A Brace for the Management of Fracture Dislocation of the Cervical Spine: Traction, Immobilization, and Myelography

Technical Note

FREDERICK W. L. KERR, M.D.
Section of Neurosurgery, Mayo Graduate School of Medicine, Rochester, Minnesota

Since damage from transection or severe contusion of the spinal cord in man is irreversible in that regeneration does not occur, it is imperative that every effort should be made to avoid or reduce to an absolute minimum any additional trauma that may readily occur during transportation of patients with fracture dislocation of the cervical spine. It is also necessary to decide as soon as possible whether surgical intervention is indicated. This question is usually resolved on the basis of clinical examination supported by x-rays and myelographic evidence in the case of tumors and other chronic lesions of the spinal cord and its surrounding structures. With fracture dislocations of the cervical spine, the risks and difficulties of performing myelography with the patient in traction are so great that this procedure is rarely carried out, even though there are situations in which this information would be of great value in deciding on the best method of management.

For these reasons, a more adequate method of handling these acute emergencies is necessary. A brace is described here which is simple, practical, and appears to meet all the requirements for management of the acute phase of cervical spine injuries.

**Requirements**

Ideally, such a brace should:

1. Provide secure immobilization with traction of the cervical spine of up to approximately 30 lbs applied via skeletal tongs or halter,
2. Enable the patient to be transported in it with ease and safety,
3. Permit x-ray examination of the cervical spine in the brace without interference in either the anteroposterior or lateral projections,
4. Permit lumbar puncture and myelography without difficulty,
5. Be adjustable to any adult body shape and if possible to older children,
6. Be easy to apply and remove, lightweight, and reasonably comfortable.

**Design**

The brace designed to respond to these requirements is shown in Fig. 1. It is composed of five main parts: a molded plastic pelvic girdle, adjustable shoulder straps, a head plate, four adjustable uprights, and the traction mechanism.*

The pelvic girdle is fashioned out of symmetrical plastic halves molded to fit over the iliac crests and upper buttocks with enough free space anteriorly and posteriorly to avoid overriding in individuals with a small pelvis and adequate room posteriorly to permit lumbar puncture to be performed for myelography. Straps and buckles permit firm comfortable adjustment of the pelvic band. It should be noted that the brace shown in Fig. 1 has now been modified; the pelvic girdle has been trimmed by 1½ in. on each side both anteriorly and posteriorly because in slender individuals overriding did occur.

At the shoulder level, two 2-in. wide soft leather straps which can be slid up and down the uprights and fixed at any level provide a second point of support for the brace. The head plate is a rectangular ¾ inch aluminum plate with two parallel slots measuring 5 in. and 7½ in. respectively. A second smaller plate that carries a grommet rides on top of the head plate and can be fixed in any desired position on the latter by means of wing nuts. This sliding plate permits more or less extension to be applied to the head. Four threaded rods are attached to each corner of the head plate and fitted into the four

* This brace can be obtained from the Stryker Corporation, 420 Alcott Street, Kalamazoo, Michigan 49001.

Received for publication March 21, 1968.
Revision received July 29, 1968.
uprights; these are cylindrical aluminum tubes attached by universal joints to the pelvic bands and by metal sliders fixed to them by wing nuts to the shoulder straps. Thus, the length of the brace can be easily adjusted manually by means of nuts on the threaded rods, which allow a greater or less penetration of the rods.

The traction system consists of a Chatillon gauge graduated from 0 up to 50 lbs. It is attached by means of a slider to one of the uprights and can be fixed in position by means of a knurled hand nut (Fig. 1 left). The requisite degree of traction is delivered by means of a chain (breaking strain 100 lbs) which passes from the Chatillon gauge through the grommet on the corner of the base plate, through the grommet on the sliding plate, and descends to end in a hook that attaches to the traction device (skeletal tong or head harness). A spreader is provided so that, in the event that halter traction is instituted first and skeletal traction later becomes necessary, the temporal area can be exposed for the requisite incisions and skull perforations while the patient is still in halter traction (Fig. 1 right).

**Use**

*Application.* This brace is relatively simple to apply, requiring about 5 minutes. Ample adjustment both for body diameter
and length is available. Little or no discomfort occurs with traction of up to 20 lbs in a halter and none with skeletal traction with Crutchfield or similar tongs. There is no complaint of pressure on the shoulders or hips provided the brace is applied correctly; this is a consequence, at least in part, of the even distribution of pressure at numerous points. However, if the uprights are not securely screwed into the universal joint at the pelvic band level, rotation of shoulder support occurs and will be a source of complaint. The brace applied to a normal volunteer is shown in Fig. 2; 24 lbs of traction is being exerted via a standard leather head halter in this and succeeding illustrations. Walking is virtually unrestricted.

Use in X-ray Procedures. The position of the patient on the x-ray table is shown in Fig. 3. Note that the sliding head plate is in the extension position here, and a small pillow is placed under the forehead. Also note that a sliding ring is provided on each of the posterior uprights for purposes of securing the brace to the x-ray table by means of a cord. All sliding attachments are provided with wing nuts for easy manual adjustment.

X-rays films of the neck, both in the sagittal and the frontal plane, can be obtained without interference of shadows from the brace (Fig. 4). Oblique x-rays can similarly be obtained, although the angle is somewhat limited. One additional advantage is that when traction is applied in this manner, the shoulders are necessarily depressed and the cervical spine lengthened to a near maximum. As a result, the seventh, sometimes the first, and even the second, thoracic vertebra may be clearly seen in the transverse projection. The advantages of being able to make a plain x-ray study while the patient with a suspected cervical fracture remains in constant traction are self-evident.

Myelography. Introduction of a lumbar puncture needle can be readily accomplished since sufficient space is available for adequate preparation of a surgical field. If necessary, the upper buckle and strap may be released to obtain wider exposure. The lack of flexion of the back with the patient in the brace has not as yet presented any problem insofar as performing a lumbar puncture is concerned.

A lateral x-ray view of the cervical spine of a patient with a fracture dislocation of C-6 on C-7 prior to application of the brace is shown in Fig. 4. Neurologically, the patient had a typical anterior spinal cord syndrome with preservation of posterior column sensation only. Myelograms taken with the brace
FIG. 3. Patient in head-down position for myelography; note the cords attached to the table from the posterior uprights to prevent sliding.

FIG. 4. Left: Fracture dislocation of C-6 on C-7; visualization of the upper part of the T-1 vertebra before application of brace. Center: Myelogram performed on same patient in brace with skeletal traction by Crutchfield tongs. Note that the metal uprights are well out of the x-ray field and also the satisfactory visualization of the whole of the T-1 vertebra and the upper anterior margin of T-2. The alignment of the cervical spine is also improved. Right: Anteroposterior view showing good visualization of spine in the same myelogram.
in place in the same patient are shown in Fig. 4 center and right. No interference with the course of the x-ray beam occurs, and the myelogram is in all respects comparable to those obtained under routine circumstances, including excellent visualization of the first and part of the second thoracic vertebrae. There was no evidence of a protruded midline disc or other surgical pathology, the alignment of the vertebrae was satisfactory, and the patient improved progressively with conservative measures.

It should be mentioned that the total time including application of the brace, transportation to the x-ray facility, lumbar puncture, myelography, return to room, removal of brace, and resumption of usual skeletal traction takes approximately 1 hour.

In cases of acute trauma of the cervical spine, particularly when the question arises as to whether a quadriplegia should be treated surgically or conservatively, a myelogram may provide invaluable information. It is well recognized that the Queckenstedt test is not adequate for evaluation of this point. When the question arises as to whether an anterior spinal cord syndrome is due to contusion of the cord, thrombosis of the anterior spinal artery, acute midline protrusion of a cervical disc, or other impingement on the cord, a definitive differential diagnosis cannot be made immediately in the majority of instances, even when the most careful clinical and plain radiological criteria are employed. Yet it is in the early stage of the condition when the best results of any surgical procedure for trauma of the spinal cord can be expected. We have used the brace for myelography in a number of patients with fracture dislocation of the cervical spine and have obtained results comparable to those illustrated in Fig. 4 without difficulty.

Other Potential Uses. Several additional applications of this brace can be suggested; these include immediate immobilization and transportation from the scene of the accident, use in certain instances of acute herniation of a cervical disc, and postoperative use in patients who have had a cervical fusion and require traction immobilization, even though capable of walking.

Immediate immobilization in traction and transportation to the hospital are the recommended emergency handling of any presumed cervical fracture. The extreme seriousness of any additional trauma to the cervical cord in such instances requires no emphasis here, and the difficulties of transporting such patients safely are well known. The brace we have described is reliable and useful for this purpose since patients wearing it can be lifted, transported, and turned from prone to supine position and vice versa with complete safety. With 20 lbs of traction applied, even an uninjured person cannot move his cervical spine in any direction.

Summary

A brace has been described for use in fracture dislocations of the cervical spine. Constant traction of 30 lbs or more can be applied to the head via halter or skeletal devices allowing safe transportation and management of the patient during the acute phase. Unobstructed views of the cervical spine are provided for x-ray purposes, and myelography can be performed with ease and safety.

Acknowledgments

The valuable technical assistance of Mr. Dana Rogers of the Section of Engineering, Mayo Clinic, and of Mr. Ernest Temple of the Rochester Orthopedic Appliance Shop is gratefully acknowledged.