

The "Gillette" Sitting Support Orthosis for Non-ambulatory Children with Severe Cerebral Palsy or Advanced Muscular Dystrophy

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This paper presents a brief review of the need for better sitting support for those children confined to a wheel chair and lack the voluntary means to sit with good posture. The "Gillette" Sitting Support Orthosis consists of a thin but rigid, plastic shell mounted in a foam block. The shell extends to the axilla laterally and to T1 posteriorly. The system often includes anterior support just under the clavicles and some form of head control. The orthotic systems are custom fabricated and are designed to: (1) support the lumbar and thoracic spine to reduce the size and progression of kyphotic and scoliotic curves, (2) securely position the patient in a posture which reduces the incidence and strength of spastic reflexes, (3) control sitting surface pressure distribution, and (4) resist the action of spastic hip adductors.

The Sitting Support Orthosis is designed and fabricated as the central component in a system which includes wheel chair, lap board, and communication system. One hundred sixteen orthoses have been fitted during the past three years with excellent acceptance by patients, parents, and others who teach or care for these children.

DURING THE PAST three years, the Orthotic and Prosthetic Laboratory at Gillette Children's Hospital has developed a sitting support orthosis which has become very important in the treatment of the non-ambulatory child with severe cerebral palsy or advanced Duchenne muscular dystrophy. The Gillette Rehabilitation Therapy Department has also been very actively involved in the development and use of the sitting support orthosis. Their knowledge of the problems associated with cerebral palsy has ensured that the orthosis not only addresses these problems but is compatible with the complementary to the rest of the child's adaptive equipment and his daily routine. Specific problems of concern are those of feeding, communication, reflex patterns, abnormal muscle tone, and learning potential in addition to spinal deformity. The medical staff of our cerebral palsy service, our spine service, and our growth and development service has provided the impetus, encouragement and support for the project (Figure 1).

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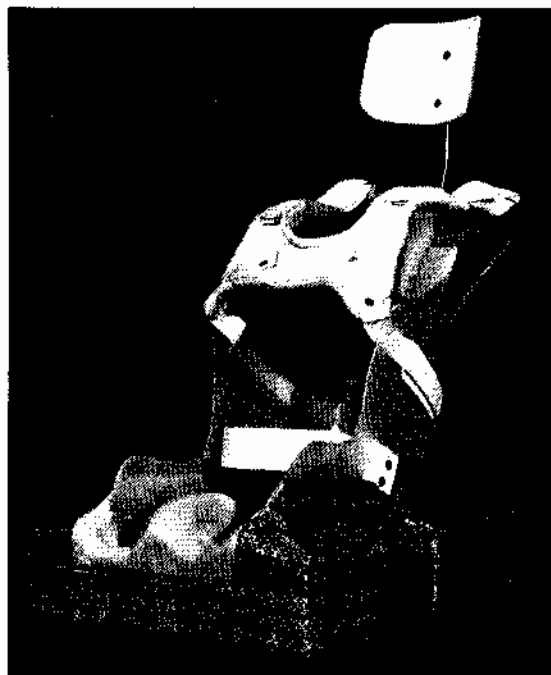


Fig. 1 — The "Gillette" Sitting Support Orthosis with anterior thoracic support and head support.

Background and History

The development began on our cerebral palsy service. Most cerebral palsy children who do not acquire the ability to ambulate, lack the balance or voluntary means to have a good sitting posture in their first decade of life. They sit in a kyphotic or kyphoscoliotic posture. The pelvis is often not horizontal. In some cases, balance, voluntary control, and sitting posture improve rapidly enough so that the flexible spine deformity of the first decade does *not* become a rigid, progressive deformity during the second decade. However, a significant portion of non-ambulatory cerebral palsy children *do* progress during the second decade to a serious spinal deformity. The spine curvature may make sitting very difficult or eventually even impossible. A hip can dislocate and become quite painful due to fixed pelvic obliquity. Cardiopulmonary function may be seriously compromised. Another important consideration is that a small but significant portion of these patients have an average or superior intelligence. Their education, social interaction and self-esteem are very important and greatly affected by their sitting posture and function.

The child with Duchenne muscular dystrophy begins to develop his spinal deformity about the time he becomes non-ambulatory. The deformity progresses to become a very large single curve. The deformity includes rotation, scoliosis, and either kyphosis or lordosis. The spine deformity sometimes affects cardio-pulmonary function and almost always creates a sitting posture so poor that the patient's function is seriously compromised. This happens long before the patient would lose this function because of other manifestations of the disease.

Our approach on seating in the past had been to utilize the hospital's carpentry shop to construct wedged seats with upholstered lateral supports. This approach is very common around the country and is successful to some degree. However, it does not adequately control the location and orientation of the pelvis. Lack of contoured conformance to the anatomy results in a concentration of the pressures generated by gravity and supports. The padded, upholstered sides of the seat were too bulky to extend lateral thoracic support very high in the sub-axillary area. Even the best of these seats accomplished very little in the way of real spine support.

Spinal Orthoses

The body jacket type orthosis is able to exert quite strong (though not always successful) control of the

spine and is typically used to control spinal deformities in cerebral palsy (Figure 2). However, this orthosis represents a major impact on the patient and his family. It obviously steals some of the patient's motion and mobility. It must be applied very carefully, and the



Fig. 2 - The two-piece Body Jacket type Orthosis on a teenage boy with severe Cerebral Palsy.



Fig. 3 — A Milwaukee Orthosis on a child with severe Cerebral Palsy.

skin must be monitored faithfully. Although it supports the torso completely, it does so as a unit. This unit still must receive external support to maintain proper sitting posture. In our experience, the child with advanced Duchenne muscular dystrophy will not tolerate the

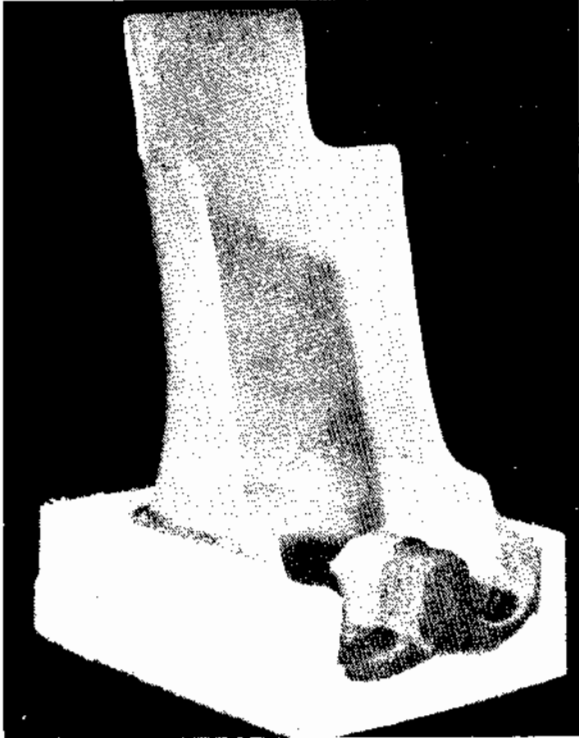


Fig. 4 The polypropylene shell mounted in a polyethylene foam block.

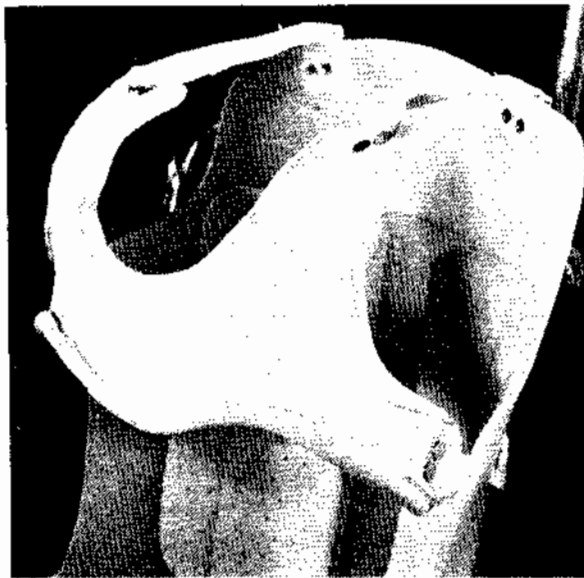


Fig. 5 The rigid, molded, anterior support for reducing kyphotic sitting postures. Pressure is concentrated in the immediate subclavicular area.

body jacket type orthosis. He and his family are reluctant to work through the initial period of discomfort for him. More important, he will not give up the upper thoracic motion which helps him greatly with hand placement and elbow control.

The Milwaukee orthosis is also capable of exerting strong controlling forces on the spine (Figure 3). However, it becomes a serious irritant for any patient not having the voluntary control to be able to withdraw from contact with the neck ring. Also, the neck ring is a hazard in some patients, because it does not permit them to position their head to best see what their hands are doing. The advanced Duchenne muscular dystrophy patient requires all his available head motion for self-feeding.

Gillette Sitting Support Orthosis

The sitting support orthosis developed here at Gillette consists of a custom-molded, plastic shell mounted on a base (Figure 4). The plastic shell is fabricated by vacuum forming hot polypropylene sheet material over a positive plaster model of the child's posterior and lateral surfaces. Thus, the plastic shell conforms to the body contours posteriorly and laterally from the knees to the upper thorax. The base provides the proper support to the shell and allows the unit to be removed from the wheel chair for use in the car or other places. A lap belt is provided to hold the pelvis snugly back into position. The hips are positioned in the amount of flexion recommended by the physical or occupational therapist. Reflex patterns in severe cerebral palsy are frequently affected by the degree of hip flexion so we follow the recommendation of the occupational or physical therapist in this regard. These children also very often have overactive hip adductors. The pommel prevents excessive hip adduction, and it also helps to prevent the patient from sliding out of the seat. In the case of muscular dystrophy patients, the hips are positioned as close to 90° of flexion as possible. The pommel is usually not necessary and is eliminated in favor of easier usage of the urinal.

Various anterior components are added as necessary. A lordotic muscular dystrophy patient will need a large abdomino-thoracic apron to pull him upright. For the kyphotic patient, a fabric halter or rigid, custom-contoured, subclavicular support (Figure 5) may be necessary, depending on the force required to obtain an acceptable posture. Stabilizing the thorax obviously aids the patient's voluntary head control, but sometimes additional head support is necessary (Figure 6). In some cases, head control is used continuously to prevent certain head positions and the

reflex patterns which are triggered by those positions. In other cases, it is appropriate to make the head support removable so that it may be used part-time only or for feeding. This is another aspect of the design which requires consultation with an experienced therapist who has had a chance to become acquainted with the child.

The exact angle of recline is not decided until fitting the orthosis to the child. We try to bring the child as nearly as practical to a vertical sitting position.

The thin plastic shell design permits us to extend our lateral thoracic support right up to the axilla without impinging uncomfortably on the medial aspect of the arm. This support eliminates most of the collapsing action of gravity.

When the child wishes to roll around and play on the floor, supporting hardware is automatically left behind in the chair. He is free to roll or scoot around unencumbered. When the child is horizontal, gravity is not operating to collapse the spine.

Results

As of this date, we have fitted 116 sitting support orthoses on ninety-seven patients. Ninety-eight were for children with cerebral palsy, and eighteen were for children with advanced Duchenne muscular dystrophy.

How effective this approach will be in reducing the progression of spine deformities during the growth



Fig. 7 — Child with severe Cerebral Palsy assuming a typical unsupported sitting posture.



Fig. 6 — Finished Sitting Support Orthosis with head support.



Fig. 8 — Child of Figure 7, now in his Sitting Support Orthosis.

years will require several more years of observation and study.

At this time, the sitting support orthosis has been very successful in several ways. The system has proven capable of providing the stabilizing support necessary for a near-normal sitting posture (Figures 7 and 8). Head control or position is usually improved, sometimes dramatically. Better head control, whether it comes indirectly through stabilization of the thorax or directly by head support, is extremely important. A child who is chronically looking straight down or straight up or sideways at the world is deprived of normal avenues of discovery, stimulation, and social interaction.

The orthosis usually improves the child's comfort and position to the point that the intensity of reflex patterns and abnormal muscle tone are reduced. Stability provided by the sitting support orthosis frees up the child's hands in some cases where they would otherwise be used for support. This also means the child does not have to try to pay attention to so many things and can better concentrate on such things as head control, communicating, or learning in the classroom. The orthosis has also greatly improved or simplified the sometimes very difficult task of feeding these children.

Discussion

The sitting support orthosis must fit quite closely to be effective. The child will not fit in his orthosis when bundled up in heavy winter clothing. Sometimes it is advisable for the child to be in his orthosis during schoolbus rides, and the temperature may be quite low. The orthosis can be accommodated under a winter coat by using a larger size or making simple adaptations. The orthosis is outgrown usually between eleven and twenty-five months after fitting.

The involvement and cooperation of the entire health team creates an overall equipment system which works. It works because the various components are compatible, and the important problems in the child's



Fig. 9 — Child in his wheel chair with Sitting Support Orthosis, lap board, and communication system.

life are recognized and dealt with. Figure 9 is a photograph of a child with cerebral palsy and his sitting support orthosis, wheel chair, and lap board with in-laid communication figures.

Our most enthusiastic response and encouragement has come from the parents, teachers, therapists, nurses, and other people who teach or care for the child in the community. These people who live or work with the children on a daily basis know better than anyone the current effect of treatment on the total child.

Acknowledgments

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