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ABSTRACT

Mobility provides young children with the opportunity for many developmental experiences. Children with spina bifida have physical limitations which hinder these developmental experiences. This paper describes two assistive devices designed to provide age-appropriate independent mobility, the Caster Cart and Crutchless Standing Orthosis.

INTRODUCTION

Children with physical limitations are denied many normal experiences, usually taken for granted, that enhance social and psychological development. A wide variety of assistive devices are available to provide some of these experiences in an age-appropriate manner. This poster presents two devices developed and fabricated at Gillette Children's Hospital in St. Paul, Minnesota.

A large number of the clients served at Gillette are children and young adults with Myelomeningocele or Spina Bifida. The majority of these young children have significantly limited muscle function of their lower extremities. Normal children are becoming very mobile on the floor before one year of age, yet this mobility is physically difficult or impossible for infants with Spina Bifida. The devices presented here provide important mobility and hands-free standing as a means to more normal, enjoyable and useful activities for the child.

Preliminary designs of these devices were adapted in the early 1970's from several used in a child paraplegic program developed by Wally Motlock and others at the Ontario Crippled Children's Center. The devices currently fabricated at Gillette have several differences, described below in Design Features, that have increased their usefulness for our clients.

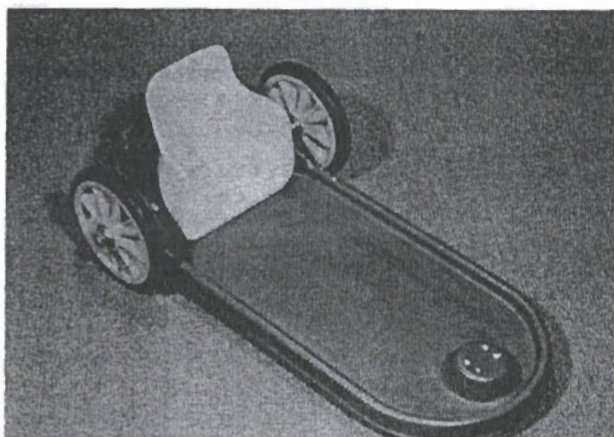
CASTER CART

Discussion of Need

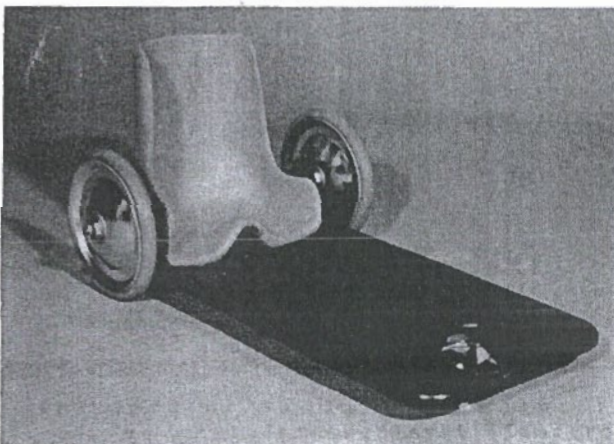
Young children use a remarkable amount of mobility in discovering their environment and building their self-image. Limitations to a child's independent mobility naturally decreases opportunity for many early developmental experiences, such as exploring one's environment, discov-

ering cause and effect relationships, or interaction with one's peers. The caster cart fabricated at Gillette, described below, is simple in its design, but has been used to provide independent mobility to a large number of our young clients with Spina Bifida.

The very close proximity to the floor (about 1-1/2") allows independent transferring by the child, and it's use simulates sitting and playing on the floor. There is also extra room on the cart to carry toys and pets while keeping hands free to propel the cart's wheels. The caster cart's design allows free rolling and is highly maneuverable. Sitting support is provided as needed.



ABS Plastic Shell Design



Aluminum Shell Design

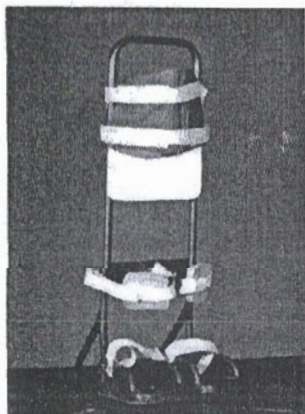
Design Features

- a. The caster cart is positioned 1-1/2 inches above the floor for independent access and peer-level interaction.

- b. We have used to different shell designs, both light in weight. Design drawings for an aluminum shell are available and may be easier to fabricate in certain facilities. The shell of the cart we currently provide is vacuum-formed from ABS plastic. The contoured edge and two base-mounted aluminum bars contribute to the shell's rigidity.
- c. Sitting support is provided by a contoured seat, as shown, which is made of polypropylene. Minimal support is supplied to give required trunk stabilization with maximum upper body freedom.
- d. There are two large wheels and one caster attached to the caster cart. The two large wheels are located on each side for propulsion and the caster is located beneath the front center portion of the cart. Aluminum plate inserts are vacuum-formed into the sides of the shell to strengthen the axle mounting. An important feature of this cart is the high quality wheels, which maximize the cart's maneuverability and minimize the energy required for propulsion.

The wheel design differs from the O.C.C.C. cart in that the caster is smaller and located forward. The side wheels are located more toward the back of the cart which gives better lateral access to the floor.

CRUTCHLESS STANDING ORTHOSIS (CSO)



Discussion of Need

Standing is a position that has physical, developmental, and psychosocial benefits. The Gillette type Crutchless Standing Orthosis (CSO) has developed over the past 11 years and is presently custom fabricated for many of our Spina Bifida clients from ages of one year to six years. Some users choose to continue use of their CSO up to age nine or ten. The CSO is

designed to accommodate growth with simple modifications. Donning and doffing is easily and quickly accomplished which helps the CSO be well accepted by both children and parents.

The minimal weight of the orthosis is very important, particularly for use with the small child. Gillette recognizes the quality of other standing orthosis designs but we have chosen our own design to decrease weight.

There are several physical benefits of the CSO. Daily weight-bearing sessions on lower limbs will maintain bone strength and decrease tendency toward osteoporosis and recurrent fractures. The upright position is reported to also improve over-all urologic function in addition to general improvement in circulation and respiration. Standing will also provide additional stretch to assist non-progression of muscle contractures, particularly about the hip and knee.

The social benefits of the standing experience can be dramatic. As peers begin to walk, effective interaction is enhanced when eye-level positioning is provided. Interaction is also enhanced when mobility is provided to move freely and play with peers. With a small amount of upper limb strength, the child can soon begin to move about with a walker. Many of our children with good balance and coordination learn to "swivel walk", with their hands free, through a rhythmic thoracic rotation. Upright positioning and working toward locomotion will exercise residual muscle strength. Playing ball, pushing a baby buggy, brushing teeth and helping with household chores are some examples of activities of our clients using a CSO.



After entering grade school, children continue use of the CSO. Larger physiques and decreased energy levels

can make the use of the CSO impractical after this age. If daily routine indicates the need for frequent sitting, a child may choose to discontinue use of the CSO and consider replacing it with the heavier, jointed parapodium. It has been our experience that children naturally come to these decisions.

Since many children with spina bifida require spinal orthotic treatment, it is important to note that the CSO is entirely compatible with any spinal orthosis.

Design Features

- a. There are three points of pressure applied to extend the hips as shown.
 1. Abdomino-thoracic apron,
 2. plate behind buttocks, and
 3. well-padded knee supports
- b. The CSO is light in weight and averages 1.24 kilograms, depending on the weight of the child. The frame is fabricated of 1/2" single anodized aluminum tubing, alloy 6061-T6. Modifications to height during fit and especially during growth are easily made by adding a minimum of telescoping 5/8" tubing. An anodized aluminum plate is located at the buttocks to provide frame structure and postural support. Anti-tip bars are added to increase stabilization against backward falls.
- c. The foot sockets are vacuum-formed of ABS plastic and attached to the aluminum frame's base. Leg length discrepancies are easily accommodated by the addition of dense foam spacers to the bottom of the ABS foot socket. The bottoms of these sockets are covered in leather to reduce floor friction which facilitates easier locomotion. The anterior lateral edge of the leather base is slightly reduced in thickness to also facilitate swivel-action motion.
- d. Trunk freedom is provided whenever possible for maximum locomotion ability. Lateral bolsters, however, are mounted to the CSO frame when indicated.

Concluding Statements

The mobility devices described in this paper have been used widely by our client population. Some mothers feel the caster cart has been the single most useful tool for their child.

Efforts are being made to explore the feasibility of commercial production of these devices. Custom-fabrication can easily be accomplished for small quantity applications and specification drawings are available at Gillette.

Technical support for the fabrication of these devices has been provided by David Lawson, Rick Weber and others of the Orthotic and Prosthetic Lab at Gillette. Please direct any questions regarding the fabrication and usefulness of these mobility devices to the authors at:

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