

# Scoliosis

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Scoliosis “obliquity, bending” is a medical condition in which a person's spine is curved from side to side. Although it is a complex three-dimensional deformity, on an X-ray, viewed from the rear, the spine of an individual with scoliosis can resemble an “S” or a “?”, rather than a straight line.

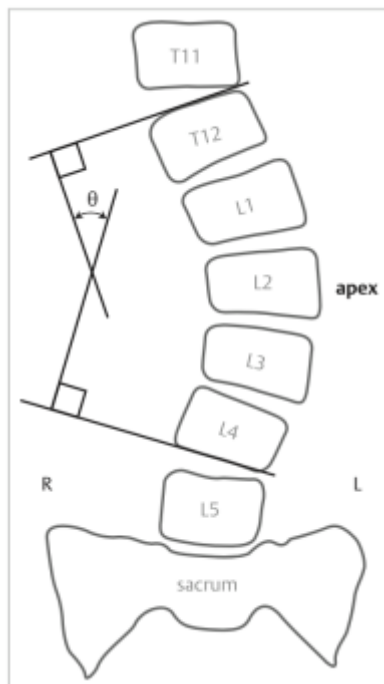
## Classification

see [Scoliosis Classification](#).

## Nomenclature

[Scoliosis Nomenclature](#).

## Measurement



## Etiology

Adult spinal deformity encompasses [scoliosis](#) and [sagittal imbalance](#).

Scoliosis is common in patients with [Chiari Malformation Type 1](#)

[Neuromuscular scoliosis](#)

## Screening

[Scoliosis screening](#)

## Treatment

Harrington<sup>1)</sup> reported [rods](#) with [hooks](#) and wires for compression and distraction to treat [scoliosis](#) in 1962.

Historically, the [Harrington rod](#) was implanted along the [spinal column](#) to treat, among other conditions, a lateral or coronal-plane curvature of the spine, or [scoliosis](#). Up to one million people had Harrington rods implanted for scoliosis between the early 1960s and the late 1990s.

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Based on current published literature, fusionless devices offer promising scoliosis treatment alternatives to conventional spinal [instrumentation](#) and fusion in the growing spine. Current compression-based devices achieve growth modulation while also compressing the [intervertebral discs](#), increasing the risk of long-term [disc degeneration](#).

## Experimental studies

An intravertebral staple acting on both the superior and inferior growth plates was inserted locally over T7-T9 of seven healthy immature pigs. Four age-matched animals served as controls. Radiographs were acquired monthly to assess induced spinal curvature and vertebral wedging (inverse model). Global (spinal) and local (vertebral, discal) geometric changes were evaluated over 3-months follow-up. Final left/right vertebral height differences were also quantified.

The only postoperative complication observed was one pig that had a persistent deep infection and was excluded from the study. No significant changes in spinal alignment were reported in control animals. Final induced Cobb angle was  $25.0^{\circ} \pm 4.2^{\circ}$  measured over T7-T9, with no observable sagittal profile modification. Highest vertebral wedging occurred at T9 with  $18.2^{\circ} \pm 2.7^{\circ}$ . Cumulative vertebral wedging over T7-T9 accounted for  $45.4^{\circ}$ , demonstrating evidence of reversed disc wedge phenomenon. Vertebral height was  $3.9 \pm 1.0$  mm shorter on the instrumented side suggesting full growth restraint. Local and regional induced deformities significantly differed from their control counterparts ( $P < 0.001$ ).

In this animal model, the local epiphyseal device achieved significant localized growth modulation over as little as three instrumented levels, with explicit vertebral wedging exclusive of the intervertebral disc. By increasing the number of instrumented levels, one may achieve higher curvature control potentially providing a unique local correction method to correct spinal deformity without affecting the intervertebral disc <sup>2)</sup>.

## Outcome

A systematic review was carried out using Science Citation Index (SCI) Expanded (1900 - present), Social Sciences Citation Index (1956 - present), Arts and Humanities Citation Index (1965 - present), Medline (1950 - present) and PubMed Central databases (1887 - present) to access information regarding efficacy of spine surgery in preventing or improving the health and function of patients diagnosed with scoliosis in adolescence.

Since 1950, more than 12,600 articles on scoliosis have been published, and nearly 50% (5721) focus on methods, rationale, outcome, and complications of surgical intervention. Among these, 82 articles have documented outcome for groups of  $>$  or  $=10$  patients, treated for adolescent idiopathic scoliosis, and followed for at least 2 years after treatment. These data provide an overview of the impact of spine surgery on scoliosis for 5780 patients as surgery methods and approaches have evolved.

For most patients, a reduced magnitude of spinal curvature can be achieved through one or more spinal fusion surgeries. There is no evidence to support the premise that this result is correlated with improved pulmonary function or reduced pain <sup>3)</sup>.

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Young adults ( $< 40$  years) with uncorrected scoliosis are at higher risk of [recurrent lumbar disc herniation](#) (LDH) after [lumbar microdiscectomy](#) <sup>4)</sup>.

## Books

### Early Onset Scoliosis: A Comprehensive Guide from the Oxford Meetings

This book is an outgrowth of the early onset scoliosis meeting held in Oxford, UK, in September of 2011. The participants and, hence, authors bring a broad perspective to the issues associated with early onset scoliosis. Along with pediatric orthopedic spine surgeons, chapters also are authored by pediatric neurosurgeons, pediatricians, a geneticist, and an anesthesiologist.

The treatment of early onset scoliosis remains perhaps the most vexing problem in spinal deformity surgery. The maintenance of spinal growth in order to preserve pulmonary function while achieving curve correction remains a major challenge. The need for a multidisciplinary approach and a focus on the patient as a whole and not just the spinal deformity cannot be stressed enough. Untreated, this truly represents a potentially life-threatening medical condition, not just a spinal problem.

Early onset scoliosis does tend to be a grab-bag classification. Although the underlying etiology may be idiopathic in nature, many affected children also carry a syndromic, neuromuscular, or neurogenic diagnosis. Congenital scoliosis presents at an early age as well, and although its natural history may be vastly different, it also must be included in this discussion. This presents a challenge for the book's organization.

Not surprisingly, given the location of the conference, the book has a distinct European perspective. Most of the authors are from the United Kingdom. There is a section entitled International Viewpoints that does try to include a broader world perspective.

The first part of the book, The Growth and Development in Mammalian Spine, is particularly strong. The section by Dimeglio and Canavese on Development of the Spine and the section by Campbell on Respiratory Implications are well written, concise, and extremely informative. They are a good starting point for someone interested in the treatment of this condition. The rest of the book is organized in sections on Congenital Deformities, Infantile Idiopathic Scoliosis, Neuromuscular Scoliosis, Syndromic Scoliosis. In addition there are sections on Perioperative Care, The Expert's View, and the Future.

The chapters organized around specific conditions discuss etiologies and treatment options both conservative and surgical. The discussion by Dr Min Mehta of the rationale for cast treatment in infantile idiopathic scoliosis is excellent. In the Expert's View Section is a chapter entitled A Narrative of the Great Debate. At the conference in Oxford, 5 of the participants debated the best treatment options in early onset scoliosis. Although it may have made for an interesting discussion at the time and captured the essence of the conference, it does not translate well to the page. It is a rather superfluous and unnecessary addition to the volume.

The book's biggest weakness is its timeliness. There has been significant evolution in the treatment of early onset scoliosis during the almost 5 years since the conference was held. Magnetic growing rods, which now account for the majority of growing rods inserted, are discussed in a section that accounts for 5 pages in a 278-page book. Growth modulation, an area of increasing interest, is mentioned in passing.

For residents and fellows, the book may provide a broader understanding of the complex issues involved in the treatment of early onset scoliosis. For those already working in the field, there is not much new information. Disclosures

Peter F. Sturm is a consultant for and member of the surgical advisory board for DePuy Synthes Spine,

a consultant for Ellipse Technologies, and on the editorial board of the Journal of Children's Orthopaedics. The author has no personal, financial, or institutional interest in any of the drugs, materials, or devices described in this article.

<sup>1)</sup>  
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<sup>2)</sup>  
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<sup>3)</sup>  
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