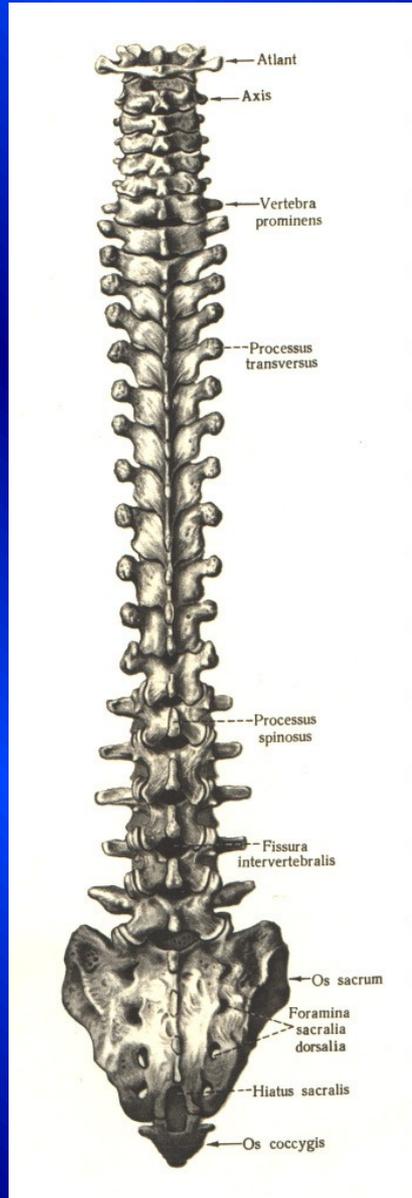


# Spinal deformities

# Physiological curves of the spine

Frontal level



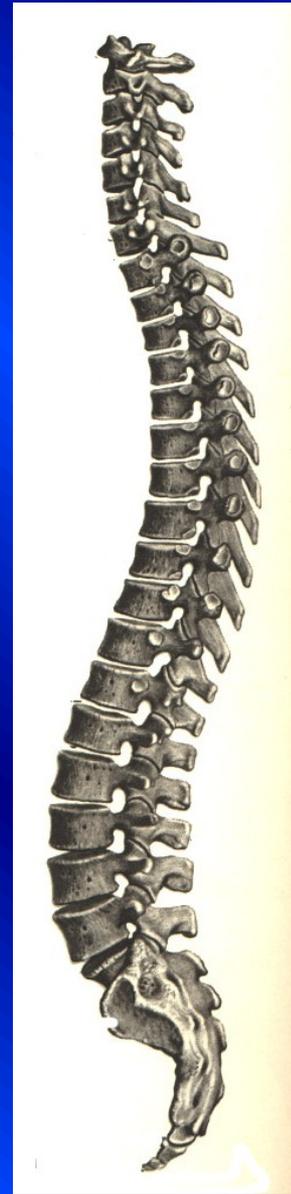
Sagittal level

Cervical lordosis

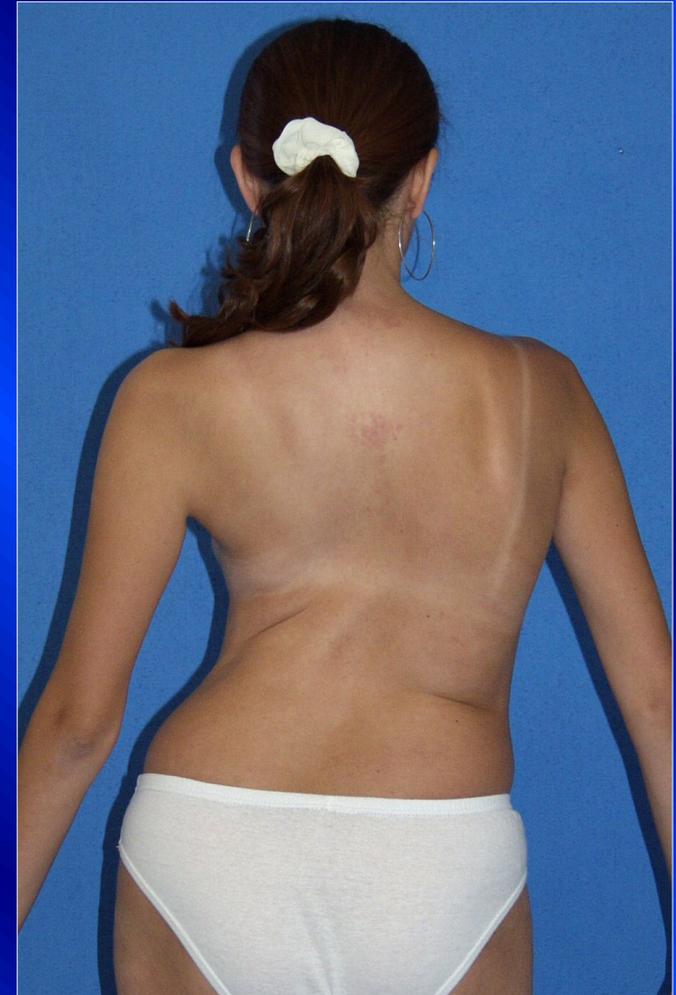
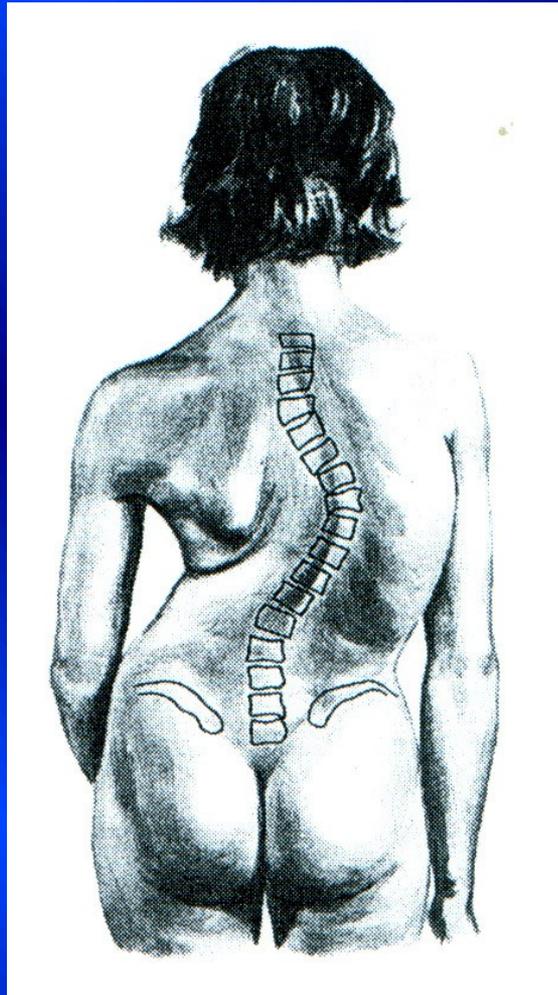
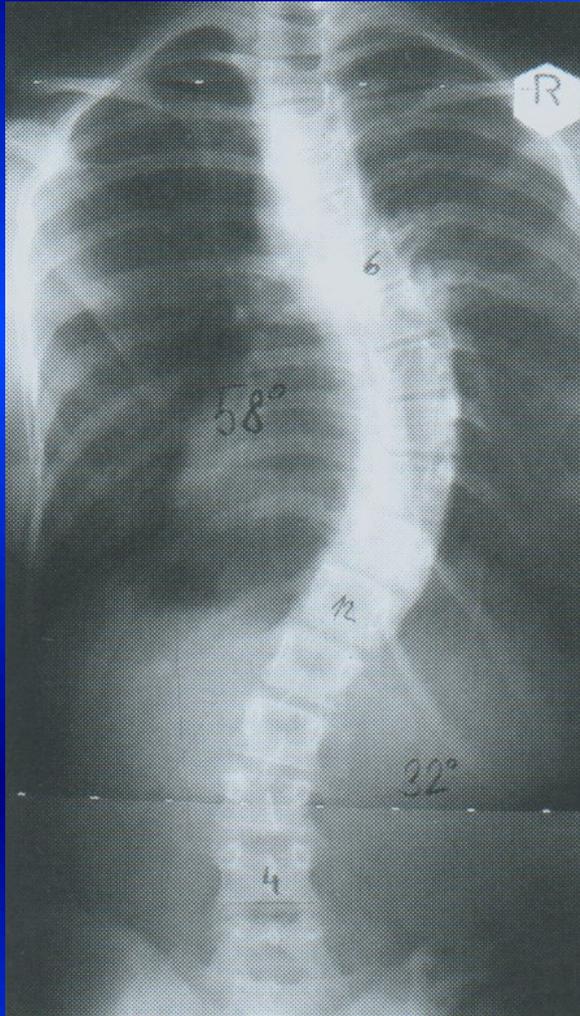
Thoracis kyphosis

Lumbar lordosis

Sacral kyphosis

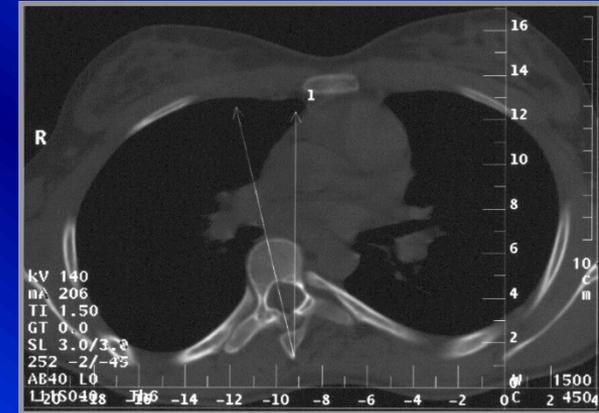


Scoliosis is a deformity in frontal level  
in sagittal level and in transversal level

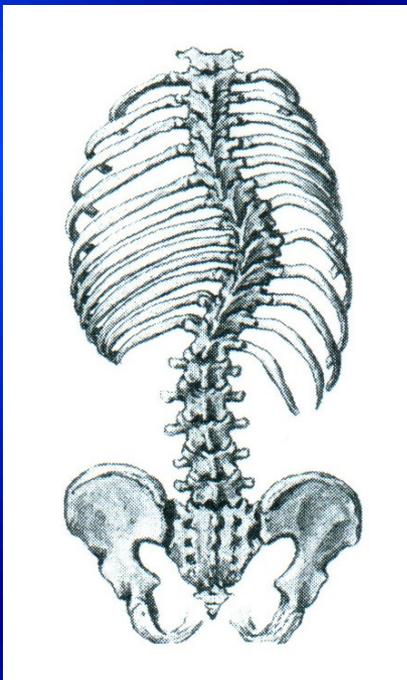


# Scoliosis is 3D deformity

- frontal level – scoliosis
- sagittal level – hypo, hyperkyphosis
- transversal level – rotation, torsion
  - rib prominence
  - proc. spinosus tilted to concave side
  - narrowing of spinal canal



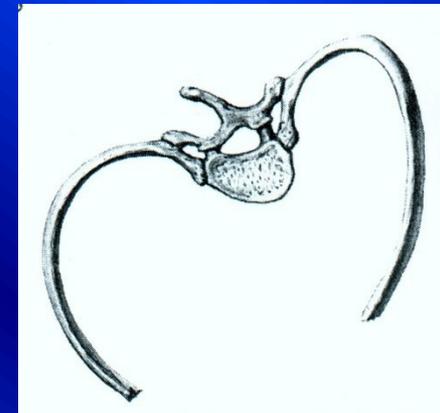
concave



convex

concave

convex



# Curve

## Structural curve

- no flexibility
- based on structural changes

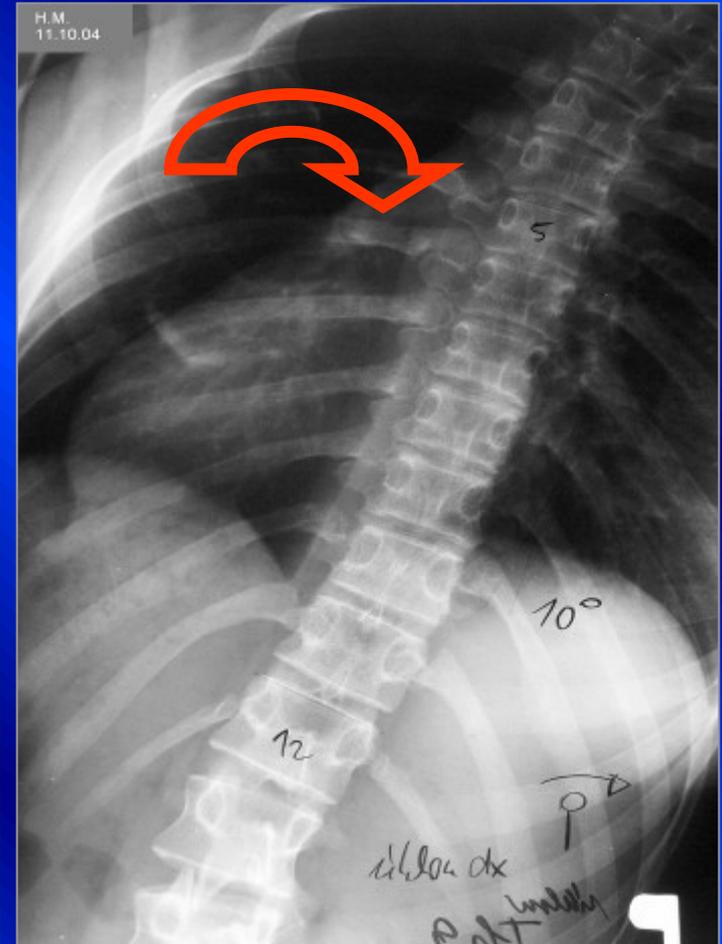
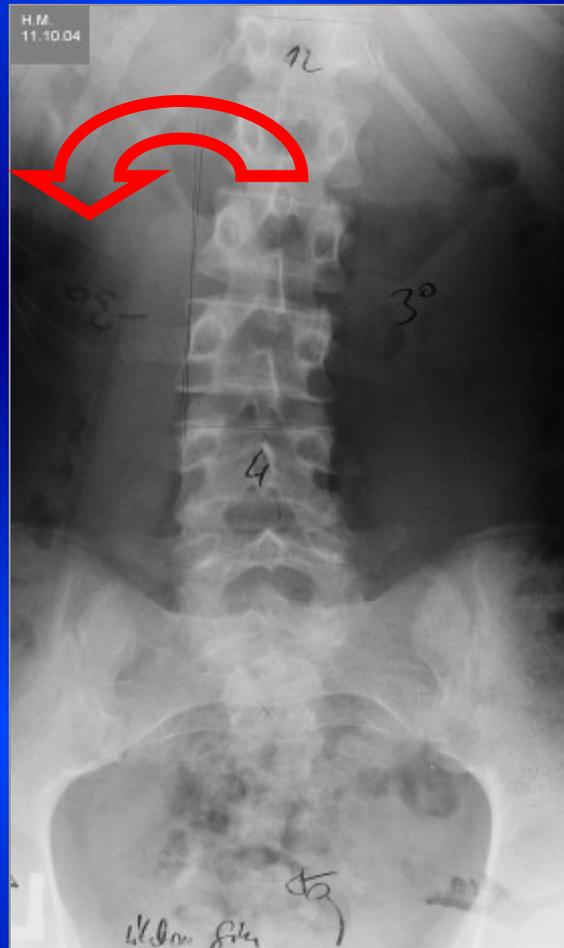
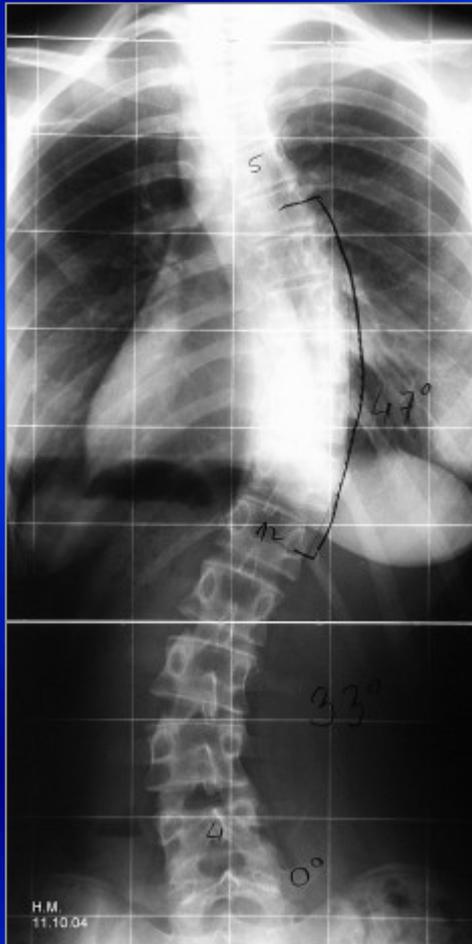
## Nonstructural curve

- is flexible
- nonbased on structural changes



Structural curve

# Structural and nonsctructural curve



# Curves

## Main curve

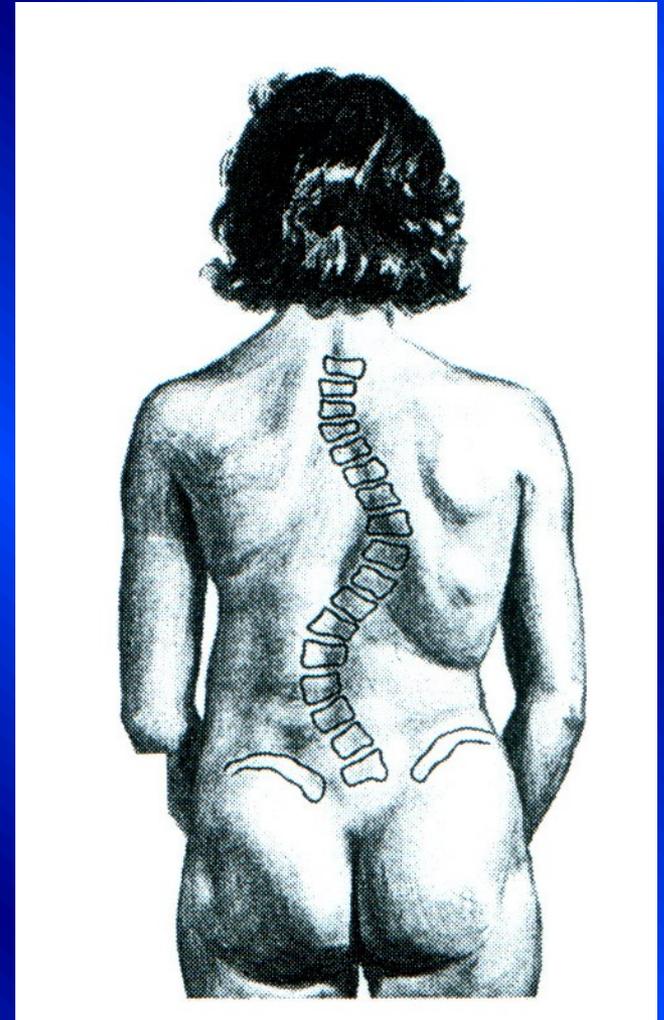
- occurs earlier
- structural
- more serious

## Compensated curve

Above and below main curve

Compensates stability of the trunk

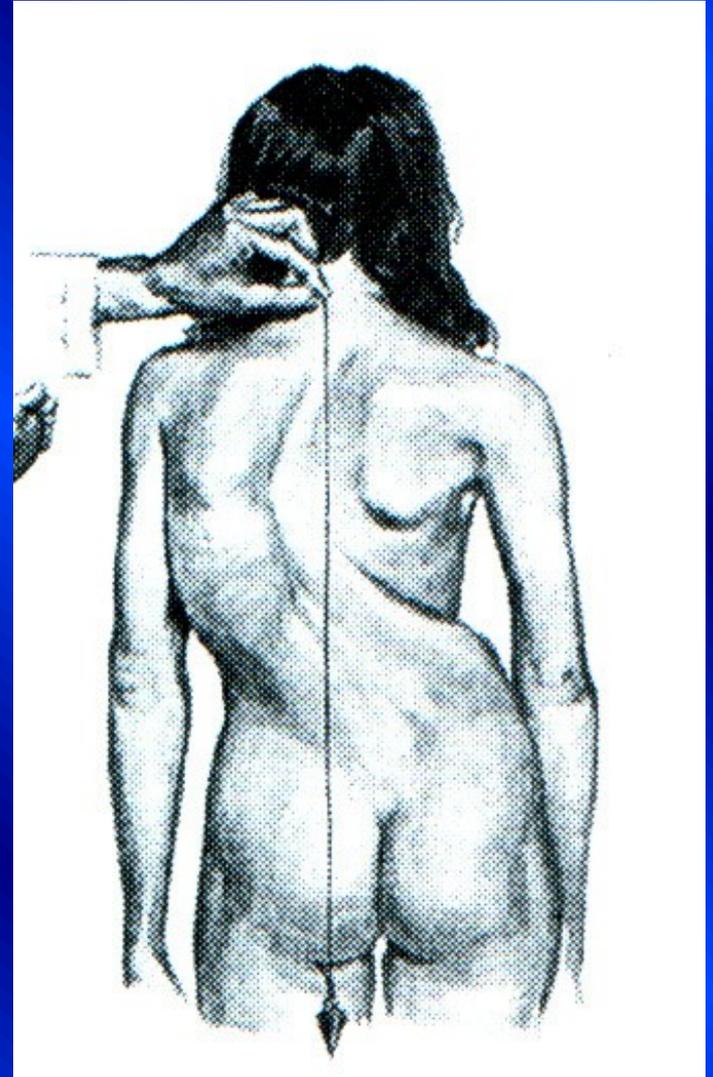
Later on changes into structural one



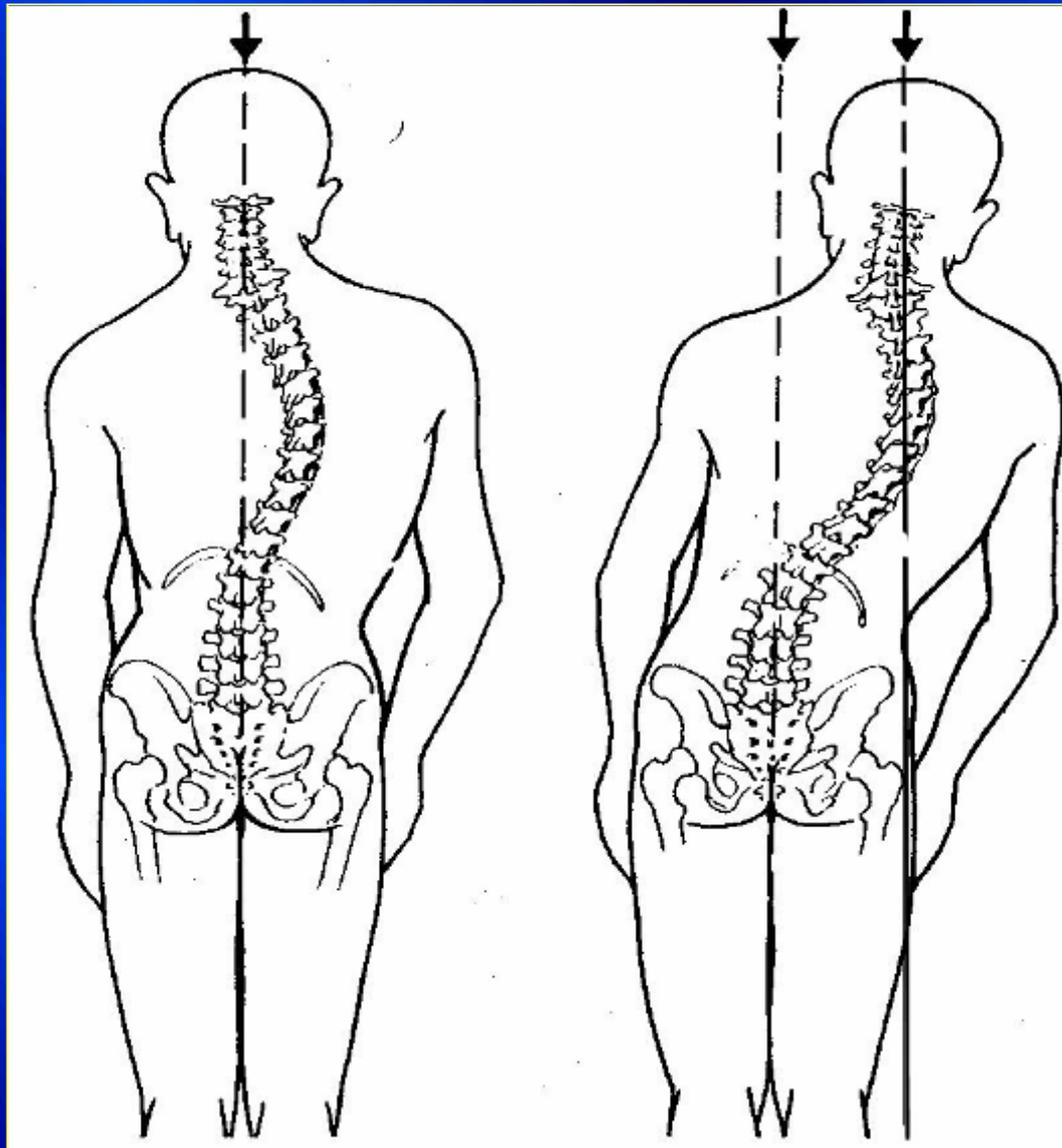
# Scoliosis

Compensated

Decompensated

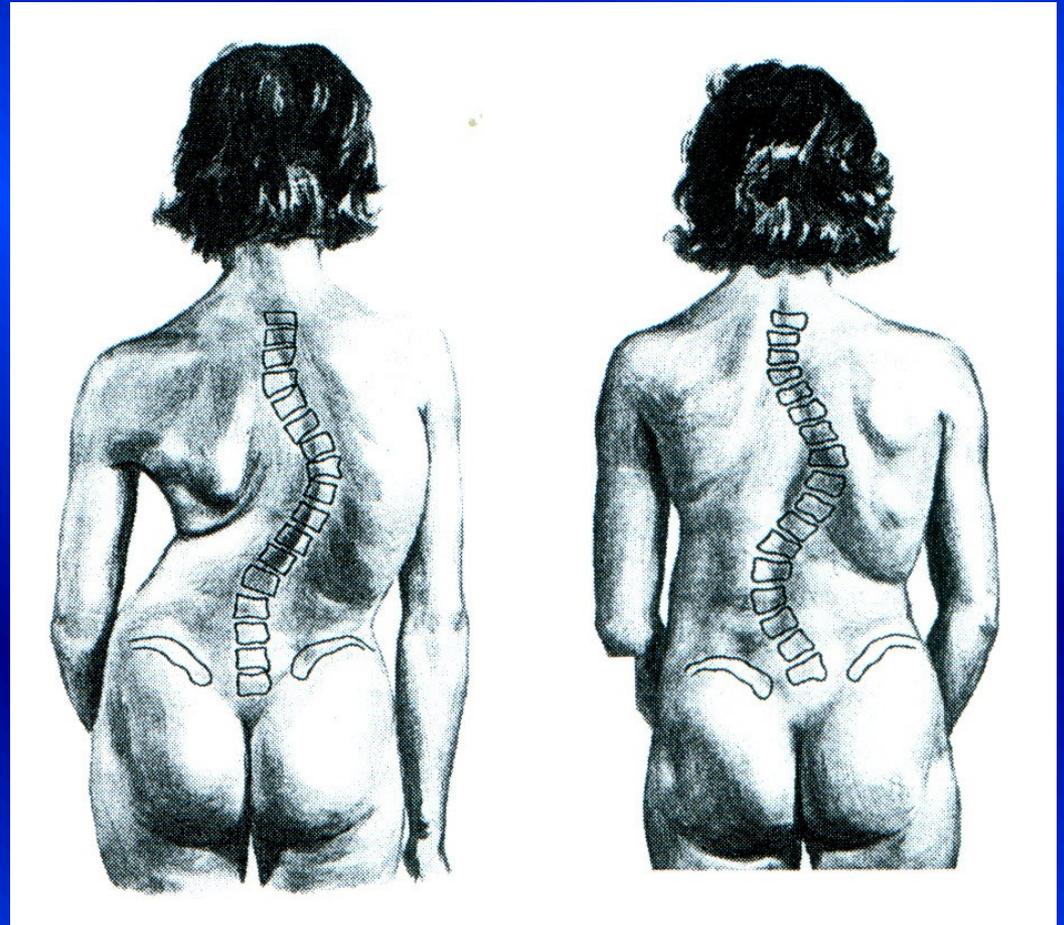


# Trunk compensated/ decompensated



# Curves

Cervical  
Cervicothoracic  
Thoracic  
Thoracolumbar  
Lumbar  
Lumbosacral



Thoracic

Thoracolumbar

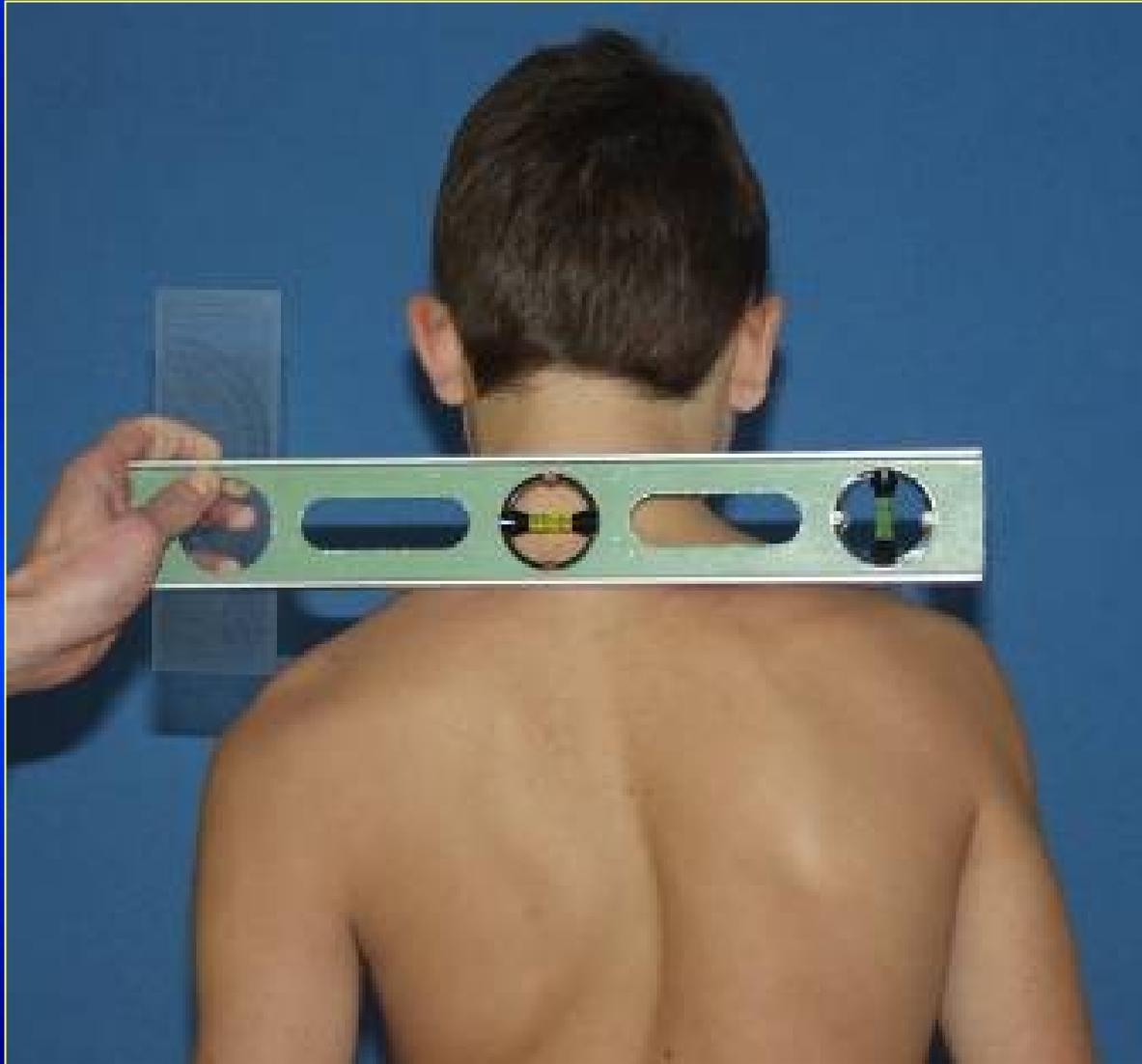
# Clinical examination

- Compensation of the trunk
- Level of shoulders
- Asymetry of the waist
- Position of the pelvis
- Flexibility of curves
- Gibus in flexion
- Others: laxity, sexual development, length of extremities
- Functional examination of lungs- spirometry

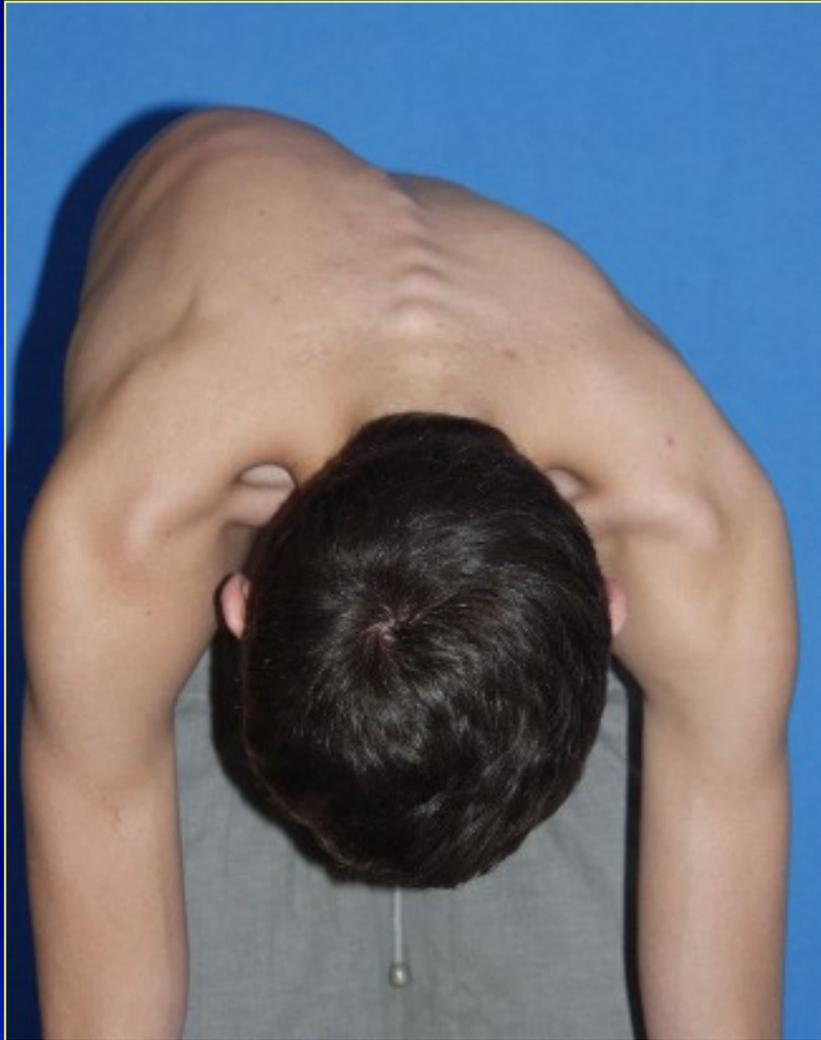
# Compensation of the trunk



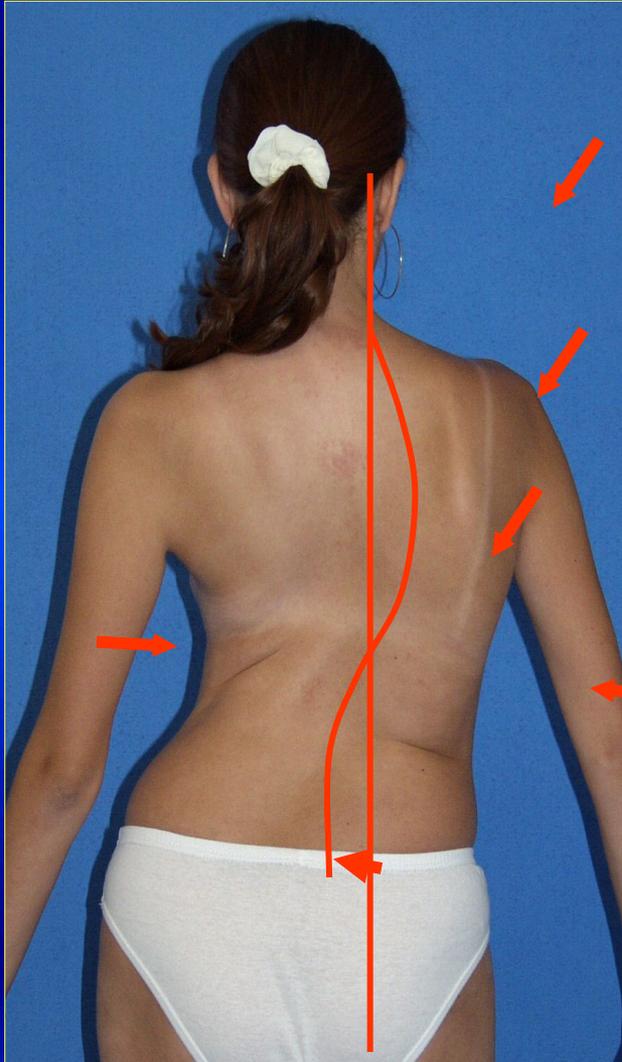
# Level of shoulders



# Gibus (hump) in flexion



# Frontal balance



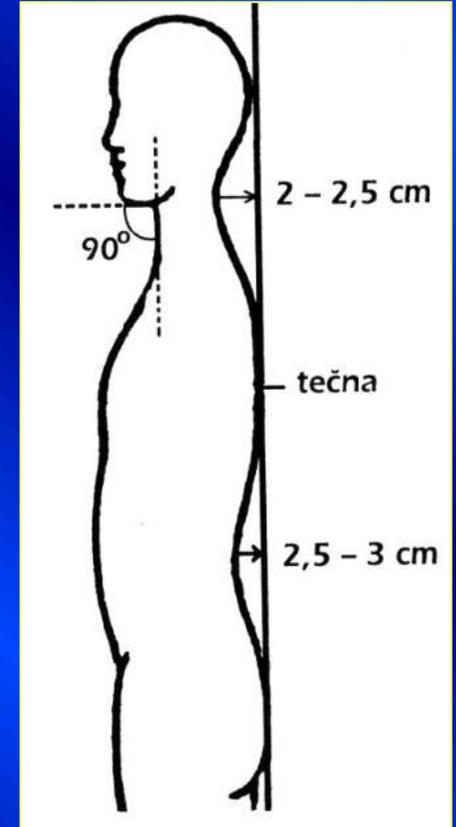
**Shoulders**

**Hump**

**Asymetry of the pelvis**

**Decompensation of the trunk**

# Sagital balance



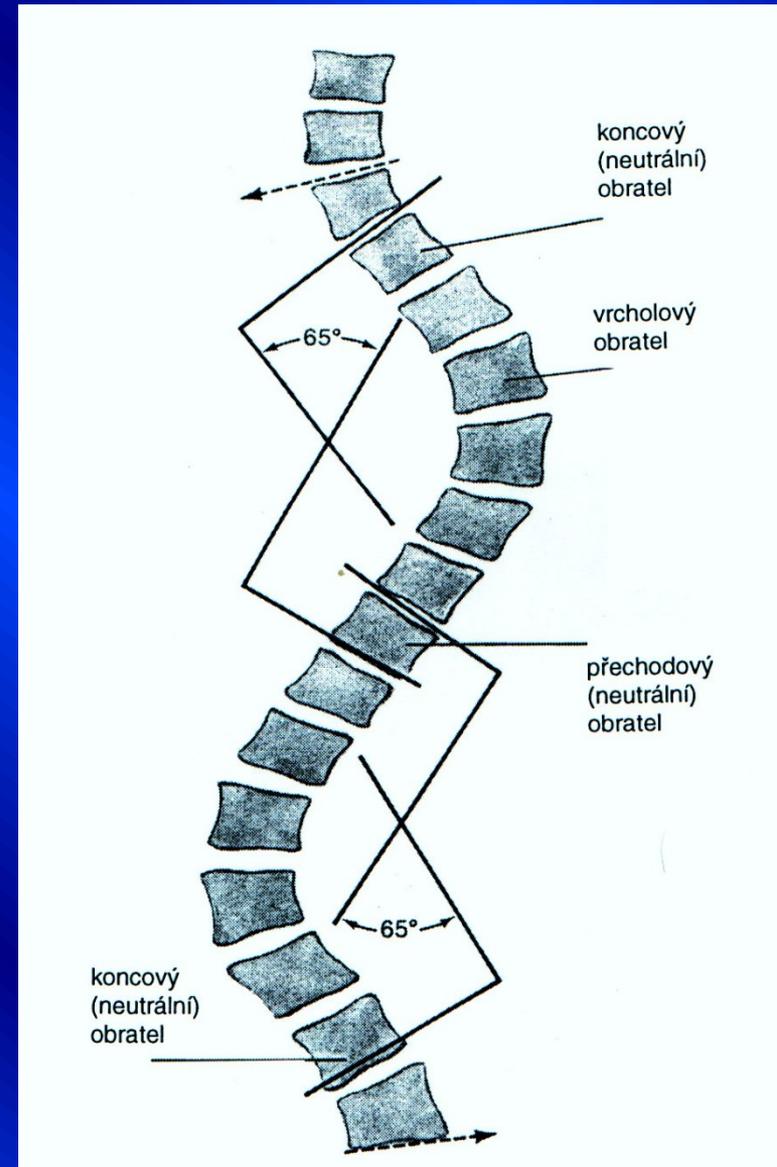
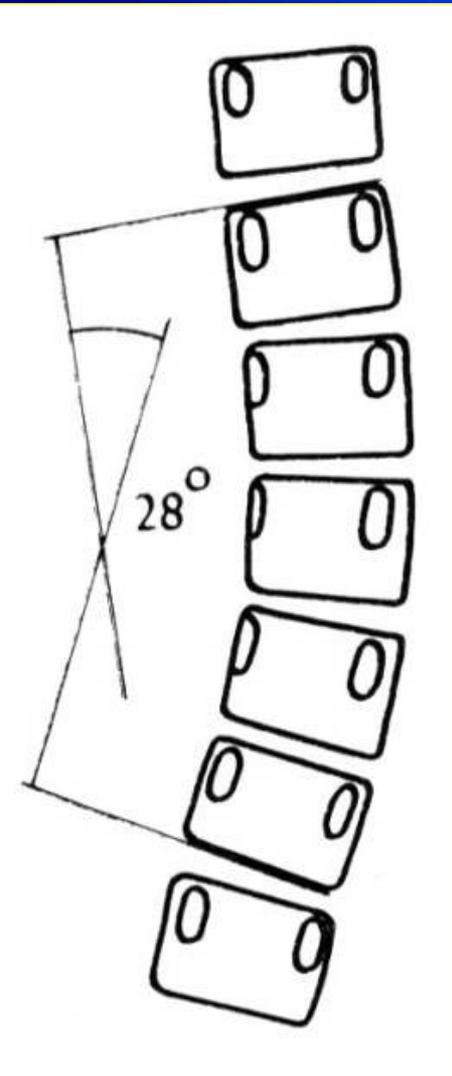
# Neurofibromatosis „café au lait“



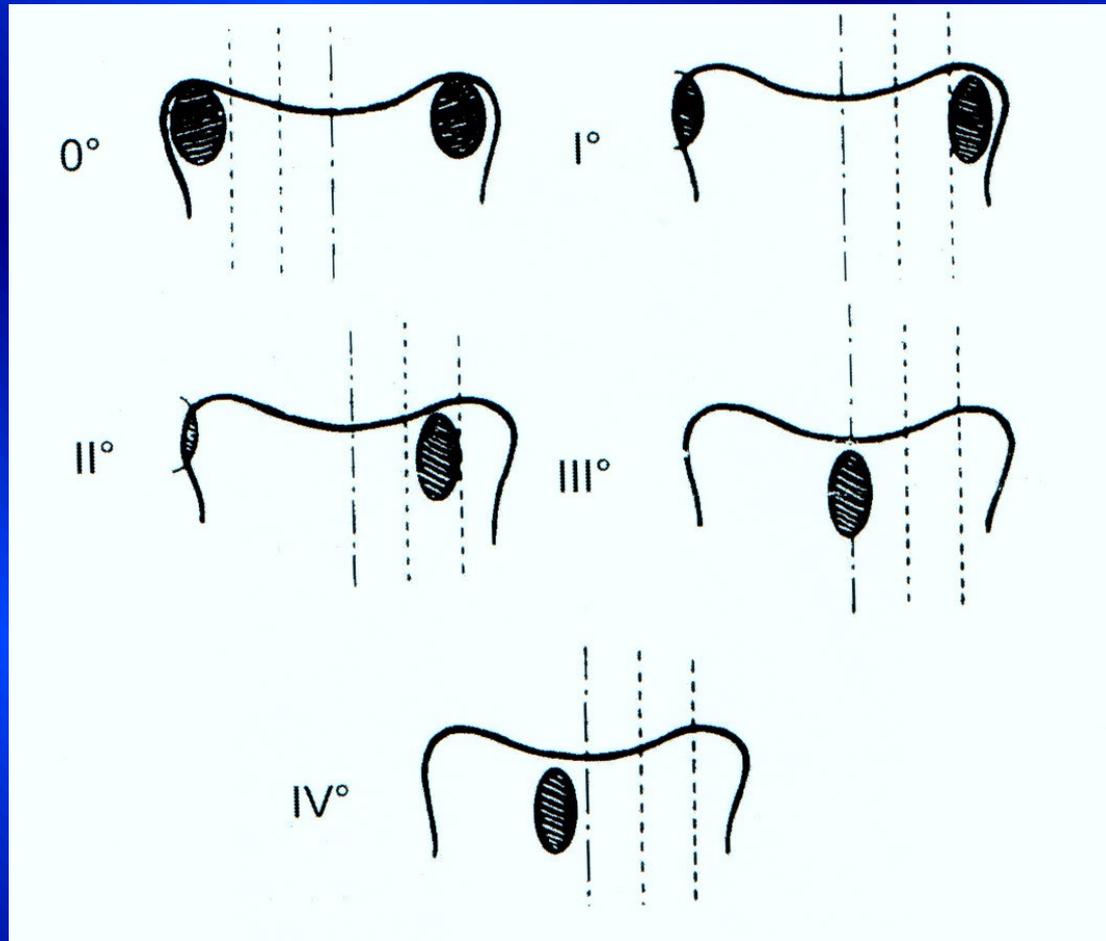
# X- ray examination

- Long films 30x90 cm
- AP, lateral, in bending , in distraction
- Check up in 6 months
- Cobb angle
- Skeletal development

# Cobb angle



# Rotation of vertebrae- pedicles



# Risser sign

0 no apophysis

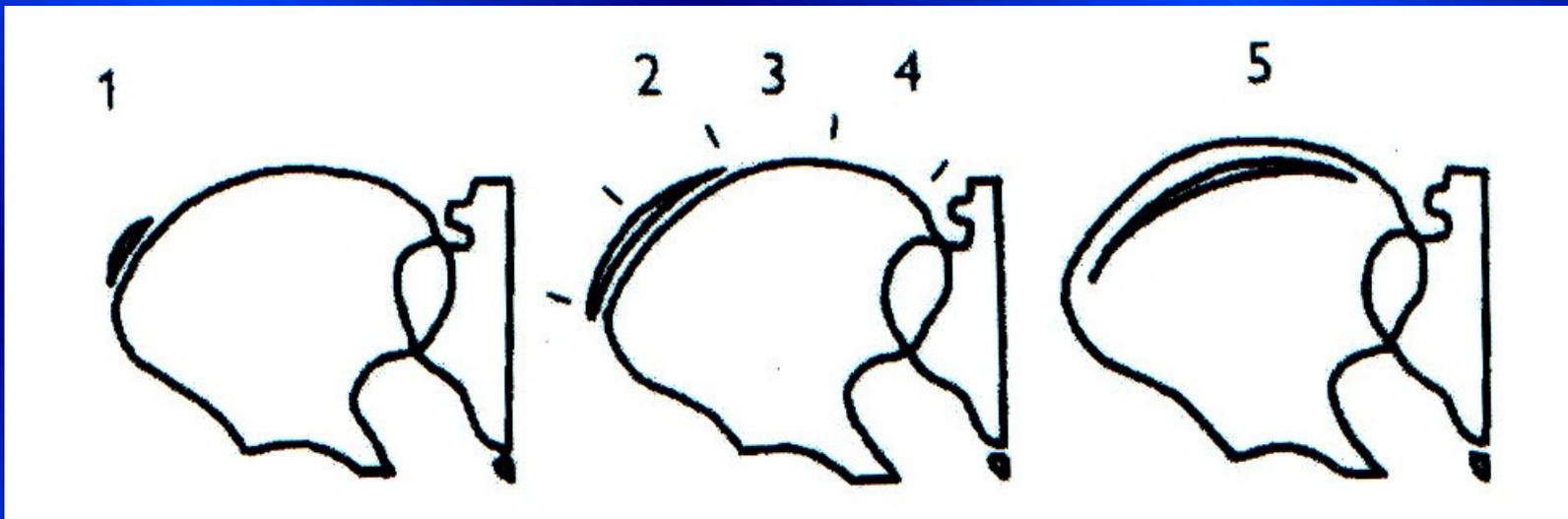
1 25%

2 50%

3 75 %

4 100 %

5 Fusion with iliac bone



# Classification

- Orientation – right, left
- Localisation, C, CT, T, TL, L, LS
- Severity of the curve- Cobb angle
- Etiology

# Classification

- Structural
  - Congenital
  - Idiopathic (80%) – infantile, juvenile, adolescent
  - Neuromuscular – neuropathic, myopathic
  - In neurofibromatosis
  - Secondary scoliosis Marfan sy, Ehlers-Danlos sy
  - Degenerative scoliosis
- Nonstructural
  - Postural
  - Hysterical
  - in other morbidities – tumor, infection

# Idiopathic scoliosis

- Etiology unknown, multifactorial
- Genetic background
- Prevalence in girls 1,5 more often
- Progression- in girls 8 times more

## Treatment

- Up  $10^{\circ}$  - no scoliosis
- 10-20 $^{\circ}$  - exercise therapy, follow up
- 20 - 40 $^{\circ}$  - orthosis, exercise therapy
- Above 40 $^{\circ}$  - surgery

# Scoliosis in adults

## Progression of the curvature

- low, in Cobb angle less than  $30^\circ$
- often, in Cobb angle over  $50^\circ$  in thoracic and over  $30^\circ$  in lumbar spine

Limited breathing in thoracic curves over  $90^\circ$

Back pain

# Idiopathic scoliosis

- **Infantile**
  - Up to 3 years of age
  - usually spontaneous resolving (90%),
  - in less cases severe progression
- **Juvenile**
  - 3 years of age – to onset of puberty
- **Adolescent**
  - Puberty - the end of growth

# Exercise therapy

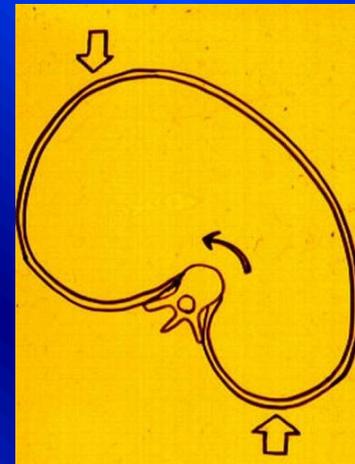
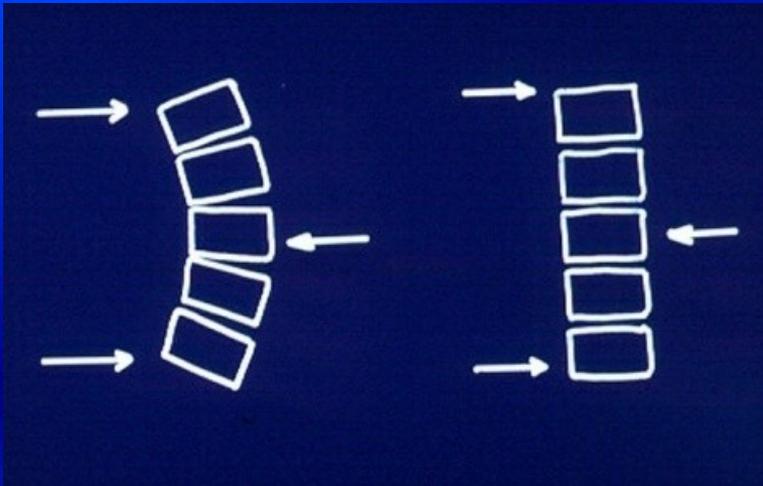
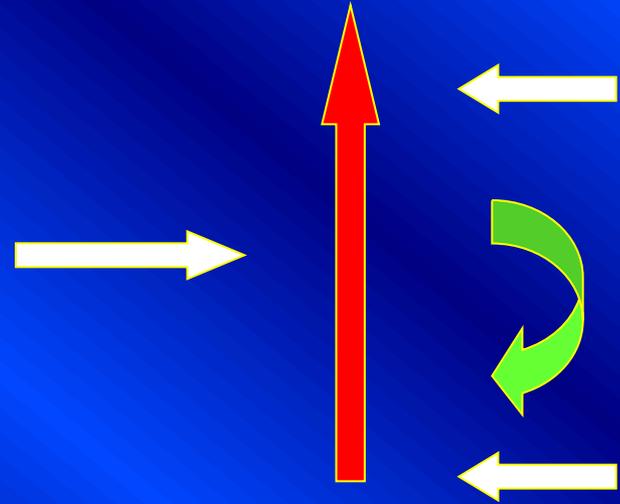
- Exercise, correct posture
- Pelvic alignment
- Strengthening of trunk and abdominal muscles
- Breathing
- High level activities
- Follow up in 6 months regime

# Exercise + bracing

- To prevent progression
- Effective only in low curves
- Over 45° no effect
- Indication: in growing children with flexible curve
- Curves are progressive in fast growing periods
- To wear 23 hours per day, up to the end of growth (16-17 years) gradually to wear less hours per day.

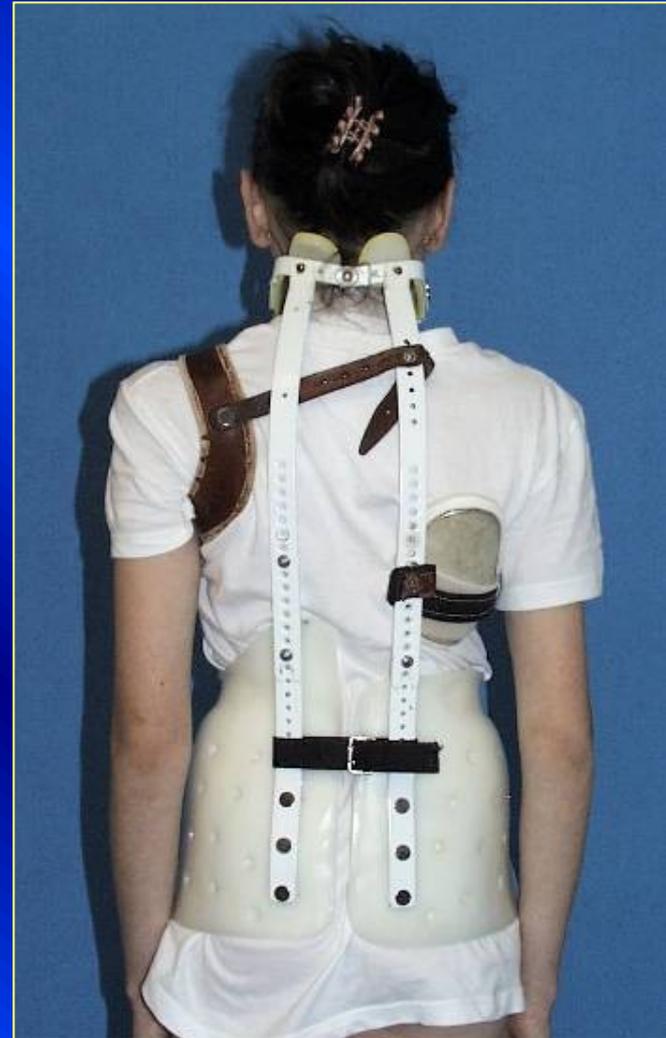
# Principles of the brace

- distraction
- derotation
- three point system



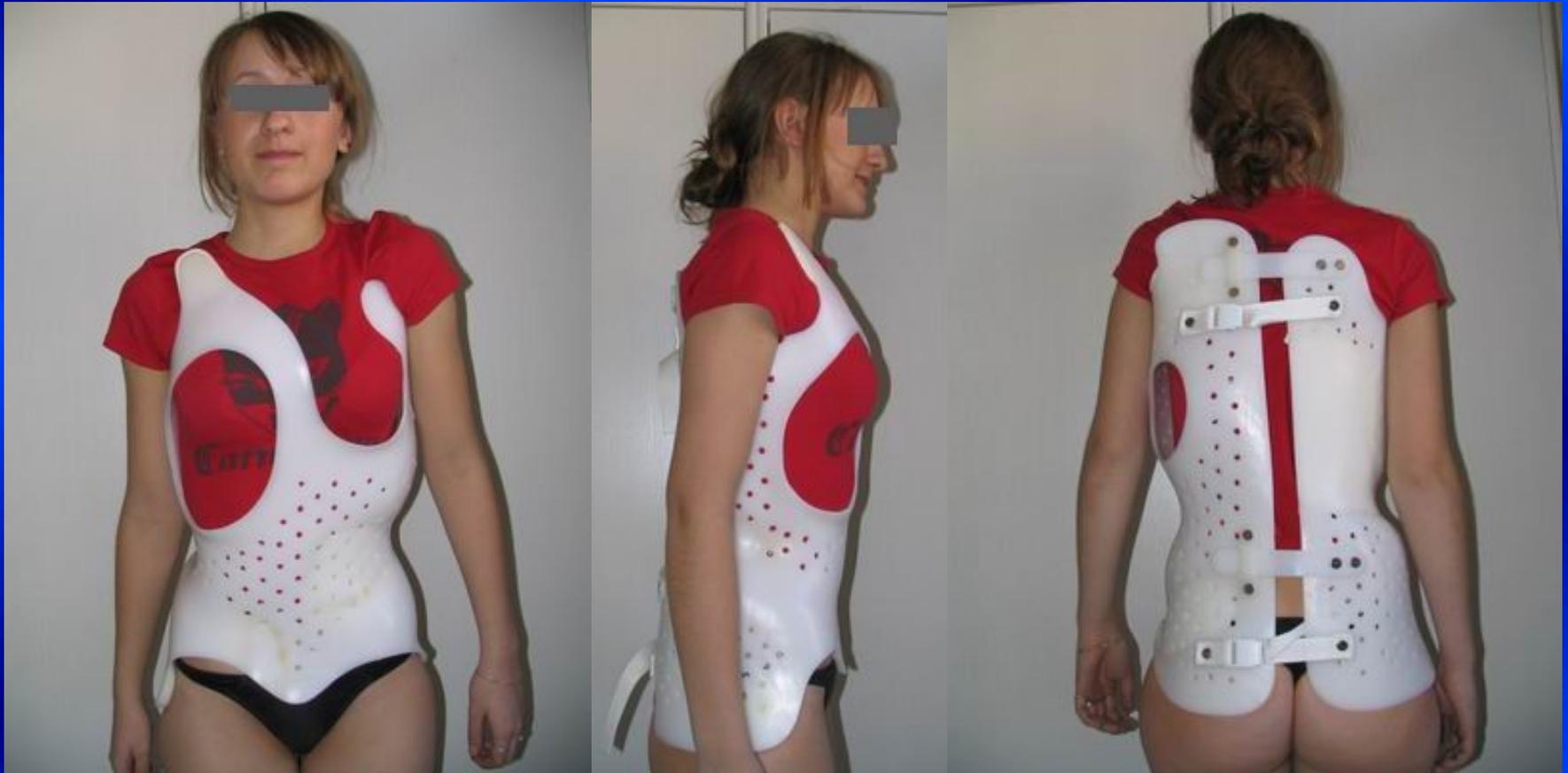
# Milwaukee orthosis

– curves T6 and above



# TLSO orthosis

- curves in Th7 and lower



# Exercise in a brace

- stretching
- correct posture
- exercise using balls
- activation in sports



- Without a brace
  - swimming
  - hippotherapy



- Breathing therapy
  - *deep breathing*
  - *bottles*
  - *derotation breathing*



# Surgery

- **Indication:**

- Above 40° in fast progression
- Above 50° in all

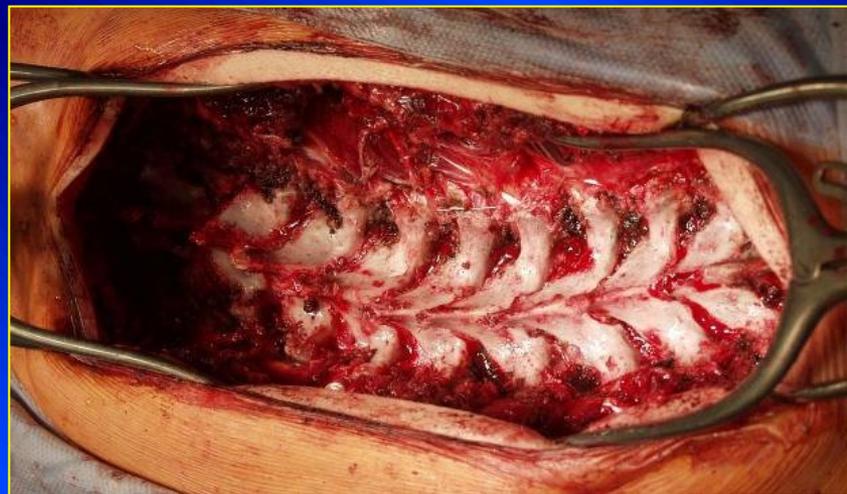
- **Principles:**

- Correction of the curve (distractions, derotation, translation of vertebrae)
- Repeated distraction in younger patients (HRI)
- growing rods
- spondylodesis
- Postoperative bracing

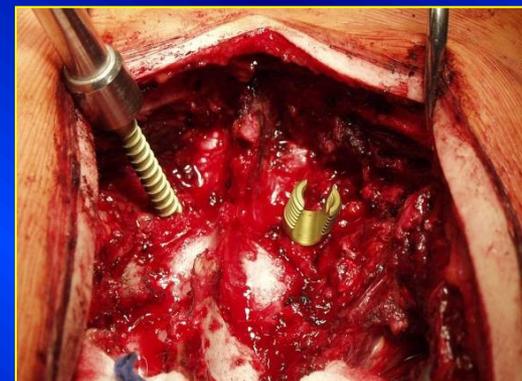
- The aim of surgery:
  - Correction of the curve
  - Prevent progression
  - Influence worsening of pulmonar function  
(cor kyphoscolioticum- ischemic heart disease)
  - Improve situation for better muscle function
  - Prevent degenerative changes ( spondylosis and spondylarthrosis)
  - Cosmetic effect

# Dorsal approach

skeletizace, resekce kloubů,  
dekortikace zadních elementů



Transpedikulární  
šrouby či  
pedikulární háčky

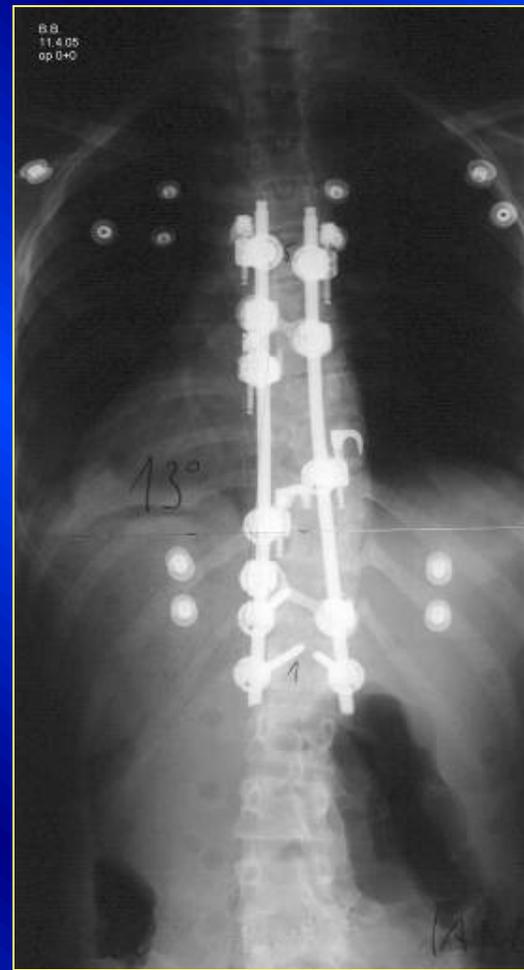
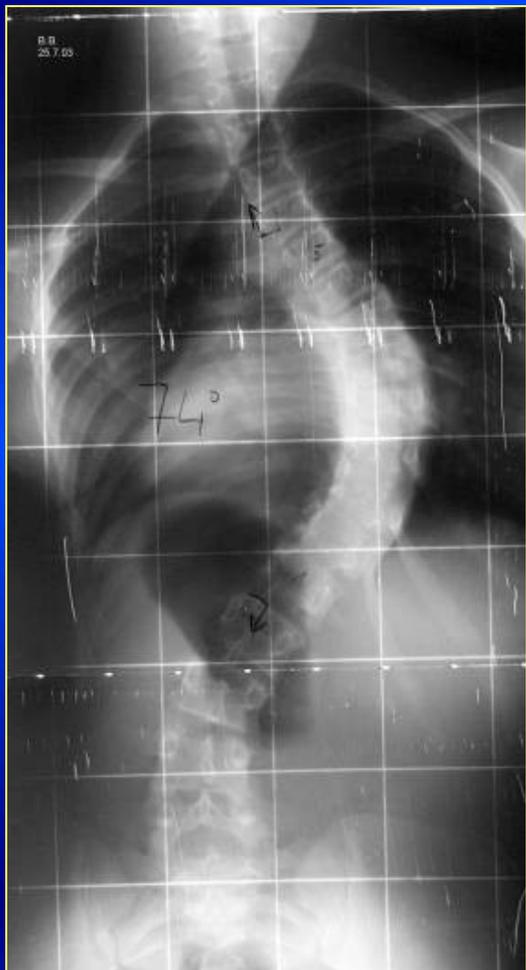


Dokončení,  
propojení,  
štěpy

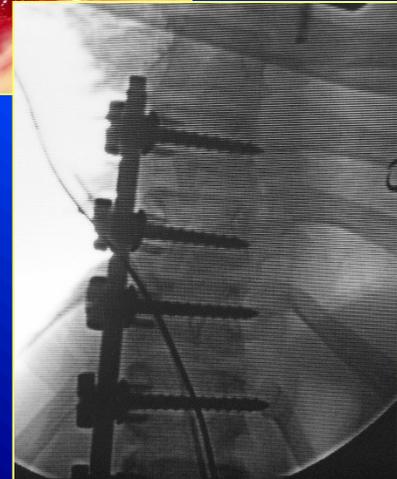
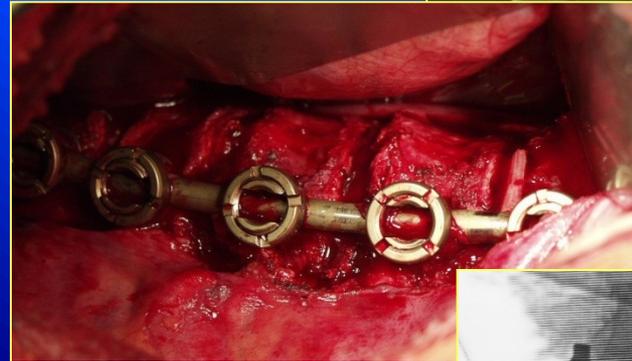
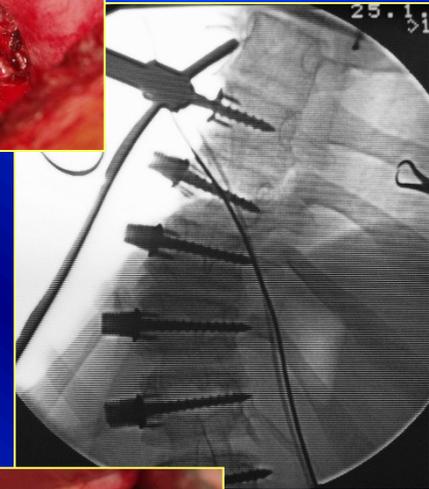
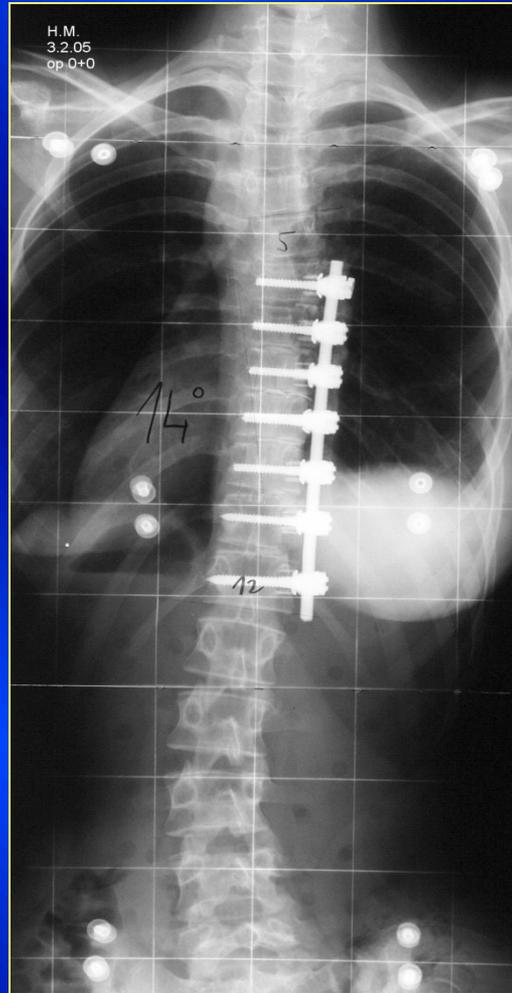


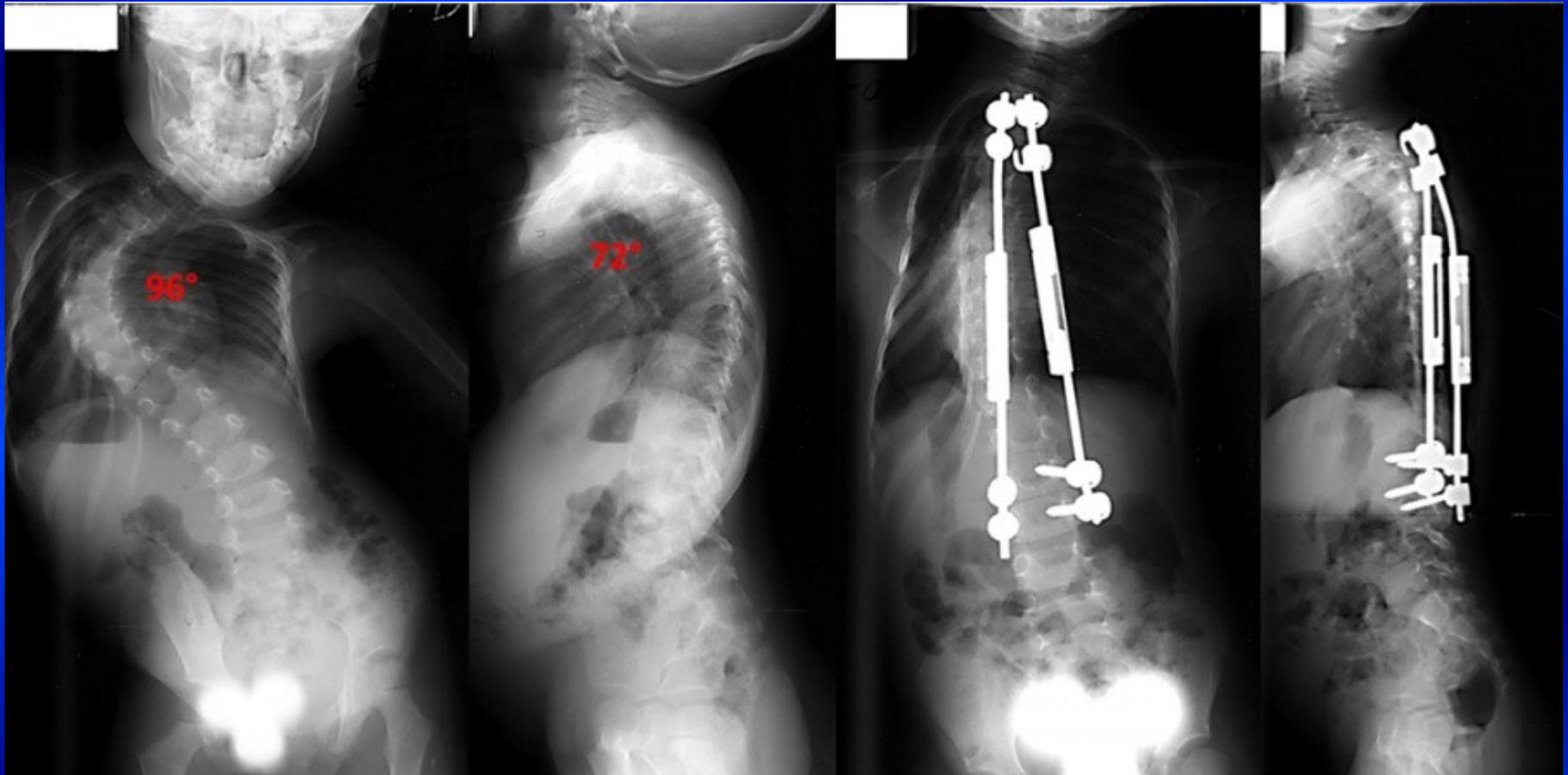
# Juvenile scoliosis

HRI + repeated distraction, fusion later on



# Dorsal approach



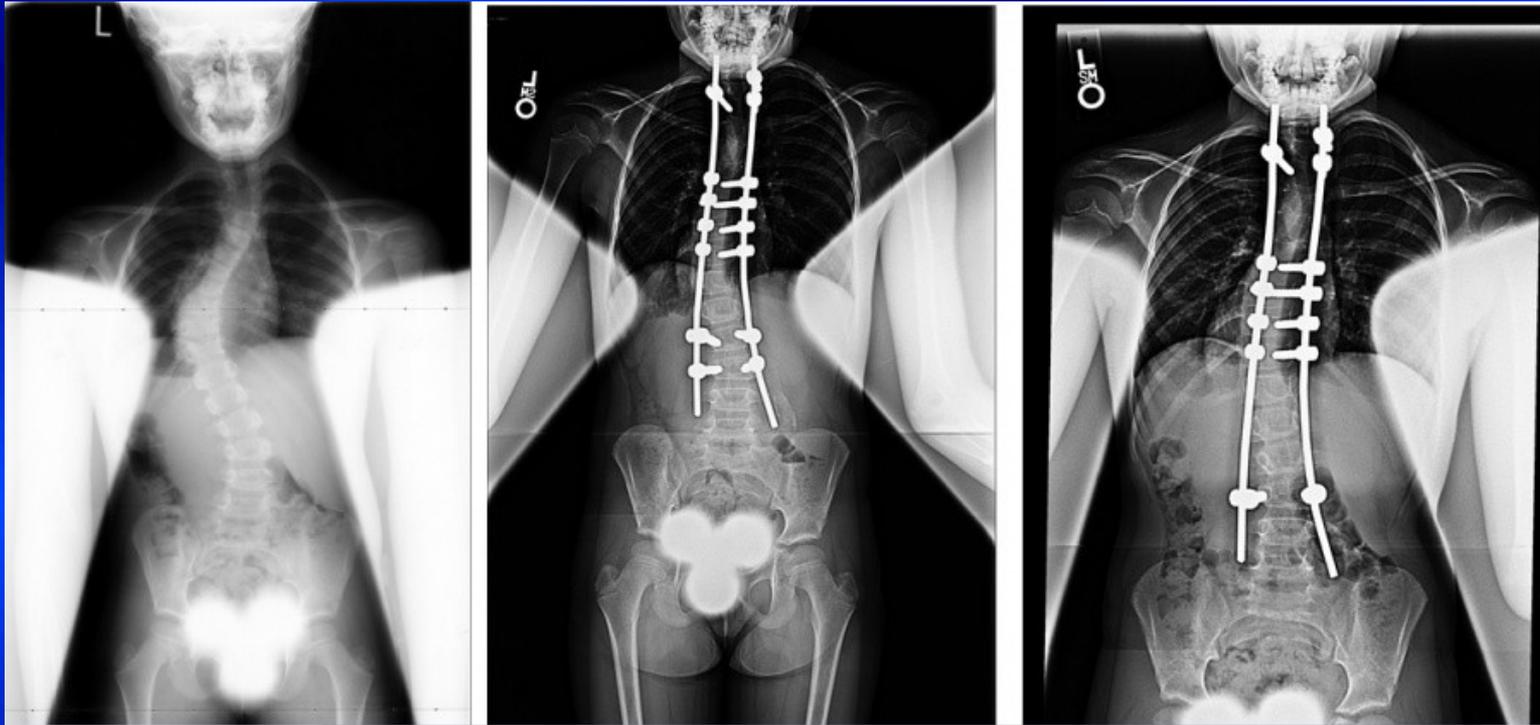


## **Traditional Growing Rods for Pediatric Scoliosis**

Children younger than age 8 have years of growth ahead,  
Repeated surgery is needed

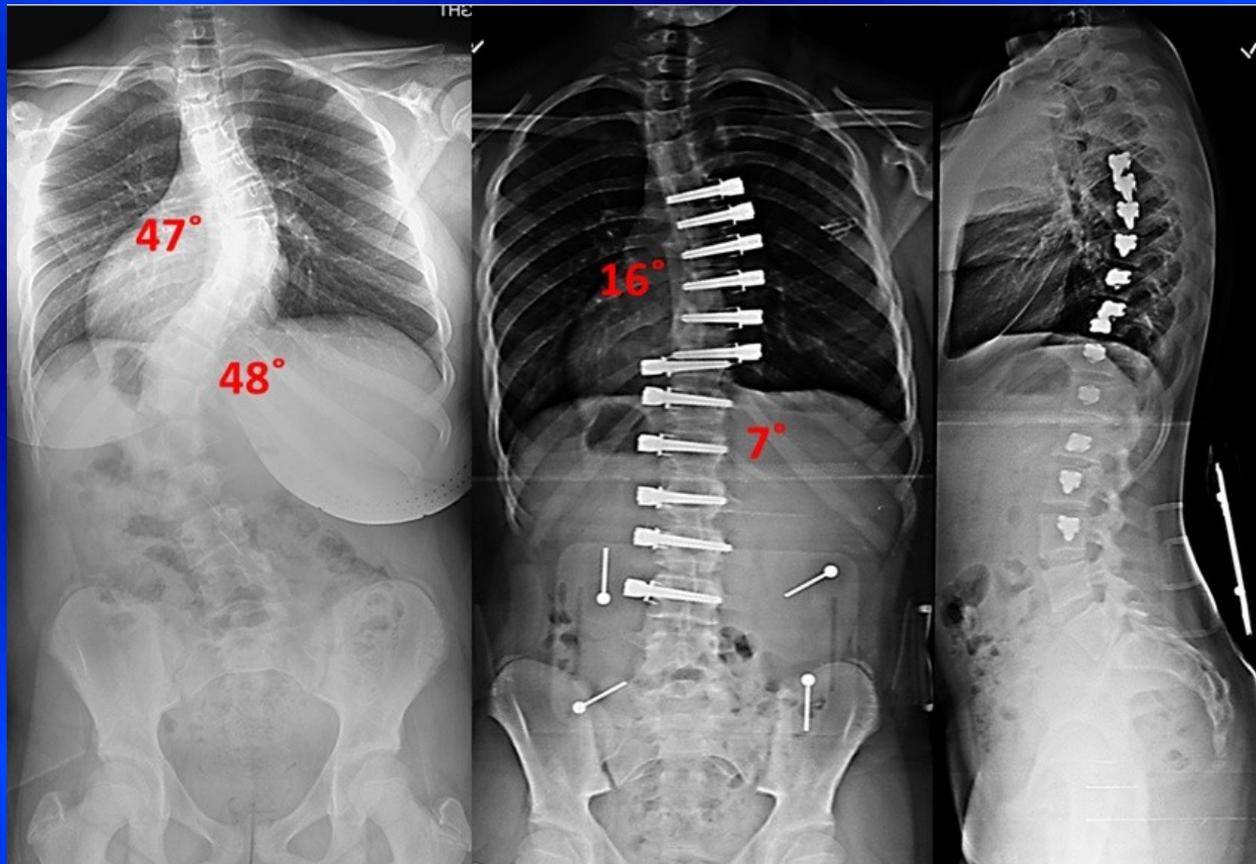


**Magnetically Controlled Growing Rods for Pediatric Scoliosis**  
**No other surgery**



## **Growth-Guided Devices for Pediatric Scoliosis**

Instrumentation designed to correct the scoliosis while allowing the child to grow.



**Vertebral Body Tethering:  
Fusionless Pediatric Scoliosis Correction**

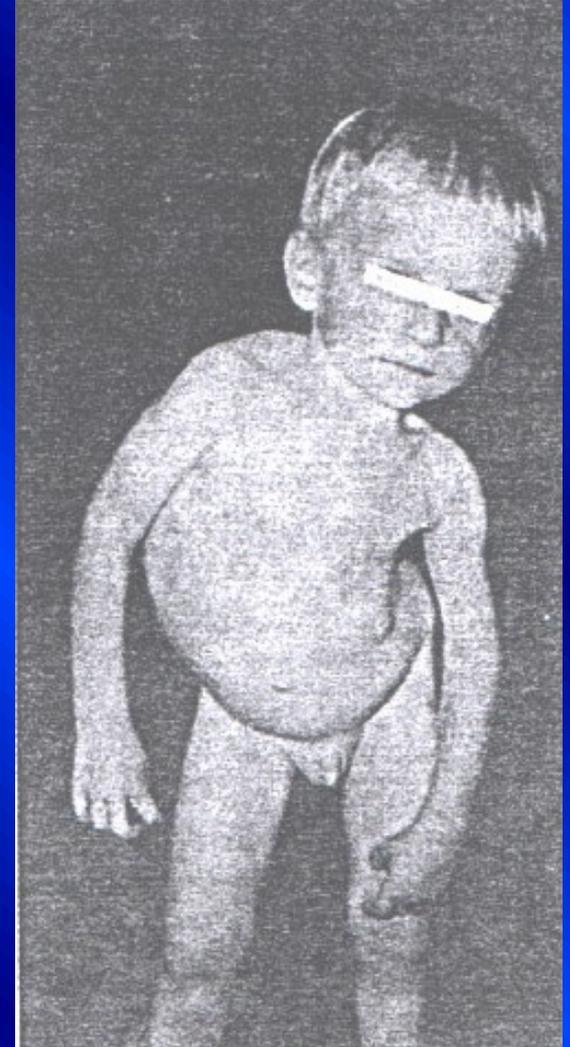
# Congenital scoliosis

- from the childbirth
- asymmetric growth of the spine
- more often fast progression

## Etiology:

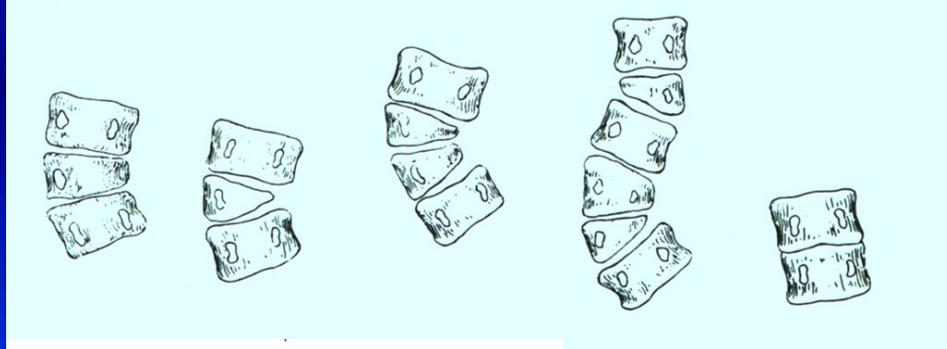
1. Disturbance of the form
2. Disturbance of segmentation
3. Combined disturbance

- Management: surgery
  - fusion
  - osteotomy + fusion
  - hemivertebrectomy

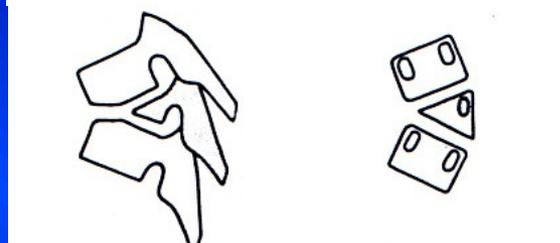


Disturbance  
of the form

Wedge vertebra  
Hemivertebra



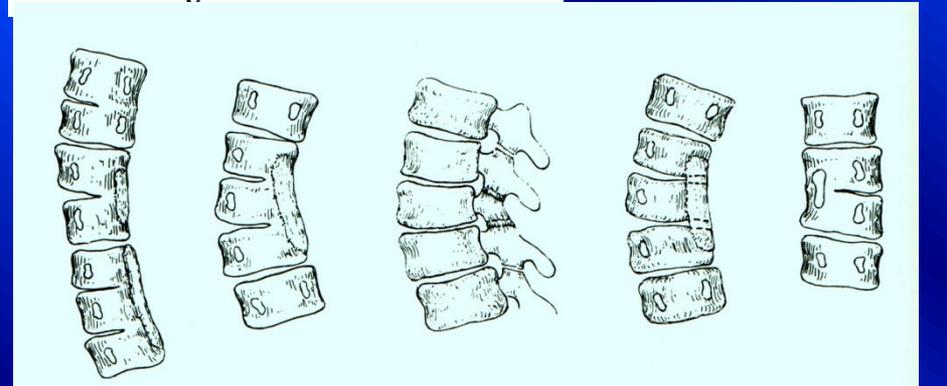
Hemivertebra



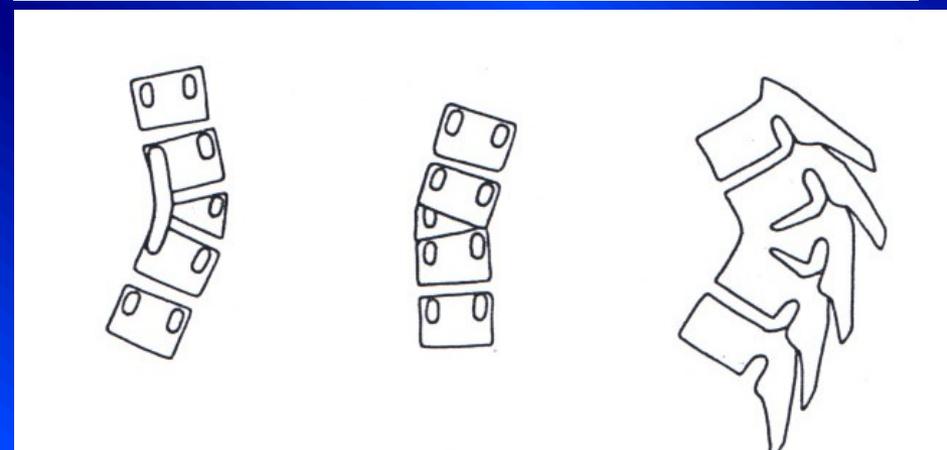
Disturbance of  
segmentation

Nonsegmented  
bone rod

Bone block



Combined disturbance



# Neuromuscular scoliosis

Neuropatic: cerebral palsy, polio,  
spinal dysraphism

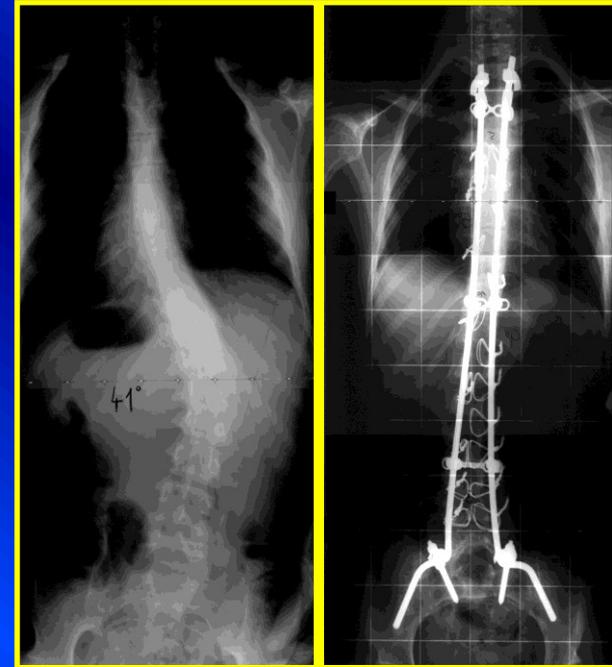
Myopathic: muscular dystrophy,  
arthrogryphosis

„paralytic scoliosis“

Long, severe curves

Therapy:

Surgery, long fusion

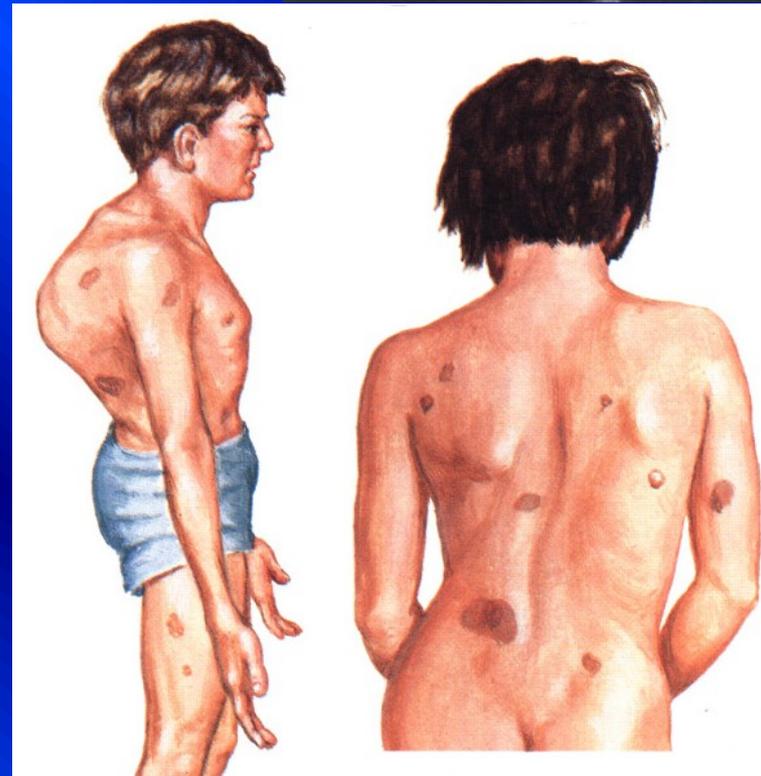


# Scoliosis in neurofibromatosis

- short curve
- atypical shape of vertebrae  
severe rotation
- changes of ribs

Typical:  
Progressive  
Surgery is necessary

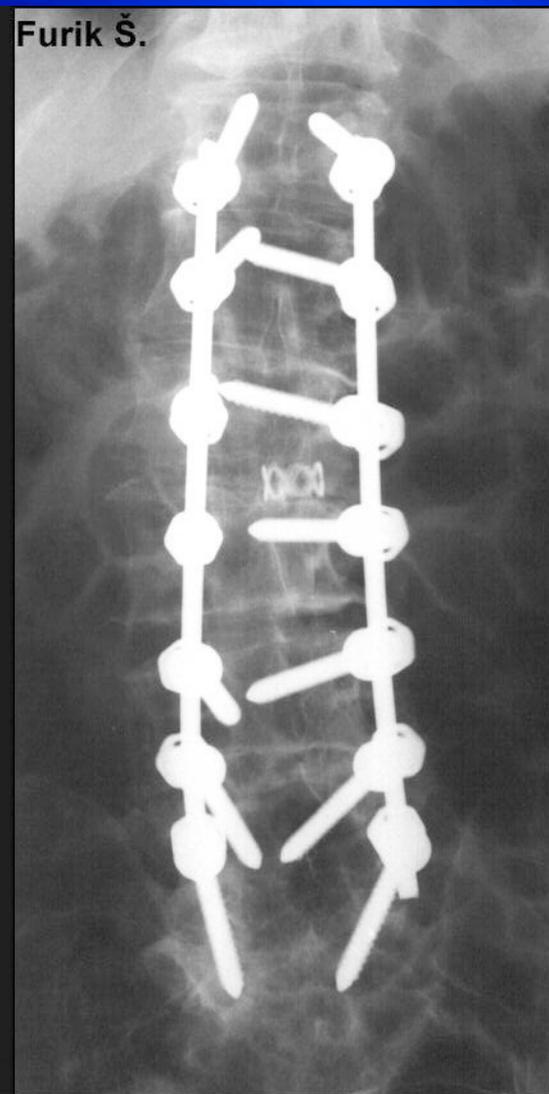
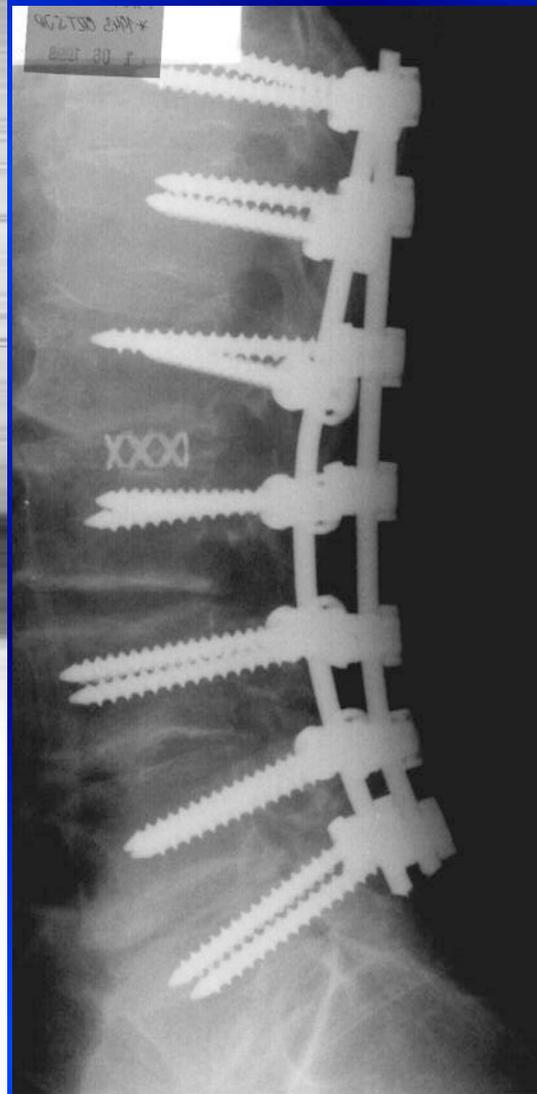
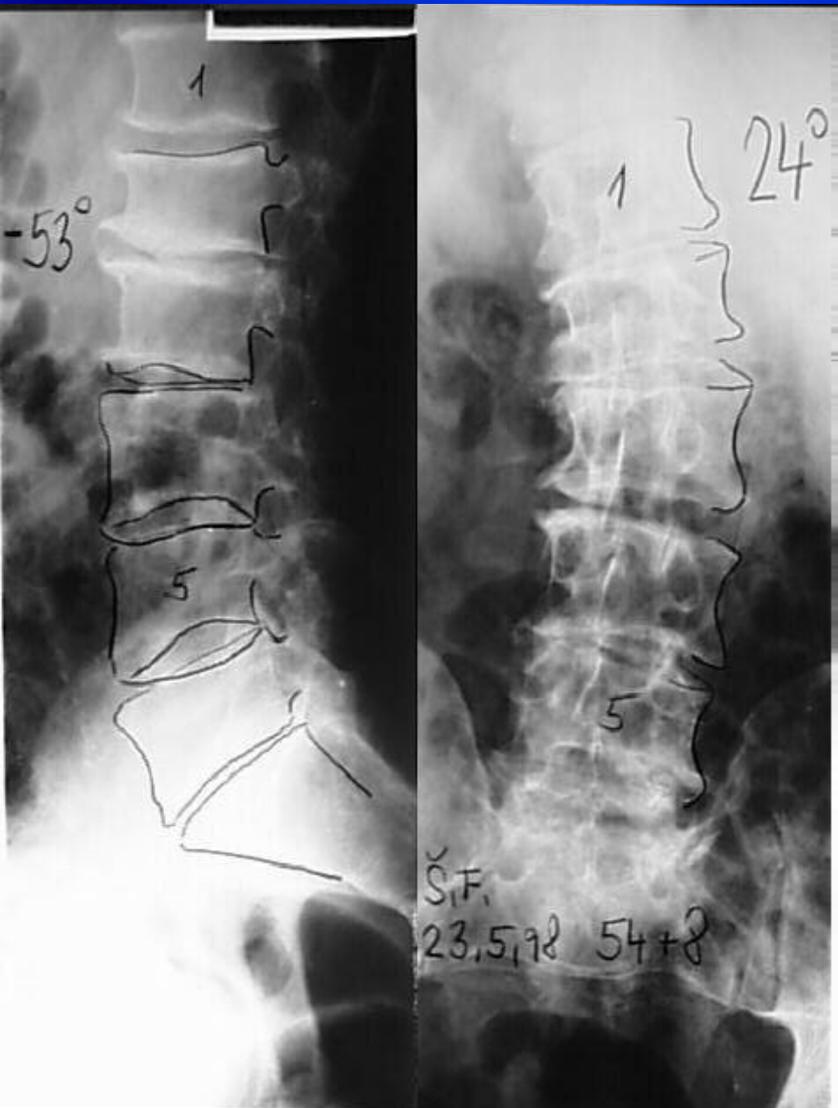
Atypical:  
Progression as in idiopathic  
scoliosis- treatment the same



# Secondary scoliosis

- Osteogenesis imperfecta
- Spondyloepiphyseal dysplasia
- Diastrophic nanism
- Rickets
- Marfan syndrom
- TB
- Injuries
- Degenerative scoliosis

# Degenerative scoliosis



# Nonstructural scoliosis

- Postural
- In sciatica
- Tumors
- Spondylodiscitis
- Leg length discrepancy
- Contractures in hip region
- Hysterical

# Pathological kyphosis

- Congenial
- Neuromuscular
- Juvenile kyphosis

## Others

- congenital deformity (achondroplasia, mucopolysacharidosis)
- posttraumatic ( + after laminectomy)
- after spondylodiscitis, TB)
- in tumors
- in osteoporosis, osteomalatia
- Postural kyphosis

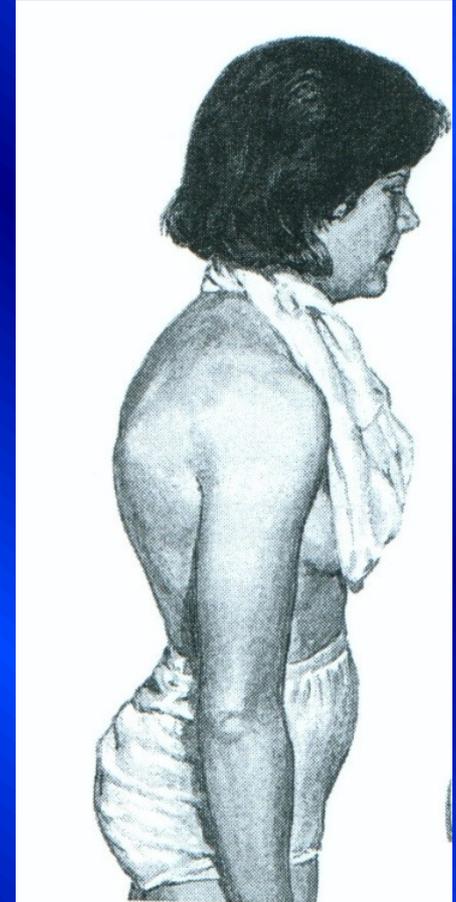
# Juvenile kyphosis

- 0,5 - 8 % of population
- boys more often
- age 12-18 years
- Etiology- idiopathic, multifactorial
- distal thoracic region more often



# Juvenile kyphosis

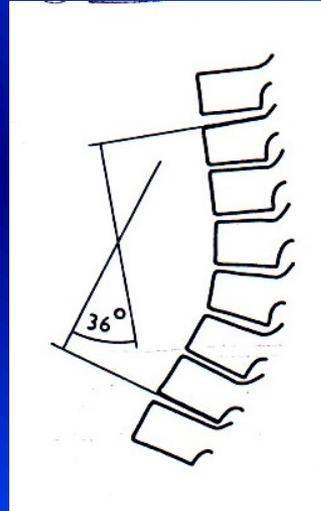
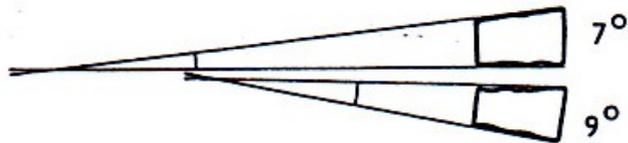
- Increased thoracic kyphosis above  $40^\circ$
- Fixed kyphosis (hyperextension test)
- Pain
- Limited movements
- Limited dynamics of the spine
- Progression of degenerative changes



# Juvenile kyphosis

X ray findings:

- kyphosis above  $40^\circ$
- Irregularities of end plates
- Schmorl's nodes
- Narrowing of intervertebral disc spaces
- Wedge deformity above  $5^\circ$   
at least in 3 vertebrae



# Juvenile kyphosis

## Stages

- I. stage - florid (9-12 years, flexible, round back, painful spine, muscle changes)
- II. stage- deformity (13-16 years, fixed advanced X ray changes)
- III. stage- consequences (chronic back pain)

# Juvenile kyphosis

## Therapy:

- Conservative

- exercise therapy
- orthosis
- plaster of Paris brace, later on orthosis  
+ exercise
- in florid stage- no sports, no weightbearing
- NSAD, analgetics, myorelaxans

- Surgery + bracing + exercise

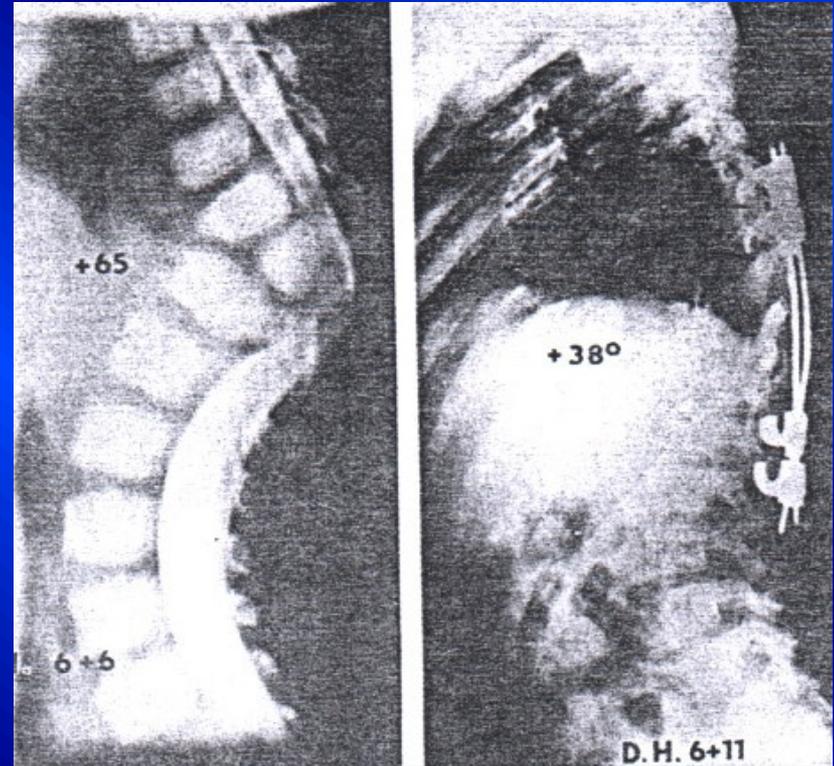
# Congenital kyphosis

## Etiology

- Disturbance of the form
- Disturbance of segmentation
- Combined disturbance

## Therapy:

- to prevent progression
- Surgery in progressive curves
- Spondylodesis – fusion + bracing  
till the end of the growth
- anterior osteotomy with correction of the curve  
+ posterior fusion with instrumentation



# Postural kyphosis

- in muscle imbalance  
lack of exercise, lack of sports  
sedentary way of life
- weak trunk and abdominal muscles  
increased lumbar lordosis and thoracic kyphosis

## Management:

- regular exercise of muscles- trunk, abdominal ..
- sports activities
- adherence to active life
- profesional fysiotherapy