Introduction to scoliosis
What is scoliosis?

Lateral curvature of the spine > 10 degrees

- Structural scoliosis
- Non-structural scoliosis
**Structural Curve**

- Cobb measurement fails to correct past zero on supine maximal voluntary lateral side bending x-ray

**Non-structural**

- Cobb measurement measurement corrects past zero on supine lateral side bending x-ray
Lumbar curve corrects and is therefore non-structural.

Thoracic curve persists and is therefore structural.
Functional scoliosis — (usu. non-structural)

- Limb length discrepancy
- Sciatic scoliosis
- Hysterical scoliosis - manifestation of a conversion reaction
- Benign tumours – painful spasm – osteoid osteoma
Sciatic scoliosis
Screening for scoliosis – Adams test
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- Spinous process deviated to concave side
- Lamina thinner and vertebral canal narrower on convex side
- Rib pushed posteriorly and thoracic cage narrowed
- Vertebral body distorted toward convex side
- Rib pushed laterally and anteriorly

Convex side

Concave side
Assessment of scoliosis - Coronal alignment
Assessment - Sagittal alignment
Classification of Scoliosis

- Idiopathic
- Congenital
- Neuromuscular
- Others
Idiopathic scoliosis

- Cobb (L) $\geq 10^\circ$ + rotation
- Unknown etiology
Types of idiopathic scoliosis

- Infantile scoliosis - presenting from birth – 2+11
- Juvenile scoliosis – 3yrs - 9+11
- Adolescent scoliosis – 10yrs - 17+11
- Adult scoliosis – 18 yrs and beyond
We describe 12 children with idiopathic scoliosis who had a persistent absent superficial abdominal reflex (SAR) on routine neurological examination. MRI showed syringomyelia to be present in ten. The average age at detection of the scoliosis was 4.3 years and at diagnosis of syringomyelia 6.6 years.

In all ten children the SAR was consistently absent on the same side as the convexity of the curve. In two it was the only abnormal neurological sign. An absent SAR in patients with scoliosis is an indication for investigation for underlying syringomyelia.

Burwell et al 1992; Williams 1992). Arai et al (1993), in a comprehensive study, reported that 4.0% of patients with scoliosis with curves larger than 20° had syringomyelia. New imaging techniques and improved clinical awareness have identified more patients with idiopathic scoliosis who have syringomyelia (Nohria and Oakes 1990). It is progressive and early diagnosis and treatment are therefore paramount (Williams 1992).

Our aim was to indicate the clinical features of importance in the early detection of syringomyelia with special reference to the superficial abdominal reflex (SAR) and to
Absent abdominal reflex

Left thoracic scoliosis

+

Absent abdominal reflex
Terminology

- Cervical scoliosis - apex between C1 and C6-C7 disc
- Thoracic - apex between T2 body - T11-T12 disc
- T-L scoliosis - apex at T12, T12-L1 disc or L1
- Lumbar - apex L1-L2 disc - L4-L5 disc
- L-S scoliosis - apex - L5 or below
Rapid Curve progression in

- **Curve size**: > 40°
- **Curve rotation**: Moe grade 2 or more
- **Age**: ~ <10, pre-menarche
- **Skeletal maturity**: - Riser grade 0-2
  - Open acetabular cartilage
Curve progression in *immature* patients...

- < 20°: 22% chance of progression
- 20-30°: 68% chance of progression
- 30-60°: 90% chance of progression
- > 60°: 100% chance of progression

Nachemson, Lonstein et al  SRS 1982
Treatment Options

Observation (but not neglect)

Orthosis – Brace

Operative
Orthosis - Brace

YB 12y
May 06
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AL 12y
Sept 06
Guidelines – Not accurate

- 10-25 degrees – Observe / Brace
- 25-45 degrees – Brace (growing children)
- > 50 degrees - Surgery
Operative Treatment — Anterior
Operative Treatment – Posterior
Congenital Scoliosis
Classification

Type I- Failure of formation

a) Hemivertebra

b) Wedged vertebra
Type II - Failure of segmentation

a) Block vertebrae

b) Unilateral unsegmented bar
Classification

Type III - Mixed anomalies
Associated anomalies

33% - Genito-urinary tract anomalies

25% - Klippel–Fiel syndrome

15% - Intraspinal anomalies

10% - Cardiovascular anomalies
<table>
<thead>
<tr>
<th>Cardiac⁹</th>
<th>Renal⁹</th>
<th>Neurologic⁹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventricular septal defects</td>
<td>Renal hypoplasia</td>
<td>Tethered cord</td>
</tr>
<tr>
<td>Atrial septal defects</td>
<td>Horseshoe kidney</td>
<td>Syrinx</td>
</tr>
<tr>
<td>Patent ductus arteriosus</td>
<td>Single kidney</td>
<td>Thickened and fatty filum</td>
</tr>
<tr>
<td>Tetralogy of fallot</td>
<td>Congenital megaureter</td>
<td>Low conus</td>
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<tr>
<td>Transposition of great arteries</td>
<td>Ectopic kidney (pelvic)</td>
<td>Diastematomyelia</td>
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<tr>
<td>Pulmonary stenosis</td>
<td>Hypospadias</td>
<td>Intradural mass/ Lipoma</td>
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<td>Sick sinus syndrome</td>
<td>Pelviureteric junction obstruction</td>
<td>Extradural mass</td>
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<tr>
<td></td>
<td>Posterior urethral valve</td>
<td>Chiari malformation</td>
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<td></td>
<td>Cloacal anomaly</td>
<td></td>
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<td></td>
<td>Epispadias</td>
<td>Arachnoid cyst</td>
</tr>
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<td></td>
<td>Exstrophy of the bladder</td>
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<td></td>
<td>Hydronephrosis</td>
<td>Dandy-Walker malformation</td>
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<td></td>
<td>Undescended testis</td>
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Pattern of progression

50% - severe progression

25% - slow progression

25% - non progressive

Winter et al  JBJS 1996
Inheritance

Isolated hemivertebra - sporadic anomaly – no risk for siblings.

Multiple anomalies - 5-10% risk for future siblings.

Wynne-Davis J Med Gen 1975

1% of 1200 patients with congenital scoliosis has a known relative with the problem

Winter RB Congenital deformities of the spine 1983
Patients with multiple levels of bilateral failures of segmentation, with multiple fused ribs and missing segments have a positive family history.

- Spondylothoracic dysplasia
- Spondylocostal dysplasia
- Spondylovertebral dysplasia
- Jarcho-Levin Syndrome

Lonstein JE  Principles and Techniques of Spine Surgery  1998
## Natural history of progression

<table>
<thead>
<tr>
<th>Site of curvature</th>
<th>Block vertebra</th>
<th>Wedged vertebra</th>
<th>Type of congenital anomaly</th>
<th>Hemivertebra</th>
<th>Unilateral unsegmented bar</th>
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<td>Upper thoracic</td>
<td>&lt; 1°–1°</td>
<td>* – 2°</td>
<td>Single</td>
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<td>2°–2.5°</td>
<td>5°–6°</td>
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<tr>
<td>Lower thoracic</td>
<td>&lt; 1°–1°</td>
<td>2°–2°</td>
<td>Double</td>
<td>2°–3°</td>
<td>5°–6.5°</td>
<td>6°–7°</td>
</tr>
<tr>
<td>Thoracolumbar</td>
<td>&lt; 1°–1°</td>
<td>1.5°–2°</td>
<td>Unilateral unsegmented bar</td>
<td>5°–*</td>
<td>6°–9°</td>
<td>&gt; 10°–*</td>
</tr>
<tr>
<td>Lumbar</td>
<td>&lt; 1°–*</td>
<td>&lt; 1°–*</td>
<td></td>
<td>*</td>
<td>&gt; 5°–*</td>
<td></td>
</tr>
<tr>
<td>Lumbosacral</td>
<td>*</td>
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<td></td>
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- **Block vertebra**: May require spinal fusion.
- **Wedged vertebra**: May require spinal fusion.
- **No treatment required**.
- **Unilateral unsegmented bar and contralateral hemivertebrae**: Require spinal fusion.

McMaster and Ohtsuka JBJS (A) 1982

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# Natural history of congenital scoliosis

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- No treatment required
- May require spinal fusion
- Require spinal fusion

Fig. 4. McMaster prognosis. (Data from McMaster and Ohtsuka (1982).)
Philosophy of surgical treatment

- Minimal concave growth potential.
- Child may be taller if fusion is done earlier.
- Better to be short and straight than shorter and crooked.
- Limited role for bracing

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Surgical options

- Posterior fusion
- Anterior and posterior fusion
- Convex hemiepiphysiodesis
- Hemivertebra excision
- Growth rods / Shilla technique
- Anterior stapling
- VEPTR (vertical expandable prosthetic titanium rib)

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Cobbs angle = 20°
No coronal decompensation
END