# Newsletter

## Prosthetics and Orthotics Clinic

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Winter/Spring


# SCOLIOSIS:

# ORTHOTIC MANAGEMENT CONCEPTS


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The orthotic management of idiopathic scoliosis (fig. 1) over the years has employed a number of different orthotic systems. Included among them have been the Milwaukee and modified cervico-thoracic-lumbo-sacral orthoses (C.T.L.S.O.) as well as various prefabricated, modular, and custom fabricated thoracic-lumbo-sacral orthoses (T.L.S.O.).

The prescription of any of the systems is dependent upon a number of variables, including the level and degree of curvature, the degree of rotation, the age and physical condition of the patient, and the degree of patient cooperation expected.

No matter which system is selected, and no matter which set or combination of variables is present, there exists a number of orthotic management principles for consideration. The purpose of this paper is to outline these principles and theories, the similarities and differences presented by scoliosis, and orthotic management systems employed.

In order to present these relationships, a number of somewhat original, and perhaps not so original, orthotic management concepts and theories are discussed. The theories include: 1. the reasons for reducing lumbar lordosis; 2. the idea and employment of a "righting reflex," both sagittal and coronal; 3. the concept of "costal distraction"; 4. the importance of axial alignment; and 5. a theory concerning the deviations of scoliosis, the creation of forces, and the force systems necessary for their control and correction.

**Lumbar Lordosis**

Historically, there has been an emphasis over the years on the reduction of lumbar lordosis (fig. 2) in the orthotic management of the spine, especially in the orthotic management of scoliosis with the C.T.L.S.O. and the T.L.S.O., for a number of reasons.[1,2]

a. In the orthotic management of a lumbar or thoraco-lumbar scoliosis,

**Figure 1**

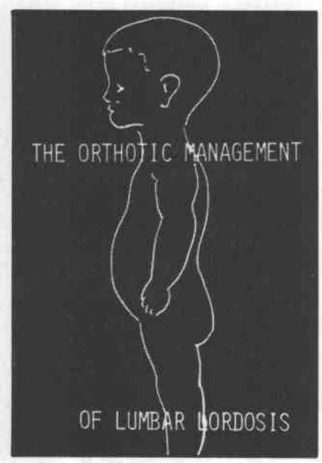


**Figure 2**

### NEWSLETTER READERS — PLEASE NOTE

Due to the move of the National Office and editorial staff turnover, the publication of the NEWSLETTER fell behind schedule. Now both the Winter and Spring editions are ready for publication. Therefore, on a one-time basis, and in the interest of reducing costs for postage and handling, this NEWSLETTER is a COMBINED WINTER-SPRING issue which will explain its larger than normal size.


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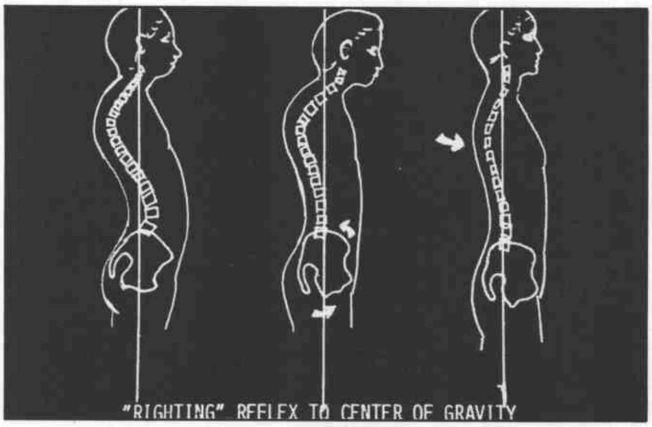


**Figure 3**

flexion of the lumbar spine has a positive effect on scoliosis. The distraction that occurs between the thoracic spine and sacrum reduces lumbar scoliosis. The reasons presented for this "correction" include the release of the hip flexors and resultant pelvic tilt, and the stretch of the posterior longitudinal ligaments; the net result being an improvement of the lumbar scoliosis.

b. When managing a lumbar curve in an orthosis with a corrective force from the posterior lateral direction in an attempt to reduce scoliosis and vertebral rotation by compressing of muscle bulge, it is necessary to provide an anterior counterforce to prevent an increase in lordosis.
c. Recognizing that the thoracic and lumbar spine are interrelated, efforts to control lordosis with encasement and stabilization of the pelvis produce an opportunity for leverage and corrective forces, both inductive and direct, to be applied to the thoracic spine.

### "Righting Reflex"

The "righting reflex" (fig. 3) is an example of an inductive force. When producing flexion of the lumbar spine, the kyphotic posture of the thoracic spine accentuates a forward flexion of the shoulder and head. The body's natural tendency to right itself over the center of gravity produces an extension or reduction in thoracic kyphosis. This sagittal plane reflex can be utilized in the orthotic management of Scheurmann's kyphosis and idiopathic scoliosis.

Another "righting reflex" force developed is in the coronal plane. In double curves, thoracic and thoracolumbar, when the lumbar curve is reduced, causing a lateral shift of the head and shoulders, the body's natural tendency to right itself results in a reduction in thoracic scoliosis as well.

In the orthotic management of scoliosis in a C.T.L.S.O., the "righting reflexes" can be planned as an adjunct to the direct counter-lateral and anti-rotational forces of the thoracic pad.

In a T.L.S.O., this inductive extension is aided by a fulcrum created by the superior trim line of the orthosis. In theory, even though the length of the lever arm superior to the apex of the thoracic curve does not appear adequate for a significant force to be applied, the planned instigation of "righting reflex" forces is used to augment a lesser, direct force.

### Axial Alignment

The encasement and stabilization of the pelvis provides the counter-force and leverage for direct force application to the thorax as well.

Because of the rotational component present in scoliosis, axial alignment of the body, rib cage and pelvis is necessary. The direct force created by symmetric alignment of the pelvic and thoracic surfaces of the orthosis results in a direct anti-rotational corrective force. This is particularly applicable in the orthotic management of a thoracic curve in a T.L.S.O. Since the rotational component present in a scoliosis is one variable that may preclude the use of a T.L.S.O., management of rotation in this system can be viewed as critical.

### "Costal Distraction"

Another direct force advantage created by the encasement of the pelvis is "distraction." Stabilization of the pelvis and the "total contact" encasement of the lower rib cage in a T.L.S.O. produces an opportunity to maximize the distance between the pelvis and the rib cage, resulting in a distraction of the lumbar spine. The flattened abdominal surface induces lumbar flexion and also increases the intra-abdominal pressures, augmenting this force. The resultant costal-pelvis distraction is another planned, direct force in the orthotic management of lumbar scoliosis in a T.L.S.O.

### Orthotic Management Goals

The concepts and theories presented might now be viewed in relation to orthotic management goals relative to scoliosis, specifically the evaluation of the various scoliosis deviations and the corrective forces available in the orthotic management system employed.

In the normal spine, the muscles act antagonistically on either side to maintain a straight, neutral spine. The spine, rib cage, and pelvis are symmetrically related and supported by the musculature.

In the scoliotic spine, as the vertebrae rotate and move laterally, the muscles lose their lever-arm advantage, and the spine, rib cage, and pelvis lose their symmetry. The orthotic management goals then become:

a. repositioning of the vertebrae, not only by direct forces, but also by inductive reflex forces.
b. re-establishment of muscle levers and re-establishment of symmetry of the rib cage and between the rib cage and pelvis.

## Thoracic Scoliosis (Two Deviations)

In identifying the orthotic system to be used, the differences in scoliosis deviations should be recognized.

Thoracic scoliosis (fig. 4a) is seen as a two-deviational deformity, 1. a lateral deviation, the curve, 2. a rotational deviation, the rib prominence. Theoretically a three-directional force system is necessary for management of these deviations. The choice of C.T.L.S.O. or T.L.S.O. force systems depends, of course, on the variables outlined previously.

In the three-directional force system C.T.L.S.O. (fig. 4b), the forces include, 1. the counter-lateral force of the thoracic pad, 2. the anti-rotational force of the thoracic pad, and 3. the distractive force of the pelvic base opposed by the occipital portion of the neck ring.

Certain thoracic curves can be managed also in a T.L.S.O. system: The two-deviational deformity of thoracic scoliosis managed with the lateral and anti-rotational force of the axially aligned surfaces of the orthosis, augmented by the righting reflex inductive forces, coronal and sagittal.

Figure 4a

## Lumbar Scoliosis (Three Deviations)

Thoraco-lumbar and lumbar curves (fig. 5) are seen as a three-deviational deformity (fig. 6). In addition to the lateral and rotational deviations there is usually a tendency toward lordosis. The asymmetry and loss of muscle levers and the shape of the lumbar vertebrae allow hyper-extension which contributes to a third deviation. It becomes necessary to incorporate a four-vector force system to manage this three-deviational deformity.

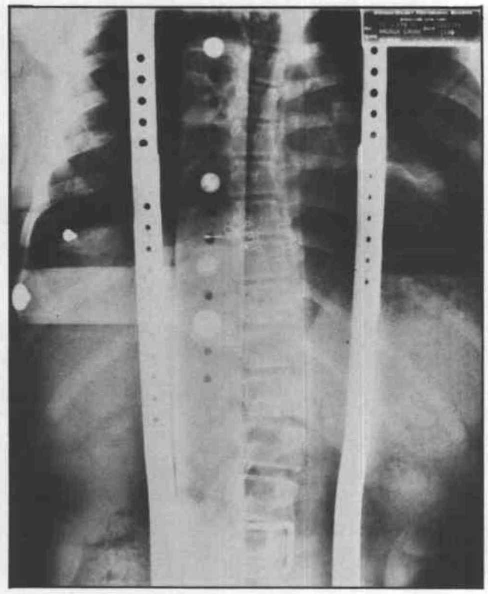

Figure 4b

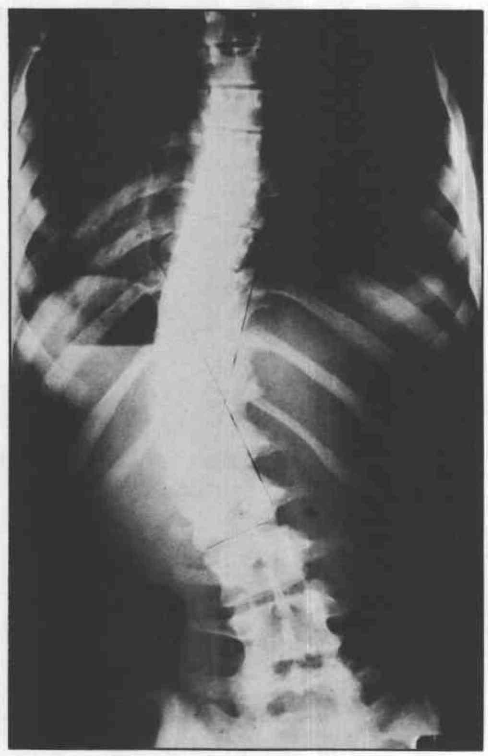

Figure 5

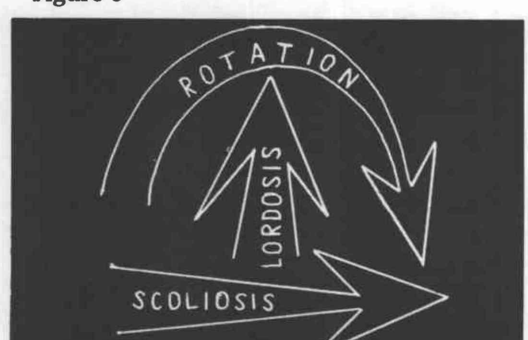


Figure 6

The four-vector force system T.L.S.O. (fig. 7) contains: 1. anti-lordotic, 2. lateral, 3. anti-rotational, and 4. costal distraction forces, all described earlier.

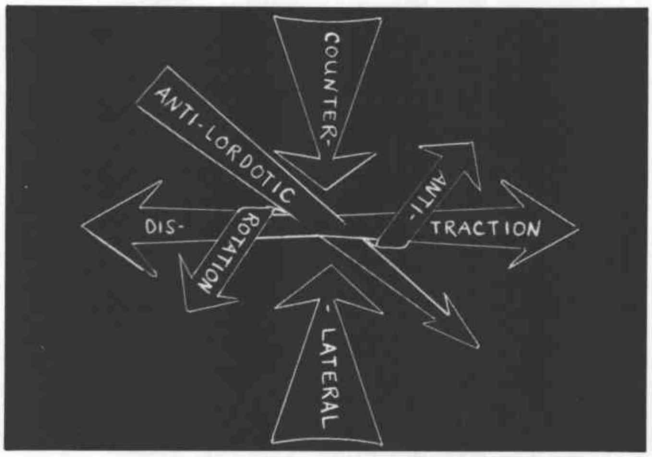


**Figure 7**

In summary, understanding of the concepts and theories presented is necessary to provide the orthotic management system reflecting the re-positioning and forces required for appropriate correction.

[1]Van Hanswyk, Edward P., Hansen, Yuan, and Eckhardt, Wayne, A., "Orthotic Management of Thoraco-Lumbar Spine Fractures with a 'Total-Contact' TLSO," *Orthotics and Prosthetics Journal*, Vol. 33, No. 3, pp 10-19, September, 1979.

[2]Van Hanswyk , Edward P. and Bunnell, William P., "The Orthotic Management of Lumbar Lordosis and the Relationship to the Treatment of Thoraco-Lumbar Scoliosis and Juvenile Kyphosis," *Orthotics and Prosthetics Journal*, Vol. 32, No. 2, pp 27-34, June, 1978.

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Inadvertently, Dr. Justin Alexander's author identification did not appear in the last issue of the *Newsletter.* He is the director of the Division of Physical Therapy, Department of Rehabilitation Medicine, Albert Einstein College of Medicine of Yeshiva University, Bronx, New York. We apologize for any inconvenience this omission may have caused.

# MEETINGS and EVENTS

**1981, March 20-21,** "Access to Technology" conference, Rehab Engineering Center of the Children's Hospital at Stanford, Stanford University, Palo Alto, California.

**1981, April 9-11,** "ITT Course on Biomechanics of the Locomotive System," Surgery Service of the Locomotive System, the Hospital de San Rafael, Barcelona, Spain.

**1981, April 23-25,** AOPA Region IV Regional Meeting, Hyatt Regency, Lexington, Kentucky.

**1981, May 1, 2,** AOPA Region I, Hyatt Regency, Cambridge, Massachusetts.

**1981, May 8-10,** Region V Regional Meeting, Plymouth Hilton Inn, Plymouth, Michigan.

**1981, June 5-7,** AOPA Region IX and COPA Combined Meeting, Doubletree Inn, Monterey, California.

**1981, June 12-14,** AOPA Regions II and III Combined Meeting, Host Farms, Pennsylvania.

**1981, June 16-21,** AOPA Regions VII, VIII, X and XI Combined Meeting, Four Seasons Motor Inn, Colorado Springs, Colorado.

**1981, June 25-27,** AOPA Region VI and Midwest Chapter of AOPA, Holiday Inn, Merriville, Indiana.

**1981, October 27-November 1,** AOPA National Assembly, Sahara Hotel, Las Vegas, Nevada.

**1982, February 17-20,** AAOP Roundup Seminar, Royal Sonesta Hotel, New Orleans, Louisiana.