Orthotics and Prosthetics, Vol. 39, No. 3, pp. 21–25.

The Open Brace Ring Halo Orthosis

Karl Fillauer, C.P.O.

INTRODUCTION

Today both the management and orthotic care a patient with a severe cervical injury receives have changed. The recent entrance of orthotists in the management of this area has allowed for improved designs and application techniques. Five years ago orthotists were usually not involved with management of a patient with a severe cervical injury. These patients were treated by traction and bed rest, placed in a plaster Minerva jacket, or had a cervical fusion, and then maybe were fitted with a cervical orthosis.

In the Knoxville, Tennessee area, physicians listed as their main reasons for the limited use of the halo orthosis the inconvenience in procuring the device, and the time and difficulty in applying the orthosis to the patient. They, in general, did not see much advantage in using halo orthoses.

HISTORY

The first halo orthoses were used for the management of massive paralysis of the neck muscles. The halo system consisted of a plaster cast and metal superstructure. Soon the halo system was applied to patients with cervical fractures. In 1972, the "low-profile" halo system was introduced by Loutkin and Levine.[1] Our involvement with a halo system was initiated in 1979, when the staff at Duke University asked if Durr-Fillauer would consider designing a system. The intent was to improve on the currently available designs and make the application easier and less time consuming. The average time required to apply a halo orthosis was 1½ hours. The first halo vest orthosis of the new design was fitted six years ago in Knoxville, Tennessee. The University Hospital had an orthopedic residency program at that time and the physicians were very helpful.

The hospitals in the area all stated that the use of a halo orthosis was very limited and they did not expect many applications. The expectation was not so much to stimulate more work but to obtain experience in the management of cervical injuries. Orthotists have commonly dealt with mild cervical injuries with various designs such as the four poster cervical orthoses, S.O.M.I.® and other similar items, but stayed clear of serious injuries to the cervical spine because they had little to offer the physician.

After several fittings of the prototype versions, the conviction grew that not only could the design be improved, but the orthotist could function as a valuable assistant to the physician during the application. This assistance prompted other physicians to try the halo system because of the availability of the hardware and the technical help. Today five to six Halo vests per month are being supplied in the Knoxville area. This is a dramatic change from five years ago, when there were only two to

three fittings per year. This initial train of development has led to the basic Durr-Fillauer Halo vest, which has been in clinical application for six years now.

DESIGN OBJECTIVES

Working with the basic D-F halo in addition to other designs and noting the drawbacks helped to determine design objectives that would be incorporated into the current open back halo ring. The evolution of this design has occurred over several years. It was noted that most of the patients followed a similar series of events. First, patients are placed in some type of traction. Then, in some cases, they undergo cervical fusion, and finally are placed in a halo orthosis.

One of the first goals was to design a system that could be used for traction and surgery, yet later be integrated with the halo vest. The ring needed to have the posterior section open so that the patient's head would lie on the bed without rocking or loading of the pins from the weight of the head. This configuration would also afford the surgeon maximum access to the posterior structures of the neck and skull. The ability to use either the standard or the spring loaded self-adjusting skull pins was important as well (Figure 1). Another objective was to eliminate all components that were not essential to the structural integrity of the system. It was felt that there were some areas of the halo vest that could be removed without detrimental effects.

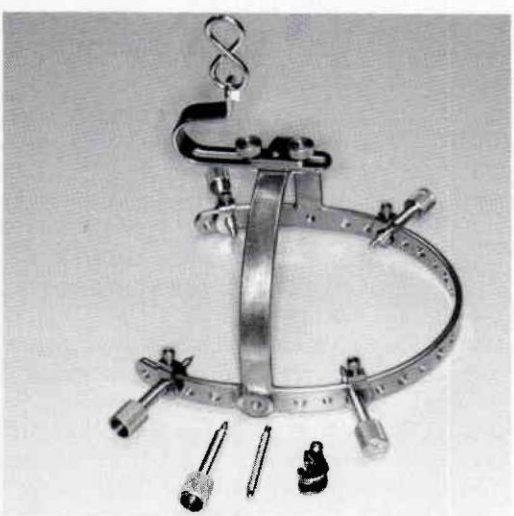

Figure 1.

CURRENT DESIGN

The above work has culminated in the most recent halo system design. The word "system" is used for the components which serve three functions (Figure 2). The first is for traction, in place of the widely used Gardner-Welles tongs. The ring has an over-the-head loop that serves as an attachment point for a traction rope or traction outrigger.

The second use is in surgery for cervical fusion. The patient's head is held firmly in position by the halo ring, which is connected to the surgical table by an adapter. This idea was suggested by a local neurosurgeon who objected to the then current procedure of removing the Gardner-Welles tongs or equivalent, placing the patient in the Mayfield head positioner, and, after surgery, applying a halo. This gave the patient up to nine pin sites and potential scars during the management of his injury.

Third, the system can be used for a halo orthosis as in the original design. The components of the system fall into three categories. These are: the ring, the vest, and the superstructure that connects the ring to the vest. All three component categories come in a range of sizes.* The vests and superstructures are the same as used with the conventional head ring. This allows for the ability to fit all patients from infants to large adults. The youngest patient fit to date was 18 months old, and the oldest was 90 years old.

GENERAL PRINCIPLES

The purpose of a halo orthosis is to stabilize the cervical spine. This is achieved by immobilizing the skull relative to the chest with an orthosis. A rigid metal band

*Available from Durr-Fillauer Medical, Inc., Orthopedic Division, 2710 Amnicola Highway, Chattanooga, Tennessee 37406.

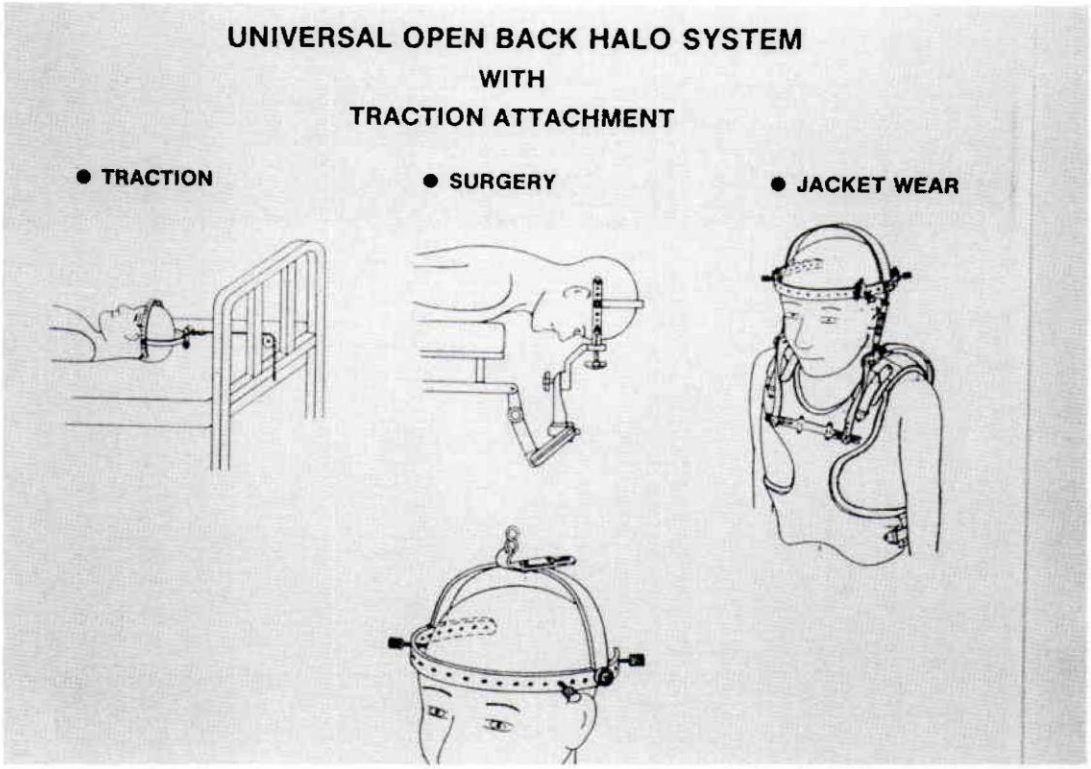

Figure 2.

is held in place by four skull pins and connected to a chest section by two turnbuckles. The advantages of the halo jacket system are:

- Early mobilization of the patient is possible.
- Better pulmonary care is permitted.
- Hospitalization time is shortened.
- Use of the arms is unrestricted.
- Aluminum parts do not interfere with x-rays.
- In case of cardiac arrest, the jacket can be removed quickly.

This new system has been designed to make application as easy and foolproof as possible. However, meticulous attention to detail is still required if good results are to be obtained, and due to the possibility of further injury from inexperienced application of the device, care must be taken to insure proper attachment of the system.

The most recent change to the vest has been the removal of the plastic shoulder sections. In place of the plastic, there is a Velcro® strap that connects the anterior and posterior sections. We have now applied ten halos with the new vest modifications. The reasons for the change are to increase cosmesis and, in some cases, to eliminate lateral pressure on the neck. No problems have resulted from this modification of the vest.

GENERAL APPLICATION TECHNIQUE

The patient may remain in his hospital bed or be transferred to a surgical table for the procedure. The use of a head positioning fixture greatly aids in safety and time reduction (Figure 3). Only two tools are needed to apply the halo orthosis with spring loaded pins. They are a $^{7}/_{16}$" open end wrench and a $^{5}/_{32}$" Allen wrench.

The steps in the procedure are straight forward and easy to follow with the aid of the Durr-Fillauer Halo manual.[2] The man-

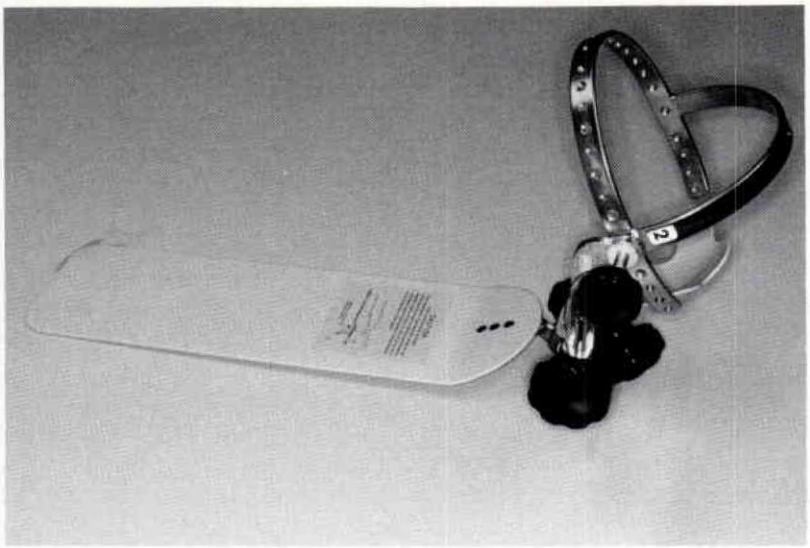

Figure 3.

ual lists all of the available sizes of components to assist in proper selection of components.

The ring and skull pins must be flash sterilized for at least three minutes. The patient must be moved so that his head is free of the mattress and supported by the head positioner. Adjustments are made to position the neck and cervical spine in flexion or extension, as directed by the surgeon. During the procedure of moving the patient forward, the posterior section of the vest is slid into place (Note: the positioning fixture is on the outside of the vest).

Application is routine with the aid of at least three assistants. The physician should hold the patient's head during this step. The ring is positioned by either using the ring positioning attachment (Figure 3) or by someone holding it by the head loop. The ring should be about ½" superior to the eyebrows and should not touch the ears. The doctor prepares the skin in the area of the pin insertion sites. Hair in the area is shaved and Betadine solution is applied prior to the infusion of a local anesthetic, usually Xylocane 1%.

The pins used most frequently are the self adjusting type, which do not require a torque wrench. If the smaller ¼" non self-adjusting pins are used, tighten them to approximately six inch-pounds. The self-adjusting pin set has two spring-loaded pins and two fixed pins. The two "like" types of pins are kept on the same side of the ring, and their position in the ring should be kept symmetrical. The pins are tightened alternately in pairs obliquely on the ring. They are turned together until the small metal rod on the spring-loaded pin protrudes approximately 1mm. When satisfied with the torque, apply a yoke clamp to each pin (Figure 3).

Now the anterior section of the vest is applied, and the four Velcro® straps are fastened. Attach the two over-the-shoulder bars to the vest first by rolling the patient slightly to one side and then the other. The posterior attachment point of the over-the-shoulder bar slides easily into the slot in the horizontal bar attached to the vest. The anterior attachment point is then secured.

The turnbuckles are now installed, which connect the head to the over-the-shoulder bar. When the proper flexion/extension attitude is attained, tighten the four 7/16" nuts, two per turnbuckle. Before sitting the patient, double check the tightness of all screws. It is recommended that an x-ray be taken while the team is still present in case changes in alignment are required.

PRECAUTIONS

Though the system is simple, there are several technical considerations to remember. If the jacket selection is improper, especially too large, adequate good purchase in the chest may not be obtained, and thus excursion of the unit after application may occur. In addition, if the over-the-shoulder bars do not fit properly, the vest antero-posterior diameter may be forced wider or narrower.

Spreading the vest may allow motion, and narrowing the anterior-posterior dimension might cause a pressure sore. A proper fit is obtained when the over-the-shoulder bars just slightly compress the vest. The bars are of malleable aluminum and should be adjusted by hand.

Double check all screws for tightness before leaving, and explain to the patient that there should not be any loose nuts or bolts. If it is decided to place the skull pins laterally, it is recommended that four self-adjusting pins be used. It is possible to create a three point fixation system instead of a four point due to the danger of misjudging the tightness of one of the non-springloaded pins, even though both spring-loaded pins indicate proper compression. Wide placement of the pins is encouraged, but we do apply them laterally very often ourselves.

SUMMARY

In the six months prior to the writing of this article, 40 universal open back ring halo systems have been used. All team members have been pleased with the function and ease of application. Though there are four sizes of rings, the number "two" size seems to fit 90 percent of the patients. It is recommended that all of the various sizes of components be maintained in stock so that the physician can be offered trouble free assistance.

REFERENCES

[1]Houtkin, Sol, and David B. Levine, "The halo yoke," *Journal of Bone and Joint Surgery*, 54-A:4, June 1972, pp. 881–883.

[2]Durr-Fillauer Medical, Inc., "Halo-Jacket System," copyright 1981, Chattanooga, TN 37406.

AUTHOR

Karl Fillauer, C.P.O. is with Fillauer Orthopedic, Inc., 314 Northshore Drive, Knoxville, TN 37919-7595.

ACKNOWLEDGMENTS

Without the cooperation of doctors Robert Madigan, Sid Wallace, Sam Marcy, Robert Harlson, Ed Jefferies, and Robert Finelli, we would not have been able to develop the halo system.