

Bivalved Spinal Orthoses for the Structurally Unstable Spine

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With the advent of plastics, particularly thermoplastics, and plastics technology, plastic molded spinal orthoses are increasingly used in the orthotics management of the structurally unstable spine for nearly all levels of involvement. Depending on the risk factor involved, they may be used in lieu of surgery, i.e. when the patient is not a candidate to undergo surgery for various physiological reasons, or they may be used in the post-surgical management of the structurally unstable spine. Because of the ability of modern plastics to be intimately contoured to the body, they provide for far safer orthotics management, particularly of the cervical spinal region, than conventional orthoses. Often they are a preferred substitute over casts since these bivalved orthoses can be readily removed, either fully or partially, for hygienic reasons and the orthosis can be kept clean much more easily than a cast.

Orthotics Designs

Two types of bivalved spinal orthoses are described below:

- a. Cervico-thoracic orthosis (CTO) with forehead band.
- b. Thoraco-lumbo-sacral orthosis (TLSO).

With slight modifications, various combinations of the above can be designed. The area of injury or surgery usually determines the height and design of the orthosis. The contours of the orthosis aid in maintaining the proper position on the patient. Overlapping edges avoid pinching and allow for some weight gain or loss.

The bivalved opening allows for fast removal in case of cardiac or respiratory problems, situations in which access has to be almost immediate. It is also a comfort to the patient, while lying in bed, that either half of the orthosis can easily be removed for short periods of time to give some relief from pressure and for ventilation.

CTO with forehead band (fig. 1)

The cervical region is the most flexible of the spine. Rotation, flexion/extension, and lateral bending are difficult to control using just a cervical orthosis. Stabilization of the thoracic spine is necessary in order to provide the base, or foundation, for control of the cervical spine and head.

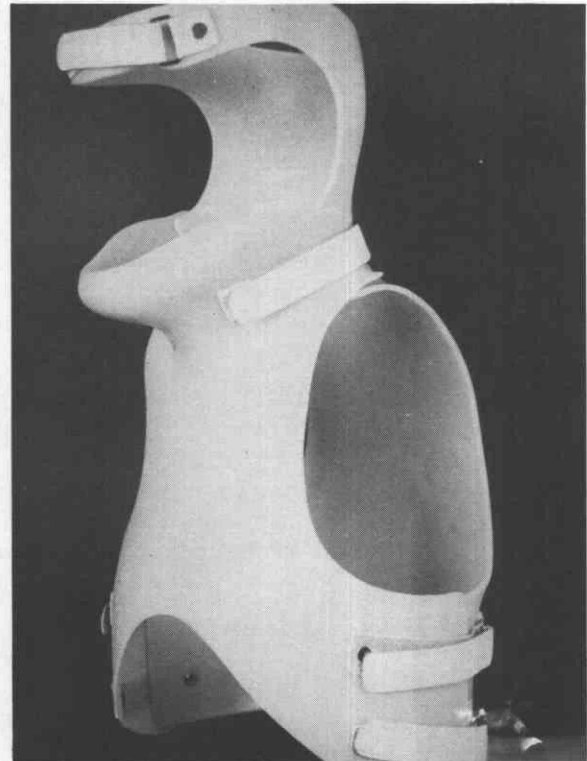


Fig. 1

It is extremely important to appreciate that without proper head control the cervical spine cannot be properly stabilized. Thus, the orthosis must extend posteriorly to cover the occipital area (fig. 2), and anteriorly around the forehead, as well as the mandibular area (fig. 3). Inferiorly, it should be noted that the orthosis covers the entire rib cage, including the floating ribs (fig. 4).

Thoraco-Lumbo-Sacral Orthosis (fig. 5)

Orthotics design for structural instability of the thoracic and lumbar spine requires the formation of a sound base inferiorly. In general, this is identical to the trimline used in the Milwaukee brace, or other orthoses for scoliosis. The superior trimlines depend on the level of involvement, but extend from at least the level of the xyphoid process to the inferior border

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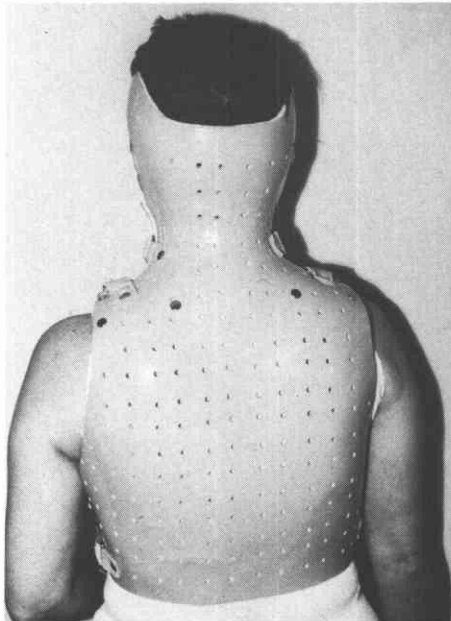


Fig. 2

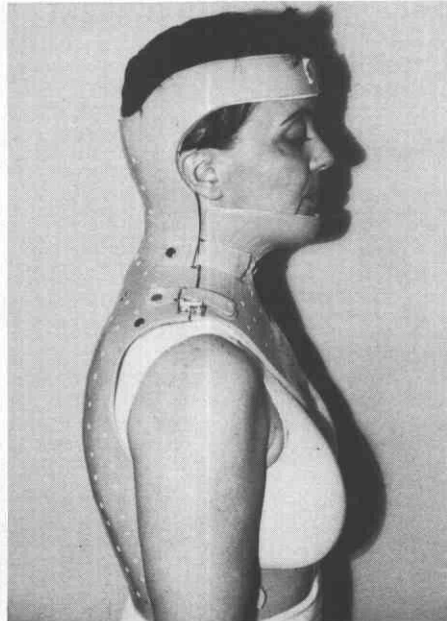


Fig. 3



Fig. 4

of the clavicle (fig. 6). The lateral Velcro® closures are of the cross-diagonal type described earlier by Ekus¹ to minimize relative vertical displacement between the bivalved sections.

Indications

The orthoses described are indicated either in lieu of surgery if the patient is not a surgical candidate for any physiologic reason, or post-surgically to maintain the desired position of the spine, instead of a plaster cast.



Fig. 5

Medical indications are:

1. Fracture and fracture-dislocations, including the odontoid process.
2. Ligamentous rupture or laxity with resultant instability of the spine.
3. Neoplastic disorders with concomitant degeneration of the vertebrae.

Physical indications are:

1. Lightweight.
2. Hygiene, i.e. ability to clean the orthosis.
3. Removability of either portion of the orthosis for patient hygiene and ventilation.

Casting Technique

The casting method requires a Stryker frame. It is essential for accurate casting, and is the safest method for the patient. Body movement is limited to transfer in the supine position from bed to frame and back to bed, if the patient is not already in a Stryker frame and

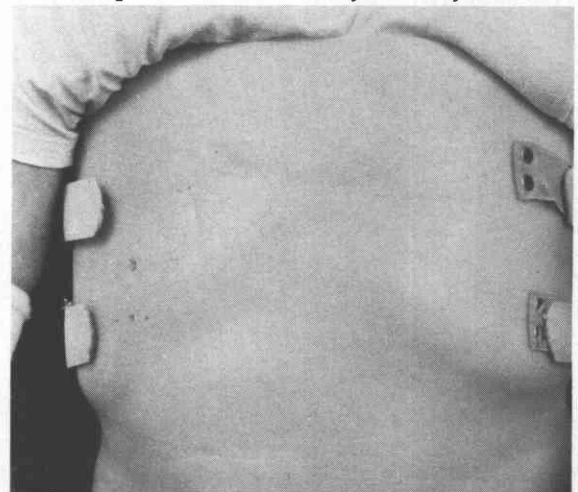


Fig. 6

¹Ekus L., CO, Cross-Diagonal Closure of Pelvic and Spinal Appliances. *Newsletter—Prosthetics and Orthotics Clinic*, Vol. 5, No. 1, 2/1981—Winter/Spring Issue

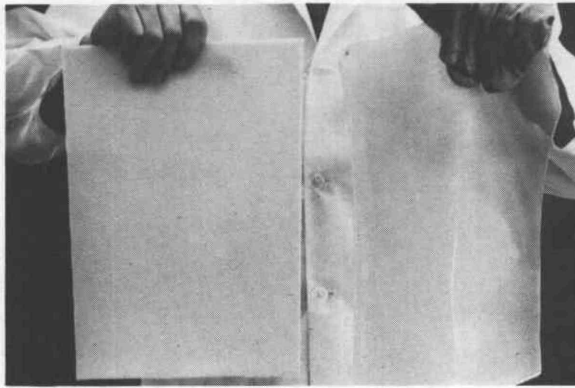


Fig. 7

in skeletal traction. The patient can be turned from a supine to a prone position by turning the frame, which has been locked to prevent body movement. This method has proven to be the fastest, simplest, and cleanest.

With the patient on the Stryker frame in the supine position, bony prominences and areas of relief are marked with an indelible pencil. The patient's anterior half is covered with a separative jelly (K-Y[®], petrolatum), except the hair, which is covered with stockinette for casting for the CTO. Approximately 8-10 layers of plaster splints are applied in alternating vertical and horizontal layers to give the anterior shell added strength. With the patient in the supine position, abdominal pressure (which supports the spinal column internally) is built in at the time of casting.

When the anterior half has hardened sufficiently to support the body without distortion, the patient is turned to the prone position. Again, bony prominences and areas of relief are marked with an indelible pencil on the posterior side which is then covered with a separative jelly. Approximately 4-6 layers of plaster splints are applied in alternating horizontal and vertical layers. The posterior half does not have to be as strong as the anterior half, as the patient will not be lying in it as in the anterior half. All casts are bi-valved with approximately 5 cm. overlap of the posterior half on the anterior half. A separative jelly is spread over the anterior areas to be covered by the posterior overlap. When the posterior half has hardened sufficiently to be removed, the sections will part easily because of the separative jelly under the overlap. They are then put back together with the overlap providing the key for proper position of the anterior and posterior halves.

The cast is then filled and modified. All bony prominences or areas of relief are built up approximately 2 to 3 cm. while in the soft tissue areas, e.g., abdomen, plaster is removed.

Fabrication

While any thermoplastic sheet material may be used for molding the orthosis, at this institution Subortholen[®] is preferred. It is a high strength polyethylene which is not only thermoplastic, but can be cold-formed as well. When heated, it can be drape-molded quite easily, and in a cold state, can be hammered similar to light alloy sheet material (e.g., hammered thin to form a hinge or channeled for

rigidity or relief). Subortholen[®] is available in thicknesses of 1 to 6 mm.

Sheets are cut to the size needed and placed in an oven heated to 150-160 degrees centigrade (350°F). The material is ready for molding when the sheet has lost its pink color and is almost translucent (fig. 7, right). When molding Subortholen[®], a half hour oven dry cast or driest possible cast is recommended. The cast should be covered with stockinette to prevent moisture contact to the Subortholen[®] which, if not done, may cause rapid cooling, bubbling, and an uneven finish on the surface.

The posterior half is molded first to extend approximately 5 cm. beyond the lateral midlines. When cooled, the posterior half is removed and cut to the desired trim lines and placed back on the cast. The anterior half is then molded to overlap the posterior half by approximately 5 cm. After the anterior half is cut to the desired trim lines, the orthosis is ready for fitting.

Special Fitting Considerations

Cervico-Thoracic Orthosis with Forehead Band :

1. Inferior trim line of forehead band should be approximately 1 cm. above the eyebrows.
2. Circumferential pressure adjustability of head band is accomplished by means of a Velcro[®] strap.
3. Mandibular pressure can be controlled by tightness of forehead band.
4. Inferior trim lines need not extend below rib cage, as not to restrict lateral and posterior/anterior motion.
5. Posterior/superior trim line should extend 3-4 cm. above the apex of the occiput.

Thoraco-Lumbo-Sacral Orthosis:

1. The orthosis must be keyed in the soft tissue area between the rib cage and iliac crests to prevent vertical displacement of the orthosis.
2. The anterior inferior aspect must be trimmed to avoid sitting problems and pressure on the pubis. The posterior inferior trimline should allow sitting without the orthosis being pushed up from contact with the chair.
3. Depending on the level of involvement, the anterior superior trimline should extend from a point somewhere between the xyphoid process to a level that follows the course of the inferior border of the clavicles.