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DYNAMIC ORTHOTICS *and* PROSTHETICS

Orthoses for Managing Cerebral Palsy

Orthotists are frequently involved in the management of young patients with cerebral palsy. United Cerebral Palsy estimates that 764,000 children and adults living in the United States manifest C.P. symptoms and that some 8000 babies and infants and 1100-1500 preschool-age children are newly diagnosed each year. Of these, a majority are affected with spastic diplegia, stiff, permanent contraction of the muscles in both legs.

Supra malleolar orthosis (SMO)

Bracing for C.P. is primarily employed to stretch hypertonic muscles and prevent contractures. Ankle foot orthoses (AFOs), the most frequently prescribed devices for C.P. patients, manage abnormal plantar flexion (equinus deformity) by controlling or eliminating ankle and subtalar motion to prevent contractures and improve gait. Splints can be employed to forestall elbow, wrist and hand contractures. Spinal braces can help children who are having difficulty sitting upright and straighten the spine in the presence of a developing deformity.

Of course, bracing is only one component of the multidisciplinary treatment of cerebral palsy. This newsletter explores the contribution orthotics can make in the C.P. management milieu. We hope you find the information worthwhile and welcome your comments and inquiries.

AFOs Bring Unruly Legs Under Control

Ankle-foot orthoses of various designs are widely considered an important aid in managing young patients with spastic cerebral palsy; indeed, they are prescribed for C.P. management more than any other orthotic device. Primary goals include contracture prevention, improved function and ambulation and tone reduction in proximal muscles to improve function at higher levels.

The chief role of the AFO in this application is to limit unwanted ankle and subtalar movement, primarily ankle plantarflexion, and indirectly to affect knee and hip function. Children with spastic C.P. often acquire a dynamic equinus deformity, which prevents them from putting their foot flat and attaining a stable base for stance and walking. Assuming the ankle can be placed in a neutral position at rest, *i.e.* the deformity is not fixed, a correction can be applied through one of several AFO constructions, depending on the capabilities of and goals for the patient.

Combination (two-piece) AFOs

See **Types** Page 2

If your organization would be interested in an in-service on prosthetics and/or orthotic care, please contact company President, Tom DiBello at (713) 747-4171.

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Types of AFOs that may be appropriate for Cerebal Palsy patients:

With a shorter profile than a full AFO, the **supra malleolar orthosis (SMO)** maintains a desired ankle position and provides support for the dynamic arches of the foot. Due to its shortened lever-arm an SMO allows ankle movement, beneficial for ambulation and sit-to-stand transitions. The basic SMO is not very effective for managing equinus, however when constructed as part of a two-piece AFO with an extended footplate, this design can address that deformity as well.

A **SAFO-LPE** helps overcome mild equinus spasticity and can improve ground clearance during ambulation swing phase. It is not normally rigid enough to control stance phase equinus however. Its low profile and thin foot plate allow it to fit in normal shoes providing improved cosmesis over some other designs.

The **solid-ankle AFO**, one of the most commonly used designs for the C.P, population, essentially prevents dorsiflexion and plantarflexion as well as varus or valgus deviations of the ankle and hindfoot.

It can be designed to hold the ankle in a neutral position or at a predetermined degree of plantarflexion or dorsiflexion depending on the needs of the patient. This design is a primary choice for controlling equinus inboth stance and swing phase and for contracture prevention.

An **articulating AFO**, which typically incorporates medial and lateral joints to allow plantarflexion-dorsiflexion, can be beneficial for C.P. patients who require increased ankle motion for higher-level balance and functional activities, including walking and sit-to-stand transitions. Stops can be incorporated to restrict plantarflexion and/or dorsiflexion beyond optimal limits for that patient. With a plantarflexion stop, for example, the ankle can be maintained in neutral from heelstrike through midstance, then allowed to dorsiflex from midstance through toeoff.

Ground Floor Reaction (GRAFO) – This solid-ankle design incorporates a broad, rigid anterior wall, which applies a knee extension moment during stance phase. The FRO can be a welcome improvement over a heavy knee-ankle-foot orthosis for addressing C.P. crouch gait and other sources of knee instability.

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Donning and wearing an AFO can be a challenge for C.P. patients with deformities, abnormally stretched muscles, pressure-sensitive feet and other tolerance issues. A fabrication option that provides relief in appropriate instances is a two-piece or combination construction featuring a flexible *molded inner boot* of thin thermoplastic, which wraps around the foot and can be donned separately from,

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A New Option for Correcting Dropfoot

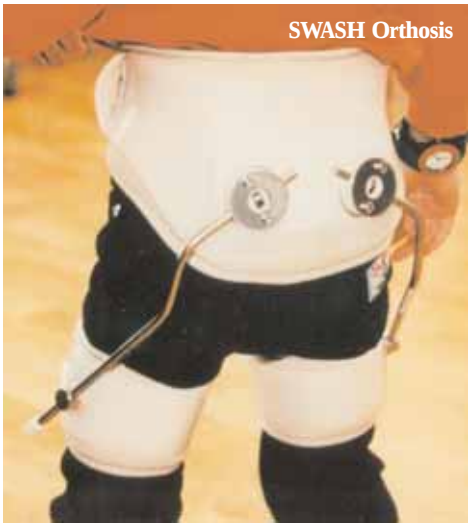
A new therapeutic concept combining the bracing role of the orthotics discipline with the muscle restoration function of FES (functional electrical stimulation) is now available for patients suffering from dropfoot through a product called the WalkAide.

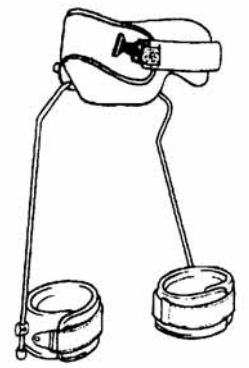
Dropfoot, the inability to properly lift the forefoot during ambulation, frequently results from interruption of normal signals from the brain to the peroneal nerve, which normally trigger dorsiflexion in swing phase. The condition is a common outcome of multiple sclerosis, cerebral palsy, stroke, traumatic brain injury, and spinal cord injury.

Common manifestations are toe dragging in swing phase and foot slap at the beginning of stance phase as the dorsiflexors are unable to overcome the plantarflexion moment created at heelstrike. Patients with dropfoot often compensate with an exaggerated high-stepping ambulation known as steppage gait.

The WalkAide surmounts dorsiflexor weakness or paralysis by stimulating the peroneal nerve at the appropriate point in the gait cycle to lift the forefoot, assuring ground clearance and providing for a normal heel-to-toe rollover. The result is a more natural, smoother, safer, and more energy-efficient gait. In recreating the natural nerve-to-muscle response, the WalkAide not only corrects for biomechanical dysfunction but may improve circulation, reduce atrophy

SWASH Orthosis Solves Multiple C.P. Bracing Needs


SWASH Orthosis



Managing children born with cerebral palsy is a challenging business as clinicians strive to address a variety of issues: dystonia, hip migration, scissoring gait that interferes with ambulation, and hip adduction that limits independent sitting. The SWASH (Standing, Walking And Sitting Hip) orthosis tackles these difficult aspects of ambulating C.P. kids.

Though its primary application has been to benefit C.P. patients, this system is intended for use by any child whose adduction and/or internal rotation at the hip joint interferes with function or induces lateral migration of the femoral head.

The orthosis ensures variable abduction during both extension and flexion and therefore can support an active child in all postures encountered during an active day: standing, sitting, walking, crawling, even toileting. It can also be of value at night to retain hips in an abducted position or maintain stretch on tight hip adductors.Though outwardly simple in appearance, the SWASH orthosis is capable of advanced biomechanical functions. It uses basic geometry to provide wide hip abduction when the wearer is sitting but narrower abduction when erect. During ambulation, the brace maintains the legs virtually parallel, thus preventing scissor gait. By neutralizing the destabilizing forces at the hips, this device also may improve overall trunk control and thereby facilitate upper limb function. The orthosis also reportedly encourages some children to learn how to overcome pathological patterns of movement on their own.

How It Works

When properly fitted, the SWASH stabilizes the hip and opposes excessive adduction and internal rotation. As the hip moves into flexion, the joint mechanism is guided into abduction, reducing scissoring gait while walking and improving balance while standing. When the child sits, the orthosis dictates continuous abduction, resulting in a wider base and potentially a balanced posture without having to use hands for support. The wearer may then be able to concentrate better on other activities.

SWASH components include a padded waist band, connected in front by a pressure pad. Two joint assemblies attached on the posterior quarters are connected by shaped leg bars to adjustable thigh bands, which guide the legs in the desired position. The leg bars are free to rotate within the respective joint assemblies.

Contraindications to SWASH use include hip dislocation (total loss of contact between the femoral head and acetabulum), a hip flexion contracture of greater than 20 degrees, dynamic or fixed, and excessive external tibial torsion or foot progression.

The SWASH Orthosis can be adapted for child growth—four sizes are available, from one for infants (to prevent hip subluxation) through two medium and one large sizes. The orthosis is easy to apply and remove and may be worn over or under clothing as desired.

and increase joint range of motion.

This technology was under development at various research centers for 10 years before recently receiving FDA approval. The device consists of a battery-operated electrical stimulator, two electrodes and electrode leads packaged into a small case, which is held in position by a cuff on the affected leg just below the knee near the fibula head.

The WalkAide is an alternative to the conventional orthotic treatment for dropfoot, an ankle-foot orthosis. AFOs have long been an effective management tool for this condition, but for some patients an FES system may provide an improved gait and be more comfortable to wear and more cosmetically acceptable.

A programmable tilt sensor built into the system analyzes movement of the wearer's leg and foot and controls stimulation during gait. The device is initially programmed with dedicated software on a laptop computer. Though a heel sensor is used for programming, it is not worn during routine use of the system.

Contraindications to the use of this system include lower motor neuron and/or peripheral nerve damage; secondary complications of knee, back or hip surgery; leg trauma; sciatica; peripheral neuropathy; spinal stenosis; post-polio syndrome and Guillain-Barre. The WalkAide should not be used by those wearing a pacemaker or who are subject to seizures.

While probably not the ultimate answer to the control of dropfoot, the WalkAide has the potential to improve gait, overall health, and quality of life for appropriate patients. A physician's prescription is required. At this time the WalkAide is not routinely covered by insurance.


Photos courtesy Innovative Neurotronics.

Types of AFOs *(Continued)*

then joined to, the outer AFO. Because the two components are custom-fabricated from the same mold, they fit together intimately and are held snugly in place by straps.

The value of AFOs for improving gait function in spastic cerebral palsy patients, relative to no orthosis, is well established.[1] Properly prescribed and custom-fabricated AFOs have been shown to increase stride length, reduce energy expenditure, and give patients a more natural appearance while walking.

When prescribing an AFO for a patient with spasticity, bear in mind that while AFOs can prevent or delay development of a deformity, they can not overcome pre-existing fixed deformities. Therefore, any existing fixed deformities should be corrected by therapy, serial casting, surgery or other means if possible before orthotic application.

In summary, AFOs serve as a positive tool in managing spasticity associated with cerebral palsy.

They will delay or prevent development of fixed deformity but not overcome an existing fixed deformity. They can prevent contractures and improve gait parameters, and give patients a more natural appearance while ambulating.

Our orthotic staff is prepared to assist in the selection and fabrication of AFOs for C.P. patients. We welcome your inquiries and referrals.

[1] Robert R. Madigan, M.D. of the Knoxville (Tenn.) Orthopedic Clinic entitled *Ankle-Foot Orthoses (AFO's) in Spastic Cerebral Palsy.*
For more information:
http://www.fillauer.com/education/ED_afo.html

Note to Our Readers

Mention of specific products in our newsletter neither constitutes endorsement nor implies that we will recommend selection of those particular products for use with any particular patient or application. We offer this information to enhance professional and individual understanding of the orthotic and prosthetic disciplines and the experience and capabilities of our practice.

We gratefully acknowledge the assistance of the following resources used in compiling this issue: Becker Orthopedic • Bio-Mechanical Composites Inc. • Custom Composite Mfg. Inc. • Fillauer LLC Hope Orthopedic • Össur • Otto Bock Health Care

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