SCOLIOSIS CARE
FOUNDATION
Supporting research & education for non-surgical treatment of scoliosis

Parent's Guide to Scoliosis

A Practical Guide For Identifying the Early Signs of Scoliosis

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A Practical Guide For Identifying the Early Signs of Scoliosis

Published by
Scoliosis Care Foundation
1085 Park Ave, Suite 1E
New York, NY 10128
United States of America

Paperback ISBN:

TEL: 1.800.391.8837

URL: www.ScoliosisCare.org

Graphic & Book Design by www.TheCreativityZone.com

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Introduction

Many of you are aware that Scoliosis is a lateral curvature of the spine that affects approximately 3% of the population, making scoliosis as prevalent as depression in its respective age group. In the event you have scoliosis, your family members are 30% more likely to have the condition as well. You may have a cousin, an aunt or you may remember a classmate who had uneven shoulders, or possibly one who was treated for scoliosis with a rigid brace (known as a TLSO thoraco-lumbo-sacral orthosis). Although these braces are still widely used today, advances in bracing, Chiropractic care and physiotherapy methods have made early treatment more comfortable and with higher rates of compliance and success.

The success of these newer brace interventions and treatments, make early detection and early intervention more important than ever. The majority of those afflicted with idiopathic scoliosis (of unknown causes) are females, who start to show signs in early adolescence. The curvature usually develops without pain and in otherwise healthy individuals. Without regular observation and screening those individuals who show signs for scoliosis are less likely to be referred to an expert for early intervention. Spinal bracing and other non-surgical interventions, when applied early, can successfully arrest and even reverse the effects of scoliosis. As parents, we believe you will have the opportunity to offer regular screening for scoliosis in an efficient and effective manner. Curvatures which are left untreated can become severe, causing physical deformity, arthritic changes, and heart and lung problems to name a few. When a spinal curvature becomes severe, the only treatment may be spinal surgery.

Awareness of this issue is the first step in becoming a great observer. . The signs of idiopathic scoliosis typically present during the pubertal growth spurt, and therefore screening is most desirable between the ages of 10-16. Recently published studies suggest dancers and gymnasts are 10 times more likely to develop progressive scoliosis, and therefore are at a higher risk for the disease. Due to this information, the Scoliosis Care Foundation has included parents, dance educators, athletic coaches and physical education teachers as those most suited to become screeners. We see these groups as ideally positioned to identify spinal curvatures early-on, when they are still small and more manageable. Newer brace designs and advances in non-surgical treatment allow those with scoliosis to continue being active while being proactive in managing their spinal curvature.

With careful training you can become an invaluable participant in helping our children avoid a progressive deformity or a potential surgery.

The purpose of this Guide is not for you to provide a medical diagnosis but to become the best observer you can be.
For more information on how to become a certified screener, contact us at info@ scoliosiscare.org or 1.800.391.8837 or visit our web site www.scoliosiscare.org

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Section 1

The Normal Spine

The human spine consists of 24 vertebra or bony segments. The upper seven vertebra are called the cervical spine, the middle twelve vertebra have ribs connected to them and are called the thoracic spine, and the lower five are called the lumbar spine.

Between each vertebra (except the top one) are discs which act as shock absorbers, and allow for flexibility and movement in the spine. The bones form a central canal in which is housed the spinal cord. The cord is comprised of nerve cell bodies which send long nerves to all the muscles and organs.

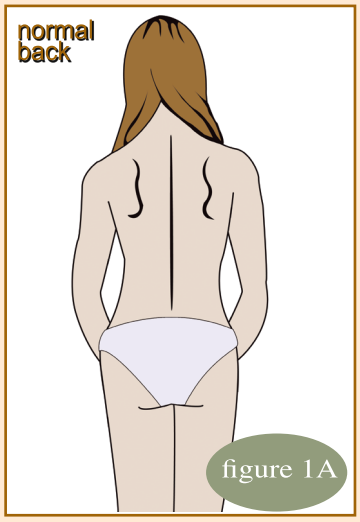

figure 1A

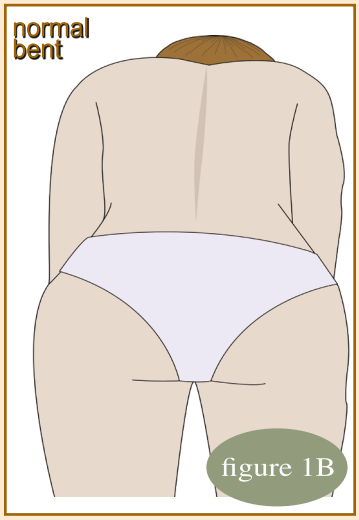

figure 1B

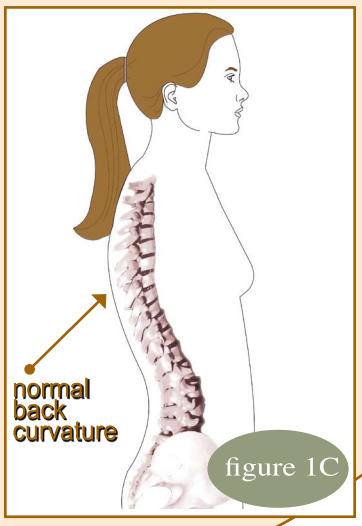

figure 1C

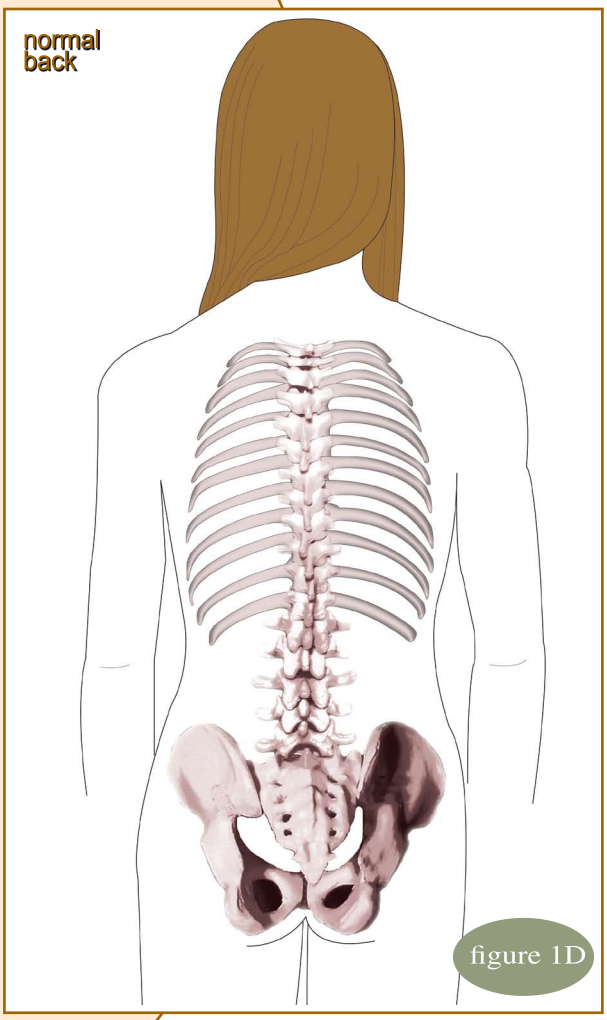

figure 1D

The lowest portions of the spine are called the sacrum and coccyx. Attached to the sacrum on each side are the pelvic bones.

When viewing the spine from the back, it should appear straight with the shoulders being level and the hips being even (figure 1A & figure 1D). The head should be centered over the pelvis.

When viewing the spine from the side it should have soft flowing curves (figure 1C).

The normal thoracic spine curve is called a "kyphosis". The cervical curve above and the lumbar curve below are called "lordoses". The shoulder blades should appear symmetrical and level with both protruding evenly on either side of the spine.

Section 2

The Abnormal Spine

Part 1 - Scoliosis

Scoliosis is defined as an abnormal lateral curvature of the spine which measures 10 degrees or more. Often the spinal column will create a side to side, "S" shaped curvature when viewed from behind (figure 2A & figure 2D). Some cases worsen with time and can result in serious problems such as a rib cage deformity and chronic back pain. In the worst cases, interference with heart and lung function may also occur.

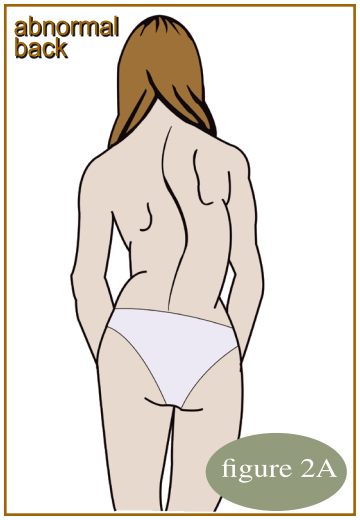

figure 2A

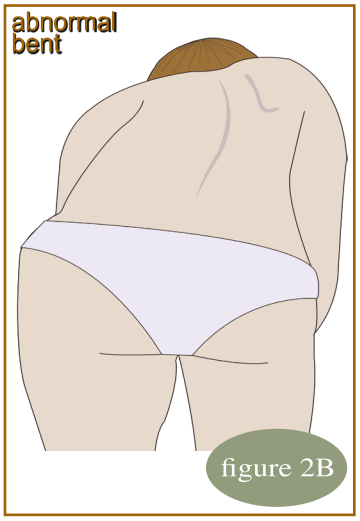

figure 2B

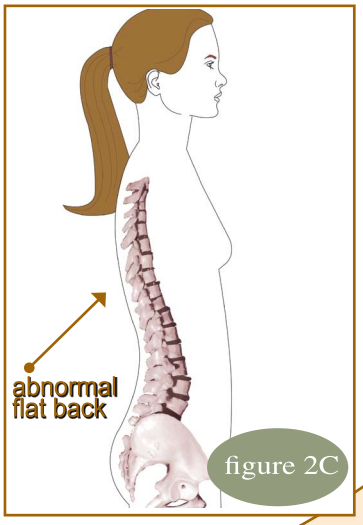

figure 2C

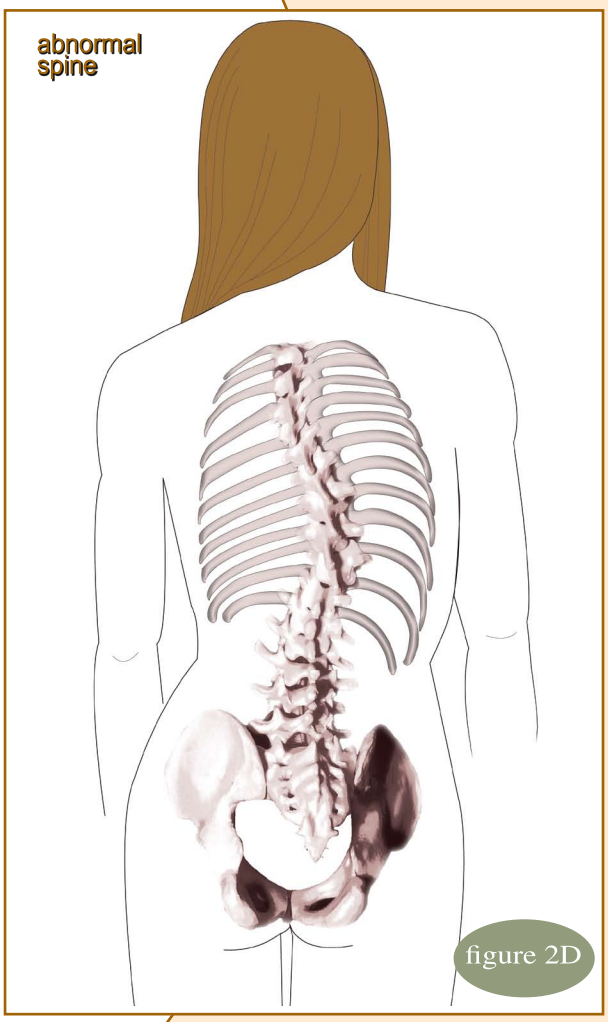

figure 2D

Structural Scoliosis

These curves are the result of changes in the alignment of the vertebrae that are "fixed". Structural curves can be distinguished from functional curves by their associated spinal twisting and appearance when the patient is asked to bend forward. The spinal twisting results in a "rib hump" usually on the right side of the rib cage (figure 2B). Unlike poor posture, these curves cannot be corrected by learning to stand up straight. New treatments can help improve muscle tone around the affected area, thereby reducing the progressiveness of this type of curvature.

Although idiopathic scoliosis is categorized as structural, it may be a mixed type which includes functional scoliosis. An abnormal flattening of the normal sagital curves (figure 2C) may be responsible for instability and a resulting buckling of the spinal column.

Functional Scoliosis

In this type of scoliosis there are no permanent changes in the shape or structure of the spine. Functional scoliosis develops secondary to another abnormality, usually a problem in the control of the muscles, or in the hip or lower extremity. The most common cause of functional scoliosis is a leg length discrepancy which makes the child stand unevenly. Uneven leg lengths can be identified by having the person stand with the suspected short leg on a block of wood. With the hips then at the same level, the spine appears straight. Other causes may be neurological problems, muscle spasms, pain, or poor posture.

Part 2 - Incidence of Scoliosis

Eighty-five percent of all cases of structural scoliosis have no known cause and are referred to as idiopathic. Idiopathic scoliosis occurs in two to three percent of the adolescent population. It commonly affects young people between the ages of 10 to 16 years of age. Gender does make a difference in the time of onset as females begin their adolescent growth spurt and reach skeletal maturity earlier than males. This accelerated spinal growth generally occurs from the ages of 10 to 14 for girls and 12 to 16 for boys. The incidence of idiopathic scoliosis occurs equally in early adolescence for both males and females for small curvatures (less than 10 degrees). Curve progression is more common in females and larger curves are more prevalent. Another factor that can contribute to the incidence of scoliosis is family history of scoliosis, suggesting a genetic predisposition. Other significant factors seems to be; low percentage body fat, late onset or abnormal menses, and vestibular dysfunction.

In contrast to idiopathic scoliosis, there are several less common types of scoliosis that have a known cause. These curves may be present at birth or related to muscle disorders and are not the focus of school screening because they occur earlier in life. For idiopathic scoliosis, the earlier in the growth spurt a curve is identified, the greater the risk the curve will worsen. For example, an immature, premenstrual female has a higher risk of progression than an adolescent female who has begun menses, or an adolescent male who has developed signs of maturation such as axillary hair. Idiopathic scoliosis can go unnoticed in a young person because it is rarely painful in the formative years.

Signs of the 4 Major Patterns are:

① **Right Thoracic** (see page 5)
The right thoracic curvature pattern is the most common found in idiopathic scoliosis. It can be identified by the hallmark right sided rib hump, and often includes an elevated right shoulder with forward rounding. A left lower back muscular prominence may also be present in this type, although it is not always the case. The center of gravity is shifted to the child's right. When viewing from behind, the right shoulder blade may appear winged and elevated from the rib cage.

② **Left Lumbar** (see page 6)
The left lumbar pattern is also quite common. The most common postural disorganization includes a lower hip on the child's left side. The waist angle is closed on the right and open of the left. The center of gravity is often shifted to the child's left.

③ **Left Thoracolumbar** (see page 7)
This type of curvature is accompanied by a left sided muscular prominence and may look similar to a left thoracic curvature, if the rib cage is involved.

④ **Right Thoracic Left Lumbar** (see page 8)
The double major curvatures may be undetectable due to the relative balancing of the posture. A pronounced waist curve on the right may be evident. The left hip may also appear slightly lower.

Section 2
The Abnormal Spine

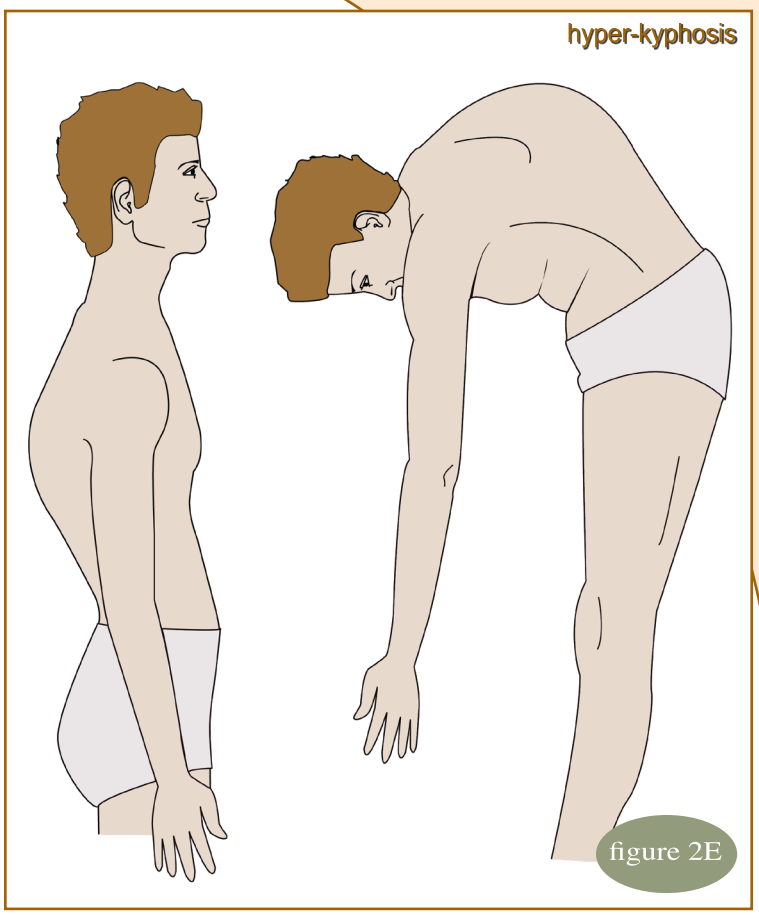

figure 2E

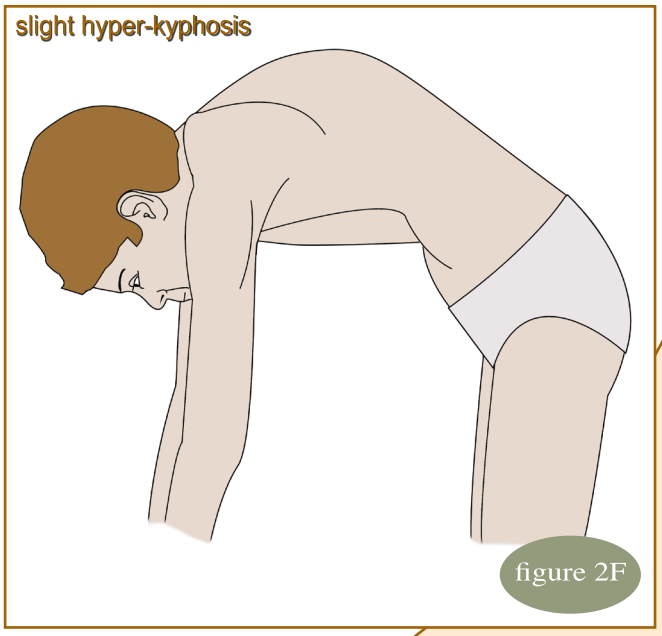

figure 2F

Part 3 - Hyper-kyphosis

Unlike scoliosis, hyper-kyphosis is an increase in the normal curve found in the middle back (thoracic). A pronounced rib hump is seen on both sides.

Hyper-kyphosis, hunch-back, or round-back, is described as an excessive curvature of the thoracic spine when viewed from the side (figure 2E & figure 2F). This deformity can be managed with chiropractic, flexible bracing and proper postural retraining. A small percentage of young people have a fixed, structural type of curve called Scheuremann's kyphosis, where the vertebrae are actually wedged. The cause for this type of deformity is unknown. Bracing or surgery may be recommended for the immature adolescent with Scheuremann's kyphosis. In relationship to scoliosis, a fixed kyphosis is a much rarer finding in teenagers, but will occasionally be identified during a spinal screening.

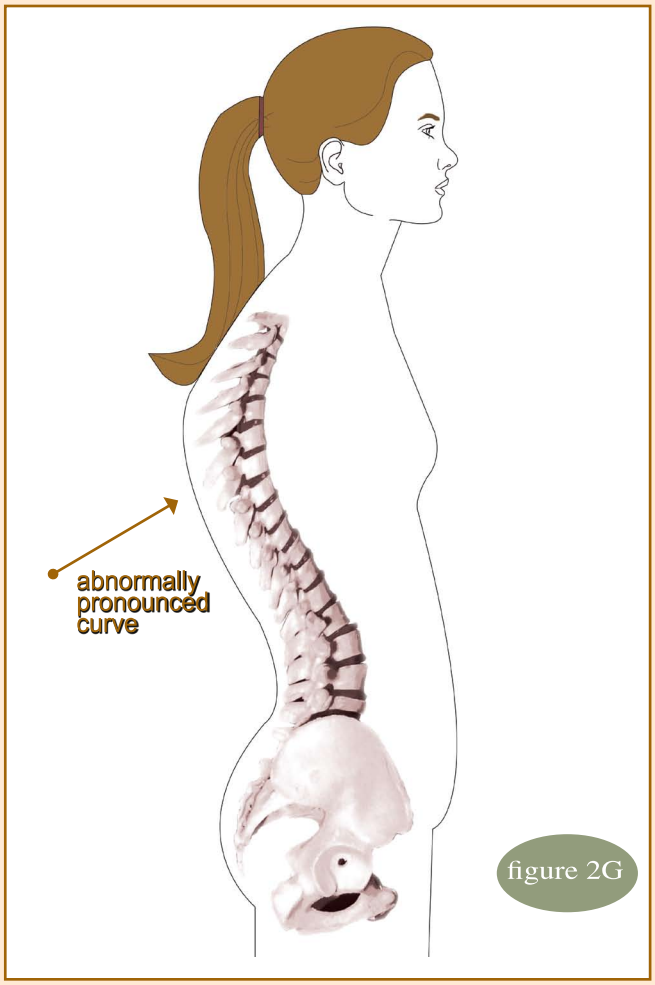

figure 2G

Section 3

Common Types of Scoliosis

Part 1 - Right Thoracic

The right thoracic curvature pattern is the most common found in idiopathic scoliosis. It can be identified by the hallmark right sided rib hump, and often includes an elevated right shoulder with forward rounding. A left lower back muscular prominence may also be present in this type, although it is not always the case. The center of gravity is shifted to the child's right. When viewing from behind, the right shoulder blade may appear winged and elevated from the rib cage.

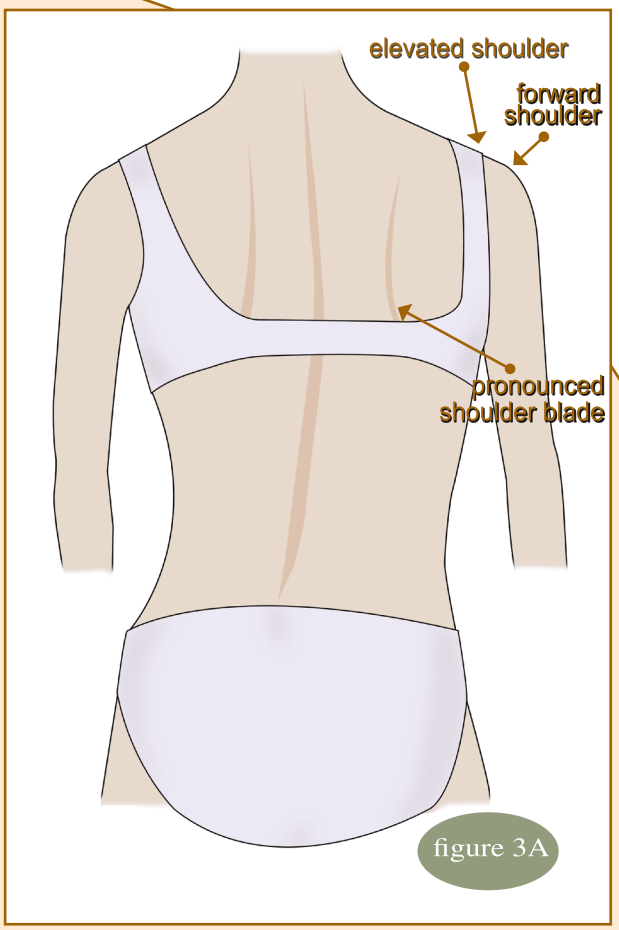

figure 3A

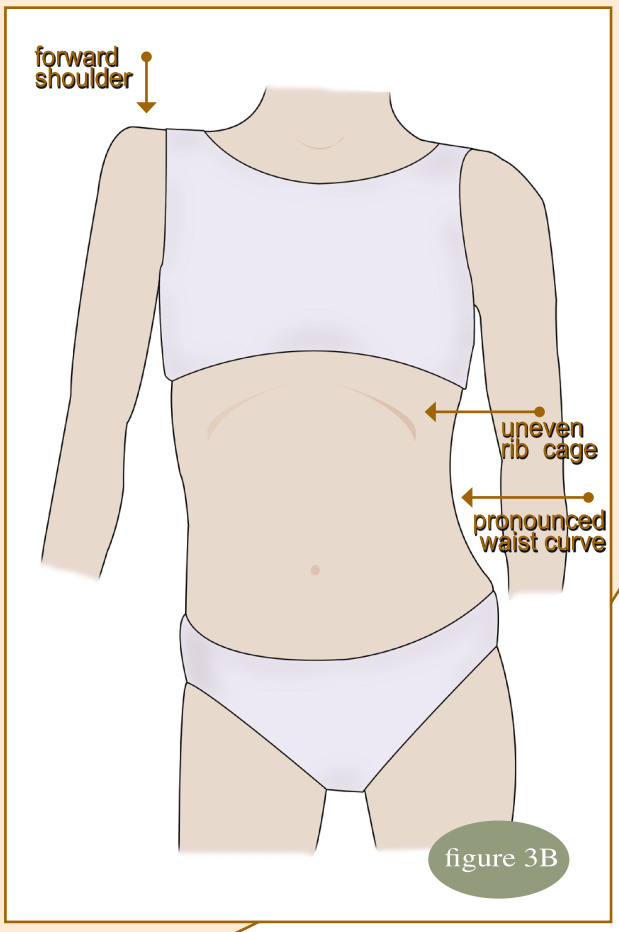

figure 3B

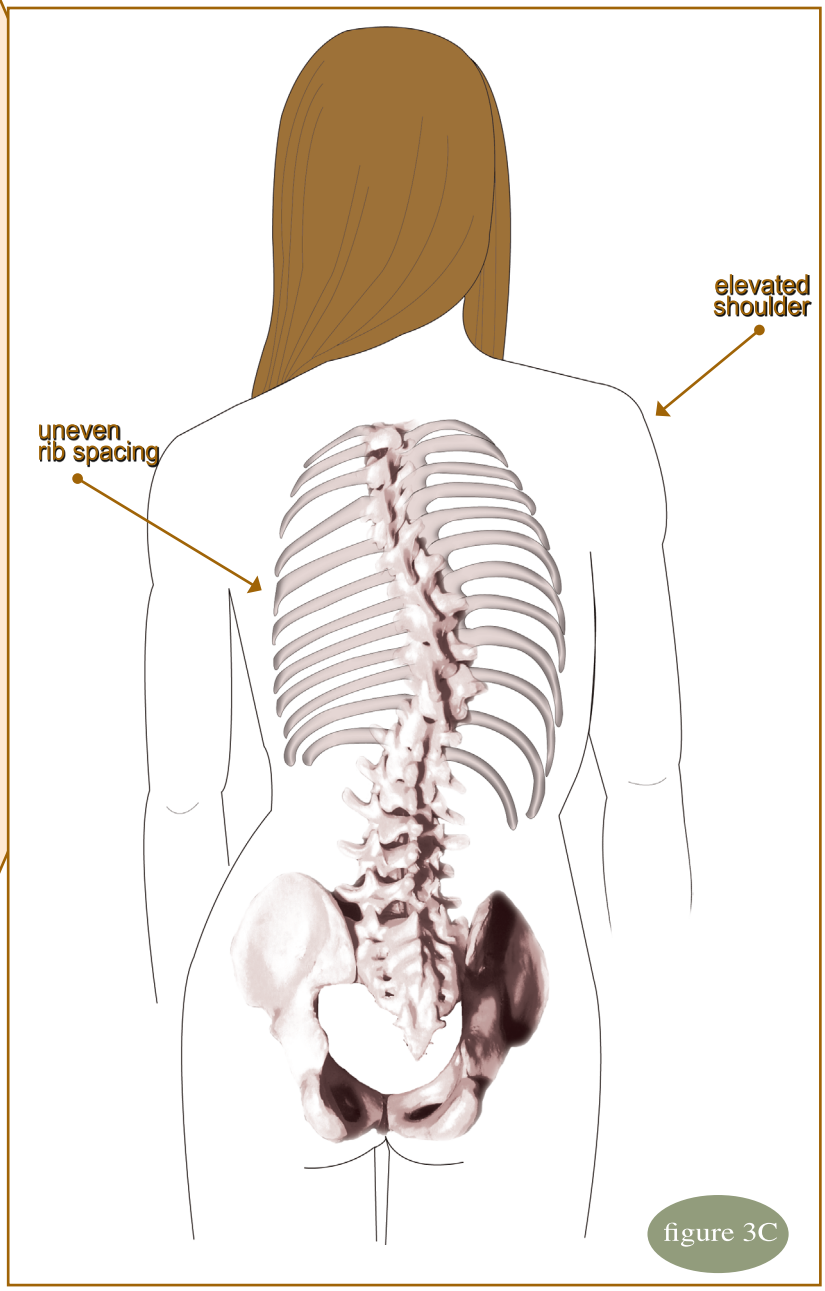

figure 3C

Section 3

Common Types of Scoliosis

Part 2 - Left Lumbar

The left lumbar pattern is also quite common. The most common postural disorganization includes a lower hip on the child's left side. The waist angle is closed on the right and open of the left. The center of gravity is often shifted to the child's left.

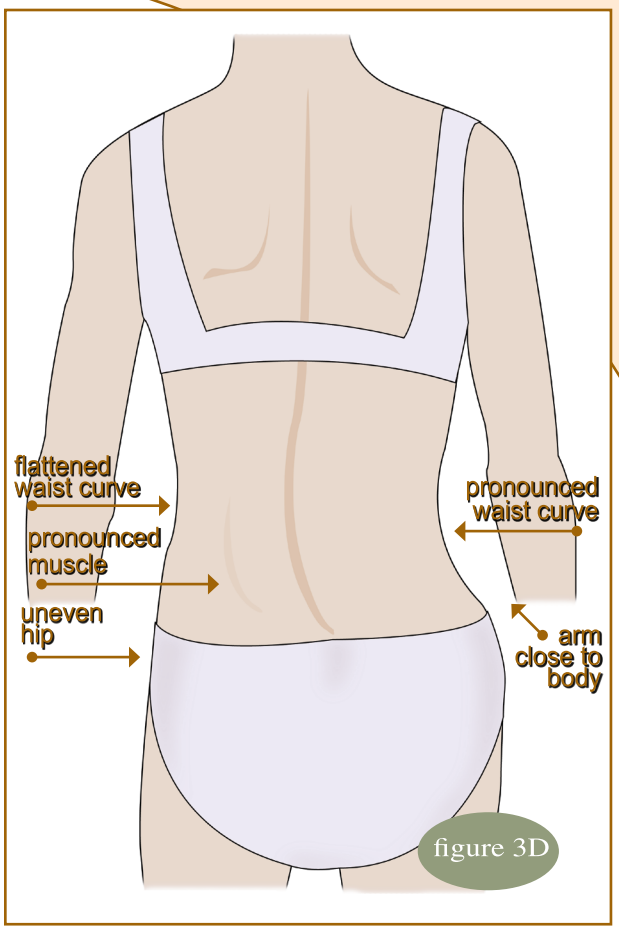

figure 3D

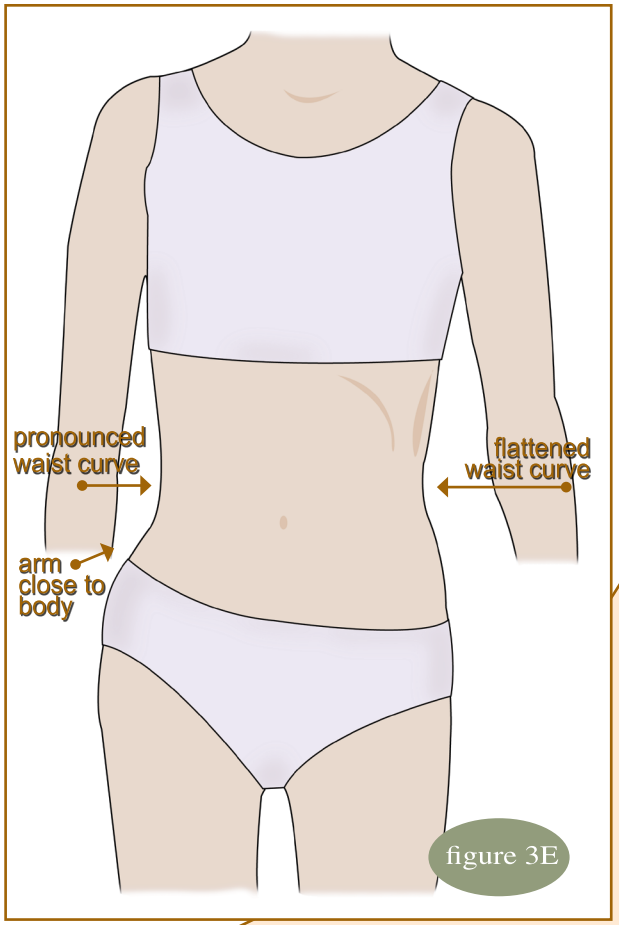

figure 3E

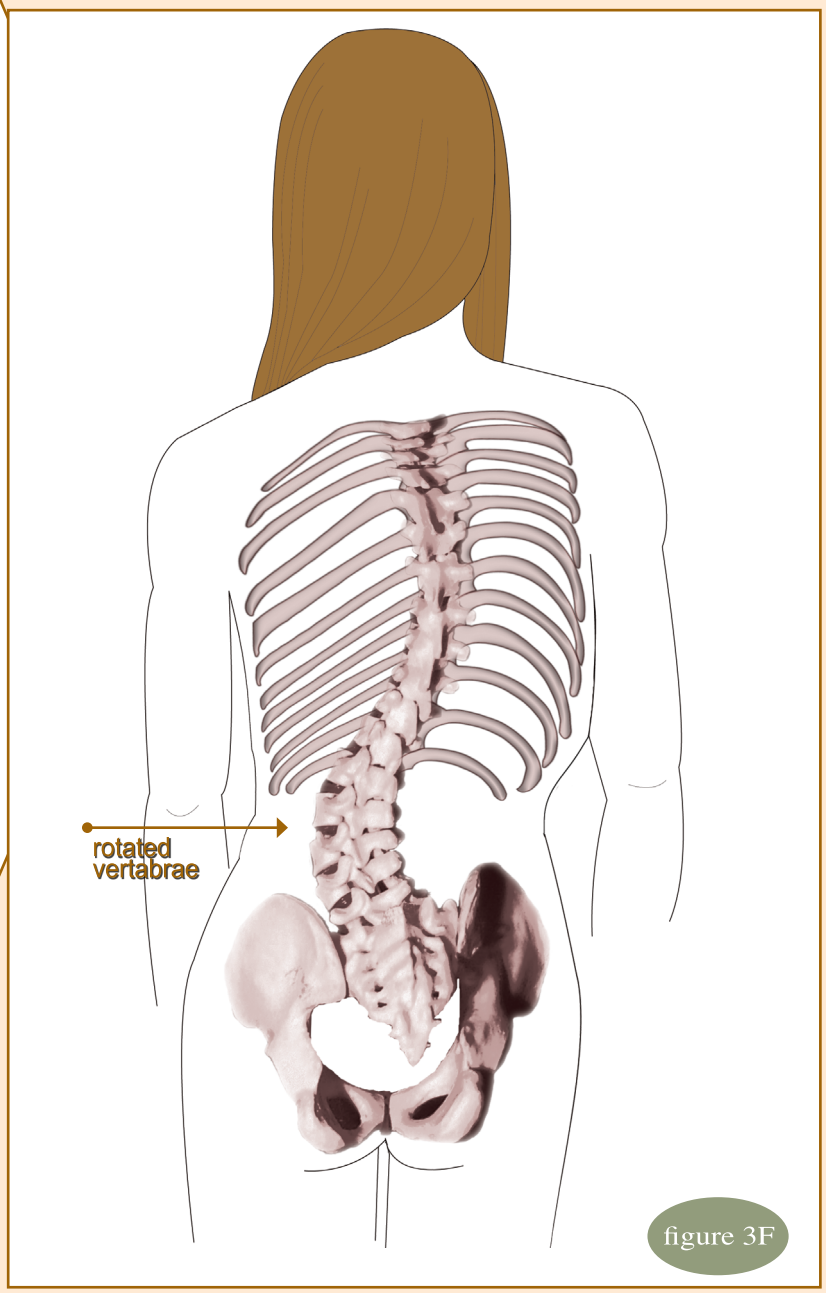

figure 3F

Section 3

Common Types of Scoliosis

Part 3 - Left Thoracolumbar

This type of curvature is accompanied by a left sided muscular prominence and may look similar to a left thoracic curvature when the rib cage is involved.

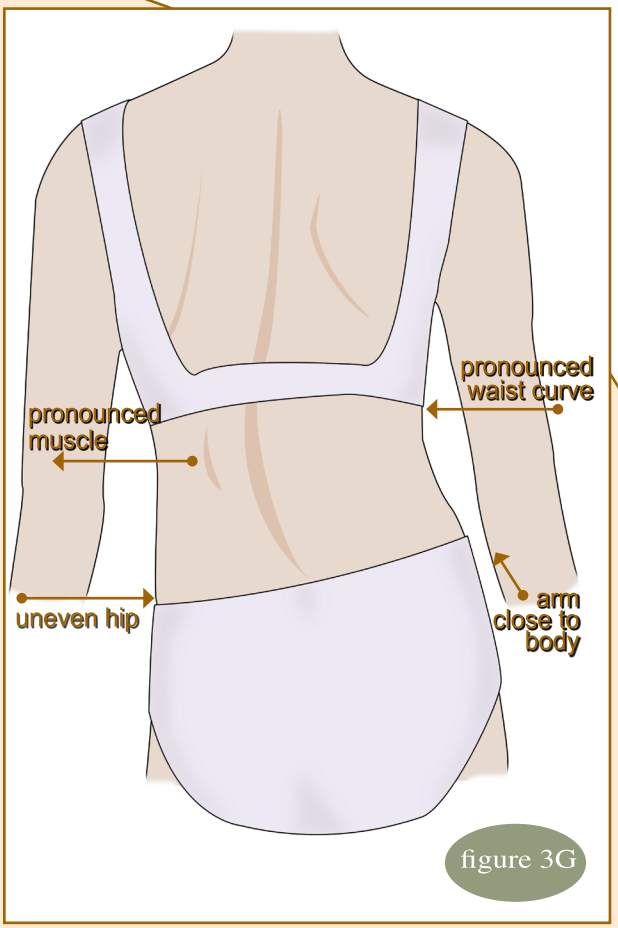

figure 3G

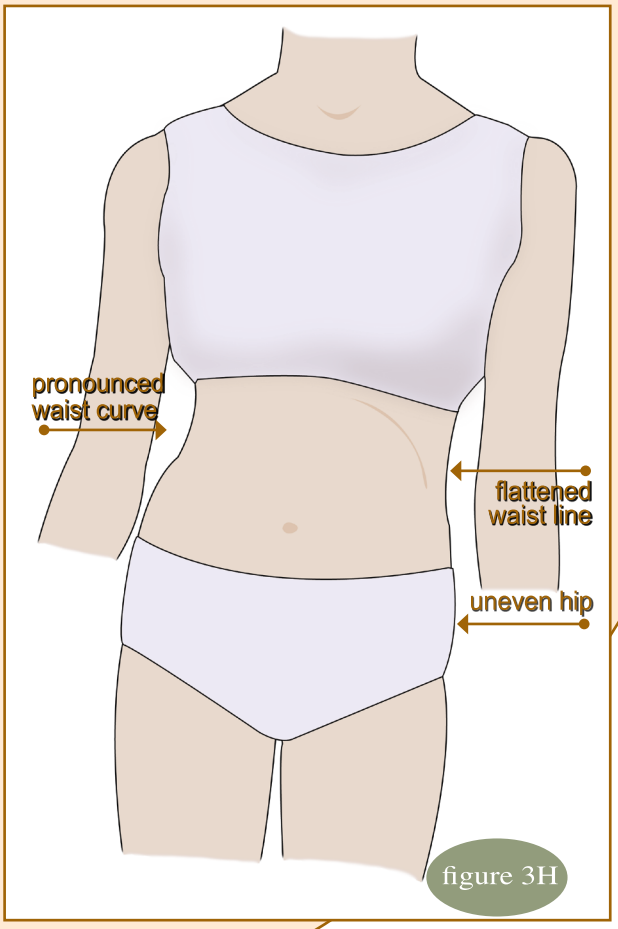

figure 3H

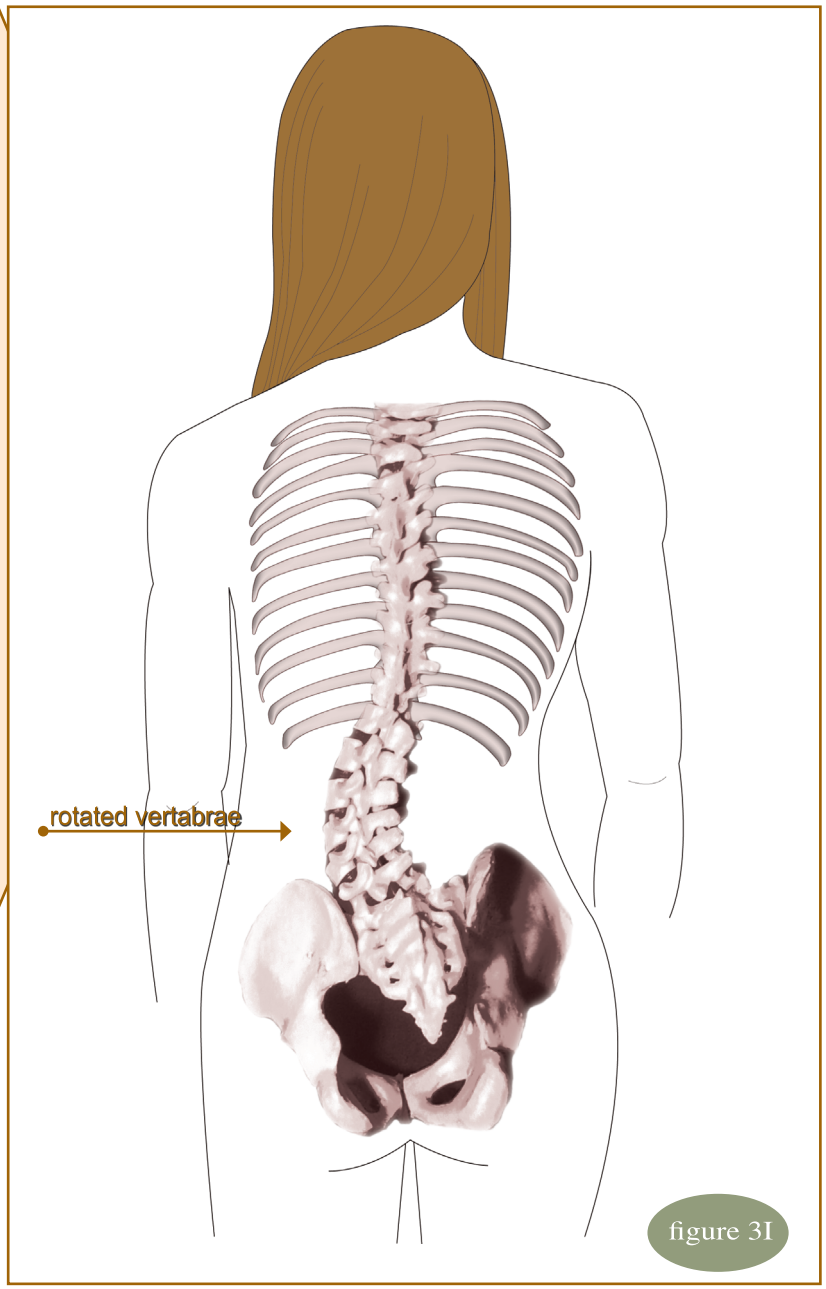

figure 3I

Section 3

Common Types of Scoliosis

Part 4 - Right Thoracic Left Lumbar

The double major curvatures may be undetectable due to the relative balancing of the posture. A pronounced waist curve on the right may be evident. The left hip may also appear slightly lower.

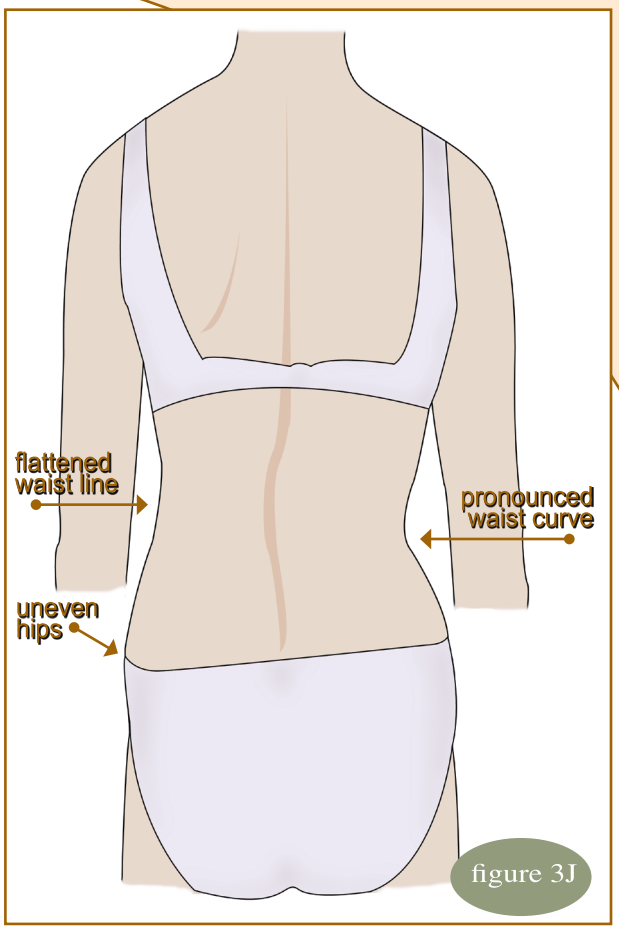

figure 3J

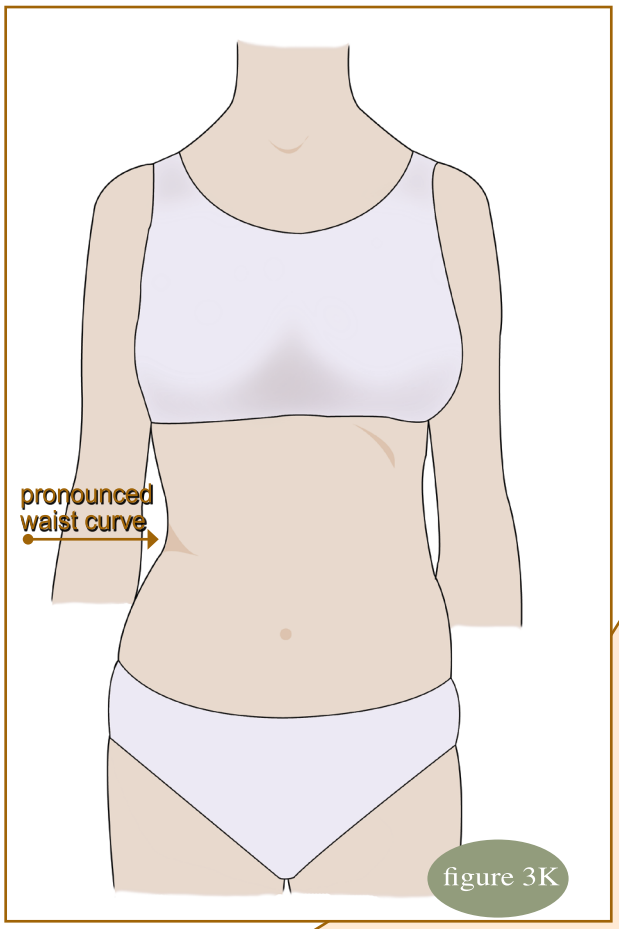

figure 3K

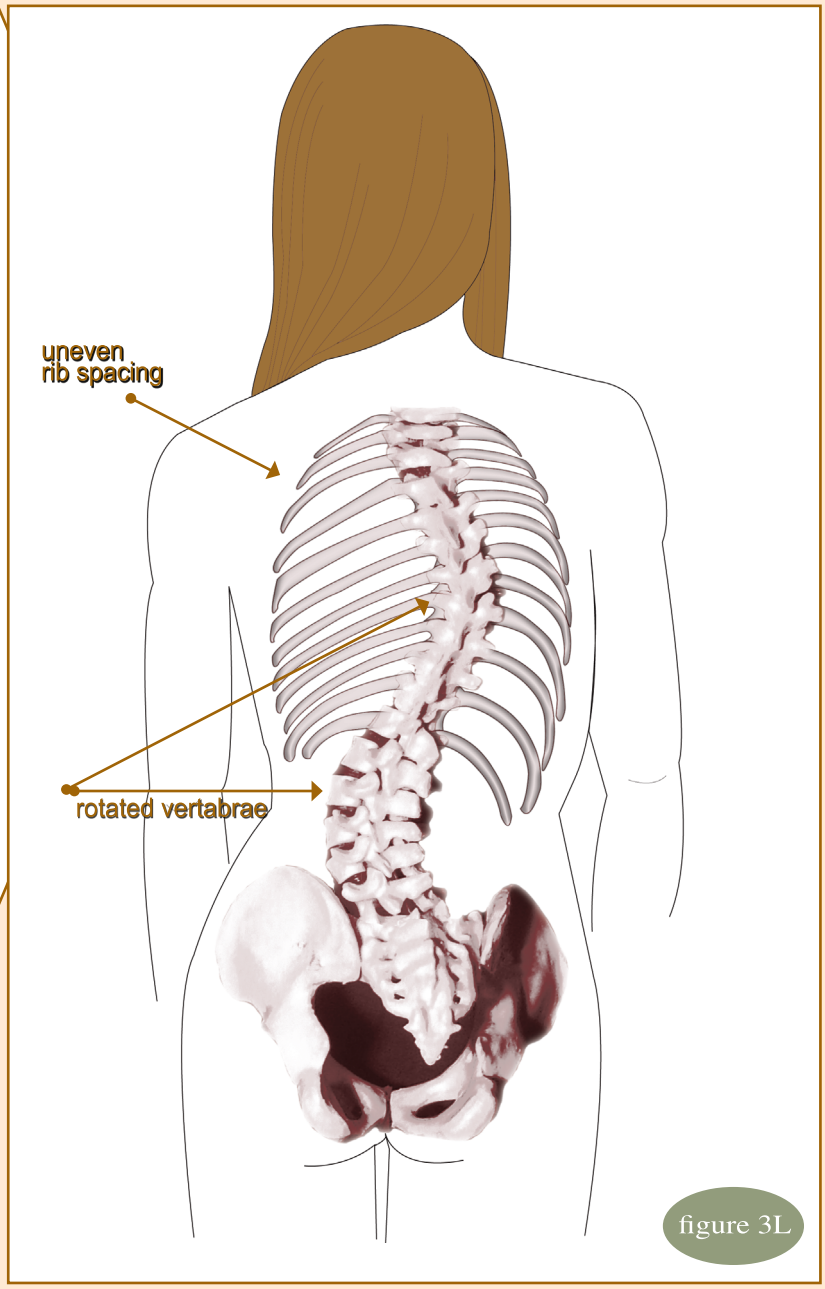

figure 3L

Section 4

Spinal Screening Process

Early detection is the key to controlling spinal deformities. The purpose of spinal screeings is to detect scoliosis and hyper-kyphosis at an early stage when the curvature is mild and may go unnoticed. Most curvatures can be treated without surgery if they are detected before they become too severe. The screening process identifies those with physical findings which suggest a spinal curvature. The screening process is not meant to diagnose the spinal deformity associated with scoliosis. Individuals with positive findings are referred to an expert who completes an extensive examination, with x-rays to confirm there is an abnormality of the spine; this is standard before a doctor can provide recommendations for treatment. The goal of the screening process is to identify those who would benefit the most from early treatment.

Part 1 - Screening Procedure

The examiner may conduct the screening from a seated or standing position. The examiner should place a mark on the floor to show the child where to stand. A distance of 5 to 8 feet between examiner and child is recommended. Children should remove their shirts so the screener has better visualization of the upper body. Females should be wearing a bathing suit top, sport bra, or other appropriate clothing item. They should ideally be wearing shorts as well, to allow better visualization of the waist, hips, and legs. Although the illustrations in this manual depict individuals in their underwear, screenings should not be done in their undergarments. If a child has not dressed appropriately for the screening, provide appropriate clothing or reschedule him or her for another date. The child begins by standing erect with feet slightly apart, knees straight, and arms hanging loosely at his or her sides while facing the examiner. Note the following:

- It is important for the child to face forward throughout the exam positions. Turning the head can cause changes in the findings.
- Long hair should be moved forward to allow full view of the child's back.

Section 4

Spinal Screening Process

STEP 1

With the child facing forward in the standing position, the examiner checks for the following signs of a possible abnormal spinal curvature:

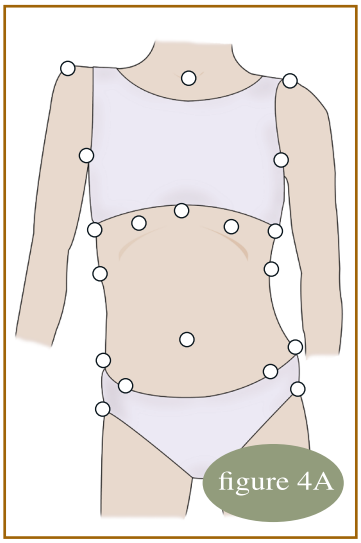

figure 4A

- One shoulder higher than the other
- Larger space from arm to the side of the body (compare both sides)
- Uneven waist creases
- Uneven hip levels

STEP 2

View the child from the back in the standing position and note any of the following:

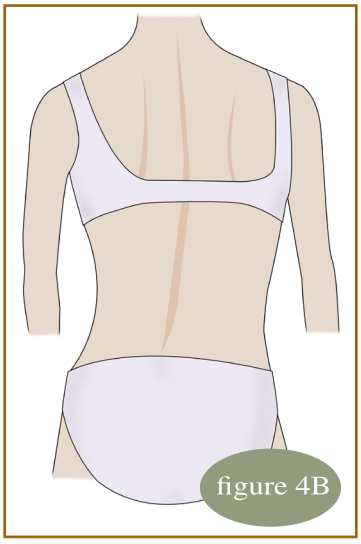

figure 4B

- Uneven contours, humps on one side
- Any curve in the spine

If the hips appear uneven, but no other abnormalities are noted, consider possibility of unequal leg lengths, and visualize alignment of the knee creases if possible.

Section 4

Spinal Screening Process

STEP 3

View the child from the side in the standing position (and check for):

- Exaggerated roundness in upper back
- Exaggerated arch in lower back

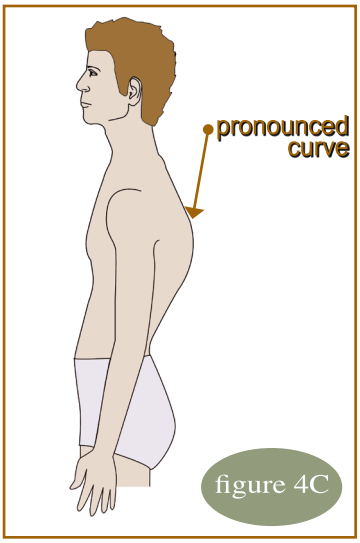

figure 4C

STEP 4

Next, view the child from the side in the forward-bend position checking for:

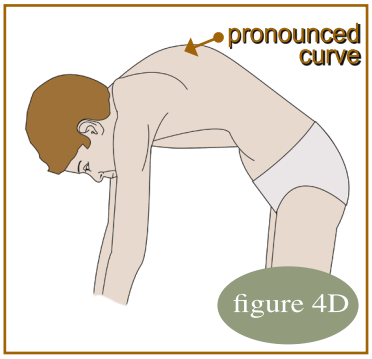

figure 4D

- Uneven contours, humps on one side
- Flexibility - can the child bend forward and touch upper shins or feet

STEP 5

The next position is the Adams forward-bending test. The child stands erect, feet slightly apart, knees straight, and puts clasped palms between the knees.

- Head is not centered directly above crease in buttocks
- One shoulder blade wing is higher or stands out more than other
- One shoulder higher than other
- Curved spine
- Uneven waist creases
- Uneven hip levels

*Children with any positive findings should be referred for evaluation.

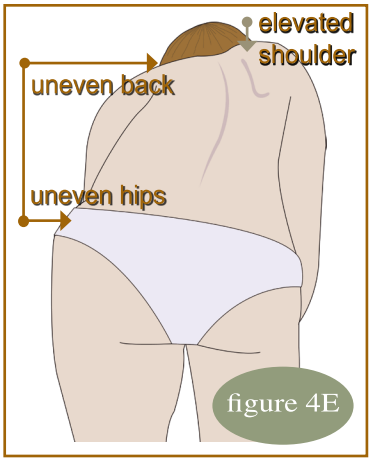

figure 4E

Section 4

Spinal Screening Process

Part 2 - Using the Scoliometer (optional)

When some physical findings are present suggesting a spinal deformity, re-screening is necessary to identify who will need a referral to a physician. The scoliometer is a type of inclinometer. It is similar to a carpenter's level and designed to measure the angle of trunk rotation (ATR). This is particularly helpful when an individual has positive physical findings on the Adams forward-bending test. The purpose again is to measure the degree of rotation to identify if the child needs to be referred to a physician for evaluation. As with any tool, correct use is important to ensure the results are accurate and consistent, when using the scoliometer remember to:

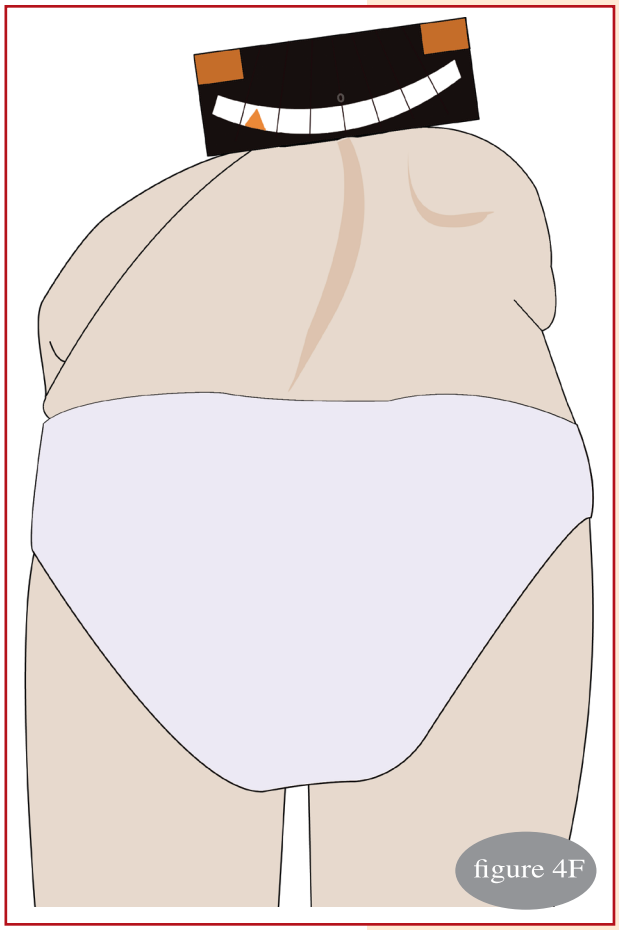
figure 4F

- Place the scoliometer gently across the child's back at the point where a hump or uneveness is most prominent.
- The number "0" should be directly over the top ridge of the spine.
- Do not press down on the device as that can distort the reading.
- Re-evaluation is recommended for children with a reading of 5 degrees or more.
- When a reading of 5 degrees or more is reproduced, a referral should be made to a professional.

Section 5

Scoliosis as a Secondary Problem

Scoliosis other than idiopathic can be from other structural, neurological or primary muscle problems. The Scoliosis Care Foundation recognizes neuromuscular scoliosis to be from both neuropathic (nerve) and myopathic (muscle) causes.

Part 1 - Structural (bone) Causes:

In the case of a hemivertebra (a triangular shaped bone), the bones of the spine are not stacked neatly on top of each other, rather the angular shape of the hemivertebra causes an acute angle in the spine and scoliosis forms as the natural tendency; as the brain reflexively attempts to keep the head over the pelvis. Other structural causes include a sacral bone or leg length discrepancy on one side. The sacrum is the last bone (excluding the coccyx) of the spine, and can deform in the front to back or side to side measurement. Many times a simple shoe lift can reduce the abnormal posture thereby minimizing the resultant spinal curvature.

Part 2 - Neuropathic (nerve) Causes:

Neurological causes can lead to scoliosis in conditions such as Cerebral Palsy, Parkinson's disease, Poliomyolitis, Frederich's Ataxia, spinal cord trauma and tumors. Cerebral Palsy includes a spastic component with muscle contracture, while spinal cord trauma and tumors may or may not depending on the site and nature of the damage.

Other types of neurological conditions which cause scoliosis include Poliomyelitis, and Spinal Muscular Atrophy (SMA). In SMA, scoliosis will usually present early-on while the child is relatively still young.

Brain injury either from trauma or vascular insult can also result in the onset of scoliosis. This is due to influence of abnormal nerve transmission affecting the tone of the postural muscles. Conditions such as Arnold Chiari Malformation (ACM), a structural abnormality of the cerebellum, also can result in scoliosis. Other neurological findings which may be found in conjunction with ACM are abnormal eye movements, ataxia (uncoordinated movements) and balance disturbances (vestibular dysfunction). Although often neglected, a side view x-ray of the spine which can identify normal sagital (front to back) curves, can be very helpful in determining if a patient is suffering from a neurogenic vs. an idiopathic scoliosis. In neurogenic scoliosis the sagital curves are normal, and in idiopathic scoliosis these sagital curvatures are abnormally flat.

Another potential cause is hip contracture. When the muscles of the hip become chronically shortened the spinal curvature can evolve into a scoliosis.

Part 3 - Myopathic (muscle) Causes:

Muscle abnormalities can cause scoliosis in such conditions as muscular dystrophy, and myotonia (low muscle tone); the spinal deformity patterns from these etiologies also vary considerably. The onset of scoliosis in muscular dystrophy is not usually seen until later on in life. Despite these differences, the common factor is an inability to provide muscular support to the spinal column. New treatments which provide support to the failing muscles are promising. Even in the adult, reducing the abnormal posture while having the patient actively participate can help to reduce scoliosis and prevent the deformity from becoming "permanent".

Part 4 - Hyper-kyphosis:

Rounding of the middle back commonly accompanies neuromuscular deformities secondary to forward tilt of the head and/or poor head control. Once the spinal curvature is present, gravity and posturing provide the impetus for the worsening of the deformity. Rigid bracing has traditionally been thought to be ineffective, although recent advances are more encouraging.

Part 1 - A Brief Description of Scoliosis from the Scientific Literature

Idiopathic scoliosis is described as a curious spinal disorder which displays striking contrasts as in some patients it is physically evident and easily seen in simple radiographs whereas in some young patients it is neither physically nor symptomatically evident (Sponseller, 2003). The condition is recognized by a lateral curvature of the spine greater than 10 degrees accompanied by vertebral rotation (Reamy and Slakey, 2001). About 75% of scoliosis is idiopathic whereas the remaining 25% can be divided into neuromuscular, congenital and miscellaneous etiologies (Diard et al, 2002). Late-onset idiopathic scoliosis (LIS) arises in otherwise normal children during puberty resulting in a structural lateral curvature of the spine (Weinstein et al, 2003). According to the US Census Bureau Population Division (2000) LIS affects more than 60, 000 adolescent population in the United States. Studies have shown that the ratio of girls to boys with small curves of 10 degrees is equal but increases to a ratio of 10 girls for every one boy with curves greater than 30 degrees (Roach, 1999). Also, the prevalence of curves greater than 30 degrees is approximately 0.2 percent, and the prevalence for curves greater than 40 degrees is approximately 0.1 percent (Miller, 1999). Curve progression is 10 times higher in females compared to males in all cases and it has been observed that with greater growth potential and larger curve, there is a greater likelihood of curve progression (Miller, 1999; Reamy and Slakey, 2001). Untreated scoliosis may persist into adulthood. The curve progress in such cases has been determined. Studies by Miller (1999) have shown that the curves less than 30 degrees at bone maturity are unlikely to progress, whereas curves measuring from 30 to 50 degrees progress an average of 10 to 15 degrees over a lifetime. Further, curves greater than 50 degrees at maturity progress steadily at a rate of 1 degree per year when left untreated. Studies have attempted to unearth the pathophysiological basis for idiopathic scoliosis and many abnormalities have been found, however none has been decisively associated with all the cases (Miller, 1999). Hereditary or genetic factors are widely accepted as having role in the development of idiopathic scoliosis (Lowe et al, 2000). Studies have shown that amongst women who display a scoliotic curve that exceeded 15 degrees 27 percent had daughters who also showed a prevalence of scoliosis (Harrington, 1977). Population studies involving index patients and their families indicate that 11 percent of first-degree relatives are affected, as are 2.4 and 1.4 percent of second and third degree relatives, respectively (Riseborough and Wynne-Davies, 1973). Studies with monozygotic and dizygotic twins have shown a higher concordance rate of 73% for the condition in monozygotic twins as compared to the latter which show a concordance rate of 36% (Kesling and Reinker, 1997). Despite the genetic nature of the condition, the mode of inheritance has been debated. Various studies have suggested scoliosis to be a single gene disorder with complex genetic interactions such as variable penetrance and heterogeneity causing numerous clinical variations of the condition (Lowe et al, 2000). Alteration in the control of melatonin production with either direct or indirect affect on growth mechanisms may play a secondary role in development of scoliosis. Studies have shown that a small percentage of thrombocytes in patients suffering from idiopathic scoliosis may be larger than normal and are similar to those found in skeletal muscles which suggest a cell membrane defect that may be genetic in these patients (Lowe et al, 2000). Abnormal magnetic resonance imaging studies, microlesions in the brains of experimental animals, and the most consistent clinical neurological studies indicate pontine and hindbrain regions to be the likely sites of primary pathology that could cause idiopathic scoliosis. Further research is required to fully understand the etiology of this condition which in turn would suggest better methods of treatment of the patients.

Part 2 - A Brief History of Scoliosis Treatment in the Scientific Literature

Treatment of idiopathic scoliosis has been attempted both non-surgically as well as surgically. As early as 1945, the Milwaukee brace was developed to provide more efficient and comfortable passive correction and to aid fixation after operation for scoliosis associated with poliomyelitis (Blount and Moe, 1973). It was meant to provide support but not to be a non-surgical treatment option as it is used today. Milwaukee braces were reintroduced for conservative treatment of idiopathic scoliosis in 1954. Studies have shown that wearing the brace results in flattening of the lumbar lordosis (Dickson, 1985) which in turn leads to an active extension in the spine causing the deformity to move back towards the sagittal plane (Dickson and Weinstein, 1999). The effectiveness of the brace treatment has been tested in a study by the Minneapolis group amongst patients aged 8 to 16 (Carr et al, 1980). However, the study did not reveal any clear role of Milwaukee brace in the treatment of idiopathic scoliosis. Later, a study involving 144 braced patients and 111 untreated patients (Miller et al, 1984) did reveal that nearly three-quarters of the untreated cases did not progress, suggesting that a similar proportion of the braced curvatures did not need bracing. Studies by Goldberg et al (1993) have shown there is no statistically significant difference between two groups of 32 braced (RIGID TLSO) and 32 unbraced individuals. Noonan et al (1997) conducted a study on 102 of 111 patients treated with the Milwaukee brace for idiopathic scoliosis with a mean time from the cessation of bracing to follow-up of more than six years; he concluded "it is currently impossible to state that bracing effectively alters the natural history of scoliosis in immature patients who are at high risk for progression." A more recent study (Danielsson, 2003) was conducted with a consecutive series of patients having adolescent idiopathic scoliosis that were brace-treated between the years 1968 and 1977. Follow-up visits were performed at least 20 years after completion of the treatment. The authors concluded that more than 20 years after brace treatment for adolescent idiopathic scoliosis, minimal pain and no dysfunction occurred compared with normal controls and compared with surgically treated patients. Studies have also shown that patients treated by posterior fusion or a brace gradually increase their pulmonary function up to 25 years after treatment (Pehrsson et al, 2001). Use of Cotrel-Dubousset segmental pedicle screw for correction of idiopathic thoracic scoliosis has been compared to the use of hooks and screws inserted in a hook pattern (Suk et al, 1995). This study evaluated the efficacy and safety of segmental pedicle screw fixation in the management of idiopathic thoracic scoliosis and revealed; segmental pedicle screw fixation is a safe and effective method for correcting the triplanar deformity of the idiopathic thoracic scoliosis. Studies have shown that pain in young adults frequently becomes progressive and less responsive to medication and non-operative treatment with time (Ponder et al, 1975; Kostuik et al, 1973; Micheli et al, 1977). In cases where the curvature is not controlled by brace (orthotic) means surgery is recommended. Operations are recommended for lumbar curves greater than 100 degrees (Gui and Savini, 1975) whereas thoracic curves greater than 60 degrees are recommended for surgery (Bjure and Nachemson, 1973). A review of the charts and radiographs of 22 patients with idiopathic lumbar, thoracolumbar, and thoracic scoliosis who underwent single-stage anterior fusion with rigid third-generation instrumentation and titanium surgical mesh implants has shown that correction of idiopathic scoliosis can be achieved with anterior instrumented fusion alone (Majd et al, 2000). In another study, Lenke et al (1999) showed that the lumbar curve correction occurs consistently after both selective anterior and posterior thoracic fusion implying an intrinsic ability of the lumbar spine to follow thoracic spine correction.

Part 2 - A Brief History of Scoliosis Treatment in the Scientific Literature (cont'd)

A comparative study involving one stage and two stage surgical treatments performed on 135 and 25 young adults (above 20 years of age) respectively, showed that the two stage posterior fusion resulted in correction that was 10 degrees more than the initial side bending flexibility in comparison to the group treated with one stage surgery (Swank et al, 1981). However, the authors cautioned that the additional cost, dangers of the extra procedure and two weeks in traction did not justify the minor improvement. Takahashi et al (2004) have analyzed clinical and radiographic results of surgical treatment for idiopathic scoliosis in patients treated at the age of 20 years or older. Their study provides useful information concerning the indications and strategies of adult scoliosis surgery. The results show that although pain was the most important indication for surgery in patients older than 40 years, it was improved reliably by surgery in most of these patients. On the other hand, the radiographic results tended to be less satisfactory in the older patients in an age-dependent manner.

With the physical deformity associated with idiopathic scoliosis, issues regarding self–image, confidence and social acceptance become a matter of concern for parents, patients and doctors. A population based case-control study aiming to inquire if scoliosis has any psychological impacts and whether there may be a gender basis for such psychological concerns was undertaken for 75,000 school age adolescents (Payne et al, 1997). The study revealed scoliosis is a significant risk factor for psychosocial issues and health-compromising behavior, and gender differences do exist in adolescents with scoliosis. In another study, the majority adolescents with idiopathic scoliosis expressed satisfaction when provided with cosmetic surgical treatment (Koch et al, 2001). However, the doctors do not agree towards providing surgical treatment in order to allow social acceptance as they contend that the main purpose of a complicated surgical process should be pain relief and attainment of body control to perform daily activities without compromise.

Section 7
Referral Process

Part 1 - Referrals

The spinal screening programs which once were offered in every state, were developed to identify adolescents with small spinal curves, and then refer them for treatment before the curvatures became severe.

Although scoliosis is of unknown origin, patients can benefit from a multimodal approach to case management. Advances in bracing procedures and personalized exercise protocols make the referral process of utmost importance. When the physical signs of scoliosis are identified by an observer, the referral process allows a qualified professional to make the actual diagnosis of scoliosis. The current accepted orthopedic management commonly includes observation until the curvature progresses to 25 degrees or more, and surgery at 50 degrees or more. However, the world literature supports the use of early non-surgical treatments such as non-rigid bracing and exercises specially designed for the curvature patterns present.

Scoliosis screenings can be properly performed by a trained professional. A scoliometer may be particularly helpful for re-screening to measure the curvature in order to confirm a referral is needed.

The Spinal Screening Worksheet provides space to record your findings. A child found to have a possible abnormal spinal curvature at the initial spinal screening and re-screening will be referred to a licensed professional. It is the recommendation of the Scoliosis Care Foundation to have the case co-managed by a Chiropractic doctor. A determination can then be made as to whether or not there is truly a spinal deformity. A complete history and physical examination involves re-evaluating the findings noted during the spinal screening. An x-ray may be taken to allow the doctor to measure the abnormal curvature of the spine. The most common measurement used is the Cobb method, which identifies the degree of curvature by its upper most and lower most borders. The skeletal maturity of a young person can also be estimated by evaluating the Risser sign on the x-ray. This is a small ridge of bone that forms over the top of each side of the pelvis. The more complete the Risser sign, the more mature the skeleton. This however does not indicate that a child cannot experience a reduction of the curvature as once was believed.

Another way the doctor may estimate bone or skeletal maturity is through a hand x-ray. This works because bones in the hand mature at different times during the child's growth spurts. The amount of curvature in degrees and the maturity of the skeleton at the time of discovery may influence the treatment selection.

Individuals with positive findings are to be re-screened prior to referral. Proper documentation of a spinal screening program includes:

- results of initial screening
- results of rescreening
- referrals made
- referral results
- planned follow-up

Management options for spinal deformities consist of the following:

Part 1 - Observation

The routine orthopedic management is to "observe" mild curvatures. This does not sit well with most parents or doctors interested in non surgical management. Researchers have suggested patients with scoliosis have neurological imbalances that may respond to treatment. One such finding is vestibular dysfunction. The vestibular system is one of the gravity sensing systems of the body. Individualized vestibular rehabilitation has been shown to be effective in reducing imbalance, and may be appropriate for patients with positive findings.

Part 2 - Orthosis (brace)

Studies show that bracing can prevent the progression of a spinal curve in a growing adolescent (Rowe 1997, Lonstein 1994). There are two basic types of braces, a rigid plastic TLSO, and an elastic tension system designed to allow for complete movement. For a child with scoliosis, preventing the curve from progressing can prevent the need for spinal surgery (Rowe). While the use of a rigid TLSO can prevent worsening of the spinal curve, it cannot undo what curve already exists. This makes the elastic tension brace more desirable, not to mention the increase tolerability and compliance. Another benefit of the elastic bracing is the ability to treat smaller curvatures. The rigid TLSO is generally recommended for curves of 25 to 40 degrees, the elastic braces can be applied much earlier due to the ease of use, and the potential to reduce the curvatures before they become permanent spinal deformities.

Part 3 - Surgical Intervention:

Surgery in patients with scoliosis is most commonly provided for cosmetic purposes. The twisting deformity of the spine causes the rib cage to push backward on one side, thereby distorting the normal body contours. The lack of a normal arch in the lower back and neck makes the rib involvement more pronounced, thereby accentuating the deformity. This is different in individuals dependent upon the location of the curvature, (i.e. the mid-back or lower back). The degree of curvature for which surgery is generally recommended may not be the same for everyone.

The health of the individual may also affect the decision to opt for a surgical intervention. Both heart and lung capacity should be monitored by a doctor in cases with curvatures larger than 80 degrees. The deformity of the ribs and spine may affect normal organ function causing shortness of breath or low blood oxygen. However, even in very large curvatures, it is rare for the lung and heart to be affected.

For those with a worsening spinal deformity surgery can reduce a portion of the curvature and may prevent it from increasing in the future. Of course surgery is not without risks or failures, the choice for surgery should be based upon the patients' needs and not necessarily a fixed maximum measurement. The need for surgery is generally considered a last option in our healthcare delivery system, except in scoliosis, where many times it is the first option to be utilized.

Usually surgery is reserved for teens and pre-teens that already have a curvature of 45 degrees or more. This arbitrary threshold for surgery is variable in real life situations. Many surgeons will opt to wait until 55 degrees or more. The most common surgical procedure is a posterior spinal fusion with instrumentation and bone graft. This type of surgery involves attaching rods to the spinal column to help straighten it. The bone graft between the affected vertebrae encourages fusion, or joining of the bone in order to prevent further progression of the curvature Instrumentation refers to the various rods, screws and hooks which are used to hold the spine in the corrected position. In post surgical care, patients with failed surgery most commonly have an incomplete fusion which may allow for movement of the vertebra, causing a possible snapping of the rod. The instrumentation is rarely removed. Following the surgery, the fused section should no longer be flexible. This causes a life-long restriction of movement which may be considered a worthwhile trade, but a trade none the less.

The average hospital stay is about 5 to 7 days, and the child usually returns to school within a 6 week period. Of course the recovery time for an adult patient is much longer and may last for a period lasting up to 6 months. During the first year after surgery, limitations are placed on physical activities in general. Most surgeons will recommend the complete cessation of strenuous dance, gymnastics and contact sports.

Part 4 - Alternative Treatments

The term "alternative" is used in relation to the standard orthopedic approach which includes observation, rigid bracing and surgery. The human form has proven to be responsive to attempts of reconstruction, and surely scoliosis can be managed without surgery. The growing human organism is dependent upon sensory clues from its environment, and will respond when that environment changes. This is consistent throughout nature, much as a tree growing on steep hill reaches upward toward the sky against gravity. In fact, our upright stature is an evolutionary response to our gravity sensing (graviceptive) nervous system. Alternative treatments care to examine these systems and attempt to understand what potential role they may have in recovery. The Scoliosis Care Foundation is dedicated to providing a nurturing environment for researchers in this field. We believe all great breakthroughs are "alternatives."

List of Alternative Treatments:

- Respiratory Exercises- Breathing using corrective body postures designed to reduce the deformity of the rib cage and oxygenate the body.

- Vestibular Rehabilitation- Is recommended in cases where the patient has a disturbed sense of body direction and position. These conditions can be identified by special testing of the inner ear. Many of the children with this type of problem will have learning difficulties or dyslexia. In adulthood, these conditions become compounded by anxiety and vertigo. Early rehabilitation procedures have been shown to be effective in correcting vestibular imbalances. For more information search keywords (vestibular + scoliosis) on any internet search engine.

- Rotational Exercises- Exercises designed to activate the muscles which rotate the trunk. They are typically prescribed in one direction only, and may be most effective in curvatures located in the mid-back.

- Posture Retraining- Although surgery is often considered for postural reconstruction it may lead to osteoarthritis and pain syndromes in adulthood. For this reason, non-surgical techniques which reduce the postural deformity are a more desirable approach to management. Postural failure accounts for much of the spinal curvature seen with scoliosis. Techniques such as whole body vibration and nutritional supplementation show promising results in improving postural tone when used over a period of time. Devices like the elastic tension braces which allow for active retraining of muscle recruitment patterns are extremely helpful in this area as well.

- Yoga- Body control and the stamina provided by yoga make it a very desirable therapy for scoliosis. However, certain postures may exacerbate or worsen curvatures, and therefore co-management with a non-surgical healthcare provider is recommended.

- Chiropractic- There are a number of Chiropractic techniques dedicated to improving the alignment of the spine. Although the literature gives mixed reviews in regard to manipulation having a significant affect on scoliosis, chiropractors have been providing clinical management of spinal deformities for over a hundred years. In addition, many of the alternative modalities discussed in this workbook can be managed by Doctors of Chiropractic. The adult patient often requires mobilization and adjustic procedures to alleviate pain and improve range of motion in affected areas.

- Physical Therapy - Exercises and other Physical Therapy techniques are also widely used to assist the scoliosis patient with alignment and pain management. Scoliosis patients often can benefit from active inhibitory techniques, muscle elongation and activation procedures commonly offered by physical therapists and chiropractors alike.

Section 9

Spinal Screening Program

FOR QUALIFIED SCREENERS

Part 1 - General Organization for Screening

When offering to Schools:
The person responsible for the spinal screening program will need to contact the chief administrators either directly or through parent-teacher (PTA) associations. The screening is a public service and not designed to create direct referrals to you.

Part 2 - Students with Physical Limitations

In the cases of students with physical limitations who cannot stand in the manner necessary for the Adam's forward-bend test, do not attempt to screen this student. The screener should contact the student's parents and inform them that their child is at the age where he/she should receive the recommended spinal screening. Ask the parents or legal guardian to request an appropriate spinal screening from a qualified professional at his/her next medical visit. A note should be placed in the school record of your recommendation. On the spinal screening report, indicate this student as a referral. Once the parents return the results of a doctor's exam, enter the data into the diagnosis/treatment section as appropriate.

Part 3 - Students under Prior Treatment

If it has been verified that a student is receiving on-going treatment for scoliosis, hyper-kyphosis, or other spinal abnormality, it is not necessary to screen this child. If you are unable to verify if a child is under current treatment for a spinal abnormality, then include the student in the school spinal screening.

Part 4 - Preparation for Screening

Students must be screened individually in a space offering privacy. If possible, locate a private area where students can remove their shirt and/or change clothing. A room adjacent to the physical education dressing room is often ideal for screening.

You may choose to have two or more adults participate in the screening process for security/liability concerns. Assistants can help with preparation and management. Conduct orientation sessions for each class of students to be screened. In some states, the Department of State Health Services audiovisual library makes available educational videos for children, designed to explain the importance of spinal screening.

With an assistant, an experienced screener should be able to screen 10 to 20 students in an hour. If necessary, coordinate this schedule with the teachers who will need to release their students from class on those days.

- Send out a pre-screening letter to the parents, you may also enclose the Scoliosis Care Foundation Brochure on Spinal Screening.

- Have a roster of children available using the Spinal Screening Worksheet.

- Students parents have the write of Religious Exemption to be excused from the screening.

- Parents may choose to have the screening conducted by a physician instead of at the school. In this case, parents are asked to provide signed results of an Adam's forward-bending test from a physician's office by the end of the school year the child is scheduled for screening, or by the beginning of the following school year if the exam is obtained during the summer holiday.

- On the day before the screening, remind students of the screening's purpose. Remind males and females to wear or bring shorts, and remind females to wear a two-piece swimsuit top, a halter top, or sports bra. Speak positively, and refer to this activity as "spinal screening" rather than "screening for scoliosis and hyper-kyphosis."

  It can be helpful to have some extra sports bras and gym shorts on hand in different sizes.

Part 5 - Screening

The screener may use a chair. There should be a table nearby for use in writing down information, and a place for students to place shirts and jackets. The screener should be five to eight feet from the student. Place a strip of tape on the floor to mark the place the student is to stand. Good lighting will facilitate the screening. Some may find the screening process upsetting. This can happen if the student feels unprepared or does not have appropriate attire. It is strongly recommended these children be allowed to visit with the counselor, school nurse, or other trusted staff person privately, or allowed to call their parent/guardian. Often these children will calm down and be able to participate in your screening. If not, add the student's name to the list of those needing to be rescheduled. Check male students with their shirts off, and female students are to be examined with their halter top, swim top, or sport bra on. In order to save time, have some students wait in a separate, but nearby area. An aide or volunteer may assist in maintaining the flow of students. Record the name of each student in the class on a spinal screening worksheet, or use a classroom roster. Record all positive findings next to the student's name on the worksheet. If a student does not receive the screening, note the reason next to his/her name. Arrange to re-screen students with positive or abnormal findings within two weeks. Use of the scoliometer (optional) during re-screening will assist in determining which students require a referral. Refer those whose scoliometer reading is consistently above 5 degrees or more. If possible, ask another certified screener to help evaluate these students.

Section 10
Follow-up Activities

Part 1 - Absentees
Students who were not screened due to absence should be scheduled for screening as soon as possible. Ideally, these screenings can be carried out during the re-screening of students found to have positive findings at your initial screening The second screening should be conducted approximately two weeks after the initial screening.

Part 2 - Exclusions
If a student was excluded from screening for any other reason, have his/her reason documented and included in the school health record.

Part 3 - Positive Findings
While screening the absentees, use the session to re-screen all students with positive findings at the initial screening. The original worksheet may be used at the re-screening. If initial positive findings are not confirmed, the parents need not be contacted. If a positive finding is confirmed by the initial screener, the parent/guardian, or managing conservator should be contacted as specified in the following section.

Part 4 - Contacting the Parent/Guardian
As a courtesy, call the parents to explain that a professional evaluation is recommended as a precaution. Give them reassurance that many findings are of no consequence, but professional observation may be needed to determine that the signs are not worsening. Inform parents that they will receive written notification of the screening findings in the form of a parent notification and referral form, which they should take with them to the professional exam. This form is to be completed and returned to the school.

Part 5 - Follow-up Letter
Parents or guardians of students with abnormal screening results are to be notified in writing. For this purpose, use a parent notification and referral form. This form should contains spaces to record the results of the screening, and include instructions to the parents, guardian or managing conservator to obtain a professional examination for their child by an appropriate health practitioner.

Part 6 - Referrals
In the event a student has been evaluated by a primary health care provider who reported no abnormalities, but about whom there is continuing concern on the part of the screener.

These Students should be tracked as follows:
1) Schedule students to be seen by the school physician or nurse who can be in communication with the student's own health care provider.
2) If the student's health care provider continues to feel that no further action is indicated, re-screen the student in three to six months.

The school nurse and physical education instructor should be aware of students who are wearing braces. The school nurse may need to supervise skin care if a rigid brace is used. In cases where a soft brace is used, extra time is usually needed when dressing and on bathroom breaks. In most cases, children who wear braces are encouraged to participate in a wide range of physical education activities, but the health care provider's recommendations will need to be followed.

Part 7 - Documentation
Be sure to include on the student's health record the date and results of the screening as well as the results of any referral.

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Resources

Scoliosis Systems
Certified Spinecor Brace Providers
(Dr. Gary Deutchman & Dr. Marc Lamantia)
www.ScoliosisSystems.com
email: Info@ScoliosisSystems.com
1-800-281-5010

Yoga for Scoliosis
Elise Browning-Miller
www.yogaforscoliosis.com

Yoga Union
Alison West and Deborah Wolk
Yoga Union Center for Backcare and Scoliosis
1-212-532-1512
32 West 28th Street, Fourth Floor
YogaUnion@NYC.RR.com
www.YogaUnionBackcare.com

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