A CLINICAL REVIEW OF THE ORTHOTIC TREATMENT OF MYELOMENINGOCELE PATIENTS

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High myelomeningocele lesions do not preclude an acceptable level of functional walking provided that an integrated programme of surgical treatment and bracing is adopted. Clinical analysis of 100 patients with myelomeningocele shows that the development of the “swivel walker” and “hip guidance orthosis” has been associated with an improved level of function. Over 30 per cent of patients with thoracic lesions and 68 per cent of those with lumbar lesions achieved independent walking. For this reason the criteria used at present by paediatricians to govern the selection of infants for non-active treatment may require reconsideration.

A major problem in the treatment of patients with myelomeningocele is the provision of independent walking, which has physiological and psychological advantages. It helps in the prevention of lower limb fractures, and improves urinary drainage, bowel function and limb circulation (Carroll 1974; Menelaus 1980; Rose 1980), and it should not be abandoned lightly. The anticipated lack of this function, with other factors, may cause the paediatrician and neurosurgeon to suggest that nursing care only is required for badly affected babies (Merrill et al. 1962; McKinlay 1979).

An ability to take a few exhausting steps should not be dignified with the status of “acceptable walking capacity” (Rose, Stallard and Sankaran 1981). Functional walking requires three features: 1) low energy expenditure while walking at a reasonable speed (30 to 60 per cent of the normal speed for the same age); 2) the ability to get in and out of a chair; and 3) independence in applying and removing orthoses.

There are many factors which determine whether these criteria can be achieved, the most important being the anatomical level of the neurological defect. Other physical factors include spinal and limb deformities, coordination, intelligence and renal abnormalities. The environment and family support also play a great part in determining the eventual function. Another important factor is the provision of effective bracing for the legs and, for higher spinal lesions, for the trunk also. We wish to draw attention to the development of orthoses designed for the severely handicapped myelomeningocele patient, which appear to provide a significant improvement in the level of function.

PATIENTS AND METHODS

This study is based on a clinical review and functional assessment of 100 myelomeningocele patients attending the Robert Jones and Agnes Hunt Orthopaedic Hospital, Oswestry. The emphasis at this hospital has been to achieve an upright posture and walking capacity, and to limit surgical treatment to deformities that interfere with the application of braces and the attainment of this functional goal.

Patients were categorised according to their age, anatomical level of paralysis, ability to walk, and orthotic prescription. The arbitrary age groups selected were 0 to 5, 5 to 10, 10 to 15, and over 15 years; and the neurological level of paralysis was subdivided into thoracic (T1–T12), lumbar (L1–L5) and sacral (S1–S4). The ability to walk was classified according to a modification of the functional categories proposed by Hoffer et al. (1973), as follows: 1) chairbound; 2) therapeutic walkers—able to walk indoors under supervision of physiotherapist or parent, but unable to transfer independently, or unable to apply and remove the orthosis; 3) household walkers— as for community walkers but with limitations, for instance, mainly or solely indoors, and outdoors only on smooth, flat surfaces; 4) community walkers—independent walking indoors and outdoors on a variety of surfaces and gradients: wheelchairs used only for long journeys.

Six different orthotic devices were prescribed, and additional appliances such as spinal jackets and crutches were used as necessary.

The Salop skate

The Salop skate (Davis and Lucas 1977; Stallard and Rose 1978) (Fig. 1) is a platform devised to fit beneath
the feet so that a pair of one-way rollers permits the body to be pulled forward more easily without sliding backwards. It greatly reduces the energy cost of "drag-to" gait due to friction. The Salop skate does not perform a bracing function and therefore is used in conjunction with long leg calipers or with these combined with a body brace.

The below-knee orthosis
The functions and indications for below-knee orthoses are well known.

Long leg calipers
These are used to brace an unstable knee and ankle (Rose 1980).

Conventional body brace and connected caliper set
This combination is used to brace unstable hips, knees and ankles. It is provided with hinges for sitting only, and has either a pelvic band alone, or both a pelvic and thoracic band.

The swivel walker
The swivel walker (Edbrooke 1970; Rose and Henshaw 1972) (Fig. 2) consists of a rigid body brace, which provides intrinsic stability. Beneath the base is mounted a pair of swivel footplates providing extrinsic stability and forward motion. The mechanics are arranged so that the patient can walk simply by rocking the trunk from side to side to raise the footplates alternately. As this happens the assembly automatically rotates forward on the grounded footplate. Further modification to produce the Oswestry orthotic research team's design (Stallard et al. 1978; Stallard and Rose 1981) permits many patients to achieve complete independence by sliding into the device from the sitting position, then raising themselves from the wheelchair to an upright stance. They then walk in the upright position without the use of crutches or other walking aids. It is supplied to children aged 12 months as a standing device, and they can be expected to achieve mobility by the age of 20 months. It thus parallels normal development stages. It has the disadvantages of relative slowness of movement, inability to move except on a level floor (although this can be supplemented by the use of crutches to achieve "swing through" gait when necessary), and an unattractive gait pattern from the cosmetic point of view. All children with lesions at the level of L3 and above have this device initially. Those with severe handicap involving the upper limbs, hemiplegia, obesity or other problems which in the past have precluded walking can continue to use the device to their functional and therapeutic benefit (Butler et al. 1982). It is manufactured in a modular form, the final adjustment being made by the appliance fitter, and in Britain is supplied through the normal prescribing channels of the National Health Service.

The hip guidance orthosis
This device (Rose 1979 and 1980; Farmer et al. 1980; Major et al. 1981) (Fig. 3) provides a rigid body brace, to which long leg calipers are attached, with rigid low friction hip joint articulations used during walking and of precisely limited range. Its function is significantly different from the conventional body brace and calipers.
because of rigidity of structure and the walking articulations. These features help to maintain the abducted geometry whilst the stance leg is extended by action of the trunk and arm muscles reacting through the swing side crutch/rollator. The system is energy conservative in contraindication. It enables paraplegic patients to perform low energy reciprocal walking over a variety of surfaces, including grass, and up inclines of 1 in 10 with the aid of crutches (or a rollator), and to surmount steps of six inches. A higher level of coordination skill is

![Figure 4](image1.png)  
**Figure 4**—Histogram showing the number of patients with thoracic (T), lumbar (L) and sacral (S) lesions.  

![Figure 5](image2.png)  
**Figure 5**—Histogram showing the number of patients in each age range.  

![Figure 6](image3.png)  
**Figure 6**—Walking status of patients with lesions at the three different levels.  

![Figure 7](image4.png)  
**Figure 7**—Thoracic lesions.  

![Figure 8](image5.png)  
**Figure 8**—Sacral lesions.  

Walking status of patients with lesions at the three different levels. Figure 6—Thoracic lesions. Figure 7—Lumbar lesions. Figure 8—Sacral lesions.

A similar manner to normal walking, in which momentum gained during the downward portion of the centre of mass path is returned during the uphill phase. Walking with a hip guidance orthosis, like normal walking, is a bilateral procedure and thus hemiplegia is a specific required than for the swivel walker, but the benefits are a "normal" looking gait pattern for low energy walking at up to 70 per cent of normal speed. At present the device has only been supplied at Oswestry, but progress towards a wider distribution system is being made.

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RESULTS

The assessment was made nine to 27 months after the orthotic prescription. Fifty-one patients had thoracic lesions, and there were 41 lumbar and eight sacral lesions (Fig. 4). There was a predominance of patients in the 5 to 10 years age group (Fig. 5).

Of the 51 patients with thoracic lesions (Fig. 6), 29 per cent became household walkers, with one patient even achieving community status; only 6 per cent were chairbound. The remaining 63 per cent were therapeutic walkers, although many were close to achieving house-

hold status. The 41 patients with lumbar lesions (Fig. 7) showed a marked ability to achieve community status (46.5 per cent), only one being chairbound. There were more therapeutic walkers (29.5 per cent) than household walkers (22 per cent) in this category. Figure 8 shows that 87.5 per cent of the patients with sacral lesions had almost normal gait and the remainder were household walkers.

The distribution of the various orthotic devices used for the different levels of lesion is shown in Figures 9 to 11. For thoracic lesions, 59 per cent of patients used swivel walkers and 33 per cent hip guidance orthoses. The one patient using conventional long leg braces attached to a thoracic band, with sitting hinges, did so in conjunction with a Salop skate. Otherwise this type of orthosis was found to be insufficiently rigid to allow low energy cost community or household walking for this group.

For lumbar lesions, the most common appliance is the below-knee orthosis (46.5 per cent). Swivel walkers (16.6 per cent) and those using the hip guidance orthosis (11.9 per cent) both made a contribution to the high level of mobility achieved by this group. Of patients with lumbar lesions 14.5 per cent used long leg braces, and 4.7 per cent were able to manage without an orthosis at all; 4.7 per cent were confined to wheelchairs permanently.

For sacral lesions three of the eight patients surveyed used no orthosis, three used a below-knee orthosis, leaving only two patients who required long leg braces.

DISCUSSION

The degree of independence achieved by patients is clearly influenced by the level of paralysis. However, Figures 6–8 demonstrate that thoracic or high lumbar lesions need not be a bar to a satisfactory functional level. Referral of patients from a wide area produced a relative disproportion of high levels of paralysis compared to that expected from the natural incidence. They have not been "selected" in any other way, although hemiplegic patients were excluded.

The functional levels achieved by patients with

THORACIC LESIONS

Fig. 9

LUMBAR LESIONS

Fig. 10

SACRAL LESIONS

Fig. 11

Type of orthoses used by patients with lesions at thoracic, lumbar and sacral levels.

thoracic and lumbar lesions appear to show an improvement over previously published figures. In a survey of 91 paraplegic children, Stauffer et al. (1972) concluded that functional mobility using lower extremity bracing was a realistic goal for an incomplete T1–T11 paralysis, but not for a complete lesion at this level. In our survey over 30 per cent of patients with complete thoracic lesions (T1–T12) achieved the status of functional independence. The improvement is due to the identification of the fundamental principles required to achieve mobility and the implementation of this knowledge into the production of new devices, in particular the swivel walker and hip guidance orthosis. Clearly there is a finite limit to the potential achievement with an orthosis for any patient, but this fundamental approach means that there can be considerable confidence that this limit has been reached. Future changes will then be of relatively minor details—for example, the use of different materials. Equally, it is apparent that orthoses that do not possess these design features cannot give optimal results no matter what other treatment is given.

Although it is recognised that some patients will lapse into wheelchairs as they reach adolescence, it is interesting that of the three surveyed thoracic lesions in this age group only one patient is chairbound. The different ages of patients prevents direct comparison with the experience of Hoffer et al. (1973), but we are optimistic that many more patients will retain the ability to walk as they become adults. Our survey has a much
larger incidence of thoracic lesions (51 per cent) compared to that of Hoffer et al. (17.9 per cent), and yet only 8 per cent of all patients compared to 51.8 per cent are currently chairbound. As orthoses develop better mechanical efficiency and become easier to apply, more patients will have the strength and enthusiasm to continue to walk as they reach adult life.

These results challenge the widely held view (Zachary 1968; Lorber 1971; Menelaus 1980) that the high neurological lesion should be included in the criteria for "selective treatment" of the newborn with myelomenigocele. The review indicates (Fig. 6) that 63 per cent of patients with thoracic lesions become therapeutic walkers. They enjoy their periods of walking and derive important therapeutic advantages which contribute to their feeling of well being at all times. Two per cent of patients with thoracic lesions achieved community status and from the mobility point of view are completely independent. The greatest number of patients (52) were in the 5 to 10, and 10 to 15 years old groups (Fig. 5). The comparatively small number in the youngest group—up to 5 years of age—is explained partly by the absolute diminution in the incidence now occurring, and partly on the treatment policy (Brocklehurst 1976). Some individual patients selected primarily for "non-treatment", who survive, commonly present even greater problems than those treated surgically from the beginning of life. When they are referred for orthopaedic treatment at approximately 12 months of age, contractures and deformity are commonly seen. The involvement of the orthopaedic surgeon within the first three months, even in these cases, can prevent problems and greatly improve the prognosis for mobility should they survive. The one-year-old child can be placed in a swivel walker and most achieve mobility within the next 12 months. In general, if the optimal mechanical assistance is provided, physical therapy in regard to mobility is limited to very short initial training sessions ranging from one day to some two months.

This investigation has also provided an important insight into the surgical objectives in the treatment of this condition. It is futile to attempt to produce anatomical normality, and the regime followed had as its objectives achievement of plantigrade feet, mobile knees which could be straightened fully, and mobile hips though not necessarily with the femoral heads located in the acetabula. The primary aim should be to provide an integrated combination of patient and orthosis. This can be achieved only when the principles, potentials and limitations of orthoses are fully understood. Orthotic knowledge is, therefore, the beginning not the end of surgical endeavour.

REFERENCES


