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Spinal problems in myelomeningocele-orthotic principles

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Spinal curvatures associated with myelomeningocele represent complex problems which, if not recognized early, determine the future ambulatory status of the patient.

In recognizing the importance of functional spinal alignment, it is mandatory to supervise closely a child from infancy and to institute early protective care (Bunch *et al.*, 1972).

Spinal problems are not necessarily evident at birth. Sharrard (1972) reported that 75 per cent of the myelomeningocele patients examined at birth showed no spinal abnormality. An earlier study conducted at Newington Children's Hospital (Raycroft and Curtis, 1972) reported comparable findings. It is of interest that in this study 79 per cent of the 130 patients involved had bony defects limited to the posterior elements. More than 50 per cent of this group developed spinal curvature due to muscle imbalance and deformation inviting positioning by the age of five years, and almost 100 per cent by the age of ten years.

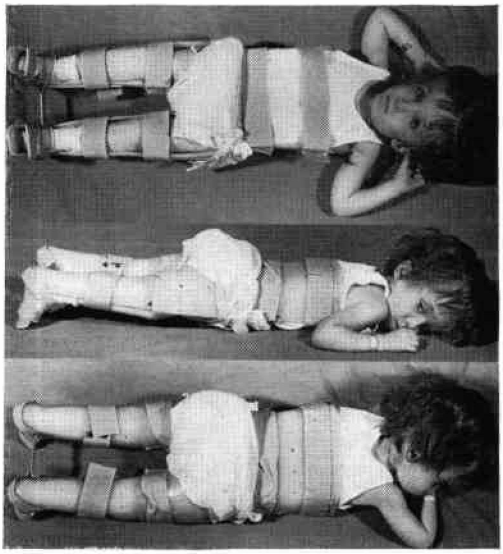

Fig. 1. Patient wearing body-control orthosis. *Upper*, anterior view; *centre*, lateral view; *bottom*, posterior view.

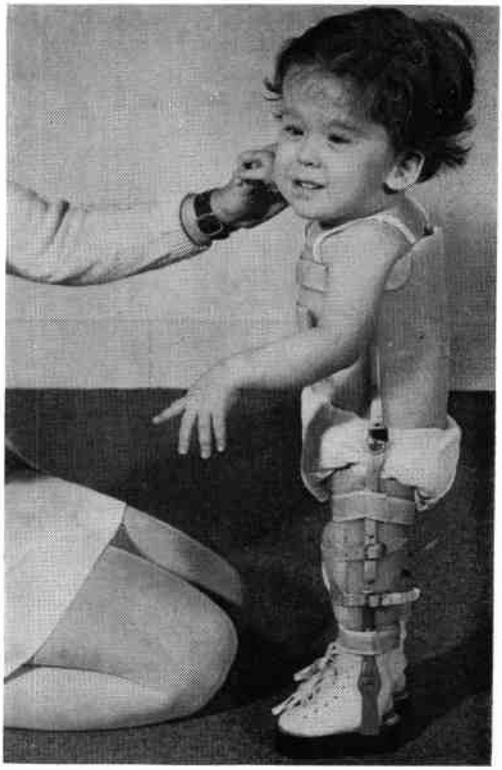

Fig. 2. Preparatory orthosis: lateral view.

A concept of early treatment of these patients, developed at Newington Children's Hospital, has diminished not only spinal curvatures but also problems of hips, knees, and feet (Curtis, 1973).

Principles of Early Orthotic Management

Birth to head control—head control. Myelomeningocele patients should be referred to centres providing the benefits of a specialty

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Fig. 3. Thoracic distraction orthosis—kyphotic patient: *left*, anterior view; *right*, lateral view.

team once the lesion is closed, renal and urological tract abnormalities are identified, and early care is initiated.

A body-control orthosis (Fig. 1), was developed (Paul, 1972) which functions as a preventive, supportive, and corrective device. This orthosis provides 15 to 20 degrees of hip abduction for diaper care. Low posterior scar areas are not included in the shell; higher locations of lesion should be relieved within the splint. The shell is made of Vitrathene (Paul, 1970), a polythene plastic, and extends proximally as far as possible without restriction of arm motion. It has a snug over-all fit and includes the lower limbs with knees extended and ankles placed at 90 degrees of dorsiflexion. Special attention must be given to possible pressure areas. The parents need to be cognizant of the splinting purpose and difficulties which can develop in periods of rapid growth.

Sitting—upright stability. The body control or positional type of plinting is maintained until the child has reached the intermittent periods of wanting to sit and stand.

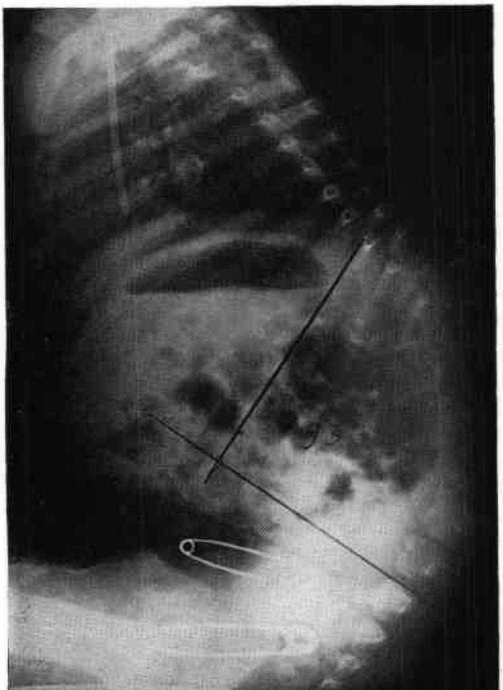

Fig. 4. X-ray of patient sitting unsupported: curve 93 degrees.

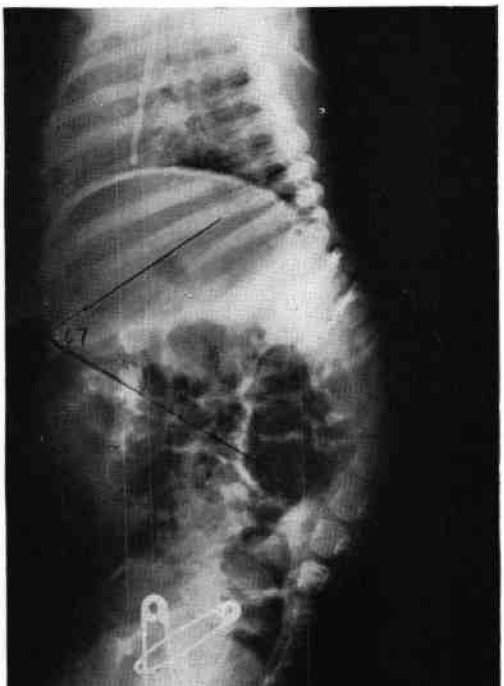

Fig. 5. X-ray: traction reduced curve to 67 degrees.

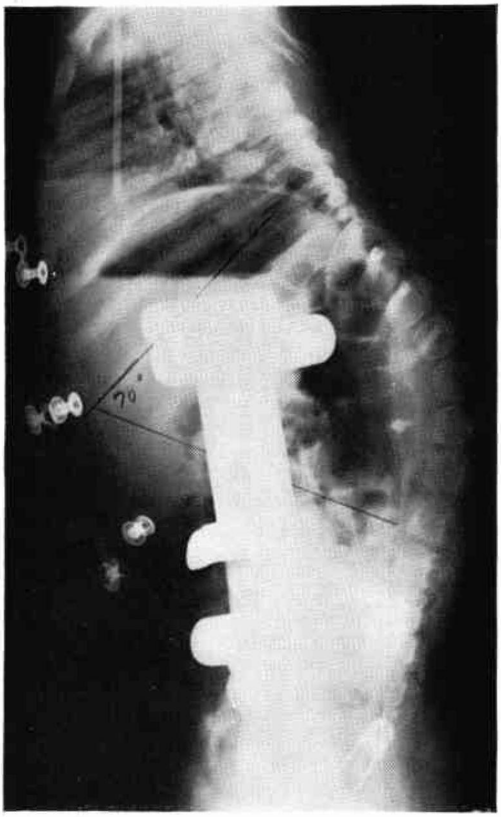

Fig. 6. X-ray of patient standing: thoracic distraction orthosis maintains 70-degree curve.

The original design of the orthosis is now modified to incorporate detachable surgical pre-walker shoes and simple hinges (Fig. 2) at the hip. This splint is now identified as a preparatory device. It is at this age also that bony malformations require surgical correction. Early removal of atypical bodies and segmental fusion have proven successful (Curtis, 1972). These patients were identified at the time of the Newington study as "congenital" cases. They constituted 21 per cent of the Newington study and 25 per cent of Sharrard's.

An additional innovation was introduced when thoracic distraction was recognized as a correcting force in the early treatment of kyphotic, scoliotic, and lordotic curves (Paul, 1973).

The spinal segment of the Newington preparatory orthosis was contoured so that the lower rib cage was exposed to forces through undercuts (Figs. 3a and 3b). Distraction was achieved by raising the splint and so avoiding

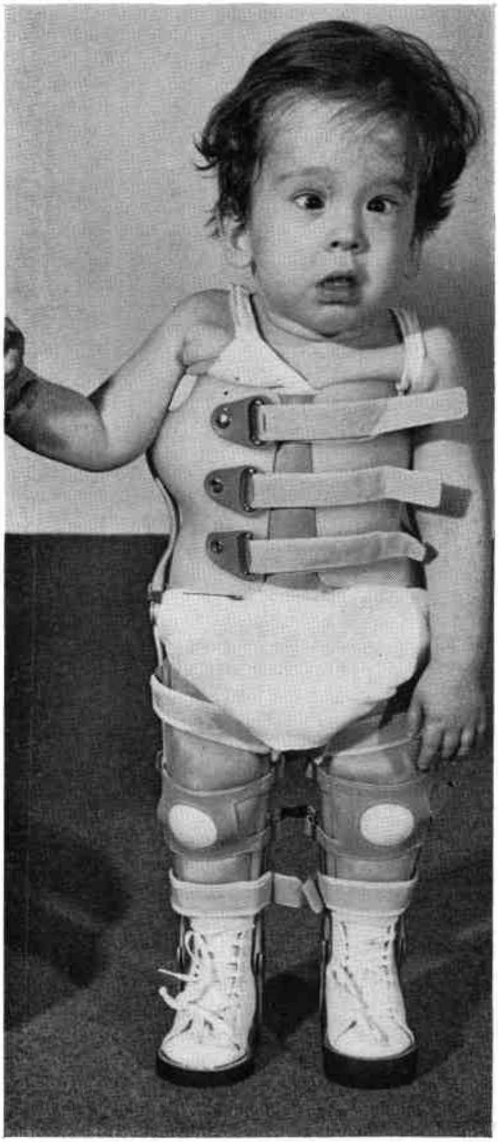

Fig. 7. Patient with severe spinal anomalies wearing thoracic distraction orthosis: anterior view.

total heel contact by approximately 4.5 to 6 mm. The correction obtained (Figs. 4, 5, and 6) was dramatic. Another case is illustrated in Figures 7 to 10.

The patient should return to the clinic every four to six weeks. At that time, fit and function of the device should be evaluated.

In the presence of pronounced bony processes, it was found advantageous to mould plastic foam with the thermoplastic to provide

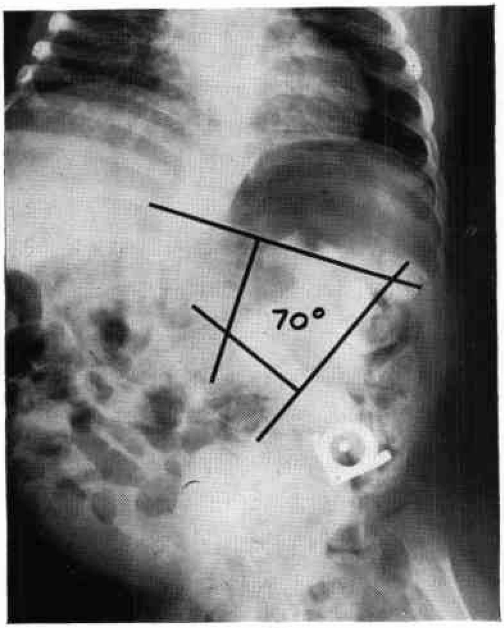

Fig. 8. X-ray of patient sitting unsupported: curve 70 degrees.

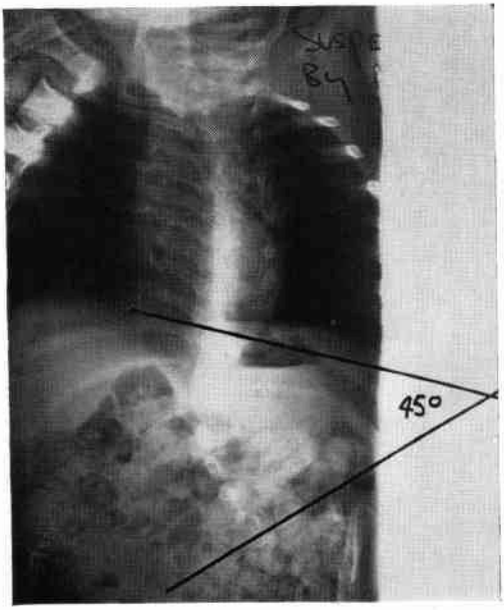

Fig. 9. X-ray of patient: curve reduced to 45 degrees by axillary suspension.

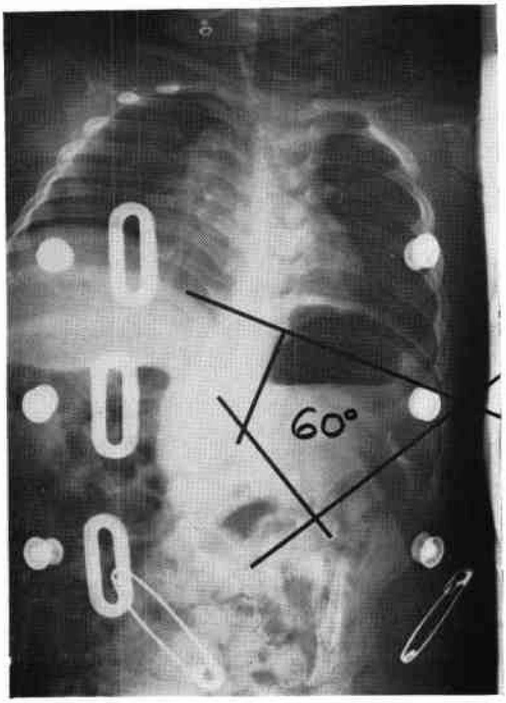

Fig. 10. X-ray of patient standing, wearing thoracic distraction orthosis.

Fig. 11. Patient sitting unsupported.

Fig. 12. Application of thoracic distraction orthosis.

Fig. 13. Patient sitting, wheelchair-suspended. Note clearance.

an interface material. Such interfacing functions as a cushion and absorbs friction (Figs. 11 and 12).

The encouraging results of initial application resulted in making the thoracic component detachable and interchangeable with wheelchair suspension (Figs. 13 and 14). The patient, now able to sit and stand, benefits from the supportive and corrective features of this relatively new concept of treatment (Fig. 15). No contra-indications were evident. Pulmonary testing demonstrated improved pulmonary function rather than restricted, as seen in other spinal total-contact orthoses.

Upright stability—upright mobility. During early childhood, the patient with spinal problems attempts to become ambulatory. The preparatory orthosis is utilized as an early testing mechanism to determine ambulation potential. The child progresses to a definitive ambulatory device or is identified as a young wheelchair user. The patient with a non-critical spinal curvature is placed in a total-contact spinal orthosis as a separate unit from the lower-limb orthosis (Paul, 1971), (Figs. 16a, 16b, 16c and 16d). This is not the case in patients requiring a thoracic distraction orthosis. In those cases, the lower-limb orthosis is utilized as a floor-contact mechanism and, therefore, attached to the spinal orthosis.

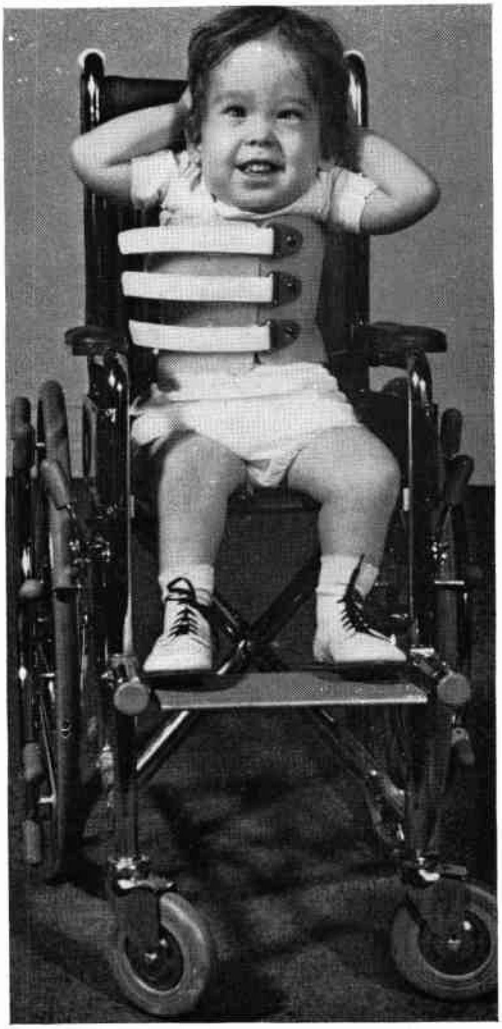

Fig. 14. Patient sitting: anterior view.

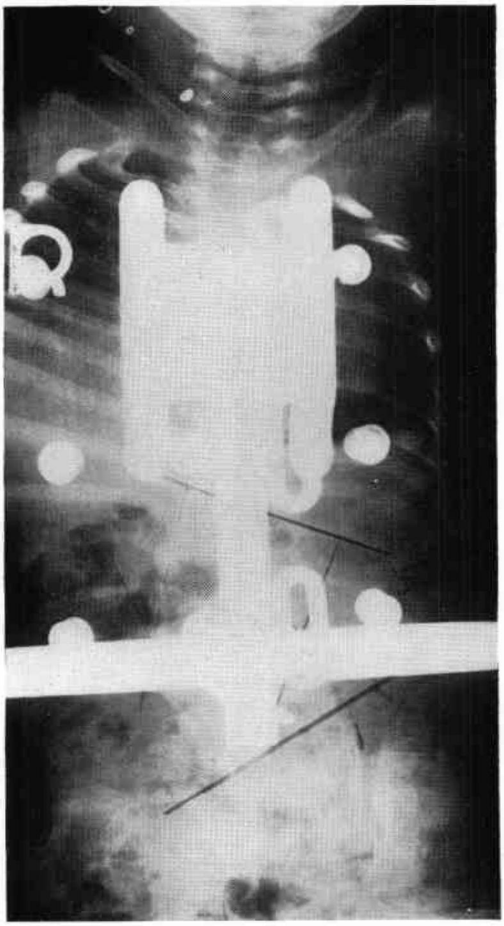

Fig. 15. X-ray of patient in thoracic distraction orthosis: anterior view.

The formative years of the myelomeningocele patient bear all the typical phases of psychological conflict that confront a paraplegic patient. The patient with spinal problems, however, needs to be better prepared for this period of life. It is now that a compromising body height has been reached and spinal-stabilization surgery, such as Harrington instrumentation or Dwyer procedure, can be performed. Surgery of such magnitude requires protective body casting and, thereafter, a total-contact spinal orthosis to be worn until the fusion can be considered mature (Paul, 1971). Spinal problems of the adolescent myelomeningocele patient, if treated from infancy, should not vary from other paraplegic curves.

Developmental years are also decisive for the ambulatory status of these patients. Obesity and indifference, complicated by effects of extensive hospitalization and varying degrees of mental incompetence, create the breaking point where the patient either continues as an effective functional ambulator or is resigned to household ambulation or wheelchair use (Curtis *et al.*, 1972). If, for reasons beyond the control of the clinic team, a patient does not benefit from preventive, supportive, or corrective care, certain alternative procedures are suggested.

Figure 17 illustrates an untreated myelomeningocele patient, aged 17, with sacral agenesis and fixed-flexion deformities of the lower limbs. This patient now functions in a wheelchair with a seating device.

The second patient, diagnosed as having uncorrectable deformities of both lower limbs

Fig. 16a. Patient wearing total contact spinal orthosis and definitive lower-limb orthosis.

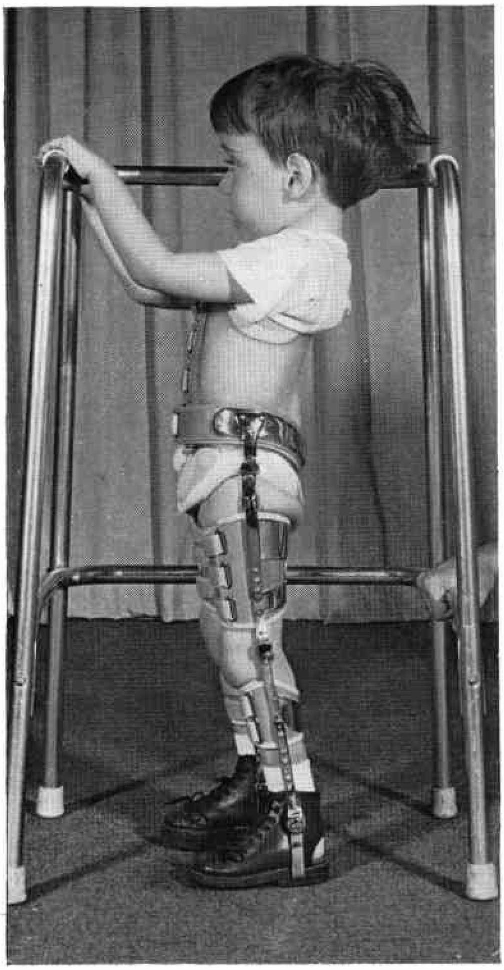

Fig. 16b. Same patient, lateral view.

Fig. 16c. Patient sitting unsupported.

and spinal deformities (Figs. 18a to 18d), required bilateral subtrochanteric amputation and fusion of the lower spine. He now ambulates in a bilateral, modified, Canadian-type hip-disarticulation orthosis (Fig. 18e). The prosthetic socket features spinal distraction and the scoliosis has not increased. This patient, capable of all activities of daily living, attends a regular school.

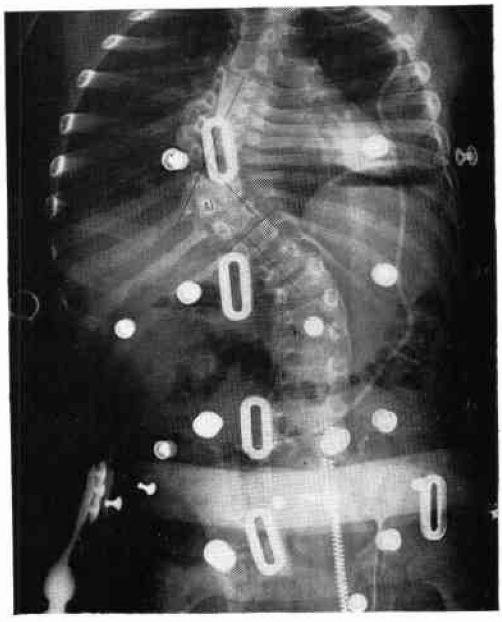

Fig. 16d. Patient standing with total-contact spinal orthosis applied.

Summary

The concept of treating spinal problems in myelomeningocele during childhood is discussed. An "orthotic" approach is identified not only as a supportive and corrective system

Fig. 17. Patient in seating device, lateral view.

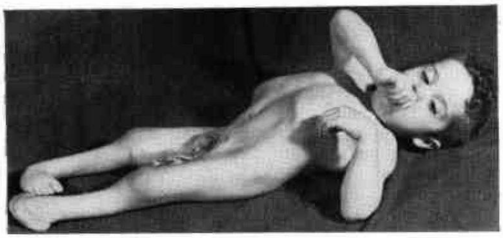

Fig. 18a. Severely deformed patient.

but as a preventive one. The primary objectives are to maintain functional positioning of the spine and, in those cases of spinal anomalies resulting in severe deformity, to maintain the body positioning until surgical procedures can be performed.

The methods discussed are also utilized as methods of postoperative care which have proven most beneficial, particularly in cases of incontinency. The various orthotic devices described represent an effective approach, not only to spinal control in the myelomeningocele, but to any paralytic conditions resulting in spinal curves. In particular, the thoracic distraction orthosis, utilized either as a wheelchair or lower-limb orthosis-connected device, has resulted in the prevention of deformity and the restoration of pulmonary control. The severely deformed patient was able to use a wheelchair effectively and was better able to perform routine daily activities.

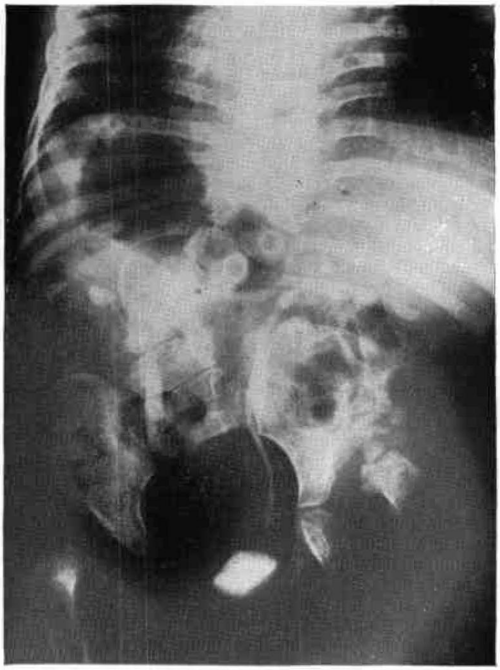

Fig. 18b. Same patient, preoperative X-ray.

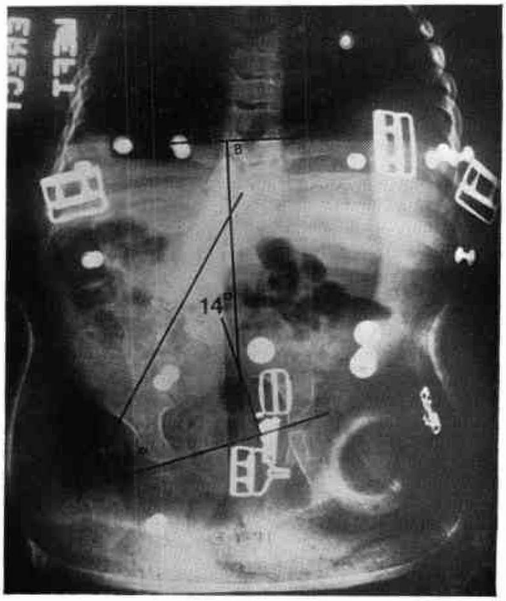

Fig. 18c. Same patient, postoperative X-ray.

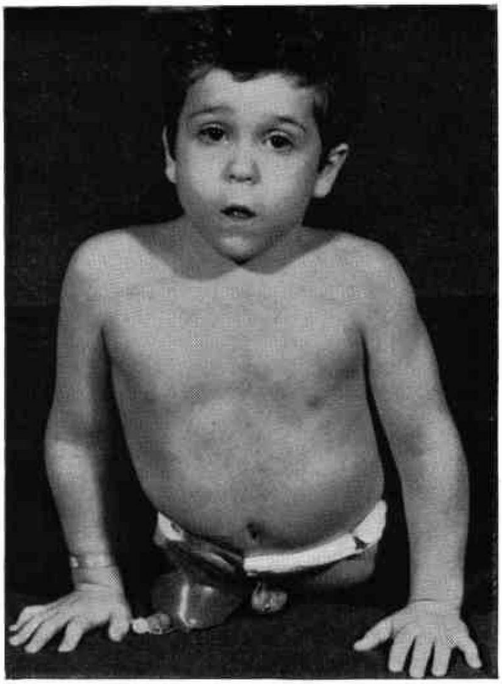

Fig. 18d. Patient sitting, postoperative.

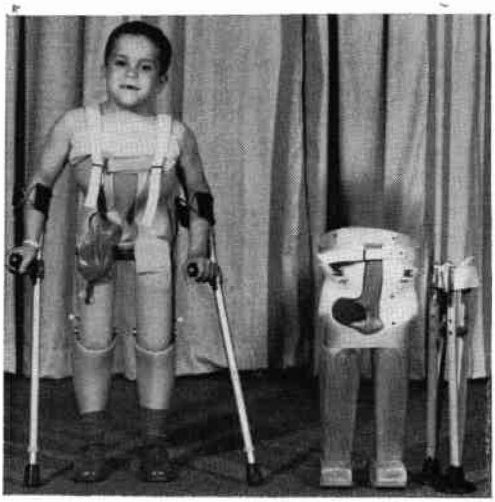

Fig. 18e. Patient standing in permanent prosthesis, training prosthesis shown on right.

Prophylactic application of the principles of treatment described will diminish the problematic spinal deformities which, in the past, frequently resulted in hopeless situations.

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