Gillette Children's Specialty Healthcare

A PEDIATRIC Perspective

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Adolescent Idiopathic Scoliosis:

Screening, Treatment and Referral

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Idiopathic scoliosis is a common condition that can easily go undetected. Routine screening for scoliosis facilitates early identification, monitoring, and treatment. In March 2009, the Minnesota Department of Health (MDH) released new recommendations for school scoliosis selective screening. This article reviews the new guidelines and their rationale. In addition, it addresses recommendations for primary-care evaluations, diagnoses and monitoring, and it reviews criteria for referring patients to a specialist.

What Is Adolescent Idiopathic Scoliosis?

Scoliosis is a lateral curve of the spine accompanied by rotation. A curve must measure at least 10 degrees on a spinal radiograph via the Cobb ruler method to meet the criteria for diagnosing scoliosis when trunk asymmetry is present on physical examination. If the diagnosis occurs at 10 years or older in the absence of an underlying congenital or neurological issue, it is classified as adolescent idiopathic scoliosis.

Idiopathic scoliosis is the most common type of scoliosis, accounting for approximately 85 percent of all scoliosis cases. Two to 3 percent of children between the ages of 10 to 15 have scoliosis, although the rate of clinically significant scoliosis requiring active treatment is a fraction of that number. The overall prevalence of idiopathic scoliosis is relatively similar for boys and girls. Girls, however, are much more likely to have larger curves and/or curves that will progress. Larger curves require monitoring and possible treatment (bracing or surgery).

History of Scoliosis Screening in Minnesota

Although scoliosis screening has always been voluntary in Minnesota, screening began in 1946 to identify residual effects of poliomyelitis. (The 1946 Minnesota State Fair was canceled due to the polio epidemic.) Minnesota's first school scoliosis screening occurred in 1963; a voluntary statewide school scoliosis screening program started in 1973. The American Academy of Orthopaedic Surgeons and the Scoliosis Research Society endorsed school scoliosis screening in 1984. Historically, approximately 3.4 percent of Minnesota school children screened positively for scoliosis; one-third of those referred were diagnosed with scoliosis (1.2 percent of all students screened).

Screening for adolescent idiopathic scoliosis is controversial because studies evaluating the effectiveness of scoliosis screening are inconsistent. Although the U.S. Preventive Services Task Force does not recommend routine scoliosis screening, the American Academy of Orthopaedic Surgeons, the Scoliosis Research Society, the Pediatric Orthopaedic Society of North America, and the American Academy of Pediatrics do **not** support recommendations against scoliosis screening. The latter four organizations recognize the benefits of school scoliosis screening programs, noting the potential prevention of curve progression with bracing and the early recognition of severe curves that require surgery.

MDH School Scoliosis Screening Update

To update Minnesota's school scoliosis screening recommendations, the MDH coordinated a multidisciplinary panel of experts who met in 2008. Discussion topics included a comprehensive literature review, the prevalence of idiopathic scoliosis, risk factors, school screening programs, screening tools, referral criteria and processes, treatments, and professional organizations' recommendations.

Although scoliosis screening in Minnesota schools is not mandated, selective screening is still strongly encouraged. The MDH scoliosis group agreed upon three major screening changes: periodicity, tools, and referral recommendations (see Table 1, Page 2).

Periodicity

The average age of menarche in the U.S. has decreased over the past 50 years. Previous scoliosis screening recommendations were based on older ages for menarche. This is an important issue, because it is important to identify curves that are at risk for progression. In scoliosis, growth can be an enemy. If curves are going to progress, they often do so during growth spurts.

Girls start their adolescent growth spurt prior to menarche. Peak height velocity typically occurs at 11.5 years for girls, and growth spurts last approximately 24 to 36 months. Studies show that the average age of menarche in the U.S. today is approximately 12.5 years. At that age, growth velocity is decreasing, with approximately 12 to 18 months of spinal growth remaining.

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Table 1: MDH Scoliosis School Screening Recommendations

	2008 Recommendations	2003 Recommendations
Periodicity	Girls in fall of fifth grade and spring of sixth grade Not recommended for boys	Girls in fifth and eighth grades Boys in eighth or ninth grade
Instrument	Scoliometer, used according to instructions	Adams Forward Bending Test with scoliometer
Referral	At 6 degrees ATR* or greater To primary-care provider No watch list	At 7 degrees ATR* or greater, lordosis or kyphosis To primary-care provider Watch list for 5-6 degrees ATR*: rescreened within three months

**ATR is the angle of trunk rotation as measured by the scoliometer.*

The goal of school screening is to identify girls who are at risk for progression (that is, girls who are at the beginning of their increased growth velocity). Previous recommendations were to screen girls in the fifth and eighth grades. Now, recommendations are to screen girls for scoliosis in the fall of fifth grade and the spring of sixth grade. The dual screenings maximize the opportunity to evaluate girls when progression of a curve is likely to occur.

Previous recommendations favored school screenings for boys in eighth or ninth grade. Although overall prevalence of scoliosis is fairly similar in adolescent boys and girls, it is much less common for boys to have large and/or progressive curves that require treatment. Consequently, school scoliosis screening for boys is no longer recommended.

Primary care providers should continue to evaluate patients for scoliosis at every well-child checkup and during physical examinations for athletes. (See *Primary Care Evaluation*, right.)

Evaluation Tools

Formerly, school scoliosis screening recommendations included two methods of evaluation: physical examination, including the Adams Forward Bending Test, and objective measurement of the angle of trunk rotation (ATR) with a scoliometer (see Photo 1, right). Because of inconsistencies in physical examination techniques, and in an effort to decrease false-positive screening results, the MDH no longer recommends including a physical examination in scoliosis screening. Using a scoliometer is the only method recommended for Minnesota school scoliosis screening.

School screeners are instructed to use the scoliometer in the following fashion. The student should:

- Stand in the Adams Forward Bending Test position.
- Stand with feet 2 to 3 inches apart, facing away from the examiner.
- Flex 90 degrees at the waist, keeping the knees straight with no flexion, palms together, arms straight down from the shoulders (perpendicular to the ground), and head down. (See Photo 2, Page 3.)

The screener then moves the scoliometer along the vertebral column, starting at the proximal thoracic spine and moving to the distal end of the lumbar spine. Observe the scoliometer for changes in curve measurements, noting the highest degree of angle trunk rotation (see Photo 3, Page 3). If the screener is uncertain regarding position or scoliometer reading, have the child reposition and perform the scoliometer measurement again.

Referral Recommendations

Previously, guidelines recommended referrals to primary care providers if scoliometer readings were 7 degrees or higher. School nurses observed children who had scoliometer readings of 5 to 7 degrees and re-screened them later. That is not screening; that is actually monitoring.

To clarify screening cut-off points, "watching" children is no longer supported. Referrals to a primary care provider are now recommended for patients whose scoliometer readings are 6 degrees or higher. School nurses no longer keep a "watch list."

Photo 1: Using a scoliometer (shown here) is the best way to obtain an objective measurement of a patient's angle of trunk rotation.

Primary Care Evaluation

Because not all children undergo school scoliosis screening, most of the responsibility for early identification and treatment of scoliosis lies with primary care providers. At all well-child checkups, primary care providers should evaluate children's spines with a comprehensive physical examination.

Look for clues to scoliosis, such as:

- An obvious curve or spinal asymmetry
- Shoulder/scapular asymmetry
- Uneven waistline
- Oblique pelvis
- Unequal distances between the arms and sides of the body when standing upright or in the Adams Forward Bending Test position
- Trunk rotation with the Adams Forward Bending Test
- Evaluate skin for possible signs of underlying spinal dysraphism, such as café au lait spots, hairy patches, dimples and spinal masses.

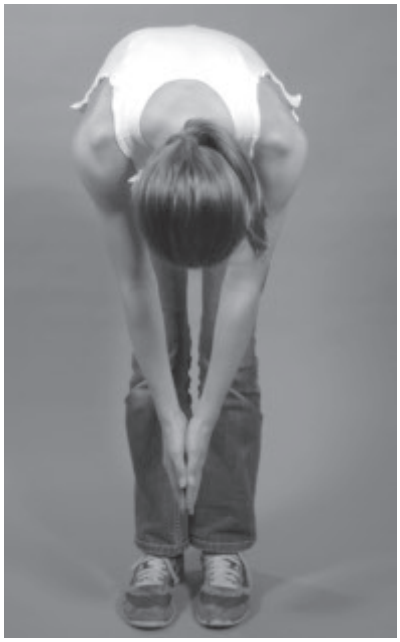

Photo 2: During a scoliosis screening, patients should stand in the Adams Forward Bending Test position, shown here.

Idiopathic scoliosis tends to run in families, so it is important to obtain a comprehensive family history. Developmental status is also important. For example, determine whether menarche has occurred, and if so, when. Include the Adams Forward Bending Test to evaluate for spinal asymmetry and sexual maturity. If there are signs of scoliosis, obtain a standing posterior-anterior spinal radiograph. Radiographs provide objective measures of spine alignment and skeletal maturation.

Refer to an orthopaedic specialist if the curve is greater than 20 degrees and if the patient has growth potential remaining. Also refer patients with curves greater than 40 degrees, regardless of skeletal maturity. Finally, refer children with excessive, stiff kyphosis and persistent back pain. If it is uncertain whether a child needs a referral, contact the spine service staff at Gillette Children's Specialty Healthcare. Gillette's staff can field questions and provide guidance.

Idiopathic scoliosis should not be painful. Additional imaging, such as an MRI of the spinal cord, might be indicated in cases involving atypical curve patterns, unusual pain, numbness, tingling, muscle spasticity, weakness, gait asymmetries, bowel/bladder changes, and/or positive neurologic findings.

Examine skeletally immature patients with mild to moderate curves (10 to 25 degrees) every four to six months during growth. In skeletally immature patients with curves from 25 to 40 degrees, consider bracing with either a thoracolumbosacral orthosis (TLSO) or a cervicothoracolumbosacral (CTLSO) orthosis to prevent progression. At Gillette, custom orthotics are most often prescribed. Bracing does not cure scoliosis. Spinal fusion surgery is indicated for severe curves (those measuring greater than 45 degrees).

Photo 3: In this photograph, the scoliometer shows the patient's angle of trunk rotation measuring 8 degrees.

Patients and families often inquire about alternative therapies for scoliosis. Numerous studies have investigated nonsurgical treatments, such as electrical stimulation, diet, exercise, physical therapy, chiropractic care and medications/supplements. None of those interventions has demonstrated a conclusive effect on the natural history of scoliosis.

The Future

Many studies are being conducted regarding idiopathic scoliosis. The National Institutes of Health/National Institute of Arthritis and Musculoskeletal and Skin Diseases is sponsoring a multicenter study evaluating outcomes in observation versus treatment in its Bracing in Adolescent Idiopathic Scoliosis trial. The goal is to enroll 500 subjects. A similar study is underway in the Netherlands. Gillette is designing research protocols to assess scoliosis treatment outcomes.

In addition, Gillette is taking part in a multicenter study conducted by Axial Biotech to investigate the genetics of idiopathic scoliosis. Skeletally mature subjects with idiopathic scoliosis are recruited. Following informed consent, spit specimens (buccal mucosal cells) are collected and 53 genetic chromosomal loci are evaluated. Clinical data, including radiographs and outcomes, are included in the

evaluation. The goal is to predict for curve progression in skeletally immature patients with idiopathic scoliosis. At the time this article went to press, more than 9500 subjects have been enrolled.

Data collected have helped establish a new test, the ScoliScore AIS Prognostic Test, intended for Caucasian girls, 9 to 13, who have mild scoliosis (10 to 25 degrees via Cobb angle). Genetic analysis yields a curve progression score, ranging from 1 to 200, reflecting the likelihood of curve progression. Less than 40 is considered low risk, 40-180 is intermediate risk, and greater than 180 is high risk. In the future, the test might help predict brace effectiveness. As with many genetic tests, results are not 100-percent certain.

Resources

Gillette Children's Specialty Healthcare:
http://www.gillettechildrens.org
(See Page 6 for referral information.)

To download a copy of *Scoliosis Screening: A Program Manual*, go to http://www.gillettechildrens.org/default.cfm?PID=1.17.1.5

Minnesota Department of Health:
http://www.health.state.mn.us/divs/fh/mch/scoliosis/index.html

Case Study

A healthy 12½-year-old girl had a positive school screening for scoliosis. Her school nurse referred her to her primary care provider, who noted a mild spinal asymmetry on examination.

The girl returned to the provider's clinic a year later. She had intermittent back pain with activities such as swimming and gymnastics, but the pain did not interfere with her ability to participate to her fullest potential. She had gone through rapid growth, per family report, growing 3 inches during the previous four months. Developmentally, she was eight months post-menarchal. On examination, her primary care provider noticed an increase in her spinal asymmetry and spinal curve. After spinal radiographs, she was referred to a pediatric orthopaedic specialist.

The patient had met normal developmental milestones. Her past medical history was noncontributory. She had no family history of scoliosis. On the Adams Forward Bending Test, she had a left lumbar prominence with a mild right thoracic prominence. Her waistline was asymmetric. Her examination revealed no spinal hairy patches, café au lait spots or dimples. Her gait appeared normal, as did her neurologic examination. A standing posterior-anterior spine radiograph demonstrated a left thoracolumbar curve of 46 degrees with a compensatory right thoracic curve. (See Photo 4, below.) Skeletal maturity was at a Risser 2, indicating additional growth potential. A lateral spine radiograph demonstrated mild thoracic hypokyphosis.

Because of the severity of her scoliosis, the fact that she had growth potential remaining, and the strong likelihood that the curve would continue to progress into adulthood, spinal fusion surgery was recom-mended, and a limited anterior spinal fusion surgery from T-12 to L2 was performed. She tolerated the surgery well and has done well during her convalescence. (See Photo 5, below.) Although she required surgery, this case study demonstrates the importance of early identification and treatment.

Photo 4: When this patient was referred to Gillette, she had a 46-degree left thoracolumbar curve with rotation.

Photo 5: This film, taken following spinal surgery, shows improved spinal alignment.

Authors' PROFILES

Sarah Gutknecht, D.N.P.

Sarah Gutknecht, D.N.P., is a certified nurse practitioner specializing in pediatric orthopaedics. Gutknecht sees children with a variety of orthopaedic conditions, including scoliosis and other spine conditions. She has worked at Gillette Children's Specialty Heathcare in St. Paul, Minn., since 2003.

Gutknecht received a bachelor of science degree in nursing, a master of science degree in pediatric nursing, and a doctorate in nursing practice from the University of Minnesota. During her studies, Gutknecht focused on working with children who have special health-care needs, and she obtained an interdisciplinary certificate in developmental disabilities. She is certified by the Pediatric Nursing Certification Board in acute and primary care.

An adjunct faculty member at the University of Minnesota, Gutknecht serves on an expert panel of the National Association of Pediatric Nurse Practitioners in orthopaedic and sports medicine. She serves on the Pediatric Nursing Certification Board and is a member of the Pediatric Orthopaedic Practitioners Society and the National Association of Pediatric Nurse Practitioners.

John Lonstein, M.D.

John Lonstein, M.D., is an orthopaedic surgeon at Gillette Children's Specialty Healthcare in St. Paul, Minn. He graduated from the University of Witwatersrand Medical School, Johannesburg, South Africa, completed his surgical residency at Boston University Medical Center, and completed his orthopaedic residency at the University of Minnesota. He began working at Gillette in 1973 and served as chief of staff in 1987-1988. He is head of the scoliosis service at Gillette.

Lonstein is certified by the American Board of Orthopaedic Surgeons and the Minnesota State Board of Examiners. His professional associations include the Scoliosis Research Society, Academy of Cerebral Palsy and Developmental Medicine, Pediatric Orthopaedic Society of North America, Societe Internationale de Chirurgie Orthopedique et de Traumatologie (SICOT), North American Spine Society, and American Orthopaedic Association.
Dr. Lonstein's appointments include staff surgeon with the Twin Cities Spine Center and clinical professor, Department of Orthopaedic Surgery, University of Minnesota.

Tom Novacheck, M.D.

Tom Novacheck, M.D., is a pediatric orthopaedic surgeon who specializes in treating cerebral palsy, scoliosis and other complex orthopaedic conditions in children and adolescents at Gillette Children's Specialty Healthcare in St. Paul, Minn. He also is director of Gillette's James R. Gage Center for Gait and Motion Analysis. Novacheck's research has focused primarily on outcomes studies concerning the management of gait disorders in people who have cerebral palsy, on developing motion analysis testing methods, and on the biomechanics of running.

Before coming to Gillette in 1991, Novacheck graduated from the University of Wisconsin – Madison Medical School. He completed his orthopaedic residency at Pennsylvania State University and his pediatric orthopaedic fellowship at Newington Children's Hospital in Newington, Conn. His professional associations include the American Academy of Cerebral Palsy and Developmental Medicine, the Gait and Clinical Movement Analysis Society, the Pediatric Orthopaedic Society of North America, the Scoliosis Research Society, the American Orthopaedic Association, the American Academy of Orthopaedic Surgeons, and the Twentieth Century Orthopaedic Association.

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Referral Information

Gillette accepts referrals from physicians, community professionals and outside agencies. To schedule an outpatient appointment, contact New Patient Services at 651-290-8707, Monday through Friday between 8 a.m. and 5 p.m. Physicians who are on staff can admit patients by calling 651-229-3890.

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Gillette Expands EMG Availability

Gillette is pleased to announce the expanded availability of electromyography (EMG) as an inpatient or outpatient testing procedure. We now offer eight clinics each month at the main campus. In addition, we have two clinics each month at Gillette Lifetime Specialty Healthcare for patients 16 or older. Sedation is available at both sites.

Physicians performing the studies include:
- Marshall Taniguchi, M.D., pediatric rehabilitation medicine specialist
- Peter Karachunski, M.D., pediatric neurologist/clinical neurophysiologist
- Supreet Deshpande, M.D., pediatric rehabilitation medicine specialist

To refer a patient, please contact Patient Appointment Services at 651-290-8707 or 800-719-4040. An office visit with the evaluating provider might be required for patients with unknown etiology or uncertain diagnostic needs.

Moving Forward in the Treatment of Pediatric Neurological Disorders

A Biennial Conference Honoring James R. Gage, M.D.

May 20 - 22, 2010
Minneapolis Convention Center, Minneapolis, Minn.

The course is intended to increase providers' understanding of advances in research, diagnoses and treatment interventions for pediatric neurological disorders. Day 1 will focus on congenital disabilities; Day 2 will focus on acquired disabilities; Day 3 will focus oncognitive development, executive function, and ethical issues related to pediatric neurosciences.

We are accepting abstracts for presentation at this conference.

For more information on the abstract submission process and the conference, visit the Gillette Web site at www.gillettechildrens.org/neurosciences2010. Or contact Paul Fiore at 651-229-1716.