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Abstract

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USE OF THE HALO-PELVIC APPARATUS FOR TREATMENT OF FRACTURE-DISLOCATIONS OF THE THORACIC AND LUMBAR SPINES ACCOMPANIED BY PARAPLEGIA

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Abstract. Twenty-five cases of paraplegia due to fracture-dislocations of the thoracic and lumbar vertebrae were treated using the halo-pelvic apparatus. Thirteen of them only needed the apparatus, two underwent laminectomy, and ten had posterior spinal fusion in addition. The advantages of this method are that gentle reduction can be achieved without severe complications, and that posterior spinal fusion can be performed with this apparatus on, thus enabling an early start to the subsequent exercise program and minimal absence from work.

There are two main methods for the operative treatment of paraplegia following fracture-dislocations of the thoracic and lumbar vertebrae, anterior spinal fusion through thoracotomy (1) and posterior spinal fusion using metal plates (2). These methods, however, increase the stress of operation and present problems related to weakness of fixation, hence neither method is really adequate.

The halo-pelvic apparatus is often used in the treatment of scoliosis (3) and tuberculous kyphosis (4, 5), but there has been no report of its use in Japan for fracture-dislocations of the thoracic and lumbar vertebrae. We have used it in 25 cases and report here the favorable results obtained.

CASE AND RESULTS

Twenty-five cases of paraplegia due to fracture-dislocations of the thoracic and lumbar vertebrae were encountered in the period of two and half years from June 1973 to November 1975. Reduction of these fracture-dislocations of the spine was attempted using the halo-pelvic apparatus. In the 25 cases, there were 22 males and 3 females.

The causes of such injuries were mostly traffic accidents or falls from heights (Table 1). The injured level was mostly located in the thoraco-lumbar junction as shown in Table 2.

With one exception, the time from being injured to having the apparatus applied was less than one week. On the day of admission to hospital, the apparatus is applied immediately. On the following day, traction is commenced

gradually under X-ray control. As soon as satisfactory reduction is obtained, functional training such as standing together with the tilting table (Fig. 1), and wheel-chair exercises are commenced. Application of the apparatus is continued for about 3 months provided there is no loosening of skull and/or pelvic pins.

TABLE 1. CAUSES OF INJURY

Cause	Cases
Fall from height	11
Traffic accident	10
Contusion of the back	4
Total	25

TABLE 2. LEVEL OF THE FRACTURE-DISLOCATION

Level	Cases
T_2 -T_3	2
T_4 -T_5	1
T_8 -T_9	1
T_9 -T_{10}	1
T_{10}-T_{11}	5
T_{11}-T_{12}	7
T_{12}-L_1	2
L_1 -L_2	4
L_2 -L_3	1
L_3 -L_4	1
Total	25

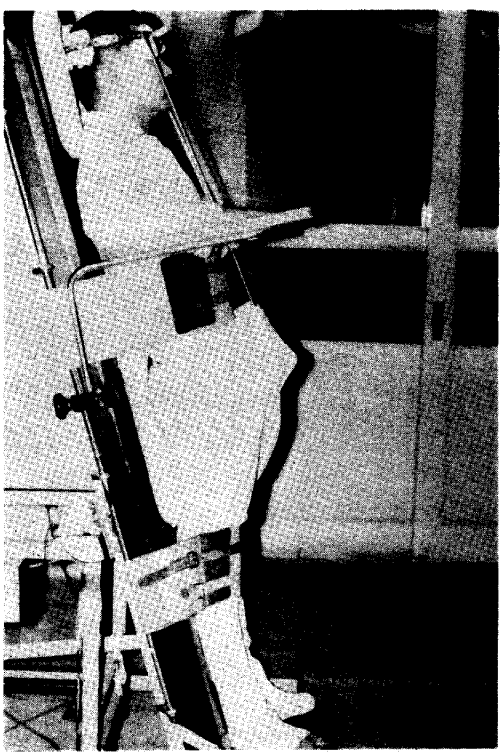

Fig. 1. Halo-pelvic apparatus. The patient is allowed to change position with the apparatus on and to stand together with the tilting table.

Points to check for complication are: 1. Neck pain due to over-traction. 2. Discharge, pain and looseness at the sites of pin insertion. 3. Neurological symptoms: a) the signs of ascending palsy b) abnormalities of the cranial nerves such as double vision, abnormal eye-ball movements (III, IV, VI), disturbances in swallowing (IX, X), inarticulation of pronunciation, hoarseness (IX, X), abnormal movement of the tongue (XII), and disorders of the sense of taste (IX) c) abnormalities of cervical nerves such as numbness and weakness of the shoulders, arms and hands. 4. X-ray checking of the cervical spine: avascular necrosis of the atlas has been reported.

The treatment given is illustrated in Table 3.

TABLE 3. TREATMENT

Method	
Halo-pelvic apparatus only	13
Halo-pelvic apparatus with laminectomy	2
Halo-pelvic apparatus with posterior fusion	10

Two cases, because of fracture of the arch of the vertebra, underwent laminectomies with the apparatus on to alleviate the compression of the spinal cord. Posterior spinal fusion with the halo-pelvic apparatus on was added in ten cases because of aggravation of the angulation of the spine after removal of the apparatus, even though correction had been achieved while in the apparatus.

At present, we perform posterior spinal fusion with bone grafts without plates or wires. This readily results in bone union.

CASE REPORTS

Case 1. A 35-year old male with fracture-dislocation of Th_{11-12}. The halo-pelvic apparatus was applied 7 days after the injury and removed 87 days later. Kyphosis measured by Cobb's method was 28° at the time of injury, 3° after the application of the apparatus, and was corrected sufficiently to 16° ten months later. The 21 mm displacement of the vertebral body improved to 7 mm after the application of this apparatus and, by the time of discharge from hospital, was well reduced to 7 mm. Decubitus healed early after application. The patient was discharged 10 months later with long leg braces and was able to walk by himself with bilateral crutches (Fig. 2).

Case 2. An 18-year old male with fracture-dislocation of Th_{12}-L_1. The halo-pelvic apparatus was applied 4 days after the injury and taken off 89 days later. Angulation of 37° at the time of the injury improved to 15° but worsened to 57° after removal of the apparatus. The 20 mm displacement of the vertebral body at the time of injury was reduced to 14 mm with application of the apparatus and to 13 mm by the time of the discharge. The patient was discharged from

hospital 13 months later with long leg braces and crutches (Fig. 3).

We consider it necessary to perform posterior spinal fusion in cases where angulation worsens after removal of the apparatus. In unstable fracture-dislocations, we perform posterior spinal fusion as early as possible after reduction.

Case 3. A 41-year old male with fracture-dislocation of Th_{9-10}. The halo-pelvic apparatus was applied 7 days after injury, and posterior spinal fusion was performed 7 days after admission to hospital. Although loosening of the head

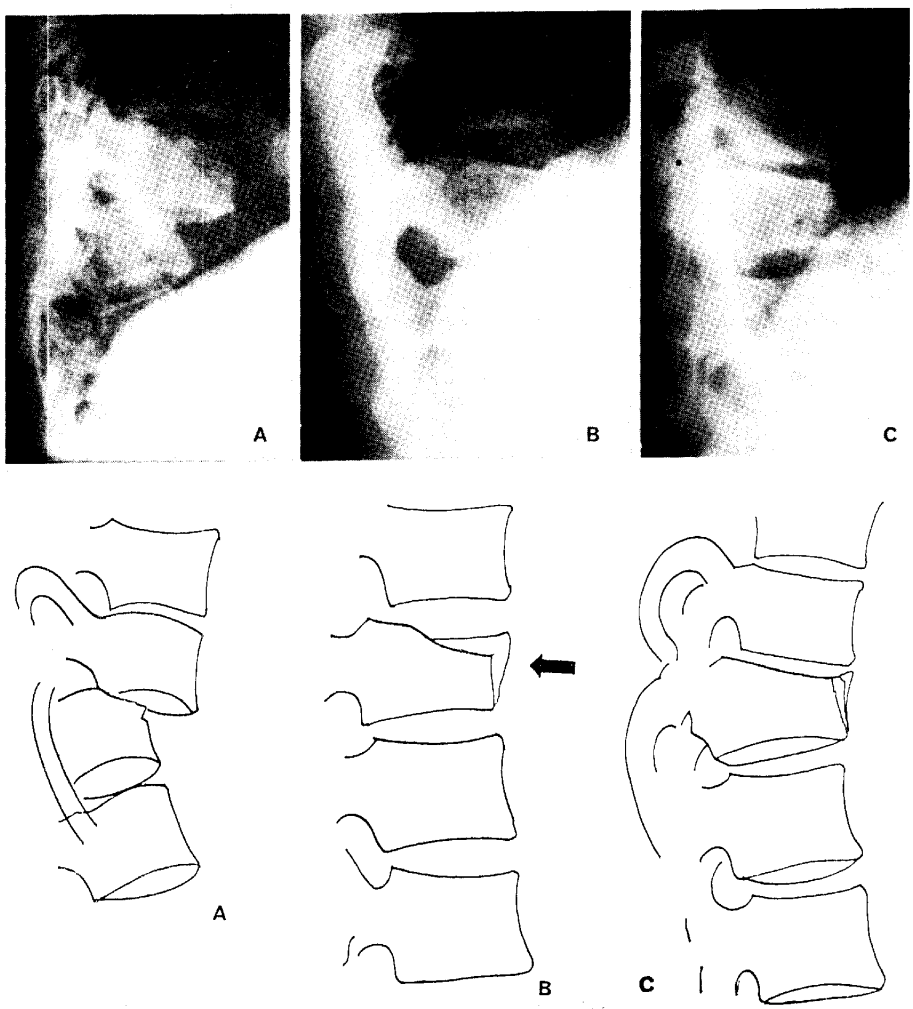

Fig. 2. Case 1. A 35-year old male with fracture-dislocation of Th_{11-12}.
(A) X-ray on the day of admission. Anterior dislocation of Th_{11} and fracture of Th_{12}.
(B) X-ray during application of the halo-pelvic apparatus. Reasonable reduction of the fracture-dislocation. (C) 10 months later.

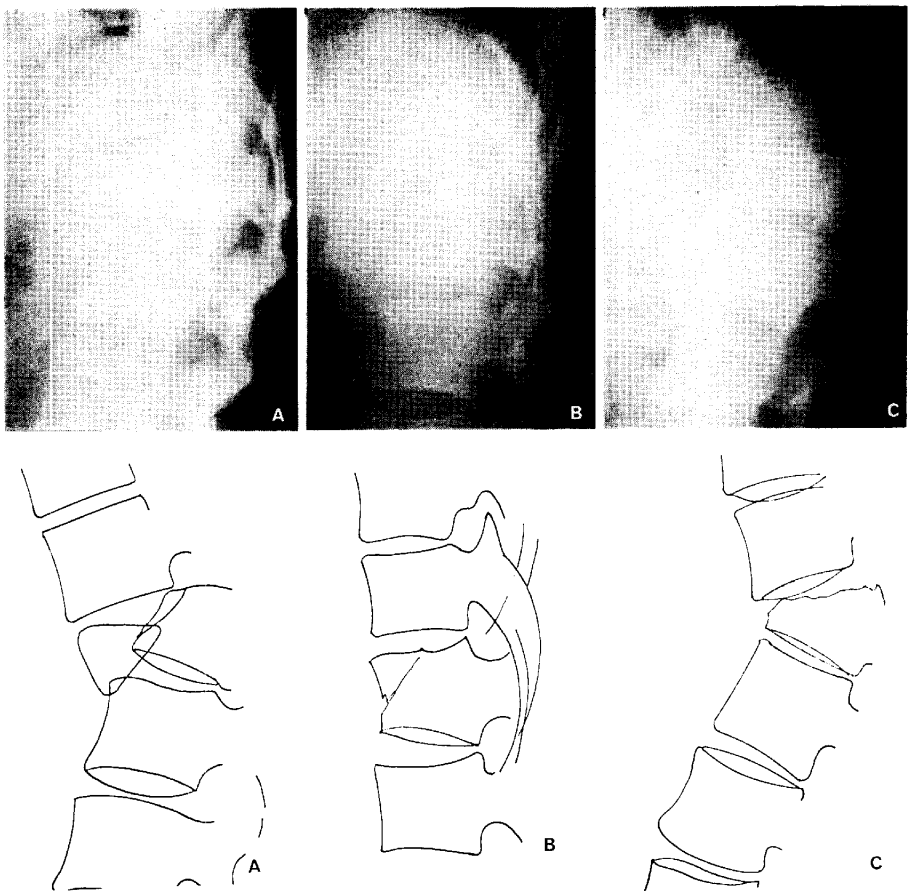

Fig. 3. Case 2. An 18-year old male with fracture-dislocation of Th_{12}-L_1.
(A) X-ray shows anterior dislocation of the vertebral body of Th_{12} and fracture of L_1. (B) Well reduced by halo-pelvic apparatus. (C) Re-dislocation occurred after removal of the apparatus. This case illustrates the need for early posterior spinal fusion.

pins occurred, the apparatus was not removed until 76 days later. Angulation at the time of the injury was 28°, after application of the apparatus 19°, and at the time of discharge from hospital 16°. Displacement of the vertebral body was 14 mm at the time of injury, 4 mm after use of the apparatus and 4 mm at the time of discharge from hospital, indicating reduction to a favorable position. Around the fifth month after the injury, contraction of the muscles of the lower limbs such as quadriceps femoris m. was noticed. The patient was discharged 11 months later with long leg braces and bilateral crutches (Fig. 4).

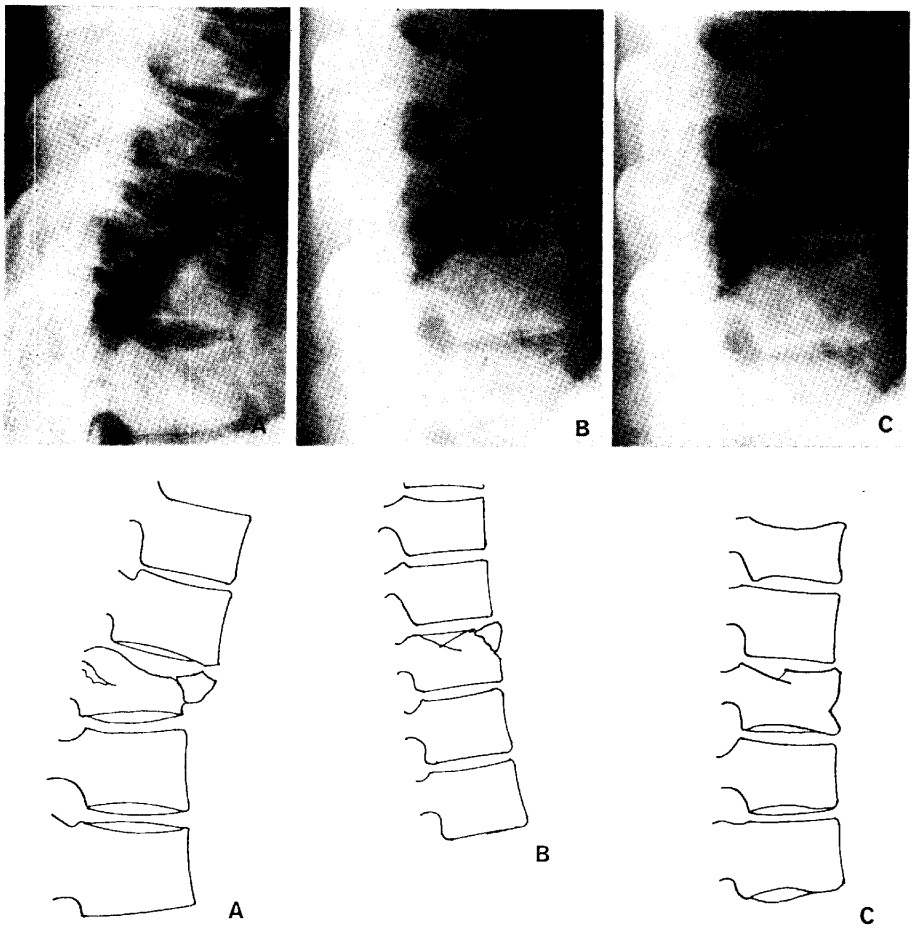

Fig. 4. Case 3. A 41-year old male with fracture-dislocation of Th_{9-10}.
(A) X-ray shows anterior dislocation of Th_9 and fracture of Th_{10} (B) The halo-pelvic apparatus was applied and posterior spinal fusion performed. (C) Good alignment and rigid stability. 11 months later.

DISCUSSION

The halo-apparatus was designed by Perry and Nickel for fracture-dislocation of the cervical spines (6). A pelvic hoop was attached by Dewald and Ray (7) to be applied to scoliosis.

In Hong Kong, Yau *et al.* treated cases of tuberculous kyphosis by halo-pelvic traction (4). Since then various improvements have been made on the apparatus and today various types are in use. In Japan Inoue *et al.* designed the one which is now being used in clinical practice (8).

Posterior spinal fusion with wires or plates originally limited early exercise

and anterior spinal fusion presented the problem of an invasive operation. The use of this apparatus, therefore, now means that reduction and stability can be readily attained.

We used the halo-pelvic apparatus on 25 cases of paraplegia following fracture-dislocations of the thoracic and lumbar spines in attempt to reduce the displacements. The apparatus was applied within one week of the injury, and in most of the cases, satisfactory reductions were attained without any severe complications. In two cases of severe dislocation that were very unstable, re-dislocation occurred after removal of the apparatus. Subsequently, posterior spinal fusion by bone grafting with the halo-pelvic apparatus on was performed and this no longer occurred. There are some who consider the traction of the halo-pelvic apparatus quite dangerous, but actually in cases of fracture-dislocations, as opposed to cases of kyphosis due to the scoliosis and tuberculosis, not only the vertebrae but also the ligaments around them are injured and become unstable so that reduction can be accomplished readily by relatively slight traction. The traction is, however, never attempted under anesthesia, but is done with the patient awake while paying attention to the degree of palsy, neck pain, weakness and numbness of the upper extremities. The traction is gradually increased under X-ray control and, up to date, no serious complications have occurred.

Reduction and fixation from the anterior side through thoracotomy or reduction and fixation from the posterior cannot, because of the operative procedures and operative invasion, be recommended in cases where no recovery is expected. If the alignment achieved by traction is acceptable, decompression can be attained to a certain degree. We can operate easily from the posterior side by mere removal of the posterior rod. Resection of the bone cortex of lamina, articular process and spinous process with an air-drill, insertion of bone slices followed by H-type bone graft, then replacement of the rod apparatus enables rigid bony union even if early exercises are allowed.

Early exercise following plate fixation frequently results in angulation again so rest in bed for long periods of time is necessary. This means delay in starting exercises and also presents the problem of complications such as decubitus ulceration. The present method has brought an end to such problems. In most of the cases, early exercise has meant the ability to walk with long leg braces on using bilateral crutches within 6 months. In less than one year after discharge from hospital, most are carrying on their usual life style.

CONCLUSION

In applying the halo-pelvic apparatus to 25 cases of paraplegia due to fracture-dislocations of the thoracic and lumbar spines, we have found the following advantages: (a) No decubitus ulceration. (b) Dislocation and fracture can

be readily reduced. (c) Because of good stability of the fractured portion, changes in the position in bed can be performed easily. (d) Severe dislocation and fracture with the possibility of angulation after removal of the apparatus can be treated by posterior spinal fusion with the apparatus on and by bone grafting alone without the use of wires and plates. (e) Exercises can be started early.

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