Diagnostic Imaging Pathways - Paediatric, Scoliosis (Adolescent)

Population Covered By The Guidance

This pathway provides guidance on imaging an adolescent with scoliosis.

Date reviewed: July 2017

Date of next review: July 2020

Published: December 2017

Quick User Guide

Move the mouse cursor over the PINK text boxes inside the flow chart to bring up a pop up box with salient points.
Clicking on the PINK text box will bring up the full text.
The relative radiation level (RRL) of each imaging investigation is displayed in the pop up box.

SYMBOL	RRL	EFFECTIVE DOSE RANGE
	None	0
	Minimal	< 1 millisieverts
	Low	1-5 mSv
	Medium	5-10 mSv
	High	>10 mSv

Pathway Diagram

SUSPECTED ADOLESCENT SCOLIOSIS

Date reviewed: July 2017
Please note that this pathway is subject to review and revision

Plain radiography (PA film)

Cobb angle < 10°

Cobb angle > 10°

Does not meet criteria for scoliosis

Plain radiography (lateral film)

Are any of the following red flags present ?

- Severe pain (back, neck, headache or radicular pain)
- Abnormal neurological examination
- Atypical curve features (left thoracic, short segment of 4-6 levels, rapid progression of > 1° per month, absence of thoracic apical segment lordosis)
- Age at presentation < 11 years

No

Yes

If surgical correction being considered

Further Imaging as required by Orthopaedic Surgeon

MRI

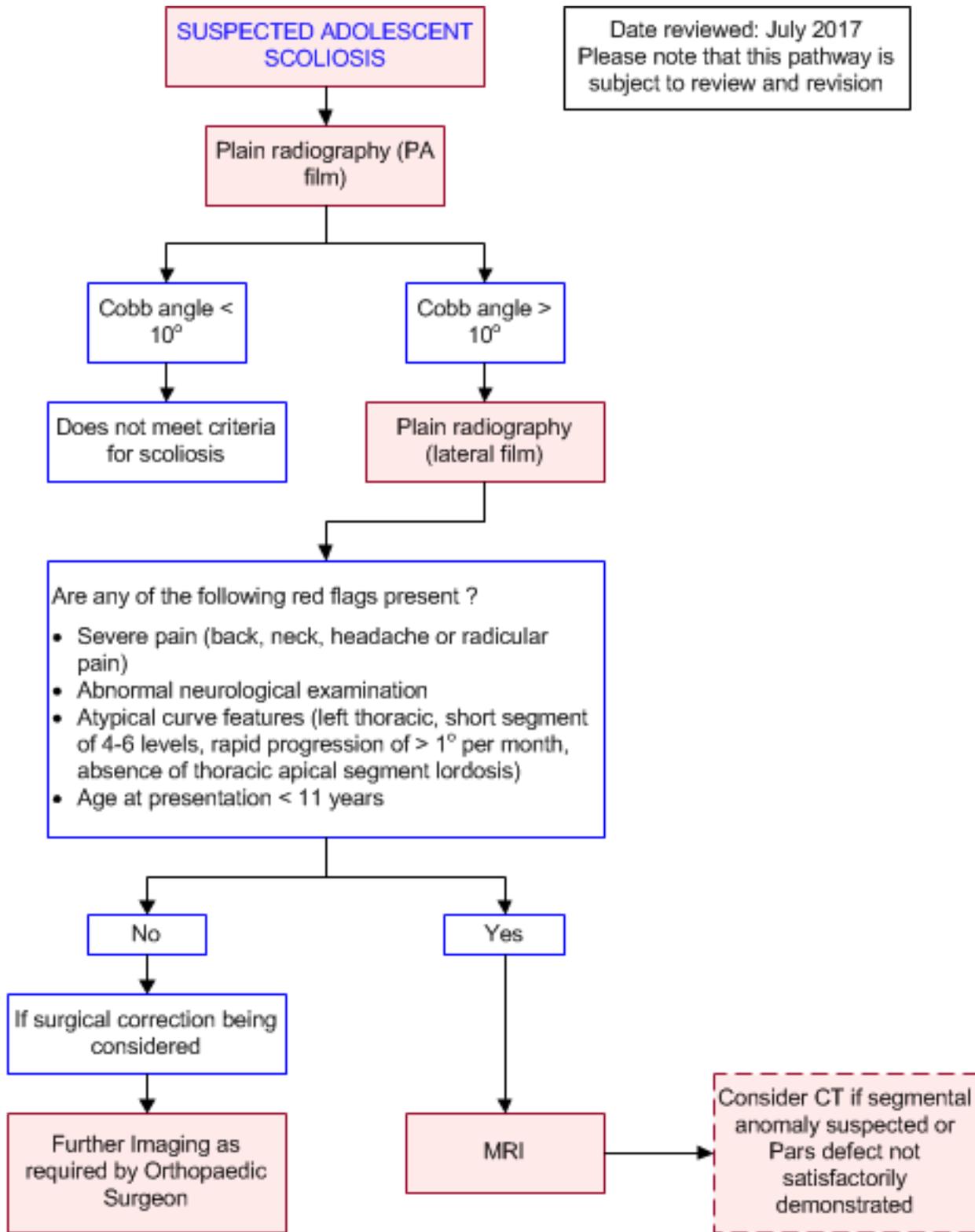Consider CT if segmental anomaly suspected or Pars defect not satisfactorily demonstrated

Image Gallery

Note: Images coming soon

Teaching Points

- Scoliosis can arise from a variety of causes and is defined as a >10° abnormal lateral curvature of the spine in the coronal plane as defined by the Cobb angle
- The most common cause of scoliosis in children is idiopathic
- The primary imaging modality for evaluating adolescent scoliosis is a single PA erect film of the entire spine and including the iliac crests. A lateral film may also be performed
- The PA view is standard as it reduces the radiation dose to thyroid and breast
- Judicious use of radiation reduction techniques (e.g. contoured filter, air gap technique) and attention to imaging frequency are needed to minimise the radiation burden as patients with scoliosis are monitored with serial radiographs
- MRI is indicated for detection of spinal cord abnormalities when one or more "red flag" features are present
- The role of MRI for imaging all patients prior to surgical correction remains controversial. Recent studies indicate MRI is not required in preoperative patients with a negative history, normal physical examination and a typical curve pattern
- Prior to surgery, passive lateral bending plain films in the frontal plane enables the surgeon to measure the degree of correction and determine the levels included in the operation

Adolescent Scoliosis

- Scoliosis is defined as >10° abnormal lateral curvature of the spine in the coronal plane, often associated with axial rotation [1, 2]
- Scoliosis can be classified as structural or non-structural (functional). Functional scoliosis can be postural or compensatory. It is non-progressive and correctable by ipsilateral bending [1, 3]
- Structural scoliosis can be classified into 5 aetiological causes: idiopathic (80%), congenital (10%), or associated with neuromuscular, developmental and other miscellaneous diseases [3]
- Idiopathic scoliosis is a diagnosis of exclusion and can be subdivided based on age of onset: infantile (from birth to 3 years – 10 years and before skeletal maturity - 2-4%) [1-6]
- Adolescent idiopathic scoliosis has a prevalence of 0.5-3% and is the most common form of the disease. Females are predominantly affected (female : male ratio 5-10:1) and are more likely to have more progressive disease and severe curves [2, 4, 6]
- Adam's test was 92% sensitive and 60% specific for detecting thoracic curves >20° and 73% sensitive and 68% specific for lumbar curves >20°, when compared with Cobb's angle as the gold standard [7]

Plain Radiography

- The primary imaging modality for evaluating adolescent scoliosis should include a posteroanterior erect film of the entire spine and including the iliac crests [1, 2, 4, 5]
- The PA view is standard as it reduces the radiation dose to thyroid and breast tissue despite delivering increased radiation absorption to bone marrow. Bone marrow is only one-sixth as sensitive to radiation as breast tissue [3]
- Authors are also increasingly recommending a lateral film as part of the initial radiographic investigation [3, 4, 8]
- The lateral view is necessary to determine the absence of apical segment lordosis of the thoracic spine (i.e. the presence of normal thoracic kyphosis or hyperkyphosis) which is considered an atypical curve pattern and found to be associated with increased incidence of neuroaxis

abnormalities 4, 9, 10

- The scoliosis curve is described as "right" or "left" depending on their convexity and named by the location of the apex vertebrae
- The Cobb method is used to quantify the degree of scoliosis. A line parallel to the superior end plate of the most cephalic tilted vertebra and a line parallel to the inferior end plate of the most tilted caudal vertebra are drawn. Perpendicular lines to these are drawn and the Cobb angle is measured where the lines intersect 5, 11
- Factors which reduce the reproducibility include patient position, radiographic technique and diurnal variation (5%deg; reported in one study) 1, 3
- Hence, in the monitoring of scoliosis a 10° difference of the Cobb angle between radiographs taken at different times is necessary in order to be 95% confident that a true change in scoliosis has occurred 3
- The PA film compared to the AP view, reduces cumulative radiation dose to the thyroid gland and breast by 3 to 7 fold and would reduce the estimated risk of lifetime cancer by 3 to 4 fold 1, 6
- A retrospective cohort study of 5573 female patients with scoliosis diagnosed before the age of 20 has shown that scoliosis patients are exposed to an average of 25 radiographs per patient with a mean estimated cumulative radiation dose to the breast of 10.8 cGy. The relative risk of dying from breast cancer was 1.7 (95% CI = 1.2-2.1) after an average of 40 years follow-up (77 observed breast cancer deaths vs 45 expected deaths in this population) 1, 3, 6

Preoperative Lateral Bending Views

- Passive lateral bending view in the frontal plane enables the surgeon to measure the degree of correction and determine the levels included in the operation 1, 3, 8
- A chest radiograph is required to exclude any associated cardiopulmonary abnormalities 3, 8

Magnetic Resonance Imaging (MRI)

- MRI is the modality of choice for assessment of the spinal cord and paraspinal soft tissues in patients with scoliosis 5
- Spinal cord abnormalities are seen in 2-3% of patients with presumed adolescent idiopathic scoliosis 9, 12
- Abnormalities detected by MRI include tethered spinal cord, Chiari malformations, hydromyelia, syringomyelia, intramedullary tumours, diastamatomyelia and intra-spinal lipomas 13-15
- Commonly accepted indications for MRI include 4, 5, 14
  - Neurological findings including headache, neck pain, absence of abdominal reflex and asymmetric lower-extremity atrophy
  - A typical curve pattern: examples are thoracic levoscoliosis, short segment curve (less than six segments), decreased vertebral rotation, rapid progression, and kyphosis near the apex of curve. Other features on scoliosis radiographs requiring MRI may be an underlying tumour or infection, widening of an intervertebral foramen or thickening of the paraspinal line. 14 In one study, there was a 25% prevalence of neuroaxis abnormalities when both an atypical curve and neurological findings were present 9
  - Age of onset

References

Date of literature search: June 2017

References are graded from Level I to V according to the Oxford Centre for Evidence-Based Medicine, Levels of Evidence. Download the document

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