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THE R.S.O.:
A Recumbent Support Orthosis for Control of Lower Limb Deformities in Children with Neuro-muscular Disabilties

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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 knees in a preferred alignment while the child is sleeping.

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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. Those 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.

Figure 1

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.

Figure 2

Figure 3

Figure 4

Such things as adductor cuffs which are used to resist bilateral hip abduction (frog-leg) and abduction wedges to resist hip adduction 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 only 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 adduction cuff device was prescribed. As you can see, the abduction deformity on her right side reoccurred and dominated. There has been no benefit. The surgery and treatment has merely traded one deformity (the frog-leg) for another (the windblown). 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 contractures. We call the devices Recumbent Support Orthoses because they support the child in a preferred alignment while recumbent.

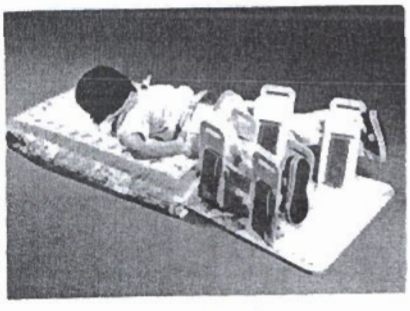

Figure 5

The basic RSO 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 goals at night, when the child is in bed sleeping and therefore does not interfere with daytime activities.

The RSO can involve various design configurations. The RSO design can hold one hip in neutral and one hip in abduction with both in full extension.

Figure 6

Figure 7

Figure 6 displays a windblown deformity which was treated with an RSO design shown in figure 7. To achieve hip rotational control, the RSO can hold the child's hips in neutral 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 reoccur 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 care-givers 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

all-night stretch of contractures. 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 RSO 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.

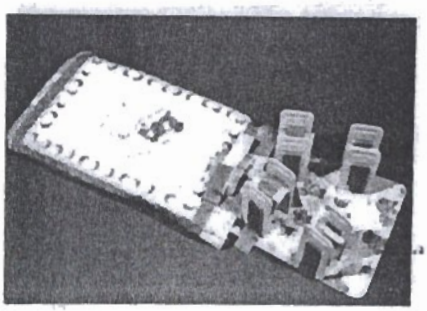

Figure 8

Since 1980, the Recumbent Support Orthoses at GCH are fabricated and fit by David Wilkie and others in his 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, RPT, 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 use and design of the RSO please contact the author at the following address:

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