Natural history of AIS

Tomasz Kotwicki¹, MD, PhD,
Edyta Kinel², PT, PhD

¹Spine Disorders Unit Department of Pediatric Orthopedics
²Department of Rheumatology and Rehabilitation
University of Medical Sciences Poznan, Poland
What is AIS?

AIS = Adolescent Idiopathic Scoliosis

AIS = Adolescents with Idiopathic Scoliosis
what is natural history?

Cobb: 12°  24°  36°  95°

untreated person = natural history of IS

Age: 5 years  10 years  12 years  14 years
Natural history of idiopathic scoliosis
Natural history of idiopathic scoliosis

Cobb angle (degrees)

age (years)
Point P = start of puberty = Tanner P2

Premenarchial girls at early stage of pubertal growth spurt with Tanner 2 stage

Tanner scale of maturation:
- Breast: Stage 1 through 5 (S)
- Pubic hair: Stage 1 through 5 (P)

Risser 0
Y cartilage open
Natural history of idiopathic scoliosis

Girls only

Cobb angle
(degrees)

α

β

γ

P

IM

R

0 5 10 15 20 25

biological age (years)

Girls only
Biological age = bone age

- Wrist and hand radiography (Greulich&Pyle)
- Elbow cartilages closure (Sauvegrain&Nahum)
- Ypsilon (acetabular) cartilage closure (crankshaft)
- Complex bone age of Dimeglio
Natural history of idiopathic scoliosis
anthropometric measurements:

- weight
- height
- sitting height
- arms span
Progression of 60° in 24 months!

Example of catastrophic natural history during pubertal growth spurt
Decisive factor = predicted spine growth
Duval-Beaupere: natural history of progression during pubertal growth spurt
Nachemson et al.

Progression risk (%) related to Cobb and age at diagnosis

<table>
<thead>
<tr>
<th>Cobb at diagnosis</th>
<th>Age at diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>(°)</td>
<td>10 - 12</td>
</tr>
<tr>
<td>&lt; 19</td>
<td>25</td>
</tr>
<tr>
<td>20 - 29</td>
<td>60</td>
</tr>
<tr>
<td>30 - 59</td>
<td>90</td>
</tr>
<tr>
<td>&gt; 60</td>
<td>100</td>
</tr>
</tbody>
</table>
the same Cobb 25°
is not the same phenotype

10 ys, Tanner 1
pre-menarchial

14 ys, Tanner 5
1 yr post-menarchial
- Idiopathic scoliosis
- Cobb range 20° - 29°
- and Risser 0 or 1

68% is progressive vs. 32% stable
- Idiopathic scoliosis
- Cobb range 20° - 29°
- and Risser 2 or 3 or 4

23% is progressive
- Idiopathic scoliosis
- Cobb range 5° - 19°
- and Risser 0 or 1

22% is progressive
J.E. Lonstein, J.M Carlson


- Idiopathic scoliosis
- Cobb range 5° - 19°
- and Risser 2 or 3 or 4

1.6% is progressive
102 untreated
follow-up 50 years
Cobb < 30° are stable
PHV – peak height velocity

- 8 cm/year for girls
- 9.5 cm/year for boys
- age of PHV in girls (North America) ca. 11.5 years

Height measures at 6 months intervals
Modifying factors (worsening prognosis)

- Sex - female
- Thoracic hypokyphosis worse than normo-or hyperkyphosis
- Double curve pattern worse than single
- Positive family history?
- Trunk rotation / Vertebral rotation / vertebral wedging
Modifying factors (worsening prognosis)

- Quality of bone
  - osteopenia

- Quality of soft tissues
  - joint hyper-mobility,
  - tissue hyper-elasticity
  - muscular weakness
assessing joint hypermobility
Beighton scale $\geq 5/9$ points
Natural history of idiopathic scoliosis

• chaotic / linear evolution

curves Cobb < 25º = chaotic evolution

curves Cobb > 25º = linear progression
Risser sign

• 0,1,2 = negative – high progression risk
• 3,4,5 = positive – low progression risk

No ossification or partial ossification means high risk

Complete excursion of ossification and partial or complete fusion means low risk
Risser sign (European)

0,1,2 = negative Risser = high progression risk

3,4,5 = positive Risser = low progression risk
USA

Joseph Risser

75% excursion

100% excursion

EU

Paul Stagnara

100% excursion

posterior fusion
Knowledge on scoliosis = knowledge on natural history diagnosis + prognosis

1. Is it scoliosis? or normal spine?
2. Is it structural 3D scoliosis? or functional, secondary spine curvature?
3. Is it structural idiopathic scoliosis? or other type of structural 3D scoliosis - neuromuscular, congenital, syndromal?
4. Is it progressive structural idiopathic scoliosis? or is it stable scoliosis?
Knowledge on natural history of idiopathic scoliosis is the key to avoid undertreatment to avoid overtreatment.

Effective screening of the high risk population = girls 10-12 year old + diagnosis with prognosis

early effective conservative management → early mini-invasive surgery
It is not enough for the Patient to put the diagnosis of i.s.

Patient needs diagnosis with prognosis and eventual early treatment
Jean Dubousset:

„at first exam of a child with scoliosis, comprising a history, a careful clinical evaluation and a standard X-ray

• in 90% of cases the future curve progression can be confirmed or excluded

• in 10% regular checking is needed to establish prognosis”

How to establish prognosis?

- Current deformity
  +
- Remaining spine growth
  +
- Modifying factors
Thank you for attention