

control and appropriate use of bracing and physical therapy.

Rydholm U et al: Synovectomy of the knee in juvenile chronic arthritis: A retrospective consecutive follow-up study. *J Bone Joint Surg [Br]* 1986;68:223.

Senac MO Jr et al: MR imaging in juvenile rheumatoid arthritis. *AJR* 1988;150:873.

Swann M: Juvenile chronic arthritis. *Clin Orthop* 1987;No. 219:38.

2. BRACHIAL PLEXUS PALSY

Brachial plexus palsy due to birth injury has three general patterns of involvement: (1) Erb's palsy, involving C5 and C6 roots; (2) Klumpke's paralysis, involving C8 and T1; and (3) whole arm paralysis, where the extent of involvement of individual roots may vary. Erb's palsy is most common and affects the shoulder, with loss of extension, abduction, and external rotation. Also affected are elbow flexion and forearm supination. Spontaneous improvement will occur and will level off by age 1½ years. Initial treatment is directed at maintaining shoulder motion by positioning and passive stretching to prevent the characteristic contracture in adduction and internal rotation. If muscle imbalance persists at the shoulder, the pectoralis major and subscapularis muscles can be lengthened with posterior transfer of the latissimus dorsi and teres major muscles, so that they become external rotators. Humeral osteotomy may be preferable to tendon transfer when the shoulder joint is unstable. These procedures will position the hand where it can best be used, but a normal limb is not achieved.

Boome RS et al: Obstetric traction injuries of the brachial plexus: Natural history, indications for surgical repair and results. *J Bone Joint Surg [Br]* 1988;70:571.

Jackson ST et al: Brachial-plexus palsy in the newborn. *J Bone Joint Surg [Am]* 1988;70:1217.

SCOLIOSIS & SPINAL DEFORMITY

The normal spine is straight in the frontal plane, whereas in the sagittal plane it is composed of three curves: cervical lordosis, thoracic kyphosis, and lumbar lordosis. Deviations in normal spinal contours comprise a group of disorders termed spinal deformities, of which idiopathic scoliosis is the most common (Table 43-1). Spinal deformities are clinically important because they may produce pain, difficulty with sitting or ambulating, neurologic compromise, unacceptable cosmesis, and, in advanced cases, cardiopulmonary compromise. Each type of spinal deformity is associated with its own clinical presentation, symptoms, and natural history for progression.

Although scoliosis has been defined as lateral curvature of the spine, it is associated with vertebral ro-

Table 43-1. Classification of spinal deformities.

Scoliosis
Idiopathic
a. Infantile (0-3 years)
b. Juvenile (3-10 years)
c. Adolescent (> 10 years)
Neuromuscular
a. Neuropathic
b. Myopathic
Congenital
a. Failure of formation
b. Failure of segmentation
Neurofibromatosis
Mesenchymal disorders
Rheumatoid disease
Trauma
Extraspinal contractures
Osteochondrodystrophies
Infection of bone
Metabolic disorders
Related to lumbosacral joint
Tumors
Kyphosis
Postural
Scheuermann's disease
Congenital
Neuromuscular
Myelomeningocele
Traumatic
Postsurgical
Postirradiation
Metabolic
Skeletal dysplasias
Collagen disease
Tumor
Inflammatory
Lordosis
Postural
Congenital
Neuromuscular
Postlaminectomy

tation, which produces the cosmetically unacceptable rib hump. Idiopathic scoliosis is classified according to the age at onset: infantile, juvenile, and adolescent. Scoliosis seen after skeletal maturity is termed adult scoliosis. Progression of idiopathic curves correlates with the magnitude of the curve, the age of the patient at presentation, and the patient's menarcheal status. Nonidiopathic causes of scoliosis must be determined because of their less predictable and generally higher risk for progression (eg, congenital scoliosis, scoliosis associated with neurofibromatosis, and neuromuscular scoliosis).

Clinical Findings

A. Symptoms and Signs: Examination of the patient with spinal deformity should include determination of the patient's overall frontal and sagittal alignment with particular attention to the relationship of the occiput with the sacrum. When the occiput is not centered over the sacrum, the patient is said to be decompensated. Asymmetry of the shoulders and the pelvis may be present with high thoracic and lumbar curves, respectively. The skin should be carefully in-

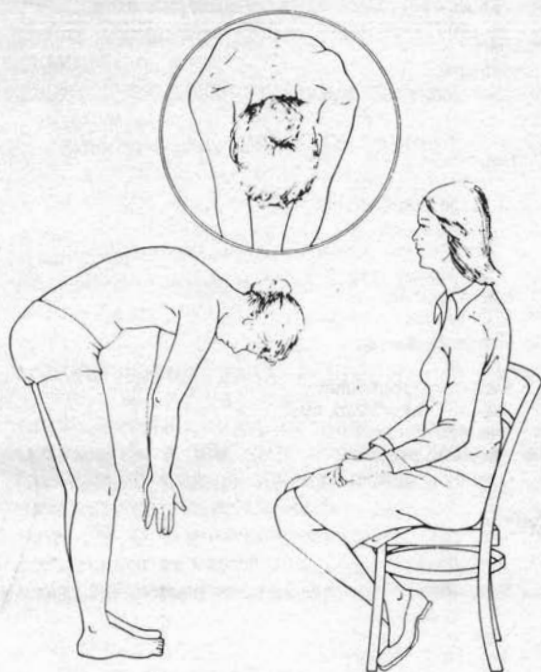


Figure 43-54. Forward bending test. Back is uncovered. Child stands with feet and fingers together, and bends forward 90 degrees, with knees straight. Examiner looks down entire spine for a "hump" (beside the spinous processes) which indicates abnormal vertebral rotation, produced by structural scoliosis. The spine should also be checked from the side for abnormal convexity (sharp angulation) or total kyphosis over 40 degrees.

spected for signs of café au lait spots (neurofibromatosis) or hair patches (spinal dysraphism). The forward bend test (Figure 43-54) detects the rib hump, which correlates with curve magnitude and vertebral rotation. A bowel and bladder history and a complete neurologic examination are mandatory for all patients.

Significant pain or neurologic symptoms are uncommon with idiopathic scoliosis. These findings warrant further investigation to rule out tumor, infection, disk herniation, or other nonidiopathic causes of spinal deformity.

B. Imaging Studies: Patients referred for evaluation of spinal deformities should be examined by standing anteroposterior and lateral radiographs, including the entire spine (3 14 film). If treatment is contemplated, bending films in the direction of each curve convexity will help to determine curve flexibility. Curves are measured according to the Cobb method (Figure 43-55). The vertebrae which are maximally tilted into the concavity of the curve are the end vertebrae. Perpendiculars from their endplates are drawn, and the angle between them determines the curve magnitude. Curves should be mea-

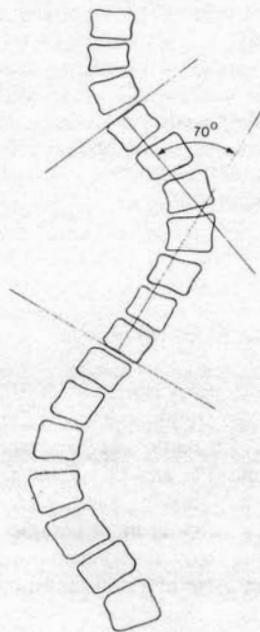


Figure 43-55. The angle of a scoliotic curve equals the angle of intersection of perpendiculars to the end plates of the highest and lowest vertebrae in the curve. This should be measured on a standing posteroanterior radiograph. The same end vertebrae must be used when serial films are checked for increasing curvature.

sured from the same vertebrae during each examination for serial comparison.

Patients presenting with neurologic signs or symptoms, left thoracic curves, or rapid progression should be examined by MRI to rule out intraspinal disease.

Treatment of Adolescent Idiopathic Scoliosis

A. Observation: Skeletally immature patients presenting with curves less than 20 degrees or those presenting with curves less than 40 degrees at skeletal maturity should be observed. Adolescent patients should be followed with radiographs at intervals of 4-6 months until the age of skeletal maturity. Curves greater than 20 degrees or with progression of greater than 5 degrees should be referred for treatment to a surgeon experienced in the management of patients with spinal deformity.

B. Bracing: Growing children with curves measuring 20-40 degrees or documented progression are candidates for brace treatment. Patients with curve apices below T8 can be fitted with polypropylene underarm-type braces. Higher curves can be controlled only with a cervicothoracic/lumbar orthosis (Milwaukee brace). The goal of bracing is to halt progression. Long-term curve correction is rarely achieved with brace treatment.

The daily duration of brace wear necessary to halt progression is controversial. Although historically braces have been worn for 23–24 hours per day, recent studies have indicated that limited daily brace wear may be equally effective. Generally, patients should be braced until the age of skeletal maturity and then should be gradually weaned.

C. Surgical Treatment: The prevalence of patients with curves greater than 20 degrees is 0.13–0.30%, with few requiring surgery. Patients with progressive curves, curves of 40 degrees or more, and those resistant or nonamenable to brace treatment are referred for surgery. Newer surgical techniques include variable hook/rod systems designed

to both correct the frontal curve and decrease vertebral rotation while providing secure fixation so that postoperative brace wear is often not needed (Figure 43–56). Instrumentation is accompanied by surgical fusion with bone grafting. Anterior fusion and instrumentation has been developed for certain lumbar curves. The length of the fusion depends on the type of curve treated. The preservation of lumbar motion segments below the fusion has been shown to correlate with a decreased incidence of low back pain in the adult patient.

Bradford DS et al: *Moe's Textbook of Scoliosis and Other Spinal Deformities*, 2nd ed. Saunders, 1987.

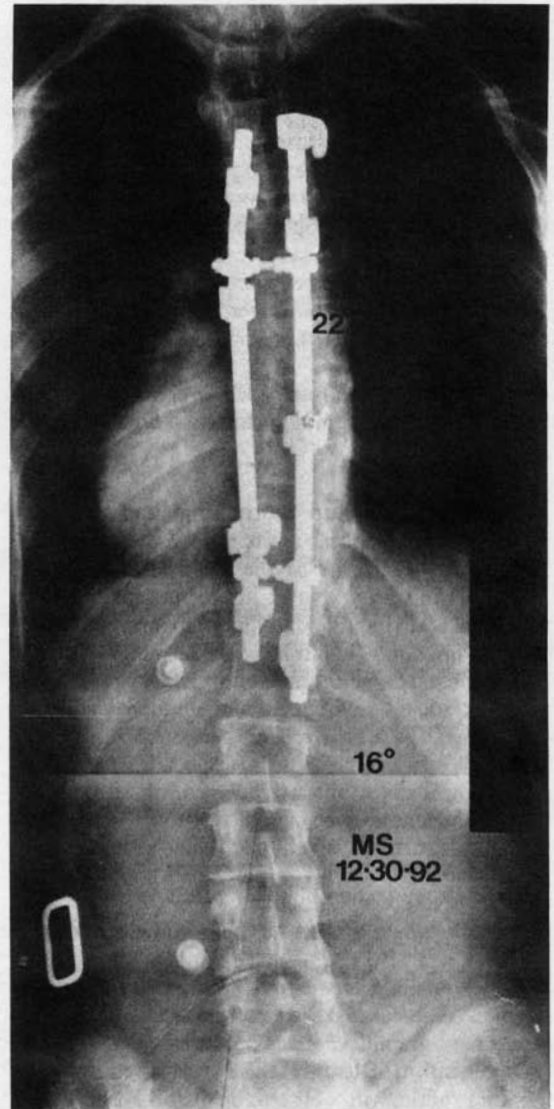


Figure 43–56. A: Posteroanterior radiograph of right thoracic idiopathic scoliosis. **B:** After surgical correction with Cotrel-Duboussset instrumentation.

- Kehl DK, Morrissy RT: Brace treatment in adolescent idiopathic scoliosis: An update on concepts and technique. *Clin Orthop Rel Res* 1988;229:34.
- Lonstein JE, Carlson JM: The prediction of curve progression in untreated idiopathic scoliosis during growth. *J Bone Joint Surg [Am]* 1984;66:1061.
- Rogala EH, Drummond DS, Gurr J: Scoliosis: Incidence and natural history, a prospective epidemiological study. *J Bone Joint Surg [Am]* 1978; 60:173.

SEPTIC ARTHRITIS OF THE HIP

Essentials of Diagnosis

- Limited hip motion, with local swelling and tenderness.
- Variable signs of systemic illness.
- Purulent exudate in the hip joint, confirmed by aspiration or arthrotomy.

General Considerations

Infection is usually hematogenous and more frequent in infants exposed to invasive measures likely to cause bacteremia. The joint can be primarily involved, or secondary involvement may occur by spread of hematogenous osteomyelitis from the proximal femur. Hip sepsis has also followed penetration of the joint during attempted blood aspiration from the femoral vein.

Staphylococcus aureus and *Streptococcus pyogenes* are the most common causative organisms.

Clinical Findings

A. Symptoms and Signs: Impaired voluntary and reflex motion of the entire involved limb—pseudoparalysis—is the most typical early finding. Fever is unlikely in very young children, but sepsis may be suggested by irritability and failure to thrive. Another focus of infection should increase suspicion. The hip is held flexed in slight abduction and external rotation, with local swelling becoming evident as disease progresses. The area is tender, and attempts to move the hip are resisted and seem especially painful. If pathologic dislocation has occurred, hip asymmetry and instability may be noted.

B. Laboratory Findings: The sedimentation rate is elevated, but the white blood count may be normal. Leukocytes are abundant in the joint fluid, and gram-stained smears of fluid show microorganisms as well. Bone scan may initially be negative, especially in children under 6 months of age, but usually shows increased uptake around the involved joint before radiographic changes become evident.

C. Imaging Studies: The early radiographic signs are subtle, with obliteration of soft tissue planes and a suggestion of "capsular distention." Lateral subluxation and complete dislocation may occur. Decreasing bone density and periosteal erosion or new

bone formation occur later. Ultrasound imaging provides an early indication of joint effusion.

Differential Diagnosis

Alternative diagnoses in the neonate are fractures of the femur occurring during birth and acute hematogenous osteomyelitis of the proximal femur that has not yet spread into the hip. Congenital hip dislocation is not painful and limits motion to a lesser extent. In older children, transient synovitis, rheumatoid arthritis, pelvic osteomyelitis, and acute hemarthrosis from hemophilia must also be considered.

Complications

Structural sequelae include pathologic dislocation, avascular necrosis that may cause total and irreversible destruction of the femoral head and neck; and leg length discrepancy, usually due to undergrowth of the involved femur. Chronic persisting infection may also result.

Treatment

Surgical drainage is required as an emergency procedure. Side effects from negative arthrotomy are so few that exploration is warranted if the diagnosis is uncertain. Gram-stained smears of intra-articular pus guide the initial choice of parenteral antibiotic, which is modified if necessary according to the results of culture and sensitivity tests. Suction-irrigation tube drainage will maintain adequate decompression. Postoperatively, traction or a spica cast is used to rest and align the joint.

Course & Prognosis

If the diagnosis is made and surgical drainage performed within a few days of onset, the long-term results are good. Delay and nonoperative treatment are predictably followed by the complications mentioned above.

- Honka L et al: Classification and surgical management of the severe sequelae of septic hips in children. *Clin Orthop* 1982;No. 171:50.
- Wenger DR: Childhood hip sepsis: Improving the yield of good results. *Instr Course Lect* 1985;34:457.
- Weggepfer JM et al: Long-term follow-up of infantile hip sepsis. *J Pediatr Orthop* 1988;8:322.

TRANSIENT SYNOVITIS OF THE HIP (Irritable Hip Syndrome, Toxic Synovitis, "Observation Hip")

This syndrome of unknown origin is the most common cause of painful hip in young children. A respiratory illness often precedes the complaint of pain, which may be localized to the knee, thigh, or hip. The