Texas Children's Professional Education Series

Orthopedics and Sports Medicine

Current Concepts in Scoliosis

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Pediatric Orthopedic and Scoliosis Surgery

Texas Children's Hospital

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Scoliosis

- 4 million new cases diagnosed per year
- Prevalence
  - Idiopathic
    - 0.5% Infantile
    - 10.5% Juvenile
    - 89% Adolescent
  - 0.5 – 3 per 100 individuals have curves > 10°
  - 1.5 – 3 per 1000 individuals have curves > 30°

Scoliosis

Prevalence – Idiopathic

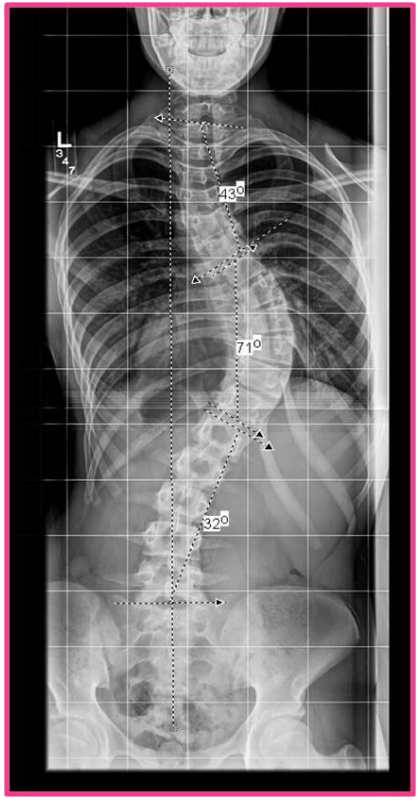
- Only 5% progress to > 30°
- M:F equal for smaller curves
- Females higher percentage with larger curves
- 8:1 F:M for those requiring treatment

Scoliosis – Prevalence

- Congenital
  - 0.5 – 1 per 1000 live births
- Neuromuscular
  - ??

Terminology – Scoliosis

- An abnormal 3D deformity of the spine
- On 2D radiographs, it is a deviation in the coronal plane (side to side) measuring more than 10˚
- There is also a rotational deformity associated with this

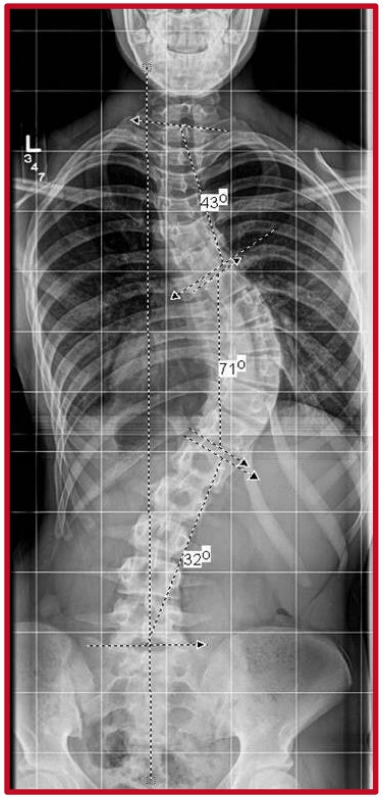


Scoliosis – Classification

- Idiopathic
- Congenital
- Neuromuscular
- Syndromic (Neurofibromatosis, Marfan’s)

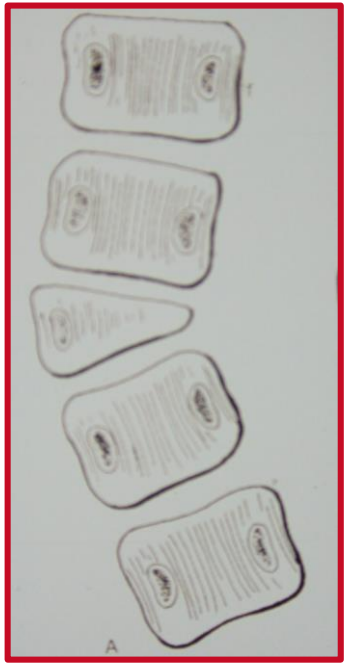
Scoliosis – Idiopathic

- Infantile: 0 – 3 years
- Juvenile: 3 – 10 years
- Adolescent: Older than 10



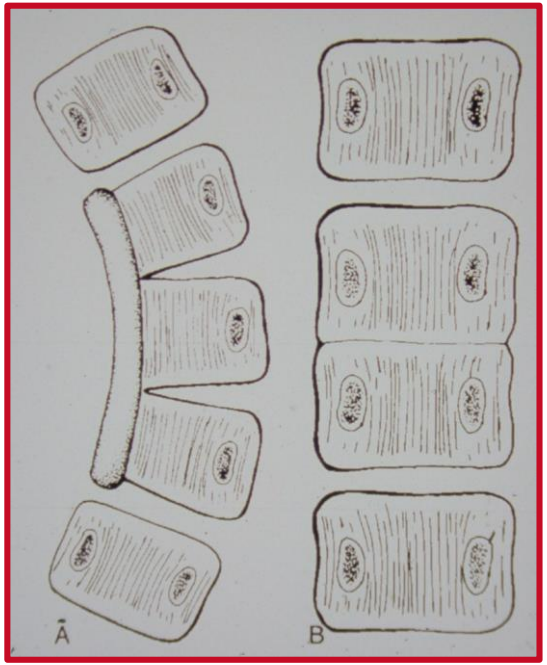
Scoliosis – Congenital

Failure of formation

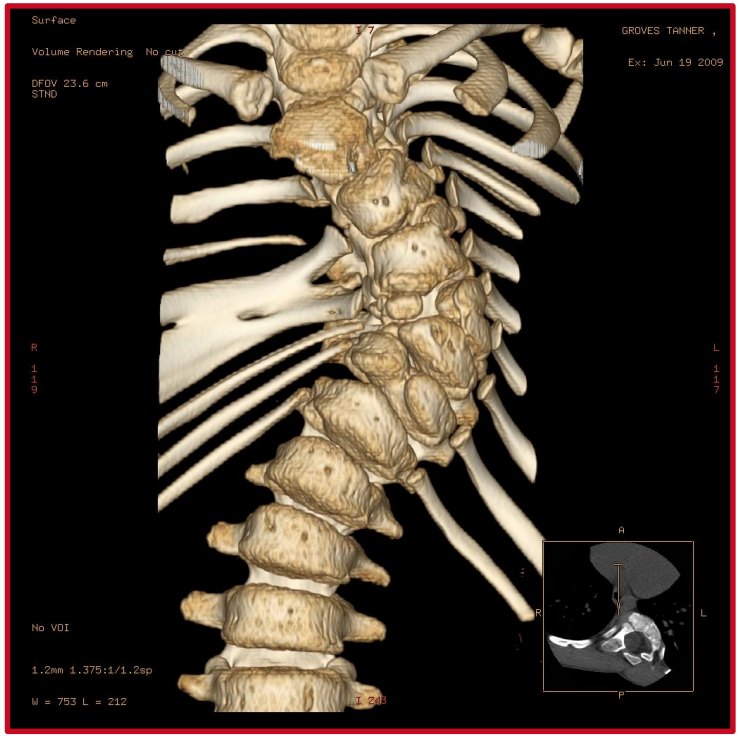


Scoliosis – Congenital

Failure of segmentation



Scoliosis – Congenital



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Scoliosis – Neuromuscular

- Duchenne's muscular dystrophy
- Spinal muscle atrophy
- Spinal cord injury

Scoliosis – Syndromic

- Marfan’s
- Neurofibromat

Early Onset Scoliosis – Classification

Current Concept

- Scoliosis with onset less than 10 yrs of age regardless of etiology
- C-EOS Classification System
  - Etiology
    - Congenital
    - Neuromuscular
    - Syndromic
    - Idiopathic
  - Magnitude of Curve
  - Kyphosis
  - Rate of Progression

Vitale, M., et. al., JBJS, Aug., 2014

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Scoliosis – Idiopathic – Cause?

- Genetic
- Hormonal
- Tissue deficiencies
- Vertebral growth abnormalities
- CNS Theories

“It’s time we face reality, my friends…We’re not exactly rocket scientists.”

Scoliosis – Idiopathic – Cause?

Current Concept

Genetic

- Great deal of research going into this
- Whole exom sequencing
- Multi-genic
- Different modes of inheritance

Scoliosis – Idiopathic – Cause?

Current Concept

Tissue Deficiencies – osteopenia and risk of progression

- 30% adolescents with scoliosis are osteopenic
  - 17.2% likely to progress to curve >45 degrees and require surgery compared to 7.6% of adolescents who are not osteopenic

Lam, Tsz Ping, POSNA 2016

Scoliosis – Idiopathic – Cause?

Current Concept

Tissue Deficiencies – osteopenia and risk of progression

- Calcium and Vitamin D supplementation may reduce the risk of progression in adolescents with scoliosis and osteopenia
  - 47% adolescents in placebo group vs. 24% of those treated with Calcium and Vitamin D progressed >6°
  - 600 mg calcium + 400/800 IU Vit D3

Lam, Tsz Ping, POSNA 2016

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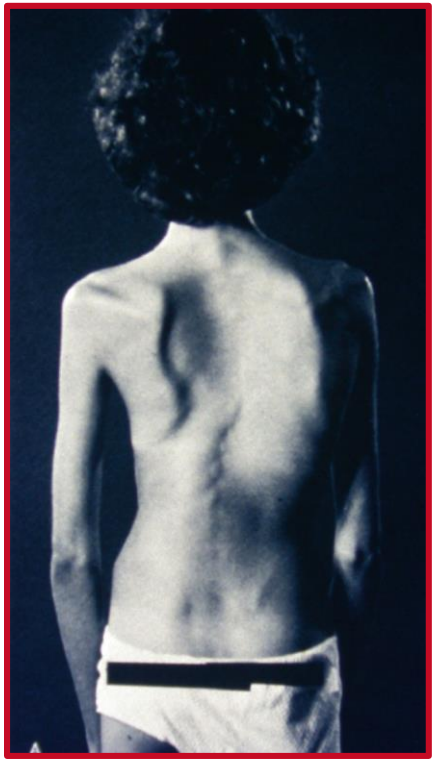
Scoliosis – History

- Onset, progression
- Pain
- Neurologic symptoms
- Family history
- Growth history
- Onset of menses in girls
- Tanner staging

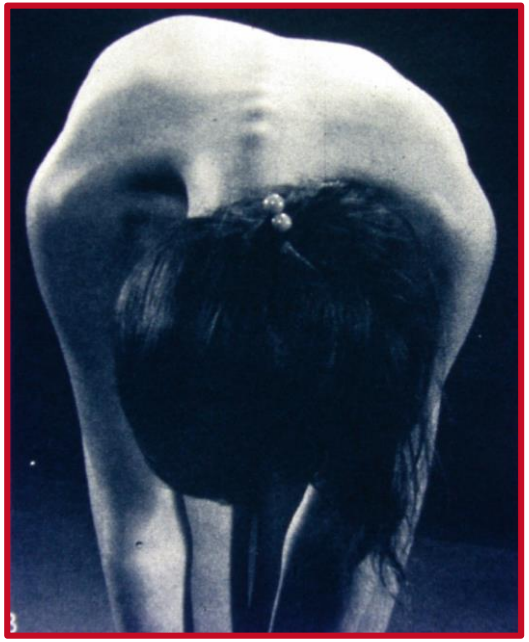
Scoliosis – Physical Exam

- Coronal alignment



Scoliosis – Physical Exam

- Sagittal alignment
  - Adams forward bend test

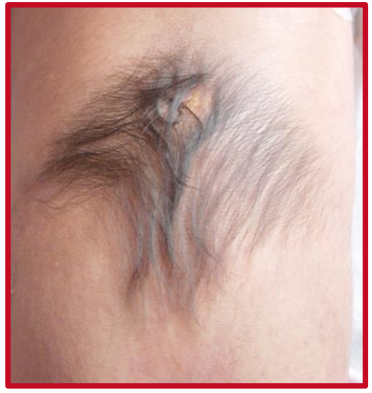


Scoliosis

- Greater than 7° detects all curves > 30°
- Obesity will mask this deformity, larger curves at referral. Recommend 5° referral threshold

Scoliosis – Physical Exam

- Other findings



Scoliosis

- 36” PA and Lateral

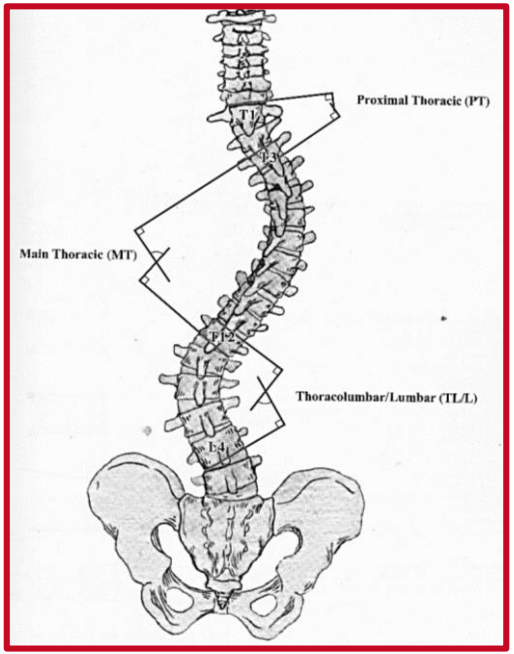
Scoliosis – Radiology

Current Concept

- Standard radiographs: Life time cumulative x-ray exposure with scoliosis management creates 4.3% cancer risk (breast, endometrial) 17X greater than normal population
- EOS reduces x-ray exposure of standard radiographs 2 -3 times
- Ability to evaluate 3D deformity

Simony, Ane, SRS 2015

Cobb Angle



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Growth vs. Progression

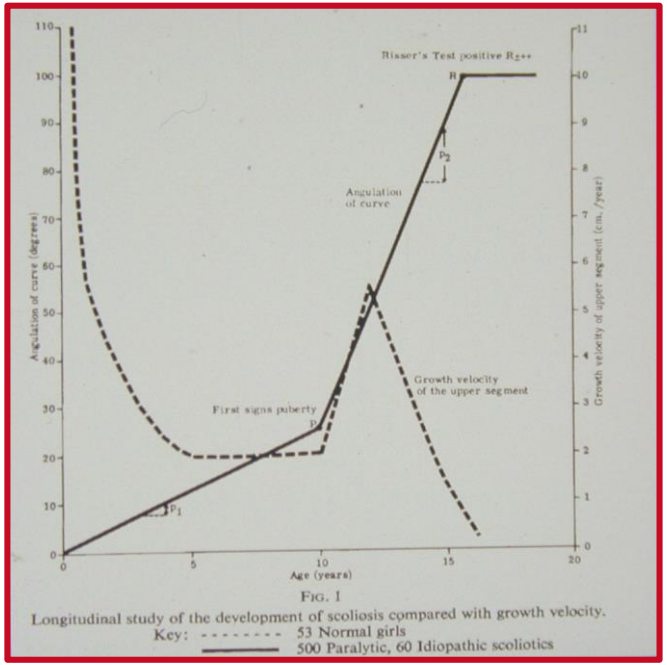

FIG. 1

Longitudinal study of the development of scoliosis compared with growth velocity.
Key: - - - - - - - - 53 Normal girls
——— 500 Paralytic, 60 Idiopathic scoliotics

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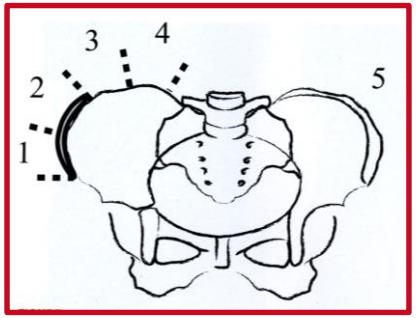
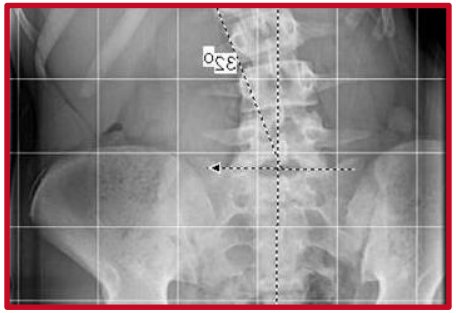
Risk and Rate of Progression

- Etiology
- Age of onset
- Gender
- Curve location
- Curve type
- Curve magnitude
- Risser sign/Phalangeal age
- Menarche



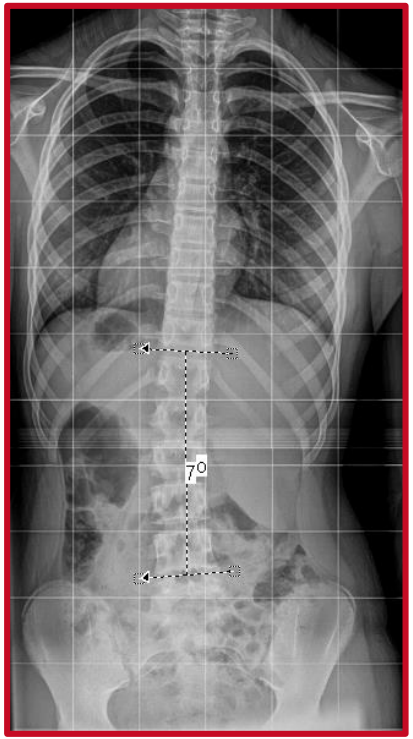


Scoliosis – Risk of Progression

- Risser 0-1 with curves 20 – 29°: 68% risk of progression
- Risser 2-4: 28% risk of progression
- Risser 0-1: 78% will require treatment

Scoliosis – School Screening, “Schooliosis”

- 40% unnecessary referral rate (Cobb <20°)
- $780/referral
- In states that have discontinued school screening, 45% reduction in unnecessary referrals with no significant change in curve size or rates of bracing or surgery
- Center for Preventative Medicine just released a statement the stated school screening was not necessary



School Screening (POSNA 2016)

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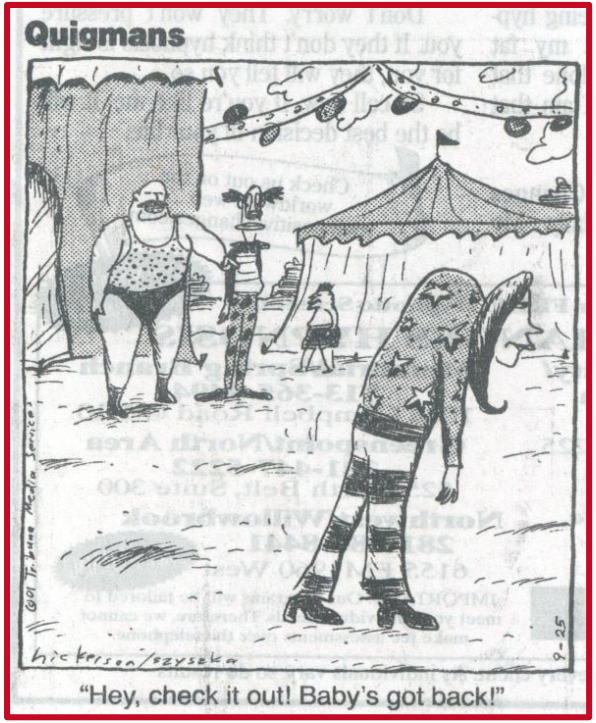
Scoliosis – Referral

- Any child less that 10 yrs. with curve greater than 10°
- Child 10 yrs. or older with a curve ≥ 20°
- Scoliometer ≥ 7°(≥ 5°in obese patients)
- Any child with scoliosis and findings suggestive of an underlying neurologic problem or syndromic problem.
- Atypical curve pattern: LEFT thoracic curve

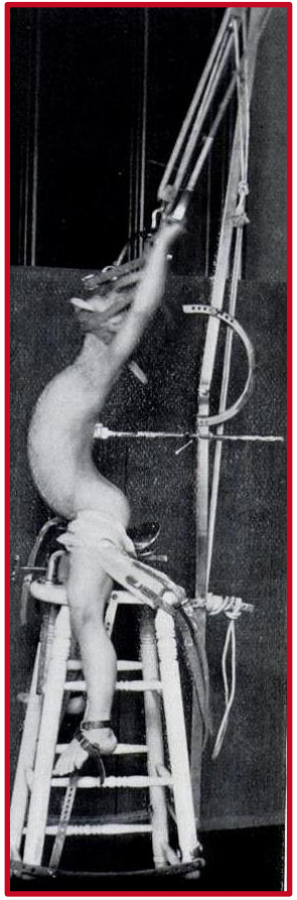
Scoliosis – Long Term Effects

- Pain
- Decreased cardio-pulmonary function
- Decreased body self image
- Neurologic compromise
- Increased mortality?



Scoliosis Treatment: What Has Been Tried?

- Traction
- Manipulation
- Physical therapy
- Massage
- Exercise
- Herb, minerals, vitamins
- Electrical stimulation, magnets



Scoliosis Treatment: What Has Been Tried?

Current Concept

- Physical therapy
  - Schroth Method – Christa Lehnert-Schroth
    - 100 + exercises to improve scoliosis
    - No good evidence that it works
    - Multicenter study underway

Scoliosis – Treatment

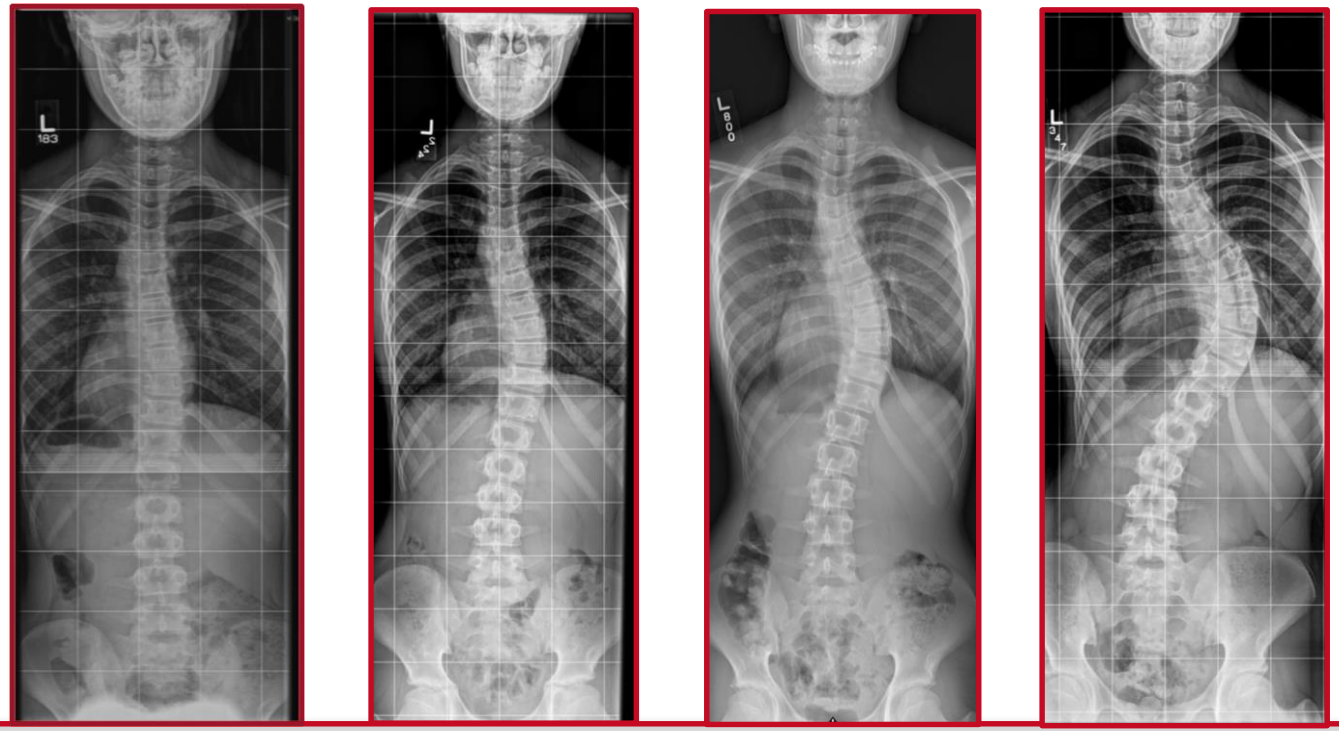
- Observation
- Bracing
- Surgery

Scoliosis – Treatment

- Observation
  - Growing child
  - Curve less than 25°

Scoliosis – Treatment

- Observation

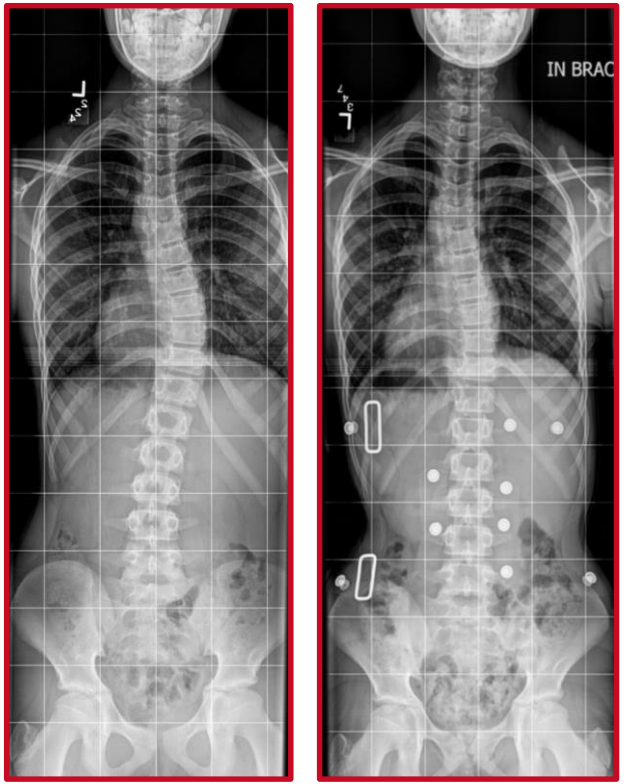


Scoliosis – Bracing

- Growing child
- 25˚ - 45˚
  - Progression to 25˚
  - 30˚ at presentation
- Risser 0,1,2

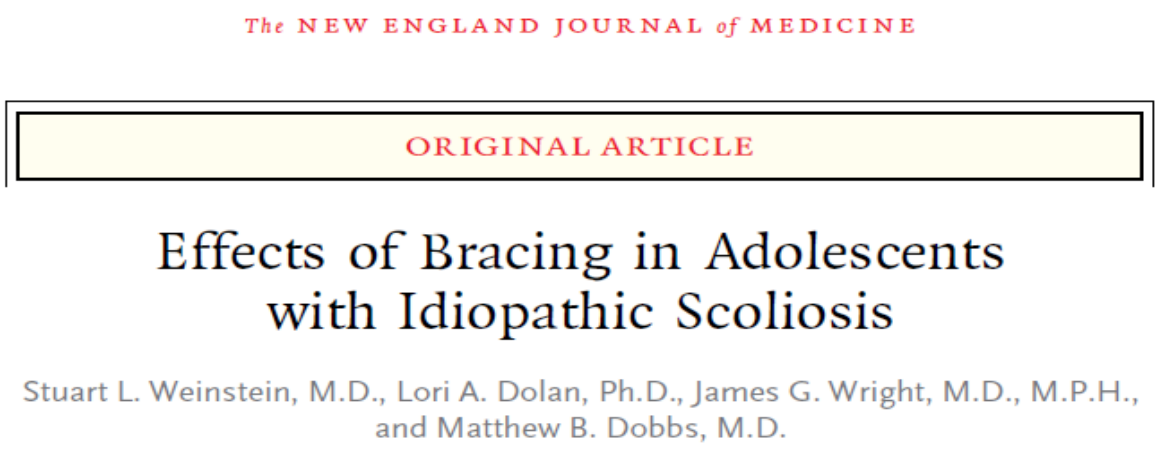
Scoliosis – Bracing

- Worn 16 – 20 hrs per day
- Prevents progression



Scoliosis – (BrAIST)

Current Concept



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.

- Conclusively demonstrated the effectiveness of bracing in adolescent idiopathic scoliosis
- Rigid Boston TLSO
- Dose response
  - Overall, 72% success rate with brace wear

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Scoliosis Treatment

- Early onset

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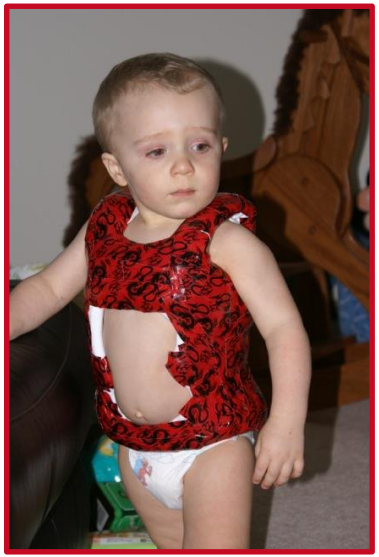
Scoliosis Treatment

- Early onset, Metha casting

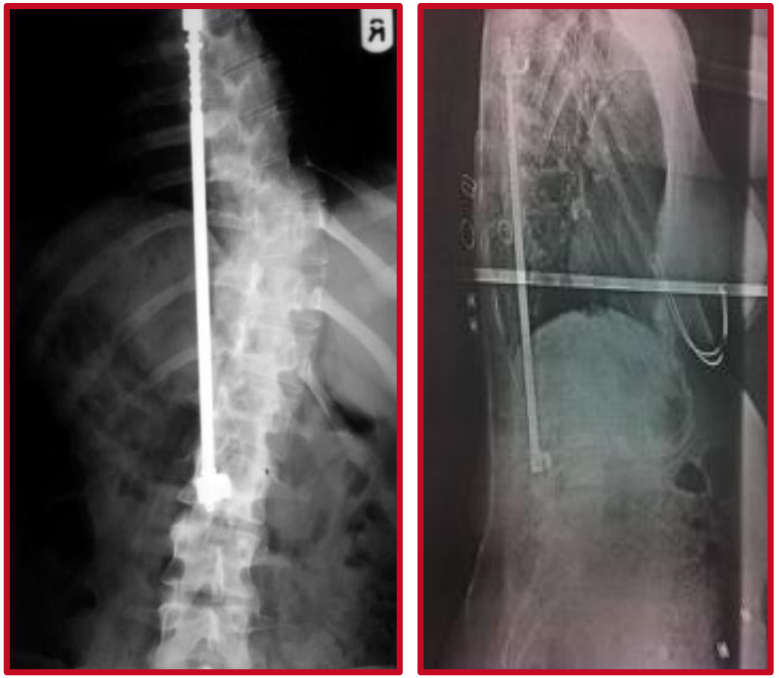


Scoliosis – Surgical Treatment

- Curves greater than 45 – 50˚
- Lumbar curves 45˚

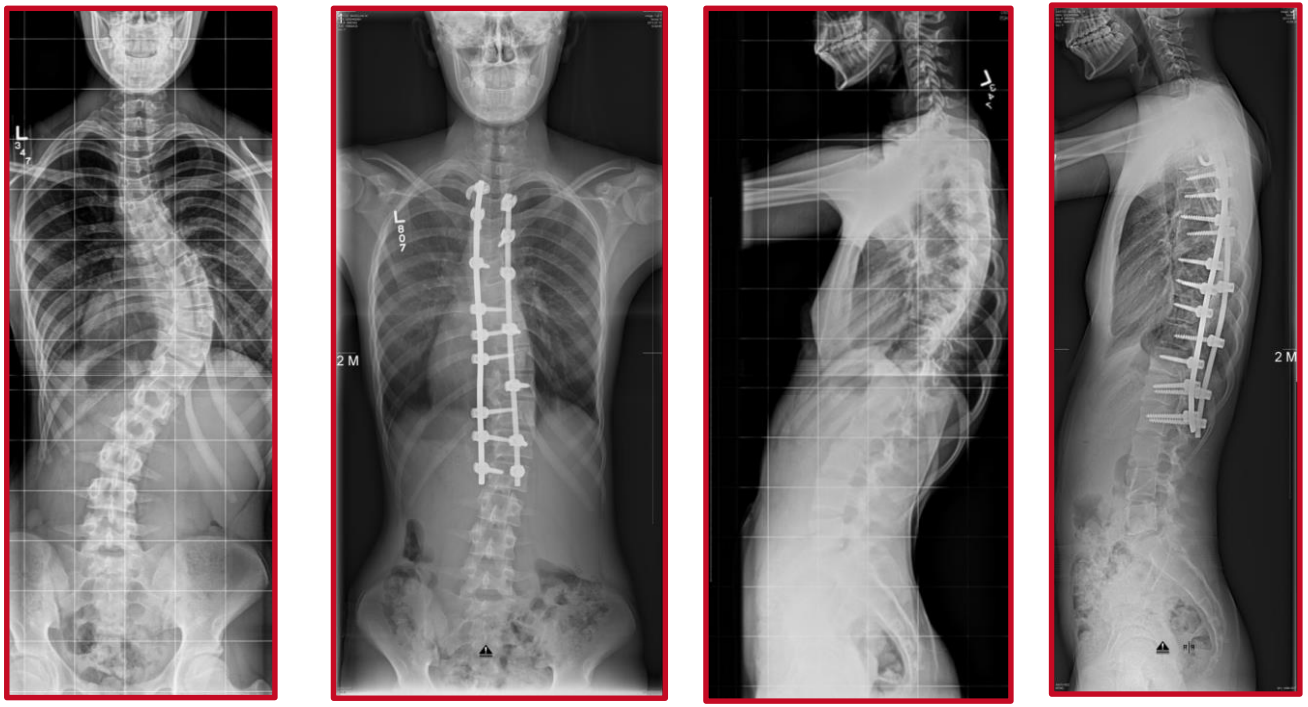
Scoliosis Treatment

- Surgery, 1960's
  - Paul Harrington, MD



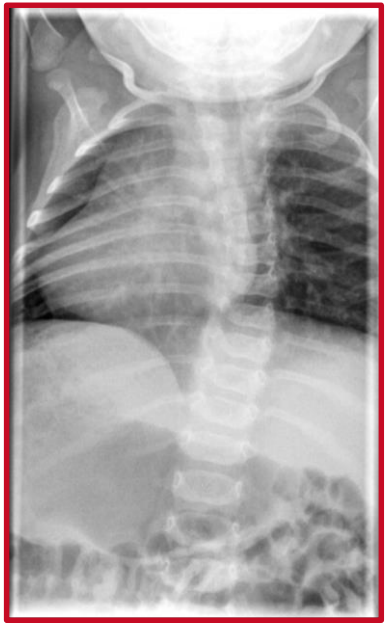
Scoliosis Treatment

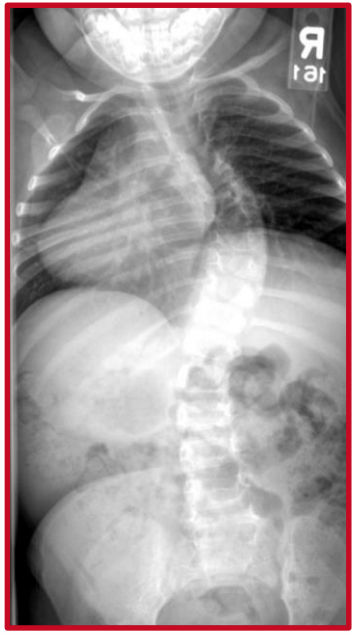
- Surgery, present day



Scoliosis

- Treatment
  - Early onset – Growth modulation





Scoliosis

- Treatment
  - Early onset – Growth modulation
    - Vertical Expandable Prosthetic Titanium Rib (VEPTR)
    - Robert Campbell, MD

Scoliosis – Current Concept

- Treatment – Early Onset Scoliosis
  - MAGEC Rods

Scoliosis – Surgical Treatment – QVSI

Current Concept

- Decrease costs without compromising outcomes
- **Patient safety initiatives to diminish hospital acquired infections, decrease blood transfusions requirements, and diminish risk or neurologic injury**

Scoliosis – Surgical Treatment – QVSI

Current Concept

- Decrease costs without compromising outcomes
  - **Expedited discharge**
    - **Decrease hospital stay form 4.6 days to 3.4 days**
    - **20 – 25 % reduction in costs without compromising patient experience**

Scoliosis – Surgical Treatment – QVSI

Current Concept

- Patient safety initiatives to diminish hospital acquired infections, decrease blood transfusions requirements, and diminish risk or neurologic injury
  - **TCH – Standardized infection protocol has reduced an infection rate of 7% to about 1.5 – 2%**
  - **Complex spine pathway has diminished in-hospital events on the neuromuscular spine patients**

Scoliosis – Surgical Treatment – QVSI

Current Concept

- Patient safety initiatives to diminish hospital acquired infections, decrease blood transfusions requirements, and diminish risk or neurologic injury
  - **Use of the O-arm and Stealth machine to guide and confirm screw placement**

Scoliosis – Current Concept Summary

- Research efforts are trying to unlock the genetics of scoliosis
- Calcium and Vitamin D supplementation may slow progression of scoliosis in adolescents with osteopenia
- EOS imaging is reducing radiation exposure and potential cancer risks
- Physical therapy had not been shown to affect scoliosis.
- Bracing (rigid TLSO) works!
- Management of early onset scoliosis has been positively impacted by the MAGEC rod
- QVS initiatives are improving patient outcomes, reducing costs, and improving patient safety

Thank you