Adolescent Idiopathic Scoliosis for the General Practitioner

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I have no disclosures

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Objectives

- Discuss what adolescent idiopathic scoliosis is, how it presents, and what leads to progression
- Evaluate and initially manage a patient with idiopathic scoliosis
- Describe current treatment options, including both conservative and surgical

Questions for scoliosis office visit:

1. Is scoliosis present?
2. Is it idiopathic?
3. Will it progress?
4. What are the treatment options available?
5. When to refer?

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1. Is it scoliosis?

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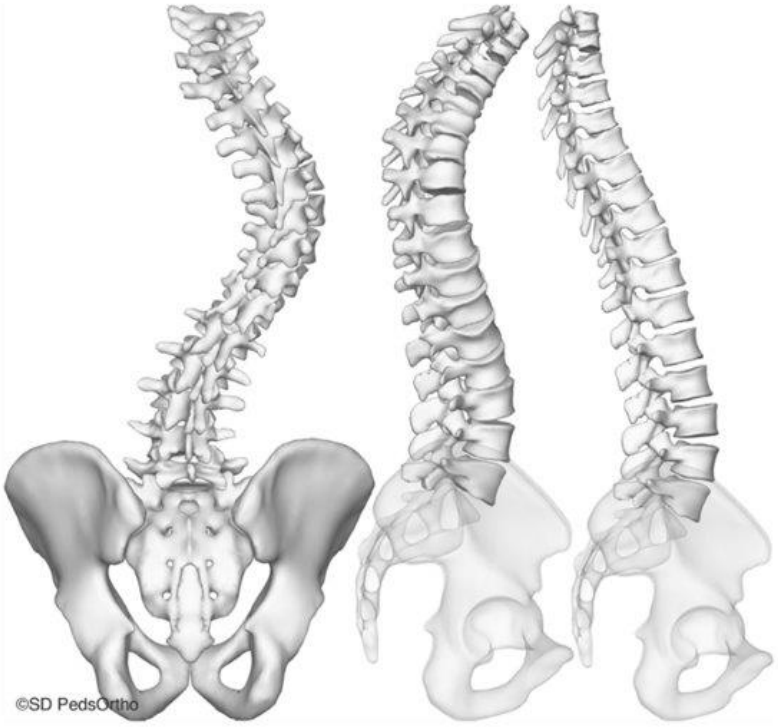
Terminology

- Scoliosis derived from Greek word meaning "bent" or "crooked"
- Defined as
  - Lateral deviation of the normal vertical line of the spine **>10'**
- Curves <10' are considered **spinal asymmetry**
- Normal spine alignment
  - Coronal plane <10'
  - Sagittal plane: 20-55’ thoracic kyphosis, <60’ lumbar lordosis

3D Deformity

- Extension in sagittal plane
- Loss of thoracic kyphosis, apical lordosis
- Lateral tilt in coronal plane
- Rotation in axial plane



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Causes of Scoliosis

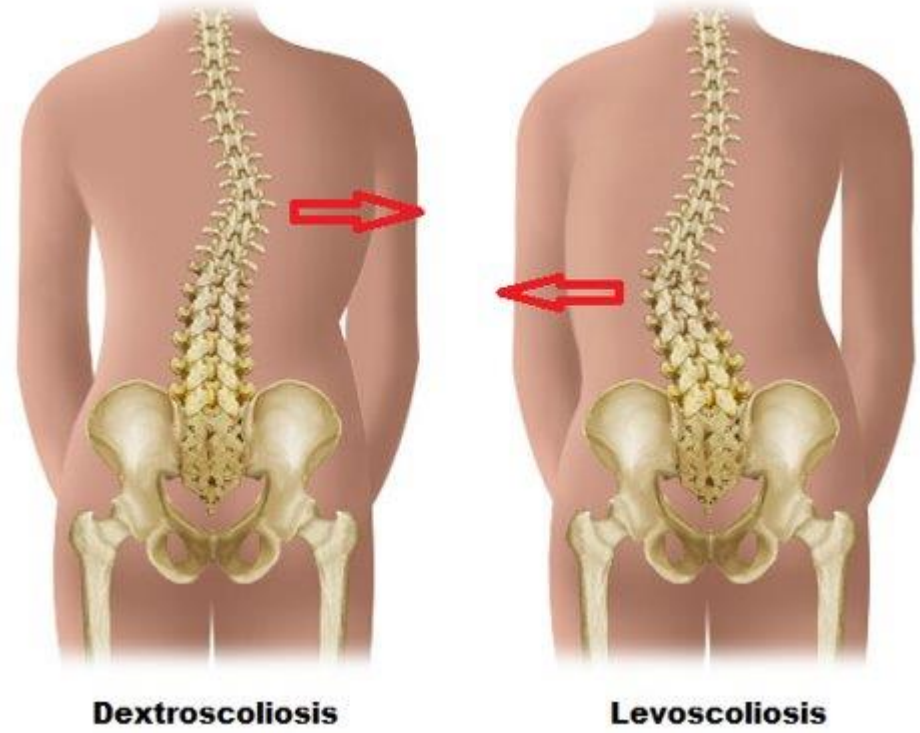
- Congenital
  - Failure of formation or segmentation
- Neuromuscular = central or peripheral nervous system dysfunction
  - Cerebral palsy, muscular dystrophy, spinal muscular atrophy
- Connective tissue disorders
  - Ehlers-Danlos, Marfan's
- Neurofibromatosis
- Idiopathic = unknown
  - **Most common;** ~85%
  - Not caused by bookbags, poor posture, inactivity, etc
  - Genetic component

Pathophysiology of AIS

- Many theories exist, none proven
- Genetic component
- Chicken or egg:
  - Rotation
  - Anterior overgrowth
- Importance --> opportunity for growth modulation?

Idiopathic Scoliosis

- Infantile
  - Birth-3 years old
  - *Left curve*
- Juvenile
  - 3-10 years old
  - *Right curve*
- Adolescent
  - 10+ years old
  - *Right curve*



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Epidemiology of AIS

- Curves > 10 degrees = 0.47 - 5.2%
- Curves >20 degrees = 0.3 - 0.5%
- Curves >30 degrees = 0.2 - 0.3%
- Relationship between scoliosis and gender, especially as curve magnitude increases
  - Curves 10-20 degrees: 1.4:1 F:M
  - Curves >40 degrees: 7-10:1 F:M

The Natural History of Adolescent Idiopathic Scoliosis

Stuart L. Weinstein, MD

- Almost 400 patients with untreated AIS followed 51 years; age/sex matched
- Curves <30 don't typically progress, while thoracic curves >50 have high likelihood:
  - ~0.75-1' per year
  - Risk of decreased pulmonary function >90'
- Back pain is more common but doesn’t lead to functional impairment or disability
- *Over 30% AIS patients felt their life was "limited" by scoliosis.*
  - Significantly less satisfied with their appearance

Screening

- Historically, screening was part of routine school physical exams.
- In 2016, SRS, AAOS, POSNA, AAP all agreed screening is beneficial and should occur:
  - **Twice** for females, ages 10 & 12
  - **Once** for males, age 13 or 14
- 2018: USPSTF and AAFP recommended against screening in asymptomatic adolescents
  - Unnecessary x-rays and referrals
- Bottomline: <u>Start screening at age 10</u>

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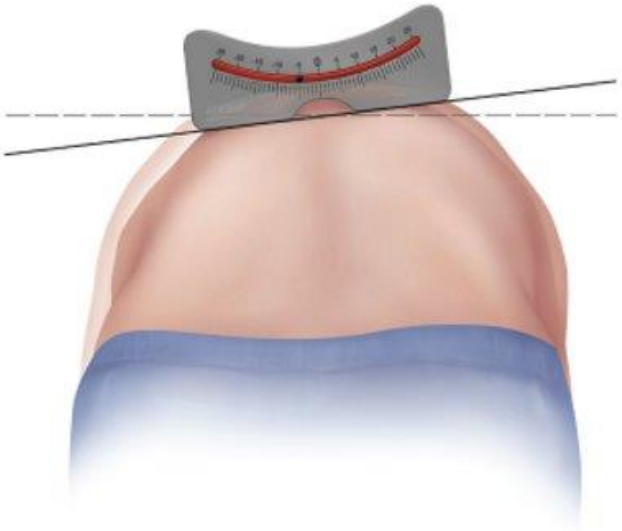
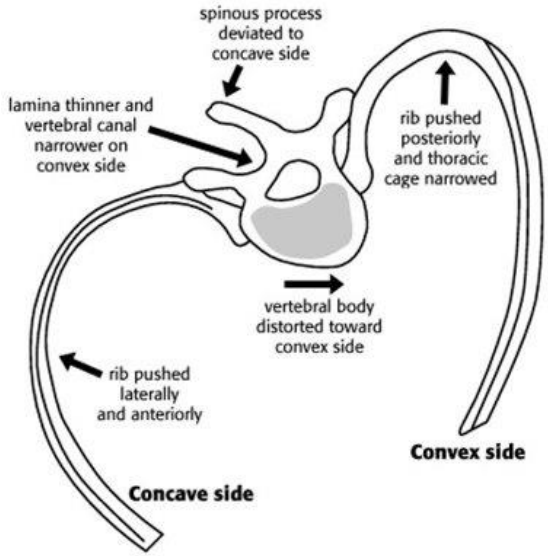
Scoliosis Screening Program

28 PA Code, Chapter 23.10(b) states "A scoliosis screening test shall be administered to students in grade six and grade seven and to age-appropriate students in ungraded classes."

Adams Forward Bend

- Sensitivity of >80% for thoracic curves
- Less reliable for lumbar curves
- Rotational asymmetry measured with scoliometer (or app)
  - 7 degrees ATR is about ~20-30' Cobb angle
  - Be weary in obese children who can hide a curve!





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Social Inequality and AIS

Impact of Social Determinants of Health on Adolescent Idiopathic Scoliosis Curve Severity

Orellana, Kevin J. BS[*]; Lee, Julianna BA[*]; Yang, Daniel MS[*]; Hauth, Lucas BS[*]; Flynn, John M. MD[*,†]

- Risk factors for presenting with severe, unbrace-able scoliosis:
  - Black patients
  - Public insurance
  - Lower COI

Disparities in Pediatric Scoliosis: The Impact of Race and Insurance Type on Access to Nonoperative Treatment for Adolescent Idiopathic Scoliosis

Heffernan, Michael J. MD[*]; Younis, Manaf MD[†]; Song, Bryant MS[†]; Fontenot, Bailli BS[†]; Dewitz, Ryan MD[†]; Brooks, Jaysson T. MD[‡]; Leonardi, Claudia PhD[§]; Barnett, Scott A. MD[†]

JPOSNA Volume 5, Number 3, August 2023

Original Research

Factors Associated with Presentation of Severe Adolescent Idiopathic Scoliosis

Ian P. Erkkila, BS[1]; Christopher A. Reynolds, BS[1]; Joshua P. Weissman, BA[1]; Oscar P. Levine, BS[1]; Hunter Aronson, DO[2]; Justin M. Knoll, PhD[1]; Jill E. Larson, MD[1,3]

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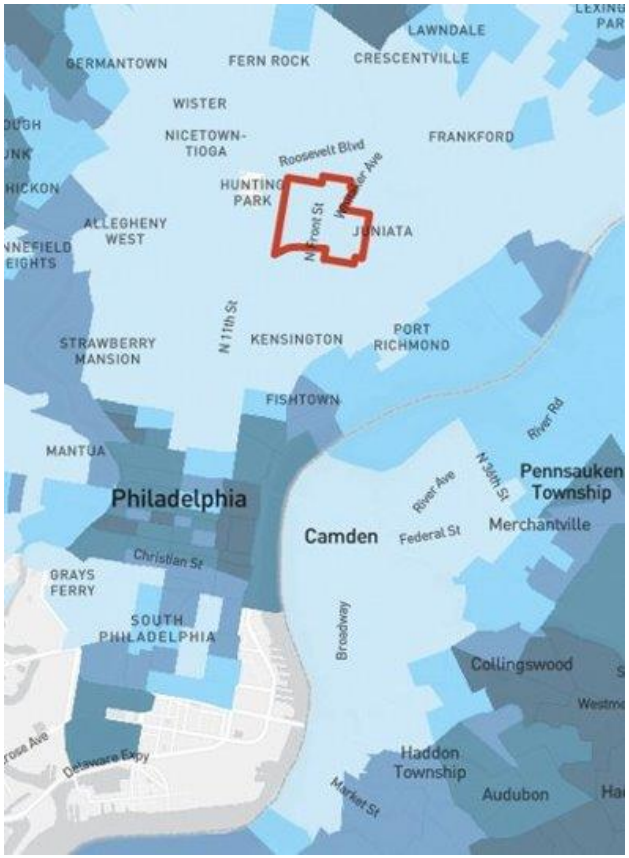
What can we do about it?

- **Screen everyone over 10!**



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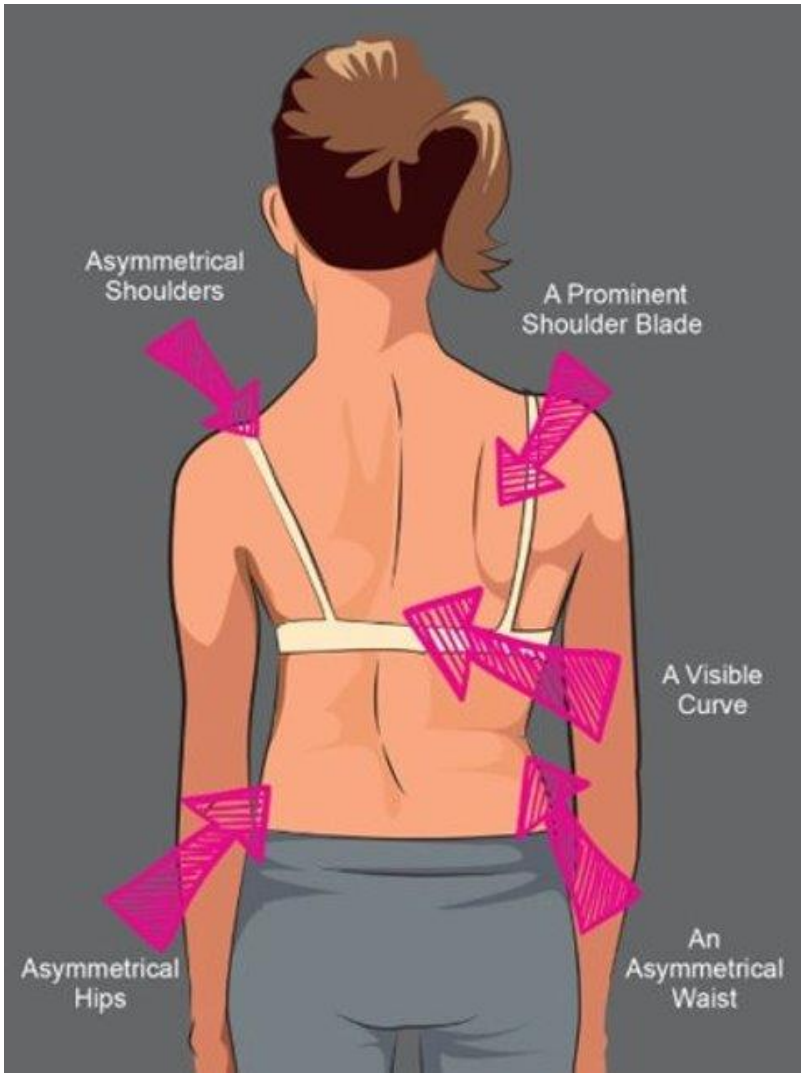
2. Is it idiopathic?

History

- Family history
  - Screen the siblings!
- Pain --> inconsistent
- **Red flags**: constant & focal pain, associated symptoms, PM pain
- Menarchal status
- Neurologic symptoms
  - Numbness, tingling, bowel/bladder
- Pyscho-social effect of appearance

Physical Exam

- Skin
  - Midline skin defects
    - Spina bifida, tethered cord
  - Café-au-lait spots
    - NF
- Asymmetry
  - Shoulder height, prominent scapula/ribs, waist, trunk shift, pelvic obliquity
- Adams forward bend
- Neurologic exam
  - Motor/sensation L2-S1
  - Abdominal, patellar, ankle reflexes



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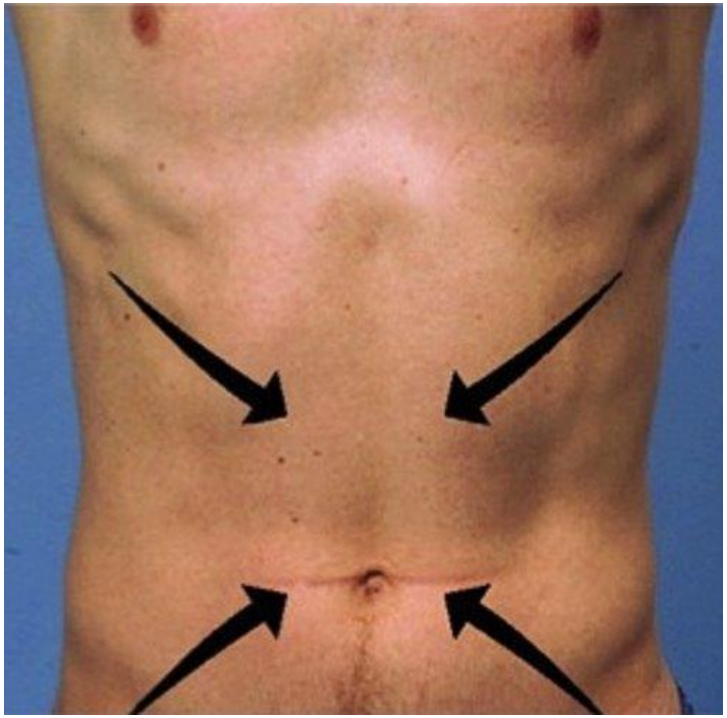
Abdominal Reflexes



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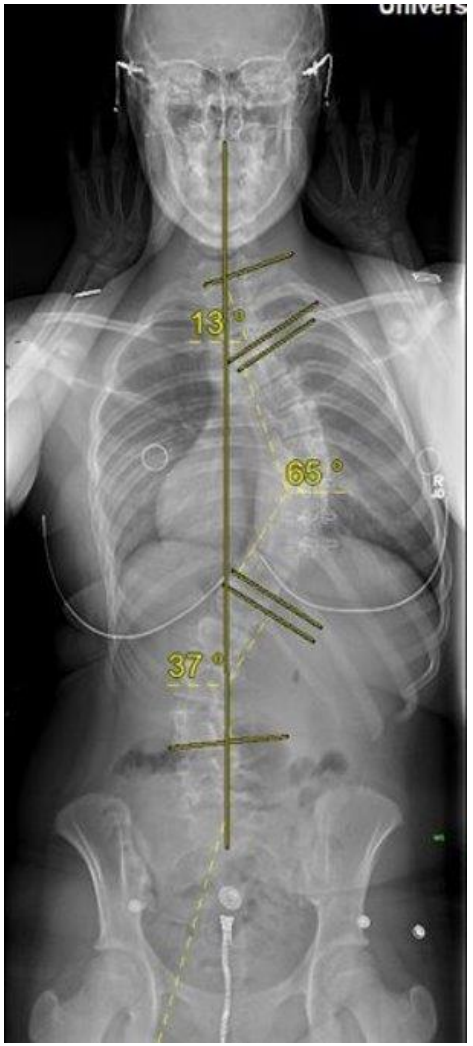
Imaging

- PA entire spine to pelvis
  - PA is less radiation to thyroid/breast tissue
  - Pelvis useful for assessing skeletal maturity
- Lateral entire spine
  - Don't need repeat laterals if normal at every visit



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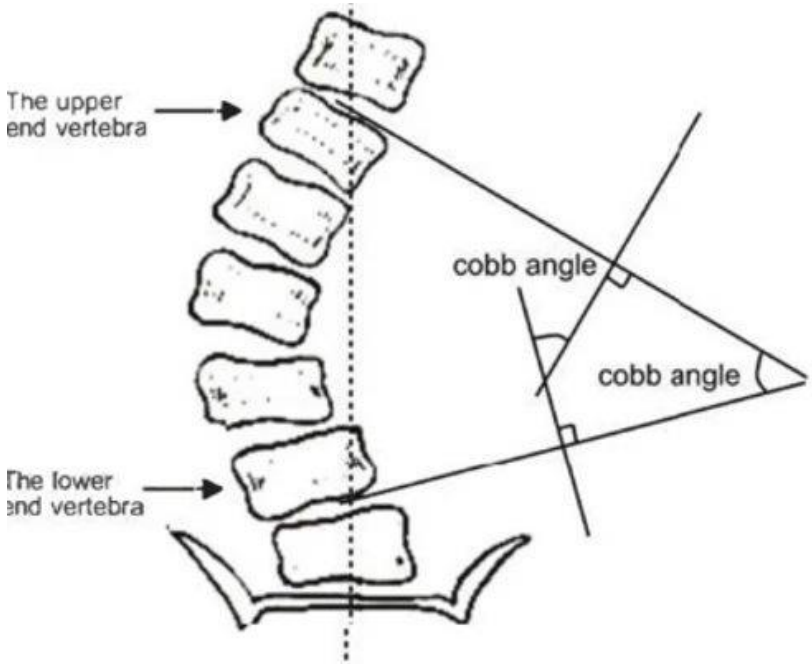
Cobb Angle



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MRI

- Entire spine from posterior fossa to conus
- Looking for: chiari malformation, syrinx, tumor, tether
- Indications:
  - Onset before age 10 (technically juvenile idiopathic scoliosis?)
    - 20% patients will have abnormal MRI
  - Neck pain, headaches
  - Ataxia, weakness, foot deformity
  - Rapid progression
  - Excessive thoracic kyphosis
  - Left curves
  - Asymmetric abdominal reflexes

Treatment

- Options include:
  - Observation
  - Bracing
  - Surgery
- Treatment Goals:
  - Keep curve small as possible
  - Prevent surgery

- Considerations:
  - Age
  - Remaining growth
  - Curve size
  - Curve pattern
  - Psychosocial factors

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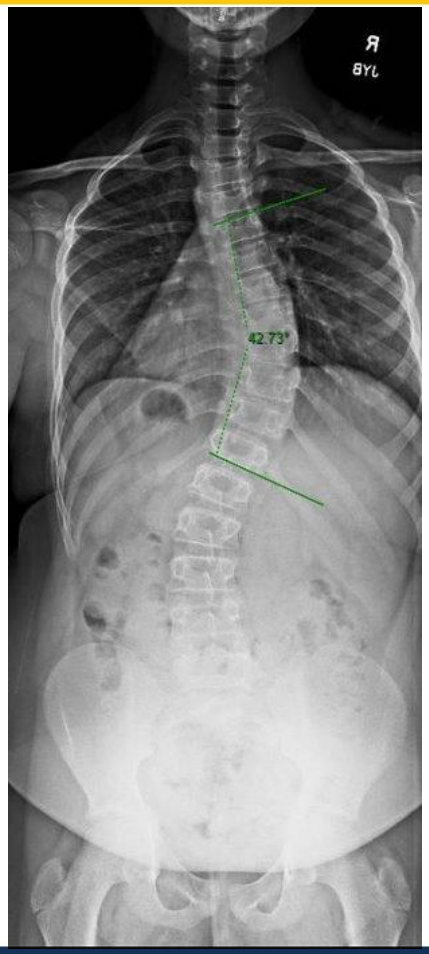
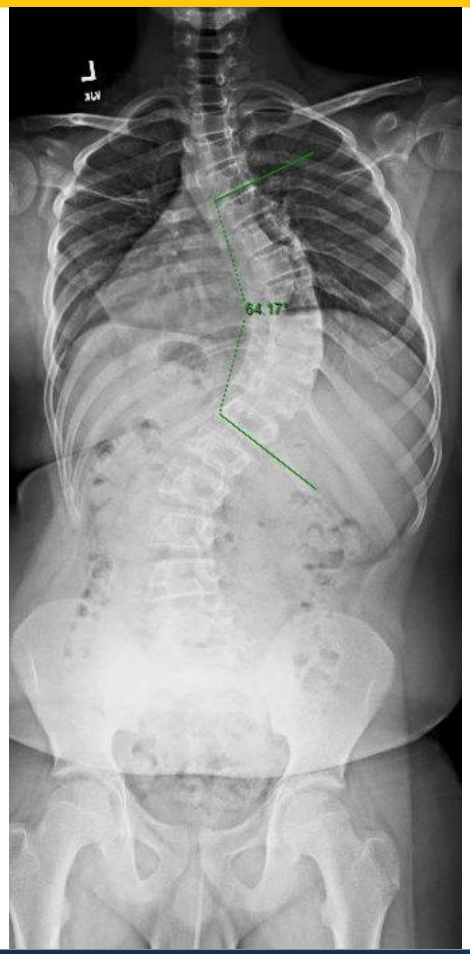
3. Will it progress?





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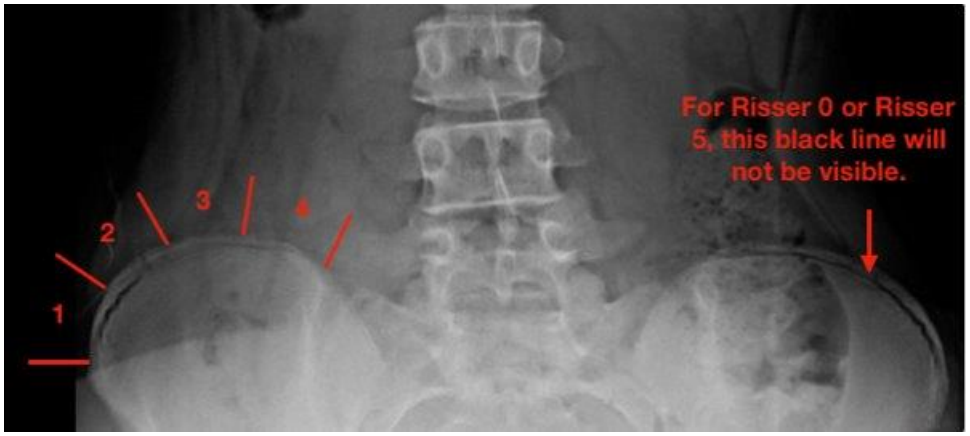
Curve Progression

- Progression = 5 degree increase
- Factors associated with progression:
  - Gender: most are female
  - Remaining growth
  - Curve magnitude
    - <30 are low risk
  - Curve pattern
    - More coronal imbalance

Remaining Growth

- Age
- Menarche
- Risser Sign
- Sanders Score



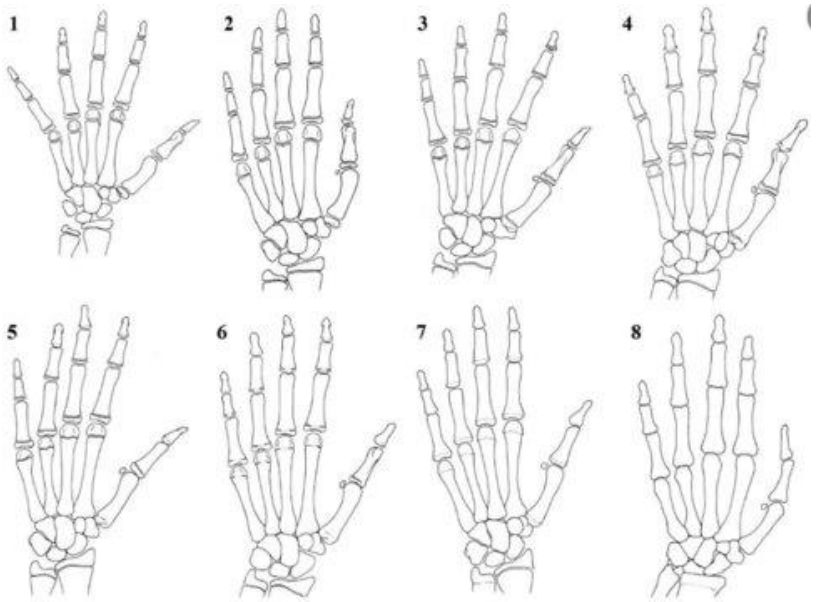


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Table 1. Incidence of Progression as Related to the Magnitude of the Curve and the Risser Sign

	Percentage of curves that progressed	
Risser sign	*5- to 19-degree curves*	*20- to 29-degree curves*
Grade 0 or 1	22	68
2, 3, or 4	1.6	23

Reprinted with permission from Lonstein JE, Carlson JM. The prediction of curve progression in untreated idiopathic scoliosis during growth. J Bone Joint Surg Am. 1984;66(7):1067.

If all don't progress, why not wait to treat?

- Harder to get full correction with larger & stiffer curves
  - 50' at 15 --> 80' at 45 --> 100' at 65
- Scoliosis surgery for elderly has significant morbidity/mortality:
  - More levels fused, longer OR time, more co-morbidities to start, etc.
- Deformity from scoliosis is *real*, not vanity!

4. What are the treatment options?

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Observation

- Appropriate for curves <20 (?)
  - Follow-up is important and individualized!
  - Shorter intervals for younger patients.
    - Or first time you meet someone!
- Start bracing with progression.
  - 5-6 degree increase in Cobb angle

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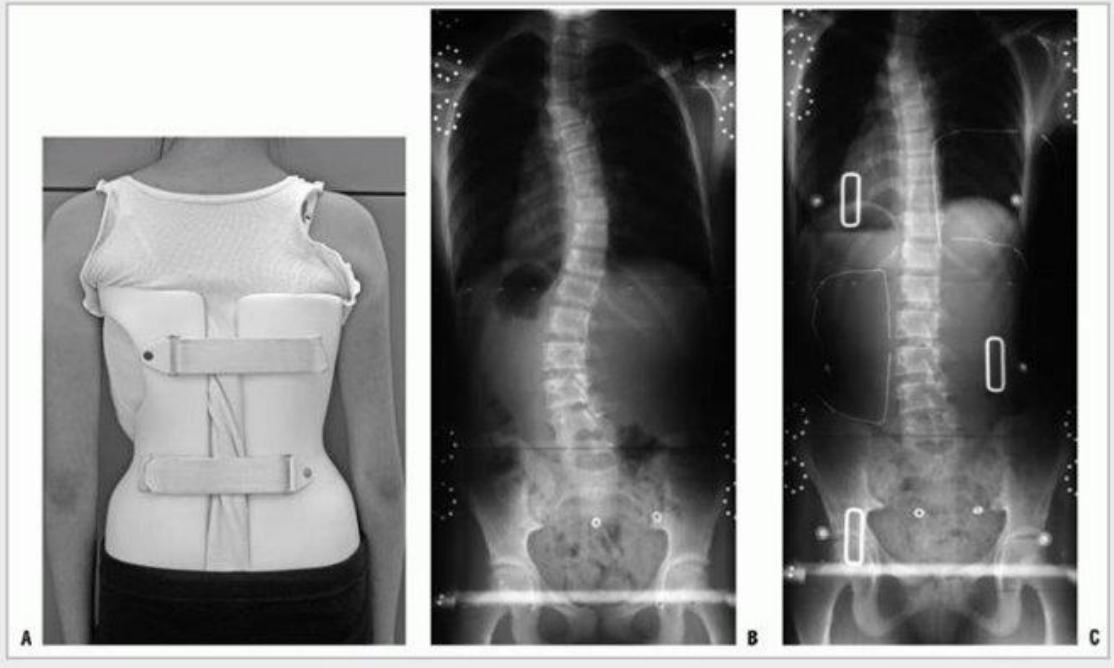
Bracing

- Young patients with curves >25'
- Skeletally immature patients to *prevent progression* with growth
  - **Does not straighten the curve!**
- Requires compliance
- Relative contraindications:
  - >40 degree curve
  - Males (less compliant)
  - Obese?
  - Emotionally unable to tolerate



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The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Effects of Bracing in Adolescents with Idiopathic Scoliosis

Stuart L. Weinstein, M.D., Lori A. Dolan, Ph.D., James G. Wright, M.D., M.P.H., and Matthew B. Dobbs, M.D.

- Randomized multicenter bracing study
- Temperature monitored for compliance
- Outcomes: progression to 50 degrees vs <50 degrees at skeletal maturity
- Study stopped early owing to efficacy of bracing
  - Bracing effective in 75%, observation in 48%
- Dose-dependent response
  - <6 hours per day similar to no brace at all
  - >18 hours per day best results

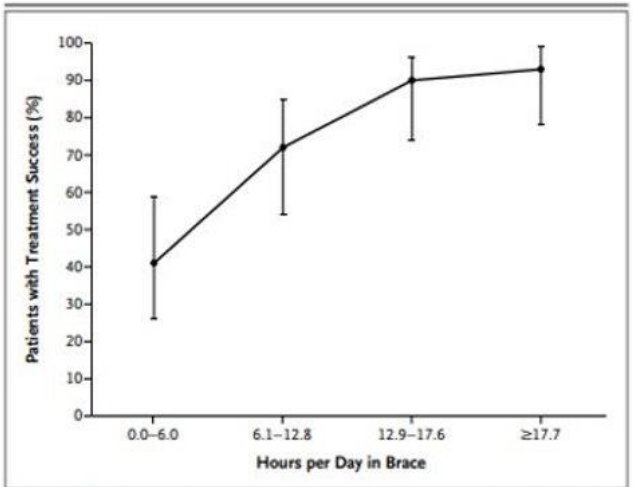

Figure 2. Rate of Treatment Success According to Average Hours of Daily Brace Wear.

During the first 6 months, patients wore the brace for a mean (±SD) of 12.1±6.6 hours per day (range, 0 to 23.0). Duration of brace wear was positively associated with the rate of success ($P<0.001$ by the chi-square test). The lowest quartile of wear (mean hours per day, 0 to 6.0) was associated with a success rate of 42%, whereas brace wear for an average of at least 12.9 hours per day was associated with success rates of 90 to 93%. I bars indicate 95% confidence intervals.

Surgery

- Curves >45-50 degrees
- Fusion
  - Posterior (most common)
  - Posterior & anterior
  - Anterior
- Growth Modulation
  - Vertebral body tethering

Posterior Spinal Fusion

- Pedicle screw and dual-rod construct +/- osteotomies
- Goal is to **prevent progression**, **improve deformity**, **balance spine**, and obtain **bony fusion**
- Current standard of care for surgical treatment of AIS
- Concerns related:
  - Decreased spinal mobility
  - Increased strain on adjacent disks, joints, soft tissues

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Post-operative Course for PSIF

- Surgical time 6-8 hours
- Hospital stay 3-5 days
- 1 month off school
- At 6 months, return to sports

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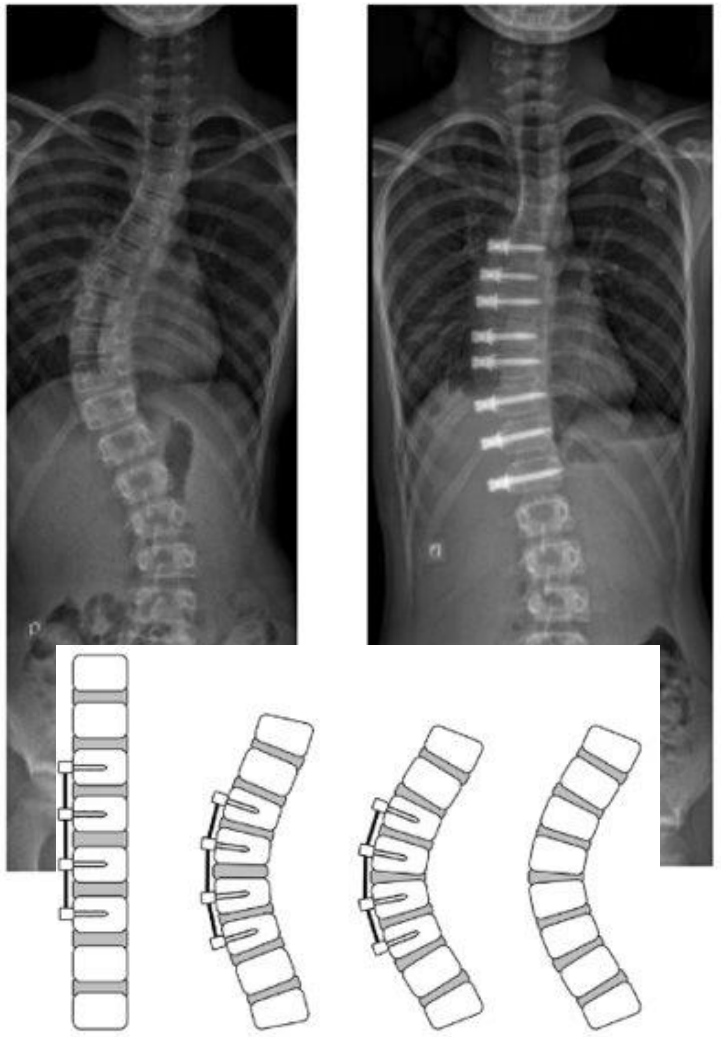
Complications

- Are rare but real!
- Pain
- Blood loss
  - Cell saver
- Infection 1%
  - Antibiotics while in hospital
- Spinal cord injury 0.1-0.5%
  - Neuromonitoring in OR
- Implant complications

Vertebral Body Tethering

- Anterior thorascopic approach
- Uses patient's growth to correct deformity and maintain motion
- Less invasive, shorter hospital stay
- Complications:
  - Tether breakage
  - Under-correct
  - Over-correct
  - Not as motion sparing



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5. When to refer?

- Short answer: anytime!
- Longer answer:
  - Skeletally immature patient with any curve
  - Skeletally mature patient with large curve
  - Any patient with abnormal exam

Questions?

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