ABSTRACT

Children with the more severe grades of Cerebral Palsy and Myelomeningocele have strong tendency to develop knee and hip deformities. We have observed that these deformities develop in accordance with the child's unusual and consistent sleeping posture. During the past seven years we have developed a rather simple, adjustable orthosis for night-time use which supports the hip and knee in a preferred alignment while the child is sleeping.

Children with spina bifida, spinal cord trauma, or the more severe grades of cerebral palsy, have a strong propensity for the development of progressive hip and knee deformities. These deformities usually have their origin in pre-existing muscle imbalances which pull the legs into positions which are consistent and repeated each nap and nighttime. Gravity and biomechanical factors seem to work together in a mischievous way.

For instance: knee flexion contractures alone, under the effect of gravity, will cause the hips to be rotated (especially when prone) and flexed when the child is recumbent on a flat surface. Hip flexion contractures cause a recumbent position which includes hip rotation of either the frog-leg or the wind-blown type. There is no one age when these deformities develop. In some children, they appear in infancy; others begin significant, progressive knee and hip deformities as they enter their second decade and spend less time upright and more time sitting.

Anytime a child spends eight or more hours per day, every day, in a consistent position of paralytic origin, the child will probably develop joint contractures and those contractures will be progressive. Significant knee and/or hip contractures will cause ambulation or standing to be more risky, more difficult, and more energy costly, if not impossible. When the deformities are asymmetrical, they cause poor sitting postures. They also make it more difficult to avoid the generation of pressure sores during recumbency.

The use of sand bags and pillows to achieve an acceptable sleeping body alignment usually does not work because it means, in effect, rebuilding a supporting structure every night in a way that appreciates:

1. The geometry of deformities,
2. The biomechanics of simultaneously resisting those deformities, and
3. The need to avoid excessive pressure areas.

In our experience, the sand bag and pillow approach is inefficient and in the long-run just does not work.
Such things as adductor cuffs which are used to resist bilateral hip abduction (frog-leg) and abduction wedges to resist hip abduction have been dismal failures for two reasons:

1. They do not cross superior to the hip joints and therefore cannot be expected to control hip position; and
2. The contracture or spasticity will always be stronger on one side so any deformity reduction will occur on the least severe side.

In figures 2 and 4, you can see exactly why the adductor cuffs or the abduction pillow does not effectively hold both hips in abduction. Bilateral abduction is usually not the position achieved. The child can very easily assume a position of unilateral abduction or unilateral flexion with no abduction. Also, of course, they have very little constructive effect on hip rotational position.

As an illustration, the child you see in figure 2 underwent surgery three years ago. That surgery was meant to correct bilateral abduction contractures. Following surgery, this abduction cuff device was prescribed. As you can see, the abduction deformity on her right side recurred and dominated. There has been no benefit. The surgery and treatment has merely traded one deformity (the frog-leg) for another (hip abduction). Figure 3 shows that a neutral position, however, is achievable if the correct set of support forces is used.

About 1978, we started to fabricate and provide devices designed to resist, during recumbency hours, the development and progression of hip and/or knee deformities. We call the devices Recumbent Support Orthoses because they support the child in a preferred alignment while recumbent.

The basic RS0 design is adaptable to any combination and severity of lower limb deformity and allows considerable growth adjustment. Since it is not form-fitting, it is relatively less expensive. It accomplishes its goal at night, when the child is in bed sleeping and therefore does not interfere with daytime activities.

The RS0 can involve various design configurations. The RS0 design can hold the hip in abduction both in full extension and abduction with both in full extension.

The RS0 can hold the hip in abduction both in full extension and abduction with both in full extension.

Figure 6 displays a windblown deformity which was treated with an RS0 design shown in figure 7. To achieve hip rotational control, the RS0 can hold the child's hips in adduction and full extension, with a bar attached across shoes to prevent rotation.

The orthosis is also regularly used at G.C.H. as a means of post-operative positioning following surgical release of hip and knee contractures. As you perhaps know, paralytic hip and knee deformities will recur following surgical release unless a long term positioning program is faithfully adhered to. At Gillette we have found a period of at least one year is required of a successful positioning program following these surgical procedures.

The "Gillette" Recumbent Support Orthosis can be designed for either the supine or the prone recumbent position. It can also be designed, if it is holding a symmetrical position, so that the prone and supine positions can be used on alternate nights or be at the option of the child or parent. This reversible design, though, requires some strap changes which not all caregivers can accomplish.

Education of the care-givers in the proper usage of this orthosis is very important. They must have a solid understanding of how the orthosis works. Some parents with good initiative and excellent understanding of the orthosis can adjust it to achieve a significant

RESNA 8th ANNUAL CONFERENCE MEMPHIS, TENNESSEE 1985 213
all-night stretch of contractions. Realistically we are not achieving that in most cases. However, we do achieve maintenance of a more neutral joint alignment which does not reinforce the contracture.

Originally, we thought cosmesis not to be a problem since the use of the ESO is confined (usually) to the child's bedroom. However, we discovered that some parents resisted its use. We think that was partly because we were depriving them of the gentle, loving act of tucking their child into their soft bed. Figure 8 shows design changes occurring since we have recently paid more attention to its appearance and are trying to make it appear a bit softer and more attractive as a place to lie your child down for the night.

Since 1980, the Recumbent Support Orthosis at GCCH are fabricated and fit by David Wilkie and others in the Adaptive Equipment team in the Orthotic & Prosthetic Department. David is responsible for many design improvements which have made the orthosis more adaptable, more cosmetic, lighter, and less expensive.

The personnel of the Rehabilitation Therapies Department at Gillette (Karen Beck, PPT, in particular) have been important in the development of the application criteria for the Recumbent Support Orthosis in our client population.

If you have any questions regarding the use and design of the ES0 please contact the author at the following address:

Gillette Children's Hospital
200 East University Avenue
St. Paul, MN 55101
Phone: 612-291-2844 ext. 160

214 RESNA 8th ANNUAL CONFERENCE MEMPHIS, TENNESSEE 1985