



The Non-Operative Management of Scoliosis

ABSTRACT

Scoliosis is a common condition that every primary care provider will encounter. There are many treatments available in its management, including observation, physical therapy, pain management strategies, casting, bracing and surgery. In this narrative review, the roles of each of the non-operative strategies in managing adult and paediatric scoliosis are explored, and the evidence supporting each is summarised. Scoliosis affects people at every stage of life, and an understanding of the treatments available will aid in counselling patients and making appropriate referrals.

KEYWORDS: Scoliosis, conservative, paediatric, bracing, physiotherapy, alternative therapies, spine cast



CME

Pre-test Quiz



Introduction

Scoliosis is a common condition with three million new cases diagnosed each year in the United States.¹ The diagnosis is made when a patient has a curve, found on an anteroposterior radiograph of their spine, of 10° or more, measured by the Cobb angle (figure 1).^{2,3} Other deformities, such as kyphosis or dysraphisms may be associated with the scoliosis but are not required for diagnosis.

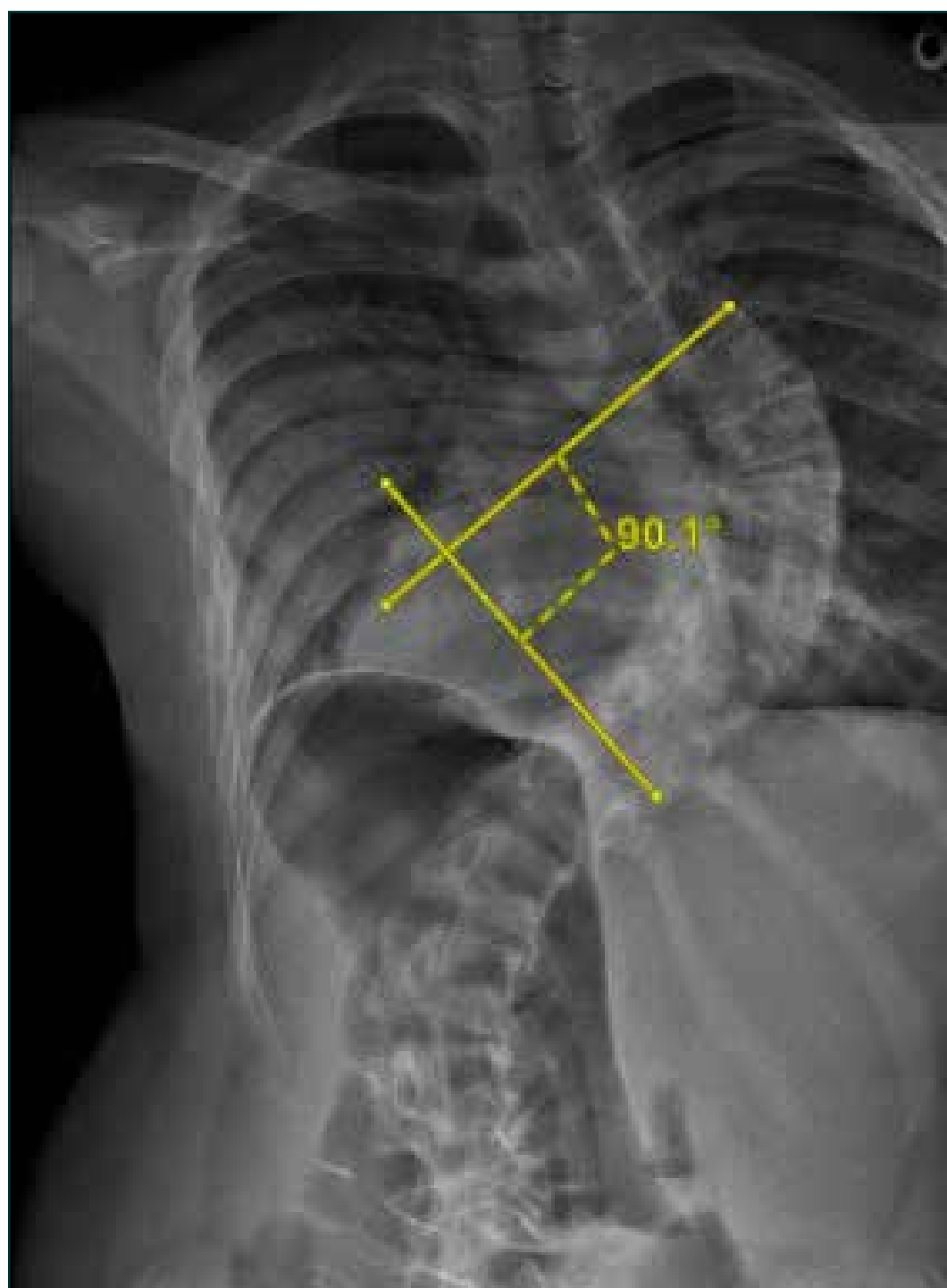
The causes of scoliosis are varied. In children, causes can include congenital deformities, neuromuscular conditions and some syndromes such as Marfan's, however the majority are idiopathic; no distinct cause can be found.⁴ In contrast, adult deformity is largely due to either degenerative disease, or existing paediatric scoliosis that has either been undiagnosed or has progressed.³ In the case of idiopathic scoliosis, the most common type in adolescents, there is some evidence that it is polygenic with a higher concordance between 1st degree relatives however the correlation is not significant enough to alter treatment.^{2,5} For adult deformity the aetiology is



usually asymmetric degenerative disc disease, which follows a predictable cascade through facet joint failure, listhesis, neurological compression and sagittal imbalance, leading to symptomatic decompensation of the ability to mobilise efficiently.

Patients with scoliosis present with a variety of complaints. In cases with a neuromuscular or congenital cause, presentation can be at a very early age, in some

Figure 1: The measurement of the Cobb angle using modern electronic radiographic storage systems.



cases diagnosed antenatally with prenatal scans.^{6,7} In these cases, early counselling and coordination with the services delivering care are essential. In idiopathic cases the presentation can be more insidious, and it may be found incidentally in younger children or, in an older child, thorough coincidental observation by a family member or friend. Pain, though frequently associated by patients with spinal deformity, is not a classical presenting complaint.⁸ Neither, in the absence of associated pathologies, is neurological disturbance.⁹ In contrast, adults will often present with changes in appearance, neurological symptoms, pain and reduced function. Such is the impact of marked sagittal imbalance that it has been said to produce equivalent disability to bilateral above-knee amputations.

Patients should be thoroughly evaluated with a history and examination and, where appropriate, imaging investigations. Sagittal imbalance is a complex topic, and its assessment combines clinical evaluation with full length radiographs.¹⁰ The basis of radiological assessment lies in the measurement of spinopelvic parameters. Pelvic incidence is the angle described between a line joining the centres of the femoral heads and the midpoint of the sacral endplate and a line perpendicular to the sacral endplate. Sacral slope is defined as the angle between the

sacral endplate and the horizontal. Pelvic tilt is the angle between the line joining the centres of the femoral heads and the midpoint of the sacral endplate and the vertical. Lastly, the sacral vertical axis is the distance between the midpoint of the C7 vertebral body and a line rising vertically from the postero-superior sacrum. As a general rule, sagittal imbalance exists when the SVA exceeds 5cm and pelvic tilt is greater than 25° .¹¹

In children, the history should assess associated symptoms, possibly indicating a multi-system abnormality syndrome which includes scoliosis. The initial evaluation may include an estimation of skeletal maturity through querying menarche and height compared to parents and siblings. In

adults, comorbidities, functional status and neurological deficits form the mainstay of initial assessment, as these will steer treatment options even at the referral stage.

The only acceptable image to assess for scoliosis is a full length spinal radiograph: either the 3-foot films available in most radiology suites or the more recently introduced EOS system, which allows for a more accurate assessment of the deformity and any correlated changes in the attitude of the lower limbs. There is seldom a role for CT or MRI at the initial scoliosis assessment, though they may form part of the evaluation prior to treatment.

Treatment

As with most musculoskeletal conditions, there are diverse treatments available for scoliosis. Most patients will not need surgery, and the current President of the Scoliosis Research Society estimates that only 10% of the cases he reviews requiring operative treatment.¹ In order to counsel patients on their initial presentation to primary care, the clinician must understand the available conservative treatments and separate those that are effective from those that may be ill advised.

Non-spinal conditions giving rise to scoliosis, for example leg length discrepancy or hip flexion contractures, should be treated directly and in many cases cor-

Figure 2: The Risser grade is a radiological measurement of skeletal maturity. The grade reflects the extent of the presence of the ossification and subsequent fusion of the iliac crest apophysis. Risser grade 5 refers to complete fusion of the apophysis to the iliac crest occurring at the completion of skeletal growth.



recting lower limb skeletal abnormalities will successfully rectify the curvature. Treatments, such as shoe orthoses or physical therapy, are low risk, and should be initiated at the earliest opportunity.

Information

Many patients present to the spine specialist already having invested considerable time querying the internet, more often than not taking their information from specious sources. As a result, many patients or parents attend secondary care with greatly heightened and completely unnecessary concerns and worries. Therefore, the first step in the non-operative management of scoliosis should be the provision of reliable and assured information. Many definitive websites are available and suitable for reference. Two excellent examples are the Scoliosis Research Society (SRS) and the Scoliosis Association UK, both of which have trustworthy and contemporaneous patient material. Providing clear, non-threatening communication at the point of diagnosis to reassure patients and guide them through an understanding of their condition, avoids much angst and many ill-advised interventions.

Observation

Because of the minor degree of deformity, patient choice or concurrent comorbidities, many patients, both young and old, will

Figure 3: The assessment of sagittal balance. SVA- Sagittal vertical axis; PT- Pelvic tilt; SS- sacral slope; PI- pelvic incidence.



be treated through observation alone. Clearly the safest operation is one that isn't done, and in many cases, observation is the right treatment both for the spine, and for the person attached to it.

Observation is not a passive strategy. In very young children, management aims to ensure that chest development is sufficient before employing orthoses, casts or surgery to control the spinal curvature. Each of these strategies leads to a change in respiratory capacity, which may compromise the patient's ability to thrive as they grow. Observation is used in these cases to chart the progression of the deformity and the growth of both the chest and child, so that treatment can be initiated at the point of maximum benefit with minimal risk. In idiopathic cases, small deformities (the definition of which varies across the world, but less than 25° is a common boundary) may be safely observed until such time as they cease to progress or skeletal maturity is established. Observation in larger curves may be appropriate if skeletal maturity has been reached (assessed through secondary sexual characteristics and the Risser stage) or if patients decline active treatment.

In the paediatric setting, the purpose of observation is to assess for the rate of curve progression. Those curves that progress rapidly are more likely to require intervention to arrest the deformity

and prevent compromise of vital organs. Those that do not progress may be best served with long term conservative management and patient counselling. Either way, understanding the character of the deformity is essential.

In the adult setting, it is often the balance of functional disability and comorbidities that determine treatment strategies. A patient who is managing their activities or is heavily comorbid may be best served through observation, perhaps definitely or at least until the risk/ benefit ratio is in their favour. Active observation is key.

The frequency of secondary care visits and radiographic investigation varies. Growing children require more frequent visits, whereas skeletally mature adolescents and adults require less frequent assessment and can be guided by their own perception of the symptoms. In either case, providing adequate information maintains the therapeutic partnership with the patient.

Alternative treatment

Alternative therapies will often purport to offer solutions, sometimes miraculous, in many diseases and scoliosis is no different. The Alexander technique, Pilates, Acupuncture, Reflexology, Chiropractors, aromatherapy; at one time all have been offered as a successful therapy for spinal deformity. To effectively answer the patient's



inquiries, the clinician must have some knowledge of their efficacy.

The Alexander technique works to develop an individual's posture and neuromuscular control through continuous self-assessment of habitual tone. Although an excellent RCT published in the BMJ in 2008 showed it to be effective in managing chronic low back pain, it has no proven efficacy in correcting scoliosis, a fact confirmed by the SRS in 2000.¹² Similarly, although homeopathic treatment, magnetic therapy, relaxation techniques, massage, meditation, reiki and yoga all may be a positive experience for a patient's general wellbeing, none are associated with the correction of structural scoliosis or prevention of progression.^{13,14} There is some suggestion that Pilates may be helpful in addressing non-structural components of scoliosis, however this remains to be formally tested, and the prevailing opinion is that it should not be recommended as a treatment.¹⁵

Chiropractic treatment from scoliosis demands particular consideration. Patients may have undergone assessment and treatment by a chiropractor prior to seeing a spine surgeon, most commonly for back pain, but occasionally for deformity.¹⁶ The National Center for Complementary and Integrative Health describe chiropractic manipulation as a controlled thrust to the joints of the

spine to exceed their normal range of movement.¹⁷ While this may be effective in relieving back pain, a systematic review carried out in 2017 by Thérout et al. showed there is presently no evidence that chiropractic treatment has any effect on spine deformity.^{18,19} Furthermore, its use is not benign, with an incidence of (admittedly incompletely characterised) adverse events being recorded in up to 50% of treatments.¹⁹

Pain management

For adult patients in particular, the management of pain associated with deformity is essential. Coherent use of analgesics and mobility aids can be extremely effective in alleviating symptoms and may obviate the need for surgical intervention. Individualised pain strategies, taking into account the potential for analgesic medication side effects, particularly in extended NSAID use is recommended. These may involve multimodal therapies including pharmacology, neuropathic pain management and cognitive therapies. In degenerative spinal deformity walking aids have a role in improving gait and reducing the workload of the posterior spinal musculature.²⁰ In the specialist setting, invasive pain management can have a role and are worthy of a consideration. In some circumstances these may offer sufficient relief of symptoms for the patient



to return to their regular activities.

Physiotherapy

Physiotherapy is often considered a useful treatment for both paediatric and adult scoliosis. While the SRS clearly states that physical therapy cannot alter the scoliotic curve, there is now some weak evidence to suggest that, in adolescent idiopathic scoliosis, specific exercises aid in slowing the progression of deformity.^{21,22} The SOSORT guidelines suggest that physiotherapists should introduce scoliosis-specific exercises at the earliest phase of treatment. Although the level of support for this therapy is only moderate, it may nonetheless form part of the multidisciplinary management.²²

In the adult setting, physiotherapy has poor evidence to support its use. A recent review in the *Lancet* by Diebo et al. explains that core strengthening has a positive effect in adult spine deformity, but that additional physical therapies are unlikely to be effective.²³ It may be that clinical trials currently in progress show a clear role for physiotherapy in preventing progression of deformity or delaying the need for orthotic use. For now, the evidence remains inconclusive.²²

Casting

The use of casting in scoliosis is limited to the paediatric setting, where these treatments rely on the growing spine for their effect. Spi-

nal casting, once a dying art, has seen a resurgence in recent decades in the early onset setting, where a moulded cast can produce derotation of the spine with consequent correction of the deformity.²⁴ First described by Cotrel in the 1960s, and further developed by Mehta, these techniques have a low risk of complication but do rely on skilled clinicians in their application, a fact that restricts their use to specialist centres.^{25,26} Casting has limited evidence in congenital scoliosis, but when performed skilfully is very effective in early onset scoliosis.²⁴

Bracing

Because of the absence of spinal growth and the degenerative nature of the condition, the role of bracing in the adult setting is very limited.²³ However, in perhaps the most impactful study within paediatric spine surgery of the last decade, the BRAIST trial has revolutionised the role of bracing in the adolescent population with idiopathic scoliosis.²⁷ In this multicentre study, published in 2013 in the *New England Journal of Medicine*, 242 patients aged 10-15 years with a Risser grades of 0-2 and a Cobb angles of 20-40° were randomised to either bracing for 18 hours per day or observation. The study showed that by skeletal maturity 72% of braced patients failed to progress to a curve size that necessitated surgery, compared to 48% in the observation group.





SUMMARY OF KEY POINTS

- Scoliosis is common
- Most patients require observation only
- Patient information is essential
- Casting and bracing have roles in the growing skeleton only
- Physical therapy has limited evidence in both adult and paediatric deformity
- Alternative therapies have no proven use in the management of scoliosis

The BRAIST trial is superb evidence that effective bracing can be employed for the correct patient, and its findings have been subsumed into daily practice. The fitting of braces needs specialist skill and must be carried out in partnership with patients and families. It can be a difficult treatment but if successful, has a dramatic effect in reducing the need for surgery in adolescent idiopathic scoliosis.

On a case by case basis, bracing also has a role in temporising patients before surgery. In select patients with syndromic or neu-

romuscular scoliosis, bracing can be effective in preserving peripheral function prior to insertion of a growing rod system or definitive spinal fusion. As familiarity with bracing grows and new theories are brought into practice, these indications may expand.

Conclusions

The non-operative management of scoliosis has a long history. Clinicians should never forget that they are treating the patient, not just the spine and so information and symptomatic management are essential from the first interaction to the last. Many patients will require nothing more. For those who need more intensive care, a clear diagnosis must precede the treatment plan. Physiotherapy, casts and braces may all have a role in the management of these complex patients and over time patients can graduate from one strategy to another.

The key is careful assessment; evaluating aetiology, comorbidity, scale of deformity, effects on the patient's function and patient's desires before committing to a plan. Specialized care is required for some of the interventions and if there is uncertainty, primary care physicians should seek specialist advice to ensure that, from the start, their patients receive the most appropriate management.



CLINICAL PEARLS

The majority of patients with scoliosis can be observed

Reliable patient information is critical

There is limited evidence that physiotherapy is effective, and no evidence that alternative therapies are effective in treating scoliosis

Bracing is useful in the growing skeleton





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Post-test Quiz

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