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Technical Report

The 10 key steps for radiographic analysis of adolescent idiopathic scoliosis

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Introduction

Scoliosis, defined as a coronal deformity of the spine, was first described as a clinical entity by Hippocrates.[1] In order for a diagnosis of scoliosis to be made, a curve greater than 10° in magnitude needs to be present.[2] Scoliosis arising between 11–18 years can therefore be broadly divided into idiopathic scoliosis and scoliosis with a known underlying osteogenic or neurological cause.[3] Idiopathic scoliosis in turn can be further subdivided based on the age of onset. Adolescent idiopathic scoliosis, a term first coined by Professor J. I. P. James of the Royal National Orthopaedic Hospital, refers to scoliosis arising between the age of 11 and 18 years[4–6] without a known underlying cause.

With an estimated prevalence of between 2 and 9%, adolescent idiopathic scoliosis is a significant cause of morbidity amongst young people. These include back pain, negative self-image and, in the case of large curves, impaired pulmonary and cardiac function. Ultimately, however, fewer than 10% of patients with adolescent idiopathic scoliosis require treatment.[7,8] The radiographs of patients with scoliosis are frequently reviewed in both general hospitals and specialists centres. Referrals to the radiology department for the radiographic assessment of scoliosis occur as direct referral from primary care or from paediatric and general orthopaedic and neurosurgical services, in addition to spinal surgeons.[9] In spite of the high prevalence of this condition and its general ubiquity, there remains a lack of clarity regarding how to analyse and best describe the radiographic features of scoliosis.[10–12]

This suboptimal radiographic assessment of scoliosis is of grave clinical concern as the radiographic evaluation of scoliosis is central not only in deciding whom to treat but also in deciding what treatment to offer.[13] For example, one of the key indications for surgery is the risk of curve progression. This is predicted by radiological findings such as

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Table 1
The Risser staging system.

Risser stage	Degree of ossification
0	None
1	1–25%
2	26–50%
3	51–75%
4	76–100%
5	Complete fusion to the iliac crest

curve magnitude and indicators of skeletal maturity.[14] Moreover, once the decision has been made to proceed with surgery, radiological features, such as whether a curve is flexible, play a central role in determining surgical approach and the extent of spinal fusion.[15] It is for this reason that we propose a simple algorithm that may be easily used by radiologists and clinicians when reviewing the radiographs of a patient with adolescent idiopathic scoliosis (Table 1).

Posteroanterior radiograph

1. Confirm the radiograph shows the whole spine and enumerate the vertebrae (Fig 1).

Before analysing a posteroanterior radiograph of the spine, its adequacy must be confirmed. The radiograph must be that of the standing patient and must include the cervical spine, sacrum, and both iliac crests to identify congenital anomalies and associated syndromes, such as Klippel Feil syndrome and spinal dysraphism. The reason for obtaining a posteroanterior radiograph as opposed to an anteroposterior radiograph is to minimize radiation exposure to the breasts.[16]

The correct enumeration of each vertebra is essential when describing a radiograph of the spine, partly because it is an important means of reducing the likelihood of wrong level surgery.[17] Counting cephalad from the presumed fifth lumbar vertebra risks overlooking variations in lumbosacral anatomy. This is an issue of considerable importance given that only around 90% of people have five lumbar vertebrae. We instead recommend identifying the second cervical vertebra and counting caudally.[18]

2. Count the number of curves present (Fig 2).

Typically the number of curves present does not exceed three.[19]

Figure 1 An adequate posteroanterior radiograph including the cervical spine and both iliac crests in a patient with six lumbar vertebrae.

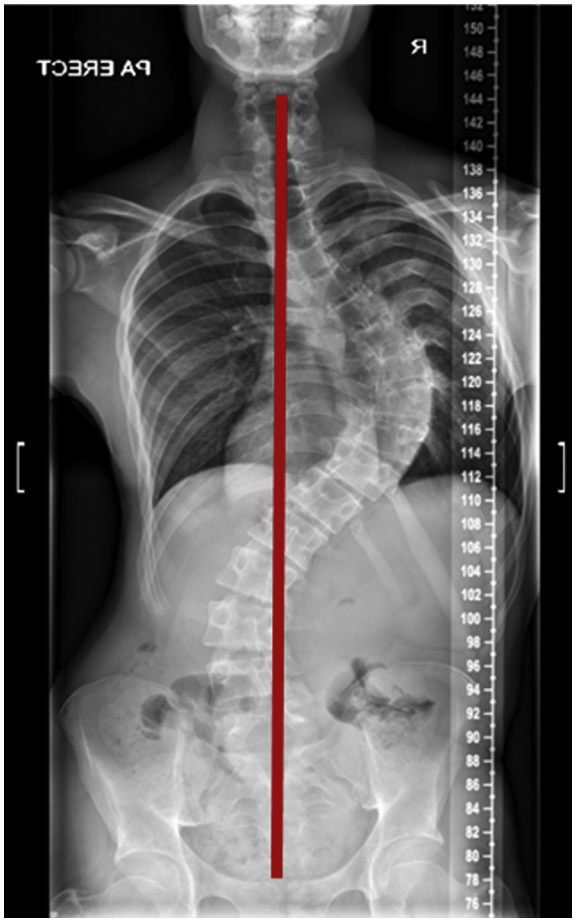

Figure 2 A radiograph demonstrating two lateral curves.