



RICHARD J. BRANSFORD, M.D.

ASSISTANT PROFESSOR
HARBORVIEW MEDICAL CENTER
SPINE

WWW.ORTHOP.WASHINGTON.EDU/FACULTY/BRANSFORD

CARLO BELLABARBA, M.D., AND JENS R. CHAPMAN, M.D.

The Halo: Allowing the Severely Injured Neck to Regenerate Stability Without Surgery

- Cervical fractures and dislocations are common neck injuries.
- We have found that the majority of these injuries can be successfully managed without surgery.
- Halo vest immobilization is the most secure way to stabilize the cervical spine without surgery. In this method a graphite horseshoe-shaped 'halo' is placed around the head and connected to it by pins that engage the skull. This halo is then secured to a vest that fits on the patient's chest.
- 74% of halos placed can remain in place for the planned duration and 85% successfully manage the cervical injury without the need for surgery.
- The major complications associated with halo management are pin tract infections and pin tract loosening.

Halo vest immobilization (HVI) with pins in the skull attached to a chest brace is an effective means for stabilizing the injured cervical spine. However, studies citing high complication rates such as infection, instability, scarring, and unacceptable success rates have called into question its clinical usefulness. The success of HVI for specific fracture types has also been studied, with published success rates ranging from 10% to 40%. At the University of Washington/Harborview Medical Center, faculty spine surgeons conducted a prospective study leading to improved safety and effectiveness of the halo in treating neck injuries. Currently we use state-of-the-art materials and a care map to guide patient management after application of the halo.

Methods

We used HVI to treat 342 patients between 1998 and 2006, the largest series published to date. Our technique used a graphite horseshoe-shaped

Halo-ring secured to the patient's skull with 4 Titanium pins applied in the typical locations (Figure 1). We followed these patients until their halo was removed, recording adverse events such as problems related to the pins, pulmonary problems and skin breakdown related to the vest, swallowing difficulties, deterioration of neurologic function, and complications. Pin tract infections were classified into 3 categories of severity (Table 1). We differentiated HVI failures into the two following categories: 1) Aborted HVI, other intervention undertaken; and 2) Premature HVI discontinuation, no further intervention necessary. Intended duration of HVI was plotted against weeks of HVI treatment in the form of a HVI treatment-survivorship analysis.

Our patients ranged in age from 2 to 94 years with an average age of 41.2 years. 311 of our patients with 445 cervical spine injuries were available for analysis. From this data set we also excluded 22 patients who died

for reasons that were not attributable to HVI. 289 patients with 418 injuries were therefore followed to completion of halo removal and healing of their injury.

Results

No patient had neurological deterioration while being treated with HVI.

There were 113 complications in 100 patients (35% of survivors). The most common complications were pin tract infection (13%, 39/311) and persistent instability (12%, 38/311). 38% (15) of infections could be managed with local care; 56% (22) required pin removal or exchange; and 5% (2) needed surgical debridement and antibiotics. Sixteen other patients (5%) had episodes of pin site loosening without infection.

Twenty-nine of 38 patients were diagnosed with fracture instability an average of 6.6 days (range 1 to 42 days) after halo application, and 9/38 were identified as having subluxation

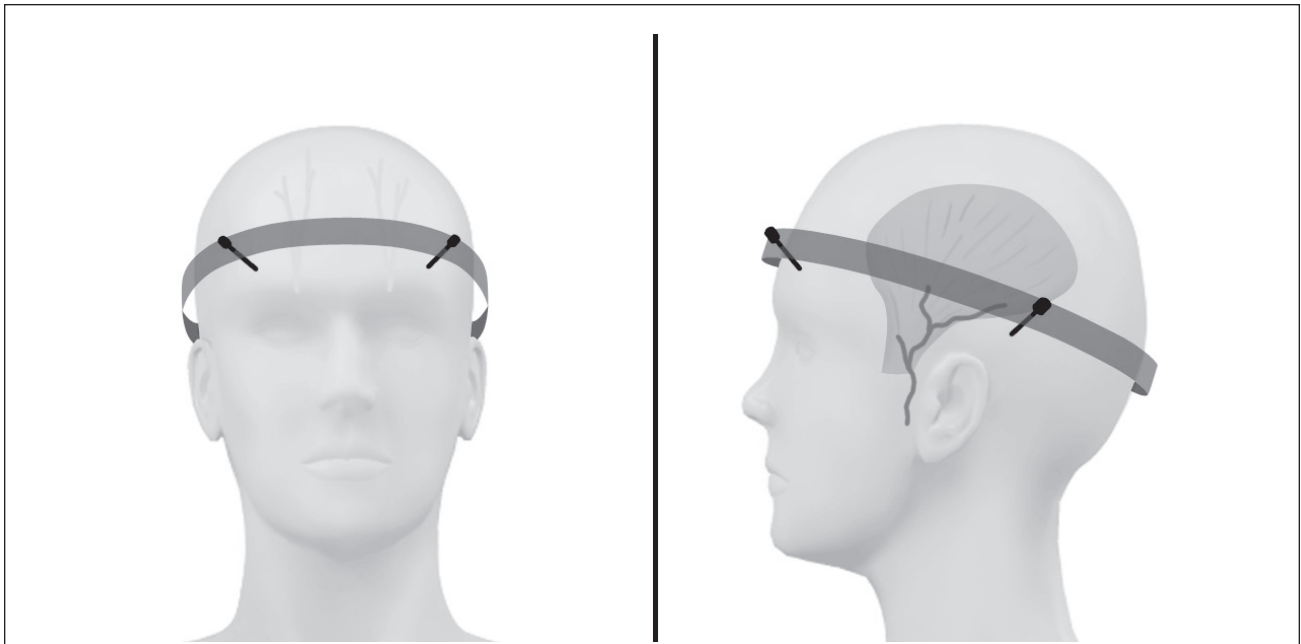


Figure 1: Recommended Halo pin placement. Temporal pins should avoid the frontal sinus and supraorbital nerve medially and the temporal artery and fossa laterally. The posterior pins should avoid the mastoids.

or non-union requiring surgery an average of 101 days (range 84-140 days) after halo application.

Of the 289 patients available for final follow-up, 207 (74%) completed the initially prescribed course of HVI (Figure 2: Survivorship Curve).

Overall 85% (208/247) of patients whose injuries were treated with HVI were successfully treated, without the need for unplanned operative management.

Failure of treatment occurred within the first three weeks in 26 of the 39

(67%) patients who failed definitive HVI. For patients who completed the first three weeks without significant HVI related complications, the likelihood of HVI fulfilling the intended goal increased to 95 percent (208/219).

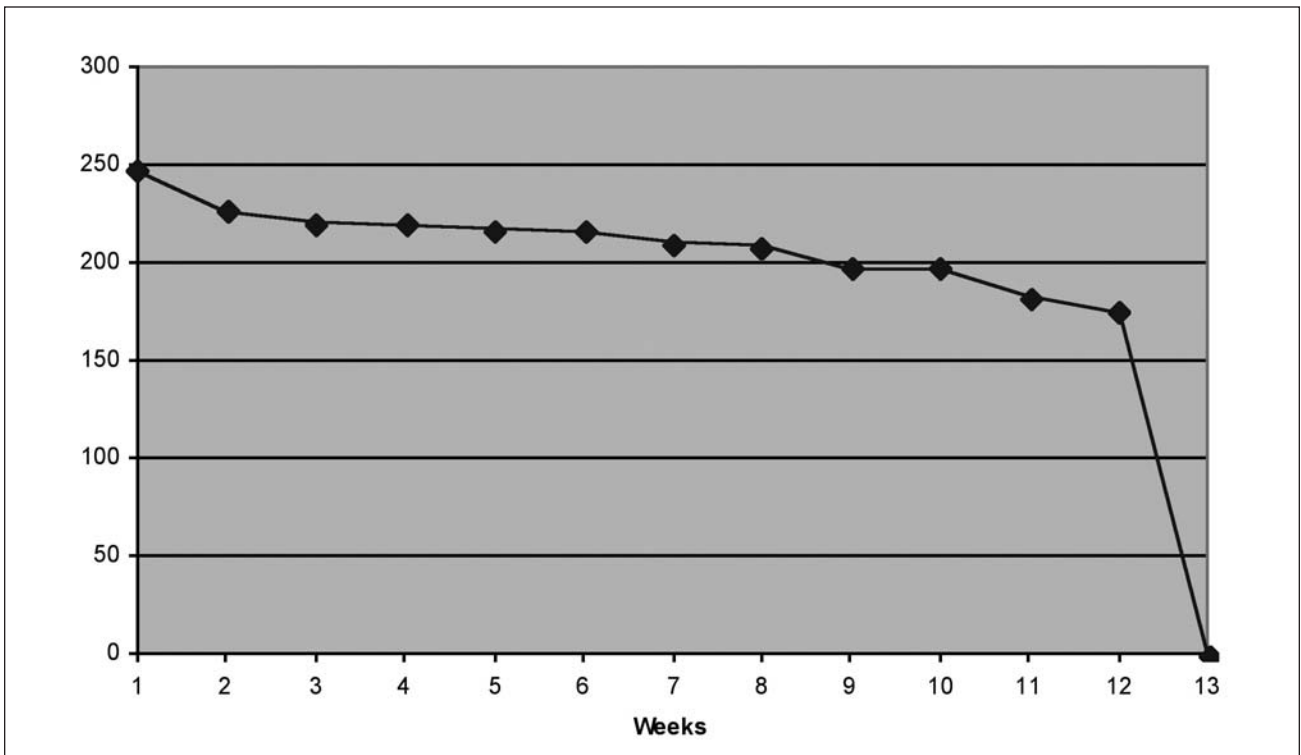


Figure 2: Survivorship Curve: Survivorship curve demonstrating rates of failure of HVI. At point of planned removal, 183 of 247 (74%) still had the halo in place.

Category	Definition	Prevalence (n / percentage)
Class I	Focal irritation or infection, no pin loosening, responsive to local measures, responds to local pin tract care, p.o. antibiotics, retightening of pin	15 (38.4%)
Class II	Pin loosening, productive purulent drainage; requires pin removal and local debridement	22 (56.4%)
Class III	Intracranial abscess, cranio facial abscess, surgical debridement / reconstruction, I.V. antibiotics	2 (5.1%)
	Sum total	39

Table 1: Classification and distribution of pin tract infections.

Discussion

We evaluated the survival of the halo-vest to full completion of the originally prescribed treatment plan, rather than only evaluating failure and complication rates. Using this approach we found that the intended duration of HVI was completed in 74% of patients who had the minimum required follow-up. When considering patients in whom HVI was discontinued earlier than intended but had served as the primary means of external fracture immobilization throughout the course of treatment, the desired clinical outcome of avoiding surgical intervention was achieved in 85% of patients.

Other than pin site infection, the primary complication among our cohort was instability which consisted of approximately one-third of all complications. In fact, failure to maintain acceptable stability of the spine was the leading cause of cessation of HVI. We found no adverse events in the 38 patients who required surgical treatment after HVI had been abandoned secondary to instability.

It is important to note that two-thirds of all failures occurred within the first three weeks of halo application, suggesting that this early phase is critical in determining the likelihood of success. In fact, the likelihood of successful fracture treatment without the need for surgical intervention increased from 85% to 95% in patients who had no adverse incident related to HVI within the first three weeks of treatment. Our finding that no patient suffered any permanent detrimental effects secondary to loss of alignment

during HVI, combined with the observation that most HVI failures declare themselves within the first three weeks of treatment, render a HVI trial in well selected patients appealing as a means of avoiding fusion in situations where the need for operative intervention is uncertain.

Conclusion

The majority of patients were able to complete a full course of HVI without needing surgery. The primary reason for cross-over from HVI to surgical treatment was persistent fracture instability, which usually occurred within the first three weeks of treatment and was not associated with neurological worsening or long-term problems. Complications related to halo treatment are relatively common, but the majority of these can be effectively treated. While halo treatment can be challenging for patients and clinicians, it remains an effective treatment option in the management of cervical spine injuries and one that may be favorable to surgery in certain situations. Implementation of a systematic care program involving clinicians, orthotists and nursing staff along with patient and support education improves the quality of care and the outcome.

Our future research will seek to identify patient and injury characteristics that may be used to predict successful HVI treatment in an effort to enhance its effectiveness and to reduce unnecessary surgery.

Recommended Reading

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