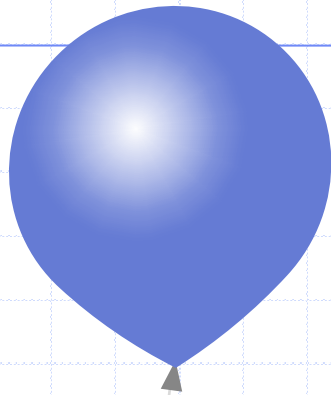


# *School Scoliosis Screening (SSS)*



# Agenda

1. *SSS*

*“to be or not to be” ! or “to do or not to do”?*

2. *Why &*

3. *How: observation, Adam test, Bunnell scoliometer, Moire topography*

*AND*

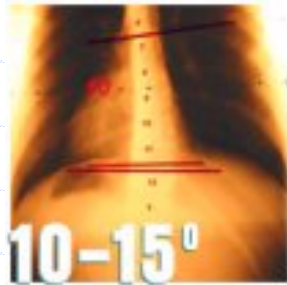
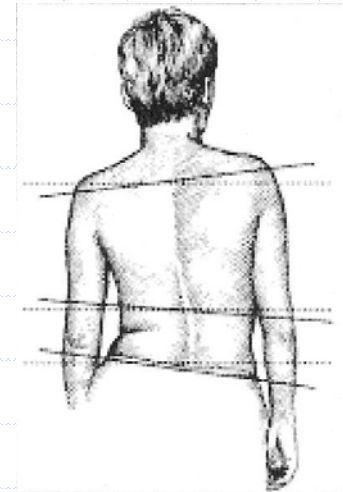
*Introducing an optical system*

4. *The problems of over-referral and cost-effectiveness*

# Degrees of Curvature

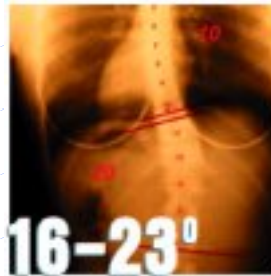
*Scoliosis is a lateral deviation of the normal vertical line of the spine which, when measured by an X-ray, is greater than 10 degrees.*

**3D: frontal, sagittal and rotational**



**MILD**

**10-15°**



**MODERATE**

**16-23°**



**SEVERE**

**24-44°**

## Screening

- *Early diagnosis* of idiopathic scoliosis (IS) has been one of the main concerns and commitments during last 50 years.
- Detection of idiopathic scoliosis at an early stage will *reduce the rate* of invasive and surgical methods.
- School screening is still a worldwide *controversial issue*.
- The rate of referrals from school screening reported with a large discrepancy from *three to eighteen* percent in different studies.

- *Untreated adolescent idiopathic scoliosis (AIS)*
  - ➔ *progress over time.*
  - Only in Greece, Japan, USA and Hong Kong*
  - ➔ *Early stage detection of scoliosis ➔ SSS programs.*
  - ➔ *Early detection ➔ slow down the curve progression*
  - ➔ *Specific exercises, brace at least education/ counseling*

*Screening is not meant to be a diagnostic exam  
or substitute for physician evaluations*

## *Incidence*

- *Present in 2 - 4% of kids aged 10 – 16 years*
- *Ratio of girls to boys with small curves ( $<10^\circ$ ) is equal, but for curves  $> 30^\circ$  the ratio is 10:1*
- *Scoliosis tends to progress more often in girls*
- *Affects approx 1 million children in the US*
  - 3-5 out of every 1,000 cases are severe enough to require treatment*
  - 25% will require medical attention to monitor for progression*

- A. *Lateral curvature of the spine  $>10^\circ$  accompanied by vertebral rotation*
- B. *Idiopathic scoliosis - Multigene dominant condition with variable phenotypic expression & no clear cause*
- C. *Multiple causes exist for secondary scoliosis*

## *Growth potential*

- *Of adolescents diagnosed with scoliosis, only 10% have curve progression requiring medical intervention*
- *Three main determinants of curve progression are:*
  - *(1) Patient gender*
  - *(2) Future growth potential*
  - *(3) Curve magnitude at time of diagnosis*

# Assessing growth potential

## Risser grading:

- Measures progress of bony fusion of iliac Apophysis
- zero (no ossification) to 5 (complete bony fusion of the epiphysis)

Critical  
threshold  
30°

↓ grade ↑ potential for Progression  
at time of bony maturity

< 30° - unlikely to progress,

> 50° - 1° per year → surgery

>100° - Life-threatening effects e.g. pulmonary

# Scoliosis Screening

- *widespread SSS → unnecessary referrals with minimal curvatures*
- *U.S. Preventive Services Task Force notes “insufficient evidence” to recommend for or against routine screening of asymptomatic adolescents for idiopathic scoliosis*
- *British OA didn't recommend screening*
- *USPST insufficient evidence, 2004 against*

*American Academy of Orthopedic Surgeons*

*- Screen girls at ages 11 and 13*

*- Screen boys once at age 13 or 14*

*American Academy of Pediatrics*

*- Screen at 10, 12, 14 and 16 years*

## *Measure spinal curvature using Cobb method:*

- *Choose the most tilted vertebrae above & below apex of the curve.*
- *Angle of intersecting lines drawn perpendicular to the top of the superior vertebrae and bottom of the inferior vertebrae is the Cobb angle.*



## *Cobb angle – golden standard?*

- *The Cobb angle has some limitations it describes only **one plane of the 3D deformity**.*
- *The Cobb angle alone cannot explain the whole of the **surface deformity**.*
- *Indices measured on **different planes do not correlate** to each other.*
- *Remarkable rib cage deformity **without** simultaneous spinal deformity in younger school screening*
- *Not all patients with radiographic scoliosis have **rotation** of the trunk*
- *The Cobb angle is **not linearly** proportional to the severity of scoliosis in a linear fashion*

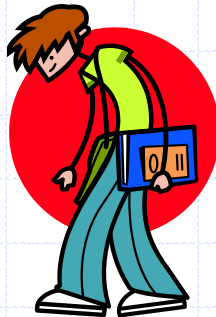
# *AIS*

## *Inspect*

- *Shoulder asymmetry*
- *Prominent scapula*
- *Hip level*
- *Body arm space*
- *Head over pelvic*
- *Adam's bending test*
- *Scoliometer*
- ✓ *Shoulders / different heights / more prominent*
- ✓ *Head is not centered on the pelvis*
- ✓ *Appearance of a raised, prominent hip*
- ✓ *Rib cages / different heights*
- ✓ *Uneven waist*
- ✓ *Changes in look or texture of skin*
- ✓ *Leaning of entire body to one side*

## *Student position*

- ▶ *Be sure student holds head/chin up*
- ▶ *Looking forward- not down*
- ▶ *Lose & relaxed, not tense or stiff*
- ▶ *Stand with feet slightly apart*



## *6 Step Screening Process*

1. *Front standing position*
2. *Back standing position*
3. *Back bending away from you*
4. *Side bending position*
5. *Front bending toward you*
6. *Side bends*

# Parent Permission Form

## ATTENTION PARENTS!

### Scoliosis Screening Permission Form

The American Red Cross of Northeast Tennessee, Sullivan County Schools and Sullivan County Health Department are cooperating in an annual program to screen 7<sup>th</sup> grade students for scoliosis. Trained Red Cross and school health nurses will be conducting the screening.

**SCHOOL NAME**  
**DATE**

*Scoliosis Screening will be provided **ONLY** to those students returning this signed form with "yes" checked.*

**Scoliosis is an abnormal curvature of the spine affecting approximately 1 out of 10 adolescents. Screening during this time of accelerated growth can help identify potential problems early before long lasting problems develop.**

Permission given:

YES \_\_\_\_\_

NO \_\_\_\_\_

(Reason):

- \* Screening is a free service offered to all students
- \* Screening is meant to be an initial observation of the spine for signs suggestive of scoliosis- NOT a diagnosis
- \* Only a physician can confirm a diagnosis of scoliosis and recommend a course of observation or treatment
- \* Results will be mailed to parents 2-4 weeks after screening
- \* Decisions for follow up will be the decision and digression of parents

**Parents: Please complete the information below, sign, and return this form to the school by DATE**

**PLEASE PRINT CLEARLY**

Student's Name \_\_\_\_\_ Contact Phone: \_\_\_\_\_

Home Address (Mailing) \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Sex: M or F

Parent or guardian signature \_\_\_\_\_

**Screening Results:**

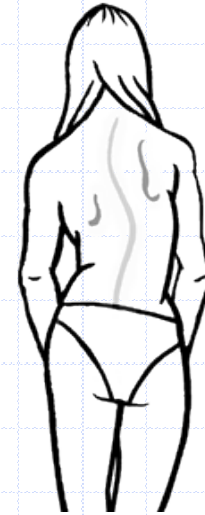
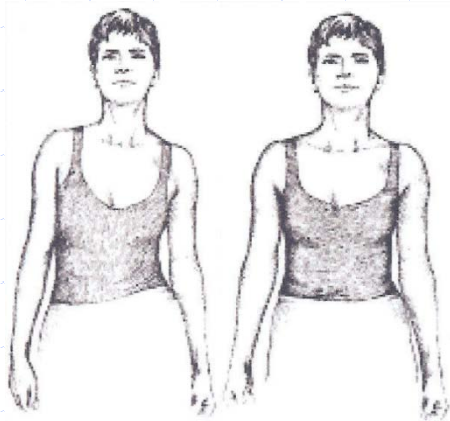
Negative

Positive

Screener Initials \_\_\_\_\_

# 1. *Front standing position* & 2. *Back standing position*

- *Shoulders should be level and at the same height*
- *Distance between arm and torso equal on both sides*
- *Pelvis level on horizontal plane*
- *Head straight and centered*



## Step 3 *Back Bending Away*



*Look For:*

- *Rib prominence*
- *Lumbar Prominence*
- *Differences in height of hip crests*

➤ *Feet slightly apart*

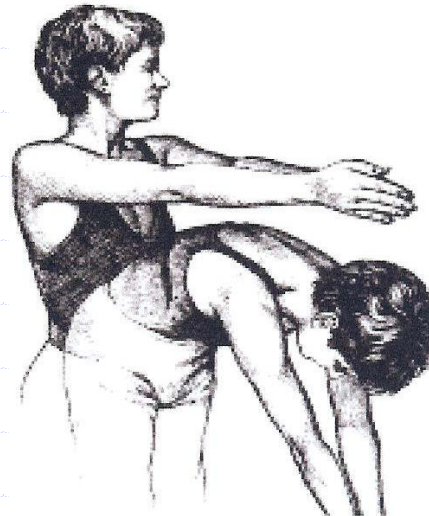
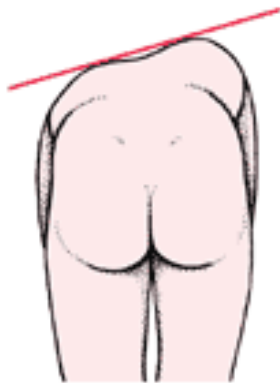
➤ *Palms together*

➤ *Arms outstretched with straight elbows*

➤ *Head out*

➤ *Bend forward at waist*

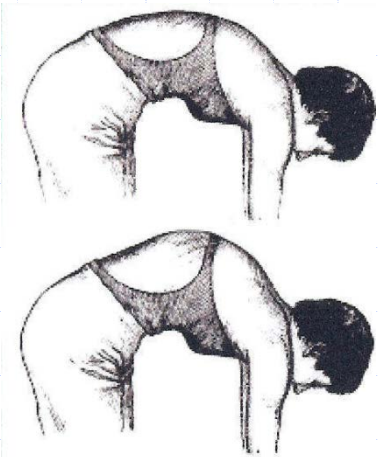
➤ *Place hands between legs at knee level*



*Adam's Bending  
Technique*

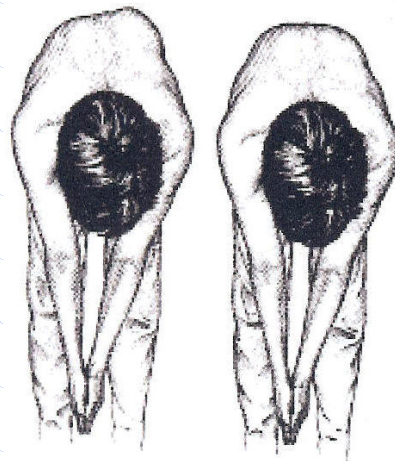
### *Step 4 Side View*

*Look for exaggerated  
Kyphosis*



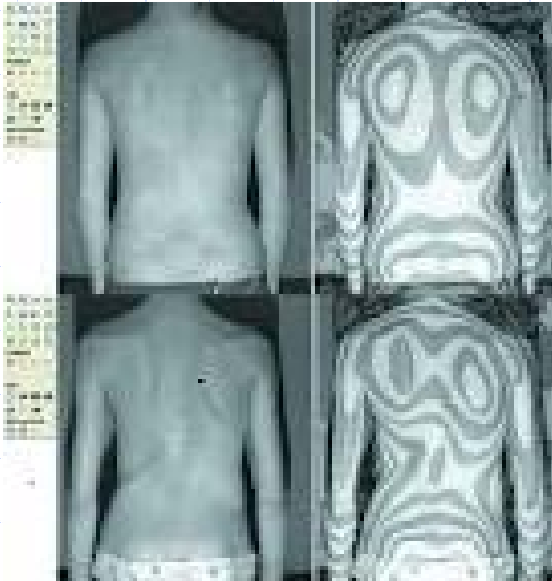
### *Step 5 Bending Front View*

- *Shoulders level?*
- *Is one side of torso more rounded than the other?*
- *Look for lumbar prominence*



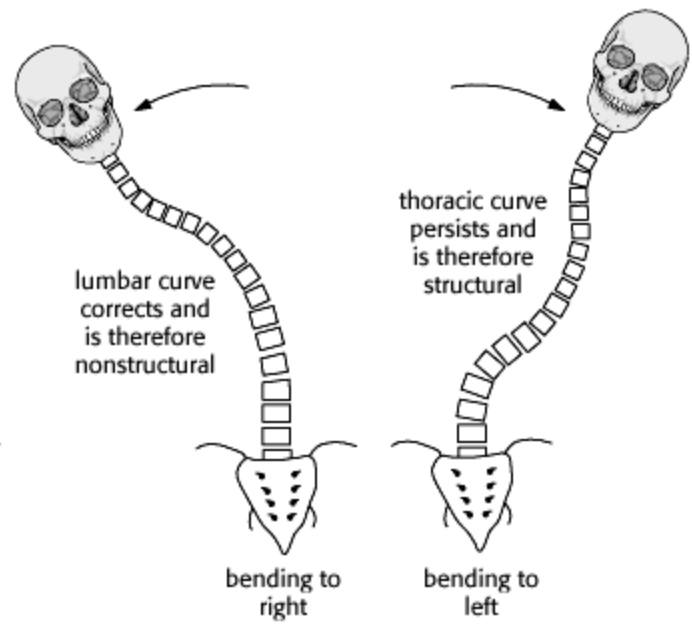
# *AIS*

➤ *Adam's forward bending test*



*Moire topography*

# Step 6 Side Bends



*Ask the student to bend at  
The waist to each side*

*Look for S curvatures*

# Scoliometer

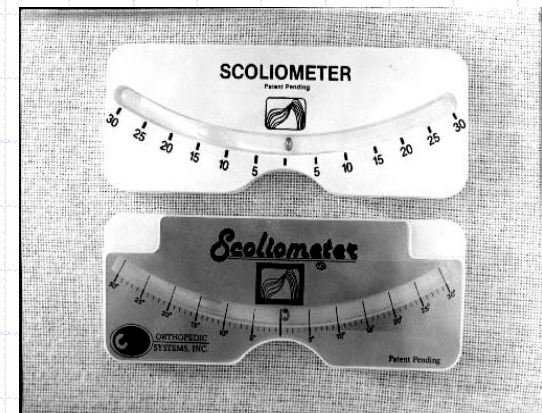
## ➤ Scoliometer

- *Bunnell 1984*
- *Over maximal deformity*



*The scoliometer is used at three areas of interest:*

- *upper thoracic (T3-T4)*
- *main thoracic (T5-T12)*
- *thoraco-lumbar area (T12-L1 or L2-L3).*



- Major error sources : complicated positioning & ambiguous anatomical landmarks → observer variations
- Automation ⇒ ↓ observer variability, ↓ human induced errors, ↑ objectivity, ↓ required experience
- patients with double curves have significantly less trunk deformity
- Indices
  - should be normalized ⇒ comparable
  - should not depend on trunk size/width of the waist/arm length

## Surface metrics

- ▶ *Surface deformity* does not accurately predict the magnitude of scoliosis
- ▶ *Surface metrics* have very little correlation to *Cobb* angle measurements.
- ▶ The angle measured by a *scoliometer* does not correspond to the *Cobb angle* measured on a radiograph
- ▶ *Adams test* actually demonstrates the rotational component of scoliosis, since the rib prominence is the result of the ribcage rotating along with the spine

## *False positive / negetive*

- *The sensitivity and specificity varies depending upon the skills of the examiner*
- *High  $\uparrow$  Sensitivity  $\downarrow$  false negatives,  $\downarrow$  patients as normal is small.*
- *High  $\uparrow$  Specificity  $\downarrow$  false positives,  $\downarrow$  normal as patients*

*for every curve  $>10^\circ$  detected, 1-5 false-positives;  
for every curve  $> 20^\circ$  detected, 3-24 false-positives*

## *over-referrals & cost effectiveness*

*↑ The number of conservative treatment*

*↓ The number of patients who need operation*

*The cost of a bracing programme < surgical treatment*

*↓ Number of scoliosis operations would save more money than screening would cost.*

*Therefore, the cost of a late treatment > the cost of an early treatment and ↑ costs at an early stage ↓ later costs.*

*Literature has also suggested that school screening could cost as little as \$0.6 to € 2.04 per adolescent*

## *Simple optical system*

- *Optical systems have been developed as **non-invasive** imaging techniques.*
- *To use a "body specific" coordinate system, in which case stable anatomical landmarks are necessary*
- *Q-angle in Quantec system*
- *Moire topography has a high false-positive rate. And the reference rate to the second screening have been decreased year by year.*

- *A low-cost automated system -a digital photograph*
- *Evaluation of the shape of the back in spontaneous position and after the active auto-correction*
- *Patients with scoliosis are able to actively change the shape of their trunk.*

FAI-C7 - Frontal Asymmetry Index C7

$$\text{FAI-C7} = \frac{i}{c+d} \times 100$$

FAI-A – Frontal Asymmetry Index Axillar

$$\text{FAI-A} = \frac{|c-d|}{c+d} \times 100$$

FAI-T - Frontal Asymmetry Index Trunk

$$\text{FAI-T} = \frac{|a-b|}{a+b} \times 100$$

HDI-S – Height Difference Index Shoulder

$$\text{HDI-S} = \frac{h}{e} \times 100$$

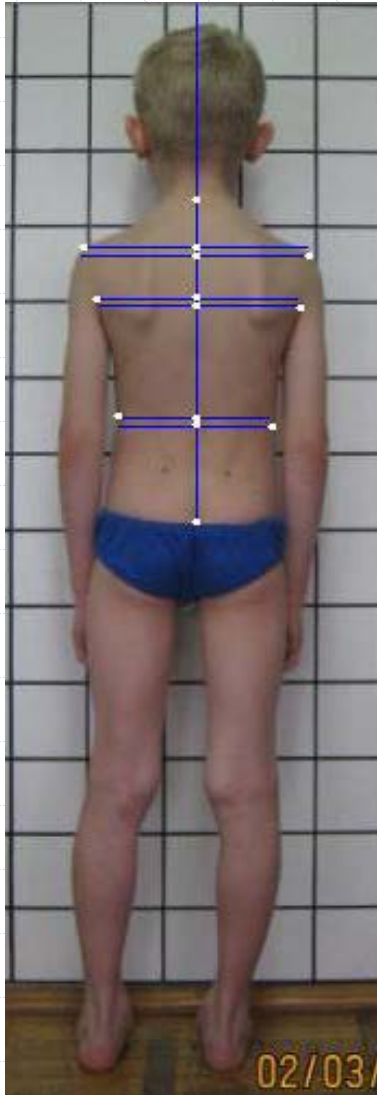
HDI-A - Height Difference Index Axillar

$$\text{HDI-A} = \frac{g}{e} \times 100$$

HDI-T – Height Difference Index Trunk

$$\text{HDI-T} = \frac{f}{e} \times 100$$

- $POTSI = FAI-C7 + FAI-A + FAI-T + HDI-S + HDI-A + HDI-T$
- *FAI-C7 - Frontal Asymmetry Index C7*
- *FAI-A – Frontal Asymmetry Index Axillar*
- *FAI-T - Frontal Asymmetry Index Trunk*
- *HDI-S – Height Difference Index Shoulder*
- *HDI-A - Height Difference Index Axillar*
- *HDI-T – Height Difference Index Trunk*

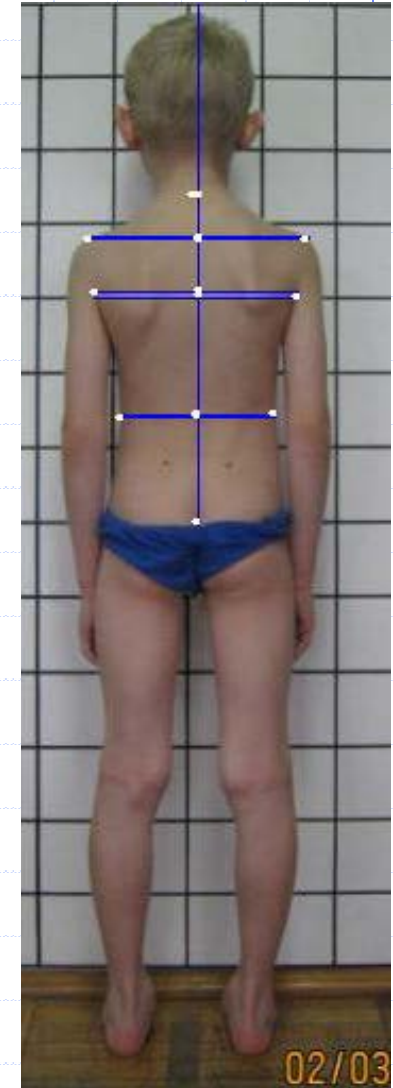


before MT

Digital photos of the trunk in standing habitual posture in a study group were performed twice:

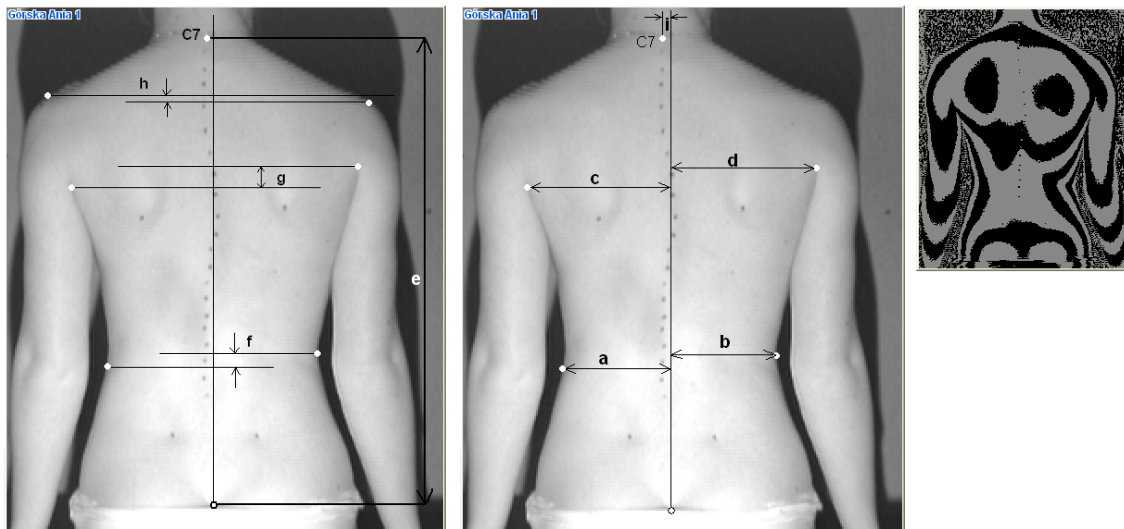
← **before** and **after** →

manual therapy comprising single manipulation of the sacroiliac joints according to Ackermann.



after MT

# Based on the photos The Index was calculated



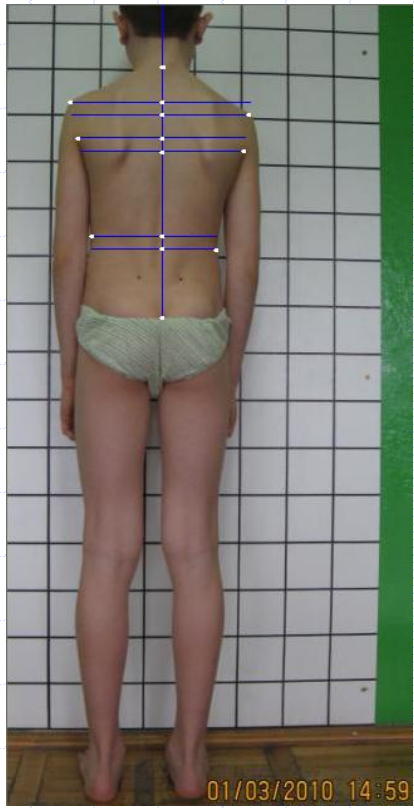
$$\text{Index} = (\text{FAI-C7} + \text{FAI-A} + \text{FAI-T}) + (\text{HDI-S} + \text{HDI-A} + \text{HDI-T})$$

Kotwicki T, Kinel E, Chowańska J, Bodnar-Nanuś A: POTSI, Hump Sum and Sum of rotation – new surface topography parameters for evaluation of scoliotic deformity of the trunk. Polish Journal of Physiotherapy 2008; 8: 231-240.

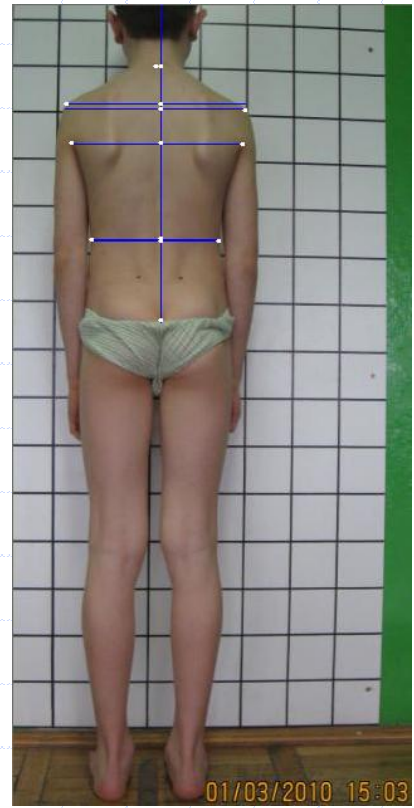
# Results

## Study group

Index before MT	Index after MT
$26.1 \pm 12.0$	$16.8 \pm 9.5$



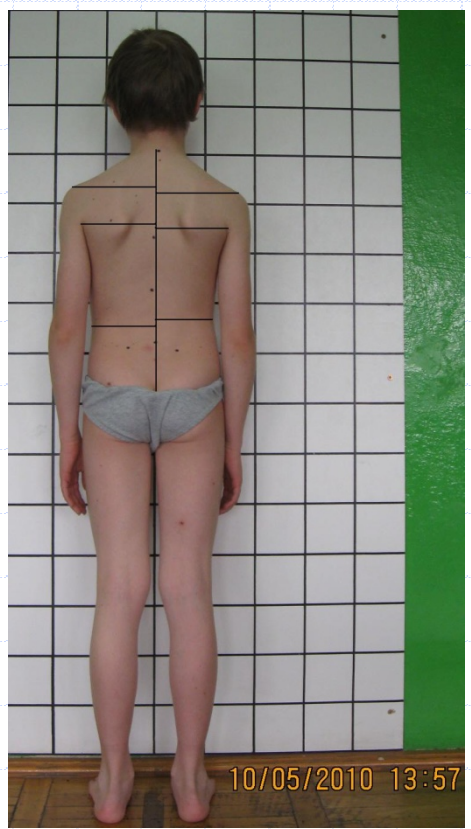
**p<0.0001**  
difference  
extremely  
significant



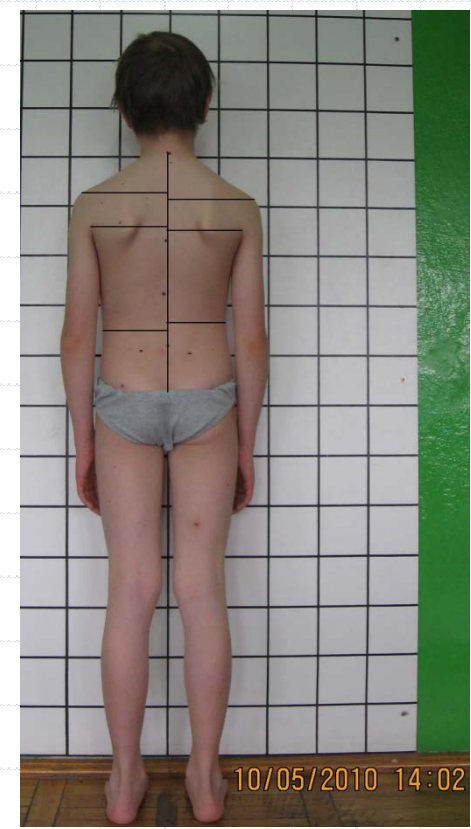
# Results

## Control group

POTSI measurement I	POTSI measurement II
$21.7 \pm 10.3$	$21.3 \pm 11.1$



**p = 0.56**  
no  
significant  
difference

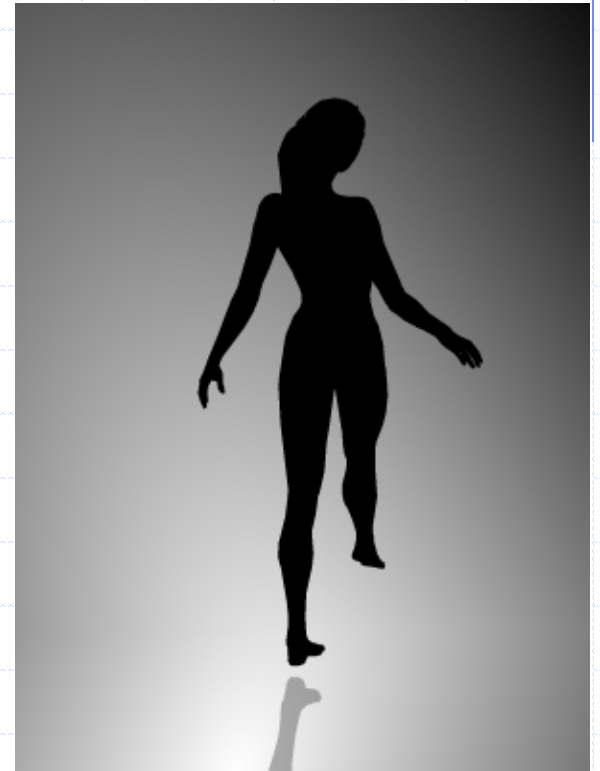


- To reduce the rate of over referrals due to false positive results, a **second stage screening** of the children with positive findings will be performed.
- The Posterior Trunk Symmetry Index  $\rightarrow$  avoid the unnecessary follow ups x-rays
- Ideal symmetry index is zero, meaning full symmetry of the back surface. This index is very sensitive in revealing any frontal plane asymmetry.
- Frequently has a negative impact on adolescents, which can give rise to quality of life (QOL)
- No treatments succeed in full correction to a normal spine



**Thx 4 ur time  
( & attention if any! )**





***Red herring***  
**Rhetorical**

