Scoliosis

Diagnosis/Condition:	Scoliosis, Idiopathic Curvature of the Spine, Unspecified Curvature of the Spine, Scoliosis Curvature of the Spine, Acquired Curvature of the Spine, Congenital Deformity
Discipline:	DC
ICD-10 Codes:	M41.20, M43.8X9, M41.10, M41.50
Origination Date:	2005
Review/Revised Date:	07/2024
Next Review Date:	07/2026

Scoliosis is defined as a lateral deviation from the normal vertical line of the spine which, when measured by the Cobb Angle on X-ray, is greater than 10 degrees. Angles less the 10 degrees are within normal limits and have no long-term clinical significance. The convexity determines the direction defined (right or left) of the curve. Scoliosis includes a range of conditions that are usually classified by type including idiopathic (the focus of this pathway), congenital (due to vertebral anomalies such as hemivertebra) and secondary to other conditions. Idiopathic Scoliosis is divided into three subcategories based on the patient's age at presentation: Infantile 0-3 years, Juvenile 4-9 years, and Adolescent >10years. Adolescent idiopathic scoliosis (AIS), which is the most common form (80 to 85%), is a disorder with a three-dimensional spinal deformity and is a common disease affecting 1-5% of adolescents. AIS is also known as a complex disease involved in environmental and genetic factors.[1] Only 10% of Adolescents with AIS require treatment (0.3 % of the population). Scoliosis can impact the quality of life with limited activity, pain, reduced respiratory function[2], or diminished self-esteem.

Routine screening of adolescents for idiopathic scoliosis in the past has been done by visual inspection of the spine to look for asymmetry of the shoulders, scapulae, and hips. However, a 2018 review update from the US Preventive Services Task Force (USPSTF) concluded that the current evidence is insufficient to assess the balance of benefits and harms of screening asymptomatic children and adolescents (aged 10 to 18 years) for adolescent idiopathic scoliosis. This update represents a change from the previous 2004 USPSTF recommendation against screening of this group. This recommendation does not apply to this population presenting for evaluation of back pain, breathing difficulties, abnormal radiography or other imaging findings, or obvious deformities in spinal curvature.

While routine screening for adolescent scoliosis in school-age children is of uncertain value, the primary concern for patients (and their parents) who have been diagnosed with AIS by whatever method is the potential for curve progression. Most patients do not need treatment of any sort such as exercises, bracing, or surgery. However, some factors that have been identified to predict a worsening curvature, may warrant continued observation and consideration of treatment. The risks of curve progression include chronological age, menstrual status, skeletal age, pubertal status, height velocity (growth spurt), and curve size.
The evidence for non-operative management of adolescent idiopathic scoliosis (AIS) is limited, however early intervention with conservative treatment like exercise therapy and bracing may help prevent surgery. Current evidence-based recommendations for manual therapies are based on expert consensus rather than randomized controlled trials. Evidence for exercise interventions is more robust, but there is a lack of high-quality evidence in that regard.

Subjective Findings and History

- Onset of the disease is typically during the period of rapid growth at adolescence.
- Family history of scoliosis or other neuromuscular condition, congenital disease, or connective tissue disorder.
- Two clear risk factors are remaining growth potential and female gender.
- Males and Females are affected equally, however females are 8-10 times more likely to progress to a curve magnitude that requires treatment.
- Patients may complain of thoracic or lumbar pain or stiffness and cervical complaints secondarily.
- Patients (or especially their parents) may note asymmetries such as uneven spinal musculature, a high shoulder, iliac crest, rib hump, scapula uneven, and arms hang unevenly.
- Clothes do not "hang right" (e.g. uneven hemlines).

Objective Findings

- *Physical examination*
    - Asymmetries (plumb line), shoulder height, scapular, uneven waistline, rib hump, anterior iliac spine levels, head alignment, anterior chest for pectus excavatum.
    - Evaluate presence of thoracic and lumber curves upon full thoracic and lumbar flexion. The Adams forward bend test is the most sensitive of the clinical examination findings.
    - Pain location and change in sitting, standing, or prone positions.
    - Height measurement, every 3-4 months for growth spurt if not full skeletal maturity (sitting height measures truncal growth rates, a better indicator).
    - Other skeletal deformities, such as leg length discrepancies.
    - Skin assessment, café au lait spots; connective tissue disorders, inflammatory or rheumatic joint signs.

- Curve magnitude and patient age are the main predictors of structural flexibility.[3]

- *Imaging*
  - AP full spine (14x36) weight bearing, if indicated, to grade curve and assess curve progression is the current standard.
    - Cobb angle method: quantifying degree of scoliosis angle on AP, note level of apex and side of convexity and vertebral rotation of apical vertebra.
  - Pelvic view if skeletal maturity is to be assessed (Risser Sign).
    - Risser sign: growth marker on ilium ossification, grade 1-4 using Tanner stages.
  - Rule out skeletal or vertebral deformities.
  - Lateral bending views to determine curve flexibility, if indicated.
  - Recent advances in diagnostic imaging may reduce ionizing radiation exposure and preserve the image quality and utility include the EOS imaging system (also known as a slot-scanning device or slit-beam digital radiography system)), the DIERS formetric scanner, and ultrasonography.
- *Neurologic* to rule out other causes, or conditions.
- *Metabolic* if necessary, to rule out disorders or conditions; run lab work.
- *Orthopedic* routine, to rule out disc problems, other spinal or extra spinal conditions.

Assessment

Diagnostic classification of scoliosis :

- *Non-structural (mobile) scoliosis*
  - Postural: resolves with forward bending or recumbency and is self-limiting, or due to muscular imbalance.
  - Compensatory: caused by leg length inequality, pelvic unleveling.
  - Transient: radiculopathy (sciatic), inflammatory, traumatic, psychogenic.
- *Structural Scoliosis*
  - Idiopathic (genetic): infantile, juvenile, adolescent, and adult.
  - Congenital: vertebral deformity, extravertebral.
  - Neuromuscular: neuropathic (polio, cerebral palsy, etc.), myopathic (muscular dystrophy).
  - Neurofibromatosis.
  - Mesenchymal disorders (Marfan's, Morquios', rheumatoid arthritis, osteogenesis imperfecta).
  - Trauma: fracture, surgery, radiation, burns.
  - Neoplastic: e.g. osteoid osteoma.
  - Metabolic: (rickets).
  - Degenerative (advanced degenerative spondylosis).

Plan

- *Non-structural Scoliosis:* Postural, compensatory, and transient scoliosis is managed by treating the underlying pathology (e.g., leg length inequality).
- *Structural Scoliosis*: Forms other than idiopathic should be ruled out and cared for appropriately.
- *Adolescent idiopathic scoliosis:* The primary goal of treatment is prevention of progression and preservation of pulmonary and cardiac function. Treatment is also aimed at reducing spinal pain and improving aesthetics. Treatment options recommended by guidelines varies and range from "watchful waiting" while monitoring for progression, to non-surgical interventions and, finally, surgical fusion. Treatment decision making is dependent on the age of the patient (skeletal maturity), the severity of the curvature and the likelihood of progression.
    - ***Risk factors for progression:*** (younger age, higher curve generally means worse prognosis):
        - 50% risk of progression before menarche, < 20% after menarche.
        - Curve greater than 30 degrees (even with skeletally mature).
        - Over 25% rotation of apical vertebra.
        - Right vs. left curve apex.
        - L5 is high in pelvis.
    - Patients with idiopathic scoliosis who have not reached skeletal maturity should be evaluated for the risk of curve progression. AIS patients with curves less than 20 degrees can be followed at 3–6-month intervals, non-radiographically. If progression is observed radiographs should be obtained to confirm and treatment instituted. Curves between 20-39 degrees should be assessed at 3–6-month intervals. Referral for orthotic treatment with a scoliosis brace should be considered if a curve reaches 30 degrees prior to skeletal maturity or in a curve of 20-30 degrees progressing 5 degrees or more over 3-6 months, or where other risk factors are present. Symptomatic patients with a curve of 40-50 degrees may be treated with bracing or surgery, and those with an angle greater than 50 degrees typically require surgery.
- *Adult idiopathic scoliosis:* In an adult with 45 degrees or more curvature and cardiopulmonary complications, a surgical consult should be considered. For adults with less than 50 degrees and mechanical pain, conservative treatment is appropriate.
    - ***Conservative Management :*** Conservative management is dependent on:
        - Accurate diagnosis.
        - Appropriate and timely non-radiographic clinical follow up.
        - Radiographic confirmation of curvature status at 3-6 months, if progressive.
        - Monitoring treatment until spine is mature.
    - ***Bracing:***[4,5]
        - Is generally not indicated for curves of less than 20 degrees.

        - Is recommended for curves larger than 25 degrees but smaller than 45-50 degrees in someone who is still growing.
        - Is only done when the patient has bone growth remaining.
        - Is generally implemented in order to hold the curve and prevent it from progressing to the point where surgery is necessary.
        - Can decrease risk of progression to a range requiring surgery with high compliance in patients likely to have curve progression.
        - If there is progression of more than 5 degrees in one year if curve is above 15 degrees and at least one year of skeletal maturity remains.
        - Rigid, asymmetrical braces may provide better correction than flexible, symmetrical braces.
    - Spinal Manipulation has been shown to relieve pain and improve sagittal imbalances, optimize spinal flexibility in degenerative scoliosis.
    - Chiropractic rehabilitation: a 24-month retrospective analysis showed improvements in pain, Cobb angle, and disability.[6]
    - Physiotherapy modalities are appropriate for pain control such as heat, ultrasound, and electrical stimulation.
    - Exercises such as Schroth[7,8], Neuromuscular Stabilizing Technique, core exercises, spinal specific exercise, Pilates[9], and myofascial to retrain proprioceptive functions, optimize muscle balance, and strength and counter-stretch the curve daily.[10]
    - Yoga[11]
    - Physiotherapeutic scoliosis-specific exercise (PSSE)[12]
    - Halo-pelvic traction.[13]
    - Symmetrical and asymmetrical weight training.[14]
    - Kinesio taping was shown to decrease back pain in patients with Lenke Type 1 adolescent idiopathic scoliosis.[15]

Referral Criteria

- Failure to achieve treatment goals of pain control or improved function.
- Curve progression despite conservative interventions.
- Clinical or radiographic findings suggestive of congenital or neuromuscular conditions.

Resources for Clinicians

Scoliosis is an open access online journal published by BioMed Central
http://www.scoliosisjournal.com/

Resources for Patients

The National Scoliosis Foundation (NSF) is a patient-led nonprofit organization dedicated since 1976 to helping children, parents, adults, and health-care providers to understand the complexities of spinal deformities such as scoliosis.
http://www.scoliosis.org/index.php

The Evidence

Scoliosis Research Society. https://www.srs.org/

Zakaria A, Hafez A, Buragadda S, Melam G. Stretching versus mechanical traction of the spine in treatment of idiopathic scoliosis. Journal Of Physical Therapy Science [serial online]. December 1, 2012;24(11):1127.

Curr Pediatr Rev. 2016;12(1):6-11.
Evidence for Conservative Treatment of Adolescent Idiopathic Scoliosis - Update 2015 (Mini-Review).
Sy N1, Bettany-Saltikov J, Moramarco M.

Theroux J, et al. Prevalence of low back pain in adolescents with idiopathic scoliosis: a systematic review. Chiropractic & Manual Therapies. 2017; 25:10. DOI 10.1186/s12998-017-0143-1

Theroux J, et al. Spinal manipulative therapy for adolescent idiopathic scoliosis: a systematic review. J Manipulative Physiol Ther. 2017; 40:452-458

Final recommendation statement: adolescent idiopathic scoliosis: screening. [internet]. Rockville (MD): U.S. Preventive Services Task Force (USPSTF); 2018 Jan [8p]. [28 references]

Dunn J, et al. Screening for adolescent idiopathic scoliosis: A systematic evidence review for the US Preventive Services Task Force. Evidence Synthesis No. 156. AHRQ Publication No. 17-05230-EF-1. Rockville, MD: Agency for Healthcare Research and Quality; 2018

Dunn J, et al. Screening for adolescent idiopathic scoliosis evidence report and systematic review for the US preventive services task force. JAMA. 2018;319(2):173-187. doi:10.1001/jama.2017.11669

Girdler S, Cho B, Mikhail CM, Cheung ZB, Maza N, Kang-Wook Cho S. Emerging Techniques in Diagnostic Imaging for Idiopathic Scoliosis in Children and Adolescents: A Review of the Literature. World Neurosurg. 2020; 136:128-135. doi: 10.1016/j.wneu.2020.01.043

Clinical Pathway Feedback

CHP desires to keep our clinical pathways customarily updated. If you wish to provide additional input, please click on the email address listed below and identify which clinical pathway you are referencing. Thank you for taking the time to give us your comments.

Clinical Services Department: cs@chpgroup.com

Disclaimer Notice

The CHP Group (CHP) Clinical Pathways are a resource to assist clinicians and are not intended to be nor should they be construed/used as medical advice. The pathways contain information that may be helpful for clinicians and their patients to make informed clinical decisions, but they cannot account for all clinical circumstances. Each patient presents with specific clinical circumstances and values requiring individualized care which may warrant adaptation from the pathway. Treatment decisions are made collaboratively by patients and their practitioner after an assessment of the clinical condition, consideration of options for treatment, any material risk, and an opportunity for the patient to ask any questions.

CHP makes no representation and accepts no liability with respect to the content of any external information cited or relied upon in the pathways. The presence of a particular procedure or treatment modality in a clinical pathway does not constitute a representation or warranty that this service is covered by a patient's benefit plan. The patient's benefit plan determines coverage.

[1] Otomo, N., et al., *Evidence of causality of low body mass index on risk of adolescent idiopathic scoliosis: a Mendelian randomization study.* Front Endocrinol (Lausanne), 2023. **14**: p. 1089414.

[2] Kan, M.M.P., et al., *Is impaired lung function related to spinal deformities in patients with adolescent idiopathic scoliosis? A systematic review and meta-analysis-SOSORT 2019 award paper.* Eur Spine J, 2023. **32**(1): p. 118-139.

[3] Deviren, V., et al., *Predictors of flexibility and pain patterns in thoracolumbar and lumbar idiopathic scoliosis.* Spine (Phila Pa 1976), 2002. **27**(21): p. 2346-9.

[4] Canavese, F. and A. Kaelin, *Adolescent idiopathic scoliosis: Indications and efficacy of nonoperative treatment.* Indian J Orthop, 2011. **45**(1): p. 7-14.

[5] Sanders, J.O., et al., *Bracing for idiopathic scoliosis: how many patients require treatment to prevent one surgery?* J Bone Joint Surg Am, 2014. **96**(8): p. 649-53.

[6] Morningstar, M.W., *Outcomes for adult scoliosis patients receiving chiropractic rehabilitation: a 24-month retrospective analysis.* J Chiropr Med, 2011. **10**(3): p. 179-84.

[7] Dimitrijević, V., et al., *Application of the Schroth Method in the Treatment of Idiopathic Scoliosis: A Systematic Review and Meta-Analysis.* Int J Environ Res Public Health, 2022. **19**(24).

[8] Dimitrijević, V., et al., *Effects of Schroth method and core stabilization exercises on idiopathic scoliosis: a systematic review and meta-analysis.* Eur Spine J, 2022. **31**(12): p. 3500-3511.

[9] Kuru Çolak, T., B. Akçay, and A. Apti, *Effects of Pilates exercises on idiopathic scoliosis: a scoping review of the literature.* Spine Deform, 2023. **11**(4): p. 797-804.

[10] Gámiz-Bermúdez, F., et al., *Corrective exercise-based therapy for adolescent.idiopathic scoliosis: Systematic review and meta-analysis.* Clin Rehabil, 2022. **36**(5): p.597-608

[11] Chen, Y., Z. Zhang, and Q. Zhu, *The effect of an exercise intervention on adolescent idiopathic scoliosis: a network meta-analysis.* J Orthop Surg Res, 2023. **18**(1): p. 655.

[12] Ma, K., et al., *The effects of physiotherapeutic scoliosis-specific exercise on idiopathic scoliosis in children and adolescents: a systematic review and meta-analysis.* Physiotherapy, 2023. **121**: p. 46-57.
[13] Sun, Y., et al., *Halo-pelvic traction in the treatment of severe scoliosis: a meta-analysis.* Eur Spine J, 2023. **32**(3): p. 874-882.
[14] Schmid, A.B., et al., *Paraspinal muscle activity during symmetrical and asymmetrical weight training in idiopathic scoliosis.* J Sport Rehabil, 2010. **19**(3): p. 315-27.
[15] Atici, Y., et al., *The effect of Kinesio taping on back pain in patients with Lenke Type 1 adolescent idiopathic scoliosis: A randomized controlled trial.* Acta Orthop Traumatol Turc, 2017. **51**(3): p. 191-196.