



Falk Prosthetics & Orthotics QUARTERLY

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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.

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.

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.



Supra malleolar orthosis (SMO)

Courtesy Orthomerica Products Inc.

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.

Orthotics Today

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.

Reviewing the different types of AFOs that may be appropriate for C.P. 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.

(Continued on page 2)



Combination (two-piece) AFOs

Courtesy of Orthomerica Products Inc. ©2007

Welcome, Mark A. Berman, C.O.

Falk Prosthetics & Orthotics is pleased to introduce Mark Berman, who recently joined our staff. Mark is an American Board-certified and Florida-licensed orthotist who will be working closely with David Falk in our Delray Beach office.

Mark has been an orthotist for the past 24 years, since graduating from New York University with a B.S. degree in prosthetics and orthotics. His knowledge and expertise will be a valuable asset to our staff as we continue to provide outstanding personalized care and service, as well as prompt response to area hospitals.

Falk Prosthetics & Orthotics is a full-service prosthetic and orthotic company serving Palm Beach County with offices in Delray Beach and Jupiter. Our ABC-certified practitioners and friendly staff work closely with our patients, referring physicians and physical therapists to maximize the functional outcome of each patient.

We hope you find this publication informative and welcome your questions, comments and suggestions.

Choosing the Right AFO for Cerebral Palsy Patients

(Continued from page 1)

A **leaf-spring AFO** 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.



Leaf-spring AFO

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 in both 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. 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.

Floor Reaction Orthosis (FRO)—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.

Tone-inhibiting characteristics can be built into many of these designs to address hypertonicity in proximal muscles. (See accompanying article.)



Solid-ankle AFO

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, 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 closure straps.

Available research is inconclusive on the relative merits of different AFO options, so selection of a particular design is a combination



Floor reaction orthosis

of art and science. However, the value of AFOs for improving gait function in spastic cerebral palsy patients, relative to no orthosis, is well established. Properly prescribed and custom-fabricated AFOs have been shown to increase stride length, reduce energy expenditure, and give patients a more natural look 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 are not valid for overcoming pre-existing fixed deformities. Therefore, any existing fixed deformities should be corrected by surgery, therapy, serial casting 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 deformities but not overcome an existing fixed deformity. They can prevent contractures, improve gait parameters, and often give patients a more natural appearance while ambulating.

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



Articulating AFO

All photos appearing in this article are from the TC-Flex AFO System, Courtesy of Orthomerica Products Inc. ©2007

SWASH Orthosis Solves Multiple C.P. Bracing Needs

Managing children born with cerebral palsy is a challenging business as clinicians strive to address a variety of issues, such as 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 SWASH brace has been proven effective for spastic diplegic and spastic quadriplegic children, even those with spina bifida.

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 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



SWASH Orthosis

child sits, the orthosis provides 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.

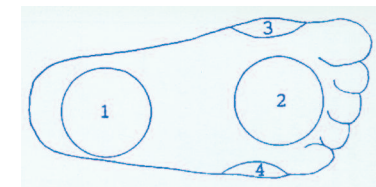
Contraindications to SWASH use include hip dislocation (total loss of contact between the femoral head and acetabulum), a hip flexion contracture of greater than 20 degrees, dynamic or fixed, and excessive external tibial torsion or foot progression.

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 easy to apply and remove and can be worn over or under clothing as desired.

Tone-Inhibiting Designs Enhance AFO Function

Is an ankle-foot orthosis incorporating tone-inhibiting features effective in managing patients with spastic cerebral palsy and other upper motor neuron disorders?

There is considerable evidence that abnormal tone in proximal muscle groups can be influenced by joint position and cutaneous stimulation. For cerebral palsy management, maintaining a neutral position of the ankle and subtalar joint and stimulating key reflexogenous areas of the plantar surface (see drawing) can inhibit deforming reflexes and/or stimulate desirable antagonist reflexes to counter a dynamic equinus deformity, overcome toe grasp, and control foot pronation-supination and inversion-eversion issues, thereby enhancing function.



Plantar surface reflexogenous areas: (1) dorsiflexion, (2) toe grasp, (3) inversion, (4) eversion.

Tone-inhibiting features can be built into different AFO designs to accommodate the needs of both children and adults with neuromuscular deficiencies. An approach particularly suited to young C.P. patients is the dynamic AFO (DAFO), so named because its flexible design intentionally permits some degree of ankle motion. This flexible supra malleolar orthosis can be designed with a custom-contoured soleplate that evokes the desired reflex response.

Key to the effectiveness of the dynamic AFO is its thin wrap-around construction, which is particularly brief over the dorsum of the foot. In creating a DAFO, an orthotist can incorporate a set degree of plantarflexion or dorsiflexion as necessary and combine tone-reduction with other features, such as plantarflexion stops and three-point pressure systems, to address unique patient needs.

A DAFO is sometimes constructed around an inner boot, usually made of thermoplastic but sometimes fabricated of very thin foam material.

The boot is formed first over the patient's mold followed by the remainder of the AFO structure so the two pieces align correctly.

With its lightweight flexible construction, the dynamic AFO is generally well tolerated by young patients. The total-contact, soft plastic design largely eliminates skin breakdown, even in children unable to tolerate other types of AFOs because of breakdown or pressure sores.

Dynamic AFOs can be worn under any type of clothing and will fit inside shoes with a wide toe box. They can be rendered in bright colors and finished with popular children's designs. Assuming the patient does not grow out of them, DAFOs typically need to be replaced after about a year of wear.

Note: The terms "dynamic AFO" and "DAFO" are sometimes associated with a particular company that fabricates finished orthoses from patient molds. Other providers fabricate these devices as well, sometimes under different product names. In using the dynamic AFO and DAFO terms, we are referring to the concept, not a particular company's product.



Tone-inhibiting AFOs

Courtesy Marta Tankersley

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



*Photos courtesy
Innovative Neurotronics.*

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 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.

What's New

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 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.

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.

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