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56th Annual Meeting &
42nd Post Graduate Course

JUNE 06-10 2022
MARSEILLE, FRANCE
Palais du Pharo

MUSCULOSKELETAL: SCOLIOSIS

Lesson from the field: when the full spine x-ray warns you



Laura Tanturri de Horatio



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SCOLIOSIS

Types of structural scoliosis

Warning signs on X-ray

Diagnostic approach

Key messages



SCOLIOSIS

Types of structural scoliosis

Warning signs on X-ray

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STRUCTURAL SCOLIOSIS

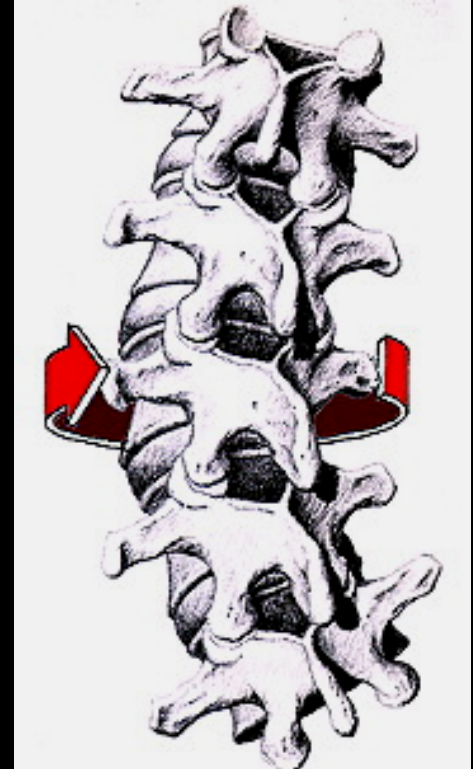
The patient's spine actually has a physical curve which can progress over time if not treated correctly

3D DEFORMITY

lateral curvature of the spine
on the frontal plane

altered orientation of the spine
on the sagittal plane
(dorsal hypo/hyperkyphosis, hypolordosis)
and

vertebral rotation
on the axial plane



Orthopaedics & Traumatology: Surgery & Research 105 (2019) 351–359

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Orthopaedics & Traumatology: Surgery & Research

journal homepage: www.elsevier.com

Review article

The third dimension of scoliosis: The forgotten axial plane

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^d Institute of Biomechanics (Istvan Gyorgy Chirpák, Arts et métiers ParisTech, 151, boulevard de l'Hôpital, 75013 Paris, France

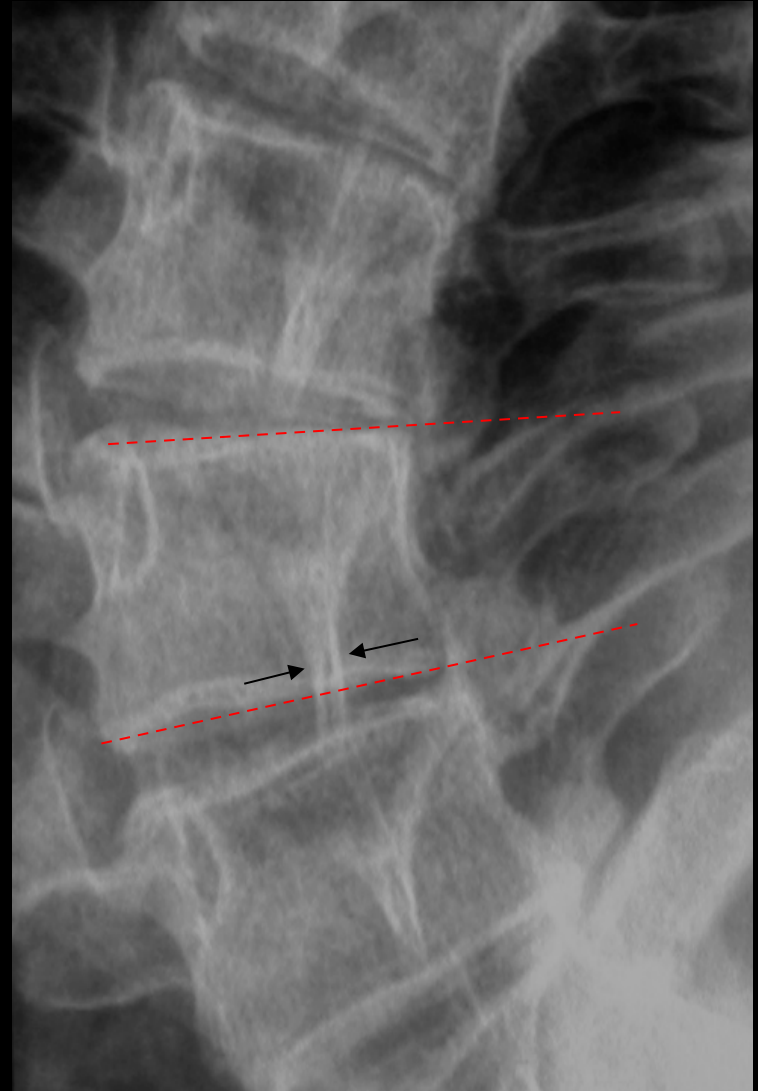
STRUCTURAL SCOLIOSIS

Deformity of the vertebral bodies at the fulcrum

Metameric rotation (*deviation of the spinous processes*)

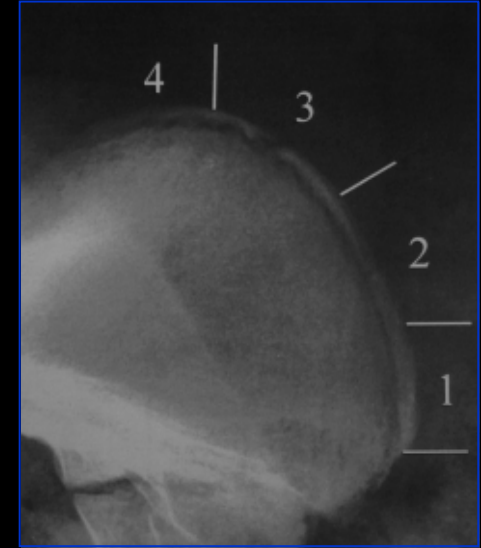
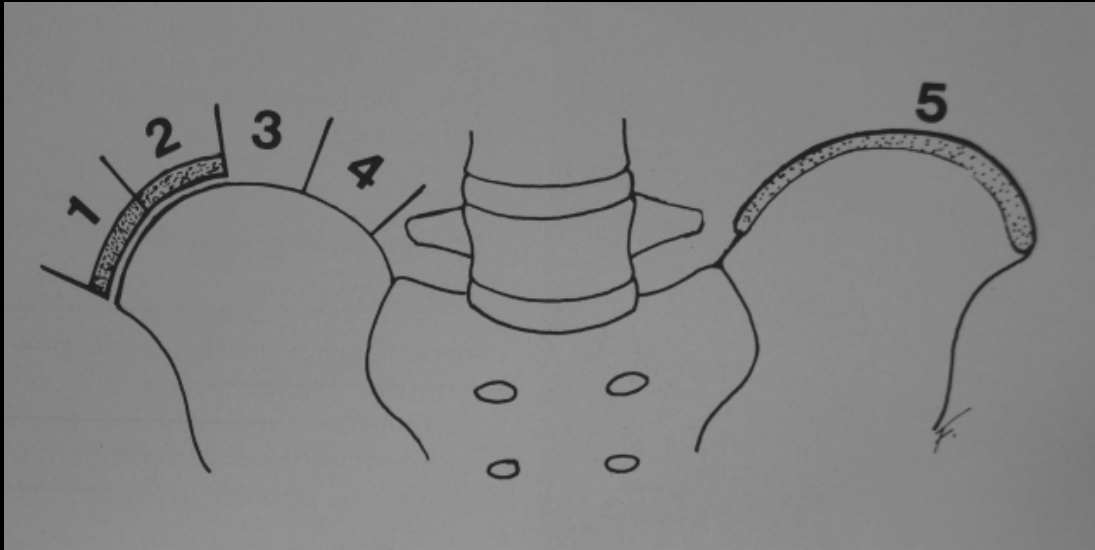
Incomplete reducibility of the curve on functional study

Evolution of the scoliotic curve up to the skeletal maturity



Risser Test

indicator of skeletal maturation



Evaluation of the “ring apophysis” ossification which progresses from the ASIS to the PSIS up to the complete ossification

Risser 0: no ossification of the iliac apophysis

Risser 5: complete fusion of the iliac apophysis (skeletal maturity)

Risser < 2: high risk of worsening of the curve

Risser > 2: risk reduction

STRUCTURAL SCOLIOSIS

IDIOPATHIC (65%)

CONGENITAL (15%)

NEUROMUSCULAR (10%)

OTHER CAUSES (10%)

Neurofibromatosis

Osteochondrodysplasias

Mesenchymal disorders (Marfan, Ehlers Danlos syndrome)

Traumatic

Neoplastic/Infective

Iatrogenic

IDIOPATHIC SCOLIOSIS

$$F > M \ 7:1$$

INFANTILE: < 3 years of age

JUVENILE: 3-10 years of age
(or before puberty)

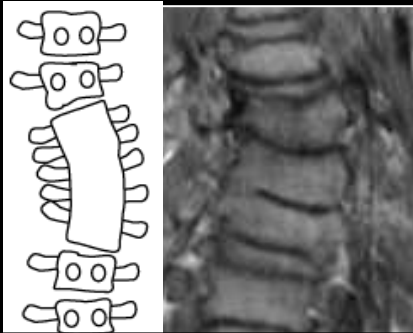
ADOLESCENT: after 10 years
of age or post puberty



CONGENITAL SCOLIOSIS

VERTEBRAL SEGMENTATION DEFECT

bilateral



Block vertebrae

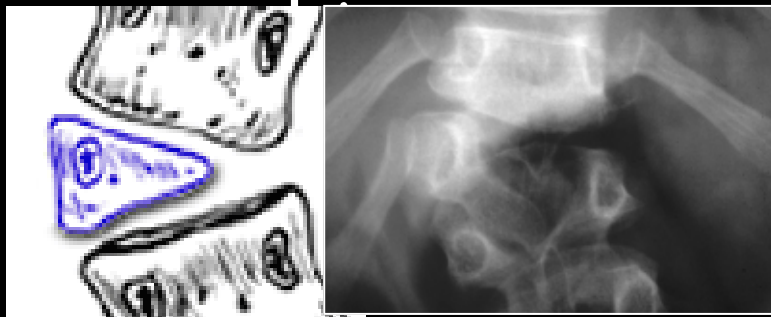
unilateral



unilateral bar

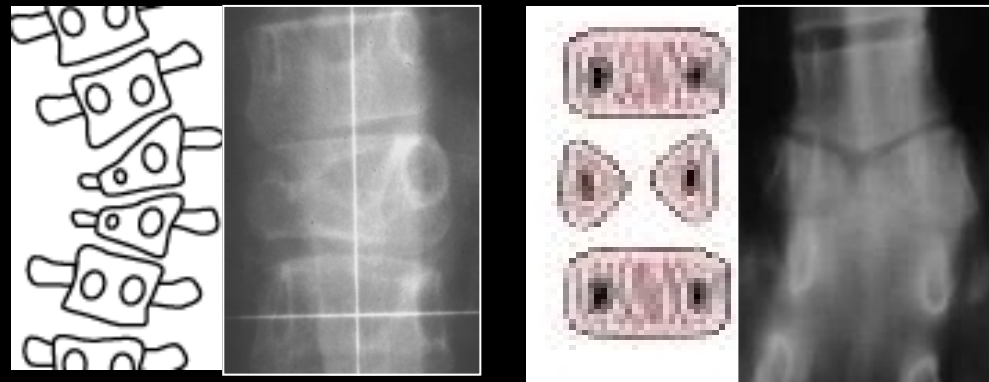
FORMING BONE DEFECT

complete unilateral



hemivertebra

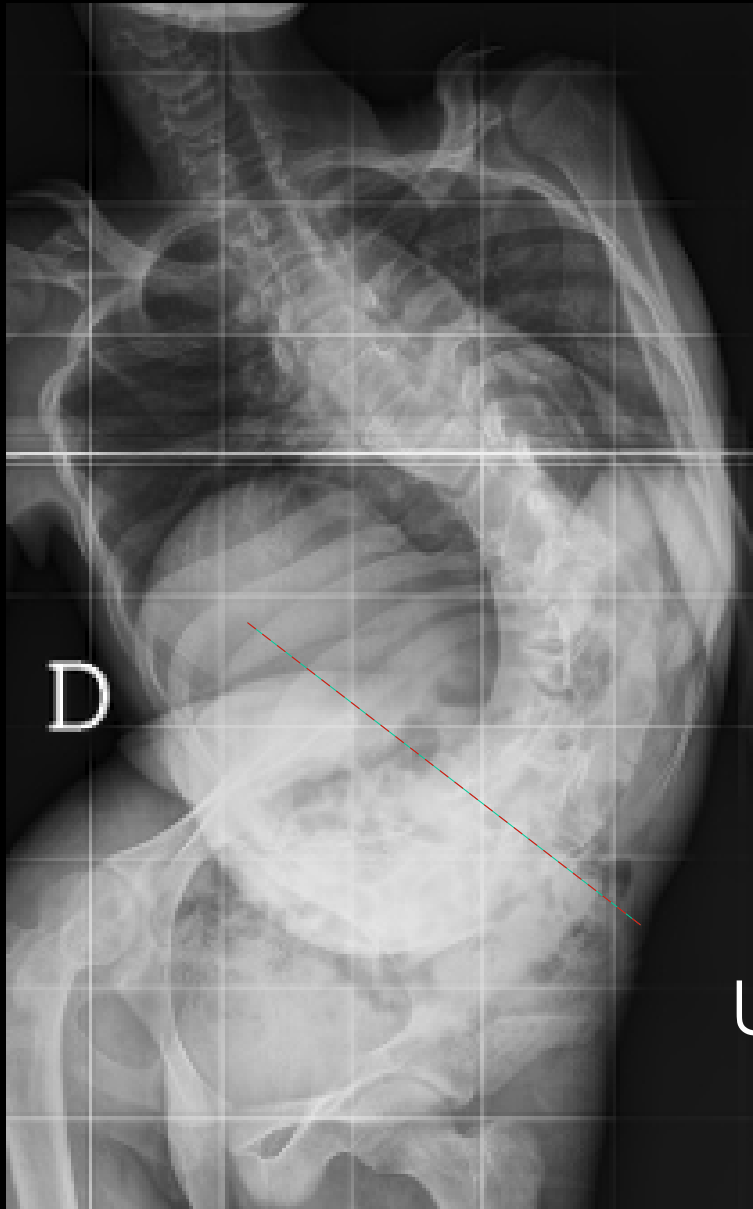
partial unilateral



trapezoidal shaped vertebra

butterfly vertebra

NEUROMUSCULAR SCOLIOSIS



Associated with disorders of the nerve or muscular system

Wide curves generally thoraco-lumbar associated to pelvic skewness

Unavoidably worsens even after skeletal maturity

SCOLIOSIS

Types of structural scoliosis

Warning signs on X-ray

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Key messages



Warning signs



BONE LESION/IRREGULARITY ++ WITH PAIN

EARLY ONSET

FAST EVOLUTION OF THE CURVATURE

FORMING BONE DEFECTS

WIDENING OF THE INTERPEDICULAR DISTANCE

SINGLE THORACIC OR THORACO-LUMBAR CURVE



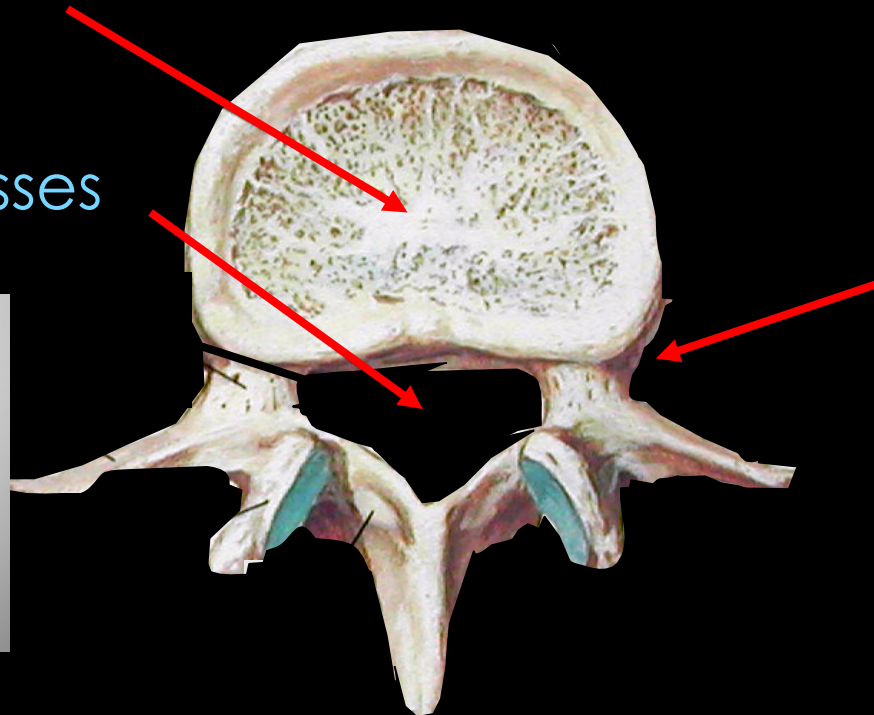
BONE LESION /
IRREGULARITY
++ WITH PAIN

PAINFUL SCOLIOSIS

Vertebral lesions (generally osteoblastoma and osteoid osteoma on vertebral body or neural arch)

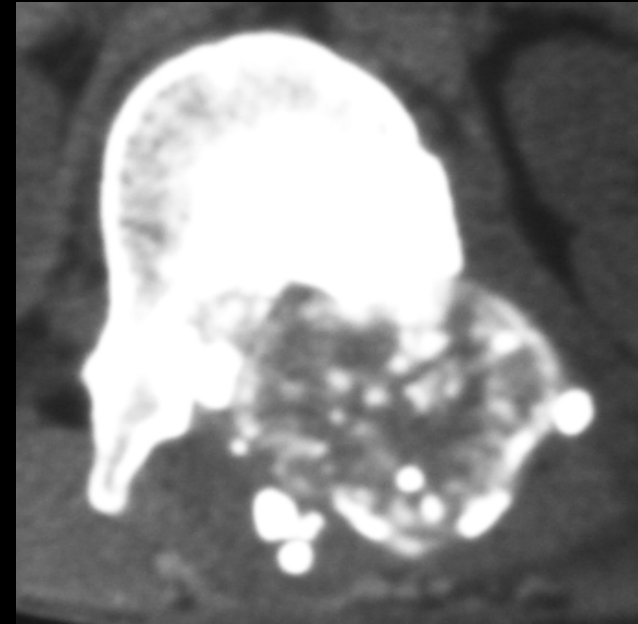
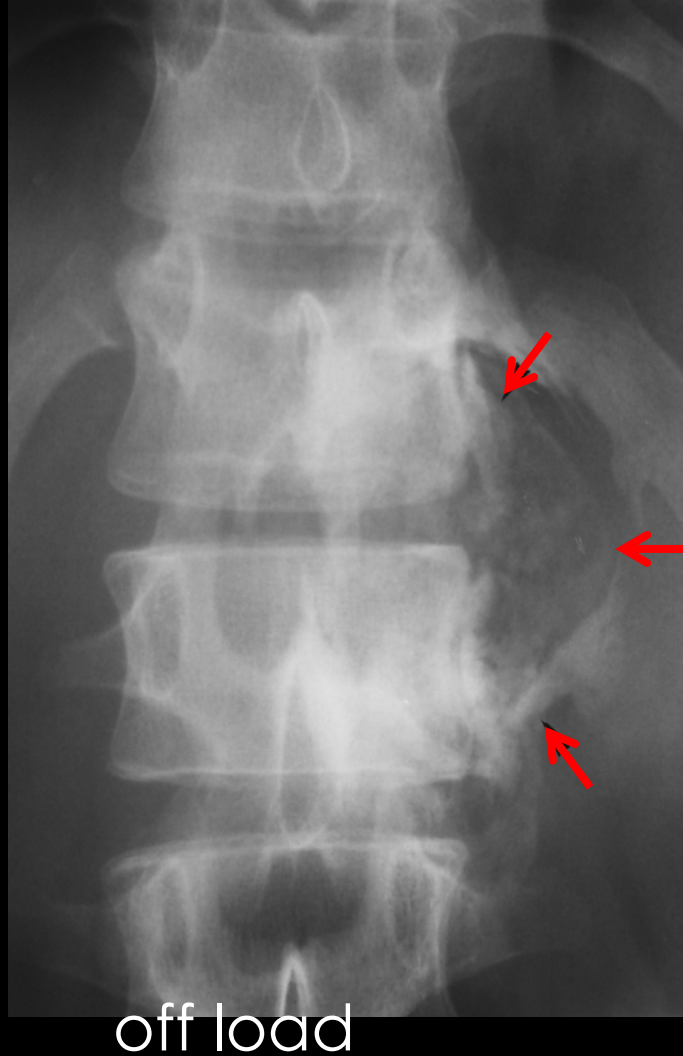
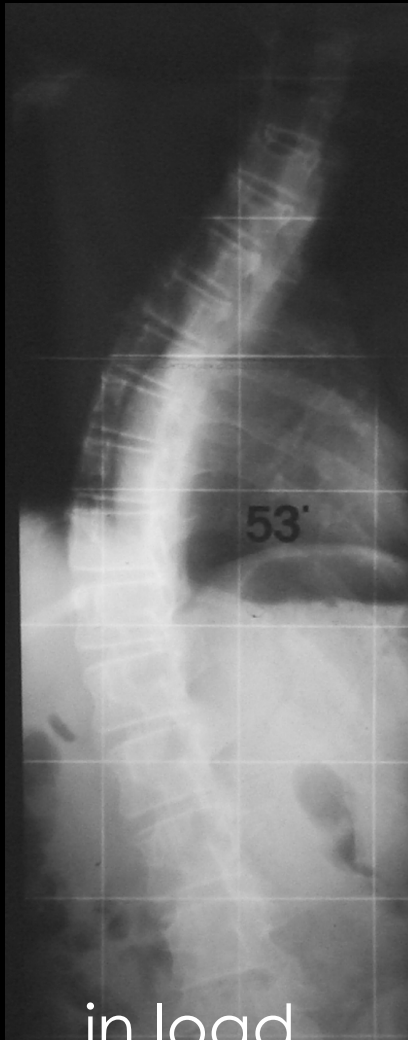
Intraspinous masses

Paravertebral lesions (rare)



In developmental age
pain is a warning sign

PAINFUL SCOLIOSIS

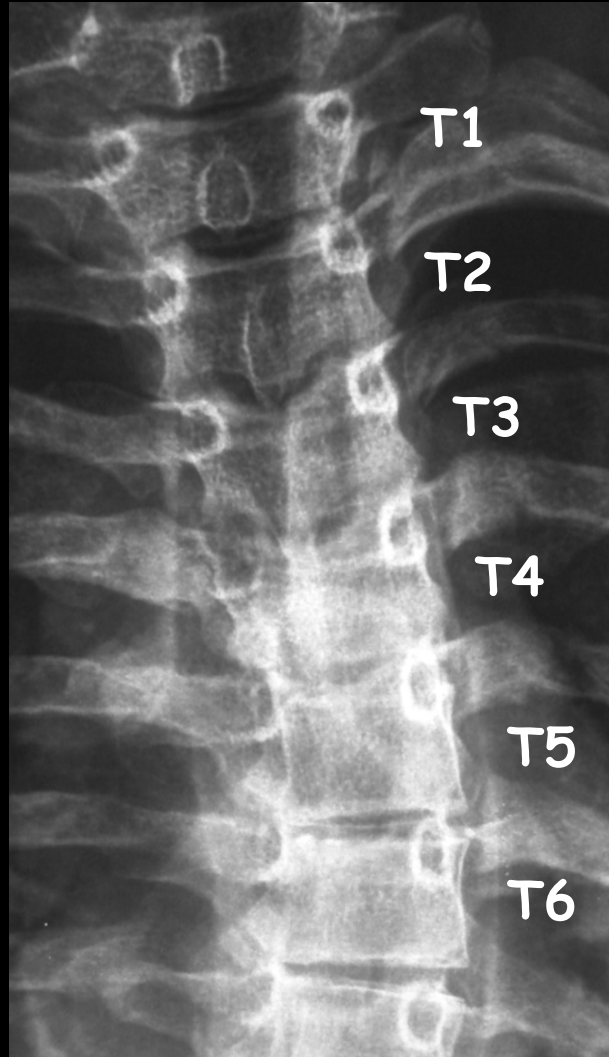


OSTEOBLASTOMA ON T12

PAINFUL SCOLIOSIS



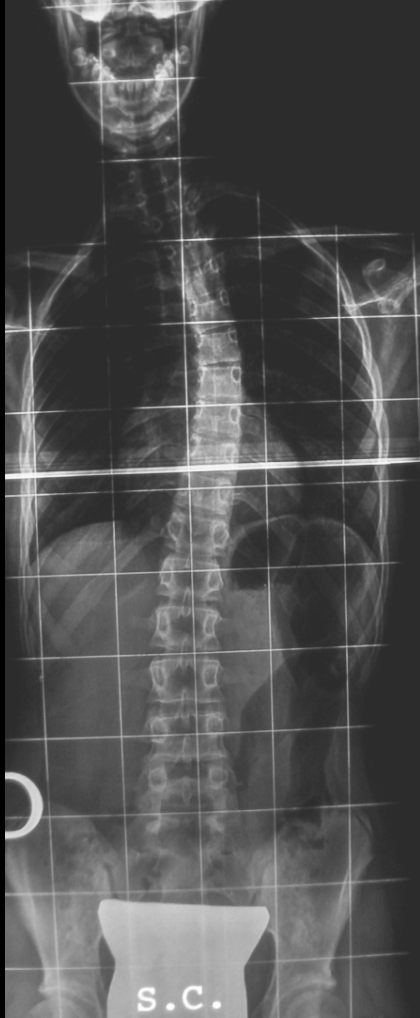
in load



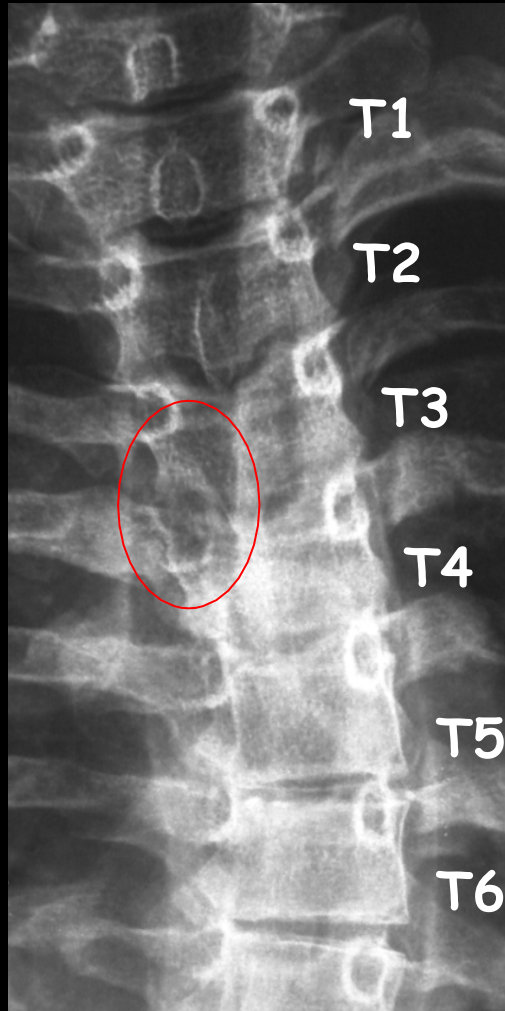
off load

Where is the lesion?

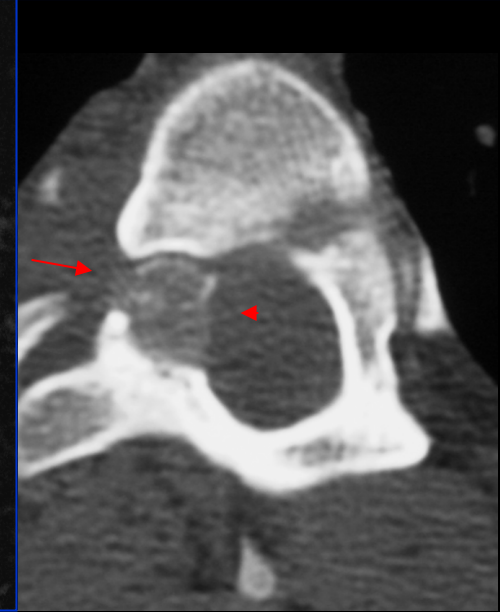
PAINFUL SCOLIOSIS



in load

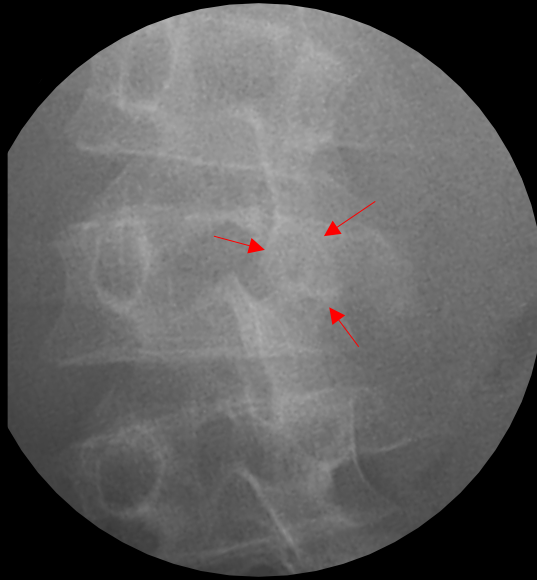
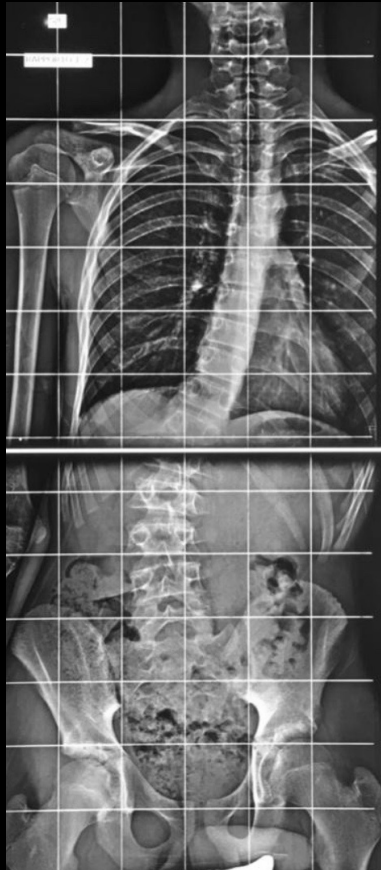


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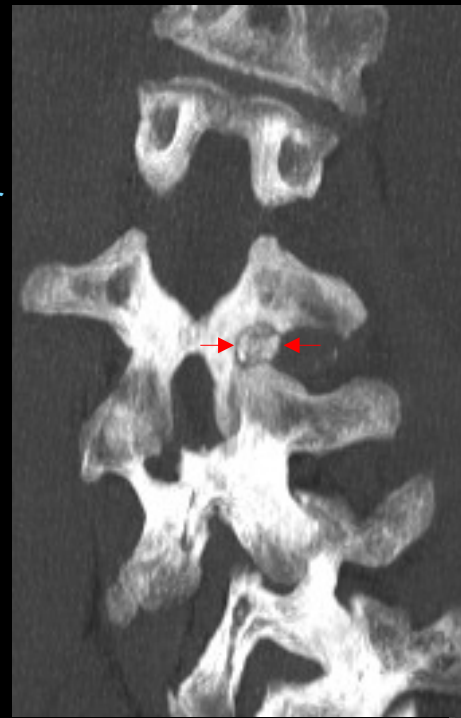


OSTEOBLASTOMA on T4

Edoardo, 14 years old
Worsening scoliosis from 6 months
Previous trauma reported
STRONG BACK PAIN after playing soccer

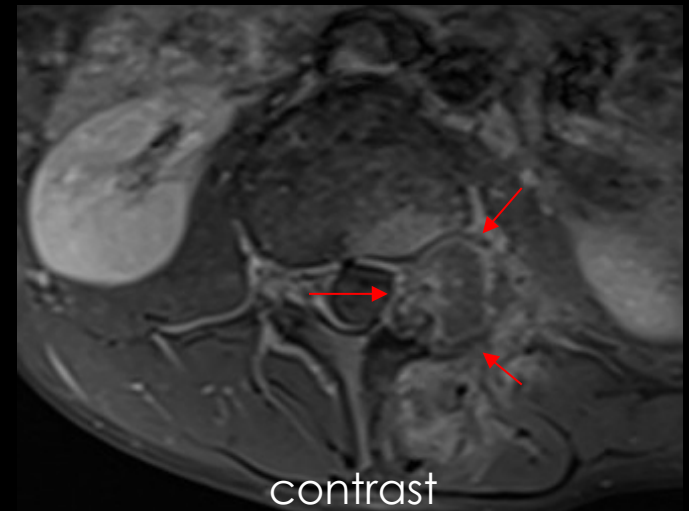


OSTEOBLASTOMA
left posterior neural arch
of L2 confirmed on CT

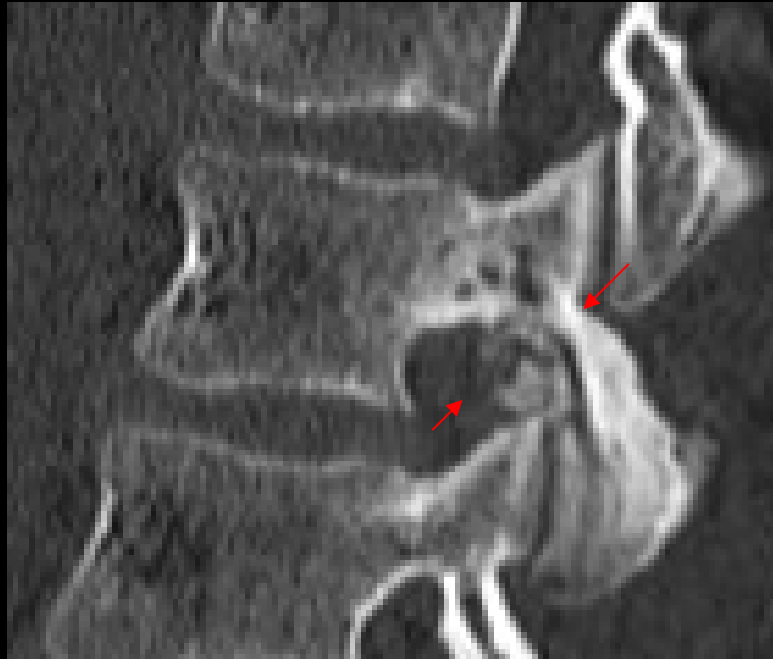


On CT an expansive lesion with the same density of the soft tissue with a wide erosion of L2 left transverse apophysis was suspected

Edoardo, 16 years old



OSTEOBLASTOMA OF THE NEURAL ARCH OF L2



SECONDARY ANEURISMAL BONE CYST



Courtesy of Dr. Enzo Pacciani

Cervical Spine Osteoblastoma with an Aneurysmal Bone Cyst in a 2-Year-Old Child: A Case Report

Ajit Mishra^a Nupur Pruthi^a B.N. Nandeesh^b Dhaval Shukla^a

^aDepartment of Neurosurgery, National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru, India;
^bDepartment of Neuropathology, National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru, India

Lumbar Spine Osteoblastoma with Secondary Aneurysmal Bone Cyst Causing Severe Trunk Imbalance and Radiculopathy: A Case Report

Carlo Iorio¹, Osvaldo Mazza¹, Federico Tundo¹, Alessandra Stracuzzi², Marco Crostelli¹

PAINFUL SCOLIOSIS



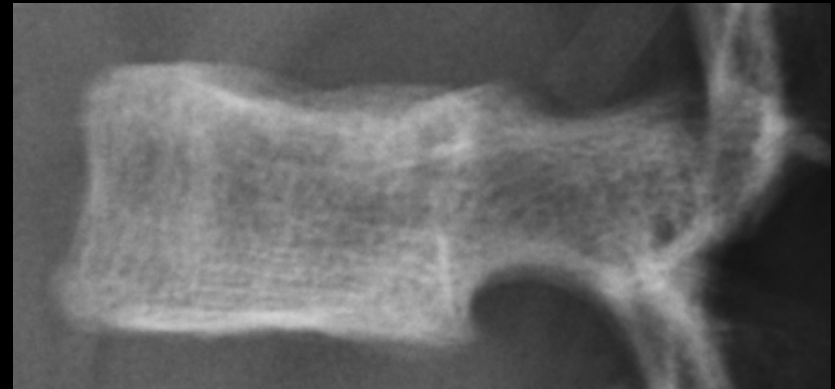
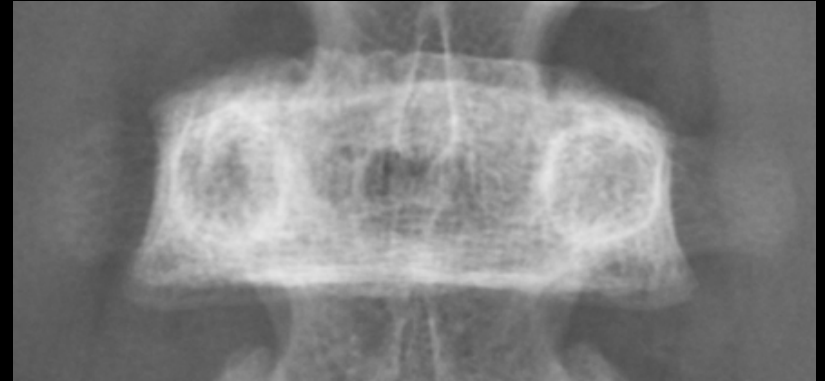
OSTEOID OSTEOMA
right L3 hemilamina

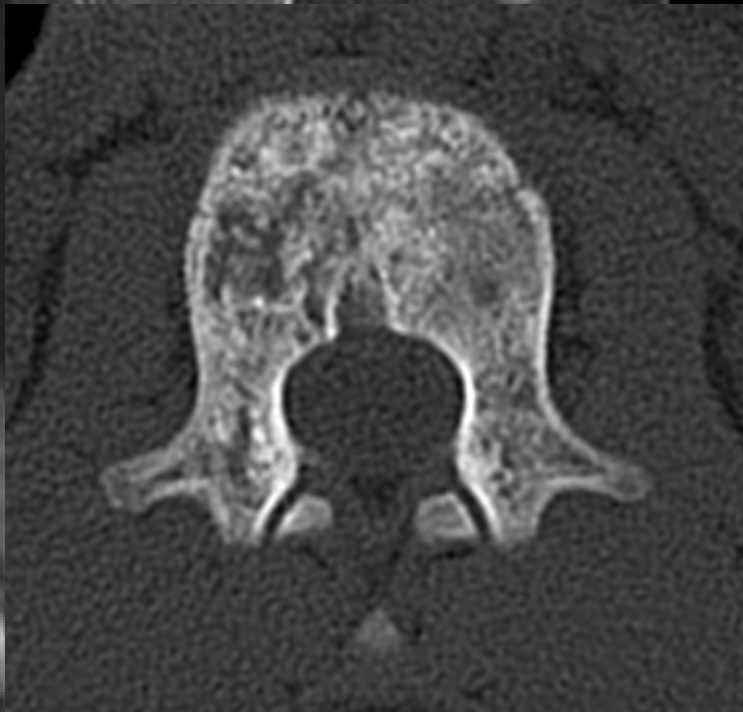
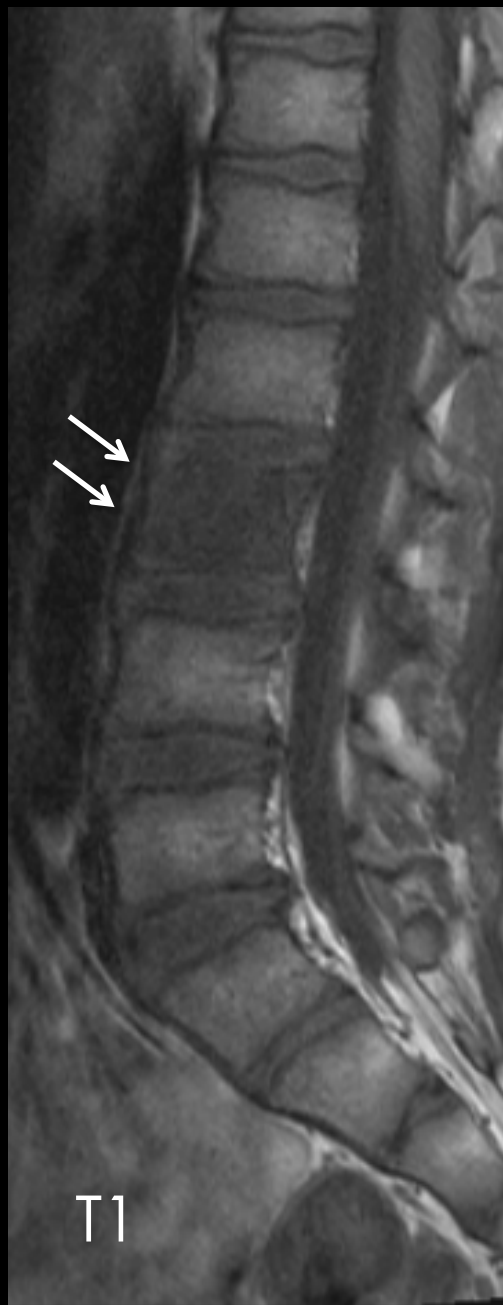


SPONDYLODISCITIS

Francesco 9 years old

Pain after minor trauma one month before





HISTOLOGY

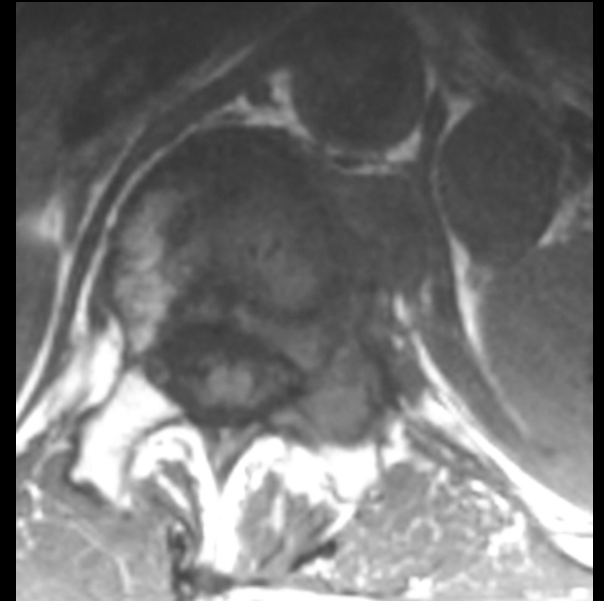
“reactive/regenerative lesion with chronic
inflammatory infiltrate (lymphoplasmacellular)”

Tumoral cells not visible



«CHRONIC NON BACTERIAL OM»
(CNO)

VERTEBRAL COLLAPSE



SURRENALIC TUMOR RELAPSE

EARLY
ONSET



OSTEochondrodysplasias

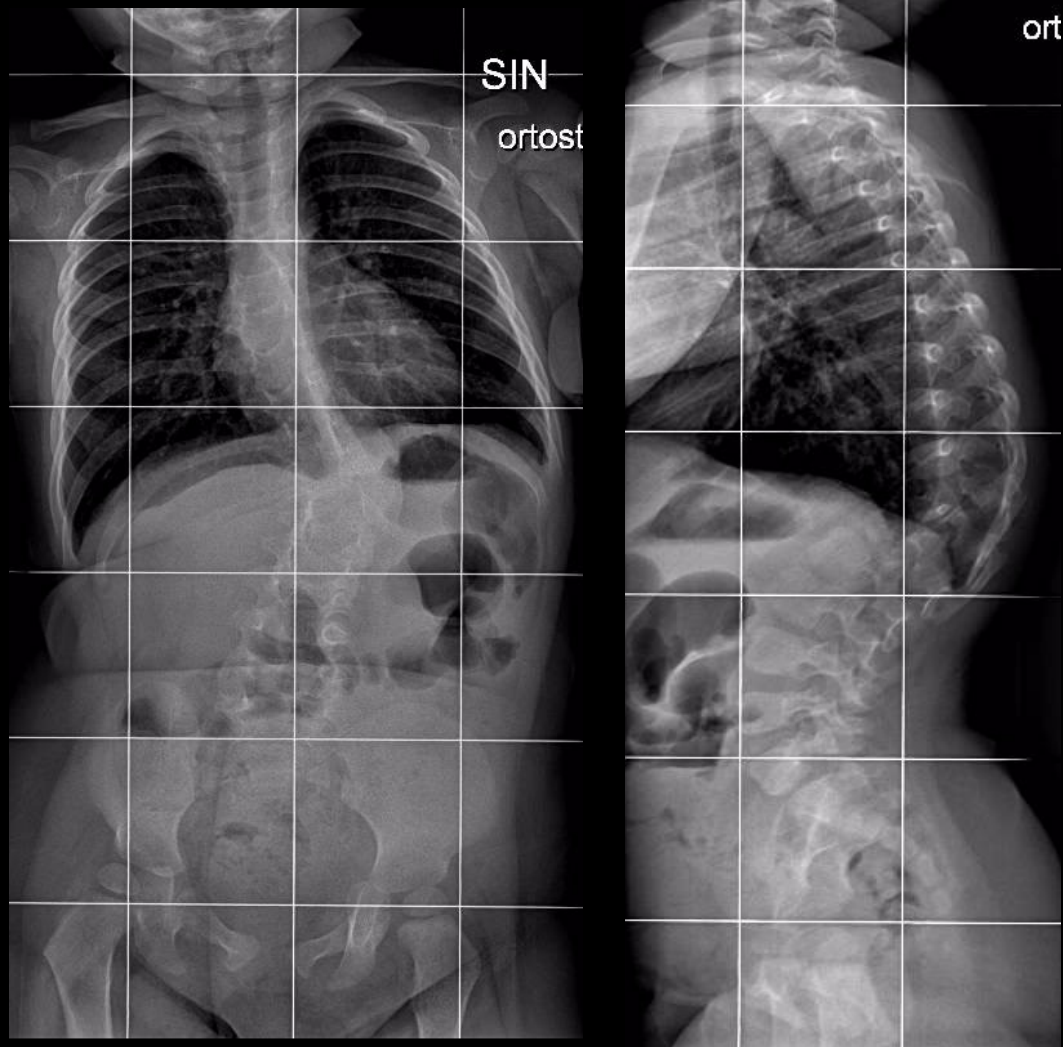


DIASTROPHIC DYSPLASIA



SECKEL SYNDROME TYPE II

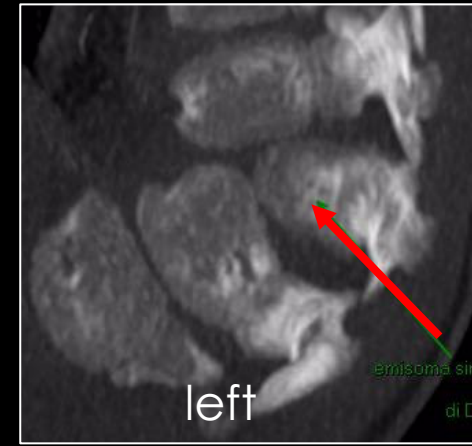
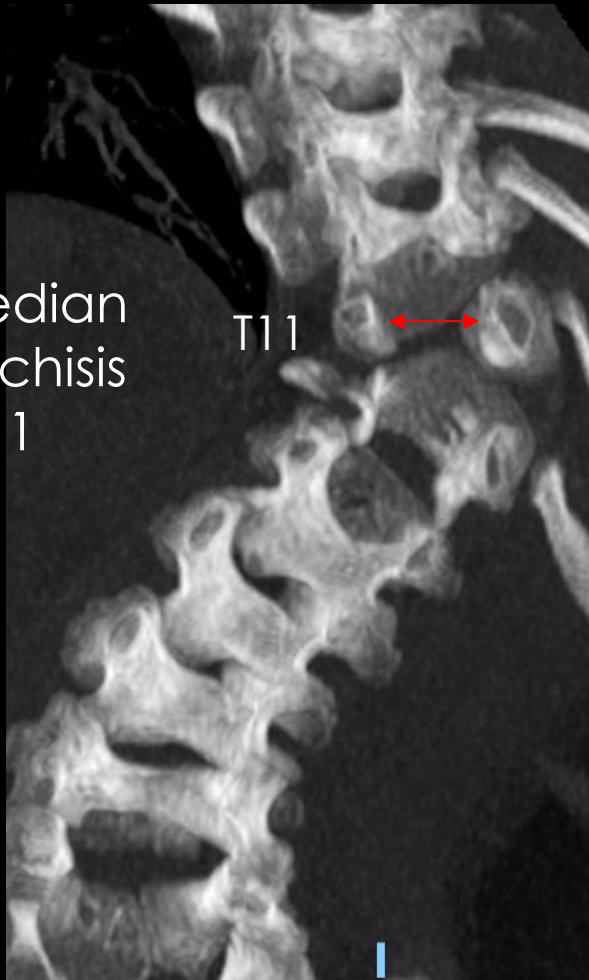
Federico 2 years old



CONGENITAL SCOLIOSIS

CT

Wide median
somatoschisis
on T11



BUTTERFLY VERTEBRA
with asymmetrical hemisoma with
cuneal deformity

FAST

EVOLUTION OF THE
CURVE





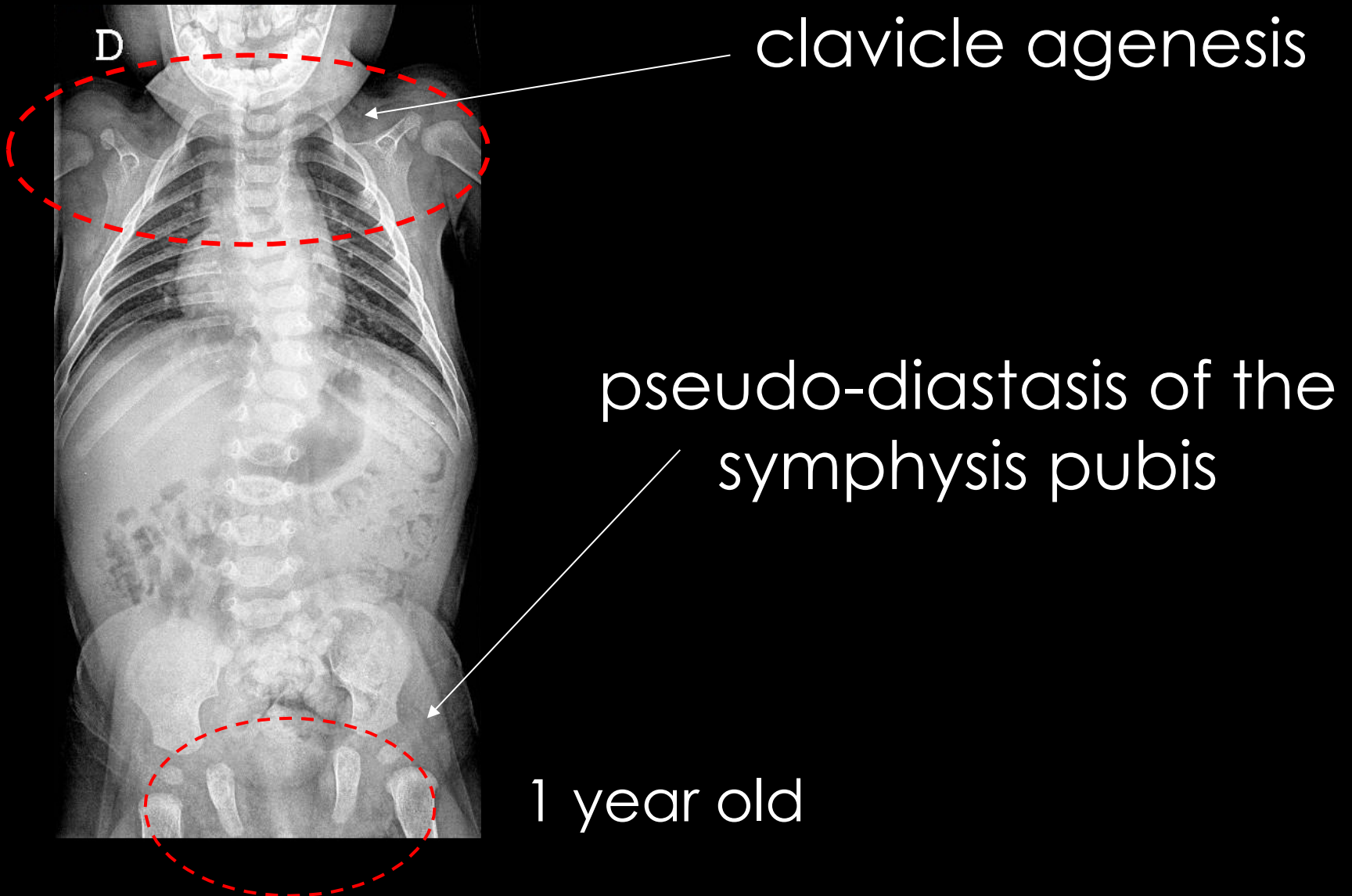
1 year old



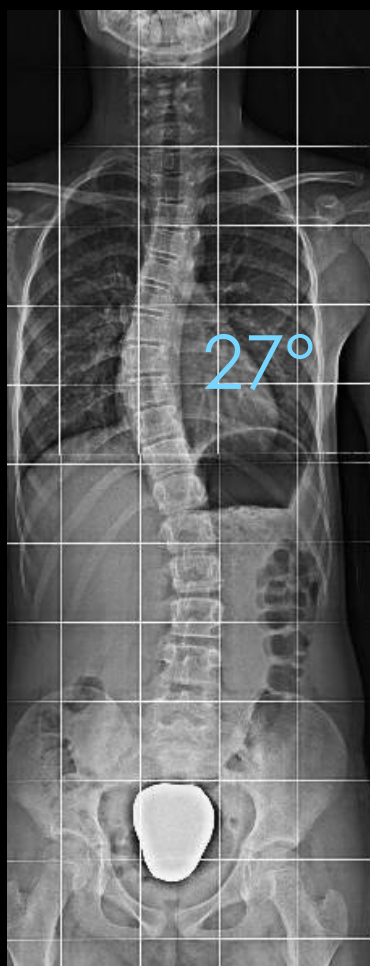
3 years old

any
other
sign?

CLEIDOCRANIAL DYSOSTOSIS



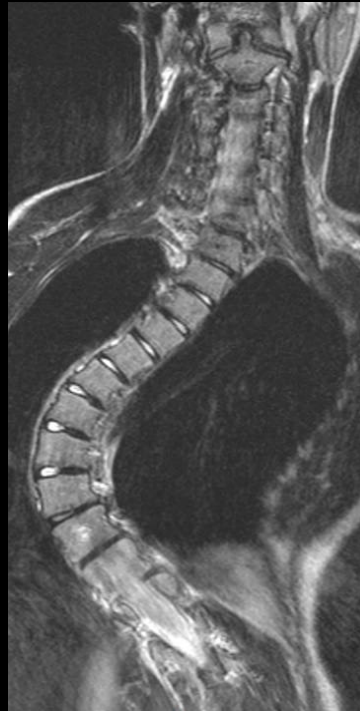
Multifidus muscle signal alteration



10 years-old



11 years-old



Pediatr Radiol (1999) 29: 360–363
© Springer-Verlag 1999

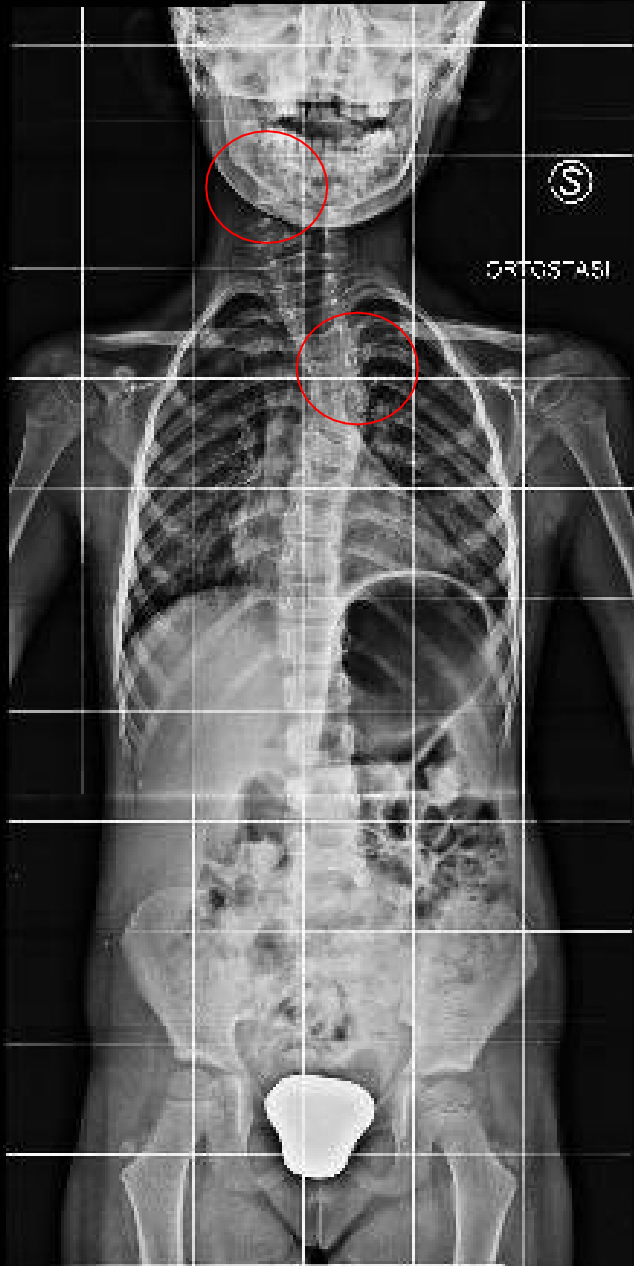
Yu-Leung Chan
Jack C.Y. Cheng
Xia Guo
Ann D. King
James F. Griffith
Constantine Metreweli

**MRI evaluation of multifidus muscles in
adolescent idiopathic scoliosis**

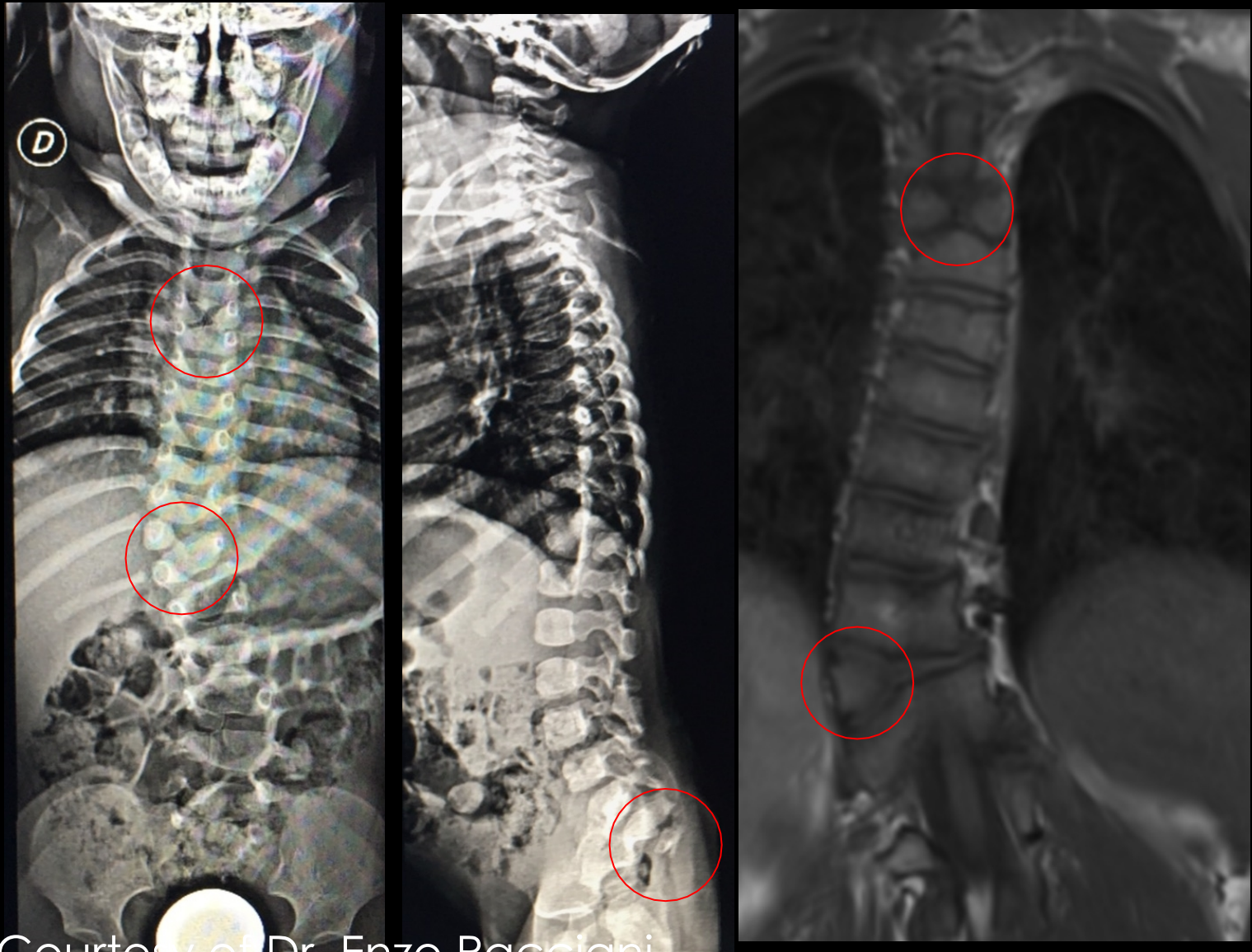


FORMING BONE DEFECTS

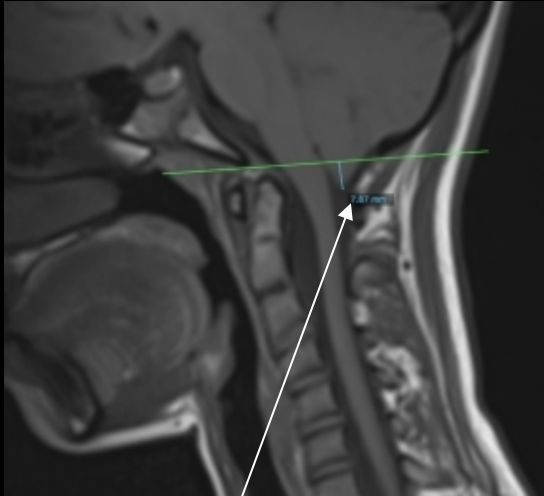
Valentina 5 years old



Chiara 3 years old



Courtesy of Dr. Enzo Pacciani

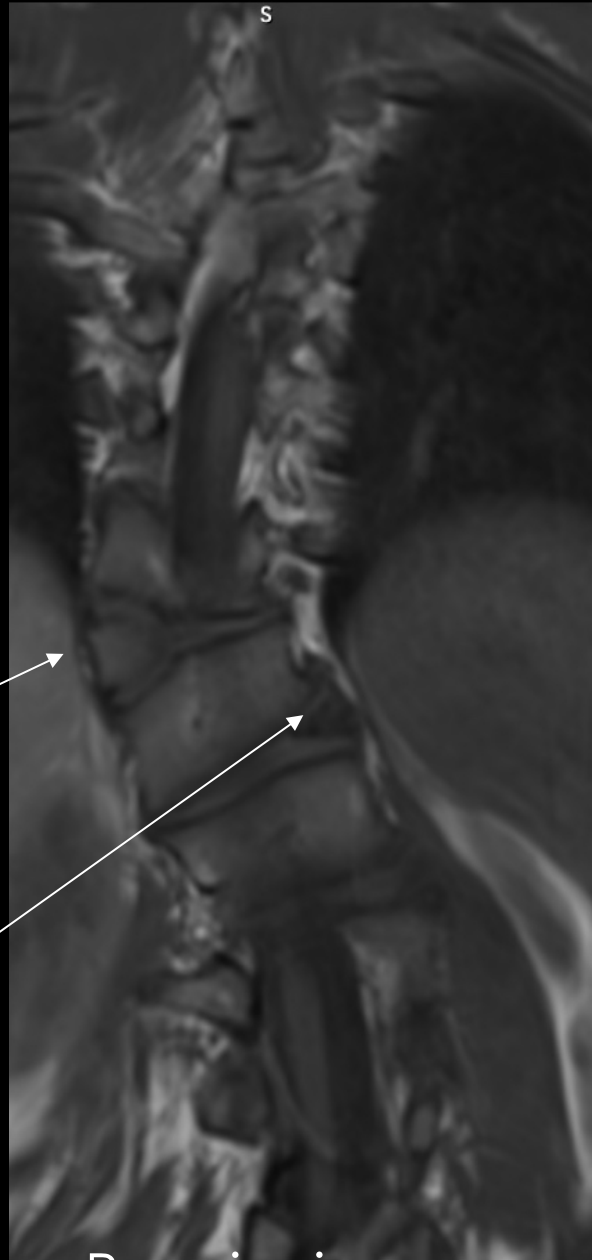


CHIARI 1

T11 RIGHT
HEMIVERTEBRA

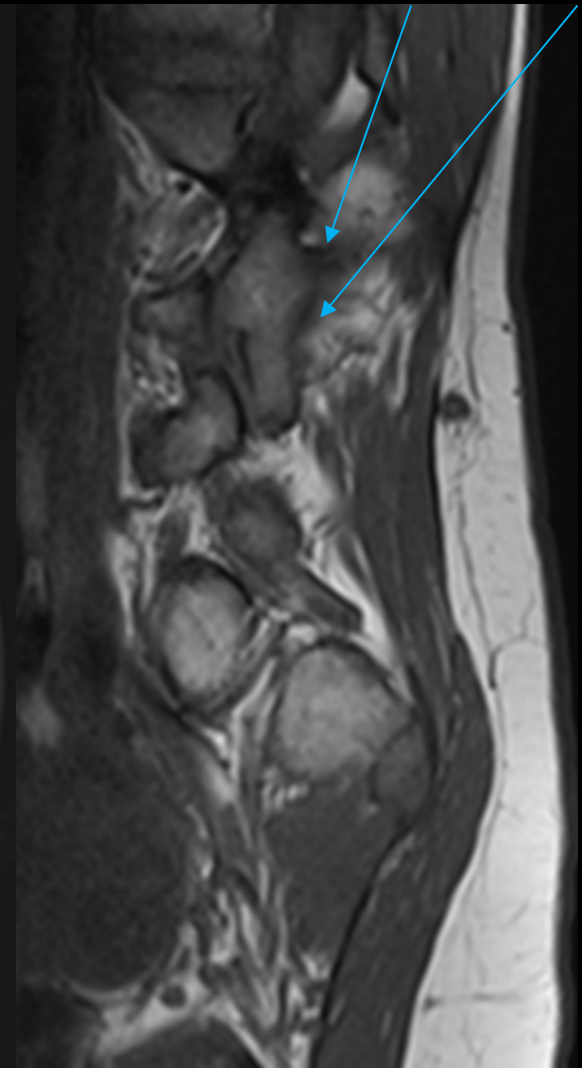
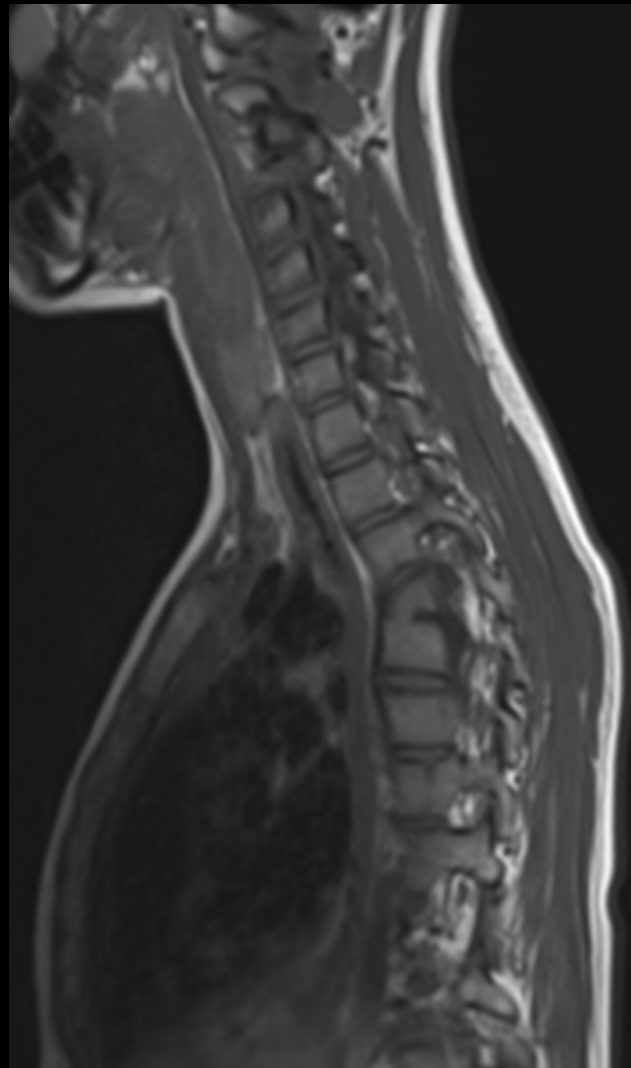
SUPERNUMERARY LEFT
HEMIVERTEBRA
INTERPOSED BETWEEN
T12 AND L1 FREE FROM
RIB

Courtesy of Dr. Enzo Pacciani



SACRAL DYSGENESIS

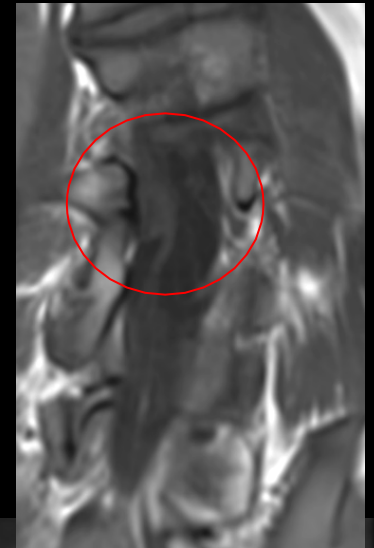
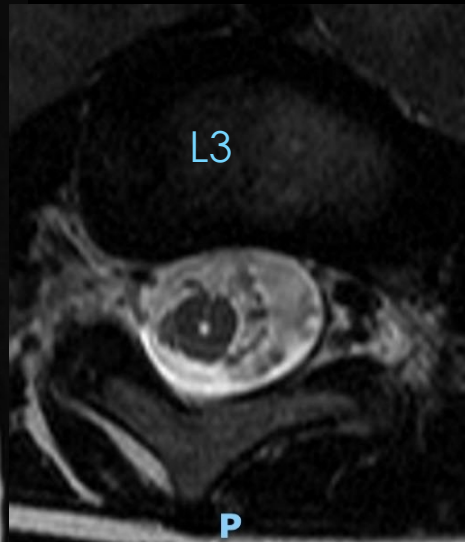
Right bone
bar L3-L4



Courtesy of Dr. Enzo Pacciani

11 years old

INCLUSION CYST IN CONGENITAL SCOLIOSIS



3 years-old

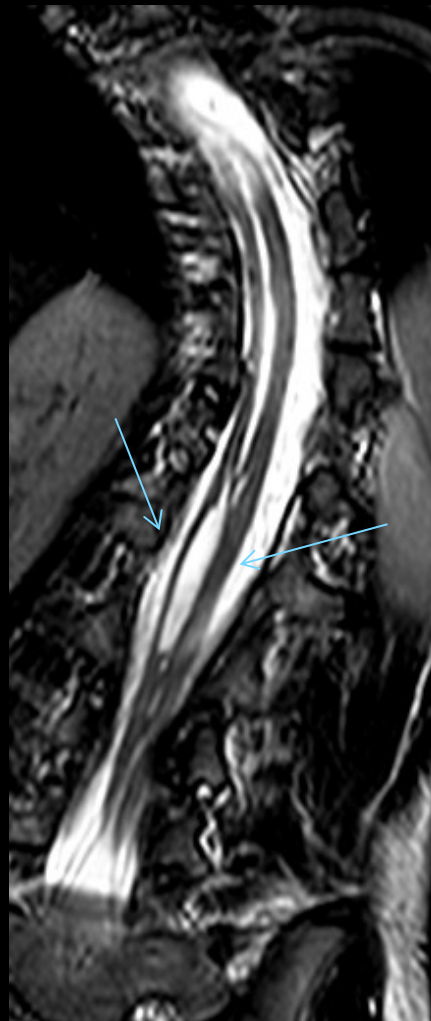
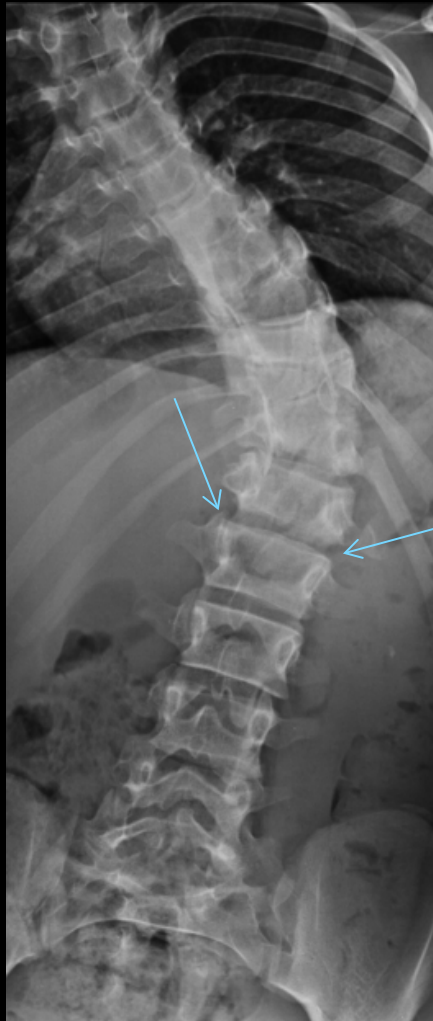
Courtesy of Dr. Enzo Pacciani

11 years-old



WIDENING OF THE
INTERPEDICULAR
DISTANCE

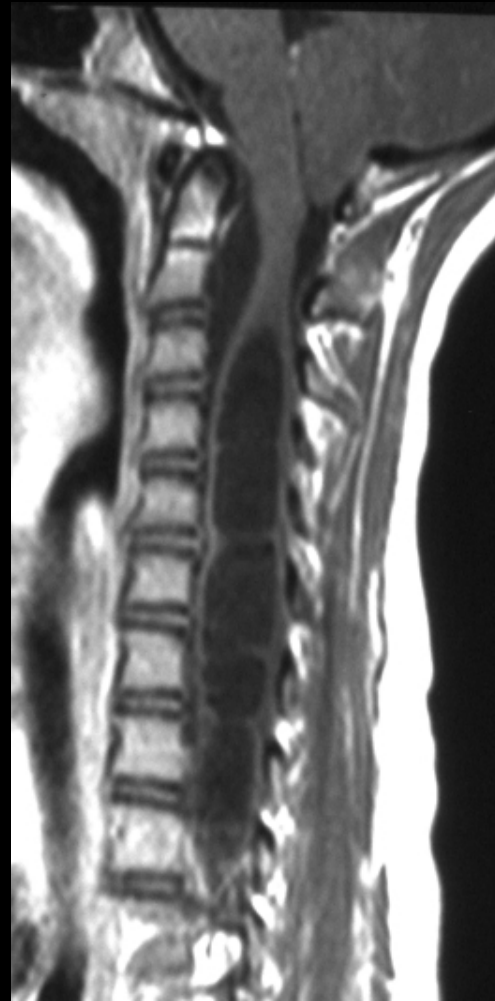
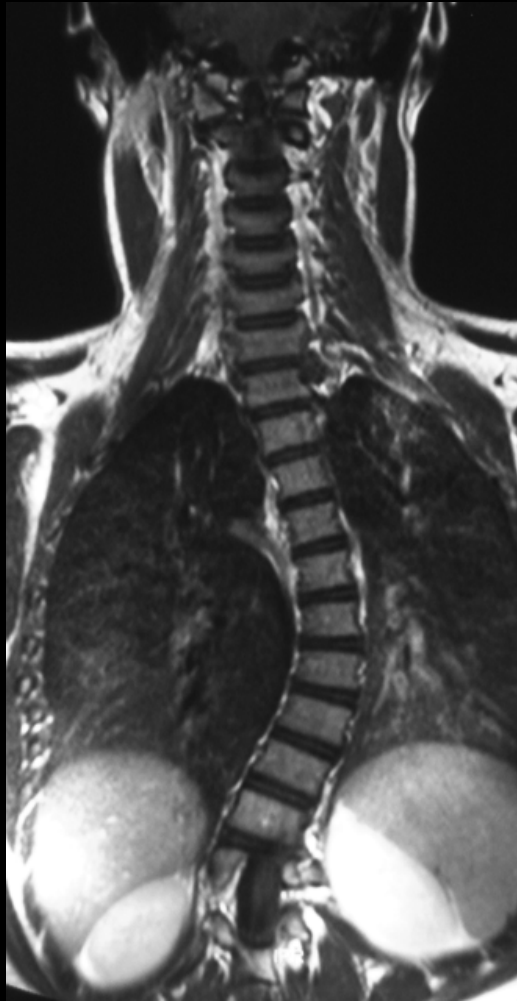
DIASTEMATOMYELIA



SYRINGOMYELIA



SYRINGOMYELIA

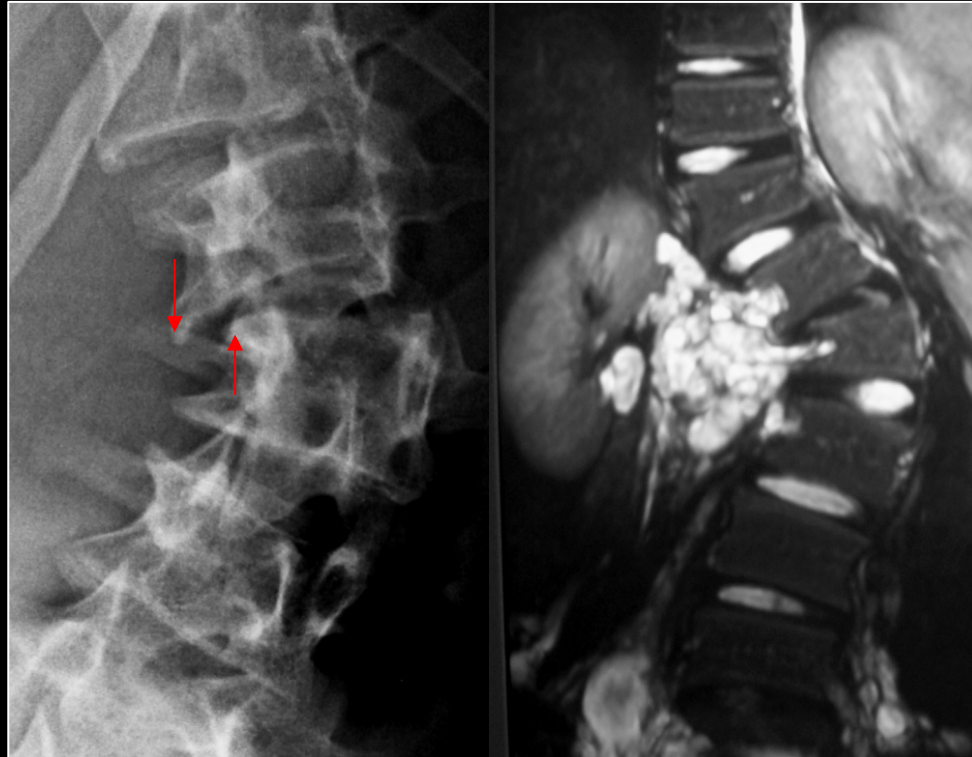
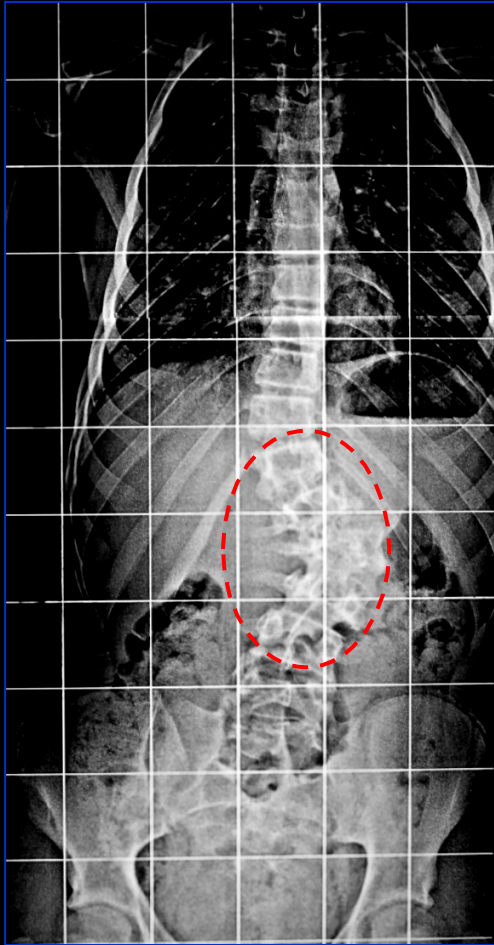


SINGLE THORACIC OR THORACO- LUMBAR CURVATURE



NEUROFIBROMATOSIS (NF1)

Short-radius, stiff, rapidly evolving curve



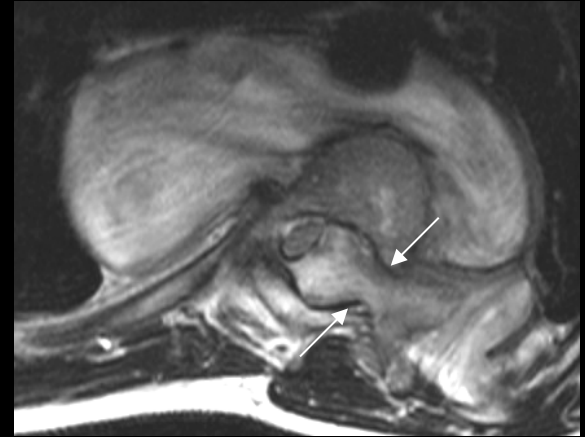
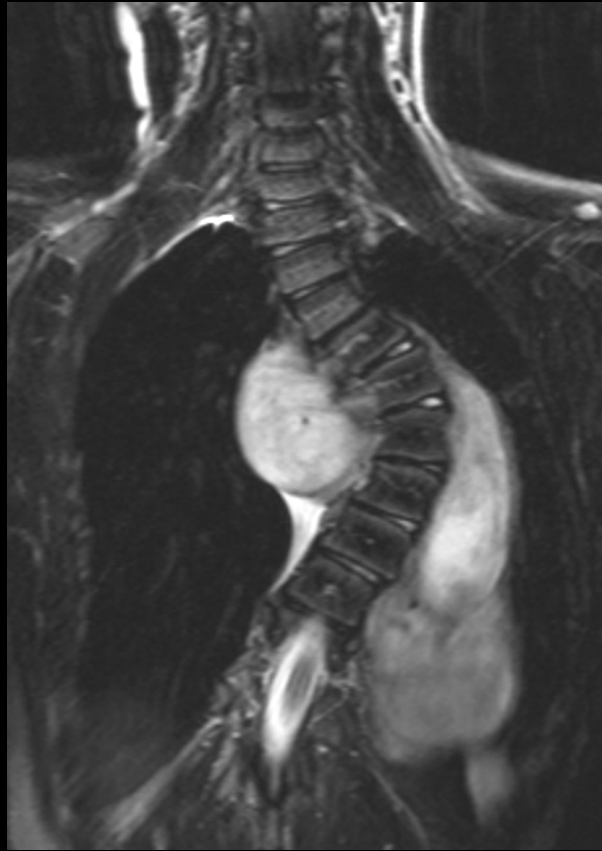
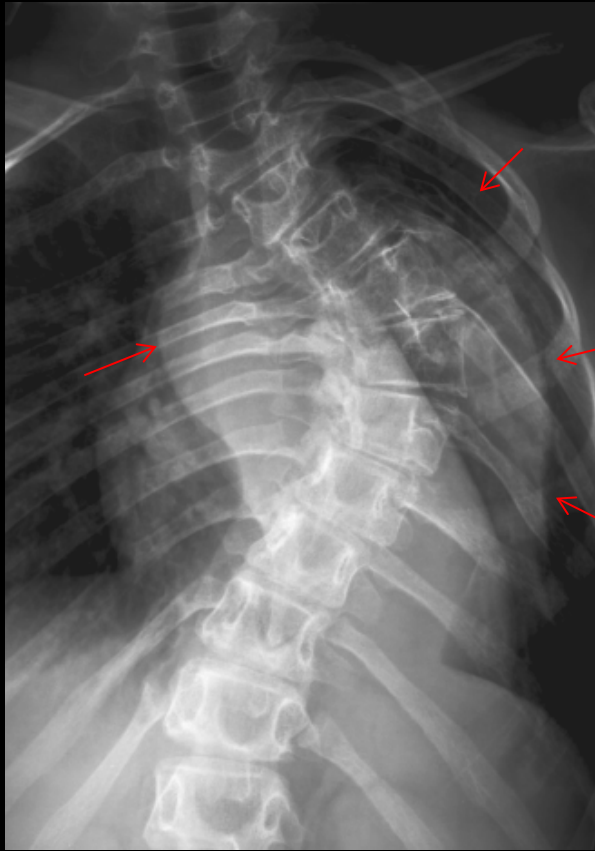
Somatic subluxation caused by
dural ectasia and/or
plexiform neurofibromas is frequent



IDIOPATHIC SCOLIOSIS?

PARAVERTEBRAL LESIONS

(ganglioneuroblastoma)



Incidental finding during
pre-surgical imaging

paravertebral bulky mass with intraspinal extension

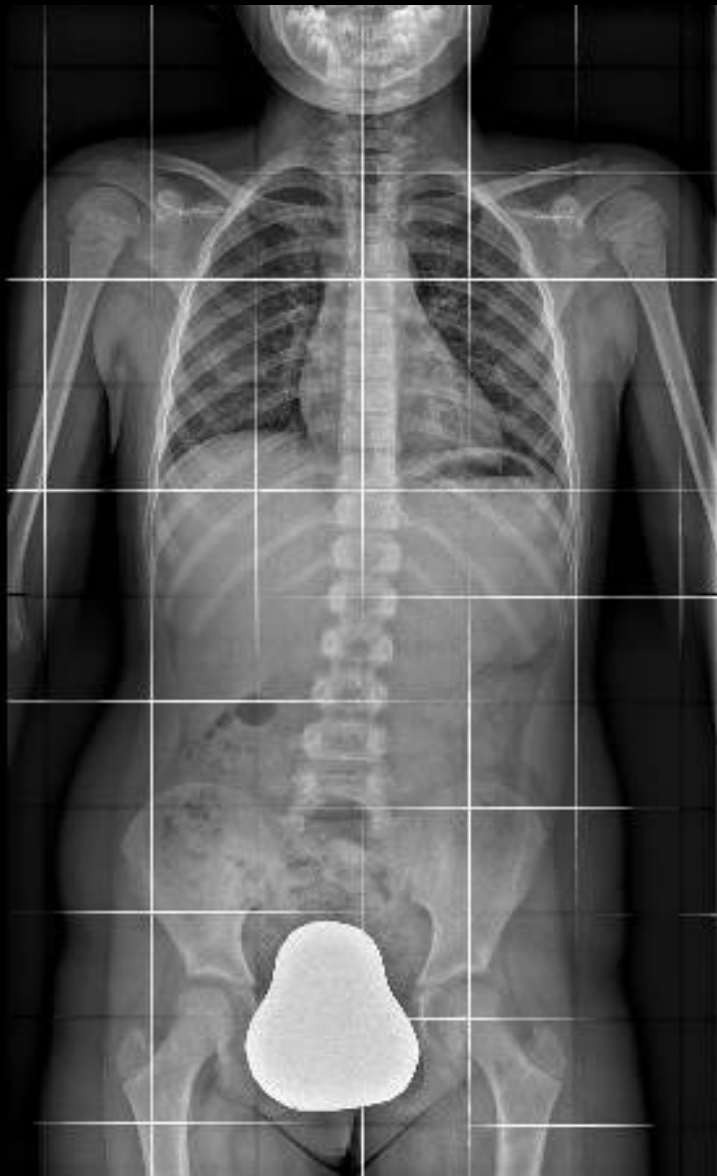


LOOK
EVERYWHERE!!

Giulia 7 years old



Anything
else?





SCOLIOSIS

Types of structural scoliosis

Warning signs on X-ray

Diagnostic approach

Key messages

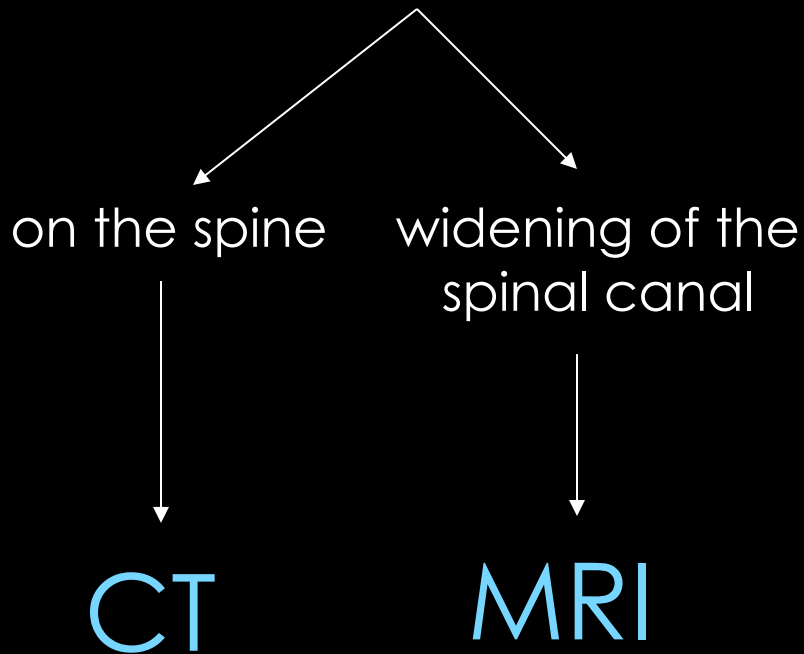


PAINFUL SCOLIOSIS: DIAGNOSTIC APPROACH

X Ray

Visible lesion

Not visible lesion



Bone scintigraphy

hypercaptation

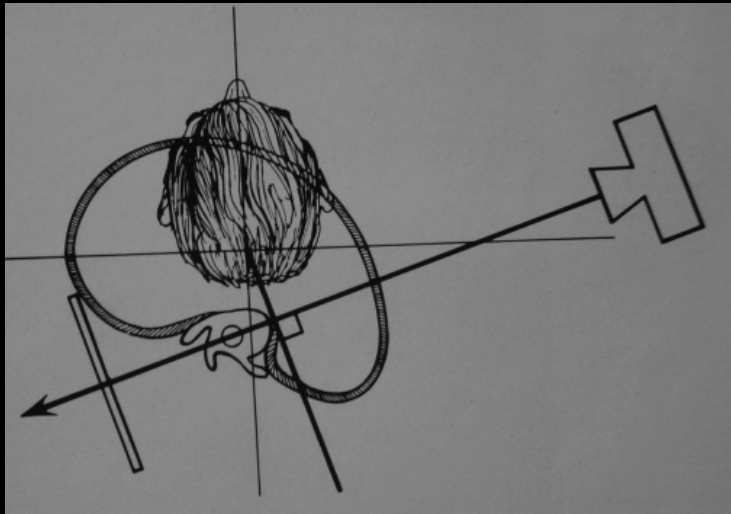
no hypercaptation

CT

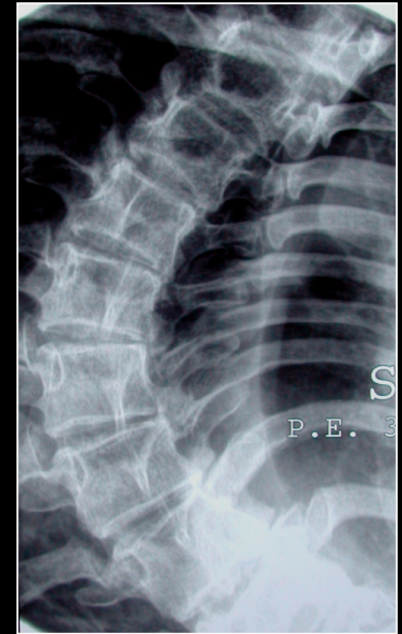
MRI

STAGNARA DEROTATION VIEW

Morphologic evaluation
of the vertebral
anatomy in severe
deformities



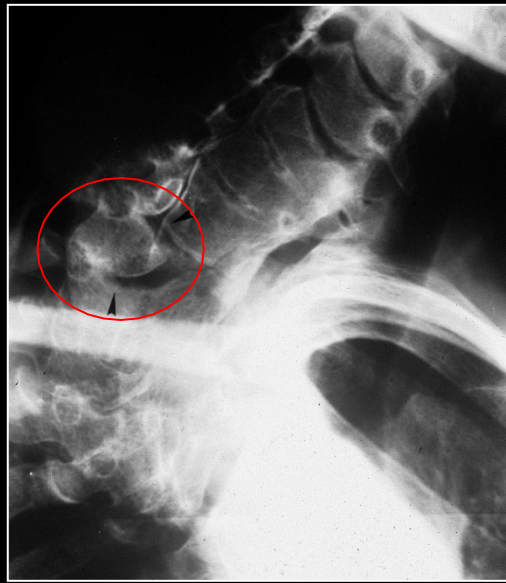
PA



Stagnara

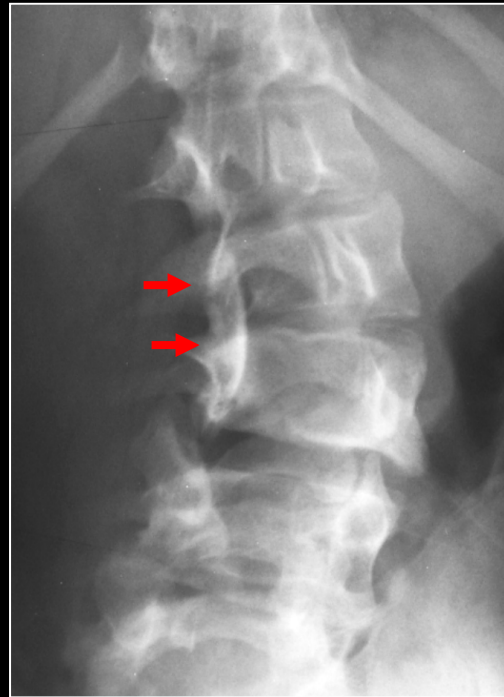


PA



Stagnara

T1 HEMIVERTEBRA



L2-L3 UNILATERAL BAR

SCOLIOSIS

Types of structural scoliosis

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KEY MESSAGES

- Be aware of pain, early onset and single thoracic curves
- Structured worsening scoliosis (++ Risser < 2) and neurological signs: perform always MRI
- Idiopathic scoliosis is not always idiopathic
- Don't stop at the first visible alteration
- Look everywhere!



OSPEDALE PEDIATRICO
Bambino Gesù



thank you

When MRI in scoliosis?

CONGENITAL DEFORMITIES
NEUROFIBROMATOSIS
other forms (idiopathic
excluded)

Absolutely **YES**
particularly before
surgery

When MRI in scoliosis?

IDIOPATHIC
SCOLIOSIS

Neurological symptoms

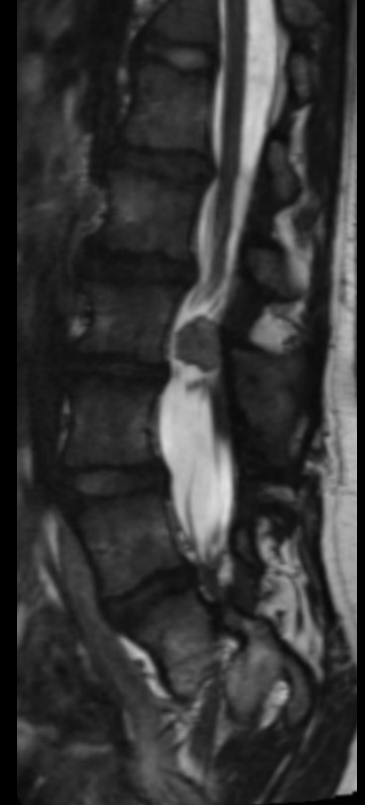
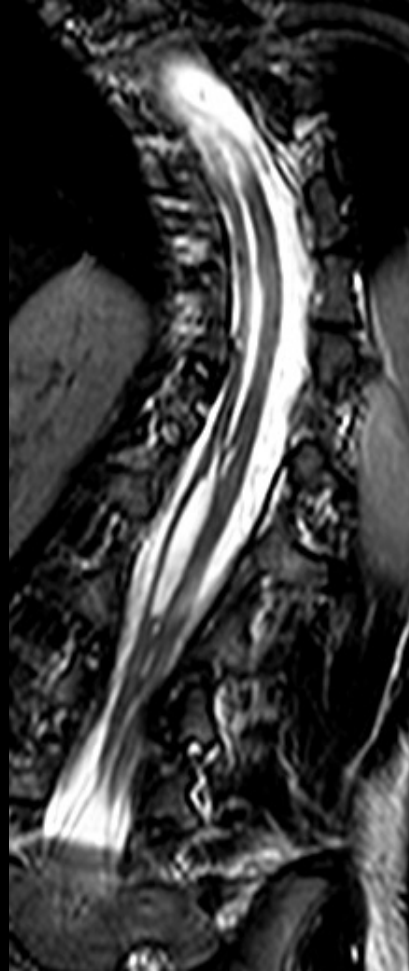
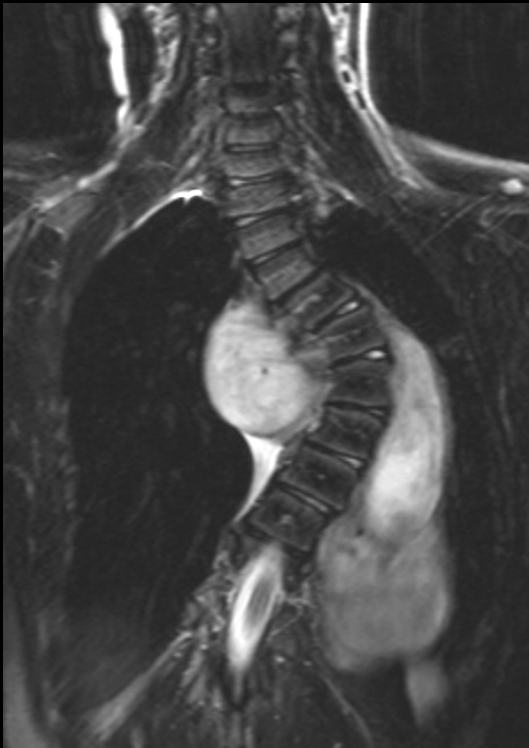
Single curve (thoracic or thoraco-lumbar)

Fast progression of the curve
++ before skeletal maturity

still controversial



MRI

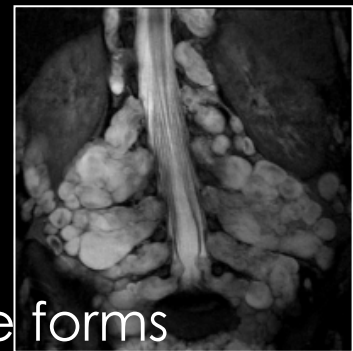
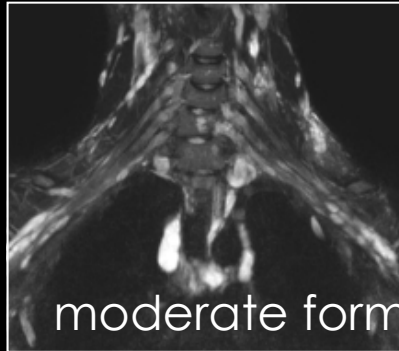


NEUROFIBROMATOSIS

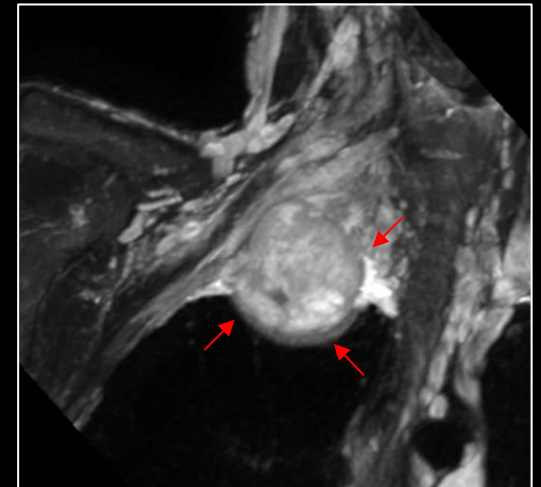
an additional study of the nerve plexuses is appropriate

MR-NEUROGRAPHY with T2 STIR sequences

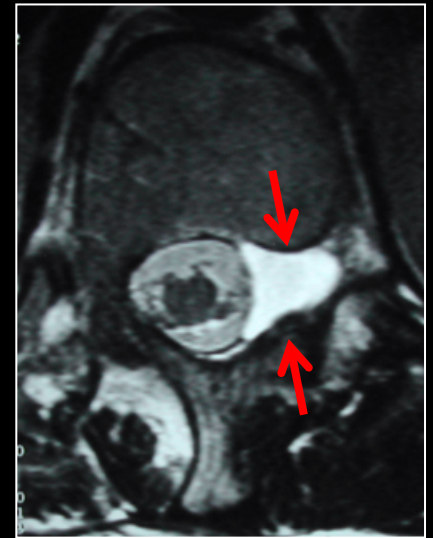
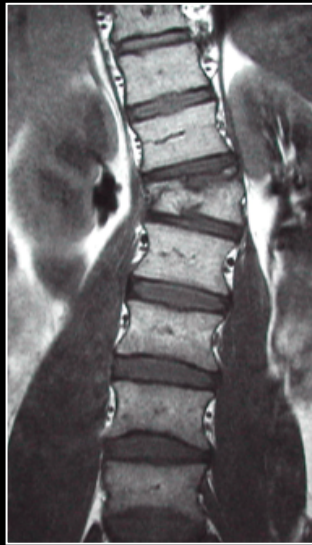
depicts the degree
of involvement of
the plexual
structures



compression of the neural structures
and possible signs of neurofibromas
degeneration



POST-TRAUMATIC SCOLIOSIS



MRI is useful to detect associated radicular lesions

SCOLIOSIS DURING INFLAMMATORY DISEASES



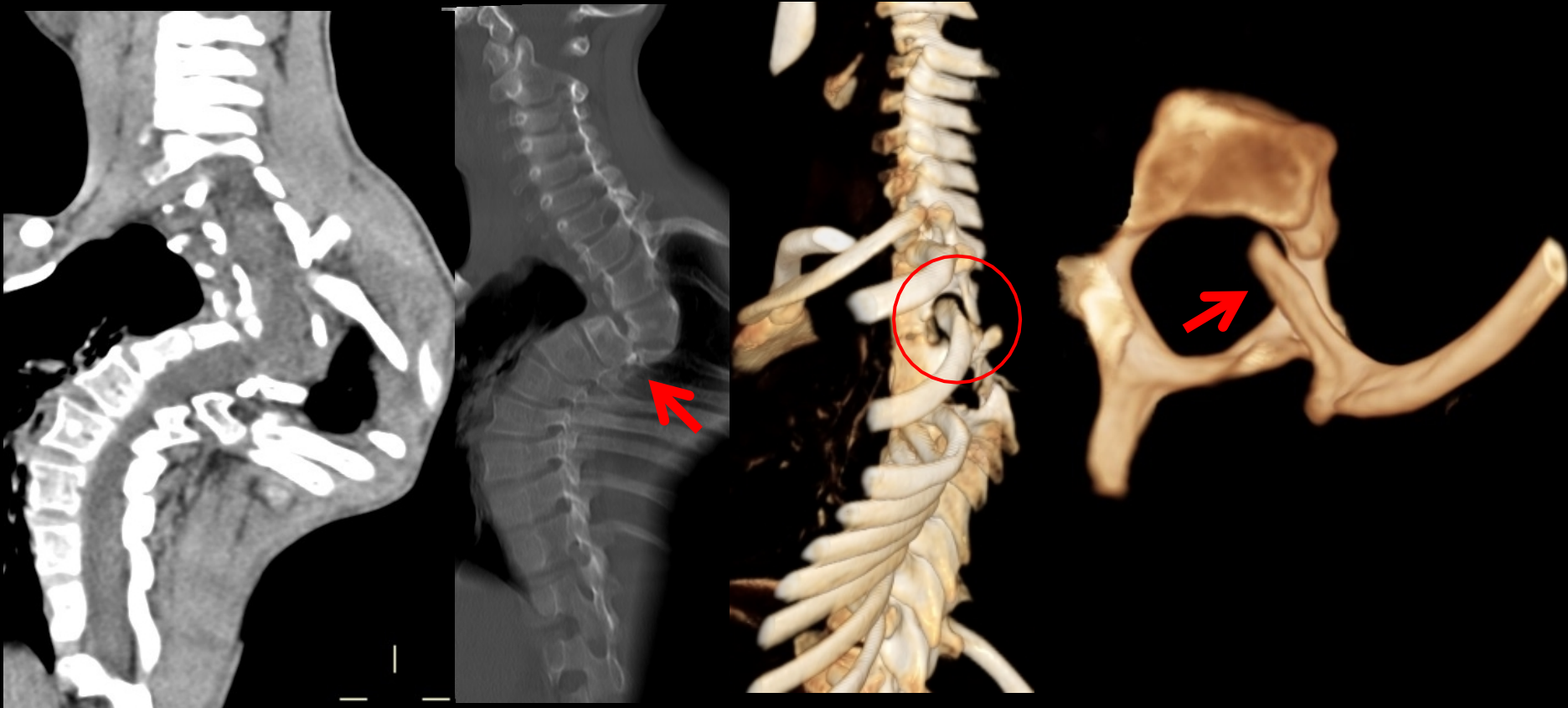
CT

limit the use of CT to the
effective needs

Possibly focusing the study to
the location/s of the bone
alterations visible on X-ray
(*congenital scoliosis, NF1, suspected
tumoral lesion*)

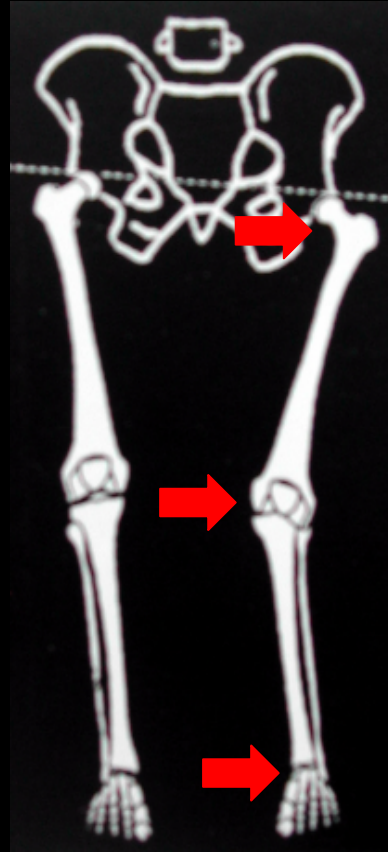
NEUROFIBROMATOSIS

PRESURGICAL EVALUATION OF
bone lesions secondary to dural ectasia
(vertebral bodies luxation, intraspinal dislocation of ribs)



IMAGING IN SCOLIOSIS

SPINAL ASIMMETRY



STATIC

Generally due to lower limbs heterometry or monolateral deformities (coxa vara, knee valgus, flat foot)



POSTURAL

Pelvis in axis
Generally during growth (self-resolving)



SEVERE KYPHOSCOLIOSIS

OSTEochondrodysplasias

Stiff curves from the first years of life, sometimes responsible for severe kyphoscoliosis



CHONDRODYSPLASIA PUNCTATA