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New Concepts in the Corrective Bracing of Scoliosis, Kyphosis, and Lordosis

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The basic concept of restoring the vertebral column to a perpendicular and symetrical attitude to the pelvis, as a result of forces applied to the column and ribs is appreciated in the following report.

A departure from the "Milwaukee" orthosis has been sought and tried in a number of designs for the treatment of spinal curvatures in the last few years.

The use of a modified body-jacket type of device, hereafter referred to as a "Low Profile", scoliosis, kyphosis, or lordosis corrective orthosis, has been successful in the treatment of 350 patients to date. Most of these were patients with scoliosis, some with associated lordosis and some with kyphosis and associated lordosis. Physicians affiliated with University Hospital, the Hospital for Special Surgery, and the Albert Einstein Institute have used this design. The New York Orthopedic Hospital, Columbia-Presbyterian Medical Center has adopted this design and called it "The New York Orthopedic Hospital Orthosis".

The "Low-Profile" orthosis is presently made of polyethylene, 1/4-inch thick, low density, and stress relieved. The orthosis covers the thorax and pelvis with an anterior opening.

Trim lines, anteriorly from xiphoid process to bilateral, anterior-lateral corn-

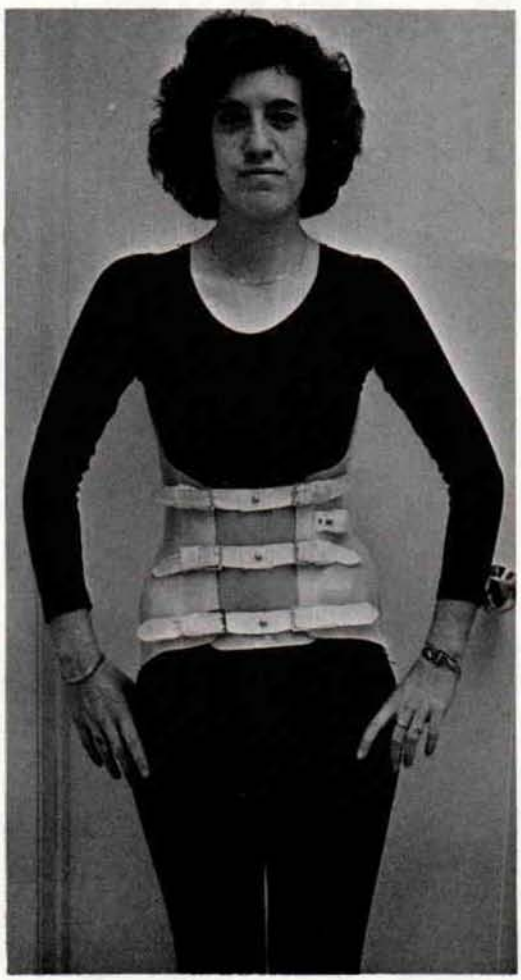

Fig. 1. Anterior view of the Low-Profile Spinal Orthosis.

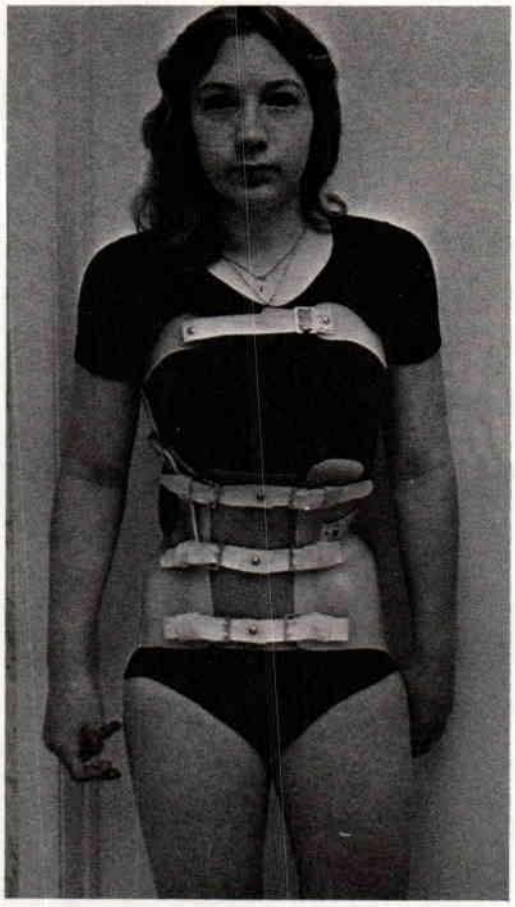

Fig. 2. Low-profile orthosis with extensions for auxiliary support.

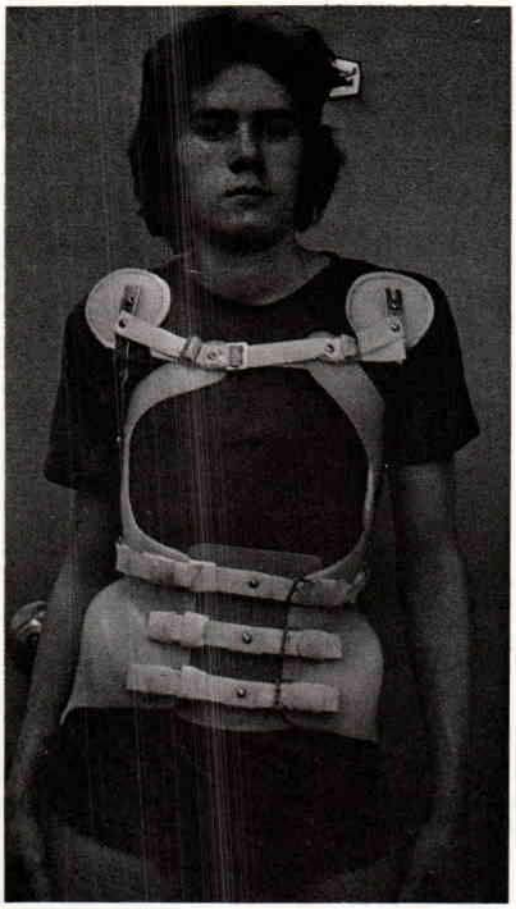

Fig. 3. Low-profile orthosis with extensions for auxiliary support and shoulder control.

ers at xiphoid level, afford a centered 2- to 3-inch wide opening, which extends distally to 1 inch below the ASIS's (Fig. 1).

A tongue of the same material is sandwiched and strapped between the opening and the body, and is overlapped by the edges of the opening.

Thoracic, kyphotic curves or treating generally large patients need extensions for axillary supports bilaterally which are joined by a strap (Figs. 2, 3).

Trim lines extend laterally from 1/2-inch posterior to the pectoralis tendon at the axillary level distally to the xiphoid level bilaterally at the anterior-lateral corners. This purchase of thorax prevents contra-lateral bending above levels of the apices of lumbar or thoraco-lumbar curves. It also affords thoracic level support or force to stabilize or reduce compensatory or flexible thoracic curves. From the ASIS level bilaterally it continues to the distal part of the greater trochanter, gradually to 3/4 inches short of the crest-to-seat measurement at the

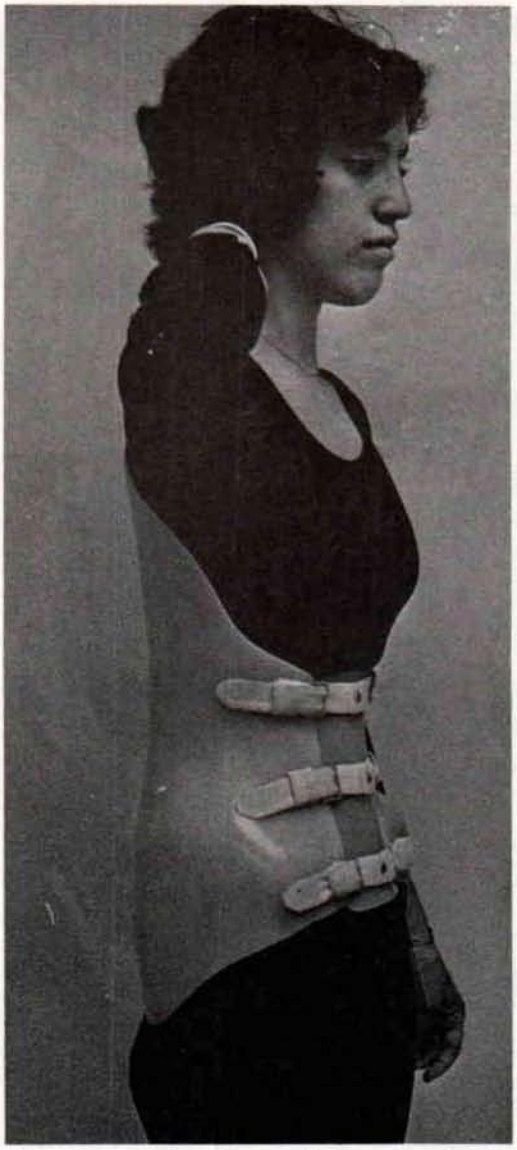

Fig. 4. Lateral view showing trimlines.

Fig. 5. Lateral view of convex side showing trimlines.

gluteus maximus posterior-laterally (Figs. 4, 5, 6, 7).

Trim lines extend posteriorly from 1 inch distal to spines of scapulae (Fig. 8), to 3/4 inch short of crest-to-seat measurement at the gluteus maximus. The attitude of the orthosis implies flexion of the pelvis, flattening of the abdomen, and firm contact at the proximal posterior areas (Fig. 4).

Pads and accessories are shaped and placed over the bodies of vertebrae at and immediately above the apices, down to and including the distal end vertebrae of a curve. The lateral extension to the anterior-lateral corner becomes a long lever arm to affect derotation and subsequent curve reduction. If thoracic lordosis is present, forces should be placed more laterally. However, since ribs are

Fig. 6. Lateral view of concave side showing trimlines.

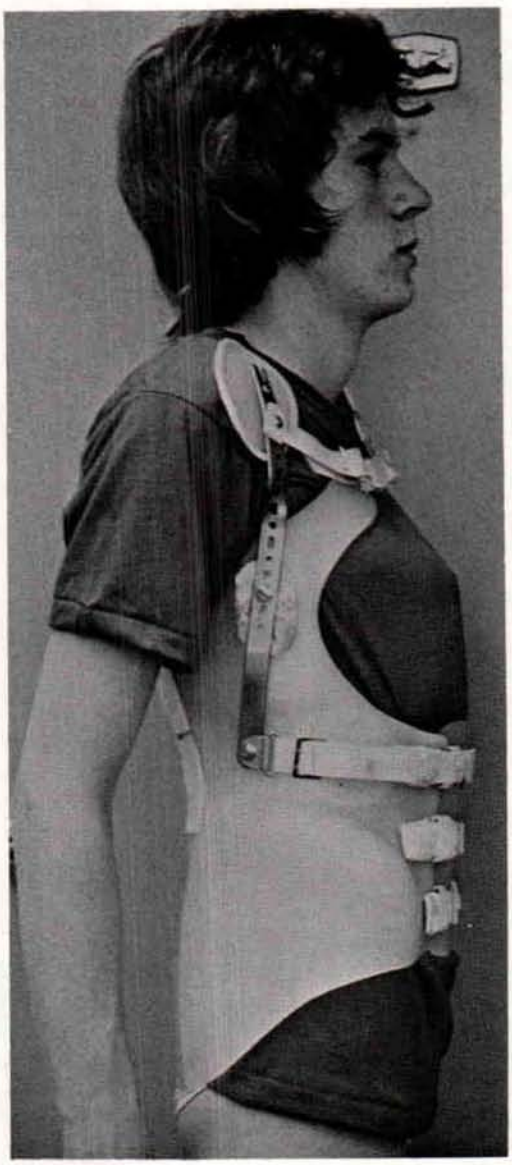

Fig. 7. Lateral view showing trimlines.

flexible extreme forces can cause deformities of the ribs, so care must be taken. Increasing thoracic lordosis can compromise respiration.

The vertical lengths of pads are determined by the distance between the area immediately above the apicle and below the distal vertebra of the curve. (Fig. 9).

The horizontal lengths are determined by the distance from a point 1/2 inch lateral of spinous processes to the anterior-lateral corners of the torso for either thoracic or lumbar curve levels, (Figs. 5, 6, 10).

The proximal edges of the thoracic or thoraco-lumbar pads are determined by the proximally involved apicle ribs so that

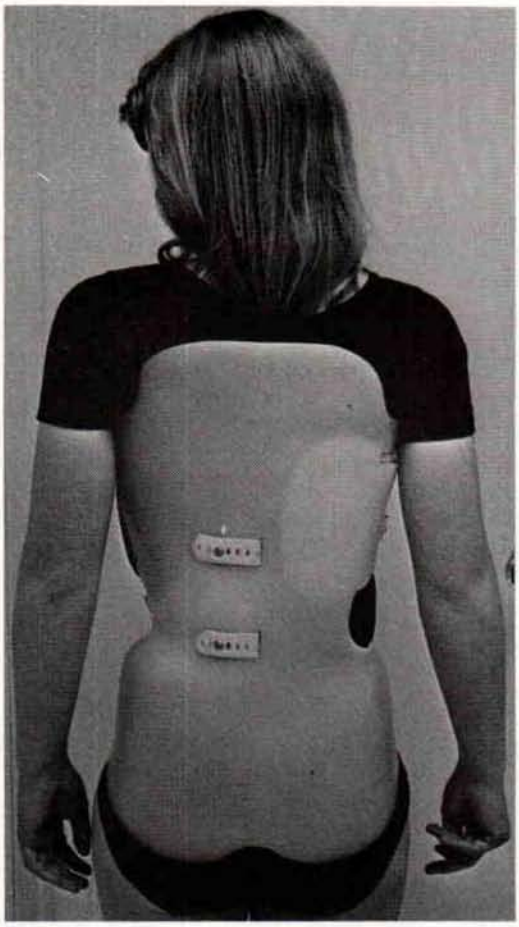

Fig. 8. Posterior view showing trimlines.

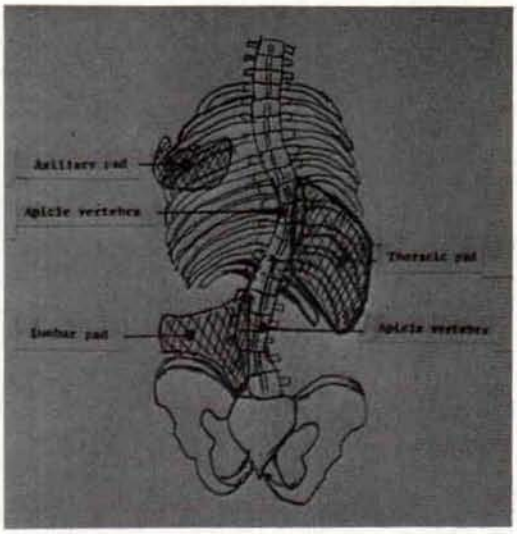

Fig. 9. The vertical lengths of pads are determined by the distance between the area immediately above the apicle and below the distal vertebra of the curve.

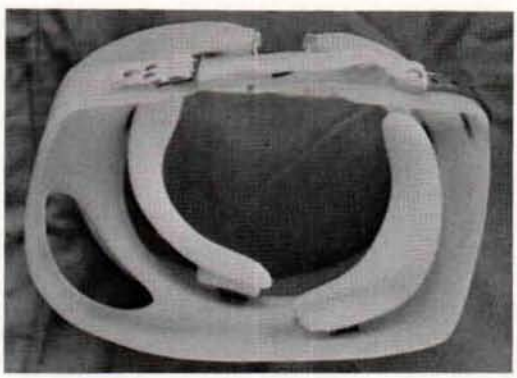

Fig. 10. The horizontal lengths are determined by the distance from a point ½" lateral of the spinous processes to the anterior-lateral corners of the torso for either thoracic or lumbar curve levels. See also Figures 5 and 6.

the verticle and horizontal sides are connected by a concave sloping side, since rib shape tapers. The concave sloping side extends over the involved apicle rib, continuing to the most distal rib involved, (Figs. 9, 11).

Axillary support by padding or trim line extension of the basic orthosis is added to offer support and/or pressure on the involved ribs of the compensatory curve. This is used with double layer, thoracic and thoraco-lumbar curves (Fig. 9).

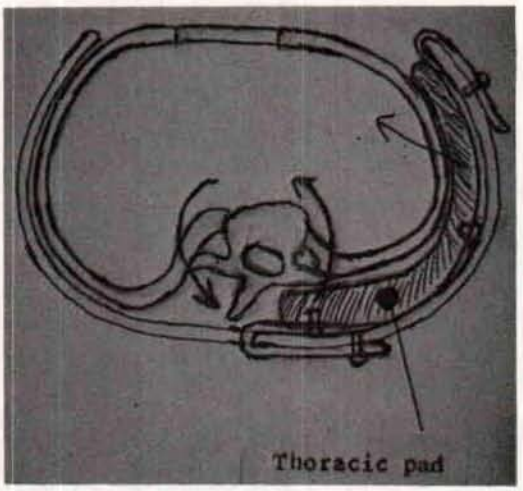

Fig. 11. Horizontal section through the thorax showing forces to achieve curve reduction and derotation. See also Figure 9.

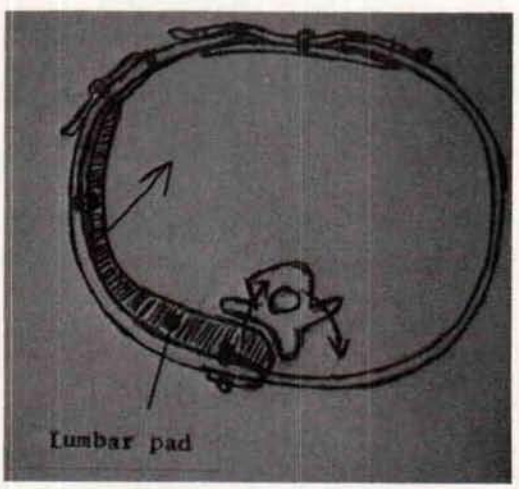

Fig. 12. Horizontal section through the waist level showing forces to achieve curve reduction and derotation. See also Figures 5, 9, and 10.

Lumbar pads cover all soft tissue posteriorly, including bodies of vertebrae 1/2 inch lateral of spinous processes, and laterally to a level in line with the anterior-lateral edge of the axilla line. The purchase of soft tissue in lieu of ribs tends to extend lever arm forces and also helps reduce unit pressure applied to skin (Figs. 5, 9, 10, 12).

Kyphosis pads afford adjustable posterior contact bilaterally from an area end vertebrae involved in the curve. They are placed 1/2 inch lateral of the spinous processes bilaterally to apply anteriorly directed forces on vertebral bodies (Figs. 13, 14).

Shoulder retractor pads are placed anteriorly and apply posteriorly directed opposing forces in the form of bilateral cup shaped pads which contact the heads of humeri. The humeral pads are attached to pivoted bars. The pivots are placed 1/3 to 1/2 the distance from humeral pads to the distal ends of the bars for mechanical advantage. The pivots are mounted on the lateral sides. The distal ends include pivoted loops through which straps are threaded and tightened to buckles or studs mounted anteriorly. Each humeral pad can then be individually adjusted (Figs. 7, 13, 15, 16).

In kyphosis treatment the posterior proximal trim line is carried to mid-scapula level to allow optimal retraction of the shoulders.

Generally the anterior opening design affords a strong posterior and lateral wall combination. Posterior and lateral walls provide necessary room for the migration of tissue involved in curvatures, to the opposite side as well as posteriorly, due to the derotational forces of the pads. Openings are made opposite pads to accomodate the migration of tissue (Fig. 17).

Thickness of pads develops a triangular shaped void of space initially. Viewing

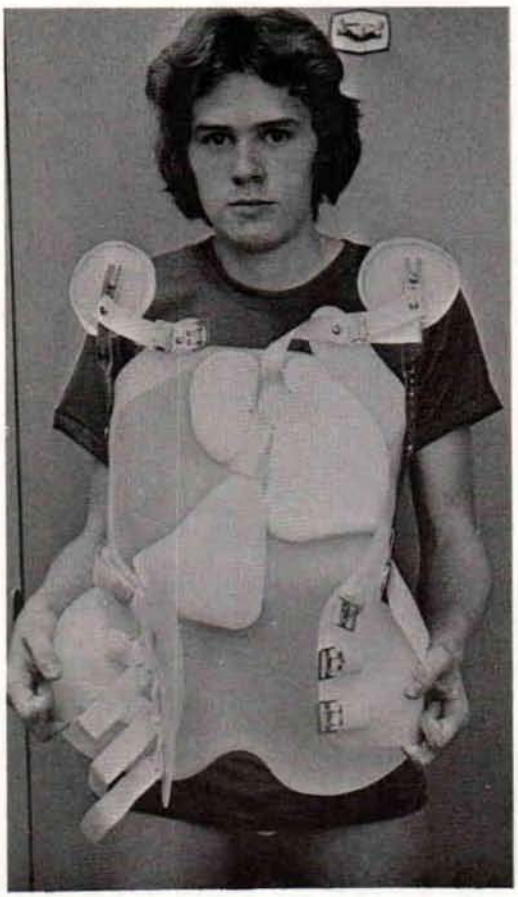

Fig. 13. Anterior view of orthosis to show location of pads.

from the proximal edge into the orthosis, as the patient flexes at shoulder level, this void is apparent. As wearing the orthosis progresses and correction occurs, viewing as above will reveal reduction or elimination of this void of space depending on the degree of correction achieved, (Figs. 11, 12).

The thickness of pads are increased along with strap tightening as curves reduce and bilateral contact occurs at the posterior wall. This pressure can be accomplished by adding material to the pads or heating and depressing the posterior wall in an anterior direction exactly behind the pads, (Figs. 11, 12).

Lordosis associated with scoliosis and kyphosis or lordosis by itself, has been successfully treated by the forces available in the "Low Profile" orthosis. The attitude of the orthosis as earlier discussed, indicates the necessary three point pressure system for correction of lordosis, (Fig. 4).

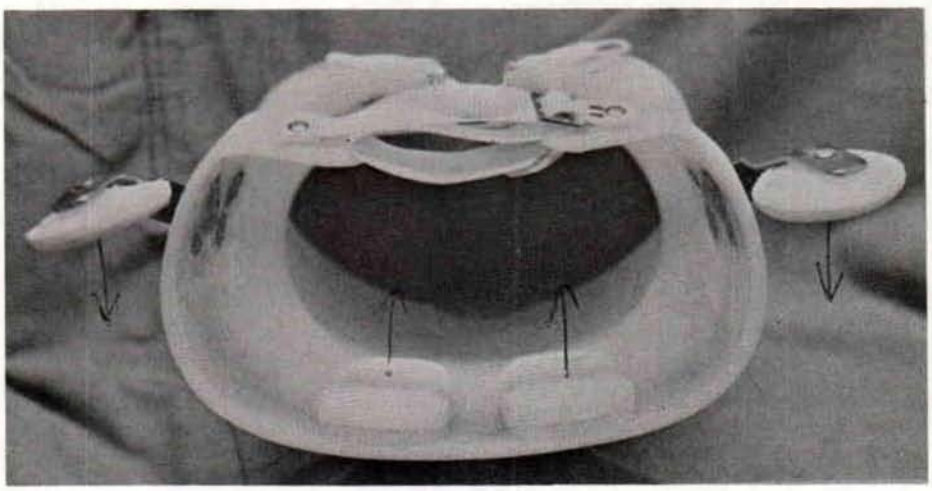

Fig. 14. Top view of orthosis to show location of pads.

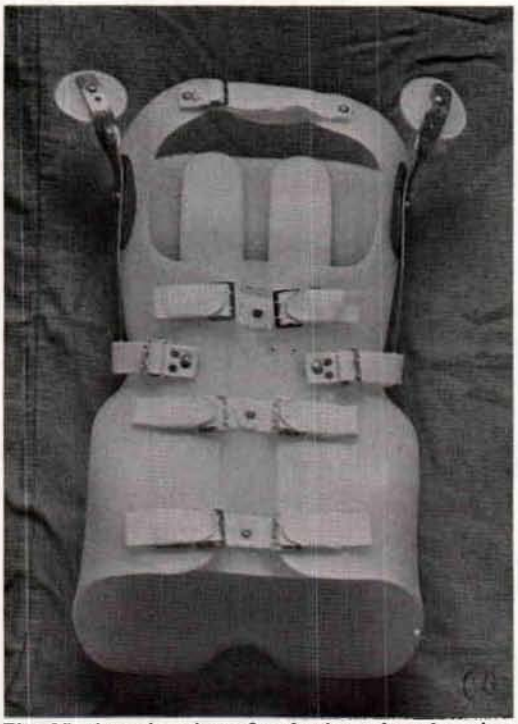

Fig. 15. Anterior view of orthosis to show location of pads at the head of the humerus.

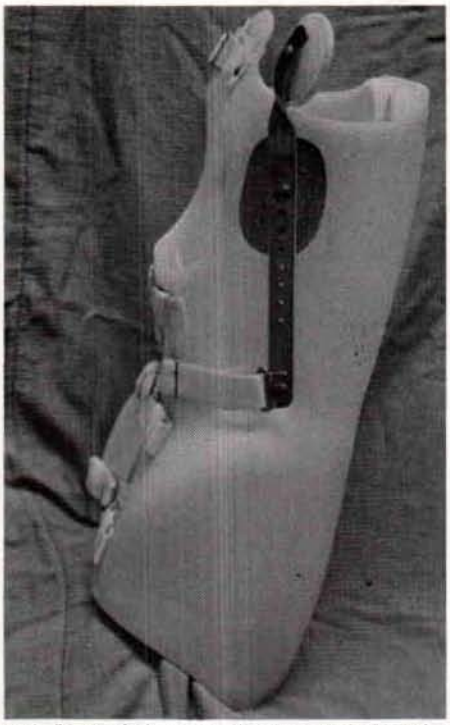

Fig. 16. Lateral view of orthosis to show location of pads at the head of the humerus.

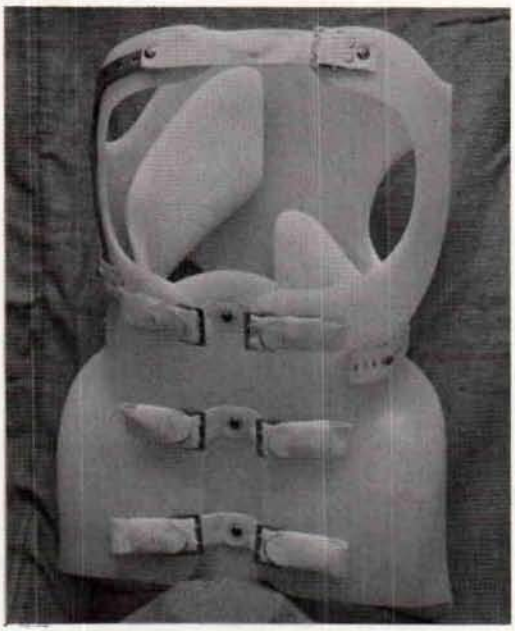

Fig. 17. Anterior view of orthosis showing the openings that are made opposite pads to accommodate for the migration of tissue.

Acknowledgement

I wish to thank Dr. Gordon L. Engler, Chief of Scoliosis Service, University Hospital, New York; Dr. Hugo A. Keim, Chief of Scoliosis Service, Columbia-Presbyterian Hospital, New York; Dr. John Denton, Columbia-Presbyterian Hospital, New York, for their advice and encouragement to develop my concept and designs successfully.

I wish to thank my son, Gary Zamosky, without whose capacity to follow through and develop fabrication techniques in the making of the orthosis, the success of my concept would not have come about.

Footnotes

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