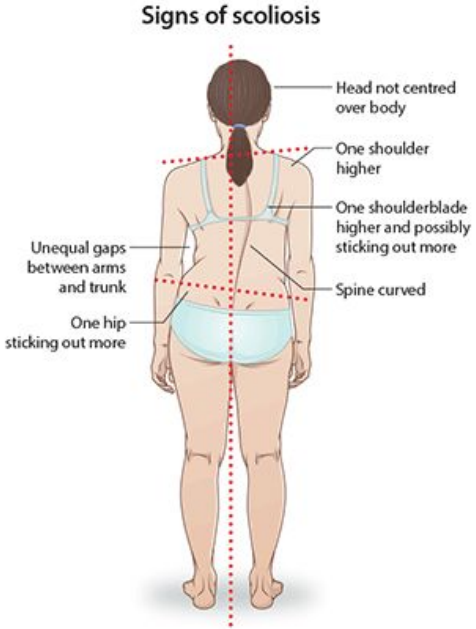
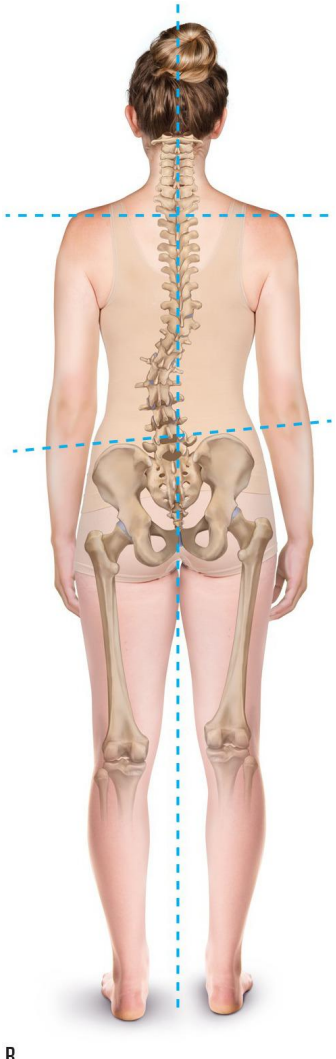
Scoliosis



What is it?

IT IS A LATERAL ROTARY DEVIATION OF THE SPINE





PRESENTATION:

- SCOLIOSIS CURVES ARE DESCRIBED ACCORDING TO THE SIDE THAT THE ***CONVEXITY*** IS ON.
- THEY ARE LABELLED AS THE ***C- CURVE, OR S-CURVE***.
- THERE IS USUALLY A COMPENSATORY CURVE IN THE C/S
- PERSON CAN HAVE AN S-CURVE AND STILL HAVE OCCIPUT CENTERED OVER SACRUM, DUE TO CURVES CANCELLING OUT

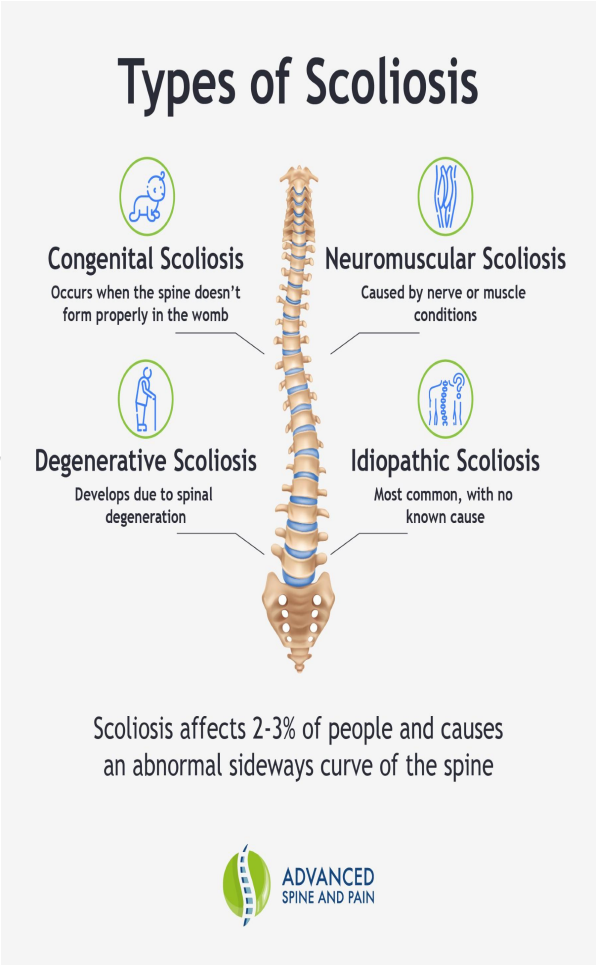
TYPES OF SCOLIOSIS

FUNCTIONAL:

- ❑ POSTURAL/NON-STRUCTURAL CURVES
- ❑ CAN BE ALTERED BY POSTURAL CHANGES OR MUSCULAR ACTION
- ❑ CAN BE CORRECTED WITH SOFT TISSUE STRETCHING, MOBS, AND ACTIVE STRENGTHENING

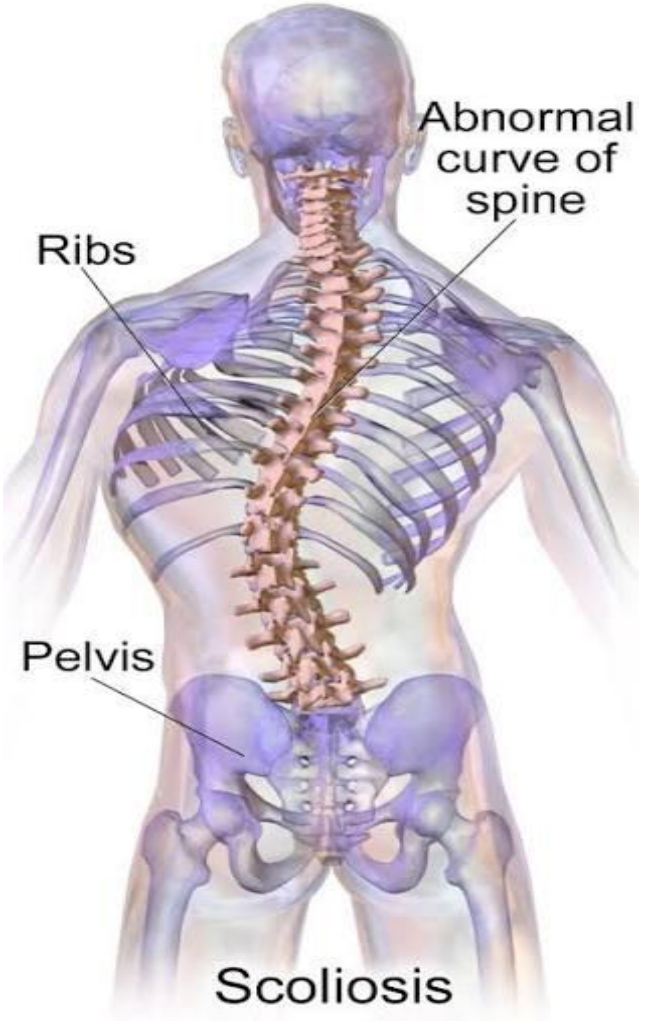
STRUCTURAL:

- ❑ CURVES ARE FIXED
- ❑ CAN NOT BE CORRECTED BY POSITIONAL CHANGES/MUSCULAR ACTIONS
- ❑ USUALLY HAVE CHILDHOOD ONSET
- ❑ CORRECTIONS REQUIRES SURGERY/BRACES



What is the SPAN?

- The distance on the spine the curves covers
- The Apex: the one farthest from the midline
- The Major: the largest curve with the greatest angulation in an S-curve
- The Minor: smaller, compensatory curve
- The Transitional: one that marks the end of one curve and beginning of another



How is it measured?

It is measured in degrees.

Can be mild: up to 20 degrees

Moderate: 20-50 degrees

Severe: greater than 50 degrees

Mild scoliosis less than 10 degrees is considered within normal limits.

Mild curves detected early can be corrected with stretching and strengthening.

Moderate scoliosis is associated with beginnings of bony changes, treated with bracing.

Severe scoliosis is associated with decreased life expectancy in children (reduced pulmonary function) and OA in adults. It is also treated with surgery.

Presentation

- Think of spine, ribs, and pelvis as 3D structure.
  - pelvis/ribs are also laterally bent, ROT'd and distorted
  - Pelvis may be torqueued (more ANT than other)
  - Can occur at shoulder girdle
- Compensation that occurs with scoliosis:
  - The righting reflex responsible for secondary curves
  - Attempt to establish center of gravity
  - Keep eyes on horizontal plane
  - Permit normal function
  - Single curves cause head to always be tilted, secondary curve balances the tilt

Presentation

- Whole body is involved
  - Wolves principal: over time, bones remodel themselves along the lines of force that are placed on them
    - Extended to connective tissue/mm/viscera
- Some degree is found in children/adolescents
  - Ex: 16 yr olds: 10 degree found in 3%, 20 degree in 0.3%, 30 degree in 0.15% of the population

Causes:

- Idiopathic: 85% of all reported cases, approx 8% of the population
  - Appears in 3 age groups:
    - Infantile: boys more affected than girls
      - Birth to 3 yrs
    - Adolescents: girls more affected than boys
      - 10-16 yrs
    - Juvenile: both equally affected
      - 4-9 yrs
  - May be symptom rather than disease
  - Can develop in adults
  - Estimated that 6% of persons over 50 yrs of age will have lumbar scoliosis with rib humping

Causes:

- CNS input altered:
  - Altered proprioceptive and vestibular sources
    - Abnormal mm spindle response to proprioception in paraspinal mm causing idiopathic scoliosis
    - Asymmetry in labyrinth of inner ear influencing spinal posture
    - Breakdown in mechanism of postural control
    - Study: increase labyrinth sensitivity on the convex side of curve and right eye dominance may be associated with left sided curves

Causes:

- Biomechanical Factors:
  - Right halves of vertebral bodies, right ribs and right humerus are larger than the left.
  - femur/fib/clavicle/bones of skull slightly larger on left side
  - Adolescents with idiopathic scoliosis were 17% more flexible than a non-scoliotic age group
  - Torsion of the spine in a mechanical model was due to actions of paraspinal mm
  - No connection to hand dominance and direction of curve
  - Studies have been performed on numerous mm involved in scoliosis other than the paraspinals (electromyographic)

Causes:

- MM imbalances:
  - Fibrosing and associated fatty deposits in mm on concave side of curve
  - Increase in mm activity on convex side
  - Counter pull from concave side
  - Biomechanical changes, collagen abnormalities, reported
  - Result of curve, no the cause
- Hereditary factors:
  - More likely environmental factors
  - Less common in infants today than in the 1930s-40s in Europe when widespread malnutrition
- Growth/sex hormones:
  - Play a role in development of scoliosis
  - female/males adolescents with idiopathic scoliosis were taller then those in same group without scoliosis
  - Minor curve: little difference between male/female
  - Risk of progression higher in females
  - Female vs male Ratio of 1.5:1 for 10 degree, 5:1 for 20 degree, and 10:1 for 30 degree
  - Suggested that due to different ages “normal” kyphotic curve develops in the two sexes is cause

Causes:

- Functional:
  - Musculoskeletal in nature
  - Can be changed by by altering position
  - Leg length inequality, shoe lift will correct imbalance in pelvis
- Bony asymmetries below pelvis:
  - Leg length inequality from unilateral pes planus/short tib/short femur/small hemipelvis places sacral base on oblique angle
  - Fracture to tib/femur shortens limb length
  - Small hemipelvis cause pelvic obliquity
  - Spine curves to compensate
- TPs:
  - QL shortening mm, raising pelvis on same side, giving appearance of short leg
- Habitual asymmetric posture:
  - stands/sits with weight shifted to one side
  - Soft tissue shortening
  - Occupational posture/sitting long time: sitting with wallet in back pocket

Causes:

- Soft tissue restrictions/contractures:
  - above/below pelvis
  - Unilateral TFL/ITB contracture produce LAT pelvic tilt
  - Unilaterally shortened ABDom oblique/Lats can lead to curving of T/S and LAT pelvic tilt
  - children/infants: atlanto-occipital JT hypomobility
- Antalgic scoliosis:
  - Temp curve caused by mm spasm accompanied by disc herniation/sciatic nn irritation
  - Convexity towards/away from affected side
- Neuromuscular conditions:
  - Cerebral palsy
  - Freidreichs ataxia
  - Muscular dystrophy
  - Spinal cord lesions
    - Lead to mm weakness/imbalance
  - Paralysis following polio result in c-curve scoliosis on side of mm impairment

Causes:

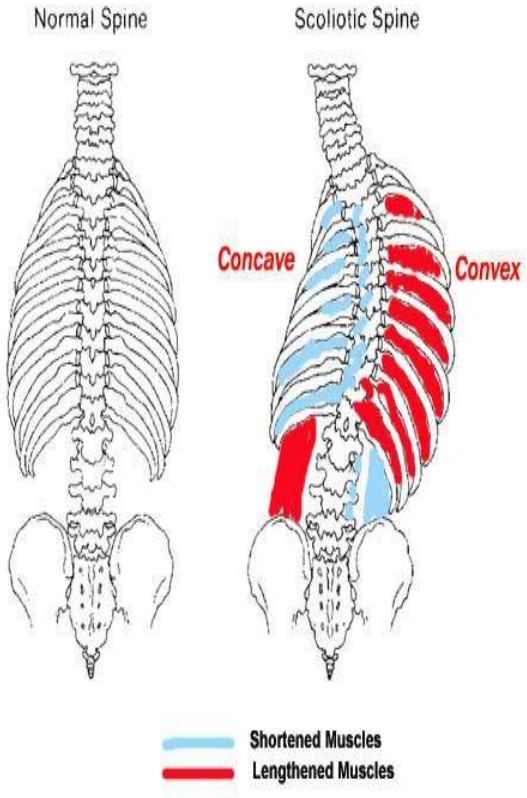
- Congenital:
  - Bony abnormalities
  - Hemivertebra: incomplete formation of one side of the vertebra
  - Vertebral wedging: increase pressure on a bones epiphyseal plate slows rate of growth
  - Slowed growth occurs on concave side
  - Vertebral bridging: failure of vertebral segmentation and bony bars exist between vertebrae
    - Tether growing bones together on one side causing curve
  - malformed/congenitally absent ribs
- Iatrogenic:
  - pneumonectomy/open heart surgery
  - Ribs resected allowing curve to develop later
  - Incisions through intercostals alone recorded to proke scoliosis in children

Progression of curves

- Can progress, stay the same, or regress
- Not understood why some progress, others do not
- Factors to prevent curve from increasing:
  - Normal passive resistance of the spine/ribs/ligs, limiting excessive mov't
  - Contraction of the mm in convex side
- Infantile idiopathic scoliosis can regress spontaneously, regression of adolescent scoliosis is less common
- Single curves increase more than double curves
- Effects of scoliosis:
  - Pulmonary function damaged in children with curves over 60 degrees, adolescents rarely shows signs with same degree of curve

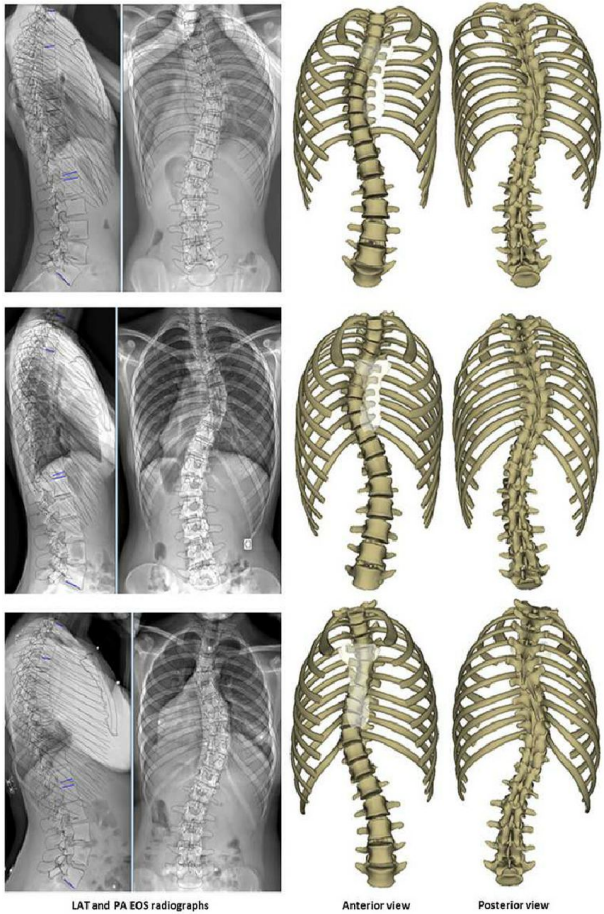
Bony/Soft tissue imbalances of scoliosis

- True leg length inequality measured to the millimeter only with x-ray.
  - Includes BiLat legs/pelvis
- Measure from MED malleolus-ASIS, client supine
- Assessing each component of the limb, malleolar height/length of tib/length of femur
- Transverse plane: vertebra ROT around axis of spinal foramen so spinal cord not compressed
- Lateral curve: vertebral bodies ROT around axis *towards convexity* of curve
- Vertebral bodies have greater mass and convex side of curve has more space to ROT into
- Spinous processes(less mass) ROT to concave side with less space
- Curves increase/vertebral ROT increases
- Greatest ROT occurs at apex of curve



Con’t

- Degree of curvature may be much greater than that which is indicated by position of spinous processes pushing against skin
- True position of vertebral bodies is observable only in x-rays
- Ribs: articulating with vertebral bodies and TVP become distorted
- POST view: TVP more POST on convex side
  - Ribs on convex side more POST/prominent
  - “Rib Humping”
  - Ribs/TVP on concave side more ANT, appear flattened
  - Convex: ribs farther apart
  - Concave: closer together
- ANT view: Ribs more prominent on concave side and flattened on convex



Con’t

- MM bulk of paraspinal mm is misleading
- Mm appear bigger on convex side
  - Pushed POST by mm and TVP
- Mm appear smaller on concave side
  - Pulled ANT by bones
- Deeper transverse mm (multifidi) play larger part than LAT/SUP erectors
- Multifidi, intercostals, and erectors on concave side of curve become short/tight/fibrosed, facilitating curve
  - Bow string
- Paravertebral/intercostals on convex side, increase activity to keep spine upright
- Mm are pulled farther apart by tethering effect of fibrosed mm on concave side
- Convex activity disappears following spinal fusion in idiopathic scoliosis
- ABdoms/iliopsoas/LATS/intercostals/erectors acting UNIlat increase severity of curve
- QL/iliopsoas/ADDs on one side plus TFL/glute med on other side maintain pelvic obliquity
- Shoulder on convex side of T/S curve elevated by actions of upper traps/levator scap
- Scap more prominent on that side

Historical Perspective

- References of “crooked back” persons found in ancient Greek/Chinese/Indian medical lit.
- Biblical sources thought no cure.
- Hippocrates believed that deformity could be straightened using traction.
- Next tx came in the 1500s
  - corsets/braces/suspension.
- Concept of exercise therapy introduced in the first “back school” early 19th century.
  - Plaster casting used to straighten spine.
- Spinal fusion in 1911
  - Stabilize spine in TB
- 1963: Paul Harrington use internal fixation to stabilize scoliosis from polio
- Electrical mm stims in 1980s were popular, not rarely used
- 1970s school screening programs to detect early signs implemented
  - Screening used to refer kids for tx if necessary and to collect data
  - Curves greater than 10% in adolescents aged 10-16 yrs warranted observation
  - Believed that curves growing in growing spines would increase with age, follow ups showed 80% of curves did not progress, some regressed
- Most curves tx’d conservatively with braces and minority required surgery
- 26,000 children studies in canada: 150 had curves > 10 degrees
  - More than half had stable curves
  - ⅓ had curves that progressed
  - 15 had curves that regressed
  - 31 (.12%) referred for tx
- 40% of adolescents are due to minor leg length discrepancy, not issue with spine.
- 50% of curves originating in spine, no clinical significance
- 10% progressive, > 5-10 degrees/yr

Medical treatment

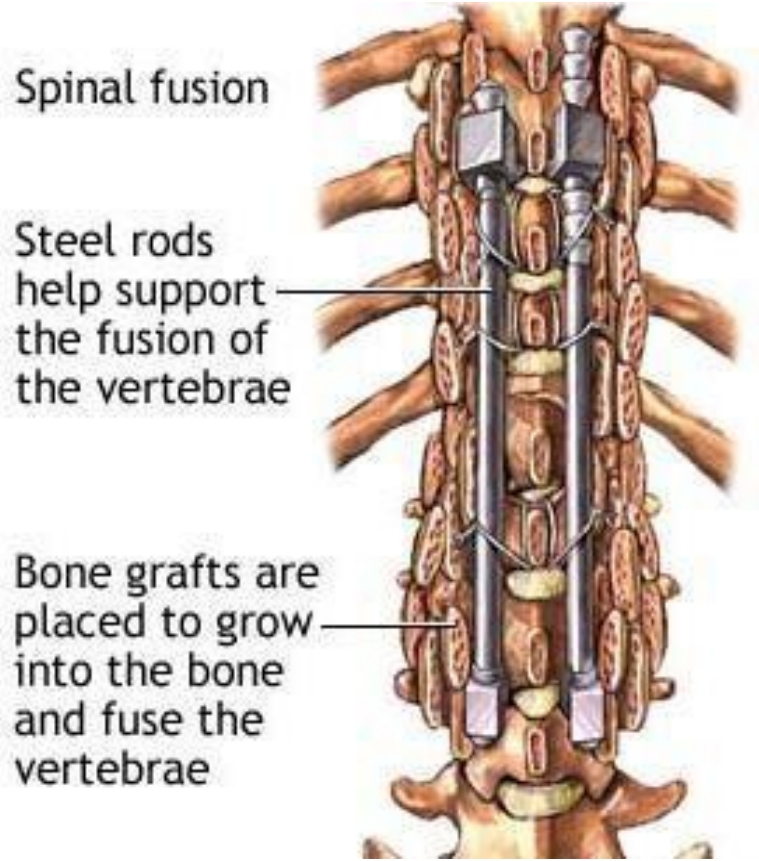
- Progressive curves usually tx'd with a brace
  - Does not reduce/halt curve
- Surgery performed in severe cases deemed life threatening
- Braces:
  - Plastic milwaukee brace
  - Generate force on thorax
  - Apex of the curve
  - Pressure applied on opposite side at axila and pelvis
  - Curves < than 40-60 degrees in children/adolescents
    - Spine continually growing
  - Braces worn 23 hrs/day
  - Several yrs
  - part-time use also effective

Med tx con't

- Surgically:
  - Usual choice for curves over 40-50 degrees
  - Spinal fusion
  - Harrington/luque rods used
    - Understand where fusion and immobilization are to perform safe tx

Med tx con’t

- Spinal fusion:
  - POST midline LONGitudinal incision along spinous process
  - Paraspinal mm not cut, but reflected to TVP
  - ligs/facet jts removed
  - Spaces left by excision of jt capsules packed with bone grafts
  - Bone grafts are placed over fusion site
- Types of grafts:
  - Autografts: bone taken from individual
    - POST ilium
  - Allografts: harvested from another person/frozen and used later
  - Xenografts: harvested from animals
    - Cow bone



Med tx con’t

- Harrington rods
  - Inserted during fusion process, before facet jt fused
  - Has two hooks inserted onto vertebral lamina at each end of curve
  - Two types:
    - distraction rods: generate force to straighten curve from concavity
    - Compression rods: pull convex side straight
  - Wiring may be used to stabilize rods to vertebrae
  - Bone grafts placed over rods
  - Paraspinal mm/skin repositioned over fusion site
- Complications: rod breakage/migration, hook dislocation, peripheral nn damage, halt of spinal growth in fused section in children/adolescents
- vertebrae/facet jts/discs SUP/INF to fused section have to compensate for immobility
- Wear and tear on peripheral nn at these hypermobile sections

Med tx con’t

- Luque instrumentation:
  - L-shaped rods
  - Generate force from side of the vertebrae to straighten curve
  - Rods placed on either side of spinous processes
  - Secured by wires under each lamina inside neural canal
  - Eliminates need for post-op immobilization
  - Believed that spinal fusion can be avoided, disproved
- Complications: high level of neuro complications.
  - Motor weakness
  - Sensory disturbances from nn damage with wire passing under lamina
- Method combined with harrington rods to avoid complications
-