



Managing Adolescent Idiopathic Scoliosis (AIS) in Primary Care: Screening, Imaging and Successful Referral

ABSTRACT

Adolescent Idiopathic Scoliosis (AIS) is a condition requiring early detection for appropriate management. Bracing can be effective in preventing curve progression so failing to detect a small AIS curve in a growing child could result in losing the opportunity to avoid a major surgical procedure. Doubts about cost-effectiveness have ended most school screening programs and assessment is now provided mainly by primary care providers. The ability to conduct a quick effective scoliosis examination is important for the busy practitioner. This article illustrates the main features of the screening test, offers guides for imaging, and outlines appropriate tips for specialist referral.

KEYWORDS: Adolescent Idiopathic Scoliosis (AIS), diagnosis, physical exam, Adams Forward Bend Test, primary care



CME

Pre-test Quiz



Introduction

Adolescent Idiopathic Scoliosis (AIS) affects 3% of the adolescent population. It is defined as a three-dimensional, structural curvature of the spine that measures more than 10 degrees on radiographs using the Cobb angle method.¹ Only 3% of those with AIS require long-term close monitoring, brace treatment or surgery. Early detection of scoliosis via primary healthcare provider screening is somewhat controversial but is generally accepted and believed to be cost effective.² The recent landmark BRA-IST study demonstrated the effectiveness of bracing in a selected cohort of patients



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with more than one year of growth remaining and a curve greater than 20 degrees. The research emphasized the importance of early curve detection to increase effective brace use and reduce the frequency of surgery.³

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In the 1980s and 1990s, based on the best evidence available at the time, the British, American and Canadian Preventive Task Forces did not recommend the use of school screening programs.⁴ Despite the ongoing support for screening by all major physician groups that actively manage scoliosis including the Paediatric Orthopedic Society of North America, the Scoliosis Research Society, the American Academy of Orthopedic Surgeons⁵ and the Canadian Paediatric Spine Society, some Canadian and US sources continue to cite insufficient evidence to recommend routine AIS screening.^{6,7}

Girls should be screened at ages 10 and 12 and boys once at age 13 or 14.⁵ Girls are considerably more at risk for significant curves requiring treatment; boys are at less risk but tend to have more rapid progression. Siblings

and children of AIS-confirmed patients have higher prevalence rates of scoliosis and should be screened during their growth spurt. The authors routinely train parents of AIS patients to perform the Adams forward bend test (AFBT) so that they can screen other children in the family.

This article provides primary care providers with a simple, efficient guide to assess paediatric or adolescent spines for deformity and offers accurate measurement techniques for leg length discrepancy (LLD), which can result in a false-positive AFBT. Although there are clear indications for imaging and for referral, simply identifying a positive AFBT is usually sufficient to warrant consultation.

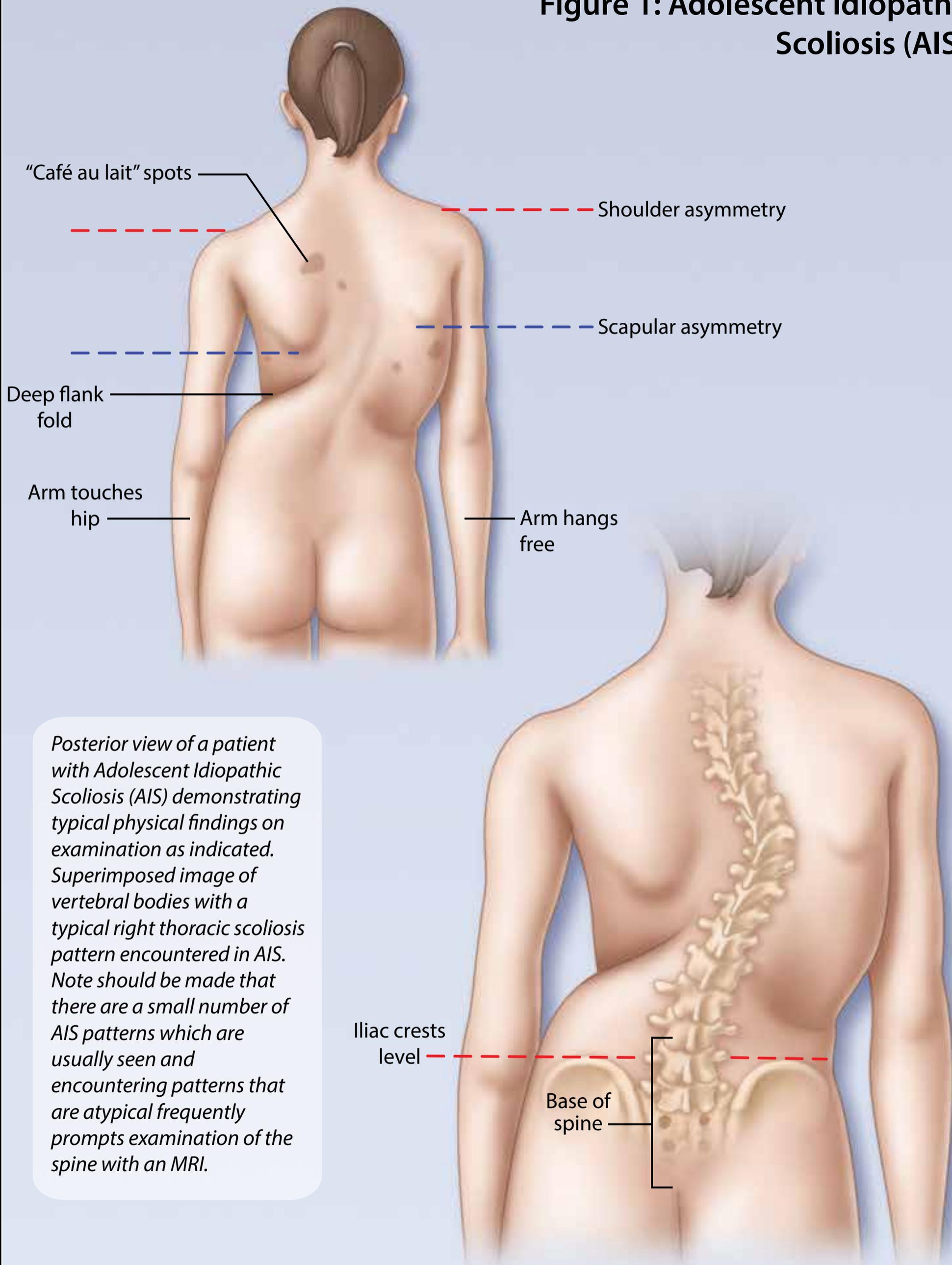
10 Tips for Effectively Screening for AIS in Less than 2 Minutes.

A preliminary note about examining these patients: the typical AIS patient is an adolescent who may be particularly sensitive about body development and habitus (Figure 1). Always ask if the patient agrees to have the parent(s) or guardian(s) in the examination room. This is almost always an acceptable arrangement but if the patient does not agree, ensure there is a chaperone present particularly for the Adams Forward Bend Test (Figure 3).

1. Have the patient appropriately dressed in undergarments only with a hospital gown open to



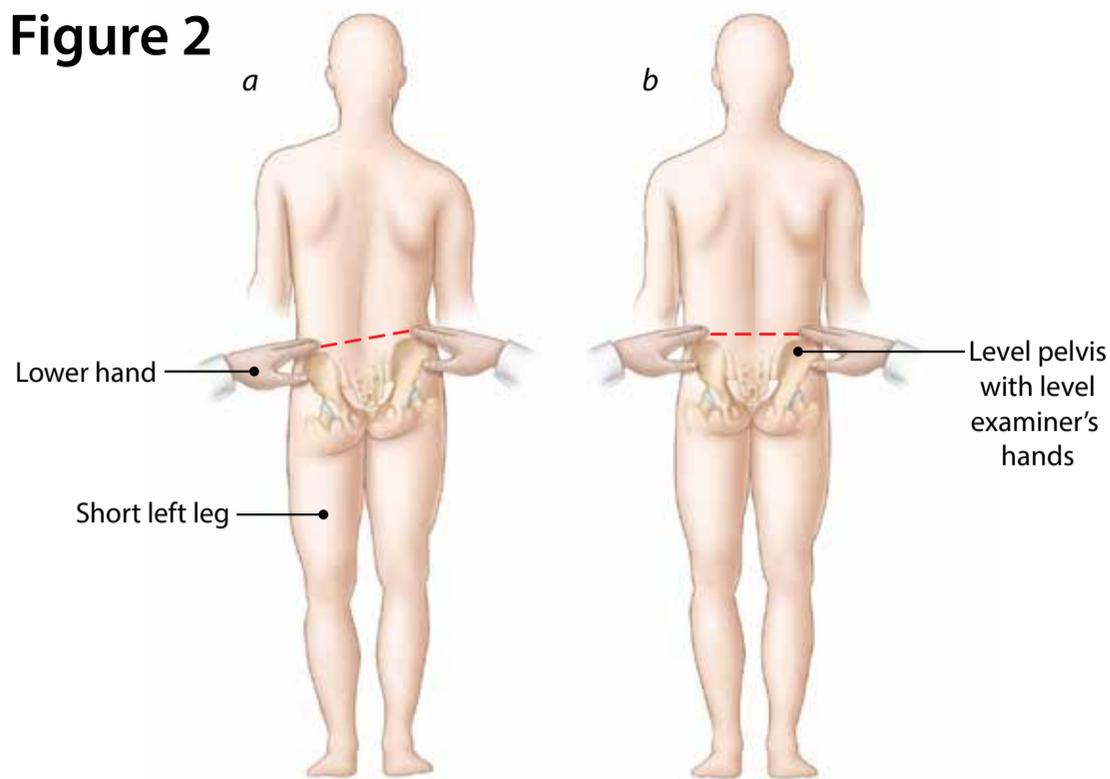
Figure 1: Adolescent Idiopathic Scoliosis (AIS)



Posterior view of a patient with Adolescent Idiopathic Scoliosis (AIS) demonstrating typical physical findings on examination as indicated. Superimposed image of vertebral bodies with a typical right thoracic scoliosis pattern encountered in AIS. Note should be made that there are a small number of AIS patterns which are usually seen and encountering patterns that are atypical frequently prompts examination of the spine with an MRI.



Figure 2



During the physical exam as the clinician is behind the subject preparing to do the Adams Forward Bend Test (AFBT) it is opportune to quickly place the hands flat and parallel to the floor on the edge of iliac crests to determine the presence of a leg length discrepancy (LLD). Viewing the clinician's hands can accurately determine if a LLD is present. The higher hand (right hand in Figure a) is the longer leg and an experienced examiner can estimate the extent of the LLD to within 0.5 cm. In this position the examiner can ensure that the knees of the patient are straight, as bending the knees can mimic a rib cage asymmetry. Figure b shows even hands and thus no LLD.

the back. This is necessary to examine the entire length of the spine down to the gluteal cleft. Use a private room with sufficient space for the parent(s), guardian(s) and/or chaperone. Parents and guardians will often ask to have the deformity pointed out to them.

2. Observe the spine for the common features of AIS: right-sided upper thoracic curve, café au lait spots, asymmetrical flanks, uneven scapulae and different shoulder levels. Offer to show these features to the parent(s) or guardian(s).
3. Ensure that the patient is barefoot. Palpate the height of the iliac crests to assess for leg length discrepancy, which can mimic a rib-cage asymmetry suggestive of AIS. (See Key Points of measuring LLD)



SUMMARY OF KEY POINTS

HOW TO MEASURE FOR LEG LENGTH DISCREPANCY

1. This can be done with a patient's gown open or closed at the back.
2. The measurement is performed with the examiner sitting and observing the patient from behind. It can be done at the same time as the AFBT, since the examiner is in the same position.
3. With the patient standing erect in bare feet and with the

knees extended, the examiner rests his/her hands on top of the iliac crests with fingers extended and palms parallel to the floor. With both the patient's feet flat on the floor, the relative levels of the hands give a surprisingly sensitive estimate of significant LLD (Figure 2).

4. There are alternative methods to measure leg lengths with the patient supine by using a tape measure. These techniques require familiarity with pelvic and ankle landmarks, are time consuming and are remarkably prone to measurement errors.



4. **AFBT 1:** The examiner is seated behind the patient. Instruct the patient: “Hold your arms forward with your palms together, keep your head up and look straight ahead”. Patients often wish to look back to see what the doctor is doing but reassure them that there are “no tricks” and nothing to see. Ask the patient to: “Keep your knees straight and bend forward like you’re touching your toes”. Be aware that bending with flexed knees can mimic LLD and AIS. Patients do not actually need to touch their toes for the test to be valid.
5. **AFBT 2:** Observe the upper and lower back as the patient bends forward. Asymmetry of the rib cage in the upper thoracic region and asymmetric prominence in the lumbar spine are particularly important. Ribcage asymmetry warrants a spinal x-ray. (See Key Points for imaging)
6. With the patient standing erect, look for evidence of spinal dysraphism along the spine at the top of the buttocks. (See Key Points for Spinal Dysraphism) This often requires pulling down the top of the undergarment; the patient should be



SUMMARY OF KEY POINTS

IMAGING FOR SUSPECTED SPINAL DEFORMITY

1. Radiation exposure using modern radiographic techniques, including digital radiography, is significantly lower than in the past.⁵
2. Radiologists’ reports may use terms related to the spine that can be misleading and worrisome. Cobb angles less than 10 degrees should not be described as scoliosis but rather as “spinal asymmetry” since the term “scoliosis” may prompt an unnecessary referral to a specialist.
3. If imaging is indicated, it is best done at a centre where the patient will be seen in consultation. Radiologists at these centres have the experience to accurately interpret imaging results and correctly report spinal deformity. This also avoids the unfortunate situation where inadequate imaging done elsewhere must be repeated at the referral centre, significantly increasing the patient’s radiation dose.
4. Never order a “scoliosis series”. It is an obsolete term that referred to pre-operative assessment films. It is still found on some x-ray requisition forms and may be ordered in a misguided attempt to provide the surgeon with as much information as possible. Since the vast majority of patients seen by the spine surgeon will not require surgery, this option is needlessly expensive and the added radiation may be harmful to the patient.
5. The authors allow patients to take smart phone or tablet images of their own spinal x-rays. This engages the patient and their parents or guardians in the management. Take account of all regulatory and privacy issues regarding patient’s recording of even their own images.



Figure 3: The Adams Forward Bend Test

Positive test result for scoliosis as seen from examiner's perspective



Positioning of the examiner and patient during the Adams Forward Bend Test (AFBT). It is best to sit behind the patient for the AFBT and that way the assessment of LLD can be made (See Figure 2) and the knees can be viewed to make sure they are straight. Knees bent can mimic a leg length discrepancy.



SUMMARY OF KEY POINTS

EVIDENCE OF SPINAL DYSRAPHISM

Most relevant abnormalities are seen in the midline at the base of the spine (See Figure 1). Findings that could indicate spinal dysraphism (a term denoting spina bifida or other incomplete development of the posterior spinal elements) include:

1. Hemangioma.
2. Lipoma.
3. Hairy tufts.
4. Dimples or sinuses.
5. Cutaneous lesions.
6. **A unilateral cavus foot***

* A significant rigid, high arch deformity of the foot, which can be congenital or occur spontaneously but which may be the most obvious physical manifestation of spinal dysraphism.

7. Parents or guardians are often disturbed by the extent of an existing deformity. Teens can be secretive about body changes during the adolescent growth spurt. It might be a grandparent or a ballet teacher who first notices the asymmetry that





SUMMARY OF KEY POINTS

REFERRING TO A SCOLIOSIS SURGEON

1. Highlight the age of the patient and the menarchal status for girls. Patients who have significant potential growth remaining and have a significant curve, one approaching 20 degrees, may be “fast-tracked”.
2. Back pain associated with an insignificant deformity is not an appropriate indication for referral to a spine surgeon. If pain is the major issue, referral first to a non-operative spine specialist such as a physiatrist, physiotherapist or chiropractor may be more helpful.

AIS may produce back pain but surgical treatment is aimed primarily at the structural deformity and not at the symptoms.

3. Obtain full-length PA and lateral spine x-rays in the standing position. PA films are preferred over AP films because they produce less radiation on radiosensitive breast and neck tissues. The standing position is preferred because it shows the true “balance” of the spinal curves, for example the relationship between the lumbar lordosis and the thoracic kyphosis. Supine X-rays flatten the normal lordosis and frequently lessen any coronal plane curves.

prompts screening. Parents and guardians may experience a profound sense of guilt because they believe that they missed something. Be supportive of the patient’s right to privacy about body changes and reassure parents that their experience is typical and that they have not been negligent.

8. Remember that girls are frequently most concerned about the anterior ribcage asymmetry associated with spinal deformity and its effect on size and shape of the breast. Young women may be reluctant to expose the anterior chest, particularly to a male examiner. Anterior ribcage deformity is often most marked at the level of the lower costal cartilages and can be viewed easily and discretely by rolling

up the gown from below without exposing the breasts. It is important to distinguish asymmetry related to scoliosis from pectus carinatum or pectus excavatum, ribcage malformations that are not treated by a spine surgeon.

9. Complete the referral to the pediatric spine center, if necessary. (See Key Points for referral)
10. For completeness this list includes the use of a Scoliometer. It is not recommended. Scoliometers are rarely used in primary care settings although they may be employed in school screening programs or by orthopaedic paediatric surgeons. A Scoliometer is merely a level that measures an angle in reference to the horizontal plane (usually the floor).





CME

Post-test Quiz

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Smart phone apps are now available that provide the same function. Studies have shown an angle of 7 degrees corresponds with a Cobb angle on x-ray of nearly 20 degrees. As 20 degrees is the lower limit to consider bracing, a reading of 5 to 7 degrees on a Scoliometer is an indication for referral to a scoliosis clinic.

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