Original Contribution

Pediatric Scoliosis, A Unique Patient Profile and Orthosis: "Thinking Outside of the Box"

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Before dealing with the plight of scoliosis in children, the condition itself must be defined. Henceforth, scoliosis is determined as a lateral curvature of the spine (Taber's 27). Upon physical examination, the spinal curvature is readily noted when observing the child from the dorsal or ventral aspect of the trunk. The condition of scoliosis is often presented as a pelvic or shoulder asymmetry with imbalanced symmetry of the trunk laterally to the left or right.

Children with this affliction will experience loss of physical function, postural instability, discomfort, decreased self-image and numerous physiological dysfunctions including decreased oxygenation which are secondary impairments to the scoliosis itself. The severity of secondary conditions will manifest in proportion to the degree of spinal curvature. An accurate vertebral curve is readily defined as being greater than or equal to ten degrees.

From the several known etiologies of scoliosis, the most common variety is idiopathic, or unknown as to cause (Bullock 871). Congenital causation is usually secondary to anomalies of the vertebra that developed in utero. Paralytic scoliosis is another variety that is secondary to muscle dysfunction or weakness. Scoliosis may also be neuromuscular in origin with conditions of muscular dystrophy, cerebral palsy or spinal bifida. Research and theory have suggested that genetic inheritance, abnormal tissue structure, neurological imbalance and dysreflexia may all predispose a child to develop scoliosis and yet the validity of any one factor regarding the etiology of idiopathic scoliosis has yet to be established.

Early detection of this condition is greatly desirable because scoliosis in childhood is generally asymptomatic and can be kept to a minimum with timely diagnosis and treatment (Martini 225). It may, however, be presented with complaint of pain, which usually is related to an underlying condition such as tumor, infection, fracture, neurological impairment, etc... The condition of idiopathic scoliosis is, for the most part, a chronic progressive concern. Curvature advancing from 15 to 20 degrees during a time frame of one year are considered most rapid in the abnormalties progression.

When evaluating a child for scoliosis, one must observe the child from the dorsal aspect, noting the levelness of the shoulders. Flanks should appear balanced, pelvis level and scapula symmetrical. A positive Adam's sign is the presence of a spinal curve on forward flexion of the trunk from the standing position. This is the only true pathognomonic sign of scoliosis (Early 1275). Viewing from the lateral side, normal lordosis and kyphosis should be presented without either being noted as exaggerated with forward trunk flexion. A complete neurological examination should include sensory, reflex examination and motor function (Merck 1265).

Radiographs may be desired in an initial evaluation for scoliosis. These should be taken on a long vertebral film with the child standing, except in spinal curvatures resulting from inflammatory agents (1: 684). It is rare for a patient to complain of back pain. If back pain is presented, especially with palpation of the vertebral column or adjacent areas, the indication is high for a more intensive work-up for evident scoliosis and secondary conditions.

Treatment approaches vary with the age of the child and the severity of the curvature. The foremost goal of all forms of treatment for scoliosis is to prevent scoliotic curves greater than forty-five degrees prior to the child entering adulthood. Treatment specifics are based on the child's skeletal age, degree of curvature and its location i.e.; thoracic vs. lumbar. At times, treatment consists only of evaluation every four to six months, with radiographs and neurological exams.

The most widely used treatment modality is the ex-

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ternal spinal bracing. This non-invasive type of treatment has shown to have a significant affect on changing the natural tendency of this condition. Exercise programs initiated by physical therapy and adaptive education provided by occupational therapy are of value to maintain and increase the child's overall fitness, thus enhancing homeostasis and positive mental outlook by remaining independent in function with regards to the child's environment and activities of daily living (Early 1278).

When external bracing is indicated, the child must be involved in a careful section process. Twenty degrees and under for a curvature are not eligible for bracing. Curvatures between thirty and forty degrees are aggressively treated. The bracing for these patients will be used as long as the patient remains skeletally immature. If the curvature progresses past forty-five degrees or reaches skeletal maturity, bracing is no longer effective. It is important to state that when implementing spinal bracing, the goal is to keep a curvature from progressing, not to correct that curve.

Surgical intervention is considered when brace treatment to prevent curve progression fails, when a cosmetically unacceptable deformity develops, when curvature progress over forty to fifty degrees and medically speaking, curves over 60 degrees are considered severe or progressive pain or decreased function exists secondary to trunk imbalance caused by the spinal deformity. Candidates are again well screened by diagnostics prior to being cleared for surgical correction techniques.

The two most widely prescribed surgical procedures are the implementation of the Harrington Rods or the use of Dwyer instrumentation. The Harrington Rod procedure is described when two rods are placed on either side of the spine and anchored to the bone by hooks. These effectively fuse the spinal segments and prevent progression of the curve. The Dwyer instrumentation requires removal of the intervertebral discs, insertion of screws, which are then, attached to a connective cable that is shortened to compress the vertebra together and reduce the flexibility for curvature progression (Wong 1098). Both of these surgical procedures are very invasive, involving a large open incision through the patient's chest to allow spinal disc removal and insertion of hardware (rods and hooks) through the incision in the back to hold the corrected spine in place. A newly developed endoscopic procedure allows surgeons to perform these delicate maneuvers through the patient's chest only, in effect skipping an entire step in the process and resulting in less scarring, improved patient comfort and decreased chance of infection (Bassett 33).

Surgical complications may include spinal cord injury, cardiac arrest, infection, as well as loosening of the fixation device. However, the most frequent complications are psuedoarthritis of the fusion and instrumentation failure. Prognosis is variable. Factors, which affect correction, are the patient's age, state of physical health, medical history, genetic makeup and psychological motivation

Now that the subject matter of pediatric scoliosis has been presented and a firm understanding of this condition and its treatment options have been established, I present an actual patient profile which will enhance ones clinical perception of pediatric idiopathic scoliosis and present a uniquely developed orthotic device which facilitates specific goals as pertaining to the patient's condition.

Orthopedic Designation: IEO
(Intercostal Expansion Orthosis) Pat. Pending
Researched and developed by John P. Mezurecky, OTC

PATIENT PROFILE

Of the following data, the patient's name is fictitious and the facility of treatment has been omitted to maintain strict patient confidentiality.

Patient: Zoey

DOB: 06/13/93

Hx: Zoey is an eight-year-old Caucasian female who is severely developmentally delayed secondary to a near drowning accident at age two. She presents with scoliosis of the thoracic and lumbar spine with convexity to the left. There is a 25-degree curvature (Group 2) with the apex at T-9 and T-10. The scoliosis is considered to be idiopathic. Zoey is tracheostomy dependent and demonstrates poor extremity control and decreased postural stability. She demonstrates dysreflexia in all quadrants and incontinence of bowel and bladder.

Orthopedic Dx: Group 2 scoliosis, idiopathic

Condition Concerning Treatment: According to the latest report from radiology, Zoey presents with scoliosis of the thoracic and lumbar spine with convexity to

the left. There is a 25-degree scoliosis with the apex at T-9 and T-10. There has been a slight increase of scoliosis in comparison with the patient's prior examination as is evidenced by current examinations provided by radiology. The following diagram is an exact representation taken from the latest radiograph of the patient's vertebral column (T-2 through L-5). (see page 8) Following this is an explanation of scoliosis mensuration utilizing the Cobb-Lippman method.(see below)

SCOLIOSIS MENSURATION
Curvature Measurement

The Cobb method is the most accepted standard for quantifying scoliotic deviation.

Cobb-Lippman Method

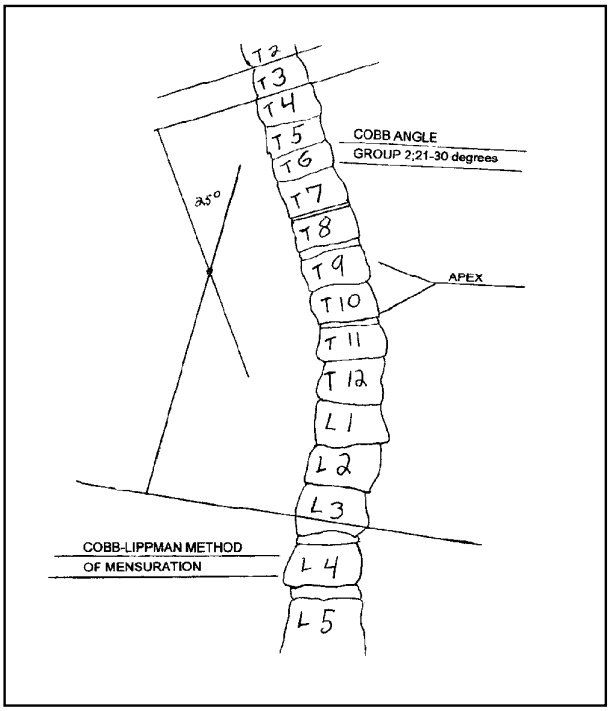
A line is drawn along the superior border of the cephalad end vertebra. A similar line is drawn along the inferior surface of the caudad end vertebra. If the end plates are not visible, the bottom or tops of the pedicles can be used. Perpendicular lines are then erected from each horizontal line and the angle of their intersection measured.

Seven groups are categorized according to the Cobb angle*:

Group 1: 0-20 degrees
Group 2: 21-30 degrees
Group 3: 31-50 degrees
Group 4: 51-75 degrees
Group 5: 76-100 degrees
Group 6: 101-125 degrees
Group 7: 126 degrees and above

Patient Objective Findings: Zoey has been observed to have little to no trunk stability when sitting upright. Without the external support of bolsters or custom supports, Zoey's trunk will slump and fall forward, laterally or backwards. With forward slumping, her neck hyperflexes and may compromise the function of her tracheostomy. Zoey responds minimally to passive exercises that encourage an increase in trunk righting reflex, and she exhibits no active trunk extension as reported by physical therapy and occupational therapy.

Reference: Yochum & Rowe: Essentials of skeletal Radiology. Vol. 1. Philadelphia: Williams and Williams. 1983



Assessment of Condition: Zoey appears to lack the muscle strength and control to actively maintain an upright posture, initiate trunk extension, or cause expansion of the intercostals.

Goal of Physician: For Zoey to develop active trunk extension and increase intercostal expansion to facilitate oxygenation.

Plan of Treatment: An orthotic device will be fabricated to facilitate an active response by Zoey to initiate trunk extension and intercostal expansion thus increasing overall trunk control and increasing oxygenation. The orthosis will wrap completely around Zoey's trunk from dorsal to ventral (see photo #1). It will incorporate foam inserts which will be positioned just subscapular and will provide a stimulus for scapular protraction facilitating trunk extension and intercostal expansion (see photo #2). The orthosis is not intended to act as a brace or passive support, but rather as a catalyst for an active response from the patient. A prototype of the proposed orthosis has been fabricated for observation. A custom device will be fabricated for Zoey by request of the M.D. (see photos #1, #2, #3).

Reference Gray's Anatomy, and Principles of Anatomy and Physiology by Torta, 5th edition.

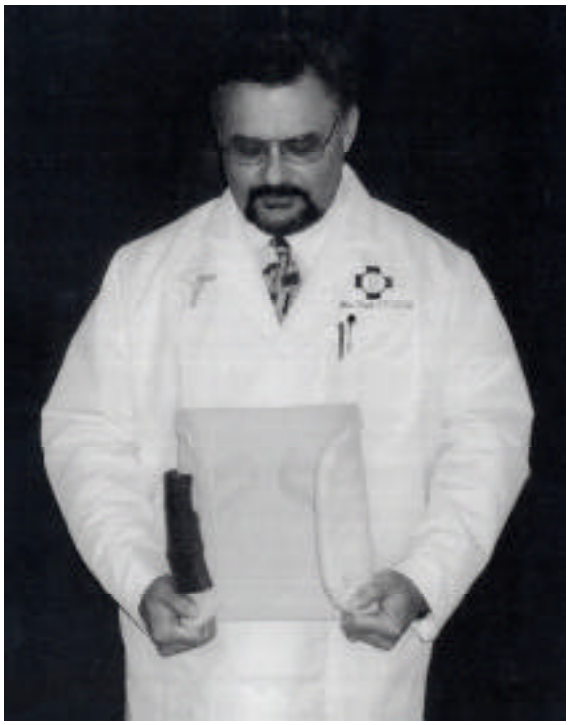


Photo 1

Photo 2

Photo 3. Child shown is a model, not actual patient

Precautions:

1. Regular skin inspections of the entire trunk, ventral to dorsal, prior to and after treatment with the orthosis for any signs of skin irritation and loss of integrity.
2. The patient will be monitored at all times when the orthosis is in place.
3. The orthosis will be placed distally to the axillary area so as not to cause nerve compression of the brachial plexus.
4. A T-shirt or similar garment should be worn under the orthosis.

Recommendations:

1. The use of the orthosis should only be implemented by caregivers who have been instructed as to its use.
2. Implementation of the orthosis will be on days and times as ordered by the attending physician.
3. It is recommended that Zoey be placed in a supine position when attaching the orthosis.
4. Zoey will be in a sitting position when the orthosis is in use.
5. Zoey will be placed in a supine position when removing the orthosis.

6. Progress will be measured in the following manner:

- •Trunk measurements will be taken prior to each orthotic treatment in supine and upright positions.
- •Trunk measurements will be taken in the aforementioned positions after each therapy treatment with the orthosis removed.
- •Measurements will be taken bilaterally and vertically of the distance between the dorsal aspect of the axillary space and the posterior aspect of the iliac crest. Measurements will be recorded in inches or centimeters to denote declines or advances in asymmetry.
- •Palpitation of the latissimus dorsi, trapezius and intercostal muscles will be performed after each treatment while Zoey is sitting upright with hip support to determine any increase in muscular tone.
- •Progress is to be monitored by the primary care physician and caregivers assigned to implement the orthosis.

7. An oximeter is recommended for pre and post orthotic implementation and daily comparisons of oxygen saturation levels need to be reported to the M.D.

CONCLUSION

In closing it is desired to state that the IEO device was developed and implemented to facilitate a specific medical goal i.e.; to stimulate active trunk extension and intercostal expansion to increase oxygenation. With knowledge of the fact that the patient is severely developmentally delayed and lacks the cognitive ability to physically act with verbal instruction or physical demonstration, the need and benefits of the IEO Device becomes clear. It is important to realize that this orthosis is not intended for universal application. Rather it was researched and created to facilitate the specific needs of a unique individual patient as stated in the previous profile. There is the belief that all medical practitioners will be of greater service to their patients if they view them holistically and globally. With this approach utilizing research, perseverance andimagination we can think "outside of the box" wherever applicable and not be plagued with the affliction of complacency. In patient treatment it should be dared to ask "What can be done, what has been done, what else can be possible ?"

ABOUT THE AUTHOR

John Mezurecky was raised in Orange County, California. He attended Loma Linda University and Santa Ana College and holds degrees in Microbiology and Occupational Therapy. Mezurecky also holds certifications in Emergency Medicine (EMT) and Orthopaedics (OTC). John is looking forward to advancing technology to facilitate patient treatment in orthopaedic medicine.

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