



Occupational Therapy

EFFICACY OF NOVEL THERMOPLASTIC HALO VEST AND THE CLINICAL OUTCOME FOLLOWING ITS USE FOR C4-C5 FRACTURE INJURY: A CASE REPORT.

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ABSTRACT **Background:** More than 60% of spinal injuries involve the cervical spine and the therapeutic options range from conservative treatment including soft neck collars, rigid cervical orthosis and halo-vest immobilization to surgical treatments including anterior screw fixation or posterior screw fixation. Non-surgical treatment with cervical collar or halo-vest immobilization may provide adequate support in type II or type III stable fractures. So, in this case report, we have analyzed pre and postoperative clinical findings of a patient with C4-5 fracture that was treated with novel thermoplastic Halo-vest. A favorable clinical outcomes were observed by greatly improving patient's quality of life and able to join his previous occupation without any modifications.

KEYWORDS : Halo vest, Spinal Injuries, Thermoplastic, QOL

INTRODUCTION

More than 60% of spinal injuries involve the cervical spine and the therapeutic options range from conservative treatment including soft neck collars, rigid cervical orthosis and halo-vest immobilization to surgical treatments including anterior screw fixation or posterior screw fixation. Non-surgical treatment with cervical collar or halo-vest immobilization may provide adequate support in type II or type III stable fractures.^{1,2,3}

A halo-vest is a brace that is used to immobilize and protect the cervical spine and neck after surgery or accident. The halo vest consists of a ring that is placed around the patient's head and attached to a vest worn over the chest, enabling definitive external stability from the skull to the mid-lower cervical spine. It helps prevent further insult to the cervical cord and allows for improved healing of cervical instability. The cervical fractures can heal with conservative treatments such as halo-vest immobilization (HVI) and Minerva jackets without surgery.⁴

The halo vest is considered to be the first choice for conservative treatment of unstable injuries of the upper cervical spine fractures but the pin track problems, accurate fitting of the vest, skin problems or pressure sores and lack of patient compliance lead to clinical failures of this vest.⁵

Also the studies have shown that individuals wearing a halo ring with added weight of a halo orthosis can lead to increased forward head posture, neck muscle fatigue, and compensatory spinal adjustments. Studies have shown that individuals wearing a halo ring or weighted headgear may experience changes in balance, reduced walking speed, and altered gait patterns due to shifts in the center of mass.

Thus, the objective of this study was to examine the clinical outcome with use of the novel thermoplastic Halo vest in C4- C5 fracture.

Patient Information

A 22year-old male is unmarried, educated till 10th standard, housekeeping attendant by occupation and the only earning member of the family. He had alleged history of bike accident and was brought to the emergency department with numbness and difficulty in moving his right upper limb. Also, he was unable to stand and walk without support. He was immediately admitted and investigations were done. His X-rays showed C4-5 burst fracture with mild neurodeficit and the canal was clear, was then shifted to Orthopedic ward for further intervention. There was lot of comminution at fracture site and the need was to maintain the height and prevent antero-posterior translation of vertebrae and hold it in distraction. Thus, Thermoplastic Halo vest was made to hold in distraction and maintain the alignment.

Clinical Findings

Patient had pain in the cervical region, difficulty in moving right upper

limb, difficulty in standing, balancing and walking thus affecting the functional mobility.

Assessment:

- 1) Muscle Power of Right upper limb
- 2) Posture through visual observation method
- 3) **Functional Independence Measure:** The Functional Independence Measure (FIM) scale is a tool used to measure a patient's level of independence in daily activities. It has total 18 items. Score ranges from 18 to 126. Lower the score higher is the dependency.
- 4) **WHOQOL-Bref Scale:** This allows the assessment of each individual's quality of life. It has 4 domains namely the physical health, psychological, social relationship and environmental. It contains 26 questions. Poor quality of life is indicated by scores pointing towards 0 and high quality of life is indicated by scores pointing towards 100.

Intervention

Initially, Orthopedic surgeon had thought of Halo vest of Plaster of Paris which is the traditionally used brace to treat the fracture but it would have been cumbersome for the patient. After, they decided for customized Halo vest which were available commercially, but it was expensive. So, the fracture was treated with novel thermoplastic halo vest brace. The thermoplastic halo vest was fabricated by Occupational therapists and the ring traction unit with extensions was attached to the vest by the Orthopedic surgeons which was given to patient for 24 hours for 3 weeks.

For moulding of the vest, two thermoplastic half sheets were used to ensure correct fitting of the vest on patient's body. As the cervical and upper thoracic spine are to be immobilized so the vest extended from the chest to the groin and had shoulder straps.

The vest was carefully moulded over the iliac crests and over all other bone prominences. The strapping was done with nawar straps and 4 screws (2 anterior and 2 posterior) were fixed on the vest to receive the attachments of extensions from the Halo ring.

The Orthopedic surgeons fixed the ring into the skull using 4 pins: 2 anterior pins (safe zone is a 1 cm region just above the lateral one third of the orbit (eyebrow) at or below the equator of the skull) and 2 posterior pins placed on opposite side of ring from anterior pins.

The extensions from the ring were attached to the screws fixed at the vest.⁶ X rays were taken during the adjustments done to ensure proper fixation of the halo vest. The patient was explained about the follow-up care, proper pin and halo care to minimize the chances of infection (Figure 1).



Figure 1. Novel Thermoplastic Halo vest

Patient Challenges and Recommended Strategies for novel Halo Vest Use.⁷

Challenges in ADL	Recommended Strategies
Sleeping	- Advised to sleep on back or slightly tilted with pillows for support - Use a rolled-up towel under the neck - If lying on the side, place the towel under the cheek
Eating & Drinking	- Due to restricted head movement, swallowing was difficult. Sit upright while eating. - Cut food into small pieces and chew properly.
Bathing	No showers or full baths to prevent pressure damage to skin and brace materials. - Instead, strip washing (with initial assistance).
Dressing	- Wear loose clothing to fit over the brace. Button-up shirts for ease of dressing. Loose pants or shorts for lower body dressing.
Outings & Travel	- Avoid long-distance travel due to discomfort. - Avoid public transport for safety reasons. Strictly prohibited from driving any motor vehicle.
Altered Body Image & Psychological Impact	- Patient felt depressed and socially withdrawn. Counseling to explain the importance of the Halo vest. - Encouraged to communicate with friends & family for emotional support.

Occupational Therapy intervention included strengthening exercises, postural training and ADL Training.

Strengthening exercises for upper and lower limbs were done with use of weighted cuffs. Moving with the added weight of the brace was physically demanding and it made him easily unbalanced standing with wide based support, reduced walking speed, and altered gait patterns due to shifts in the center of mass. So he was given postural training which included:

- Avoid bending at the hip to avoiding being unbalanced and tipped forward.
- Mirror-based postural training with the novel Halo vest to maintain erect posture and avoid trunk flexion.
- Activity levels were increased gradually as endurance and spatial awareness of the brace developed.

Halo vest was removed after 3 weeks and then patient was advised to wear soft cervical collar for next 3 weeks. The patient's muscle power of right upper limb, FIM score and quality of life were assessed at the application of novel thermoplastic Halo vest (Pretest), after 3 weeks of application of novel Halo vest (posttest) and 3 weeks after removal of novel Halo Vest. (follow up test)

Follow-up and Outcomes:

Table 1. Muscle power of right upper limb

Muscle group of right upper limb	Grading at application of brace (Pre test)	Post 3 weeks of application of Halovest (Post test)	3 weeks after removal of Halo Vest (Follow up test)

Shoulder flexors	3+	4	5
Extensors	3+	4	5
Abductors	3+	4	5
Adductors	3+	4	5
Internal Rotators	3+	4	5
External Rotators	3+	4	5
Elbow Flexors	2+	3+	5
Extensors	2+	3+	5
Pronators	2+	3+	5
Supinators	2+	3+	5
Wrist Flexors	2	3	5
Extensors	2	3	5
Ulnar Deviators	2	3	5
Radial Deviators	2	3	5

Table 2. FIM score

	Grading at application of brace (Pretest)	Post 3 weeks of application of Halovest (Posttest)	3 weeks After Removal of Halo Vest (Followup test)
FIM Scores	82	96	120

Table 3. Transformed score of all domains of WHO QOL- BREF.

Domains of WHO QOL- BREF	Grading at application of brace (Pretest)	Post 3 weeks of application of Halovest (Posttest)	3 weeks After Removal of HaloVest (Followup test)
Physical	19	56	94
Psychological	19	44	88
Social Relationship	19	31	56
Environmental	44	56	94

DISCUSSION

The halo vest seems to be the first choice for conservative treatment of unstable injuries of the upper cervical spine, although pin track problems, accurate fitting of the vest, and a lack of patient compliance lead to clinical failures.⁵

Thus, this brace was made of thermoplastic material to ensure accurate fitting of the vest to the patient. It thus prevented the scapular pressure sores which are otherwise caused due to prolonged use of the vest. It also helped in prevention of Kyphosis.⁸

We had used Halo orthoses as it provided a high degree of restriction and immobilization which helps in conservative management of the fracture.⁹

Patient was discharged the next day hence novel halovest reduced his hospital stay as compared to surgical intervention also it is relatively cheaper than surgical intervention. This goes in accordance with the study on role of conservative treatment of cervical spine injuries by Philippe Lauweryns which states that halo brace reduces the hospital stay and is cheaper method of intervention.¹⁰

The motor power of the right upper limb improved with the use of strengthening exercises. (Table.1) Also the activities of daily living and the WHO QOL-BREF scores also improved significantly in all the four domains after the use of novel thermoplastic halovest and Occupational Therapy intervention.(Table.2,3) This is in accordance with a systematic review by Lu Xiaowich reported that training including exercise therapy of the upper limb following cervical spinal cord injury leads to improvements in muscle strength, upper limb function and activity of daily living or quality of life.¹¹

As it was of thermoplastic material, patient used the brace for 3 weeks and had no complications or skin breakdown. This is supported by the study role of conservative treatment of cervical spine injuries by Philippe Lauweryns that use of thermoplastic materials enhances comfort, compliance and prevent complications.¹⁰

The Advantages Of The Thermoplastic Material Used For The Brace Were:

- Adjustments in attachments was easier before fixing the halo traction.
- Less expensive than other commercially available halo vest.
- Easily mouldable so no pressure sores
- Had pores so patient didn't complaint of any itchy skin or irritation

- Loosening of straps of lower part of vest helped the patient cleaning the lower trunk part

CONCLUSION

The C4-5 fracture injury was successfully treated with novel thermoplastic Halo vest with favorable clinical outcomes thereby greatly improving quality of life. The fracture was managed conservatively and the patient was able to join his previous occupation without any modifications.

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