49. Myers GE. When angina is a pain in the neck. Medical World News 1977; April 18.
Hippocrates first described the type of deformity whereby the spine deviates laterally; however, it was Galen (A.D. 131–201) who actually coined the term *scoliosis*. Galen also created the terms lordosis and kyphosis to describe postural deviations in the sagittal plane. Today, *scoliosis* is defined as being an appreciable lateral curvature of the spine in the coronal plane. Most authors consider a deviation greater than 10° (Cobb’s method) to be a scoliosis, and a curve less than 10°, a convexity. This chapter will provide a literature review of scoliosis, especially scolioses afflicting the adolescent, classifications of curvatures, and, treatment and management strategies that may prove beneficial for this often crippling disorder.

**BACK PAIN**

Back pain associated with adolescent scoliosis appears not to have a higher incidence than the population of adolescents as a whole; however, adult scoliotic patients do seem to have a higher incidence of back pain (1). With age, many curvatures progress, albeit slowly, possibly explaining the higher incidence of back pain in adult scoliotics.

**VISCERAL DISTURBANCES**

It has been hypothesized that scoliosis is associated with visceral disturbances (2). The osteodegenerative changes that occur around the nerve roots in patients with scoliosis may affect visceral function through somatovisceral reflexes. Whether scoliotic individuals have higher incidences of visceral pathology has not yet been determined. Severe curvature, however, especially in the thoracic spine, has been associated with cardiac and pulmonary complications caused by compression of the lungs and vessels of the heart (3,4).

**EARLY DEATH**

Autopsy studies have revealed an interesting correlation between severe curvature and the average age of death. More severe curvature is related to earlier death. Moreover, the mean age of death (30–50 years) was especially correlative if the curves had started during adolescence (5–7).

In the long-term, patients with scoliosis show a marked increase in mortality, with the cause of death in 60% of cases being cardiopulmonary complications (8).

Another long-term follow-up study (9) revealed similar results with a population of severe scoliotics. It is noted, however, that no radiographs were obtained during this study; therefore, the exact amount (degree) of curvature was not determined. It was concluded that the mortality rate of a patient with a severe scoliosis (> 80°) is well over 100% when compared with the general population. Thoracogenic, congenital and neurogenic scoliosis were found to have a worse prognosis when compared with the idiopathic, rachiogenic or poliomyelic types of scoliosis. Nachemson’s study (9) revealed the cause of death in 80% of cases to be kyphoscoliotic cardiopathy with cor pulmonale.

**COSMETIC DEFORMITY**

Scoliosis is also an obvious cosmetic deformity that may have an effect on the personality of the individual. Specific psychological disorders or behaviors associated with scoliosis are not known. In one study (8) it was noted that 76% of the females involved in the investigation did not marry.

**ETIOLOGY**

There are many different causes for scoliosis. Most authors identify scoliosis as a multifactorial disorder involving mostly genetic and growth factors. It has been estimated that 80% of all scolioses have no singular identifiable cause (10). Idiopathic scoliosis is the major focus of this chapter.

**Structural vs. Functional**

Structural scolioses are those that remain in a curved position during forward bending. Nonstructural or functional scolioses are those curves that remit or improve during forward bending. Functional scolioses are commonly associated with leg length inequality. Lateral bending should improve a functional curve, whereas, in using the same movement, a structural curve will remain. There may be levels of the functional curve, however, which will exhibit some asymmetry of motion due to the beginning effects of ligamentous creep at the motion segment. Although the adolescent idiopathic scoliosis is commonly referred to as a structural curve, this may not be the case during the beginning stages of the disorder. A functional
curve caused by a lateral flexion malposition of a spinal segment will, over time, undergo bone remodeling because of Heuter Volkmann's or Wolff's law, thereby creating a structural curve.

Classifications for Scoliosis

A review of the literature indicates that approximately 80% of scolioses have no known cause. The chiropractic community may find this number to be arguable. The chiropractic specialty revolves around subtle and large changes in the spinal column which may be associated with abnormal structure or function.

To learn more about biomechanical causes for scoliosis, case reports and case control studies of successes and failures in scoliotic patients need to be performed. Large populational studies could be performed with scoliosis patients, thereby allowing for a classification system that would be more reflective of the type of patient encountered in private chiropractic practice. Without this much needed research, chiropractic would surely follow the obtuse course of medicine whereby most cases have no known cause. A biomechanical approach, which emphasizes the subtle interactions between structure and function, needs to be used to direct treatment at the cause of the curvature rather than at the reaction to the dysfunctional motion segment.

The approximately 20% of cases that do have an identifiable cause, have varied etiologies. Winter has provided the majority of the categories for scoliosis classification (11). Additional categories that appear to be unique to the chiropractic profession have been included by the author:

Structural Scoliosis

I. Idiopathic
   A. Infanile (0–3 years)
      1. Resolving
      2. Progressive
   B. Juvenile (3–10 years)
   C. Adolescent (>10 years) (most common; 80% of all curves)

II. Neuromuscular
   A. Neuopathic
      1. Upper motor neuron lesion
         a. Cerebral palsy
         b. Spinocerebellar degeneration
            i. Friedrich's disease
            ii. Charcot-Marie-Tooth disease
            iii. Roussy-Levy disease
         c. Syringomyelia
         d. Spinal cord tumor
         e. Spinal cord trauma
      2. Lower motor neuron lesion
         a. Poliomyelitis
         b. Traumatic
         c. Spinal muscular atrophy

B. Myopathic
   1. Arthrogryposis
   2. Muscular dystrophy
      a. Duchenne (pseudohypertrophic)
      b. Limb girdle
      c. Facioscapulohumeral
   3. Fiber type disproportion
   4. Congenital hypotonia
   5. Myotonia dystrophica

III. Congenital
   A. Failure of formation
      1. Hemivertebrae (Fig. 9.1)
      2. Unilateral sacral inferiority (hemivertebra of S1)
   B. Failure of segmentation
      1. Unilateral (unsegmented bar)
      2. Bilateral
      3. Mixed

IV. Neurofibromatosis

V. Mesenchymal disorders
   A. Marfan's
   B. Ehlers-Danlos

VI. Rheumatoid disease

VII. Trauma
   A. Fracture
   B. Surgical
      1. Postlaminectomy
      2. Postthoracoplasty
   C. Irradiation

Figure 9.1. Biomechanical effect of a wedge vertebra. The patient has usually had years for adaptation to take place before the anomaly is discovered. Asymmetrical compression fracture can cause a wedge-like configuration of the vertebral body. In these instances, the demands in terms of adaptation are often greater than the ability of the spinal compensatory mechanism. The degenerated spine will have even less tolerance for this acute adaptational disturbance. There is often associated anterior/posterior plateau asymmetry that causes compensatory reactions in the sagittal plane as well.

   i. Werdnig-Hoffman
   ii. Kugelberg-Welander
   d. Myelomeningocele (paralytic)
   3. Dysautonomia (Riley-Day)

   B. Myopathic
   1. Arthrogryposis
   2. Muscular dystrophy
      a. Duchenne (pseudohypertrophic)
      b. Limb girdle
      c. Facioscapulohumeral
   3. Fiber type disproportion
   4. Congenital hypotonia
   5. Myotonia dystrophica

   III. Congenital
   A. Failure of formation
      1. Hemivertebrae (Fig. 9.1)
      2. Unilateral sacral inferiority (hemivertebra of S1)
   B. Failure of segmentation
      1. Unilateral (unsegmented bar)
      2. Bilateral
      3. Mixed

   IV. Neurofibromatosis

   V. Mesenchymal disorders
   A. Marfan's
   B. Ehlers-Danlos

   VI. Rheumatoid disease

   VII. Trauma
   A. Fracture
   B. Surgical
      1. Postlaminectomy
      2. Postthoracoplasty
   C. Irradiation
Figure 9.2. Spondylolisthesis with spondylolysis may at times present with other anomalies such as asymmetrical bony elements which cause scoliosis. Often, young scoliosis patients are monitored with only an AP radiograph. Without the lateral radiograph, important information may be missed. Two orthogonal radiographic exposures are mandatory for a minimal radiographic evaluation. Figure 9.2 is a radiograph of a patient with a lateral spinal deviation beginning at the level of a spondylolisthesis.

VIII. Extraplinal contractures
   A. Postempyema
   B. Post burns

IX. Osteochondrodystrophies
   A. Diastrophic dwarfism
   B. Mucopolysaccharidoses (e.g., Morquio’s syndrome)
   C. Spondyloepiphysyeal dysplasia
   D. Multiple epiphyseal dysplasia

X. Infection of bone
   A. Acute
   B. Chronic

XI. Metabolic disorders
   A. Rickets
   B. Osteogenesis imperfecta
   C. Homocystinuria

XII. Related to lumbosacral joint
   A. Congenital anomalies of the lumbosacral region
      1. Unilateral sacral inferiority (See Congenital)
   B. Spondylolysis and spondylolisthesis (Fig. 9.2)

XIII. Tumors
   A. Vertebral column
      1. Osteoid osteoma
      2. Histiocytosis X
   B. Spinal cord (see neuromuscular)

Figure 9.3. Lateral flexion (θZ) positional dyskinesia caused by disc lesions or other factors often will result in a compensatory lateral deviation above.

Figure 9.4. AP radiograph showing the effect of leg length inequality on the development of scoliosis.

Nonstructural or Functional Scoliosis

I. Postural scoliosis
II. Hysterical scoliosis
III. Nerve root irritation
   A. Herniation of the intervertebral disc
B. Disc block subluxation (12) (Fig. 9.3)
C. Tumors
IV. Segmental (Fig. 9.3) and postural positional dyskinesia
V. Inflammatory (e. g., appendicitis)
VI. Related to leg length inequality (Fig. 9.4)
VII. Related to contractures about the hip

INFANTILE IDIOPATHIC SCOLIOSIS

Infantile scoliosis appears at birth or sometime before the age of three. Most (80–90%) remit spontaneously; therefore, no treatment is indicated. Those curves that do progress usually become quite severe and disabling. Infantile scoliosis is seen predominantly in the male and is usually left thoracic in nature. Mehta (13) has devised a rib angle differential measurement which appears to be helpful in distinguishing those curves that are likely to progress (14) (Fig. 9.5).

JUVENILE IDIOPATHIC SCOLIOSIS

Juvenile scoliosis is detected after the age of three and before puberty (Fig. 9.6A-D). Unfortunately, most of these curves are progressive in nature. If treatment is not directed in the early stages, severe deformity can result. Most curves begin before the age of ten and there is a preponderance in females (15).

Observation is very important in the juvenile group, because the great majority of these curves do progress. After initial examinations are performed, follow up radiographic examinations should be performed at approximately 4- to 6-month intervals. During the growth spurt, curve progression is greatest, making careful monitoring important. After the growth spurt, most curves have little progression. Many scolioses that started in the juvenile stage are discovered during adolescence. There are no sharp lines of differentiation between the varying age groups.

Figure 9.5. Shows the method of measurement for determining the rib-vertebra angles. If the difference between the right and left angles is > 20°, then progression is likely for the infant. Kristmundsdottir and coworkers (14) found that if the rib-vertebra angle on the convex side (measured at the apex) is < 68° then progression is also likely. From Mehta MH. The rib-vertebra angle in the early diagnosis between resolving and progressive infantile scoliosis. J Bone Joint Surg 1972;54B:230–243.

Figure 9.6. Juvenile scoliosis. This is an example of a non-attack rotational lesion (P-L-, +θ') of the sacrum causing a lateral deviation through the normal coupling mechanism of the spine. The left sacroiliac and T4-T5 articulations were adjusted. The comparative radiographs were taken after two months of chiropractic care (i.e., spinal adjustments). The AP radiographs demonstrate a marked reduction in the sacral rotation and lateral spinal deviation. The initial radiograph was taken on 1-22-80 (A) and the comparative one on 3-26-80 (B). C, Initial lateral radiograph. D, Post-treatment view.
ADOLESCENT IDIOPATHIC SCOLIOSIS

Most forms of scoliosis fall into the adolescent idiopathic type (Fig. 9.7A-B). The age range is from the onset of puberty to adulthood or skeletal maturity. The adolescent curve is usually discovered shortly after puberty. Curves greater than 20° tend to be more common in females, but the male to female ratio approaches 1:1 for curves less than 20°.

It is interesting to note that adolescent scoliosis patients are taller and heavier than their peers (16). The height change may be partially due to the thoracic hypokyphosis commonly observed.

Not all adolescent curves are progressive. This variation has been a problem in documenting the efficacy of a given treatment. It is rare, however, for the adolescent curvature to spontaneously improve as seen in the infantile types. Monitoring curve progression is especially important during the rapid skeletal development phase. It is complicated by the fact that onsets of puberty are quite varied from individual to individual. The time taken to reach skeletal maturation is also quite varied. For instance, individuals may take from two to five years to mature.

The average age of menarche is 12½ to 13½ in American girls, but approximately 1 to 2% of all females have not menstruated by the age of 16 (17). Males have an onset of puberty between the ages of 9½ and 13½. Growth usually ceases between the ages of 13 and 17. After the growth spurt, most curves (both male and female) have little progression.

Three-Dimensional Perspective

Most adolescent scoliotics present with not only a lateral deviation of the spinal column in the coronal plane, but also a flattening of the normal kyphosis, viewed from the sagittal plane. The normal kyphosis of the thoracic spine can be thought of as rotating toward one side or the other, thereby creating two dysfunctions simultaneously—scoliosis and hypokyphosis. It is integral to the examination when seeking biomechanical causes for scoliosis to look at the lateral radiograph for signs of dysfunction in the sagittal plane.

EXAMINATION

Those examinations that are specific to scoliosis are presented here. The spinal examination is presented in Chapters 4 and 5.

Posture

Postural analysis is essential to the examination and can be performed physically and radiographically. The analysis is performed in part to determine which curves are compensated. Compensation refers to the spine assuming a horizontal or level position in response to a postural dysfunction.

Anterior carriage of the head is a common finding in patients with scoliosis. This is commonly due to dysfunction in the lower spine rather than in the neck itself. In the coronal plane, compensated curves with the rib cage centered over the pelvis have usually been present for the longest duration. Rib and shoulder girdle remodeling is usually extensive and these curves hold a poor prognosis for correction (Fig. 9.8). The well-compensated curve is also unlikely to progress. Adult scoliotics tend to have very well compensated curves. Uncompensated patterns occur more often in the juvenile or adolescent or in the acute patient with antalgia.

Radiography

The radiographic examination will give the most detailed information with regard to posture and compensation reaction. This examination usually entails a minimum of an AP and a lateral full spine radiograph.

The AP radiograph includes an evaluation for leg length inequality and associated pelvic posture. For a
The radiographic examination should include those views necessary to determine skeletal maturity. Skeletal maturity is determined through observation, radiologic analysis, and a careful history, which includes the age of menarche in the female. The iliac crest, visible on the AP full spine or on the AP pelvic radiograph, is best evaluated using the Risser method (18). The crest is divided into four quadrants, and the epiphyseal excursion grade is calculated by determining the extent of excursion (Fig. 9.9):

Grade 1 = 25% excursion  
Grade 2 = 50% excursion  
Grade 3 = 75% excursion  
Grade 4 = 100% excursion  
Grade 5 = Full excursion and complete fusion of the ilium to the epiphysis

The vertebral body epiphysis can also be of help in determining skeletal maturity because complete fusion of the epiphysis to the body occurs at the cessation of vertebral growth. The lateral film best visualizes the vertebral epiphysis.

Because breast tissue is highly sensitive to radiation, the AP radiograph should be performed with adequate shielding or, in the absence of shielding, in a posterior to anterior fashion. Thorough x-ray shielding is important during all radiographic examinations, and this is especially true in the young, because maturing bone marrow is a very radiosensitive tissue.

Eighty-four inches or greater film focal distance (FFD) should be used. This will result in less skin dose to the patient (19) and also decrease the extent of magnification distortion. Appropriate patient identifying information should be present on the film, including technologic factors for the radiograph. Film focal distance is especially important in order that future technicians can use similar technique. Keeping the FFD constant, although not affecting angular measurements on the film, will remove one variable should the amount of the scoliosis angle change due to improper patient positioning during the examination.

A supplemental radiograph of importance, is the sacral base tilt or Ferguson projection (Fig. 9.10). This view is taken posterior to anterior or anterior to posterior depending on facility limitations and is performed with gonadal shielding. Visualization of the L5-S1 disc space in the standing position is done with this view as well as determination of the presence of anomalies at the lumbarosacral junction, especially unilateral sacral inferiority (20).

The Cobb's method of measurement is preferred for analysis of the curvature of scoliosis. A report by Goldberg indicated an average intraobserver disagreement of 1.9° (21). Figure 9.11A and B details the method of mensuration.

Lateral flexion x-rays should be performed to ascertain the flexibility of the curvature and to determine potential sites for spinal adjustment. These motion segments would exhibit fixation dysfunction in a particular plane of motion due to soft tissue effects. All attempts must be made to differentiate between fixation dysfunc-
tion and motion restriction caused by anomalous changes in the vertebrae themselves.

Tomography, helpful in evaluating congenital problems, may also be indicated along with other advanced imaging such as computerized axial tomography (CT) or magnetic resonance imaging (MRI).

Physical Examination

In addition to the normal spinal examination, for the presence of vertebral lesions, the orthopaedic examination includes Adam's maneuver (Fig. 9.12). This test simply stresses the vertebral column making a functional curve remit and a structural one appear as a raised area lateral to the spine due to axial rotation of the vertebrae.

The clinician should also be watchful for the presence of café-au-lait spots which may indicate neurofibromatosis. A patch of hair over the lumbosacral region may indicate a diastematomyelia and abnormal scarring with extreme elasticity of the skin may be indicative of Ehlers-Danlos syndrome.

HANDEDNESS

In a report by Goldberg and Dowling (22), an attempt was made to determine correlation, if any, between the convex side of a scoliosis and the handedness of the individual. The sample of 254 females had curve patterns assessed in terms of the lower thoracic portion only. Of 228 right-handed children, 197 had a right convex curve.

The 26 left-handed children had convexities to the left in 12 cases. The correlation between scoliosis configuration and handedness, although not occurring in every instance, was statistically significant.

CURVE PROGRESSION

The natural history of scoliosis must be considered before evaluating the effectiveness of a given treatment. A lateral curvature has been shown to do one of three things during the child's development:

1. Progress; the largest amount occurring during growth spurts.
2. Remain stationary.
   a. Adult curves; those with only a single scoliosis and those which are past skeletal maturity.
   b. Functional curves; especially those seen with leg length inequality which appear to have little tendency towards progression.
3. Spontaneously improve or remit commonly seen in infants and to a much lesser extent in acolsecents.

Treatment, therefore, must be effective in altering the natural history of the disease before it can be of any value.
Although manipulation is not a contraindication for scoliosis patients and most likely has a positive effect on back pain, especially in the adult (10), spinal adjustments should be directed at eliminating the cause of the curvature. Though adjustments may be helpful in managing pain the patient is experiencing, a rapidly progressive scoliosis (>50°) in an adolescent or juvenile should be managed by both the chiropractor and an orthopaedist familiar with the disorder.

Slowing or stopping the advance of a progressive scoliosis is a positive clinical result. Improving or correcting progressive or stationary curves is another positive result. Intervention must be evaluated in light of the specific natural history of that patient’s curve. Chiropractic care must be objectively evaluated, especially in those cases in which spontaneous improvement was likely regardless of the form of treatment.

Determining which curves will progress is somewhat difficult. Clarisse (23) found that curve progression past 30° was documented in 53% of the cases in which the patient’s initial curves were in the range of between 10° to 29°. When evaluating curve progression in the premenstrual patients, 12% of lumbar curves progressed, as did 42% of single thoracic curves and 67% of double major curves.

Another study (24) involving 727 patients showed that curve progression was intimately associated with skeletal maturity (Risser sign), age of menarche and type of curvature (double, thoracic, etc.) present. Progression greater than 10° in curves less than 19° and progression of 5° for curves between 20° and 29° was considered significant. Spontaneous remission occurred in about 11% of the cases. Menarche had occurred in 68% of the patients with a nonprogressive curve and in only 32% of the patients with progressive scoliosis. For curves less than 19° and also having a Risser sign of 2, 3 or 4, there was little progression (<2%). However, 68% of patients with 20 to 29° curvatures with a Risser sign of 0 or 1 were progressive. The magnitude, as well as the pattern of the curve, have effects on progression (Fig. 9.13).

The follow-up in a premenstrual patient with a double major curve needs to be quite aggressive because the majority of these curves do progress (Fig. 9.14A–B). The follow-up in adults with single curves less than 20° needs to be less frequent. Radiographic guidelines for comparative examinations after chiropractic treatment are undefined. If the curve has been determined to be progressive, then a comparative radiographic examination after 3 to 6 months is not unusual. If the physical examination findings are inconsistent with the radiologic picture, then reexamination is in order.

CHIROPRACTIC RESEARCH

Scientific evidence substantiating the uses of different therapies in the treatment of scoliosis is lacking. The Milwaukee brace, which for years was the mainstay of conservative management of idiopathic scoliosis, has never been adequately tested (25,26).

Similarly, chiropractors have claimed success with scoliotic individuals (20,27), but to date no clinical trials (controlled or otherwise) have been performed. Case reports, for which there are little technical difficulties in performing, are sorely missing (28). Controlled studies are difficult at times to perform, because withholding treatment in this often crippling disorder is unethical. Retrospective studies would be a beginning for our research endeavors in this area. One report (29) demonstrated no significant change in curvature after 9 adjustments in a series of 13 adult patients. Another study (30) showed significant reduction in lumbar scoliosis after a combination of manipulation and lift therapy. Others (31) have demonstrated the benefits of lift therapy in the adult with scoliosis.

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**Figure 9.12.** Adam’s test. Two rib humps (lumbar and thoracic) indicating structural asymmetry are shown.

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Figure 9.14. Spinal curvature in an adolescent. A, Pretreatment radiograph. B, Curvature that has reversed the direction of laterality after a series of spinal adjustments. This case demonstrates the need for comparative examination to evaluate the effectiveness or lack thereof of treatment.

Figure 9.15. Lateral deviation creates asymmetrical loads on the motion segments, precipposing them to injury.

CHIROPRACTIC MANAGEMENT

The specific short lever arm adjustment is designed to restore function at a dysfunctional motion segment. Because scoliosis is a global postural problem, finding the causes of the curvature is difficult but important.

The most caudal portion of the curve may be the genesis of the scoliosis. Lateral flexion malpositions have been suggested (20,32) to be significant areas of involvement in the scoliotic patient. These malpositions could be due to disc, or disc and posterior joint trauma. The apex of the curvature is another likely site for dysfunction. The long lever arm (Fig. 9.15) at this area allows a large lateral moment to be created on the spine because of the force of gravity. This stress is concentrated on the motion segment at the apex of the scoliosis.

If it is determined that the apex is freely movable, then adjustments are contraindicated. Mobile and hypermobile functional spinal units are contraindicated for any manipulative therapy. Interssegmental spinal mobility is best evaluated with stress plane film analysis or videofluoroscopy.

It is important to approach all adjustments from the convexity of the curve to reduce the likelihood of increasing the deviation. Generally, this is also probably the best approach for reducing the curvature.
Disturbances in the vestibular apparatus have been associated with scoliosis patients (33). Also, dysfunction in proprioception has been documented (34). Whether this is a cause of the scoliosis or simply an effect of the disease is presently unclear. Lewit (35) has hypothesized that mechanical dysfunction in the upper cervical spine may have an influence on the curve or its genesis. The doctor should examine all segments of the spinal column for signs (e.g., edema, tenderness, etc.) of a vertebral subluxation complex, because the etiology of the deformity may occur at any level (See Chapters 4 and 5) (Figs. 9.16–9.18).

**Scoliosis and Exercise**

Exercises have not been shown either to correct the curvature or halt curve progression in most scoliotics. This apparent ineffectiveness does not mean that exercise is not an important adjunct to overall spinal fitness.

After the initial phase of adjustments, general exercises such as swimming and walking and other nonspine stressors may be implemented. This will prepare the patient for more stressful spinal maneuvers in the future and also improve cardiovascular function.

After a few weeks of general exercise, the patient can then progress to specific therapies designed to strengthen weak paraspinal musculature and stretch chronically contracted fascia and muscles. Nautilus trunk flexion and extension machines or similar designs are helpful in strengthening the torso musculature.

Asymmetric lateral flexion isotonic and isometric exercises to the side of convexity will help to stretch those tissues on the concavity of the curvature. In the case of compound curves this becomes more difficult. The patient must be careful in avoiding hypermobile motion segments with the stretch or exercise because this may accelerate creep at those levels.

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**Figure 9.16.** AP radiograph demonstrating a short leg in a 31-yr-old female patient.

**Figure 9.17.** Stress x-rays of patient in Figure 9.16, indicate global postural coupling dysfunction during left lateral flexion (A) and fixation dysfunction at L5-S1 during right bending (B). The treatment for this patient included spinal adjustments (L5-S1), specific postural maneuvers to reverse the abnormal coupling pattern during left bending, and a heel lift.
Braces

Bracing for scoliosis is a controversial subject. Although some authors feel that it is an excellent therapy, others discount any supposed efficacy. Braces are seldom recommended for curves greater than 50° or less than 20°. One report (36) indicates that the Boston brace has little effect on curve magnitude. In a series of 107 patients, it was determined that scolioses with apices at T10-T12 showed slight improvement (i.e., 2°), whereas other areas remained unchanged. A preliminary study by Price et al (37) showed that nighttime brace therapy (Charleston) compares favorably to the results obtained from full time orthoses (i.e., Milwaukee).

One serious complication of brace therapy to which the physician should be aware is that of persistent vomiting associated with wearing the brace. The device may press the superior mesenteric artery against the duodenum. The brace should be removed immediately if vomiting occurs due to the risk of abdominal obstruction and death (38).

Compliance with orthoses such as the Milwaukee brace is quite low due to the cumbersome nature and unattractiveness of the device. Compliance rates are about 50% with most children.

Patient Compliance

Compliance with chiropractic care in the adolescent is made difficult because of the repetitive nature of treatment in the absence of symptomatology. Rehabilitative or reconstructive care entails multiple adjustments unlike a typical pediatric patient without a spinal curvature. Education for parents is essential so that they understand the need for prolonged and often expensive treatment.

Electrical Stimulation

Electrical muscle stimulation in the treatment of idiopathic scoliosis has gained popularity in recent years (28,39,40). Whether electrical muscle stimulation is a helpful adjunct to chiropractic adjustments, or has the ability to halt progression or, indeed, corrects lateral deviations of the spinal column has yet to be determined. Muscle stimulation’s effectiveness is still largely unknown but appears to be equal to bracing in terms of slowing progression (39).

Studies differ on appropriate position for the electrodes. Some authors have used a position close to the midline of the spine, whereas others have advocated a more lateral approach (41,42). Sleep disturbance has been reported to be a problem in some patients. This is due to the sometimes irritating effects of the electrodes. Although sleep disturbance is a problem, it is manageable and compliance rates in patients using stimulation appear to be much higher than brace therapy (40). Unfortunately, the patient must sleep in the prone position with electrical stimulation, necessitating head rotation which places rotational stress on the cervical spine.

Electrical stimulation and its role in the chiropractor’s practice has been summarized by Dutro and Keene (40). This summary emphasized that proper patient protocol including patient education is mandatory, in order for the therapy to have maximal results. It is suggested that the doctor work closely with the equipment manufacturer and an experienced clinician before integrating the therapy into practice.

TERMINOLOGY

The terminology committee of the Scoliosis Research Society has developed a glossary of terms which will be of use to the practitioner with an interest in scoliosis. These terms create a common language between health care disciplines and should be used when detailing reports about scoliotic individuals.

Glossary

Adolescent scoliosis. Spinal curvature presenting at or about the onset of puberty and before maturity.
**Adult scoliosis.** Spinal curvature existing after skeletal maturity.

**Apical vertebra.** The most axially rotated vertebra in a curve; the most deviated vertebra from the vertical axis of the patient.

**Café-au-lait spots.** Light brown irregular areas of skin pigmentation. If sufficient in number and having smooth margins, they are suggestive of neurofibromatosis.

**Compensatory curve.** A curve, which can be structural, above or below a major curve, that tends to maintain normal body balance by keeping the majority of the trunk over the midline.

**Congenital scoliosis.** Scoliosis due to congenital anomalous vertebral development.

**Curve measurement.** Cobb’s method: select the upper and lower end vertebrae with the steepest inclination towards the concavity of the curve. Erect perpendiculars to lines drawn through the end-plates of the end vertebrae. If the end-plates are poorly visualized or anomalous, then draw a line which bisects the centers of the pedicles.

**Double major scoliosis.** A scoliosis with two structural curves.

**End vertebra.** 1. The most cephalad vertebra of a curve, whose superior surface tilts maximally towards the concavity of the curve. 2. The most caudal vertebra whose inferior surface tilts maximally towards the concavity of the curve.

**Fractional curve.** Compensatory curve that is incomplete because it returns to the erect. Its only horizontal vertebra is its caudad or cephalad one.

**Full curve.** A curve in which the only horizontal vertebra is at its apex.

**Gibbus.** A sharply angular kyphotic deformation.

**Hyperkyphosis.** A sagittal alignment of the thoracic spine in which there is more than the normal amount of kyphosis.

**Hypokyphosis.** A sagittal alignment of the thoracic spine in which there is less than the normal amount of kyphosis.

**Hysterical scoliosis.** A nonstructural deformity of the spine that develops as a manifestation of a conversion reaction.

**Idiopathic scoliosis.** A structural spinal curve for which there is no known cause.

**Iliac epiphysis, iliac apophysis.** The epiphysis along the wing of an ilium.

**Inclinometer.** An instrument used to measure the angle of thoracic inclination or rib hump.

**Infantile scoliosis.** Spinal curvature which is developing during the first three years of life.

**Juvenile scoliosis.** Spinal curvature which is developing between the skeletal age of three and the onset of puberty.

**Kyphos.** A change in alignment of a segment of the spine in the sagittal plane that increases the posterior convex angulation; an abnormally increased kyphosis.

**Kyphoscoliosis.** A spine with a scoliosis and a true hyperkyphosis. A rotary deformity with only apparent kyphosis should not be described by this term.

**Lordoscoliosis.** A scoliosis associated with an abnormal anterior angulation in the sagittal plane.

**Major curve.** Term used to designate the largest structural curve.

**Minor curve.** Term used to describe the smallest curve. This curve is always more flexible than the major curve.

**Nonstructural curve.** A curve that has no structural component and that corrects or overcorrects on recumbent or standing lateral bending radiographs.

**Pelvic obliquity.** Deviation of the pelvis from the horizontal in the frontal plane. Fixed pelvic obliquities can be attributable to contractures either above or below the pelvis. Functional obliquity can be caused by leg length inequality.

**Primary curve.** The first or earliest of several curves to appear, if identifiable.

**Rotational prominence.** In the forward bending position, the thoracic prominence on one side is usually due to vertebra axial rotation causing rib prominence. In the lumbar spine, the prominence is usually due to axial rotation of the lumbar vertebrae.

**Skeletal age, bone age.** The age obtained by comparing an AP radiograph of the left hand and wrist with the standards of the Grullich and Pyle Atlas.

**Structural curve.** A segment of the spine with a lateral curvature that lacks normal flexibility.

**Vertebral ring apophysis.** The most reliable index of vertebral immaturity, seen best in lateral radiographs or in the lumbar region in AP lateral bending roentgenograms.

**REFERENCES**