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EARLY TREATMENT OF TRAUMATIC PARAPLEGIA AND TETRAPLEGIA BY A NEW METHOD, USING A 'ROLLING PLASTER JACKET' OR A 'ROCKING PLASTER SHELL'

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I WOULD like to introduce our method of early treatment for spinal injuries. Our method is conservative, and consists of using a 'rocking plaster shell' or a 'rolling

FIG. 1

plaster jacket', which has been routinely applied to 47 cases in our Clinic since 1965. As it is well known, plaster casts for paraplegics are not usually recommended, because of fear of causing bed-sores and weakening of the back muscles.

However, at our Clinic this method has been proved to be safe as well as easy, and our concept is also supported by theoretical and experimental evidences. In Japan, economical conditions in the medical field are still rather poor and the

nurse-patient ratio is 1:4 at present. Even under such unfavourable conditions, we were able to prevent bed-sores with retention of the strength of the back muscles, and successful rehabilitation of the patients was accomplished.

All the results presented here are facts obtained by our method. It consists of three stages: first aid, critical term management, and long-term management.

1. First Aid

Injuries to the spinal cord must be handled most carefully from the beginning, because skeletal protection should be carefully maintained to prevent further damage to the spinal cord due to fracture of the vertebrae.

For this purpose we devised a special stretcher, a rocking stretcher, for transporting victims (fig. 1). We can transfer a patient in a supine position on this stretcher, since it is equipped with a supporting device to keep the fractured spine immobile and a rocking device to prevent localized pressure contacts.

We safely transported all of 14 cases at an average distance of 72 kilometres, ranging from 3 to 202 kilometres.

2. Critical Term Management

The first two weeks after the injury are the most critical period, because spinal cord injuries, especially at the cervical level, are often accompanied by serious complications, such as hyperpyrexia, asphyxia and shock, and these complications may endanger the life of the victims.

In this period, we treat the patient on a rocking-tilting bed, which can be elevated electrically to either side to an angle of 45 degrees and tilted 70 degrees from the horizontal position. For the cases with spinal cord injuries in cervical or high dorsal region, skull traction tongs are applied and a weight of a few kilograms is added to the traction. The injured parts can be maintained immobile by a traction apparatus attached to the bed, even when the patient is turned around (fig. 2).

For the cases with injuries in the lower dorsal and lumbar region, a soft pillow is placed under the back so that the spine can be maintained in a hyperextended position. The patient is closely observed on this bed until his general condition is improved.

In a series of 19 early cases of traumatic tetraplegia treated by this method, no single case became complicated by hyperpyrexia or decubitus ulcers.

3. Long-term Management

A long period of nursing care is needed for healing vertebral fractures. During this period, it is most important to keep the injured spine immobile as well as to prevent complications such as decubitus ulcers or urinary infections. It is our view that in the treatment of traumatic paraplegia securing immobilisation of the injured spine in good alignment should be compatible with prevention of these complications.

Immobilisation of the injured spine is essential for turning the patient around safely and for early initiation of physical exercise. Moreover, restoration of stability of the spine in good alignment is of vital importance for the future activity of paraplegics.

Reduction of the injured spine is achieved by gentle traction. A weight of a few kilograms or more may be added to the skull traction to reduce cervical

FIG. 2

FIG. 3

FIG. 4
Before correction. After correction. Twenty-seven months after.

FIG. 5

injuries. Compression fracture with a slight dislocation in the dorsal or lumbar spine can be reduced without any danger by a simple suspension method with the patient in a supine position (fig. 3). However, in the case of traumatic lesions with marked displacement or with locked facets, the patient should be subjected to a heavy craniocaudal skeletal traction with the weight being gradually increased to approximately 30 kilograms until reduction to a proper condition is achieved (fig. 4). If reduction cannot be obtained with this weight, operative reduction will be indicated.

Anyway, the reduced position of the injured spine is maintained by plaster fixation. We found that plastering can be applied rather easily and safely, using a rocking plaster shell (fig. 5), that is, a plaster shell equipped with a couple of half bicycle-wheel rims at its back or a rolling plaster jacket, that is, a plaster jacket

TABLE I
ENERGY REQUIRED TO TURN THE PATIENT

With Wheel Rim	Without Wheel Rim
Kinetic Energy: $E_k = \frac{1}{2} w^2 = \frac{M a^2}{2} w^2$ = 81 Kg·m	$E_k = \frac{1}{2} w^2 = \frac{a^2 + b^2}{6} M w^2$ = 156 Kg·m
Potencial Energy: $E_p = 0$	$E_p = Mg \left(\frac{a}{2} - \frac{b}{2} \right)$ = 2940 Kg·m
Sum ---- 81 Kg·m	: 3096 Kg·m ≈ 1 : 40

equipped with a pair of bicycle-wheel rims at its upper and lower end. The bicycle-wheel rim is readily available in Japan.

For long-term management, the rocking plaster shell is applied to patients with injuries of the cervical cord, and the rolling plaster jacket is used on those patients with injuries below the cervical cord. In this method, a bicycle wheel is used for easy rotation of the patient. As indicated in Table I, the energy required to turn the patient over by this method was approximately one-fortieth of that required when the wheel was not used. In practice, the patients were turned over at least twice hourly either by themselves or by a single nurse, and none of the patients developed decubitus ulcers.

Naturally, our method of plastering has some inherent disadvantages which are not unique to our method. However, we would like to emphasise again that development of bed-sores is definitely prevented by our method.

Management of a paralysed bladder is one of the most important problems in the treatment, particularly with regard to the patient's life expectation. We insert

a special balloon catheter into the bladder as soon as the patient is placed on a hospital bed, the penis being taped to the abdomen. This catheter has a by-pass tube so that the bladder can be continuously irrigated with 0.5 per cent. hibitane solution. The main tube of the catheter is connected to a two-way closed system by a Y-tube. The tube from the bladder is clamped off every three or four hours, when the bladder is gradually filled to a volume of 300 to 400 cc. of sterilised urine. Clamping off the tube can be performed by the patient himself, when a certain sensation of filling the bladder occurs to him. The catheter is changed once a week with aseptic precautions. The regime mentioned above can be performed safely with a rocking plaster shell or a rolling plaster jacket, affording a considerable saving of hands of doctors in charge. A good storage capacity in the bladder is maintained, the recovery of reflex activity in the muscular wall is facilitated and urinary complications are prevented.

FIG. 6

EXERCISE

Both tetraplegics or paraplegics need sufficient exercise for strengthening the muscular power in the unaffected parts of the body. The patient will depend on these muscles in later active life. The patient in the rocking plaster shell or in the rolling plaster jacket is transferred to an electrically controlled standing bed and given a programme of intensive physical exercise. This includes rocking or rolling, push-ups or pull-ups, and weight lifting, as well as standing exercise (fig. 6). Through this physical exercise we expect the same effects upon the trunk muscles as those achieved by Böhler's method of treatment for spinal fractures without involvement of the cord.

Assisted exercise and massage are routinely applied over the paralysed extremities to prevent development of stiffness and deformities in those areas. Pulleys

and ropes attached to the rolling apparatus for the paralysed legs are favourably used by the patient in a rolling plaster jacket for this purpose.

The patients treated by these methods develop an ability to walk with or without appliances within three or four months. Then the patients are transferred to a rehabilitation centre for further training.

RESULTS

Forty-seven cases of spinal cord injuries have been treated by the methods described in this report. Of these, 21 cases had a lesion of the cervical cord, 19 had dorsal and lumbar cord injuries, and in 7 cases the cauda equina was affected. None of 40 cases which were seen within an average of 48 hours after the injury were complicated by decubitus ulcers (Table II) or marked urinary complications

TABLE II
Results

Level of lesion	No. of cases	Incidence of complications	
		Bed-sores (cases)	Urinary infection (cases)
Cervical . . .	19	0	4 (slight)
Dorso-lumbar	16	0	5 (slight)
Cauda equina .	5	0	2 (slight)

such as infection and calculus formations. However, in only 4 out of 40 cases, small scratch wounds were developed in the gluteal region as the result of a heavy physical training in the rolling plaster jacket. The wounds were not of the nature of bed-sores and were healed within one week. Moreover, it should be noted that seven old cases with large long-standing bed-sores were successfully treated by a rocking plaster shell and all of the sores were cured very rapidly.

The affected spines were restored to a good alignment with stability. Calculating the amount of dislocation and the wedge deformity of the injured spine from the formula given in Table III, the residual dislocation was 4.6 per cent. of the normal alignment on the average, ranging from 0 to 13.1 per cent., and the residual wedge deformity was 9.7 per cent. of normal vertebrae on the average, ranging from 5.0 to 30.8 per cent.

The neurological status of the patients were carefully examined over long periods and the degrees of recovery from paralysis were calculated from Table IV. Among 19 patients with a post-traumatic course of over 10 months, neurological recovery was 46.7 per cent. in sensory function and 59.4 per cent. in motor function. Cases of injury to the cervical cord showed the best recovery (average

71.5 per cent.), and those of trauma to the cauda equina showed considerable improvement (average 51.9 per cent.), whereas the poorest recovery (average 19.6 per cent.) was recorded among cases with dorsal and lumbar cord injuries.

Spontaneous micturition began in 46.6 days on the average, ranging from three days to five months after the injury.

The results mentioned in this report are in no way inferior to those obtained by some other methods.

TABLE III

Rate of Dislocation

$$= \frac{L'}{L} \times 100$$

Rate of Wedge Deformity

$$= \frac{a-b}{a} \times 100$$

TABLE IV

Recovery Rate

$$\text{Rate} = \frac{\text{Total after} - \text{Total before}}{\begin{matrix} \text{Sensory } 3 \\ \cdot \\ \cdot \\ \cdot \\ \text{Motor } 5 \end{matrix} \times \text{Segments}} \times 100$$

Standard of evaluation:

Sensation	Marks	Muscle power	Marks
Normal	3	Normal	5
Hyperesthesia	2	Good	4
		Fair	3
Hypoesthesia	1	Poor	2
		Trace	1
Anesthesia	0	Zero	0

CONCLUSIONS

A new method for the early treatment of spinal cord injuries is reported here. A rocking plaster shell or a rolling plaster jacket is used to immobilise the injured spine and to prevent complications while encouraging physical exercise. The technique of the treatment is simple and safe, and the results obtained are excellent.