The orthotic management of spina bifida children
present status—future goals

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All spina bifida children should have functional
goals established for them. These goals will vary
with the severity of the motor and sensory
deficit, and with the child's developmental
threshold. In establishing such goals it is con­
venient to group the children according to
neurosegmental level: thoracic, upper lumbar,
lower lumbar, and sacral.

Children with spina bifida tend to be delayed
in their developmental landmarks: (a) head
control, (b) creeping, and (c) ambulation
(National Academy of Sciences, 1973). They
should be reared in a milieu which is intellect­
ually and physically challenging. Every effort
should be made to "normalize" their lifestyle.
These children benefit from a sense of achieve­
ment. Mobility is essential if the child is going
to attain social maturation and educational,
vocational and avocational goals. Goal­
orientated programming requires a co-ordinated
team effort, with the patient the most important
member of the team.

From birth to head control, the goals are to
correct deformities, avoid contractures, en­
courage development through mobility and
protect anaesthetic skin.

The goals from the time of head control to
creeping are to achieve a sitting balance, prevent
deformities, protect anaesthetic skin, encourage
the use of hands bilaterally, improve eye-hand
co-ordination, improve upper-limb strength,
improve interaction with a broadened environ­
ment and improve mobility.

As regards ambulation, spina bifida children
can be classified by functional level into non­
ambulators, nonfunctional ambulators, house­
hold ambulators and community ambulators
(Hoffer et al., 1973).

"Nonambulators—These patients are wheel­
chair-bound but usually can transfer from
chair to bed.

"Nonfunctional ambulators—Walking for
these patients is a therapy session at home, in
school or in the hospital. Afterwards they
use their wheelchairs to get from place to
place to satisfy all their needs for transport­
ation.

"Household ambulators—These patients walk
only indoors and with apparatus. They are
able to get in and out of their chair and bed
with little if any assistance. They may use the
wheelchair for some indoor activities at home
and school, and for all activities in the
community.

"Community ambulators—These patients
walk indoors and outdoors for most of their
activities and may need crutches or braces, or
both. They use a wheelchair only for long trips out of the community."

In a study of 68 spina bifida children aged 12
and over, De Souza and Carroll (1974), found
that the eventual ambulatory status was
primarily dependent on (1) the neurosegmental
level of the lesion, (2) the motor power within
a given neurosegmental level, (3) the extent and
degree of the orthopaedic deformities, (4) age
and stature, (5) the design and effectiveness of
the orthosis, (6) intelligence, (7) motivation,
(8) spasticity, (9) obesity, and (10) possibly sex.

The goals for a child with a thoracic neuro­
segmental level who has progressed to the point
where he is ready to ambulate are (1) good
sitting balance, (2) ambulation at least during
first decade, (3) ability to do transfers, (4)
wheelchair propulsion, (5) self-care, (6) social
acceptability, (7) schooling, (8) access to environ­
ment. As an adult, the patient should learn to
drive an automobile.

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The goals for a child with an upper, lumbar, neurosegmental level who has progressed to the point where he is ready to ambulate are similar to the goals for a child with a thoracic neurosegmental level. However, one would hope that the child with the upper, lumbar, neurosegmental level would learn to be a household ambulator.

One of the goals for a child with a lower, lumbar, neurosegmental level is to make him a community ambulator. He should be capable of crutchless standing and self-care; he should be able to go to a regular school; and he should be motivated to be self-reliant.

The child with a sacral level, neurosegmental lesion should become a community walker with minimal bracing.

The spina bifida programme at the Ontario Centre for Crippled Children includes an information class for the parents of pre-schoolers, a multidisciplinary clinic, and an orthotic clinic. In the information group parents are taught how to avoid contractures, to encourage development through mobility, and to protect anaesthetic skin. The spina bifida clinic is conducted with a neurosurgeon, an orthopaedist, and a urologist in attendance. The orthotic clinic is attended by an orthopaedic surgeon, an orthotist, orthotic technicians, physiotherapist, occupational therapists, nurses, and social workers. A child is presented at the orthotic clinic when he requires orthoses to help him achieve the next developmental threshold. Most of the children are 10 to 18 months old. The child’s specific functional loss is determined, goals are established for the present and future, and decisions are made as to the role of physiotherapy, surgery and orthoses in his programme.

A child with a thoracic or upper lumbar lesion may have difficulty in dragging himself from point A to point B. We frequently prescribe a prebracing mobility aid called a Caster Cart (Fig. 1) for such a child (Carroll, 1974). The Caster Cart makes it easy for the child to move about and explore his environment. He learns to use his hands to manipulate the wheels. His skin is protected.

When a child with a thoracic or upper, lumbar, neurosegmental level demonstrates that he is frustrated with sitting and that he wants to stand, we prescribe a Standing Brace as shown in Figure 2 (Carroll, 1974). This is an inexpensive prefabricated orthosis which gets a patient upright without delay. It is made of a tubular frame to which parts are riveted. The fitting can be completed in under two hours and the patient can stand without crutches. He can move without crutches by pivoting. He can use crutches to achieve a swing-to or swing-through gait. As a preliminary device it enables the clinic team to assess the child in standing.

We believe that these children should stand and walk even if later in life they will give up their orthoses for wheelchairs. When they stand, their horizons are broadened, their lower limbs are less osteoporotic and they have fewer fractures, their bladders drain better, bowel function is improved and their cardiovascular system is stimulated by the increased physical activity. Upper-limb strength is increased.

Some of the children with an upper, lumbar, neurosegmental level have been fitted with a Reciprocating Gait Brace (Carroll, 1974). This
device, by means of a gearbox, harnesses the power of hip flexors on one side to produce hip extension on the opposite side. With the assistance of crutches, a reciprocal gait is possible by activating one hip flexor at a time. Swing-through gait is achieved by activating both hip flexors at the same time to keep the legs rigid. This orthosis is aligned so that it allows crutchless standing. It is hoped that dynamic stretching of the hip flexors will prevent progressive hip-flexion contractures. We have experienced gearbox maintenance problems with this orthosis.

Children with a total paraplegia, i.e. thoracic neurosegmental level, progress from the standing brace to a Parapodium (Fig. 3), (Carroll, 1974).

This device supports the spine during both sitting and standing and is aligned so that the child can stand without crutches. A swing-to or swing-through gait can be achieved by the use of crutches. The Parapodium is constructed from a prefabricated kit which has the following design features: stability, low weight, adjustability for growth, quickness of assembly, ease of alignment, ease of maintenance. With the Parapodium the shoe is "part of the child," not part of the brace. Crutchless walking can be facilitated by attaching a pivot-walker or swivel-walker platform to the footplate. Special-purpose attachments can be designed and mounted easily. Crutchless standing makes it easier for the paraplegic child to engage in activities such as tossing a ball, dialing a telephone, reading from a book in front of a class, opening a bottle, or pounding a nail at a workbench.

In the last couple of years we have been making more and more use of polypropylene. Practically all our children with instability of the ankle-foot complex are fitted with a vacuum-formed polypropylene insert (Carroll, 1974). If knee stability is a problem, a polypropylene insert can be attached to a polypropylene thigh support by means of side hinges.

Orthoses in the research and development stage at the Ontario Centre for Crippled Children are as follows:-

- Plastazote shoes—to protect deformed insensitive feet.
- Trunk-suspension systems—to prevent scoliosis, pelvic obliquity, and ischial pressure sores.
- Curb-climbing wheelchairs—to broaden the nonambulator's environment.
- Stand-up wheelchairs—to enable a nonambulator to assume and maintain a standing position.

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Early in this paper, goals were listed for children with varying neurosegmental levels. How often are these goals attained? De Souza and Carroll (1974) found that in the second and third decades, community ambulation was achieved by 53 per cent of children with a sacral neurosegmental level, 30 per cent of children with a lower lumbar level, 10 per cent of children with an upper lumbar level, and no children with a thoracic level. Our great challenge for the future is to have these children continue to ambulate when adult, not just during the first decade.

The third most important factor in determining ambulatory status is the extent and degree of the orthopaedic deformities (De Souza and Carroll, 1974). It is incumbent on the orthopaedic surgeon, therefore, to ensure that the spina bifida child under his care has the spine balanced over the pelvis and hip, the hip balanced over the knee, and the knee balanced over a plantigrade foot. Our orthoses must have the following design characteristics: they must be effective, comfortable, lightweight, low in cost, durable, cosmetically acceptable, easy to manufacture, easy to maintain and adjust for growth, easy to apply and remove, and they must not impede any of the activities of daily living (Carroll, 1974).

Through research we must develop a means of avoiding abduction, flexion and external rotation contractures of the hip, while still
maintaining a position favouring hip stability. We need better trunk supports. As yet we do not have good multiaxial hip joints. We must develop a means of maintaining directional stability for limbs that are in below-knee braces.

The fourth most important factor in determining ambulatory status is the age and stature of the patient. As yet we do not have a satisfactory means of getting a tall, heavy paraplegic from a sitting to a standing position. We need urinary-collecting devices for both males and females. We must assess the feasibility of externally powered braces for ambulation. We need suitable stair-climbing aids. Our architects need to be educated so that environmental barriers are removed from the community. We need total mobilisation of medical, paramedical, engineering and community resources to meet these challenges.

REFERENCES


