Spinal Pain in the Young Athlete

Pierre A d'Hemecourt
Children’s Hospital Boston

History

Alexander the Great
Typical scoliosis posture

Vasiliadis, S. et al. Historical overview of spinal deformities in ancient Greece. Scoliosis 2009, 4:6

History

Spinal Deformities

Hippocrates (460-370 BC) from the Greek Island of Kos
Founder of scientific medicine and description of anatomy and pathology of the spine derived from cadavers in battlefields, from observations of athletes exercising in the gymnasiums, and from dissections of animals

Vasiliadis, S. et al. Historical overview of spinal deformities in ancient Greece. Scoliosis 2009, 4:6
History

Spinal Deformities

Hippocrates described the normal curves of the spine: "thiscoliosis," which indicates that the spine is straight in the coronal, but curved in the sagittal plane.

5 diseases of the spine:
1) kyphosis: either non traumatic (TB, spondylitis 2300 years before Pervical-Pott in 1700 s) or traumatic
2) scoliosis
3) concussion: burst fractures
4) dislocations
5) fractures of the spinous processes.

Implicated the role of growth in development of spinal deformity.

Vasiliadis S. et al. Historical overview of spinal deformities in ancient Greece. Scoliosis 2009, 4:6

History

Hippocrates recommended diet and extension for the treatment of scoliosis.
Spinal manipulation as a treatment for spinal deformities
First to invent devices based on principles of axial traction and three points correction
Ladder and Board

History

Galen of Pergamon 130–200 AD

Medical schools in Smyrna, Corinth, and Alexandria
First job — surgeon to the gladiators
Father of Modern-Day Surgery

Vasiliadis S. et al. Historical overview of spinal deformities in ancient Greece. Scoliosis 2009, 4:6
History

Physician of Emperor, Marcus Aurelius as surgeon and anatomist

History

Fresco

Epidemiology
Sport Specific
Epidemiology

Back pain in adolescent non-athletes

Taimela - Spine injuries in Sports - variable Spine
1999:22(10)

Epidemiology

Back pain in the adolescent athlete

Kujala et al. Low back pain in adolescent athletes, Medicine & Science in Sports & Exercise Volume 28(2) February 1996 pp 165-170
98 adolescents: 33 nonathletes, 34 boy athletes and 31 girl athletes
LBP >1 wk 45% nonathletes and 18% of non-athletes
MRI changes at the apophyseal ring were noted from baseline and associated with back pain

Epidemiology

USA Gymnastics

3 million recreational
85,000 competitive
4,000 clubs
Epidemiology
Gymnastics
Garrick: 43% of high school gymnastic injuries involve low back.
Range of studies: 13-43%

9% of pre-elite, 43% elite, 63% olympic and 15.8% of swimmers had MRI changes in the disc. Related MRI spinal pathologies with greater than 15 hours participation per week.

Dance Injuries
Micheli: 11-18% of Dancers with LBP
Incidence is 60-80%

Skating Injuries
Dubravic-Simunjak: Junior elite Figure skaters 32% female and 35% male skaters complained of LBP

Dubravic-Simunjak et al. The Incidence of Figure in Elite Junior Figure Skaters. Am J Sports Med July 2003 vol. 31 no. 4 511-517
Why?

What is happening at this time of life?

Sagittal Balance

**Spino-pelvic alignment**

3 basic parameters:
- Pelvic Incidence (PI)
- Pelvic Tilt (PT),
- Sacral Slope (SS).

Positional and relate to pelvic anteversion and retroversion

Pediatric population (age 3-18)

PI = 49.1 +/- 11.0 degrees

Adults, PI = 53.2 +/- 10.3 men

48.2 +/- 7.0 females

Increased PI infers an increased lordosis
Maturation of Spinal Sagittal Alignment


Demonstrated developmental increase in lumbar lordosis and thoracic kyphosis

<table>
<thead>
<tr>
<th>Kuphosus (°)</th>
<th>Lordosis (°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age 3-6</td>
<td>44.9 ± 11.4</td>
</tr>
<tr>
<td>Age 7-9</td>
<td>47.8 ± 15.5</td>
</tr>
<tr>
<td>Age 10-12</td>
<td>49.8 ± 15.8</td>
</tr>
<tr>
<td>Age 13-15</td>
<td>53.3 ± 13.3</td>
</tr>
</tbody>
</table>

Volume of time in gymnastics


2270 children (407 girls and 1863 boys) between the ages of 8 and 18 years, football, gymnastics, ice hockey, swimming, track, volleyball, or wrestling

Associated increased kyphosis particularly in the gymnast

Increased Lumbar Lordosis

Maturation of growth cartilage

Rapid Skeletal Growth

Relationship of maturation and competitive level

<table>
<thead>
<tr>
<th>Time lost</th>
<th>Injury rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I and II</td>
<td>Stable growth</td>
</tr>
<tr>
<td>Class III</td>
<td>Stable growth</td>
</tr>
</tbody>
</table>

Risk Factors

Strength

Hongtau et al. The Study of Methods of Functional Core Stability for Gymnastics Training.

Improved postural control
What are the sports specific biomechanics that relate to spinal injury?

**Sport specific biomechanics**


**Biomechanics Gymnastics**

Female gymnasts four events: the beam, uneven bars, floor, and vault
Male gymnasts train and compete on six events: the floor, pommel horse, rings, vault, parallel bars, and horizontal bar.

Rhythmic gymnasts require extreme levels of flexion and extension of the vertebral column. Pairs, trios, or more (generally five) manipulate one or two apparatus: rope, hoop, ball, clubs and ribbon.

Landing skills (vault, dismounts and tumbling) require varying amounts of extension, flexion and vertical stability.

Hanging events (bars, rings) 6.5 to 9.2 times body weight during the downward ring swing.

Gymnastics Positions:
- Hollow position. Requires scapular protraction, thoracic hyperkyphosis, and anterior pelvic tilt.

Biomechanics in Gymnastics

I. Uncontrolled extension is one factor in spondylolysis

II. Poor hip extension factored with poor thoracic extension place more force at T-L juncture compression (Brady)

III. Jull and Janda: Pelvic Crossed Syndrome
- Dysfunction of the lumbar-pelvic-hip complex whereby tight hip flexors and erector spinae muscles inhibit the abdominal and gluteal muscles with increased lordosis and anterior pelvic tilt
- Hemipelvic dysfunction

Dance Injuries

Similar biomechanical issues with tight hip flexors, erector spinae, and Dorsolumbar fascia will increase lordosis.

Holding an arabesque with leg extended will tend to allow anterior pelvic rotation with fatigue.

Maintaining a vertical trunk posture is also a risk factor

Gelabert found (dancers with LBP) that approximately 45% are related to those who lift their hip and 25% to those who forcefully try to raise their leg above 90° while keeping their back too straight in an arabesque.


Gracovetsky (EMG) demonstrated increased spinal compression forces with dance landing and anterior pelvic tilt

Figure Skating
Singles, PAIRS AND Ice Dancing

LAYBACK SPIN

DEATH SPIRAL

Evaluation
History and Physical

History
Sport involvement
Relation of pain to sports
Systemic symptoms
Axial vs peripheral symptoms

Red flags
Night pain
Immunosuppressant medication
Bowel/bladder involvement
Systemic symptoms
Family history
Disc
Connective tissue
Spinal curve
Disorders
Physical Examination

Gait
Beighton score
Skin
Flexion/extension
Neurologic examination
Hip and pelvic dysfunction

Biomechanical Evaluation
Single leg squat
Gluteal strength
Core strength
Abdominal strength
Hip flexor strength and tightness
Hamstring tightness.

All to plan rehabilitation regardless of diagnosis

Biomechanical Evaluation
Prone hip extension
Muscle activation pattern, predictable order
Hamstring → Gluteal → Contralateral Erector Spinae
Ipsilateral Erector Spinae muscles

LBP with delayed gluteal muscle firing
Hemipelvic Dysfunction
- Asymmetrical pelvic anterior rotation
- Sacroiliac joint dysfunction
- Piriformis spasm and possible sciatica
- Psoas strain
- Gluteus medius bursitis

Injury Patterns
Anterior and Posterior
Adult vs. Adolescent

48% Discogenic

47% Spondyloysis (5% general population)

11% Disc related

Athlete vs non athlete

Micheli LJ, Wood R. AJSM1995 149:15-18

Spinal injury patterns:
Posterior Column
Spondylolysis

Case #1

15 Year old football (D-back) and basketball player

Insidious back pain since January

No specific trauma

Midline back pain with radiation to his right leg

Sitting > standing but very much activity related
Case # 1

Examination:
- pain on flexion
- Tight peripelvic
- Neurologic exam intact
- Negative SLR

X-rays

MRI
CT Scan

Treatment

Boston Overlap Brace
RTP 7 weeks
4 touchdowns in one game
3 year follow up: pain free

Epidemiology

Only 8.02% overall
Highest percentages occurring in throwing sports (26.67%)
Artistic gymnastics (16.96%)
Rowing (16.88%)

**Posterior Column Spondylolysis**

General prevalence: 6%

Kalichman (Framingham) 11.5% with no associated LBP

Japanese study: 5.9%

Spina Bifida Occulta 7.7% with a 3.7 fold increase in odds ratio for spondylolysis

**Sports Spondylolysis**

Klein: good outcomes in 83.9%

Unilateral defects healed 71%

Bilateral defects healed 18.1%

Acute defects healed 68.1%

No significant difference in clinical outcome between bracing and non bracing


**Abstract Title:** “A Retrospective Review of Pars Interarticularis Stress Fractures: Diagnosis and Management to Assess Incidence and Radiographic Healing.”

2010 AMSSM  Ashlee Warren, MD Stephen Simons, MD

2000-2009. 135 patients: extension based pain, positive bone scan and CT

Boston Brace for pain management and early return to sport once pain-free.

A repeat CT was obtained 3 months

54 (28 bilateral, 26 unilateral) positive bone scan

59 patients had an initial CT and 35 patients followed through with a second CT.

23 of 35 showed healing (13/16 9-14 and 10/19 15-22).

11/12 with unilateral and 12/23 with bilateral fractures healed
**Anatomical Risk Factor**

Decreased interfacet spacing increases the pincer mechanism


Hodzic E and Latimer B. Normal Radiographs of Spondylolysis. JORJ Vol 3, 1

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**Spondylolisthesis Etiology**

Kajura et al demonstrated the weak link of the growth plate in the immature spine.

Ikata et al showed that the slip occurred between the osseous and cartilaginous end plates with MRI in children and adolescents.


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**Spondylolisthesis Progression**

Increased pelvic incidence (PI) in high grade slippage


Correlation with spondylolysis and low grade spondylolisthesis.

**Imaging**

Radiographs: AP, lateral and obliques

SPECT Bone Scan

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**Posterior Column Spondylolysis Imaging**

CT
Morita: Early (73%), progressive (39%) and terminal (0%) healing

Early

Progressive

Terminal

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**Posterior Column Imaging**

MRI

Campbell: 79 extension back pain athletes MRI vs CT vs SPECT
Only discrepancy of MRI was those with reactive and no fracture
Skel Radiol Springer Berlin / Heidelberg 1413 1616 34, #3,2005

Sairyo: compared known spondylolysis with CT and MRI for high pedicle signal
Only discrepancy is in the progressive stages (50%)  
SPINE Volume 31, Number 2, pp 206–211  
©2006, Lippincott Williams & Wilkins, Inc.
Posterior Column
Spondylysis
Treatment

Limitation of activity

Rest for 12 weeks and then assess

TLSO (Boston Brace)

Physical Therapy all stages

O'Sullivan Evaluation of Specific Stabilizing Exercise in the Treatment of Chronic Low Back Pain With Radiographic Diagnosis of Spondylolysis or Spondylolisthesis. Spine Nov 2006;31(21):2959-2967

Brace Protocol

At 4-6 weeks the athlete may start to return to participation if they are pain free on extension and they are compliant with PT and brace

At 4 months, a CT is considered.
A painful non union is a consideration for electrical stimulation.

Case # 2

12 year old male with 4 years of insidious LBP
Recently worse with football and snowboarding
Activity related and sitting pain
No night pain/systemic symptoms/morning stiffness
MRI lumbar spine reportedly normal
Case #2

Examination:
- pain on extension and single leg hyperextension on right
- Otherwise normal exam

Case #2

Bone scan with SPECT

Transitional Vertebrae

CT
Clinical Course

Placed in a brace and started on a neutral zone core stabilization along with naproxen
Pain free in the brace for 6 weeks
Still with some pain on extension but mild

Consideration for a fluoroscopic corticosteroid injection

Transitional Vertebrae Bertolotti Syndrome

In the adult population not associated with any increased LBP

In the young athletic population with extension based LBP and a transitional vertebrae 63% with uptake at that site only

Case # 3

13 Year old gymnast with 3 months of LBP axial only
No systemic sx
No night pain
Hx benign mandibular tumor
Examination: pain with extension
Baastrup’s Syndrome

SI Pain

Anterior Column
Case #4

18 Year old football player (offensive line) and wrestler developed right buttock pain late in the football season.
No specific injury
No radiation
No game time lost but out of practice for about one week

Case #4

Pain resolved at the end of the season but immediately recurred with wrestling
Soon developed right leg pain in lateral thigh and anterolateral calf
He was unable to continue wrestling
Denies weakness as well as bowel and bladder symptoms
Sit > standing pain
PMH negative/ Family history of disc disease

Case #4

Examination:
Pain on lumbar flexion to knees (leg pain) with scoliosis
Minimal extension pain
Positive SLR 45°
Neurologic exam with diminished right knee reflex
MRI

Flexion based pain with sciatica
MRI 6 weeks of leg pain

Treatment

Ketoprofen 200 SR QD
Tramadol 50mg
Started early rehab phase of an extension biased core stabilization with progression as tolerated
Elliptical crosstrainer as able

After 6 weeks of treatment

VAS ↓ from 7 to 4-5
Mostly leg pain
Forward flexion to mid calf
Neuro intact
SLR at 60°
LESI (transforaminal)
Advanced PT to late rehab phase
Week 10 of treatment

VAS ↓ 0-1
Lumbar scoliosis resolved
SLR negative
Advanced rehab started
Tolerated this well
2 weeks later started
sports specific drills for lacrosse

Lumbar Disc Herniation

Usually present with a flexion component
SLR ≥30°, ≤70°
95% at L4-5 and L5-S1
2/3 posterolateral
1/3 central
Both with sciatica

90% will improve with non-operative treatment and best in the most fit

Sciatica resolution
50% by 1 month
75% by 6 months
Progressive neuro deficits (first 2-3 wks)

Lumbar Disc Herniation
Nonoperative Management

Directional Preference for core stabilization
Extension Biased

NSAIDS/analgesics
Epidural steroids

PT components:
Phase
Direction
Athlete specific biomechanics
Aerobic activity
Lumbar Disc Herniation
Nonoperative Management

Epidural Steroids
- 44% of athletes responded positively
- 56% of randomized patients responded without harm in delay
  Butterman G: Treatment of lumbar disc herniation: epidural steroid injection compared with discectomy

Lumbar Disc Herniation
Operative Management

Surgery: cauda equina, progressive neurologic deficit, intractable pain
Excellent outcomes in 65-90%
Return to play 6-8 weeks
Long term outcome is no different
33-90% return to previous level

Surgical Outcomes of Lumbar Disc Surgery
14 elite college athletes lumbar disc surgery
Mean age 20.7
10 single level microdiscectomy
3 two level and one percutaneous
3.1 year follow up
9/10 single levels returned 90%
3 double level and percutaneous retired prematurely
### Surgical Outcomes of Lumbar Disc Surgery

137 diagnosed with HNP 1979-2006
96 (74%) underwent lumbar discectomy
34 treated nonoperatively
78% of 96 RTP average of 36 games over 3.1 years (8.3% reoperative)

No ∆ in performance score
22 of 30 (73%) > age of 30 RTP
59% (20/34) non-op RTP
76% general population RTW

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### Surgical Outcomes of Lumbar Disc Surgery

24 NBA players had LD 1991 and 2007
Control of position, BMI and age
Measurement:
- games played, minutes per game, points, rebounds, assists, steals, blocks and shooting percentage

18/24 (75%) RTP in the NBA, compared with 42/48 players (88%) controls
No ∆ in performance

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### Surgical Outcomes of Lumbar Disc Surgery: Timing RTP

88% PTP

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### Table 1: The Calculation of the Performance Score for Each Position

<table>
<thead>
<tr>
<th>Score</th>
<th>Tally</th>
<th>Points</th>
<th>Performance Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

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### Table 2: WJ Players Diagnosed with a Lumbar Disc Herniation as Positions

<table>
<thead>
<tr>
<th>Position</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guard</td>
<td>1</td>
</tr>
<tr>
<td>Forward</td>
<td>2</td>
</tr>
<tr>
<td>Center</td>
<td>3</td>
</tr>
</tbody>
</table>

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Watkins R. Microscopic lumbar discectomy results for 60 cases in professional and Olympic athletes. The Spine Journal 3 (2003) 100–105

Anterior Column
Pediatric Herniated Disc

Finnish study: negligible hospitalization < 15 YO and only 9 case reports less than 10
90% with positive SLR but less neurologic symptoms

Conservative therapy included 2 weeks bed rest followed by bracing for a few weeks and NSAIDS and a few reports of ESI: 25-50% success. (Level IV)


Surgical Outcomes of Lumbar Disc
Surgery: Pediatric

Female patients (60%)
64% described themselves as competitive athletes
Leg pain 95%
Urinary complaints 2/87 pts
6% reoperative rate


Anterior Column
Kyphosis

Normal Kyphosis is 20-45º
Postural Kyphosis: flexible and less than 60º
Scheuermann's Kyphosis criteria:
  5º wedging of 3 vertebrae at apex
  Cobb angle >45º
  Endplate and disc changes
Surgical indications for > 75 º
Spinal Deformity (Sagittal Plane) Kyphosis

Classic Scheuermann’s Thoracic Kyphosis
Juvenile Round Back

Anterior Column Kyphosis

Reported incidence ranges 1% to 8%.

Etiology: genetic and some environmental factors.

Murray reported more pain than normals but not with loss of work days or self esteem. Average curve was 71 degrees.

Modest improvement with Milwaukee brace:
prebrace 55° - 64° improved 7°
65° - 74° improved 13°
74° improved 19°.

DuPont kyphosis brace

Atypical Scheuermann's

DuPont kypnosis brace

Evidence Based Medicine Analysis of Scheuermann Kyphosis
SPINE Vol 32, 19S, S115–S119

Some efficacy with low profile braces: 9/22 with improvement

Case # 5

14 year old gymnast presents with 6 months of insidious axial midback pain. Pain is worst with sitting but also limits activities. Axial only. Sleeping well. No Δ bowel/bladder.

Case # 5

Examination: pain with flexion to mid calf and extension to 20° (mild). Flat back noted on flexion. Neurologic examination is normal. Tight hip flexors and hamstrings. Tender at the T-L juncture. Very week on single leg squat.

Case # 5

Plain x-rays showed some mild upper lumbar endplate changes. MRI. Diagnosis: atypical Scheuermann's.
Case # 5

Treatment:
Neutral to extension
biased core stabilization
15°→22° TLSO over 2 months
Attention to peripelvic
flexibility and strength
At 2 months, sports
specific drills with a
corset brace

Case # 5

Outcome:
At 3 months, significant
improvement
Return to gymnastics in
4 months

Case # 5


9% of pre-elite, 43% elite, 63% olympic
and 15.8% of swimmers had MRI
changes in the disc. Related MRI spinal
pathologies with greater than 15 hours
participation per week
Case# 6

17 year old boy was playing hockey, skating quickly after puck and was slammed into boards hitting his neck, forcefully bending his upper torso. 5 seconds of lower leg numbness

Taken to OSH in board and collar. Spine XR and MRI of spine performed which showed a L1 burst fracture with 4-mm of retropulsion displacing cord posteriorly. No cord signal abnormality.

Moderate sized posterior epidural hematoma from T12 to L1.

Mild compression fx of T12.

He was then transported, boarded and collared to CHB ER for spine evaluation.
DATE OF PROCEDURE: 12/07/2009

PROCEDURES PERFORMED: Open reduction lumbar spinal fracture, spinal segmental instrumentation T11, 12 L1 and L2, left iliac crest bone marrow aspirate, allograft bone graft.

Post Operative

7 degrees of kyphosis over his instrumented segment. This flows gently into his upper thoracic region and his lumbar region. His sagittal contour and coronal posture are well maintained.

Post Op August
There is no evidence of loosening of his screws. There is some loss of disc space over the segment of his two fractures, which were at L1 and T12. The posterior spinal fusion mass although present is still somewhat limited in its appearance.

278 respondents of SRS
Gym class between 6 months and 1 year
Noncontact sports between 6 - 12 months
20% insisted and 35% suggested, that patients never return to collision sports

Table 3. European's Preference for Return to Sport in Patients After Spinal Fusion

<table>
<thead>
<tr>
<th>Activity</th>
<th>Immediate (%)</th>
<th>6 Weeks (%)</th>
<th>12 Weeks (%)</th>
<th>1 Month (%)</th>
<th>6 Months (%)</th>
<th>1 Year (%)</th>
<th>2 Year (%)</th>
<th>Enrollment (%)</th>
<th>Mean (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical therapy</td>
<td>30</td>
<td>29</td>
<td>25</td>
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<td>15</td>
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<tr>
<td>Water sports</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Contact sports</td>
<td>6</td>
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<td>6</td>
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<tr>
<td>Collision</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
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</tr>
</tbody>
</table>

Injury Prevention
Chart the growth of the athlete and increase vigilance during peak growth velocity with attention to increasing lordosis
Screen for athletic amenorrhea and eating disorders
Injury Prevention

Consider limitations of the number of repetitive back extensions in a given session similar to baseball pitches.

Consider cross-training or rest days.

Enhance lumbar extension with training for a gradual combined extension flexibility of the hips, thoracic and lumbar spine.

Injury Prevention


Screen and monitor pelvic flexibility and core strength with consideration of sagittal alignment.

Developmental Deformity

Scoliosis
Scoliosis

1. Infantile scoliosis manifests under 3
2. Juvenile idiopathic scoliosis manifests between 3 and 10. (12-21%): high rate of progression
3. Adolescent idiopathic scoliosis manifests from 10 to skeletal maturity

Idiopathic Scoliosis

Curves that are > 50 degrees at maturity progress 1°/year
Curves between 30-50° will progress 10-15°
Curves at 30° at maturity are stable

Adolescent Idiopathic Scoliosis

Often detected on the Adams forward bending test
Best in girls 11-13 and boys 13-14
Scoliometer reading of 7 yields a 3% referral rate
Adolescent Idiopathic Scoliosis Progression Risk

Early Risser sign
Premenarchal
Curve > 20°
Age < 12

Adolescent Idiopathic Scoliosis Progression Risk

<table>
<thead>
<tr>
<th>Degree of curve (Cobb angle)</th>
<th>Age 10 - 12</th>
<th>Age 13 - 15</th>
<th>Age over 16</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20°</td>
<td>25%</td>
<td>10%</td>
<td>0%</td>
</tr>
<tr>
<td>20° - 30°</td>
<td>60%</td>
<td>40%</td>
<td>10%</td>
</tr>
<tr>
<td>30° - 60°</td>
<td>90%</td>
<td>70%</td>
<td>30%</td>
</tr>
<tr>
<td>&gt;60°</td>
<td>100%</td>
<td>90%</td>
<td>70%</td>
</tr>
</tbody>
</table>

Adolescent Idiopathic Scoliosis

Critical factors to consider tumor, tethered cord and syringomyelia

Left thoracic
Juvenile onset
Abnormal neurologic exam
Structural abnormality
Excessive Kyphosis
Adolescent Idiopathic Scoliosis

*Treatment Guidelines*

- 0-25° Serial observation
- 25°-30° if 5-10° progression, then brace
- 30°-40° Brace
- >40° Surgery
Thank You